Revue de l'OFCE

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The French Economic Observatory (Observatoire français des conjonctures économiques – OFCE) is an independent centre for economic forecasting and research and the evaluation of public policy. Created by an agreement concluded between the French State and the Fondation nationale des sciences politiques (Sciences-Po) and approved by Decree 81.175 of 11 February 1981, the OFCE brings together more than 40 French and foreign researchers. The OFCE's mission is to "ensure that the fruits of scientific rigour and academic independence serve the public debate about the economy". It fulfils this task by conducting theoretical and empirical work, participating in international scientific networks, ensuring a regular presence in the media and cooperating closely with the French and European public authorities. Philippe Weil chaired the OFCE from 2011 to 2013, following Jean-Paul Fitoussi, who in 1989 succeeded the OFCE founder, Jean-Marcel Jeanneney. Xavier Ragot has chaired the OFCE since 2014 and is assisted by a scientific council that reviews the orientation of its work and the use of its resources.

Contact
OFCE, 10 place de Catalogne 75014 Paris
Tel. : +33(0)1 44 18 54 24
mail : revue.ofce@sciencespo.fr
web : www.ofce.sciences-po.fr

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WHITHER THE ECONOMY?

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Xavier Ragot
Sciences Po, OFCE

The global economy is emerging painfully from the financial crisis that kicked off in 2008 in the United States and then hit Europe. The economic debate is now shifting from the urgencies of the crisis to taking a look at more distant horizons. Global warming is currently demanding investment in new technologies and changes in consumption patterns. More generally, current trends are once again raising the old but still topical question of the economic and social stability of market economies. This question has multiple ramifications: in addition to the issues of instability and financial crisis there are the dynamics of inequality and the distribution of income. Finally, with the emergence of digital technologies, technical change is posing new questions. While digital potentials are often formulated in ways that provoke anxiety, the ability of these technologies to improve our everyday lives is one of the key issues facing thinking about the economy over the next twenty years.

These new issues have evoked some recent research in economics, which this issue of *Revue de l'OFCE* tries to present and review. The issue is composed of contributions by authors who are all specialists in their field. They had the freedom to write texts in which the thinking, while certainly argued, also gives space to personal considerations that the constraints of academic rigor do not always permit to be expressed: discontent and enthusiasm are instructive for observing thought in the process of taking shape. The contributors strived to present robust results and newly emerging issues.

The purpose of the issue is therefore to both convey knowledge and pose questions. The seventeen contributions are not exhaustive but

cover most of the current debate, with a specific focus on macroeco-
nomic issues. In addition to the diversity of subjects treated by the
various contributions, there is a certain difference of "seniority" in the
discipline, as young researchers striving to move the frontiers of knowl-
edge in a precise direction work alongside more experienced
researchers presenting a more topographical version of the discipline
by describing what we already know.

The purpose of this introduction is not to substitute for reading the
texts, which are all instructive and enlightening, but to identify points
of intersection or divergence in terms of both method and economic
policy measures. Four themes emerge. The first is the relationship
between economics and history. The second is the question of the
stability of market economies. The third is the need to rethink the
coherence of economic policies. Finally, the fourth theme concerns
developments in economists' tools and methods.

The Era of the Economy: Economics and History to Conceptualize Trends and Crises

When reading these texts, what is important is first and foremost a
return to historical time and economic history. It is when faced with
history that a situation becomes an event or a cycle or reveals a trend.
Indeed, this issue shows the richness of the analysis of historical time
for the subjects that animate economic debates. Thus, one big debate
that divides economists concerns growth and technical progress. In
the long time described by **Antonin Bergeaud, Gilbert Cette** and
Rémy Lecat, there is a gradual slowdown in productivity and technical
progress that could pose the risk of low growth, or even secular stag-
nation. This contrasts with the apparent acceleration of technical
progress due to digital technology. Three explanations are presented
in this issue. The first, defended by **Celine Antonin** and **Philippe
Aghion,** sees in the debate on secular stagnation an ill-founded pessi-
mism. First, errors in measurement fail to capture the ongoing change
in the nature of growth. Second, some diffusion time is necessary for
economies to adapt to major technological changes such as those
wrought by digital technology: the best is yet to come. For their part,
Bergeaud, Cette and Lecat insist on a relationship between finance and
growth that can account for weak growth. The authors observe two
simultaneous trends. The first is the decline in productivity gains in all
countries. The second is the decline in real interest rates that has lasted

almost forty years now. The authors believe that there may be a causal relationship between these two trends. Low interest rates help to facilitate the financing of low-productivity companies and therefore induce a poorer allocation of capital. The problem then is that the financial markets are less demanding in terms of profitability in a low interest rate environment. A third explanation is put forward by **Gilles Le Garrec** and **Vincent Touzé**. They analyse the short-term adjustment constraints of economies, such as nominal rigidities or the zero bound on interest rates. As a result of the latter and the mismanagement of the crisis, the developed economies found themselves trapped for the long term in situations where growth, interest rates and inflation are all low, while unemployment is high. The poor management of demand and short-term inflation leads to a long-term economic problem. This analysis in terms of multiple regimes links the short time of economic policy to the long time of secular stagnation. An inflation-enhancing policy would help economic adjustment by restoring room for monetary policy to manoeuvre.

The debate between these three explanations of weak growth (supply, finance, demand) will continue to be lively because economic policy recommendations differ: should we support the allocation of capital or demand and, therefore, inflation? Should these two policies be managed together, as Aghion and Antonin invite us to do? Is there a trade-off between the two, as suggested by Garrec and Touzé, or are these two policies independent, thereby making it possible to focus reforms on changes that better benefit from the digital revolution, as advised by Bergeaud, Cette and Lecat? These three texts provide the arguments in the debate.

Two contributions range from economics to history to consider how market economies produce history because of their endogenous fluctuations and economic cycles. **Michel Aglietta** and **Franck Portier** offer some of the most recent analyses, coming from very different, not to say opposed, foundations within economic thought. Franck Portier looks again at the dominant approach in economics, which sees market economies as stable processes that adapt to external shocks. As a result, the economy evolves after some shocks. Portier observes that this vision is not well founded either empirically or theoretically. There are profound destabilizing forces in market economies, including strategic interactions between the actors, households and firms. These push the latter to do the same thing at the same time,

which destabilizes the economy. As a result, the economies lead to cycles that are both endogenous and affected by random events that make fluctuations unpredictable.

Michel Aglietta begins his contribution by recalling the difference between logical time in economic models and historical time, which always contains a degree of uncertainty. This leaves room for financial speculation, generating recurrent crises whose different phases have been described by historians. As a result, economies are marked by financial cycles that have a horizon of 15 to 20 years. Aglietta presents the relationship between finance and macroeconomics by describing the stages of financial cycles as well as the various economic policy measures that can prevent the contagion of financial instability spreading to the real economy. For Aglietta, destabilizing behaviours are the result of mimetic behaviours, which are presented as an anthropological invariant. For Portier, similar behaviours are the product of economic mechanisms and are therefore contextualized. Other differences, presented below, separate the authors, but both find themselves thinking about the production of endogenous cycles in market economies where finance and capital accumulation play a central role. In addition, both authors differentiate economic policy measures according to the state of the financial cycle.

A third question raising the ability of economists to think in the long term involves the issue of the environment and ecology. This is dealt with by two contributions, one by **Katheline Schubert**, and the other by **Gissela Landa, Paul Malliet, Frédéric Reynès,** and **Aurélien Saussay**. There is no longer any doubt that the issue of global warming is one of the key issues for the coming decades. Economists studying scarce resources, externalities, and the sustainability of economies need to be pioneering new tools to link the long time of global warming with the short time of public decision-making. However, as Katheline Schubert notes, "environmental issues occupy a very small place in macroeconomic models, as their study remains largely the preserve of microeconomics and the public economy. We can even say that short-term macroeconomists are not interested in it, or more precisely that their potential interest is confined to the question of the macroeconomic impact of oil shocks." In both academic journals and textbooks, the environmental issue remains marginal. Landa, Malliet, Reynès and Saussay show that the difficulties in this field of study stem, at least in part, from the difference in the tools used to think about

environmental issues. They present the two classes of models used: integrated evaluation models, at the frontier of economics and the natural sciences, and computable general equilibrium models, which are more anchored in economic modelling. It is interesting to note that the main shortcoming of these models, which the authors try to overcome through their own efforts, is their complexity, which renders the results less transparent, and therefore less convincing for analysts and public decision-makers. The introduction of different temporalities therefore has a cost in terms of complexity. If broader horizons are to be embraced, a great deal of simplification is needed to identify the essential causalities.

The introduction of historical time, understood either as long time or the study of historical events, is finally taking place in many contributions. **Cecilia García-Peñalosa** studies the dynamics of inequality over time, in terms of both the distribution of "wages/profit" and wage inequalities. It is through the prism of long time, especially since the work of Anthony Atkinson, Thomas Piketty and Emmanuel Saez, that the issue of inequality has gathered renewed interest by unveiling new trends. **Anne Épaulard** analyses the link between finance and the economy. In particular, she puts private debt at the heart of the lessons that can be drawn from a historical study of financial crises. However, the manoeuvring room for economic policy to avoid excess private debt is slim, while the effectiveness of macroprudential measures remains to be demonstrated, and the monetary instrument may simply be too brutal. Finally, **Patrick Artus** examines the problems of divergence within the euro area. For the most part, his analysis is based on the observation of historical trends in key variables, an approach that can be described as informed historical narratives, as they are not based on particular models but on mechanisms identified in the economic literature. This type of analysis has the merit of giving a large space to the data and allowing a great deal of freedom to suggest causalities that go beyond correlations. The relative disadvantage is that the freedom of analysis comes at the cost of weak demonstrative power, which may leave room for alternative analyses.

For this reason, this issue of *La Revue de l'OFCE* begins with a text by **Pamfili Antipa** and **Vincent Bignon** that documents the return to long time and to economic history. The authors describe economic history as a place of reasoned intellectual debate. They describe three ways of producing economic history. The first is cliometrics, the application of

a precise economic theory to the study of history. The historian thus proceeds from economics to history. An example of this approach is found in elements of Aghion and Antonin's text in this issue, describing the lessons of the Schumpeterian approach to the theory of growth. A second way of producing history is to construct long series, which allow a quantification of history specific to economic history and then to bring out regularities and ruptures. This approach dates back to the *Annales* school and its systematic formulations. The long time for the evolution of prices and wages to think about the difference in development between Europe and China is a prime example. The work of Bergeaud, Cette and Lecat reflects this process. A third way of doing history is to approach it as narrative or analytical narration using economic theory (or the contributions of other disciplines) to transform events into causes. Michel Aglietta's work on financial crises provides an example of this.

The Coherence of Market Economies: Heterogeneity, Aggregation and Instability

A second theme runs through the contributions in this issue: the issue of the stability of market economies. The financial crisis that began in 2008 revealed that market economies could become deeply unstable and that unprecedented monetary and fiscal policies were needed to restore jobs and growth. The inability to foresee or even to understand this crisis on the part of most economists has brought the profession into profound disrepute. The question of stability brings up an even deeper question, which is to understand how the sum of uncoordinated decisions by households, firms and financial actors can lead to a satisfactory economic order. Hence the question facing economics is to understand the *aggregation of heterogeneity*. As the three contributions by Michel Aglietta, **Rodolphe Dos Santos Ferreira** and **Jean-Luc Gaffard** pointedly note, the majority of pre-crisis macroeconomic models in fact assumed the stability of the economy as a working hypothesis for studying representative agents, thus removing the question from view simply by hypothesis.

The modern treatment of heterogeneity in economics has accelerated dramatically since the crisis as a result of access to data and the diffusion of digital technologies. Two contributions summarize milestones in this work. The contribution of **Édouard Challe** takes up a very lively debate in the United States that unfortunately has too little pres-

ence in Europe: Does macroeconomics lack scientificity in its relationship to the data?

Some criticism states that it has not passed the empirical turning point of other domains of economics (economics of education, of work, of development) and because of this provides non-falsifiable and therefore unscientific theories. This question is all the more important as some empirical work (experimental and quasi-experimental work) makes it possible to start from the heterogeneity of microeconomic behaviour to build theories.

Edouard Challe's answer is that interdependencies cannot be studied in isolation. It draws on three examples to show that moments like economic crises cannot be safely sliced up into separate problems. The accumulation of empirical results is necessary but not sufficient for economic analysis. The first example is the liquidity trap. The spectacular growth of central banks' balance sheets has little effect on the economy due to the complexity of inflationary expectations. The second is the destabilizing role of precautionary savings. In wanting too much to protect against uncertainty, economic actors all cut their spending at the same time, which destabilizes the economy. The third is the effect of public spending on economic activity and, at its core, the issue of fiscal multipliers. There is a big difference between local multipliers (estimated using geographic data) and global effects due to economic interdependencies. In these three cases, the microeconomic lessons do not tell us much about the global consequences.

A second example of the lessons of the modern treatment of heterogeneity is the analysis by **Paul Hubert** and **Giovanni Ricco** of the role of information in economic coordination. Here again, the subject of information brings up the deepest issues in economics. Hayek based the superiority of market economies over other forms of social organization on their ability to aggregate the heterogeneity of information. Hubert and Ricco revisit this question from a resolutely empirical angle. Diverse models of imperfect and scattered information are now available. What do we learn when we compare these with the data? What is gained empirically (and scientifically) from the inevitably complex modelling of the heterogeneity of information? The authors use advanced econometric techniques to show that the effect of monetary and fiscal policies changes radically when the heterogeneity of information is taken into account. In particular, central banks must consider

their communications as an element of economic policy because they change the nature of the information available to the public.

A more radical approach to the treatment of heterogeneity is defended by **Mauro Napoletano**, who summarizes the recent results of a current in economics called agent-based models (ABM). For Napoletano, it is the interaction between economic agents that is essential, even primary. This should lead to agreeing to simplify behaviour by introducing a very limited rationality and then considering the economy as a large dynamic system that can only be simulated on a computer. It's a time of mourning for analytical solutions and small models; it's time to move away from reductionist strategies that seek to simplify the real to find causalities and proceed directly from complex environments. The author shows that these models can reproduce instabilities, cycles and inequalities between agents (households and businesses) that are close to the data. These models are spreading in the academic world as well as among economic institutions. They do, however, pose the difficult question of the nature of understanding in economics. Is the reproduction of aggregated facts sufficient to validate a model? Should we not be concerned about the realism of the hypotheses and behaviours lest we find ourselves able to reproduce everything without being sure of the generality of the possible recommendations? These questions will concern the profession for years to come.

In addition to the theme of aggregation, another theme marks many contributions. It is the inadequate treatment of a central actor: *the company*. Rodolphe Dos Santos Ferreira considers the weak modelling of corporate behaviour and the nature of competition in macroeconomics to be a major source of discontent with the way the profession is going. This finding is shared by Jean-Luc Gaffard and Michel Aglietta, who lament the simplistic modelling of the company as the only financial asset, which prevents a deep contribution concerning the notion of capital. The importance of the company is strongly emphasized by Antonin and Aghion, who situate it at the heart of the Schumpeterian dynamic. Finally, Bergeaud, Cette and Lecat argue that we cannot understand recent trends in productivity gains without thinking about innovation within companies and the allocation of capital between companies. The importance of the company can also be seen in Cécilia Garcia-Penalosa's contribution, which treats it as an essential institution for understanding the dynamics of inequality.

To sum up more concretely, three sources of instability for market economies can be seen in the contributions:

1. The first covers finance in the broadest sense. Four mechanisms are presented:
    — the uncertainty of the valuation of financial assets, with the recurrence of bubbles and financial crises (Aglietta);
    — the still more destabilizing role of the excessive indebtedness of the private sector (Épaulard);
    — the contribution of precautionary savings to economic instability (Challe, Portier);
    — finally, the potentially inadequate level of the interest rate: either too high and therefore limiting the economic recovery (Challe) or too low and contributing to the misallocation of capital (Bergeaud, Cette and Lecat).

2. The second source of instability concerns the distribution of the wealth created and the dynamics of inequality (García-Peñalosa): do market economies produce unsustainable inequalities?

3. Finally, the environmental issue cannot be overlooked: global warming and the depletion of resources and of biodiversity concerns much more than just the viability of market economies.

The Tools of Economists

It is interesting to go more deeply into the influence of digital technology on the economy, not so much to raise the question of the productivity gains to be expected, but to show the changes in the profession of the economist. Antipa and Bignon highlight the new fields being opened up to economic history by the digitization of archives. This is giving much wider access to historical documents, requiring different tools to process this new mass of information. Cecilia Garcia-Peñalosa and Édouard Challe point out how the use of computers has considerably increased the complexity of economic models so as to simulate greater heterogeneity. Likewise, the econometrics of Hubert and Ricco becomes possible only thanks to computers' calculating power. Finally, Mauro Napoletano goes further and proposes that large-scale systematic computer simulations that introduce statistical uncertainties (Monte Carlo) can be considered to be an accepted analysis of economic models, rather than their analytical study. The data, the data processing capabilities, the size of the

models that can be simulated are increasing extraordinarily. While we can ask what tools can be developed to test a theory, the relationship can also be reversed: what theories can be developed to make the most of all these tools?

Economic Policies

Most of the contributions in this issue of *La Revue de l'OFCE* refer to economic policy recommendations, whether that means monetary policy (Épaulard, Hubert and Ricco), corporate governance (Aglietta), fiscal policy (Challe, Saraceno, Portier, Gaffard), structural reforms (Bergeaud *et al.*), taxation (Aghion and Antonin, García-Peñalosa), or the reform of the euro zone (Artus). However, as many contributors point out, what matters is not just specific recommendations but the overall coherence of a set of economic policies. Policies do indeed interact strongly. Caricatural economic debates between "supply/demand" or "monetary/fiscal" policy thus generate a high intellectual cost, because it is precisely the intersection of these policies that needs to be thought out.

As **Francesco Saraceno** explains, a period finished in 2007 with the end of a consensus that had reigned since 1980. This consensus was based fundamentally on the stability of market economies. While both short-term frictions and nominal rigidities do indeed create inefficient fluctuations in employment, it is economic policies founded on rules (and not discretionary policy decisions) that will facilitate a return to economic efficiency. The greater financialisation of the economy should have only beneficial effects, especially as regards the allocation of capital. The crisis has opened the eyes of economists. The debate over financial regulation, the support for demand during the recession and structural reforms destroyed the old consensus, without of course any fanfare. Francesco Saraceno is calling for an eclecticism in economic policy that should be the guiding principle of economic policy recommendations.

This eclecticism must, however, be anchored in a solid conception of the complementarities between economic policies. One initial complementarity concerns the need for a policy of support for demand when policies are put in place to increase productivity (increasing the educational level and the mobility of labour and capital). This view seems to be shared by almost all the contributors.

A second set of complementarities comes from the reform of the euro zone. Patrick Artus discusses the policies needed to solve the euro zone's main difficulties. At least three complementarities appear. The first concerns the need for fiscal transfers and fiscal federalism as well as trade integration that promotes industrial specialization. The second is the coordination of fiscal policies in the euro zone to avoid excessive fluctuations in demand due to externality effects. The last is the coordination of labour market policies to minimize the dangers of diverging unemployment rates or wages, both upward and downward.

This issue leaves room for debate on economic policies. It undoubtedly demonstrates the need for a stronger link between economic thought, in all its diversity of methods and themes, and economic policy decisions. Rather than bring the debate about economic policy choices to a close, it opens it.

Each of the contributions can be read independently. For ease of reading, these are presented while taking into account the proximity of the themes. The *Revue* begins with historical considerations, then addresses the issue of the stability of economies and finishes with questions of economic policy.

The authors know how difficult it is to write short and synthetic texts rather than long and detailed ones. These eighteen contributions could not have been gathered without the scientific and editorial work of Sandrine Levasseur, editor-in-chief of *Revue de l'OFCE*. Finally, the *Revue* enjoys a high-quality team capable of ensuring the formatting and preparation that allows rapid publication.

WHITHER ECONOMIC HISTORY?
BETWEEN NARRATIVES AND QUANTIFICATION[1]

Pamfili Antipa
Sciences Po and Banque de France
Vincent Bignon
Banque de France

Macroeconomic analysis is not just a game of equations; it is a narrative of the real. We argue in this article for a re-evaluation of the importance of narratives. Because each financial crisis is a unique event, the narrative is the natural form of analysis. In addition, the effects of economic policies can no longer be analysed independently of the narratives appropriated by economic agents (Schiller, 2017) and policy makers (Friedman and Schwartz, 1963). There is a twofold value in adding the historical dimension. Economic history is instructive by multiplying case studies, i.e. by increasing the variety of policy successes and failures analysed. History also loosens the shackles of our preconceptions, since comparing the past and present calls into question the exceptional nature of what we are living.

Keywords: economic history, cliometrics, narrative, economic policy.

> "*A glance back at History, the return to a past period or, as Racine would have said, to a distant land, gives you perspectives on your own epoch and helps to clarify your thoughts about it, to see more sharply the problems that are the same or that are different as well as the solutions to them.*"
>
> Marguerite Yourcenar

Following the financial crisis of 2007, the demand for economic history has flourished. Historical arguments and narratives that draw on historical precedents dominate major economic policy debates.[2] This resurgence of popularity is global. Not only are publications aimed at a broad audience booming, but so are publications of academic articles in economic history: their number has quadrupled since 1990 in the five major economic journals.[3] Moreover, policy makers consider economic history important for informing their understanding of economic policies during crises. Jean-Claude Trichet, President of the European Central Bank until 2011, noted that "in the face of the crisis, we felt abandoned by conventional tools. ...[W]e were helped by one of the areas of economic literature: historical analysis" (Trichet, 2010). This point of view also resonates on the other side of the Atlantic. Larry Summers, former US Treasury Secretary and head of the National Economic Council during Barack Obama's presidency, said he relied on historical analyses by Bagehot (1873), Minsky (1957a, b) and Kindleberger (1978) to understand the subprime crisis and its consequences.[4]

What makes economic history so useful in terms of economic policy advice? The usual arguments are of course important. The past is replete with all types of natural experiments, whose analysis helps to broaden the range of studies assessing the impact of unconventional policy measures or of rare events (Eichengreen, 2012). By construction, no model can compete with this level of detail and realism, even if consequently history carries the risk of drowning the reader in peculiarities. A more elaborate argument is that research into the causes of the Great Depression of the 1930s sheds light on the fragility of modern

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2. http://www.economist.com/blogs/freeexchange/2015/04/economics-and-history
3. This percentage includes articles that appear in the category of economic history i.e. under the code JEL "N" in the journals *American Economic Review, Quarterly Journal of Economics, Journal of Political Economy, Econometrica*, and *Review of Economic Studies* (Abramitzky, 2015).
4. Cited in Delong (2011).

economies, and on the dilemmas decision-makers have to confront when extraordinary events occur. This brings up the argument of Friedman and Schwartz (1963), who attributed the depth of the Great Depression to the monetary policy errors the US Federal Reserve committed. They argue that these errors were linked to the decision-makers' desire to remain faithful to their habitual intellectual framework and to the values that guided them in their decision-making process. Policy makers should rather have adapted to the context of the time by forging an informed opinion about the microeconomic dynamics of the banking crisis. Thus, it is understandable why all the prestigious government and business schools in U.S. universities endow a chair of economic history. The study of this type of historical event teaches humility and shows the importance of informing decision-making by historical experience as much as by economic theory.

There is another reason why economic history is instructive. As Jean-Pierre Faye (1972) points out, history is the elaboration of a narrative. To write history is to write a new narrative of the real, whose value comes from the originality of the explanation proposed. A historical narrative is distinct from a novel or an essay. Unlike a novel, which focuses on the marginal, a historical narrative is interested in the average, the most common effect (a modal metric as statisticians put it). Unlike an essay, a historical narrative is refutable. In a historical narrative, the facts are stubborn and stand up against the author's best intentions. This is true at the time the narrative is written because the facts often contradict the author's theoretical or political assumptions. It is also true a posteriori, once the story is published, as the historian faces the risk that someone else will demonstrate that their story is just a house of cards.

The quality of a historical narrative, which consists in being true on average, is thus based not only on its originality but also on the veracity of the facts used to grant credibility to the narrative, thereby rendering the explanation plausible. There is no absolute proof of a historical narrative's veracity. The latter resides in its elegance, which requires providing the reader with quantified facts and logical explanations embedded in a system of rational argumentation. While checking the veracity of the facts is paramount, this will be of little value to the contemporary if the narrative does not shed a different light on the case under consideration. The demand addressed to history is therefore both to verify the plausibility of explanations and to apply a rigorous imagination in the construction of an original narration.

Consequently, economic history belongs as much to historians as to economists. It belongs in fact to those who are able, in a single movement, to write the explanation of a phenomenon and to find facts, anecdotes and quantified measurements to support this interpretation. The originality of the historical narrative stems from the fact that history naturally leads the researcher to reason in double differences. The distance between the economic and political stakes of the past and those of the present create the first difference. It is by a thorough reading of the archives aimed at understanding the reactions of the actors and the institutions in light of her understanding of the contemporary world that the historian builds a model of the past that informs the present. The second difference on which the historian relies concerns the distance between the theory used to understand a historical period and the legacy of history, that is to say, the archives. The archives here play the role of a bulwark, because they resist the most laudable intentions, and compel a process of going back and forth between the historical reality and the theoretical imagination, between what can be quantified and what must be narrated.

The lessons of history obviously do not reside in its repetition. History instructs through its capacity to imagine reality; through learning to distinguish between the economic and political forces as the origin of change; through paying particular attention to details as disruptive indicators; and through telling the difference between specificities of the historical period and the general features of a story. Separating the important from the negligible details and identifying economic forces requires a solid knowledge of the social sciences, and particularly of economics. Our first section presents the three most commonly used methods for producing a narrative in economic history, using the methods of economics. This leads us to consider the relationship between the methods of producing history and the reasons why historical analyses are called for in our second section.

1. Different Strokes for Different Folks

Organized around its two pillars – the narrative and the proof of its likelihood – there are as many ways of producing economic history as there are people who engage in it or as there are historical case studies. No way of producing economic history is wrong, and everyone can appreciate one or another approach, or all of them. Diversity stems from the fact that the process of creating and proving a narrative

requires a theoretical framework to explain the assumptions necessary for constructing the reasoning and interpreting the facts. Three different ways of writing economic history co-exist today, depending on the starting point of their producer. A first way of writing economic history is cliometrics. The starting point of this approach, which appeared in the 1950s, is the postulate that a theory explains a historical phenomenon. In the second method, the historian starts with collecting and processing data. The genealogy of this approach goes back to the Annales school. This approach has experienced a marked revival of interest due to the declining cost of digitizing data. Finally, the historian with an affinity for literature seeks to write a historical narrative, that is to say, to create an original analytic narrative.

1.1. Cliometrics

Cliometrics is the application of a specific model of economic theory or econometrics to the study of history. This approach is anchored in the heart of economics. It involves using quantitative techniques to criticize or counter a narrative or to question certain key elements of a pre-existing narrative. The "cliometrics revolution" began in 1957 with the seminar presentation of an article on the quantification of slavery in the United States in the nineteenth century (Godden, 2013). Initiated by former PhD students of Kuznets (Lyons, Cain and Williamson, 2008), cliometrics has won a place in the history of ideas by revisiting two major narratives in American economic history. Cliometricians have reconsidered the role of slavery in the economic model of the American South and have established the railways' marginal contribution to the development of the United States in the nineteenth century, notably because of an inexpensive alternative system of waterways.

The neoclassical model of trade under perfect competition and its conclusions shaped the theoretical structure of the early works. Today, cliometrics still actively generates controversies, but uses more recent models to question established historical narratives. Four reassessments have caused heated debate.

The debate on the origins of economic development was revived by growth models that incorporated simultaneous parental choices regarding the number of children and the latter's level of education. These models thus explained the spectacular development of Western Europe in the 18th and 19th centuries as the product of rational parental choices (see for example Galor and Weill, 1996).

The study of the international monetary system was given new life by demonstrating that the demonetization of silver in 1873 by the United States and France was a "crime" against the stability of the fixed exchange rate system. Milton Friedman (1990) and Marc Flandreau (1995, 1996) have shown that price variations between gold and silver on the various financial markets translated into capital flows that stabilized exchange rates in monetary regimes, in which both gold and silver served as reserve currency.

Arthur Rolnick and Warren Weber (1986) have shaken the understanding of the monetary phenomena that were at work before the creation of central banks. The authors explained "Gresham's law" by the importance of imperfect information regarding the quality of money in circulation. The relevance of some of the authors' interpretations has been called into question. Nonetheless, their approach has given birth to a variety of models, in which the difficulty of recognizing the quality of money explains either anomalies in monetary circulation or the endogenous emergence of institutions, such as currency exchanges (see Velde, Weber and Wright, 1999; Redish and Weber, 2011; Bignon and Dutu, 2017).

Finally, Harold Cole and Lee Ohanian have reviewed the historiography of the Great Depression of the 1930s in-depth more recently. By using a growth accounting methodology, Cole and Ohanian (2004) explain the depth and duration of the Depression by the unintended effects of Hoover and Roosevelt's counter-cyclical policies encouraging the cartelization of markets.

The main virtue of cliometrics is to create controversy and thus to force a re-examination of existing narratives and their frameworks. The methodology of cliometrics is explicitly teleological. It postulates the raison d'être of a phenomenon (a theory, an explanatory hypothesis), views the story exclusively in this light, and selects only historical facts that are consistent with this explanation. This subjects the narrative to simply establishing consistency between the postulated purpose and the chosen facts. The approach's historical relevance lies in confirming the veracity of the new explanation thus created. The bewilderment regarding the conclusions of certain cliometric studies experienced by specialists is generally a good predictor of the volume of future research on the same question. It also often explains the strangeness felt by the observer when confronted with the themes of certain articles presented at economic history conferences. It follows that cliometrics structures its field of research by multiplying the research

currents aimed at testing the historical and archival generality of some initial intellectual speculations. The most emblematic example is the hundreds of articles attempting to measure the railways' impact on economic development.

Cliometrics have been abundantly criticized, including recently (Boldizzoni, 2011). As always, Solow adroitly clarified the issues at stake when he pointed out in 1985 that, in the absence of context, the economic historian is simply an economist who likes dust (Solow, 1985). The foremost risk implied in the rational reconstructions of history proposed by cliometrics is therefore to produce anachronisms. At the same time, the creativity of a historical narrative arises from the reasoned use of anachronisms. By observing the alterations in the context through the prism of a new theory, history is ever changing. The second risk inherent in the cliometric approach concerns the tension between the veracity of the facts recounted by historical research undertaken on primary sources, and notably in archives, and the reorganization compelled by the use of a theory foreign to the period under consideration (Redlich, 1965). Historical analysis observes when the economics assumes. This tension can be extremely fruitful, when the piece of research is respectful of both intellectual traditions. By valuing the facts and the chronologies, this approach questions the theoretical frameworks left by the men and women of the past and allows deducting lessons and conclusions- a fable that illuminates the contemporary.

1.2. The use of long series in economic history

The growing ease of digitizing historical data is leading to an in-depth renewal of economic history. The decreasing cost of digitizing printed documents and archives, improved digitization techniques and the possibility of outsourcing data entry have rendered the construction and processing of micro-economic and even individual databases easy. In addition, access to previously confidential data and documents is revealing information that was inaccessible to researchers studying the contemporaneous context. The intensified effort to collect original data driven by the decreasing cost of digitization has thus made it possible to revisit major historical questions or to test previously untested economic theories.

Like the Annales school, certain researchers have used these greater facilities to build new databases to support intellectual speculation. For

example, based on a comparative analysis of European wages in the eighteenth century, Allen (2009) suggested that the high level of real wages in England instigated the industrial revolution by leading to a wave of innovations that permitted the substitution of capital for labour. Pomeranz (2000) initiated another field of data-rich research, arguing that Europe and Asia were characterized by similar levels of development until the early nineteenth century. In the wake of this publication, Shiue and Keller (2007) collected thousands of grain prices to show that grain markets were as integrated in China as in Europe until the eighteenth century; the industrial revolution was accompanied by greater market integration in Europe afterwards.

By contrast to the Annales school, the accumulation of long series also makes it possible to give an answer to a clearly formulated testable hypothesis. This type of research does not necessarily require extensive econometrics. Research on inequality in income and wealth provides an example of how data construction can inform contemporary economic debates (Bergeaud, Cette and Lecat, 2016; Garbinti, Pineau-Lebret and Piketty, 2017a, b). Research using long-period data often combines these in panel regressions using difference in differences techniques. This addresses the classic issues of endogeneity and reverse causality. Many studies have for instance revisited the impact of Protestant ethics on the development of capitalism (Becker, Pfaff and Rubin, 2016) and the economic determinants of delinquency (Mehlum, Miguel and Torick, 2006; Bignon, Caroli and Galbiati, 2017).

Economic history's shift towards exploiting the digital revolution began ten years ago in the main foreign central banks, which produced the long series necessary for informed decision-making. Examples include the ALFRED tool of the US Federal Reserve and the statistical series published by the Bank of Norway, the Bank of England, the Bank of Sweden, the Bank of Denmark, and the central banks of Italy, Austria, Romania, Bulgaria and Greece. By increasing the number of available observations, these databases allow identifying regularities, which is of obvious interest for studying the business and credit cycles. Longer series are also more variable. They contain structural changes and are marked by rare and major events.

The digital revolution in economic history is especially pronounced in the United States and England. It has already transformed historical research in macro-finance, orienting this strain of literature towards studying micro-economic mechanisms of shadow financing in the

nineteenth century, towards the intervention of lenders of last resort as well as the conflicts of interest prevalent in the financial sector (see Flandreau and Ugolini, 2013; Eichengreen, 2016). In France, this area of research is currently under construction, notably with the building of a database of stock and bond prices traded on the Paris Stock Exchange (Hautcoeur, 2012).

One consequence of the sharp drop in the cost of processing and digitizing historical data has been an increase in the relative price of converting data into relevant and reliable information. Reliability requires an excellent knowledge of the historical context, in which the data were originally produced. Contextual knowledge allows for example understanding and treating the institutional changes and the shifts they caused in historical series. Another important issue is the institutional context of data production. Considering these issues is very time-consuming and requires meticulousness. Thus it is some-times neglected under the pressure to publish or out of affinity for work done quickly. Yet, to treat an interest rate series spanning 200 years as something homogeneous over time neglects major transformations in the economic and financial system: it compares the incomparable.

To produce data for a historical analysis does not amount to piling up series; it consists in writing the historical context in which this quan-tification of the economy was undertaken (Cartelier, 1990). This approach makes for informed analyses of historical series, but requires both time and a significant investment in historical capital. It is worth the effort, since the declining attention to the quality of data produc-tion comes with a rapid backlash. Recent academic history is replete with examples of researchers who (too) hastily drew lessons from Excel worksheets compiled by others. Reinhardt and Rogoff's (2011) study of sovereign defaults provides the emblematic example for this issue, as pointed out by Herndon, Ash and Pollin (2013).

1.3. Analytic narratives

A third way of writing economic history is by constructing analytic narratives. Economic history here returns to its origins, that of a narra-tive of a particular episode in history. Based on archival evidence, the narrative constructs an interpretation of reality, and observed facts are interpreted using an analytical framework. Analytic narratives borrow from history the desire to answer the questions "what", "when" and "why" (Redlich, 1965). Reading and critically appraising archival

evidence or any other primary source plays a prominent role in assembling the narrative elements.

This type of work pays attention to the literary attachment of economic history. In the following, we defend Jean-Pierre Faye's (1972) point of view. According to the latter, the veracity of a narrative rests on the creation of the narrative itself. Put differently, the veracity of the narrative resides in writing an original relation of causality that explains why the facts observed constitute a historical phenomenon. Bates *et al.* (2000) developed a scientist version of the concept of analytic narratives. The authors argue that the multiplication of case studies implies the generality of a narrative, ultimately authorizing the construction of an explanatory model of the world. Conversely, the literary point of view on analytic narratives has its source as much in fact, as in beliefs and theories.

Economic theory is one of the most fruitful sources to structure a narrative. Examples are Neal's work (1990) on the growth of financial capitalism since the eighteenth century, or Nye's study (2007) on protectionism inducing England's economic growth and the great Bordeaux wines emerging as a consequence of the trade war waged by England against Louis XIV. Flandreau's (2008) political economy interpretation of the gold standard emerging in England as a means to constrain central bank policy is another example. So is his explanation of the role of anthropology in the production of Latin American rail bonds, which were bought massively by European savers in the 19th century (Flandreau, 2016).

Analytic narratives cannot exclusively rely on economic theory. The latter can lead to misinterpretation when archives are not used to confirm that the hypotheses of the theoretical model actually apply to the case studied. The financial crises under Philip II of Spain in the sixteenth century are a striking example. Based on fiscal data collected by Ulloa (1963) and archival evidence regarding the loan agreements (*asientos*) between Philip II and the Genoese bankers, Alvarez-Nogal and Chamley (2014, 2015) provided a new interpretation of these crises that evolved around the impasse in the Cortes between the central government and the cities. The latter resisted the doubling of the tax for which they were responsible (*encabezamiento*) and which was allocated to the service of the long-term domestic debt (*juros*). Without a tax increase, there was no refinancing of *asientos* in *juros*. In particular, the most important crisis, from 1575 to 1577, was not a

sovereign crisis of the kind experienced in the 1980s; it rather resembled the standoff between the US Congress and the Presidency in 2012, with certain government functions suspended for several days. In Castille, the crisis lasted more than two years, froze the credit market and halted the trade fairs. The consequences of this economic crisis forced the cities to accept the doubling of taxes. The settlement with the bankers followed suit immediately.

The researcher has to interrogate the archive in order to write the narrative. Constructing the latter involves defining the counterfactual: an alternative, a hypothetical situation that would have materialized if one had not observed the facts as they occur in the chronology of the archives. This step requires reflecting about the economic and political mechanisms at work in the case studied. The construction of a counterfactual therefore calls for assumptions regarding individuals' rules of action. Economic theory, including the assumption of (weak) market rationality or efficiency, provides a starting point, as it defines a limiting case for constructing hypotheses to interpret the actions or silence of primary sources. This step also allows considering the plausibility of the proposed interpretation. The comparison with similar situations in other countries or times facilitates the construction of the counterfactual. Economic theory and the endogeneity of facts vis-à-vis the economic and political context structure the narrative. The production and evaluation of evidence organizes the sense of causality between the facts observed.

Contrary to history written using long-times series, redacting the interpretation is not primarily data-generated as numbers are only one of potential modalities to convince of the verisimilitude of an explanation. Compiling statistics from the archives, transcribing information stored in hundreds of boxes, does not teach us anything about reality other than the researcher's patience. Contemporary accounts of economic history draw on research on long series in that they analyse reality through the lens of double differences. The first difference corresponds to the gap between the interpretations of the past and present. History isolates the most basic functions performed by very diverse institutions and studies their underlying motivations, in order to understand which institutions of the past correspond to present-day institutions. The second difference resides in analytical creativity. History drives the imagination; it fosters creativity in understanding the world of the past because an explicit analytical framework structures the researcher's reasoning. In this endeavour, economics and political

science are not auxiliary to history but serve as a conceptual toolbox (Bignon and Flandreau, 2009).

Because of their inclusive and multidisciplinary approach, and because they lead to generalizable lessons in the same way fables do, analytic narratives inform decision-making. By explicitly considering change, by including social and political institutions and by studying parameters that the economist takes as a given, this type of narrative is also useful to economic theory. As Stigler (1960) suggested, history isolates major and recurrent economic phenomena, those that theory must care about.

2. The Supply of Economic History and its Demands

Our tripolar typology has a heuristic purpose. It highlights the three possible starting points for contemporary works in economic history: the theoretical clarification on which cliometrics insists, the numerical description that long-series history emphasizes, and the story that is at the heart of analytic narratives. Depending on the author's strengths and weaknesses, or their tastes, an economic history article or book includes a more or less strong dose of each of these three ingredients. At any point in time, the diversity in qualifications and tastes of researchers in economic history defines the supply available for each type of research. But even if it is possible to individually focus only on one way of doing research, interactions and discussions in economic history lead to the amalgamation of researchers and methods. This culture becomes particularly prevalent during the publication process, because this is the moment when authors encounter their readers.

What explains the increasing demand for economic history? The different types of studies are not uniformly benefiting from the growing demand for economic history. Studies based on long time-series, including articles exploiting natural experiments involving exogenous changes in individual behaviour, benefit from higher demand in academic journals. This type of demand should not be confused with the one emanating from the public or economic policy makers. The type of historical research that public debates call for contains a (strong) narrative dimension related to current political issues, as illustrated by the broad successes of Piketty (2013) and Gordon (2016). Finally, the use of historical analyses in formulating economic policies, especially concerning central banks, is more variable.

The 2007 financial crisis could easily explain economic history's new popularity. Standard economic models had not signalled any risks before the crisis; once the crisis occurred, these same models indicated few solutions. The situation called for other types of reasoning, and historical analogies became fashionable again (Eichengreen, 2012). The 2007 crisis also heightened the demand for frameworks that could be used to explain public policies and that differed from the economic models that practice had invalidated. In a world of unconventional policies, the use of history provided a wealth of case studies. The latter inform about the detailed effects of policies and allow thinking about how to break with the past. The subject of history is change over time, imposing the inclusion of dynamics and structural breaks in the otherwise stationary world of economic models. Incorporating more of the past into an analysis raises the question of how and why institutions and economies evolve over time. *In fine*, a historical approach to economic questions thus needs to discuss how applicable and generalizable assumptions and results of an analysis are.

Historical records and analyses instruct the specificity of cases and their context. The lessons drawn also shed light on the present -with respect to the role of central banks in dealing with a crisis and fulfilling their role as lender of last resort, for example. How important access to the Bank of France discount window was during the phylloxera crisis, which decimated vineyards between 1862 and 1890, teaches us that the central bank's operating procedures can reduce contagion, and hence the cost of financial crises (Bignon and Jobst, 2017). Maintaining a fixed exchange rate or restructuring a public debt overhang is another issue that has been raised recently. Studying the English policy choices at the end of the Napoleonic wars, when the ratio of public debt to GDP was approaching 260%, is informative about the inevitability (or not) of sovereign defaults (Antipa and Chamley, 2017). In other words, it is possible to learn from the specificity of historical analyses, as they highlight economic, political and social issues that may emerge in other times and places (Eichengreen, 2016).

Another reason rendering economic history more attractive resides in a shift from theoretical fictions (models of the economy) to a narrative mode whose hypotheses are chosen to explain a given situation. This shift questions Milton Friedman's postulate that one should assess the quality of a theory by the accuracy of its predictions rather than by the adequacy between its assumptions and reality. Economic history pays attention to the choice of underlying hypotheses. It carefully

considers whether the narrative structure suits the historical materials and is thus enjoying a markedly renewed interest. This may also explain the revived interest in applied theory. Economic history, however, goes a step further by analysing parameters that economists take as given (North, 1997). The contribution of history to economic theory manifests along a third dimension, depth in space and time. By describing how social and political institutions affect economic decision-making, economic history accounts in a different way for the ramifications and interdependencies of the real world. Economic history is thus a joint description of economic and political relations.

A final set of reasons is related to the methodology of history, based on endless back and forth between the past and the present, between the strange and the familiar. In addition, training and discussions of academic work in economic history take place in an ecosystem that creates intellectual plasticity, as it implies acquiring a quasi-encyclopaedic culture of multiple historical precedents for a given situation or policy. No one studies history if their curiosity is not insatiable, and if they are not on the lookout for the latest historical case illuminating the world as it is. The intellectual training implied in the study of economic history demonstrates the need to question existing intellectual frameworks. This is useful when it comes to making an informed but risky diagnosis.

Economic history teaches two types intellectual plasticity

Economic history is a science of observation as much as of supposition. It does not postulate any precise theoretical framework, nor does it impose a methodology. No hypothesis is given. Everything must be verified and tested by studying the archives and by rigorously reasoning, which also implies to treat as variables the parameters that others take as given. In considering change, including that of social and political institutions, history is interdisciplinary. The scope of the field and the flexibility of an author's approach are also reflected in the language of economic history, which does not indulge in jargon, even if there is a great risk of refusing to translate a situation into its contemporary equivalent.

On the other hand, economic history is built not around theoretical topics or empirical objects, but around the past. In history, the field is structured in such a way that no one can say, "this does not concern me", or "this is irrelevant for my research", without the risk of

becoming isolated in the field. It follows that the training of an economic historian is based on accepting the heterogeneity in conceptual frameworks, in episodes, facts and cultures, and in his/her ability to explain the relevance and novelty of the case under study for the writing of the world's history. Neophytes find themselves immediately plunged into the core of a fundamental contradiction bequeathed by the culture of research in economic history, which consists in writing the history merely of one particular case – for example, the history of a central bank. The narrative of this piece of history has however often been told in a similar way for another country, and this must be taken into account to establish the novelty of a study. Researchers thus do not only have to correctly narrate a particular episode they also have to explain how this specific narrative is new compared to other existing ones, for other countries or eras. When this approach is implemented seriously, the historian's contribution consists in teaching cultural and historical relativism as well as the rigor of narrative demonstration. In doing so, history demonstrates the insularism of our preconceptions.

Finally, to reason based on archives allows understanding the traces left by the past and drawing precise, concrete lessons for the present. In a given situation, we often face a choice between several possibilities, several measures, but it is difficult to extrapolate the problems created by each of these solutions. The archive bears witness to a policy's failure or success. We know, for example, that inflation destroys confidence in currencies and eventually social cohesion. Confronted with high inflation, central bankers have often been tempted – or forced by their governments – to fight inflation by tightening monetary policy or by regulating prices. These price controls have always led to spectacular ways of circumventing the price system. The archives for any of these episodes thus suggest that it is impossible to impose such controls and disqualifies this type of measure as an effective way to fight inflation. This disqualification does not have the status of truth, only that of inevitability. It is in this way that the archives are informative.

3. Conclusion: Economic History, a Narrative

Economic history is back. Thirty years ago, the field was marginalized in both the public and scientific debate. Renewed interest in historical approaches has marked the last decade. This revival stems from the hybridization of the discipline, which in turn originated in accepting history as a narrative embedded in a theoretical framework

that allows structuring the story, most often in economic terms. This is good news, as history stimulates the imagination (McCloskey, 1976) and encourages the creation of new paradigms and interdisciplinarity (Lamoreaux, 2015). Historical analysis forces one to pay attention to institutions, contexts and politics in order to validate the hypotheses of the analytical framework. This leads to a more adequate reading of situations and establishes robustness, which are both essential characteristics for designing economic policies. Reflecting on and conceiving of economic policies in a constantly changing world cannot be done without understanding change over time. This suggests a critical role for the study of economic history (North, 1997).

We advocate in this study in favor of the acknowledgement of the importance of narratives, especially in economic history. The conception of economic policy today cannot do without a study of the narratives that economic agents and decision makers act on (Schiller, 2017). A great deal can be learned from case studies or unique events, such as economic and financial crises that reveal the role of preconceptions and psychological and cultural factors in decision-making (Morson and Shapiro, 2017).

From a methodological point of view, the construction of a narrative is the natural form for analysing unique events. There is a twofold value in adding the historical dimension. History expands the extensive margin, since it is an inexhaustible source of possible narratives. Only the number of historians thus limits the shelf length of documented cases. History affects the intensive margin as well. Narratives arise from the interaction between the theoretical concepts used to interpret the facts and the detailed knowledge of the historical context, the available data and the archives. The quality of a narrative instructing the present is therefore limited only by the narrator's toolbox, their imagination or curiosity in terms of theoretical speculation.

This characteristic of economic history was discovered by chance, as a constraint of a discipline that by its nature must be interdisciplinary – borrowing from economics, psychology, sociology and political science – even though the field consisted of few researchers. We have explained how this numerical weakness has created a methodological strength. Analysing macroeconomics through the prism of this method suggests that the generalization of this mode of producing information about the real can contribute to de-insulariz thee various subfields of macroeconomics that compete to shed light on the way the economy evolves today.

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LONG-TERM GROWTH AND PRODUCTIVITY TRENDS:
SECULAR STAGNATION OR TEMPORARY SLOWDOWN?[1]

Antonin Bergeaud
Banque de France and Paris School of Economics
Gilbert Cette, and Rémy Lecat
Banque de France and Université d'Aix-Marseille - AMSE

Economic growth in advanced countries has slowed in successive stages since the 1970s and, since the crisis, has fallen to a historical low compared with the 20th century. This slowdown is mainly attributable to weaker growth in total factor productivity. In emerging countries, the situation varies: in some countries, such as South Korea and Chile, GDP per capita have been converging for several decades; in others, such as Argentina, Brazil and Mexico, relative GDP per capita has stagnated or even declined. While weak long-term growth in these latter countries can be attributed to a lack of appropriate institutions, the widespread slowdown observed in advanced countries is more difficult to interpret. One possible explanation that we explore is the decline in real interest rates since the 1990s. A circular relationship appears to exist between interest rates and productivity: productivity determines long-term returns on capital and thereby interest rates; interest rates in turn determine the minimum productivity expected from investment projects. The decline in real interest rates, which is in part attributable to demographic factors, may have led to a slowdown in productivity by making an increasing number of unproductive companies and projects profitable. We illustrate this circular relationship using a cross-country panel regression. One way of breaking out of the circular relationship would be via a new technological revolution linked to the digital economy, or, in countries where there is still room for convergence, via structural reforms to improve the diffusion of Information and Communication Technologies (ICT).

Keywords: growth, total factor productivity, real interest rates, digital economy.

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1. The views in this analysis are those of the authors and do not necessarily reflect those of the institutions for which they work.

According to economists such as Robert Gordon, the low GDP and productivity growth observed in all major geographical regions since the start of the 21st century could be a lasting phenomenon (see Gordon, 2012, 2013, 2014, 2015). Gordon posits that the slowdown in productivity is linked to the smaller gains in productive performance derived from today's innovations. Innovations, he suggests, now deliver less growth than the previous technological revolutions, which profoundly changed modes of production and consumption. As a consequence, in addition to the risk of a secular stagnation caused by insufficient demand, as discussed by Summers (2014, 2015) or Eichengreen (2015),[2] there is also the risk of a supply-side stagnation, caused by subdued productivity growth.

This pessimistic vision of future productivity growth has been countered by several economists, including Mokyr, Vickers and Ziebarth (2015), Brynjolfsson and McAfee (2014), van Ark (2016), and Branstetter and Sichel (2017). In their view, the current slowdown is a temporary lull ahead of a sharp pick-up fuelled by the digital economy. Moreover, the acceleration could prove to be particularly strong as it will affect all segments of the economy simultaneously.

This article aims to revisit the debate over secular stagnation. In section 1 we describe empirically the long-term slowdown in GDP and productivity growth in advanced countries; in section 2 we examine the situation in a sample of emerging countries; and in section 3 we offer various explanations for these long-run trends. Section 4 then discusses the outlook for the future and section 5 concludes.

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2. The term "secular stagnation" was first coined by Hansen (1939) to describe the risk of low growth in the United States stemming from a shortfall in demand relative to potential supply. The term was recently reprised by Summers (2014, 2015) to describe the current risk of weak growth resulting from subdued demand. Today's situation is linked to an inability to stimulate demand, both on the part of central banks due to excessively low inflation which is constraining monetary policy (a situation known as the Zero Lower Bound), and on the part of governments due to the poor state of public finances which leaves little room for fiscal manoeuvre. The expression "secular stagnation" has rapidly become widespread and is now used in all approaches studying the possibility of a lasting slowdown caused by insufficient supply or demand.

1. The Decline in Growth is Attributable to a Slowdown in Productivity

Chart 1 provides an accounting breakdown of average annual growth in nominal GDP for the period 1890-2016 in the main developed economies.[3] Five components are identified: population growth, the employment rate (here the number of people in employment as a share of the total population), the number of hours worked, total factor productivity (or TFP for short) and capital intensity. The sum of TFP and capital intensity corresponds to the contribution of labour productivity.

Chart 1. Accounting breakdown of average annual GDP growth from 1890 to 2016

% change and contributions in percentage points
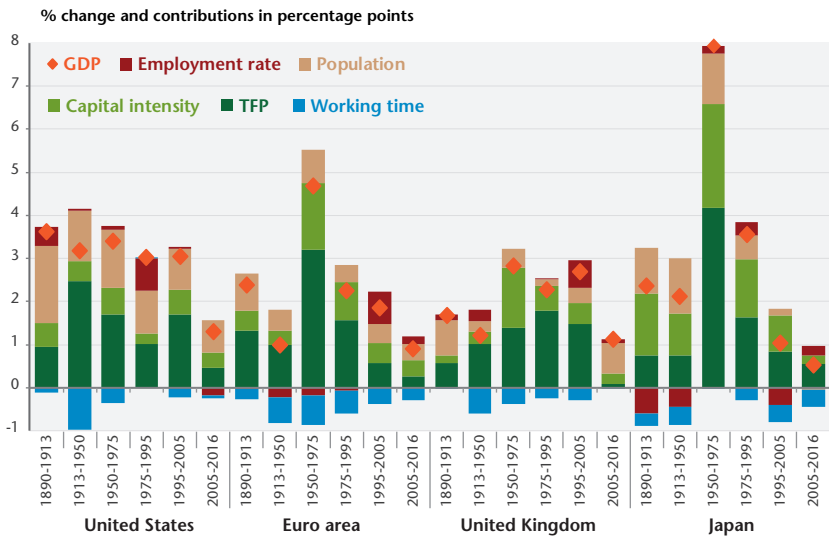
Lecture note: On average, from 1890 to 1913, US GDP grew by 3.6% per year. The contributions to this growth were 1.0 percentage point for TFP, 0.5 percentage point for capital intensity, 1.8 percentage points for population growth, 0.4 percentage point for the employment rate and -0.1 percentage point for hours worked.
Source: Bergeaud, Cette and Lecat (2016); See: www.longtermproductivity.com

Over the entire period and in all geographical areas studied, the strongest contribution to GDP growth comes from hourly labour productivity. Moreover, within hourly labour productivity, the TFP component makes a much larger contribution than capital intensity. It should be noted, however, that the breakdown of hourly labour productivity into TFP and capital intensity is statistically fragile. In

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3. This accounting breakdown is based on the usual simplifying assumptions, such as a Cobb-Douglas production function with constant returns where the elasticity of GDP to capital is set at 0.3 for the entire period and for all economies considered. For further details, see Bergeaud, Cette and Lecat (2017).

particular: (i) the weighting applied to the two main factors of production, capital and labour, which is necessary to calculate TFP, relies on major assumptions, notably that this weighting remains stable over time and space; (ii) the volume-price breakdown of investment and therefore capital is based on investment price indices that do not accurately capture gains in product performance and quality, especially in the case of information and communication technologies (ICTs for short);[4] (iii) in order to construct capital stock figures from investment data, assumptions need to be made about mortality rates for different investment components. These assumptions and how they evolve over time are based on incomplete information.

Chart 1 also reveals that TFP and labour productivity have not grown steadily over the period. Several studies have shown that they have in fact increased in a wave-like pattern, and that different countries have emerged as leaders at different times. Moreover, not all countries have succeeded in catching up with the leaders (see, for example, Crafts and O'Rourke, 2013, or Bergeaud, Cette and Lecat, 2016), and the success or failure of this catch-up process depends on interactions between innovation, education levels, and economic and political institutions (see notably Aghion and Howitt, 1998, 2009).

In the United States, three main stylised facts can be singled out concerning the contributions of TFP and labour productivity to GDP growth:

— Throughout most of the 20th century, productivity made a significant and incremental contribution to growth, a phenomenon referred to by Gordon (1999) as "the one big wave". This wave corresponds to the Second Industrial Revolution which saw numerous innovations, the most notable of which, according to Gordon, were the increasing use of electricity in lighting and motors, the use of the internal combustion engine in industry and transport, the invention of chemicals and notably petrochemicals and pharmaceuticals, and the transformation of information and communication with the dissemination of the telephone, radio, cinema, etc. These new technologies translated into major productivity gains, thanks to an increasingly educated population.

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4. See, for example, Byrne, Oliner and Sichel (2013) or Byrne and Corrado (2016).

— The decade 1995-2005 saw a sharp increase in the contribution of productivity to growth. This period corresponds to the Third Industrial Revolution or Digital Revolution, characterised by the diffusion of ICTs. There is ample literature on this phenomenon in the United States, notably Jorgenson (2001), and Jorgenson, Ho and Stiroh (2006, 2008).

— With the exception of the decade from 1995 to 2005, the contribution of productivity to growth has declined steadily since 1950, which explains the slowdown in GDP growth. Various studies have shown that the slowdown observed at the end of the recent period in fact began before the Great Recession (see, for example, Byrne, Oliner and Sichel, 2013; Fernald, 2015; Bergeaud, Cette and Lecat, 2016, 2017).

In the other main economic regions studied here, the wave of labour productivity growth corresponding to the Second Industrial Revolution occurred several decades later than in the United States (although the lag was slightly smaller in the case of the United Kingdom). Moreover, the wave of productivity growth corresponding to the Third Industrial Revolution never actually materialised in the euro area or Japan, and was only felt to a limited extent in the United Kingdom. In these three economic areas, as in the United States, the contribution of productivity has declined steadily but, in contrast with the United States, the decline began after the first oil shock and not after the Second World War. Moreover, the United Kingdom saw a very slight rise in the contribution of productivity to growth in the decade from 1995 to 2005.

These stylised facts have already been commented on (see for example Crafts and O'Rourke, 2013; Bergeaud, Cette and Lecat, 2016 and 2017) and are now widely accepted. The point we need to underline for the purposes of this study is the historically low level of productivity growth reached since the start of this century.

2. Convergence Trends Differ Across Emerging Countries

The very low rates of productivity growth observed recently in advanced countries have not been replicated in all emerging countries. In the latter, productivity growth tends to be driven by the process of convergence towards the productivity frontier in developed countries. And this convergence is in turn influenced by institutional factors, such

as the educational attainment of the working age population and the quality of existing institutions (for a summary of the literature on this subject, see Aghion and Howitt, 1998, 2009).

A study currently underway[5] has put together comparable productivity series for a number of emerging countries, in particular in South America, using a similar logic as for the developed countries discussed above. Chart 2 shows the level of hourly labour productivity[6] for five emerging countries (Argentina, Brazil, Chile, South Korea and Mexico) relative to that of the United States for the period 1890-2016. As can be seen, the speed and degree of convergence with the United States varies markedly across countries. The following main trends can be observed in relative productivity (i.e. expressed as a percentage of that of the United States): (i) an almost continuous decline over the entire period for Argentina; (ii) a relative stability in Brazil and Mexico over the entire period and, for South Korea, in the period prior to the war at the start of the 1950s; and (iii) a fairly rapid rate of convergence in Chile since the 1980s and in South Korea since the mid-1950s. These differences in trajectories confirm that convergence in productivity levels is not automatic and that the speed and success of the process depend on various factors. Argentina is a particularly interesting case as, at the start of the period, it was one of the leaders and the only country with a comparable level of productivity to the United States. Despite this, it failed to adapt its institutions sufficiently to profit from the growth delivered by innovation: due to strong demographic growth, it had insufficient domestic savings to finance its development when the international financial markets collapsed in the interwar period. As a result, from the First World War onwards, its productivity declined steadily relative to developed countries (see in particular Taylor, 1992, on Argentina, and Acemoglu, Aghion and Zilibotti, 2006, for a demonstration of the importance for growth in frontier countries of having institutions that are adapted to innovation).

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5.   The sources and methods used for this study are available at the website for the Long Term Productivity project: www.longtermproductivity.com

6.   Due to the statistical difficulty of evaluating capital stock in emerging countries, the indicator used here is hourly labour productivity and not TFP. That said, our evaluations of TFP for these countries produce qualitatively similar results (see www.longtermproductivity.com)

Chart 2. Hourly labour productivity relative to US

As a % of US productivity
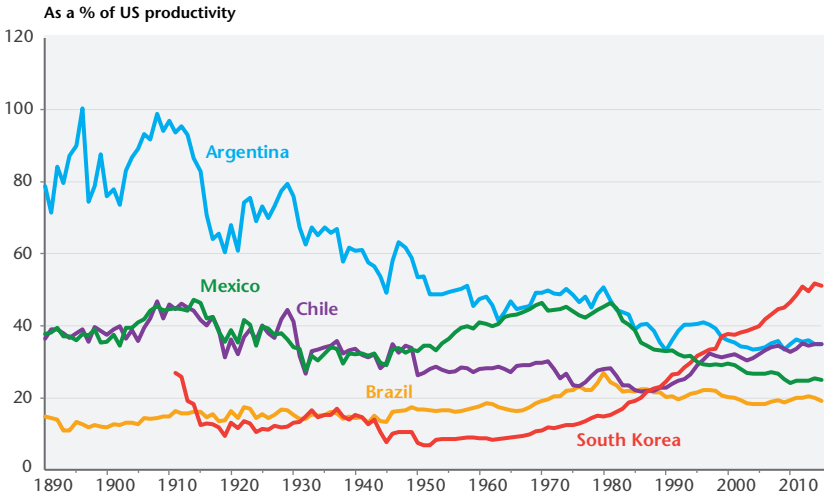
3. Growth in Productivity and Real Interest Rates: A Circular Relationship?

One comment frequently made is that GDP growth (and therefore productivity growth) fails to accurately measure, or even ignores, several aspects of effective growth over the recent period, which is being increasingly driven by the digital economy and by new technologies. A number of studies have focused on this issue in recent years, and all seem to concur that the size of this underestimation has remained fairly stable for several decades and cannot therefore explain the recent slowdown (see, for example, Byrne, Fernald and Reinsdorf, 2016, Syverson, 2016, Aghion *et al.*, 2017, or, on France, Bellégo and Mahieu, 2016). Moreover, this measurement bias is only one of the many difficulties with GDP – traditional measures of economic output also ignore other elements that have become increasingly important in recent decades, such as non-market home production.

The mismeasurement of GDP does not therefore appear to be the cause of the observed slowdown, and various other explanations have been put forward. Analyses conducted by the OECD on firm-level data, for example, indicate that the global productivity slowdown since the

start of the 2000s has not affected frontier firms, and could therefore be explained in part by stalling technological diffusion between these firms and the laggards (see Andrews, Criscuolo and Gal, 2015). This decrease in diffusion could in turn be attributable to various factors, some of which relate to the digital economy: difficulties appropriating certain forms of intangible capital, "winner-takes-all" dynamics in many sectors of activity, etc. However, the study says nothing of the causes of these phenomena, and why they appeared simultaneously in all developed economies, despite marked differences in their respective productivity levels, technological progress, education levels and institutions. Moreover, these phenomena only apply to certain sectors of activity, whereas the observed slowdown extends beyond those sectors that are ICT-intensive.

Recent analyses by Cette, Corde and Lecat (2017) on a vast sample of French firms confirm that the slowdown in productivity in the 2000s does not stem from a loss of momentum at the technology frontier. There has been no visible slowdown in productivity at frontier firms which, for France at least, appears to refute the theory that we have exhausted the potential gains from technological progress. However, the same data also show that there was no slowdown in the convergence of followers towards the technology frontier in the 2000s, which contradicts the theory that there was a decline in the diffusion of innovations between frontier firms and laggards. At the same time, the dispersion of productivity levels appears to have increased, which could point to a less efficient allocation of factors of production towards frontier firms. This problem could stem from the fact that various shocks have made it necessary to reallocate resources (globalisation, emergence of ICTs, financial crisis) but that this reallocation process has been made difficult by existing rigidities.

One explanation for the increase in productivity dispersion could be the steady fall in real interest rates to ultra-low levels. These enable the least productive firms to survive but also make less efficient investment projects more profitable. Chart 3 shows that real interest rates did indeed start to decline in the main advanced countries from the mid-1980s onwards.

The fall in real interest rates from the mid-1980s could indeed have slowed mortality rates for less productive firms (decline in the "cleansing effect"), thereby hampering the reallocation of factors of production to firms at the frontier. Lower rates could also have made it

easier to finance less efficient projects, and this combination of factors could in turn have reduced productivity gains. Several studies have provided support for this explanation (see, for example, Reis, 2013, Gopinath et al., 2017, Gorton-Ordonez, 2015, and Cette, Fernald and Mojon, 2016). It is interesting to note that the majority of these studies, in particular those of Reis (2013) and Gopinath *et al.* (2017), have focused on southern European countries (notably Spain, Italy and Portugal) and on the recent period. For the same period (i.e. since the start of the 2000s), the studies find no such relationship between financing and productivity in other countries such as Norway, Germany or France. Moreover, the decline in productivity gains and hence in potential growth is itself a contributing factor behind the fall in real interest rates (for an empirical analysis of this relationship and a summary of the existing literature, see Teulings and Baldwin, 2014, Bean, 2016, or Marx, Mojon and Velde, 2017).

Chart 3. Real long-term interest rates – 10-yr government bond yields
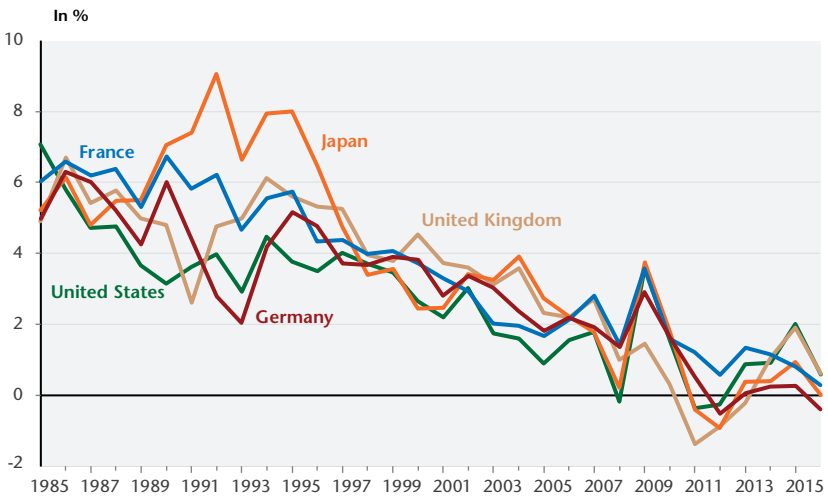
Source: OECD.

Low interest rates thus appear to lead to a fall in productivity which in turn leads to a decline in rates, creating a circular relationship between TFP growth and real interest rates. Only a technology shock could disrupt this downward spiral, but for an economy to reap the full benefits of such a shock, it needs to have the right institutions in place. Not all countries would derive the same TFP gains from a technology

shock. Yet, due to capital mobility, all would experience a simultaneous rise in real interest rates caused by the increase in potential growth in those countries that have benefited fully from the shock because they have adequate institutions. Countries with poorly adapted institutions would thus be dually penalised: real interest rates would rise, but they would not profit fully from the acceleration in productivity growth stemming from the technology shock.

In this study, we carry out a model estimation based on this circular relationship, using both macroeconomic data and individual firm-level data. The results of our estimations using macroeconomic data for 17 developed countries over the period 1950-2016 are described in the appendix. These results provide an initial confirmation that a circular relationship exists between TFP growth and real interest rates.

4. What is the Outlook for the Long Term?

The literature generally cites two potential sources of future productivity growth. The first is an acceleration in ICT performance gains and the second the extension of the use of existing ICT performances to other segments of the economy.

Regarding the first source, various recent analyses based on in-depth technological studies of semiconductor manufacturers indicate that there could be significant gains in the performance of these products at various stages in the future: first, in the nearer term, the widespread operational use of 3D chips; second, in the longer term, the harnessing of the potential offered by quantum computing (see summary by Cette, 2014 and 2015) and artificial intelligence (see Aghion, Jones and Jones, 2017).

Regarding the second source, various analyses have stressed that it always takes a long time for the full impact of a technological revolution to be felt in productive activity (see, for example, Brynjolfsson and McAfee, 2014; van Ark, 2016; Branstetter and Sichel, 2017). As Robert Solow famously wrote in a 1987 article in the New York Times,[7] "You can see the computer age everywhere, but in the productivity statistics". This impatience suggests we have forgotten what happened in previous technological revolutions: the profound changes were only

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7. Article entitled "We'd better watch out" published in the *New York Times Book Review*, 12 July, 1987.

diffused gradually, and their impact on productive performances was not felt until decades later. David (1990) has shown that between 50 and 60 years passed between the invention of a working electric dynamo in 1868 and its full exploitation in production (in the 1920s to 1930s). The widespread use of ICTs in the most developed countries has clearly had an impact on productivity, but the benefits have so far been limited and the best could yet be to come. All, or nearly all, sectors of the economy could be profoundly affected by the digital revolution. The huge improvements in ICT performance are making it possible to exploit massive databases almost instantaneously (big data) and at the same time are fuelling the development of artificial intelligence. In other words, as van Ark said (2016), the current pause in the productivity gains from the Third Industrial Revolution could in fact be a period of transition between the creation and installation of new technologies and their full deployment. As with previous technological revolutions, notably the invention of electricity, this deployment phase will take time and will require major changes to our institutions and to our methods of production and of management. However, it is already close at hand.

It is still difficult to predict with any accuracy how the digital economy will change productive activity and, more broadly, our way of life. The historical analyses conducted by Mokyr, Vickers and Ziebarth (2015) remind us that forecasts of this type are frequently wrong. At best, we can probably predict what will happen in a few sectors where the changes are already partly visible or imminent. One example, of course, is in transport, where the emergence of driverless vehicles will lead to major gains in productivity, and will completely transform the production of transport equipment, such as cars. These changes will relate not just to the technological content of the equipment itself, but also to the quantities manufactured, as the same needs will be met more efficiently with smaller amounts of materials. In other areas such as banking and retail, similar radical changes are already starting to make themselves felt.

5. Concluding Remarks

There is no real consensus among economists as to the causes of the marked productivity slowdown in advanced economies. However, numerous studies suggest the phenomenon could be temporary and that productivity could in fact accelerate again, although it is still

unclear when. According to this hypothesis, a secular stagnation could yet materialise if the conditions are not in place for an improvement in demand. In the euro area, these conditions are particularly difficult to achieve, as they imply genuine economic policy coordination between fiscally independent countries, in a context where weak demand, characterised by high unemployment, is concentrated in certain countries (mainly southern Europe), while the fiscal leeway and current account surpluses are concentrated in others (essentially northern Europe, mainly Germany and the Netherlands). Monetary policy has done a great deal to stimulate domestic demand in the euro area, with the implementation of so-called non-standard tools in the past few years, including the purchase of sovereign debt. But monetary policy is not the only game in town and it certainly cannot make up for a lack of coordination in domestic demand policies. The only way to alleviate this lack of coordination is to stimulate domestic demand in those countries where there is room for manoeuvre, via stronger wage growth or more expansionary fiscal policies (cuts in taxes or hikes in public spending).

With regard to productivity, the euro area undoubtedly suffers from ill-adapted institutions, which are preventing it from reaping the full benefits of new technologies and the associated productivity gains. However, as part of this debate over productivity, another important issue needs to be addressed: the outlook for the euro area as a whole. The bloc's underperformance relative to the United States is not inevitable, but is the result of institutional choices and specific policies. Without important changes in these fields, the euro area will increasingly be left behind by other advanced economies, and will struggle to face the numerous challenges of the future. These challenges, which Gordon (refers to as headwinds 2012, 2013, 2014, 2015), are significant and include population ageing, growth sustainability and the reduction of public debt. Moreover, without sufficient productivity growth to oil the wheels of the economy, the political risks to European democracy would inevitably increase.

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APPENDIX. **Estimation of the Circular Relationship Between TFP Growth and Real Interest Rates**

Table 1 shows the initial results obtained regarding the circular relationship between TFP growth and real interest rates using macroeconomic data for 17 developed countries for the period 1950-2016. These results provide initial confirmation of the existence of a circular relationship between TFP growth and real interest rates.

The estimated model is as follows:[8]

$$\begin{cases} TXR_{i,t} = \beta_1.TXR_{i,t-1} + \beta_2.XTFP_{i,t} + X_{i,t}.\gamma + \varepsilon_{i,t} \\ XTFP_{i,t} = \alpha_1.XTFP_{i,t-1} + \alpha_2.TXR_{i,t} + Z_{i,t}.\delta + \eta_{i,t} \end{cases}$$

Where $TXR_{i,t}$ is the level of real 10-year interest rates in country i and year t, $XTFP_{i,t}$ is the rate of TFP growth, and X and Z are vectors for exogenous control variables. Lastly, $\varepsilon_{i,t}$ et $\eta_{i,t}$ are two error terms that include a fixed country effect. $Z_{i,t}$ contains the following control variables: EDUC which is the average education level of the working-age population, here the first-difference of the average number of years spent in school, ICT is the first-difference of the two-year lagged nominal ICT capital coefficient (ratio of nominal ICT capital to nominal GDP), POP is the average population growth in the previous decade and ELEC is the change in electricity output per capita in neighbouring countries five years previously. The control variables included in $X_{i,t}$ are POP35-59 for the population old enough to save (here the population aged 35 to 59 years as a share of the total population) and VARINFL which is inflation volatility (here the variation coefficient) in the five preceding years.

We estimate these two equations separately and using two different methods. First we estimate them both using the dynamic panel method described in Arellano and Bond (1991). The results of this are shown in columns (1) and (2) of Table 1. To correct any potential endogeneity problems, and in the absence of any clear instruments, we use the Lewbel method (2012), the results of which are shown in

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8. The list of countries is the same as in Bergeaud, Cette and Lecat (2018): Germany, Australia, Belgium, Canada, Denmark, Spain, United States, Finland, France, Italy, Japan, Norway, the Netherlands, Portugal, United Kingdom, Sweden and Switzerland.

columns (3) and (4). The results are consistent with the theory that there is a positive relation between interest rates and rates of TFP growth, as the coefficients β_2 and α_2 are both positive and significant (except in the estimation in column 2 where the coefficient α_2 is not significant at the standard thresholds).

Table. Results of the model estimations

Dependent variable	XPGF	TXR	XPGF	TXR
Estimation method	Arellano-Bond		Lewbel	
Δtfp_{-1}	0.266***		0.279***	
	[0.049]		[0.047]	
Δtfp_t		0.061		0.304**
		[0.059]		[0.144]
TXR_t	0.089***		0.138***	
	[0.024]		[0.032]	
TXR_{t-1}		0.682***		0.653***
		[0.052]		[0.044]
EDUC	2.809		3.174**	
	[1.789]		[1.403]	
ICT	0.306*		0.279**	
	[0.165]		[0.138]	
POP	1.287***		1.347***	
	[0.221]		[0.185]	
ELEC	0.051***		0.052***	
	[0.015]		[0.012]	
POP35-59		0.073**		0.110***
		[0.031]		-0.035
VARINFL		0.097**		0.055**
		[0.044]		[0.026]
R^2	0.164	0.488	0.158	0.467
Number of observations	986	986	986	986

Note: The values in square brackets are standard errors measured with a variance-covariance matrix that allows "clusters" by country. ***, ** and * correspond to p-values of less than 1%, 5% and 10% respectively.

Columns 1 and 3 show the results of the model estimation using the rate of TFP growth (as a %) as an autoregressive dependent variable, 10-year government bond yields (as a %), the first-difference of the average education level (in number of years) of the working-age population (EDUC), the first-difference of the ICT capital coefficient at t-2 (ICT), average population growth (as a %) in the previous decade (POP), and a first-difference estimate of electricity output per capita in neighbouring countries, weighted by distance, at t-5 (ELEC). Columns 2 and 4 show the results of the model estimation using interest rates as the autoregressive dependent variable, the rate of TFP growth, the share (as a %) of the population aged 35 to 59 (POP35-59) and the volatility of inflation (here the variation coefficient) between t-5 and t-1 (VARINFL).

Data sources: Data on TFP are from Bergeaud, Cette and Lecat (2016, 2018), see www.longtermproductivity.com, 10-year government bond yields and inflation are from the OECD and are extrapolated backwards to 1950 using the work of Jorda, Schularick and Taylor (2017), ICT data are from Cette and Pommerol (2018) and series on electricity output and education are from the sources described in Bergeaud, Cette and Lecat (2017).

These estimations are still preliminary and are shown here for information purposes. Several points can nonetheless be highlighted. First, our model does not include fixed year effects. This choice was made to take into account the effect of global changes in interest rates and TFP, which are precisely the changes that interest us the most (for example, the slowdown in productivity since the 1970s). It is interesting to note that our effect remains significant even when such fixed effects are introduced into the model. The model is therefore robust to the use of these fixed effects for capturing the global economic cycle. Furthermore, our model does not take into account the quality of the financial system or other institutional characteristics, which may appear to be a limitation given the results of Gopinath *et al.* (2017) for example. For the period after 1950, there is no clear evidence that southern European countries are more affected by this link between interest rates, the quality of credit allocation, and growth and productivity. A formal test of this hypothesis, consisting in the insertion of a binary variable taking the value 1 if the country is Spain, Italy or Portugal, and our variable $XPFG_{i,t}$ in the first equation, rejects the idea that our results are only linked to insufficiently adapted institutions and to an inefficient financial system in southern European countries.

TECHNICAL PROGRESS AND GROWTH SINCE THE CRISIS

Philippe Aghion
Collège de France and London School of Economics
Céline Antonin
Sciences Po, OFCE

The 2008 crisis revived doubts about growth and resuscitated the debate on secular stagnation initiated by Hansen in 1938. Particularly in a post-crisis context of zero or very low growth, Schumpeterian theory may seem to be outdated. Nevertheless, in this article, we show that it remains a valid conceptual framework.

We begin by recalling the main highlights of Schumpeter's model of growth. We then argue that this conceptual framework remains relevant to many aspects of growth, notably secular stagnation, structural reforms and the debate on inequality. We show that because of creative destruction, the growth in productivity induced by innovation is underestimated. In addition, we explain why the Schumpeterian framework calls for a complementarity between structural reforms and macroeconomic policy. Finally, we show the positive impact of innovation and creative destruction on social mobility.

Keywords: technical progress, growth, Schumpeter, innovation, secular stagnation, inequality, structural reforms.

Even as macroeconomics seemed to have succeeded in containing the likelihood of a serious recession, the 2008 crisis shook many macroeconomic certainties and reopened debate about the sustainability of growth. In reality, the debate on the increasing weakness of growth is much older: it emerged in the 1930s, and media coverage dates back to 1972, when the Massachusetts Institute of Technology published the Meadows Report, *The Limits to Growth*. This report showed that the pursuit of exponential economic growth could only lead to exceeding material limits, and that growth would stop because of both the system's internal dynamics as well as external factors, first of all energy.

The economic stagnation engendered by the crisis in the industrial countries has put questions about growth back at the heart of the economic debate. Some have perceived the crisis as a harbinger that growth is running out of steam (Gordon). For others, the crisis has highlighted the phenomenon of widening inequalities and the marginalization of the middle classes. Finally, the crisis has revived debates on growth policies, especially between those who favour purely macroeconomic policies and those who advocate structural reforms.

In this article, after briefly presenting the highlights of the Schumpeterian model, we defend the idea that this conceptual framework has not been invalidated by the crisis and that it remains relevant in three ways. First, we show that productivity growth is likely to be poorly measured, casting doubt on the idea of secular stagnation and rehabilitating the theory of creative destruction. Furthermore, the Schumpeterian paradigm demonstrates the need for structural reforms to support innovation and growth. Finally, it helps to rethink the debate on inequality by showing the positive impact of innovation and creative destruction in promoting social mobility.

1. The Schumpeterian Model

The Schumpeterian growth model developed in 1987 by Philippe Aghion and Peter Howitt (Aghion and Howitt, 1992) is based on four ideas inspired by Schumpeter.

The first idea is that long-term growth results from innovation. Without innovation, the economy is stationary. A stationary economy prevailed before capitalism and works like a closed loop, reproducing itself identically.

The second idea is that innovation does not fall from the sky and that it is an eminently social process. It results from investment decisions (in research and development, training, the purchase of computers, etc.) on the part of entrepreneurs, who are seen as the pillars of capitalism. Unlike in the classics and the Marxist vision, Schumpeter's entrepreneurs are not related to any particular social group. They are the ones who innovate,[1] who create. They respond to positive or negative incentives from institutions and public policies: for example, the presence of hyperinflation or insufficient property rights protection in a country discourages innovation.

The third idea is the concept of creative destruction: new innovations make previous innovations obsolete; in other words, Schumpeterian growth is the scene of permanent conflict between the old and the new; it tells the story of the innovators of yesterday who turn into daily managers falling into a routine, trying to prevent or delay the entry of new competitors into their sector of activity.

The fourth idea is that productivity growth can be generated either by innovation "at the boundaries" or by the imitation of more advanced technologies. The more a country develops (that is to say, approaches the technological frontier), the more innovation becomes the engine of growth and takes over from the accumulation of capital and technological catch-up (imitation).

2. The Debate over Secular Stagnation

The 2008 crisis has revived doubts about growth and once again brought up the concept of secular stagnation. This is not a new idea. In 1938, the economist Alvin Hansen explained during his Presidential Address to the American Economics Association (AEA) that, in his view the United States was condemned to weak growth in the future. His reasoning was based on a predictable slowdown in population growth and a lack of aggregate demand. In 1938, the world economy was just recovering from the effects of the 1929 crisis, and Hansen did not anticipate a Second World War that would result in boosting public spending and thus aggregate demand.

More recently, in regard to the Internet revolution, Robert Solow noted in 1987 the paradox that "you can see the computer age everywhere but in the productivity statistics". Solow noted that the spread of Information and Communication Technologies (ICT) in the US economy did not seem to be translating into significant gains in productivity and growth. This finding was shared by Robert Gordon (2000), for whom the Internet revolution is not comparable to previous industrial revolutions; productivity growth has remained low, and it is benefiting only the ICT-producing sectors. For Gordon (2012), the risk

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1. Schumpeter distinguishes inventions, i.e. the discovery of new scientific knowledge, from innovations, i.e. the introduction of these inventions into the productive sphere. For Schumpeter, it is the innovations that explain the dynamics of growth, and the bearer of innovations is the entrepreneur who introduces the inventions provided by technical progress into the economic process.

of secular stagnation reflects a supply problem. Gordon advances the idea that the great innovations have already taken place, using the parable of the fruit tree: the best fruit are also the ones that are picked the most easily (low-hanging fruit), after which the picking becomes more difficult and less juicy.

In addition, the onset of the 2008 subprime crisis led Larry Summers along with others to use the term "secular stagnation" to describe a situation they consider similar to that described by Hansen in 1938. The idea put forward by Summers is that demand for capital goods is so weak that it would require a negative interest rate to restore full employment and keep output at its potential.

The idea of secular stagnation has gained emulators. Indeed, eight years after the subprime crisis, in 2016 most developed economies are still plagued by a lag in production, with serious output gaps. This situation contrasts sharply with these economies' past cyclical behaviour, when GDP was rapidly brought back to its potential. This leads to questioning the causes of the disruption of the growth path that has occurred for almost ten years, reviving the debate around "secular stagnation".

The thesis of secular stagnation related to an insufficiency of supply is refuted by several economists: thus, Crafts (2002) evaluated the US economy over a very long period and showed that the contribution of the diffusion of information and communication technology (ICT) to output and productivity has grown considerably faster than the contribution of the steam engine and the distribution of electricity. In addition, Fraumeni (2001) and Litan and Rivlin (2001) showed that the evaluation of growth has been low because many forms of improvement in the quality of certain services (trade, health, etc.) resulting from the diffusion of ICT are not taken into account in national accounts statistics.

Schumpeterian economists have a more optimistic view of the future than Gordon, for several reasons:

— The ICT revolution has drastically and radically improved the technology of the production of ideas (Dale Jorgenson) by creating positive diffusion externalities between sectors. In fact, in a recent work, Salomé Baslandze showed that while the direct impact of the ICT revolution on US growth was of a limited duration, this revolution has had a much longer-lasting indirect effect. It has enabled companies in the most "high-tech" sectors,

the sectors most dependent on new ideas in related fields and sectors, to improve the productivity of their production and innovation activities. The effect of this diffusion of knowledge has resulted in a reallocation of productive resources from traditional sectors to these "high-tech" sectors, which has had a significant and lasting impact on US growth (Baslandze, 2016).

— Globalization, which is contemporary with the ICT wave, has significantly boosted the potential gains from innovation (scaling effect) as well as the potential losses of not innovating (competitive effect). It is therefore hardly surprising that in recent decades we have witnessed an acceleration of innovation, in quantity and also in quality, particularly with regard to the volume and impact of patents. Akcigit *et al.* (2016) highlighted the link between patent production and productivity growth.

— Nevertheless, this acceleration of innovation is not fully reflected in the evolution of productivity growth, in particular because of a measurement problem (Aghion *et al.*, 2017). This measurement problem is likely to be exacerbated when innovation is accompanied by a high rate of creative destruction. Chart 1 below shows that the number of patent applications is positively correlated with the growth of labour productivity in US states where creative destruction[2] is weaker, whereas the correlation is negative in US states where creative destruction is stronger. The same phenomenon is found when considering business sectors: the correlation between patent production and productivity growth is more positive in the sectors that experience the least amount of creative destruction.

Why does more creative destruction imply more errors in measuring productivity growth? The reason is that, when analysing the growth of the monetary value of the output of a sector or a country, statistical institutes do not know how to distinguish between what results from inflation and what reflects the real growth in the value of goods. With regard to an object that remains the same from yesterday to today or an object that is modified only at the margins between yesterday and today, we can easily distinguish what is due to inflation and what corresponds to a real improvement in the good's quality. But how is

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2. Creative destruction is measured as the average of the number of jobs created and the number of jobs destroyed (US data *Quarterly Workforce Indicators series*).

Chart 1. Correlation between patent applications and the growth of labour productivity in the United States, 1994-2010

Thousands of patents
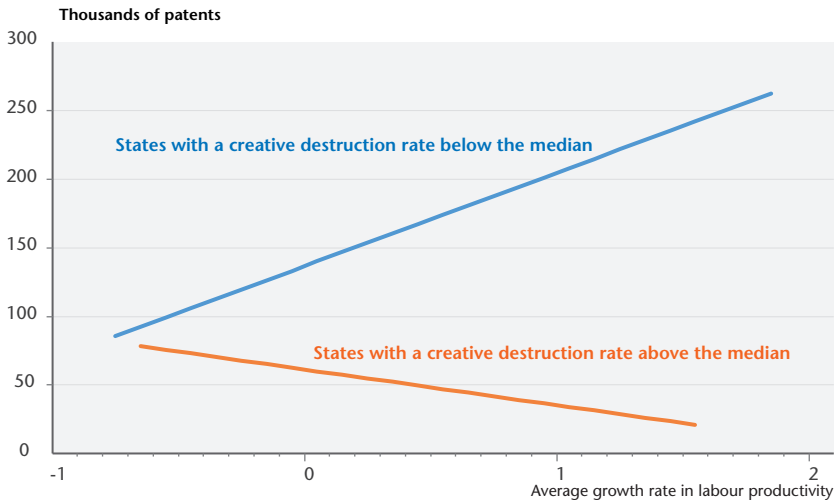
Source: Aghion (2017).

this to be done when an object is replaced by another object between yesterday and today? In this case, the statistical offices systematically use imputation: in other words, for each category of goods, the statistics institutes calculate the inflation rate based on the inflation measured on the goods that have not been replaced between yesterday and today. Then they extrapolate this measure by stating that this rate of inflation is the inflation rate for all products, including those that were replaced between yesterday and today. Yet it can be shown that because of the use of extrapolation, the growth rate of productivity in the United States has been underestimated by nearly 0.6 percentage point per year on average over the last thirty years (Aghion *et al.*, 2017). Similarly, in France over the last ten years, actual growth in productivity exceeds measured productivity growth by 0.5 percentage point; in other words, actual growth is twice the measured growth (Aghion *et al.*, 2018).

— Finally, our optimism about the prospects for future growth is based on the observation that many countries, starting with ours, are lagging in benefiting from the technological waves, and benefiting only partly, in particular because of structural rigidities and inappropriate economic policies. For example, some countries have not fully transformed from catch-up economies into innovation economies. The comparison between

Sweden and Japan (Bergeaud *et al.*, 2014) is particularly instructive: productivity growth is accelerating in Sweden, whereas it is slowing down in Japan (Chart 2).

Chart 2. Trend in factor productivity growth in Sweden and Japan
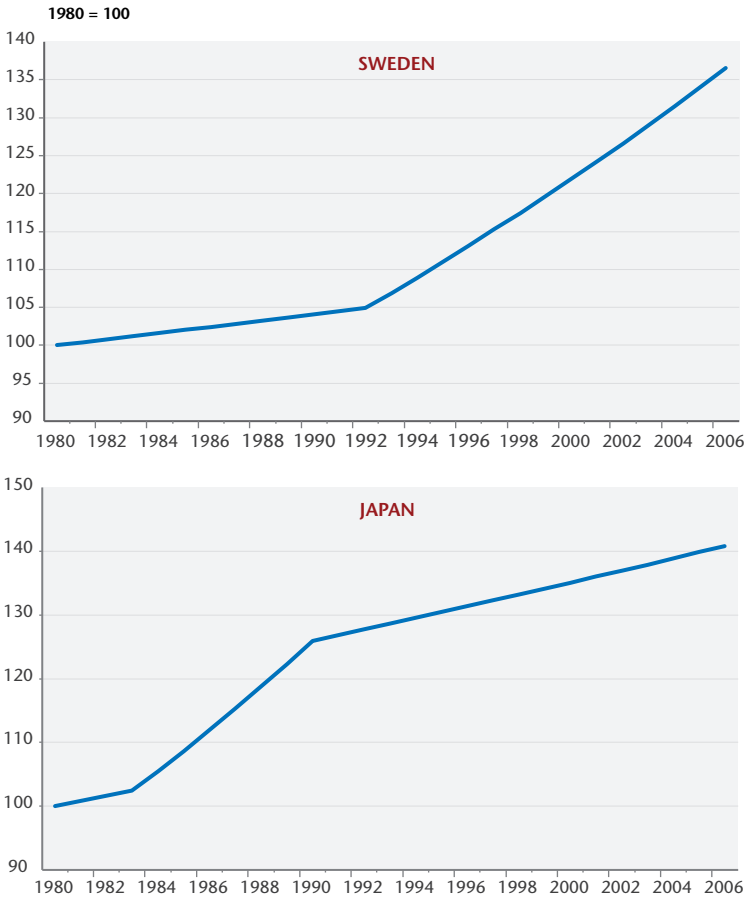
Source: Bergeaud *et al.*, 2014.

Moreover, innovation and policies to promote innovation can be used to act not only on supply, but also on demand, and avoid the situation described by Summers, namely stagnation characterized by a liquidity trap and insufficient aggregate demand. Thus, Benigno and Fornaro (2015) used a Keynesian-inspired model to show that two stationary states can be reached: on the one hand, a stationary state characterized by a full employment equilibrium and growth that meets

its potential; and on the other hand, a stationary "stagnant trap". In this equilibrium, the weakness of aggregate demand depresses investment in innovation, pulling the nominal interest rate to zero and perpetuating weak aggregate demand. To determine the equilibrium that will be chosen, Benigno and Fornaro emphasize the crucial role of expectations: when agents anticipate low growth, and thus low income, this leads to a decrease in aggregate demand, and therefore a decline in corporate profits and investment. Unfavourable expectations may thus create the conditions for a stagnation characterized by low aggregate demand, involuntary unemployment and inefficient monetary policy. On the other hand, policies to encourage and subsidize innovation can pull an economy out of the "stagnation trap": innovation not only acts on supply, but also boosts expectations and stimulates aggregate demand.

3. Structural Reforms and Macroeconomic Policies

The US economy has proved more resilient than the European economy in the wake of the 2008 financial crisis. Some have blamed the lack of macroeconomic responsiveness in Europe, while others have pointed to France's slow pace in adopting structural reforms that would have affected potential growth. In the face of a recession, there are in fact always those who on the one hand advocate stimulus policies (notably using the deficit and public spending) and on the other those who advocate a state withdrawal, except for guaranteeing the regulation of the markets.

Our feeling is that both factors are in play simultaneously; in particular, persistent rigidities in the goods and labour markets reduce the impact of any "proactive" macroeconomic policy. Basically, we are just paraphrasing the European Central Bank President Mario Draghi, who declared two years ago at Bretton Woods that the ECB could carry only half the load by easing its monetary policy, and that it was up to the States to do the other half by undertaking reform.

To encourage companies to innovate, it is crucial to reform the products market: according to the IMF, this would have a greater impact than labour market reform. An analysis of labour market reforms shows that these have only a relatively modest effect on productivity and GDP (see Barnes *et al.*, 2011; Bouis and Duval, 2011), especially if the public expenditures associated with these measures are

offset by additional austerity measures elsewhere (Antonin, 2014). On the other hand, according to the IMF's Global Integrated Monetary and Fiscal Model (GIMF), if labour market reform is accompanied by product market reform, then the potential for growth rises sharply. In the euro zone, the simultaneous reform of the goods and products market would increase GDP by 4.1 percentage points after 5 years,[3] and by 12.3 points in the long term (Schindler *et al.*, 2014).

In fact, the preliminary results of research conducted by Aghion, Farhi and Kharroubi (2017) suggest a *complementarity* between structural reforms and a more counter-cyclical monetary policy (with lower interest rates during a recession and higher interest rates during an expansion). A counter-cyclical monetary policy is conducive to growth, especially in sectors subject to credit constraints or liquidity constraints. It reduces the amount of liquidity that entrepreneurs must set aside to guard against future liquidity risk. Moreover, the effect will be stronger in countries with weaker regulation of the goods market.[4] Conversely, when the goods market is highly regulated, the cyclical evolution of short-term interest rates has no impact on growth: companies benefit from extra income and are not sensitive to changes in financial conditions. In addition, the unexpected decline in yields on government bonds in the euro zone countries – following the ECB's announcement of the Monetary Securities Transaction programme (MST) in September 2012 – had a much stronger impact on the growth of the most indebted sectors, but only in countries that had weak regulation of the goods and services markets. In countries with strict regulation, the fall in yields had either no effect or a positive effect on the least indebted sectors. The regulation of the goods and services market has thus diverted the financing of the ECB from the indebted sectors to the sectors benefiting from extra income.

In other words, by being bolder about structural reform, we will not only encourage our German neighbours and the ECB to accept more flexible macroeconomic policies, but above all we will increase the extra growth to be expected from this macroeconomic easing.

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3. Reform of the goods market alone (or the labour market) would increase GDP by 1.7 points (respectively 1.4 points) after 5 years.
4. Regulatory intensity is measured using the OECD Barriers to Trade and Industry indicator

4. Inequality and Inclusive Growth

In recent decades, income inequality in the developed countries has increased at an accelerating pace, particularly at the top of the income ladder: the "top 1%" has seen its share of total income rise rapidly. Various explanations have been proposed to account for this fact, but these have not always adequately taken account of the data and empirical analysis. The strong correlation between inequality and innovation reflects that innovation has a causal link with extreme inequality: the revenue from innovation contributes significantly to the growing share of income held by the "top 1%" (Aghion *et al.*, 2015). It is crucial to understand that the increase in the "top 1%" results partly from innovation and not only from land and speculative rents. Innovation increases inequality, but it also has virtues that other sources of high income do not necessarily have.

First, innovation is the main driver of growth in developed economies. This is largely supported by empirical studies, which show an increasing correlation between growth and R&D investments and between growth and patent flows as a country moves closer to the technological frontier. Second, while it is true that in the short term innovation benefits those who have generated or permitted it, in the long run the benefits of innovation are dissipated because of imitation and creative destruction (replacement by new innovations) and because patents expire after 20 years. In other words, the inequality generated by innovation is temporary in nature. Third, the link between innovation and creative destruction means that innovation generates social mobility: it allows new talent to enter the market and to oust (partially or totally) existing firms. It is interesting, in this regard, to note that, in the United States, California (which is currently the most innovative US state) is well ahead of Alabama (which is among the least innovative US states) both in terms of income inequality at the top 1% of the income scale and in terms of social mobility.

Overall, then, innovation propels its beneficiaries into the highest segments of the income distribution, and at the same time innovation stimulates social mobility.

How can growth be reconciled with innovation and social mobility? One promising approach might be to first identify the levers of growth in the context of the economy in question, and then to analyse the effects of each of the levers of growth on the various measures of inequality: income inequality in the broad sense (Gini, etc.), the share of

income captured by the top 1% of the income scale, and social mobility. We have seen that innovation affects these different measures of inequality differently, and in particular that it increases social mobility.

It turns out that the main levers of growth through innovation have a positive effect on social mobility. These levers have been identified in previous studies[5] as education (especially higher education), a more dynamic labour market and a more competitive goods and services market, and innovation-friendly taxation. What is the effect of these different levers of growth on social mobility?

Education is "inclusive" in that it tends to increase social mobility and reduce income inequality in a broad sense: Chetty *et al.* (2014) show how, for example, social mobility is positively correlated with the results obtained in educational tests.

Perhaps more surprising is the fact that the flexibility of both the labour market and the products market also appear to favour social mobility, as shown in Chart 3 below, based on the ongoing work of

Chart 3. Social mobility and the creative destruction of businesses in the United States
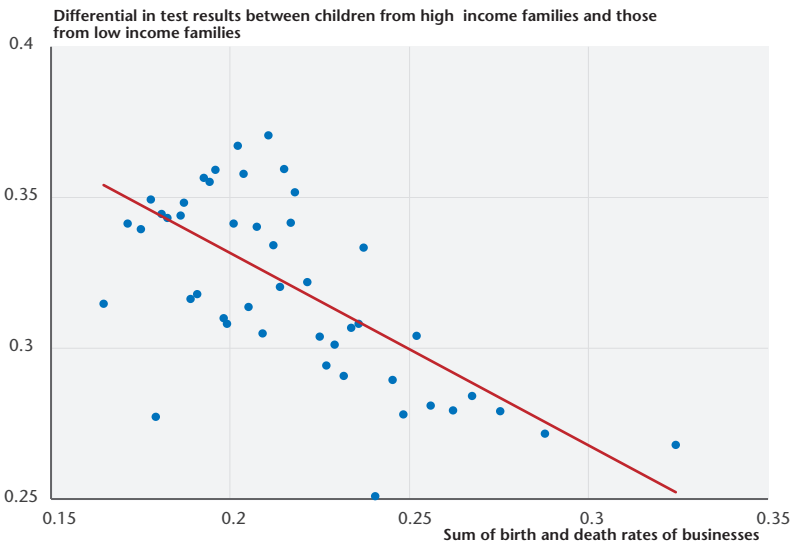
Sources: The corporate data is based on the survey data *Business Dynamics Statistics* and the data on social mobility is from the *Equality of Opportunity Project.*

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5.   *Cf.* Philippe Aghion, Gilbert Cette, Elie Cohen and Jean Pisani-Ferry, 2007, *Les leviers de la croissance française*, Paris, La Documentation Française.

Alexandra Roulet. Using US data, we observe that when creative destruction increases, the difference in outcomes between children from high-income families and children from low-income families decreases, and consequently social mobility increases.

This is encouraging news: the levers of growth through innovation also have the virtue of stimulating social mobility. Finally, one thing is certain in the light of our previous discussion: tackling innovation through inadequate taxation is tantamount to reducing not only growth but also social mobility.

5. Conclusion

In this article, we examined three debates rekindled by the crisis of 2008: the debate on secular stagnation, the debate on the relationship between macroeconomic policy and structural reform, and the debate on widening inequalities and the link between inequalities, innovation and growth.

We have tried to explain how, in each of these debates, the Schumpeterian paradigm makes it possible to reason differently and suggests both new questions about the growth process and some solutions in terms of growth policies.

First, our discussion of secular stagnation has led us to believe that productivity increases are not measured correctly and are in fact largely underestimated, and that overall while our economies are actually subject to secular trends, linked to the diffusion of new technological revolutions, it is difficult to speak of stagnation once growth has been correctly measured.

Our discussion on macroeconomic policy and structural reform showed that there is complementarity between macroeconomic policies (fiscal and/or monetary) that are more reactive to the economic cycle, and structural reforms that promote fluid markets: this is what we call the "Draghi approach".

Finally, our analysis of the relationship between innovation and inequality has shown that while innovation helps to increase the share of the top 1% in a country's total income, at the same time innovation and the reforms underpinning it tend to stimulate social mobility by virtue of creative destruction. As a result, a smart fiscal policy must treat

innovation differently from other sources that increase inequality at the top of the income ladder.

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MACROECONOMICS IN THE AGE
OF SECULAR STAGNATION[1]

Gilles Le Garrec, Vincent Touzé
Sciences Po, OFCE

The "Great Recession" that began in 2008 plunged the economy into long-lasting stagnation with high unemployment, depressed output and very low inflation. This crisis, whose exceptional duration is difficult to explain using the theoretical tools of contemporary macroeconomics, invites us to enrich fundamental analysis. Conceptualizing secular stagnation is then based on the introduction of market imperfections such as credit rationing on the financial market as well as nominal rigidities on the labour market. The resulting equilibrium is characterized by the underemployment of factors of production (high unemployment, low capital accumulation) associated with a fall in prices (deflation) and monetary policy that is inactive because of the zero lower bound constraint on the key rate. In a period of secular stagnation, the impact of economic policies is affected, and many Keynesian properties appear: a deflationary impact of supply policies, ineffective conventional monetary policy and a positive effect of public spending, although limited by the crowding out of private investment.

Keywords: secular stagnation, accumulation of capital, budget policy, zero lower bound.

Τhe economic and financial crisis of 2008 caused a severe recession that has been characterized by an unusually slow recovery (Summers, 2013 and 2014; Rawdanowicz *et al.*, 2015). There are two types of issues posed about the causes of the insufficient recovery. First, potential growth has been weakened, reflecting a lack of supply. Second, the output gap might be abnormally persistent, that is to say, the economies are having difficulty absorbing demand deficits.

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1. This article takes up, updates and extends an OFCE Note published in 2016. We would like to thank Sandrine Levasseur and the anonymous referee for their numerous and useful remarks.

The weakening of potential growth could result from a lack of traditional factors (low productivity gains, rising social inequalities, aging of the active population, globalization, scarcity of raw materials, *etc.*) but also hysteresis effects (Keightley *et al.*, 2016) since the crisis could have "permanently damaged" the factors of production (destruction of productive capital, depreciation of the human capital of the unemployed, decrease in investment). As for the persistence of the output gap, this could reveal an inability to bring the economy towards full employment or at least towards the frictional unemployment rate, hence the hypothesis that stagnation has become sufficiently persistent to be deemed "secular".

The hypothesis of secular stagnation was first raised in 1938 in a speech by Hansen published in 1939 as an article entitled "Economic Progress and Declining Population Growth". This explored insufficient investment in the United States and a decline in the population after a long period of economic and demographic expansion. The secular stagnation hypothesis is interpreted as an abundance of savings that pushes the "natural" real interest rate (defined by Wicksell in 1898 as the real interest rate compatible with full employment) below zero. However, if the real interest rate remains above the natural rate over a long period, this results in a chronic deficit not only of global demand but also of investment, which depreciates the growth potential. The very weak inflation and even deflation observed since the beginning of the crisis underlines the relevance of the secular stagnation hypothesis in accounting for the current economic situation.

In support of this thesis, it should be noted that as a result of the 2008 crisis, public debts have increased significantly, rising from 62.5% to 106.1% in the United States and from 69% to 89% in the euro zone (from 68% to 96% in France, but just 65% to 68% in Germany after peaking at 81% in 2010). Long-term interest rates have nevertheless remained remarkably low, with 10-year yields on US, German and French government bonds averaging 2.2%, 0.38% and 0.75%, respectively, in the third quarter of 2017. The low level of long-term rates could mean that the markets do not anticipate an increase in inflation in the near future. With this in mind, Summers (2016) concluded that the state of stagnation will persist.

The purpose of this article is to present the concept of secular stagnation as a new field of macroeconomic analysis. The first section reviews the factual analysis, which raises the question of whether the

Great Recession caused a lasting change in the economy, thereby requiring a need to review the fundamentals of macroeconomic analysis. The second part examines how a secular stagnation equilibrium can be characterized from a theoretical point of view. The third part then considers how effective economic policy can be in an economy frozen in a state of secular stagnation. The final part offers a conclusion.

1. The Post-crisis Economy: A Lasting Change?

1.1. An abnormally slow recovery and blocked monetary policy

The economic crisis of 2008 has hit the developed countries hard (Le Garrec and Touzé, 2017a). It caused a fall in GDP relative to its potential level[2] (Chart 1). The difference with potential, i.e. the output gap, widened to 4.5% in the United States in 2009 compared with the euro zone's peak of 3.6% in 2013. The growth rate of potential GDP (Chart 2) has also deteriorated due not only to the disappearance of companies and a decline in investment but also to a reduction of the labour force in the United States. Before the crisis (1998-2007 period), the average growth rate of potential GDP was 2.7% in the United States and 1.9% in the euro zone. Following the crisis (2009-2018), the average has been only 1.6% in the United States and 0.8% in the euro zone, reflecting a lasting change.

Excess production has led to a significant decline in the inflation rate (Chart 3). On average over the period 1998-2007, it fluctuated around 2.7% in the United States and 2% in Europe. After the crisis, the inflation rate fell to almost zero before rising again very slowly. Over the period 2008-2018, the average inflation rate was down by an average of one point.

Before the crisis, the average unemployment rate (Chart 4) hovered around 4.9% in the United States and 8.8% in the euro zone. Employment paid a heavy price for the crisis. The unemployment rate rose to almost 10% in the United States and 12% in the euro zone. A change came earlier in the United States, where the unemployment rate began falling in 2011. This was achieved at the cost of a reduction in the labour force participation rate (Chart 5), which may well reflect long-term discouragement among a section of the working-age population.

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2. The measurement of potential output is a subject of debate – see in this regard Sterdyniak (2015).

The turnaround came later in Europe on average, from 2014, and has in contrast been accompanied by a rise in participation rates.

Chart 1. The output gap

As a percentage of potential output

Dotted line: average for the period.
Source: Authors' calculations based on the Economic Outlook (OECD).
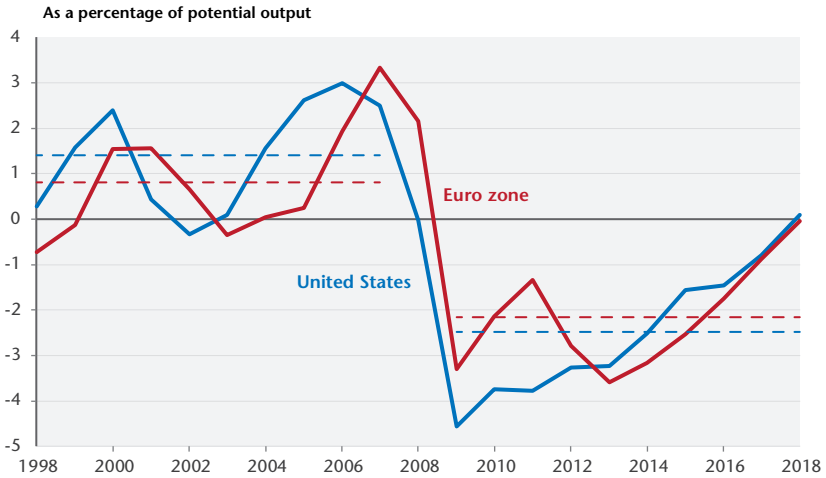
Chart 2. Growth rate of potential production

In %

Dotted line: average for the period.
Source: Authors' calculations based on the Economic Outlook (OECD).

Chart 3. Inflation rate

Dotted line: average for the period.
Source: Authors' calculations based on the Economic Outlook (OECD).

Chart 4. Unemployment rates

Dotted line: average for the period.
Source: Authors' calculations based on the Economic Outlook (OECD).

Chart 5. Participation rates

As a percent of the working-age population

Dotted line: average for the period.
Source: Authors' calculations based on the Economic Outlook (OECD).

Many developed countries have resorted to fiscal policy to deal with the crisis, first in automatic mode (increased social spending and lower tax revenues) and then in a voluntary way. The aim was to support economic activity, but also to protect the financial sector, which had been severely weakened by the depreciation of its a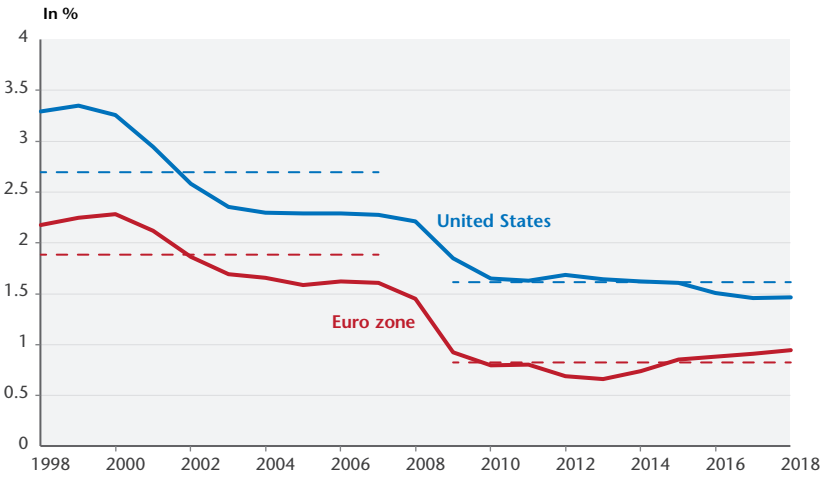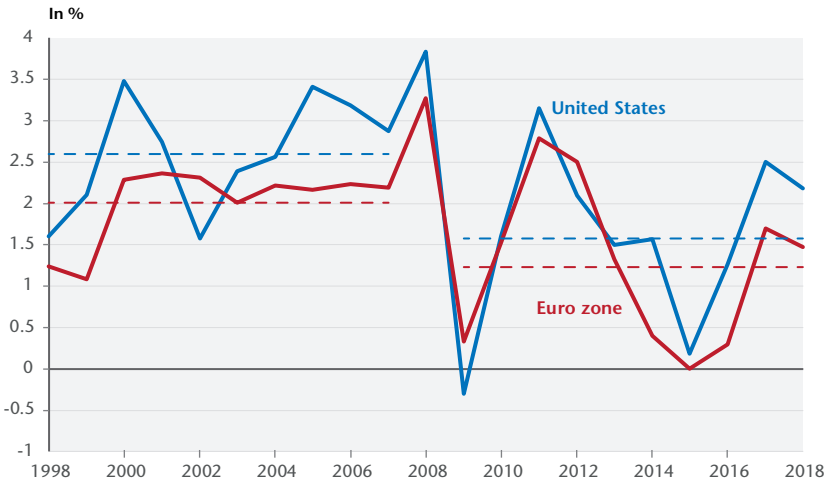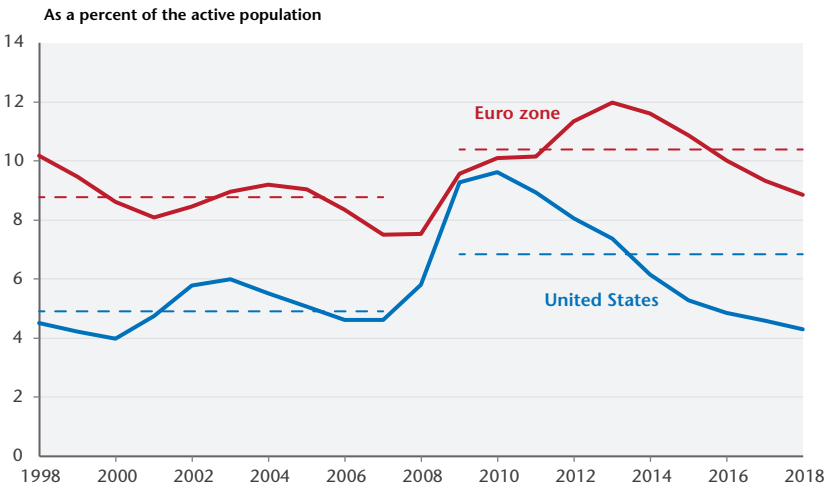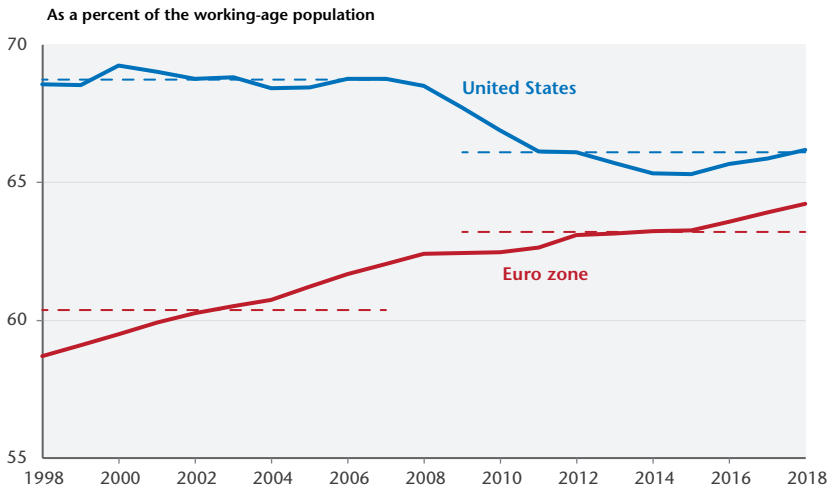ssets. In a third phase, due to the high levels of public debts and public deficits and thus in order to protect their solvency, the States were compelled to increase compulsory contributions and tighten up public spending. The constraints were more pronounced in southern Europe because of fiscal rules and the sovereign debt crises that hit these countries, which led to soaring interest rates and a partial default on Greek debt.

In response to the financial crisis, the central banks lowered their key interest rates (Chart 6). The rate cut was sharp and quick in the United States. In Europe, it took place later and was initially a little more limited. Rates have reached a very low level. With the return of a low level of unemployment in the United States and a potential increase in production, the key interest rate has risen slightly there since December 2015, with the last rise in March 2018 putting the rate at 1.75%. In the euro zone, the key interest rate has been zero since March 2016. It is difficult for the European Central Bank (ECB) to go down any further as adopting a negative interest rate would mean that

the ECB would have to pay banks to borrow. Moreover, in the presence of negative rates, economic agents would be more inclined to keep their savings in a monetary form with zero interest rates. It is said in this situation that the nominal rate is constrained by a zero lower bond (ZLB). The heterogeneity existing between euro zone countries, particularly in terms of public debt and bank liabilities, has forced the ECB not to change the level of the key rate for a long time, even though some countries such as Germany and the Netherlands are seeing a return to full employment.

Chart 6. Key interest rates
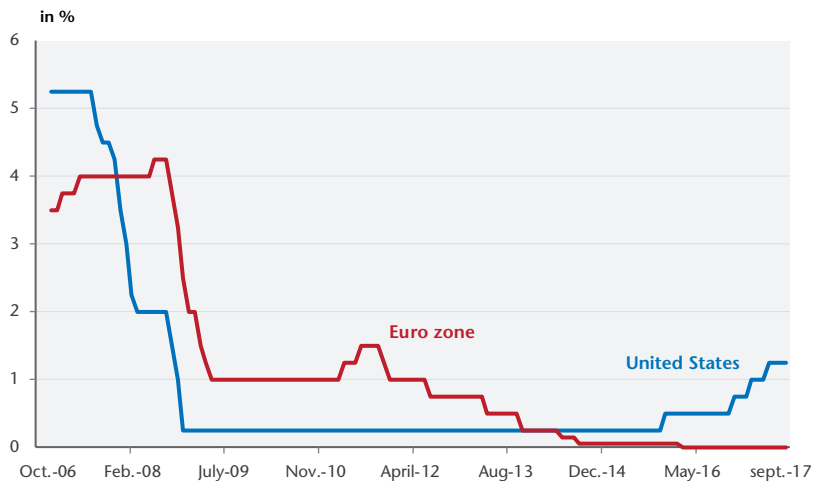
Source: US Fed and ECB.

1.2. Productivity underestimated?

The US economist Robert Gordon sees the 2008 crisis as a symptom of a downward trend in productivity that clearly pre-dates the crisis. According to his calculations (Gordon, 2003), hourly productivity grew at an annual rate of 2.7% in the United States during the period 1950-1973 (4.4% in Europe), while the rate came to only 1.4% in the period 1973-2000 (2.4% in Europe). Based on these downward trends in productivity growth, Gordon (2014) predicted that by 2100 the standard of living (measured by real per capita income) would be rising each year by only 0.2% per capita, i.e. a level of growth similar to that observed before the first industrial revolution, which began in the late eighteenth century.

Humans' innovative capacity is behind this change: after the steam engine, the automobile, electricity and digital technology, "break-through" technologies that are able to make deep transformations in the productive system have become rare. Robert Gordon brings in other causes for the decline in the growth rate of living standards: population aging, the stagnation of educational levels, increasing inequality and too much public debt. One could add the scarcity of natural resources (raw materials, natural resources) and negative externalities related to pollution and global warming.

Gordon's thesis is debated on several levels. First, the supposed weakness in productivity growth imposes, de facto, a constraint on supply, which should have an inflationary impact, whereas we observe very low inflation. In addition, he is accused of being overly pessimistic about the potential of future innovations. The technological changes associated with digital technology could herald new sources of growth. Certainly, any process of innovation plays a role in the destruction of the old models of production, which can generate difficult transitions as productive capital and job positions disappear. However, the emergence of more efficient production systems and vectors of new products is helping to boost productivity. Finally, to echo Solow's famous paradox in 1987 ("You can see the computer age everywhere but in the productivity statistics"), one can question the statistical robustness of Gordon's results. They could be linked to problems in measurement (Aghion and Antonin, 2018). While the nominal wealth produced can be calculated by summing up all the value added at current prices of the production units, the volume / price breakdown is more delicate. To do this, we generally rely on measures of value added at constant prices to deduce deflators. Even if the calculation is simple, the method may be biased. Indeed, for new products or products whose quality has been greatly improved, the choice of a past reference price is particularly complex.

Aghion *et al.* (2017) propose an alternative measure of productivity. They rely on a Schumpeterian model that incorporates a process of creative destruction. Using US data, they consider that productivity has been underestimated by an average of 0.6 point per year over the 1983-2013 period. This result is significant and can be interpreted to mean that the decline in productivity growth observed by Gordon is not fully proven.

Another interpretation of this result is that statistics overestimate inflation. In the context of secular stagnation, if the effective productivity growth is structurally stronger than what is measured, there must be concern about the consequences of inflation that is even lower than that measured, which reinforces the possibility of creeping deflation.

1.3. The dangers of deflation (or overly weak inflation)

The post-crisis period marks a singular economic episode since it contradicts the principle that an accommodating monetary policy should favour overheating and inflation (Le Garrec and Touzé, 2017a). The crisis has clearly provoked disinflationary and even deflationary pressure.

This weak inflation has, of course, resulted from an aggravated global context that has led to a fall in commodity prices. However, the deterioration of private and public sector balance sheets has also played an important role. On the one hand, with a growing risk of private defaults, banks have become more demanding with regard to the distribution of credit. On the other hand, companies have tried to clean up their balance sheets. They have notably been able to reduce their investments. This double contraction helped to trim the outlets for savings, which then became overabundant, thus favouring deflationary pressures as aggregate demand fell and savings shifted towards less risky assets (monetary deposits, government bonds and real estate). To explain these mechanisms, Koo (2011) developed an analysis of the recession based on balance sheets. Another approach to these mechanisms developed by Fisher in 1933 focused on "deflation by debt" to explain the Great Depression (Challe, 2000).

From the consumer's point of view, lower prices have the merit of boosting purchasing power. However, from the point of view of economic equilibrium, deflation or too little inflation are problematic because of the nominal rigidities resulting from exchange contracts defined in nominal terms. Indeed, a reasonably positive inflation allows for adjustment through prices. For example, for company managers, it is difficult, to reduce the nominal wages recorded for employee payrolls because these are fixed contractually. On the other hand, when there is inflation, it is easy to lower real wages by freezing the nominal amount or by indexing it below the level of inflation. Thus, as is seen in the results of Verdugo (2013), the wage rigidity observed in the French labour market partly explains the rise in unemployment

following the crisis. More specifically, estimates show that the real (constant composition) wage should have been 1.5% lower in 2011 to be consistent with past indexing.

In addition, low inflation has a significant fiscal cost. Indeed, the rate of inflation is a natural rate of depreciation of the public debt. As inflation increases, the real value of the public debt decreases, which reduces the need for fiscal efforts in the future.

Finally, deflation can render conventional monetary policy ineffective. Indeed, to maintain the level of inflation close to its target, the central bank could have to set its nominal policy rate at a negative level, which is hardly possible for the reasons previously mentioned. The key rate is then limited by the zero lower bound (ZLB).

1.4. The return of macroeconomic policies to support demand: towards an exit from the crisis?

Central banks had to be inventive both to boost the economy and to generate inflation, because they were constrained by an already very low key rate. They have implemented less conventional monetary policies than those based on the key rate, which sets the marginal price of liquidity or conventional refinancing operations. The abundance of liquidity has been made possible thanks to massive buybacks of debt securities. This policy has helped to reduce the liabilities of the private sector. These unconventional policies mean that the key rate is no longer the best indicator of the monetary facilities granted by the central bank. Wu and Xia (2015) calculated an implicit monetary policy rate by developing an extension of Black's (1995) financial model. The result is that the implicit rate has been negative in the United States since July 2008, and has been persistently negative in Europe since December 2011 (Chart 7). According to their calculations, unconventional monetary policies would thus have made it possible to circumvent the zero lower bound constraint on the nominal interest rate.

Despite the already deteriorated state of the public finances (high levels of debt accumulated even before the crisis, automatic stabilizers that aggravated public deficits), there was a turn to fiscal policy. In the United States, the 2009 Obama Plan injected nearly USD 800 billion of public spending, or about 5.5% of US GDP. The new president, Donald Trump, has announced that he wants to increase the public deficit. In Europe, since September 2015, the Juncker Plan to provide public support for investment projects has been part of a recovery process. At

the end of 2016, the European Commission asked Member States with budget margins to work towards an expansive fiscal policy. In October 2017, the French government announced a plan to boost investment by around 57 billion euros to finance the ecological transition, the training of young people with low skills, and the modernization of public activities, transport, agriculture and the health system. Policies to support public or private investment have the merit of strengthening demand in the short term, with inflationary effects, while increasing the long-term productive potential.

Chart 7. Implicit monetary rate (2006-2015)
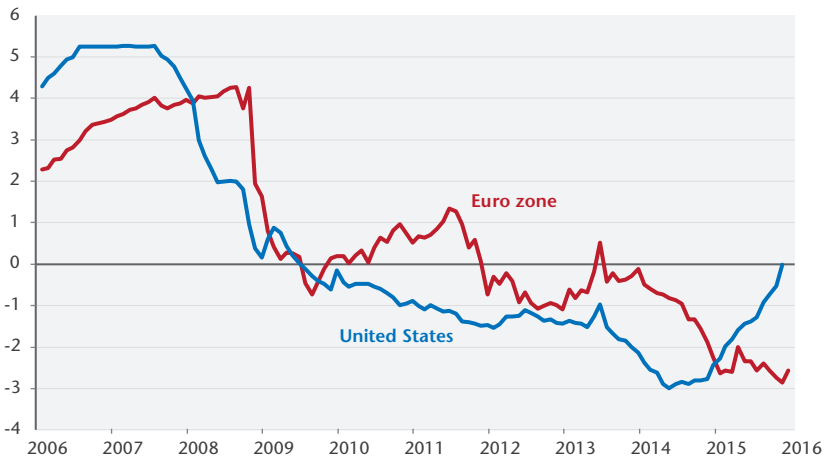
Source: Wu and Xia (2016).

These changes mark a turning point relative to the policies to support supply that gained some consensus prior to the crisis.

Numerous studies[3] show that the public expenditure multiplier is higher in times of crisis than in the upper phase of the economic cycle. An initial explanation would be that, in times of crisis, the financial fragility of part of the population translates into a higher propensity to consume, which makes demand support policies more effective. A second explanation is that, in times of secular stagnation, the overabundance of savings contributes to the low natural interest rate in Wicksell's sense,[4] and that weak demand leads to disinflationary or

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3. For a review of the literature, see the survey by Le Garrec and Touzé (2017b).

even deflationary pressures. Another reason for the effectiveness of stimulus policies is their ability to raise inflation to a level sufficient to render nominal rigidities inactive.

According to the latest OECD forecasts, the United States and the euro zone are expected to return to a normal level of output in 2018 (Chart 1). However, this return to normal must be put in perspective, because it not only is relying on an increase in demand but also on a reduction of potential growth, and therefore of supply (Chart 2). In addition, low long-term interest rates do not point towards a quick return to normal inflation, which led Summers to say in 2017 that "secular stagnation is the defining economic problem of our time".

2. The Identification of the Secular Stagnation Equilibrium

2.1. The importance of modelling

The stakes for economic analysis are multiple. Although the post-Keynesian models of the 1960s and 1970s were not able to deal with post-oil crisis episodes of stagflation, it seems that the break made in the 1980s by the new applied macroeconomics, based on expectations grounded in rational anticipations and microeconomics, has also left many disappointed hopes in terms of the predictability and analysis of crises (Mankiw, 2006; Woodford, 2009). In particular, the standard approach of economic fluctuations focuses almost exclusively on local dynamics around a long-term equilibrium that is considered unique and stable. The long-term level of production is then guided by supply. In this kind of configuration, the solutions to support a productive potential that is too low involve freeing up the factors of production by fighting rigidities and encouraging investment to boost productivity. Without going into detail, we could think of any policy favouring investment in R&D (Aghion and Howitt, 1998) or in human capital (education, training, apprenticeships – Lucas, 1988; Cohen and Soto, 2007).

The possibility that a demand shock may have a persistent effect is a major challenge for macroeconomics. Indeed, in its current consensus, long-term phenomena can be explained only by supply factors. More

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4. The natural interest rate in the sense of Wicksell (1989) is the one observed when there is a balance of supply and demand across all markets, and therefore full employment. When markets are not in equilibrium, the observed money rate is not equal to the natural interest rate.

precisely, the standard model places the accumulation of productive capital at the heart of the process of economic growth: the unutilized part of today's income is invested in the productive capital of tomorrow (Solow, 1956). It also highlights the importance of factor productivity. Therefore, if we admit that the economic crisis may have permanently damaged this productivity, then this will also generate a fall in investment and accumulated capital. We immediately see the limits of this explanation for dealing with key issues in the 2008 crisis. Indeed, the weakness of supply should have an inflationary effect, whereas we are seeing low inflation. Moreover, if we characterize the crisis in the standard model by a negative demand shock that is capable of retranscribing the weakness of inflation, this effect can only be transitory since a demand shock can only initiate temporary fluctuations around a stationary equilibrium, which is assumed to be unique and stable. The persistence of the crisis is left unexplained. In the end, the symptoms of the 2008 economic crisis argue for approaches that are based on the existence of multiple equilibria and / or regime switching. In models like this, the crisis would consist of a transition from a full employment equilibrium to a notoriously inefficient equilibrium that would translate into a lower long-term level of production, weak inflation and high unemployment.

The long stagnation arising from the crisis thus highlights both a macroeconomics based on numerous market imperfections to provide the basis for macroeconomic imbalances (Benassy, 2003) as well as the need to understand the mechanisms underlying global macro-dynamics to go beyond purely local approaches. This change of perspective is especially important as economic policy recommendations can be affected

2.2. The Eggertsson and Mehrotra model (2014)

The model developed by Eggertsson and Mehrotra (2014) is part of this conceptual renewal aimed at understanding the multiplicity of equilibria and the persistence of crises. In addition to the full employment equilibrium, they highlight what is called a secular stagnation equilibrium that is characterized by a persistent output gap and deflation. Their model is based on the consumption and savings behaviours of agents with finite lives in a context of a rationed credit market and nominal wage rigidity. To this end, they use an overlapping generations model (Samuelson, 1958; Diamond, 1965; Galor, 1992). In this

economy, households live in three periods: in the first period, they borrow to consume; in the second, they work, consume, repay their credit and save; in the third, they consume their savings and income. As for the monetary policy conducted by the central bank, it consists in setting the nominal interest rate according to a Taylor rule. This theoretical framework makes it possible to go beyond the model of Eggertsson and Krugman (2012) with agents with infinite life horizons, which is not able to explain the persistence of the crisis. Eggertsson and Mehrotra (2014) then show how taking into account agents who are positioned differently in their life cycles, in a context of credit rationing and nominal rigidity, makes it possible to obtain a stationary, and therefore lasting, secular stagnation-type equilibrium.

Their model has the great merit of explaining the mechanisms for the descent into secular stagnation. According to this approach, secular stagnation was initiated by the 2008 economic and financial crisis. The crisis was associated with households' excess debt, which was reflected during the crisis by credit rationing to these same households. In this context, credit rationing led to a fall in demand and excess savings. As a result, the equilibrium real interest rate falls. To counter the low inflation associated with depressed demand, the monetary authorities must then reduce their key rate, but such a policy is possible of course only when the nominal rate associated with ensuring that the inflation target can be hit is positive, that is, if the equilibrium interest rate is not too negative. If this is not the case, then conventional monetary policy becomes inactive as it comes up against the zero lower bound constraint (ZLB) on the nominal rate. In this configuration, it is no longer possible to hit the inflation target, leading the economy into a zone of low inflation, or even deflation. In this latter case, nominal downward wage rigidity translates into higher real labour costs and thus lower labour demand from firms. As a result, unemployment steadily rises. The interaction between deflation and nominal wage rigidity is at the heart of the result obtained, and explains why there is no force pushing back towards a full employment equilibrium.

2.3. Accumulation of capital and transition dynamics (Le Garrec and Touzé, 2015 and 2016b)

In the model proposed by Eggertsson and Mehrotra (2014), there is no accumulation of capital. Therefore, the underlying dynamics is characterized by adjustments without transition from one stationary

equilibrium to another (full employment towards secular stagnation if a credit crunch, and vice versa if the credit constraint is loosened).

To extend their analysis, we considered (Le Garrec and Touzé, 2015 and 2016b) the accumulation of physical capital as a prerequisite for any productive activity. More specifically, individuals are expected to borrow when they are young (first period of life) to invest in a productive activity that will be effective in the next period (second period of life). This way of modelling the accumulation of capital fits into the standard framework of growth models (Samuelson, 1958; Solow, 1956). In this way, the overall dynamics of the economy is characterized by a predetermined variable, capital, and a free variable, inflation.

The dynamics of capital is based on a Solow-type (1956) accumulation mechanism,[5] while the level of inflation is determined by Fisher's equation (1933). The latter links the nominal interest rate set by the central bank with the real return on capital obtained at equilibrium on the financial market. Since the central bank sets the nominal policy rate according to observed inflation, it follows that the level of current inflation depends on expectations about the future state of the economy in terms of inflation and accumulated capital.

This theoretical framework makes it possible to characterize the long-term convergence with the transient dynamics and thus not to be limited to the study of stationary states alone. It also helps in examining how fiscal policy can promote inflationary pressures that are beneficial to the economy but also lead to an unfavourable crowding out of private investment.

Chart 8a illustrates the dynamics of the fall into secular stagnation following a tightening of credit at date $t = 0$. Starting from a situation of full employment characterized by an initial capital level, denoted k_{FE}, and a rate of inflation at its target level (denoted π^*), shown that if the credit crunch is sufficiently large then the equilibrium interest rate becomes sufficiently negative that it is no longer possible to actively pursue a conventional monetary policy.

In this case, the only equilibrium the economy has is a secular stagnation type, and it plunges into recession with underemployment of the labour factor (unemployment induced by nominal rigidity) associated with production that is below its initial potential (decline in the

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5.   In each period, a portion of the output is saved and invested in capital. The latter will be used in producing during the next period.

Chart 8. Dynamics of entering and exiting secular stagnation: profile of capital and inflation trajectories

a) Dynamics of entering (credit crunch) **b) Dynamics of exiting (credit loosening)**
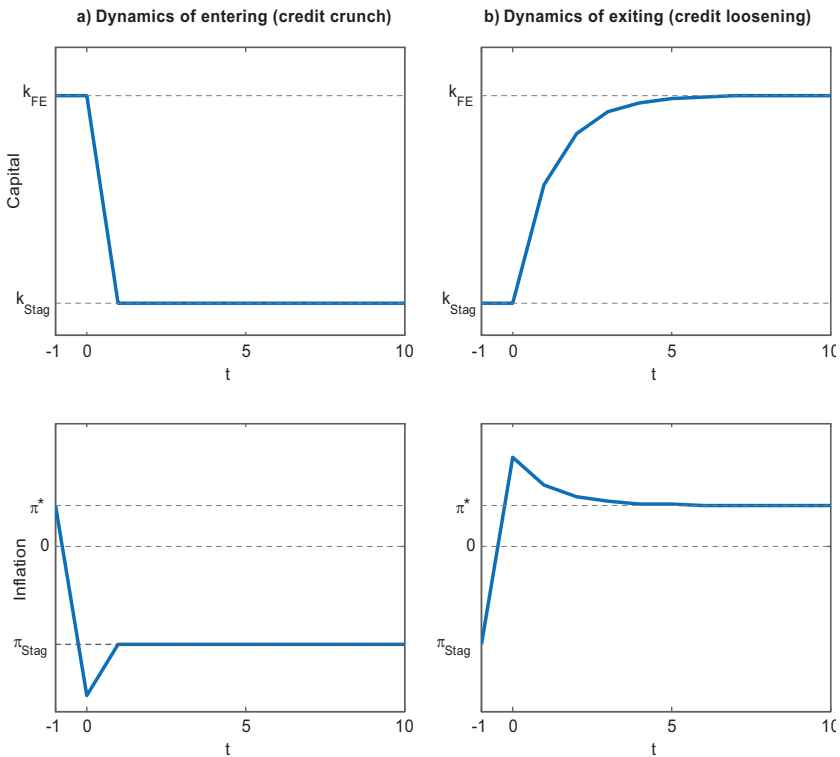
Source: Le Garrec and Touzé (2016b).

stock of productive capital) and a negative inflation rate (deflation) denoted $\pi_{Stag} < 0$. If we assume that initially the economy is at its stationary level of full employment, following the first period when the capital cannot be adjusted since it is already installed, the latter will then decrease to directly reach its new equilibrium level of secular stagnation denoted k_{Stag}.[6] It is worth noting that the level of deflation over-adjusts at the moment of the shock. Indeed, since the installed capital does not adjust instantaneously, there is a higher supply, which results in stronger deflation. Deflation then adjusts to a lower level.

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6. Technically speaking, this adjustment is due to the presence of an eigenvalue equal to zero (the other being greater than unity which guarantees a determinate equilibrium).

The determination of the dynamics of secular stagnation (Charts 8a and 8b) shows an asymmetry. Thus, in Chart 8b, which characterizes the credit constraint loosening to return to its initial level, we observe that capital takes time to return to its initial level while the entry into secular stagnation is immediate (Chart 8a). In other words, the fall into secular stagnation seems to take place significantly faster than the process of exiting the crisis. This observation suggests that economic policy interventions to combat secular stagnation must be made as quickly as possible.

3. Efficiency of Economic Policy in the Age of Secular Stagnation

The secular stagnation equilibrium thus highlighted, as in Eggertsson and Mehrotra (2014) and Le Garrec and Touzé (2015, 2016b), and contrary to Krugman and Eggertsson (2012), is an equilibrium that will persist as long as the tight credit lasts. From this point of view, active policies to counter the scarcity of credit, all other things being equal, are crucial for combatting secular stagnation. But the conditions for a secular stagnation equilibrium are not due solely to the effects of a financial crisis. Excess savings that lead to negative real interest rates can also result from other factors, such as the aging of the population. The latter is characterized by a decrease in the growth of the workforce as well as an increase in life expectancy:

— The reduction in the growth of the labour force hinders investment needs, which reduces the demand for capital.

— A longer life expectancy increases the need for life cycle consumption, which requires greater savings.

These two effects cumulate to favour an excess of savings.

In addition to the stabilization of the financial markets, any other economic policy that could prove effective in fighting unemployment must therefore be considered: first and foremost, monetary and fiscal policies, but also more structural policies aimed at making the labour market more flexible and promoting productivity.

3.1. Structural policy: Keynesian paradoxes in a supply model

First of all, to reduce unemployment one naturally thinks of policies that promote productivity: training, innovation and investment. However, in secular stagnation, this leads to a paradox that was first

formulated by Eggertsson (2010): "if everyone tries to work more, this will in fact reduce aggregate employment in equilibrium". More generally, in a configuration of the secular stagnation type, any increase in productivity leads to recessionary effects in the economy because it generates deflationary pressure. As a result, since monetary policy is constrained by a zero bound on nominal interest rates, deflation is accompanied by an increase in the real interest rate, which tends to reduce demand at equilibrium. On the other hand, rising productivity has a positive impact on full employment output, even if the actual impact is reversed in a state of secular stagnation.

Second, making the labour market more flexible is often considered in fighting against unemployment. However, in secular stagnation, a decrease in nominal wage rigidity also tends to reduce the level of output and push up unemployment. Indeed, this wage deflation policy also weighs on households' purchasing power, which reduces their demand and tends to lower inflation expectations, which in turn favours greater deflation and therefore a downturn in economic activity.

3.2. Monetary policy: inflation target and instability of anticipations

To get out of secular stagnation, the monetary authorities could go for a policy aimed at raising the inflation target π^* as advocated by Blanchard *et al.* (2010). However, Eggertsson and Mehrotra (2014) as well as Le Garrec and Touzé (2015, 2016b) show that raising the target too little does not make it possible to exit the secular stagnation equilibrium, which remains unique and stable. However, a sufficient increase would make it possible to bring back the full employment equilibrium, but without removing the secular stagnation equilibrium. The economy would be facing a situation of multiple equilibria. So nothing indicates that inflation expectations will automatically align with the target, which poses problems of an instability in expectations, as the secular stagnation equilibrium is locally determinate. In such a configuration, anchoring the expectations of private agents to align with the target is a difficult task for the monetary authorities. For inflation targeting to be effective, it is crucial in particular that the central bank have sufficient credibility (Woodford, 2004).

The low efficiency of conventional monetary policy poses the need to develop models capable of accounting for the impact of other, less conventional forms of monetary policy, such as quantitative easing or the helicopter currency devised by Friedman (1970).

3.3. Fiscal policy, the impact of crowding out and the size of the multipliers

Fiscal policy is a natural candidate for breaking out of secular stagnation. In fact, by supporting demand, any fiscal impulse generates inflationary pressures which, if they are sufficient, will be able to bring the economy out of the deflationary zone and subsequently into secular stagnation. However, it is necessary to be vigilant about the effectiveness of such a policy. First, if it is financed by debt, it can further increase an already high level of debt, which can pose significant solvency problems. Second, if it is financed by taxes, it can have a negative impact on capital accumulation and thus depress potential GDP. So there may be a trade-off between "exiting from secular stagnation" and "the accumulation of capital". We highlight this by studying the fiscal multiplier:

$$\frac{\Delta \, Production}{\Delta \, Public \, Spending} = 1 + \frac{1}{s} \, \frac{\Delta \, Private \, Investment}{\Delta \, Public \, Spending}$$

where s is the savings rate.

The size of the multiplier depends crucially on the variation in private investment (and thus on capital accumulation) in response to the fiscal stimulus. If investment increases, then the multiplier is greater than one, meaning that fiscal policy is effective.

The fiscal stimulus has two effects on investment. On the one hand, if the rise in aggregate demand helps to avoid deflation, the gain in efficiency (nominal rigidities become inactive) leads to an increase in household income and demand for capital. On the other hand, the rise in tax-financed public spending reduces the disposable income to be saved, which pushes up interest rates and crowds out private investment.

When the crowding out effect is weak, after-tax household income rises and the economy accumulates capital. The fiscal multiplier is then greater than one, marking an effective policy (Chart 9a). In contrast, when the fiscal stimulus is too large, after-tax household income declines and the crowding out effect depresses investment. The fiscal multiplier is then less than one even though the economy has moved out of a state of secular stagnation (Chart 9b). The capital accumulated in the state of full employment is then lower than that accumulated under the secular stagnation regime: $k_{FE} < k_{Stag}$.

Chart 9. Fiscal impulse and exiting secular stagnation
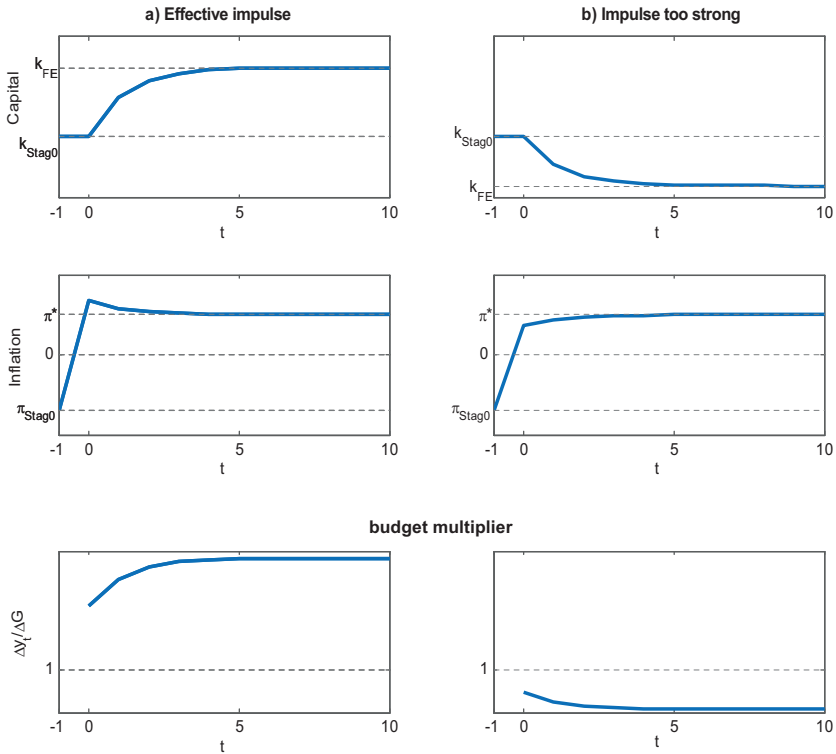
Note: The fiscal impulse is permanent and begins at $t = 0$. y_t denotes the level of production at the date t and G the volume of public expenditure.
Source: Le Garrec and Touzé (2016b).

4. Conclusion

Even if over time certain features of the crisis seem to fade, its impact is lasting (reduction of potential), and the resort to fiscal policy in a context of high public debt as well as to unconventional monetary policies raises questions about the nature of the crisis and its impact on the functioning of the economy. Modelling the secular stagnation equilibrium is therefore a promising avenue for research.

The secular stagnation hypothesis and the formal study of its dynamics thus invite us to rethink the analysis of classic macroeconomics, and therefore the conception of economic policy. In our approach, following Eggertsson and Mehrotra (2014), based on two

types of market imperfections that hit, respectively, the credit market (rationing) and the labour market (nominal rigidity), the emergence of a nominal rate that is close to zero (zero lower bound) raises concerns that "conventional" monetary policy, which is based mainly on setting a key rate, will lose its effectiveness. In a context where the effective inflation rate and the full-employment equilibrium interest rate are negative, macroeconomic dynamics can lead to trajectories of permanent underemployment that are synonymous with secular stagnation.

The lessons of this approach are multiple. First, to avoid the ZLB, there is an urgent need to create inflation while avoiding speculative asset "bubbles" (Tirole, 1985), which may require special regulations. The existence of a deflationary equilibrium poses questions about the validity of monetary policy rules that focus too much on inflation (Benhabib *et al.*, 2001). Second, one must be wary of the deflationary effects of policies aimed at increasing potential output. The right policy-mix could be to support structural policies with a sufficiently accommodating monetary policy. Reducing savings to raise the real interest rate (for example, by facilitating access to credit) is an interesting avenue, but the negative impact on potential GDP must not be overlooked. There is an undeniable trade-off between getting out of secular stagnation and not depressing capital accumulation (crowding out effect), and therefore the economy's long-term productive potential. One interesting solution might be to finance infrastructure, education and R&D policies (higher productivity) through public borrowing (raising the equilibrium real interest rate). Indeed, a strong investment policy (public or private) could make it possible to satisfy a twofold objective: to support aggregate demand and develop the productive potential.

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INEQUALITY IN MACROECONOMIC MODELS

Cecilia García-Peñalosa[1]

Aix-Marseille University, CNRS, EHESS, Centrale Marseille, AMSE

This articles focuses on the recent research efforts to incorporate income, wage and wealth inequality in macroeconomic models. I start by reviewing recent models on the impact of inequality on, on the one hand, long-run growth and, on the other, and macroeconomic fluctuations. The articles then reviews the literature concerned with the macroeconomic determinants of wage and wealth inequality. It concludes by discussing a number of possible avenues of research that seem to me particularly important, such as the impact of macroeconomic policy on distribution or the effect that firm size can have on both growth and wage inequality.

Keywords: inequality, Gini, wealth, growth, redistribution.

Macroeconomics has changed since the Great Recession. One of the aspects that has received most attention has been the role of rational expectations, but other traditional features of macro models are also under scrutiny, such as how to model the financial sector or the new role of aggregate demand. Introducing heterogeneity has become a further concern, partly motivated by the recent evolution of distributional measures as well as by the suspicion that income inequality may have been a factor in the Recession as well as in its slow recovery.

The rise in inequality in recent decades is by now a well-established fact. Chart 1 depicts the Gini coefficient of household income over the period 1972 to 2015. The data correspond to disposable income, that is, the sum of income from all market sources (i.e. wages, capital income, self-employment income), to which transfers have been

added (such as family benefits, unemployment income, or alimony) and from which income taxes have been subtracted. The upper panel presents data for the US, the UK, and Canada, and depicts the increase in inequality that started around the mid and late 1970s and which has slowed down in the last decade. The bottom panel depicts data for France Germany Spain and Sweden. There have been a variety of experiences. The Gini coefficient has been stable in France, while it grew in the other three countries. Between 1980 and 2015, the Gini coefficient by 12% in Spain, 23% in Germany and 30% in Sweden, with the sharpest increases taking place in the 1990s in some cases, and in the early 2000s in others.

Chart 1. Income inequalities
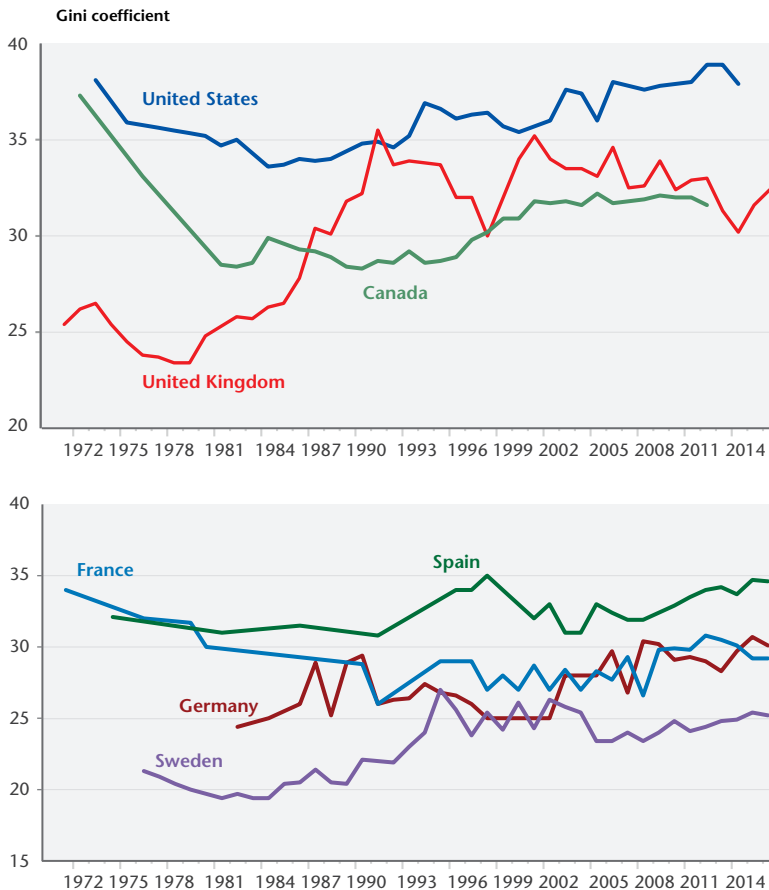
Source: https://www.wider.unu.edu/project/wiid-world-income-inequality-database.

While the Gini coefficient encompasses features of the overall distribution of income, a large body of work has brought to our attention changes in the share of income accruing to those at the top of the distribution. Data from the UN-WIDER database,[2] indicates that the income share of the top 1% of the distribution has increased over the past four decades in many countries. For example, in 1970 the top 1% received 8% and 7% of total income in the US and the UK respectively, and by 2012 these shares had grown to 22% and 13%. In contrast, the share has fluctuated around 9% in France. It is only natural that these experiences have pushed inequality into the forefront of the research agenda.

Extensive work on 'top incomes' shows that despite the increased weight of wages in the incomes of those at the very top of the distribution, the contribution of income from assets is still very important for this group; see Atkinson, Piketty and Saez (2011). Although over the past two decades capital income inequality has received much less attention than the evolution of the distribution of earnings, recent work indicates that the distribution of wealth and its returns are an important force that, in some cases, has contributed substantially to changes in inequality. In my own work we find that increases in the share of capital income in household incomes partly explain the rise in inequality in a number of economies, while most of the countries for which we have data on the labour share have exhibited a reduction in this share over the past decades, a reduction that averaged 5 percentage points over the period 1975 to 2012.[3]

The relationship between growth and income inequality is both important and controversial. It is important because policy makers need to understand the way in which increases in output will be shared among heterogeneous agents within an economy, and the constraints that this sharing may put on future growth. The controversy lies both on the fact that causation runs both ways, from inequality to aggregate outcomes and vice-versa, and in that the theories proposed explore each a single mechanism. To this debate we have to add recent developments which in the past decade or so have changed the focus from

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2. The data are from the UN-WIDER database (https://www.wider.unu.edu/project/wiid-world-income-inequality-database, accessed on May 11 2017). Most of the data concerns household disposable income adjusted for the number of household members (equivalence scale). For the US and Germany a consistent series is not available, hence we report unadjusted household income up to 1996 for the US and 1984 for Germany, and the adjusted series from then onwards. See http://wid.world/, data access on May 24, 2017.

3. Voir García-Peñalosa and Orgiazzi (2013) and Karabarbounis and Neiman (2014).

the relationship between inequality and long run growth to the response to the Great Recession. The timing of this event has raised the question of whether the preceding increase in income inequality has been one of its causes, while the uneven impact of the recession has clearly had distributional implications. Moreover, the Great Recession has occurred as academic economists were improving their tools for addressing distributional phenomena, notably as computational capacities allowed the simulation of rich models and as more micro-data concerning inequality was collected. As a result, the profession is increasingly allowing for heterogeneity in aggregate models and the Great Recession has made this approach more salient and its answers more pressing.

In this paper I give a brief overview of recent models of the relation-ship between macroeconomics and distribution, focusing first on the impact of distribution on growth and cycles, and then on the determi-nants of inequality. The literature on the relationship between inequality and economic growth boomed from the mid-1990s onwards but was largely seen as an independent branch, with a focus on developing countries and little impact on mainstream macroeco-nomic analyses. At the same time, research on economic cycles and the propagation mechanisms of shocks was giving a considerable role to credit constraints. Nevertheless such analyses were performed in a pseudo-representative agent framework and hence with no considera-tion of the distributional implications of cycles or adjustment policies. The Recession has widened interest in the former approach and pushed the latter to be more specific about inequality.

The paper is organised as follows. The next section introduces the sources of inequality and discussed the key implications of the neoclas-sical growth model. I next consider the effect of inequality on growth and fluctuations, while section 3 reviews the literature on the macroe-conomic determinants of the wage and wealth distribution. Section 4 concludes.

1. The Gini Coefficient and the Neoclassical Growth Model

Let us start by examining the determinants of personal income inequality. In order to illustrate the various mechanisms in operation, consider a simple model economy with four types of agents character-ised as follows. First, a fraction $1 - e$ of the population is not employed,

and receives a government transfer T. Of the fraction e of employed population, n_u are unskilled workers earning a wage w_u and n_s are skilled workers, so that $e = n_u + n_s$. Skilled workers may also own capital. We suppose that $n_s - \kappa$ of them own no capital and have an income equal to the skilled wage w_s, while κ own capital and earn profits π as well as the wage w_s. The unskilled wage is assumed to be greater than the government transfer and lower than the skilled wage, i.e. $w_s > w_u > T$.

Under our assumptions, the labour share is simply $s_L = (w_s n_s + w_u n_u)/\gamma$, the average wage $w = (w_s n_s + w_u n_u)/e$, and the profits received by each owner of capital $\pi = (1 - s_L)y/\kappa$. Assuming a proportional tax rate τ on all incomes, mean disposable income is then given by $y_d = (1 - \tau)(\kappa \pi + n_s w_s + n_u w_u + (1 - e)T)$.

The degree of income inequality can be measured by the Gini concentration index computed across the four groups of population. We can write the Gini coefficient of disposable income as:

$$Gini_d = (1 - \tau)\left[(1 - \kappa)(1 - s_L) + (1 - e)\left(1 - \frac{T}{w}\right) + s_L \frac{n_s n_u}{e}\frac{w_s - w_u}{w}\right],$$

which is thus a function of the distribution of wealth, the labour share, the wage differential, the employment rate, e, and government transfers and taxes.

Our analysis so far highlights the close link between the personal distribution of income and macroeconomic variables, such as the labour share or the employment rate. Let us consider first how the neoclassical model deals with distribution. The seminal work of Chatterjee (1994) and Caselli and Ventura (2000) examines a neoclassical model were agents differ in their initial endowments of wealth and human capital and shows that there is a single direction of causality. Distributional variables do not affect aggregate magnitudes thus permitting the use of a representative-agent model to analyse the behaviour of the economy. In contrast, macroeconomic aggregates have a direct impact on inequality, as the labour share, employment or the skill premium affect the Gini coefficient.

This approach created a dichotomy between those interested in macroeconomic activity and those concerned with distributional questions, as macroeconomists could continue to rely on a representative agent model to examine income dynamics and policy choices, and leave aside the resulting distributional effects which did not feedback

into their analysis. This result is a consequence of the strong assumptions of the neoclassical model: homothetic preferences, constant returns to scale, no fixed costs and a perfect capital market. As we start to relax these assumptions, inequality can affect both long-run growth and short-term fluctuations.

2. The Impact of Inequality on Macroeconomic Outcomes

2.1. Inequality and growth

The traditional view that inequality should be growth-enhancing is based on three arguments: the classical hypothesis that the marginal propensity to save out of profits is higher than that out of wages (see Kaldor, 1955 and Stiglitz, 1969), the argument that investment indivisibilities imply that in the absence of well-functioning capital markets, wealth needs to be sufficiently concentrated in order for an individual to be able to cover the costs of new firms, and the idea that incentive considerations, as formalised by Mirrlees (1971), necessarily imply a trade-off between productive efficiency and equality. All these approaches imply that more unequal societies will grow faster.

Starting in the mid-1990s the 'new growth literature' opened new avenues through which inequality may affect growth, emphasising the role of human capital, entrepreneurship and various forms of credit market constraints and yielding very different conclusions from those found in the early literature.[4] A large literature has emphasized the importance of access to credit. In modern, industrial economies the effect of credit market imperfections is likely to operate in part through their impact on human capital accumulation. Human capital has two particular features. First, it is embodied in the individual, making it difficult to use education as collateral against which to borrow and hence investing in education is only possible if the agent has sufficient parental wealth. A second feature of education investments is that they exhibit strong diminishing returns, implying that it is more efficient to invest a little in many individuals than a lot in few. The combination of credit market imperfections and non-convexities in education investments implies that the distribution of wealth can affect the level of education in the economy and consequently growth, as shown by

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4. See Bertola (2000) and Bertole, Foellmi, and Zweimuller (2014) for reviews of this literature.

Galor and Zeira (1993). In this context, lower inequality allows a greater share of the population to invest in education and fosters growth.

A second approach has focussed on incentive effects, reversing traditional theories. Inequality in rewards creates incentives to exert effort thus increasing output and growth, but inequality in opportunities (wealth) can have a negative incentive effect. With limited liability, the lender rather than the individual is the residual claimant, and as a result borrowers may have little incentive to exert effort. Greater inequality in endowments hence reduces effort and slows down growth; see Aghion and Bolton (1997).

Inequality may sometimes take the form of polarization, that is, of a division of society into distinct and distant income groups. Keefer and Knack (2002) argue that polarization creates pressures from different groups with conflicting interests that result in sudden and sharp policy changes. These could take the form of abrupt changes in tax rates, withdrawal of recognition of certain types of contracts, or major changes in regulatory requirements for firms. In both cases the overall effect is the same: polarization leads to greater uncertainty in the economic environment in which economic agents operate. Agents' response to increased uncertainty is to reduce investments in physical capital, and potentially also in human capital, which in turn lowers growth.

These models, developed as the 'endogenous growth' literature emerged in the 1990s, have not been revised by the Great Recession. What the crisis has done has been to increase interest in this literature and raise the question of whether some of this mechanisms, initially seen as applying mainly to developing economies, are also important in rich countries.[5] In these countries inequality can also lead to a lack of opportunity with important long-run consequences, and polarization of jobs and incomes is becoming an important concern; see Atkinson (2015) and Katz (2014).

2.2. Inequality and business cycles

The literature on inequality and cycles has a very different history. There is a substantial literature that has introduced financial market frictions in business cycle models, often by assuming that a share of the

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5. See Willis (1987) for a review of the empirical evidence.

population is credit constrained. For example, in the seminal contribution by Bernanke and Gertler (1989) individuals differ in terms of entrepreneurial net worth. Market incompleteness together with this heterogeneity plays a crucial role in the propagation and amplification of aggregate shocks. The literature that followed has identified two sources of market imperfections. On the one hand, some agents may be credit constrained; on the other, even in the absence of such constraints, incomplete insurance markets imply that risk-averse agents underinvest. The intuition in the former case is simple to understand; higher borrower net worth reduces the agency costs of financing real capital investments, and as a result any shock to that reduces net worth will increase agency costs and amplify a downturn.

Interestingly, although these models relied crucially on heterogeneity they did not examine the role that changes in distribution could play. The Great Recession has changed this, as the increase in inequality that preceded it has raised questions about the role that distribution has played. A key contribution is the recent article by Kumhof, Rancière and Winant (2015).[6] The authors document the sharp distributional changes that occurred in the US both before the Great Recession of 2008 and before the Great Depression of 1929. As we have seen before, income inequality rose sharply in the late twentieth century. In the US, the share of the top 5% of the income distribution was 22% in 1983 and rose to 34% just before the crisis. This change was accompanied by a doubling of the ratio of household debt to GDP, as well as by an increase in the heterogeneity of debt-to-income ratio. In 1983, the top 5% had a ratio of around 60%, which was about twenty points larger than that of the rest of the income distribution. By 2007 the opposite was the case, the debt-to-income ratio of the top 5% remained roughly constant and was below that of the rest of the distribution which approached 150%. In other words, the larger debt ratio found in aggregate numbers was due to greater indebtedness by low-income and middle-class households. These changes were associated with a divergence in wealth shares, with the top 5% owning 43% of assets in 1983 and 49% by 2007. That is, the 25 years preceding the recession exhibited major changes in the distribution of assets and debt.

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6. See also Lansing and Markiewicz (2017) for a model in which top incomes affect macroeconomic responses.

Kumhof, Rancière and Winant develop a dynamic stochastic general equilibrium model in which a crisis arises endogenously as a result of greater inequality, hence making distribution a key source of aggregate fluctuations. Their framework assumes two groups of agents, the top 5% and the remaining 95% of the distribution. The stochastic aspect of the model consists in a series of permanent shocks to the income shares of the two groups in favour of the former. High-income individuals are assumed to care directly about their financial wealth. As a result, as their income share increases, they save a larger fraction of it in the form of financial wealth, which is then lent to the rest of the households. Initially, low-income households compensate the loss of consumption that should be entailed by their lower income share through higher borrowing, and this creates a financial fragility that eventually leads to a rational decision to default on their debt. At this point, the crisis arises endogenously. Bottom earners rationally decide to default on their debt as this provides a relief on payments. However, the default results in a financial crisis and a collapse in real output, thus triggering a period of recession.

In this context, inequality is also a culprit in preventing a rapid recovery. Because the decline in output hits mainly low-income workers, the medium-term effect of the default on their debt-to-income ratio is small, and if income inequality does not change, debt starts to accumulate again, keeping the economy in a fragile state. In other words, the authors use the well-established tradition of seeing leverage as a key source of fluctuations, but link debt patterns to those found in the data for different income groups. The resulting analysis implies that shocks that increase income inequality are both a cause of the recession and a break to fast recovery.

3. Macroeconomic Determinants of Distribution

3.1. Earnings inequality

Let us turn now to the way in which aggregate magnitudes affect distribution. Wage income is the main source of personal and household income, and hence its distribution has major implications for inequality. A large literature has hence examined the evolution of the distribution of labour earnings,[7] and documented that in the last two decades of the 20th century a number of industrialised countries experienced a substantial widening in the earnings distribution. Moreover,

the evidence clearly indicates that an important component of the increase in earnings inequality has been an increase in the so-called "relative wage", that is the ratio of the hourly wage of those with tertiary education to that received by those with only secondary education; see Gottschalk and Smeeding (1997) and Atkinson (2008).

In order to understand the determinants of the relative wage consider a production function where unskilled labour, L_u, and skilled labour, L_s, are imperfect substitutes, implying that the supply of skilled and unskilled workers will affect their rewards. Furthermore, technical change may not affect the productivity of skilled and unskilled workers in the same way.[8] To capture this idea, let us modify the production function and suppose that aggregate output is given by

$$Y = K^{\alpha}\left((A_s L_s)^{\gamma} + (A_u L_u)^{\gamma}\right)^{(1-\alpha)/\gamma},$$

so that the two types of labour use skill-specific technologies. A_s represents the technology used by the skilled and A_u that used by the unskilled. The relative wage can then be expressed as:

$$\ln w_s / w_u \cong \gamma \ln A_s / A_u - (1-\gamma) \ln L_s / L_u,$$

and is affected by changes in relative labour supplies and in the skill-specific productivities.

In this context, the source of growth matters. When growth is driven by an increase in the relative supply of skilled labour (i.e. higher ratio L_s / L_u) it will be associated with a reduction in the relative wage. This is the traditional effect of education on inequality, which drove the reduction in wage dispersion observed in the 1960s and 1970s in high-income economies. In contrast, when growth is due to technical change, its effect will depend on whether A_s or A_u grows faster. If technological improvements lead to a faster increase in A_s, we will say that there is *skill-biased technical change*. Under the (empirically validated) assumption that $\gamma > 0$, i.e. that the elasticity of substitution between the two types of labour is greater than 1, skill-biased technical change will result in an *increase* in the relative wage. That is, skill-biased technical change will be accompanied by an increase in earnings inequality.

Measuring the effect of biased technical change is a complex task. In a recent paper, Carneiro and Lee (2011) propose a careful supply

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7. I use the terms wage distribution and earnings distribution interchangeably, even if this is not entirely accurate since earnings are the product of hours of work and the hourly wage rate.
8. An excellent review of this literature is provided by Hornstein, Krusell and Violante (2005).

and demand analysis to account for the role that biased technical change has played in the evolution of wage inequality in the US. A key element in their analysis is that, as the supply of college-educated workers increases, their average ability falls, and their empirical analysis supports this hypothesis. This effect can be due to a crowding out effect (such as a reduction of the number of teachers per student) or simply to the fact that the ability threshold to enter higher education falls as the fraction of young individuals in education increases. Carneiro and Lee then argue that between 1960 and 2000 the evolution of the skill premium has been driven by three forces: skill biased technical change, the increase in the supply of college-educated workers, and a reduction in the average ability of skilled workers. The former has tended to increase the skill premium, while the latter two effects have tended to reduce it. The quality effect accounts for a sizeable fraction of wage movements, amounting to 6 percentage points. In other words, between 1960 and 2000 the skill premium increased by 20 percentage points, but would have increased by 26 percentage points in the absence of the quality effect. Obviously, these results cannot be generalised to other countries as they depend on the intensity of changes in both the supply and the demand for skills. For example, for France, Verdugo (2014) shows that wage inequality has fallen over the last decades of the 20th century, and that this fall has been mainly driven by a sharp increase in the level of qualifications of the labour force.

An alternative explanation of changing trends in relative wages is that, at some point around 1980, technical change became skilled-biased. Thoenig and Verdier (2003) suggest that firms may change and influence the rate of diffusion of knowledge embodied in their products. In particular, they may render their products immune to imitation by reinforcing the skill intensiveness of their production process. If international integration increases the possibility of imitation, then it will give firms incentives to undertake technological change that will be biased towards more educated workers, making their products harder to copy by foreign competitors. That is, globalization may have an indirect effect on inequality through its impact on the choice of technologies.[9] Whether or not this has been affected by the Great Recession is still hard to predict. The recovery has resulted in a sharp

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9.   See Bloom, Draca and Van Reenen (2016) for evidence on trade and technological change.

temporary collapse in world trade[10] and we will only be able to address its consequences on market shares and incentives to innovate as data becomes available in the next few years.

3.2. The distribution of wealth

The distribution of earnings is, obviously, a main factor in determining the distribution of wealth since richer agents will be able to save more and hence accumulate more wealth. In this section I discuss how macroeconomic factors can affect the distribution of wealth for a given degree of earnings dispersion.

As we saw above, the neoclassical model is compatible with a continuous of income and wealth distributions. It allows for rich dynamics for the distribution of wealth which depend on model parameters as well as policy and shocks to fundamentals, in other words, on history. It is interesting to note that temporary shocks that do not affect the steady-state of aggregate magnitudes generate transitional dynamics that will have a permanent impact on the distribution of wealth. The key mechanism in this model is that both agents with lower wealth and with greater ability tend to supply more labour, hence labour supply decisions may have an equalising effect or an unequalising one (see García-Peñalosa and Turnovsky, 2008, 2015). The model also allows us to examine the dynamics of income mobility, as the combination of heterogeneous initial wealth and heterogeneous abilities leads to agents switching their relative positions over time in response to changes in factor prices. This relationship is nevertheless complex. For example, a reduction in the interest rate and an increase in the wage rate reduce capital income inequality and allow upward mobility of the ability-rich. However, the increase in the labour supply of high ability agents in response to higher wages raises earnings dispersion and thus has an offsetting effect. Interestingly, depending on the source of shocks, high mobility can be associated with an increase or a decrease in overall income and wealth inequality.

Another branch of the literature has focused on market incompleteness to analyse wealth dynamics for given processes for individual earnings.[11] This type of ex post inequality was first studied by Bewley (1977) and also Aiyagari (1994). The two key assumptions are a

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10. Levchenko *et al.* (2010).
11. See Quadrini and Rios-Rull (2014) for a review.

stochastic individual earnings process and the lack of insurance against wage shocks. Holding riskless assets allows agents to smooth consumption over time in the face of such shocks. This precautionary saving motive will generate wealth inequality, as households that have been lucky and got positive wage shocks will hold more assets than unlucky households.

More recently, the emphasis has been on building models that could reproduce observed distributions (Krusell and Smith, 1998; Cagetti and De Nardi, 2006). A combination of increasingly available microdata and simulation methods has allowed us to develop a rich framework of analysis that reproduces the stylised facts and permits the assessment of policy. Data from different sources is used, with panel data being employed to estimate the stochastic process for earnings at the individual or household level and cross sections giving information on the distribution of income and wealth that is then matched through the selection of suitable values for model parameters. Allowing for uninsured idiosyncratic shocks to labour income is important as around 40% of an individual's lifetime income uncertainty is due to income shocks occurring after she enters the labour market (Storesletten *et al.*, 2001; Hugett *et al.*, 2011). In this context, rich policy analyses are possible. For example, Cagetti and De Nardi (2009) examine the role of estate taxation on entrepreneurship and firm output and show that although the tax distorts investment and reduces growth, general equilibrium effects of a reduction of its rate imply an increase in the income of those at the top of the distribution at the expense of the majority of the population.

A concern with these studies is that most of the datasets have no information on the very rich, and hence the dynamics of that group tend to be ignored. An exception is Benhabib *et al.* (2011) who use a model with both labour and capital income risks that cannot be insured. They show that the shape of the wealth distribution is mainly driven by wage income uncertainty, although the right tail is shaped by capital income uncertainty. In fact, this source of uncertainty is essential to obtain distributions that fit the data.

An alternative approach has consisted in focusing on the key role played by the gap between the rate of growth of output, g, and the interest rate net of taxes, *r*; see Piketty (2013), Piketty and Saez (2013), Piketty and Zucman (2015). The former affects growth in average income, while the later determines the return to wealth holdings.

Under plausible assumptions, a lower growth rate and a higher net interest rate both increase the ratio of wealth to income in a country and lead his a greater concentration of wealth holdings. The postwar period, with high output growth resulting from the increase in population and the expansion of education, presented all the necessary conditions for a reduction in the concentration of wealth, while the subsequent slowdown has reversed this trend towards equalisation.

The literature maintains that the secular slowdown in growth that started in the 1970s has been a major force in the increase in wealth inequality, and the Great Recession has made this analysis even more relevant. For example, in a number of countries, notably the US, the recovery has been characterised by an increase in profitability that has been accompanied by a much more moderate rise in employment and the wage bill (see Lazonik, 2014), implying a growing gap between r and g. As a result, there are reasons to think that this type of recovery will result in a further increase in wealth inequality in the years to come.

3.3. Endogenous redistributive policies

In rich industrialised economies, taxes and transfers reduce the Gini coefficient by about a third. Moreover, differences across countries in the extent of redistribution account for a large fraction of overall differences in income inequality. In 2010, the Gini coefficient for *market incomes* was similar in France and the US, 50 per cent, and was 44 per cent in Sweden. The Gini of *disposable income* was 38 in the US but only 30 per cent in France, while in Sweden it was 27 per cent. Distributive policies hence place France amongst the most equal and the US amongst the most unequal of the high-income economies in terms of disposable income, even if they both share similar market outcomes.[12]

We hence need to ask what determines the degree of redistribution, or, more generally, the size of the welfare state. Bénabou (2005) provides a framework to think about this question. He studies a model where inequality, human capital accumulation, and the welfare state are jointly determined. Suppose that growth is driven by the accumulation of human capital, and that individuals are endowed with different levels of human capital (or education) and of random ability. These endowments, together with the degree of redistribution τ, determine an individual's disposable income. There are two key elements is his

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12. Data from the WIDER database.

analysis. First, some individuals are credit constrained and hence invest in the education of their offspring less than they would in the absence of credit constraints. Second, individuals vote over the extent of redistribution, and do so before knowing their children's ability.

In this context, there are two negative relationships between the degree of human capital inequality and the degree of redistribution that individuals vote for. The first follows from the fact that individuals want some redistribution as it provides insurance against random ability. When human capital is equally distributed, all differences in income are due to random ability, and individuals vote for a highly redistributive policy to insure against ability shocks. When human capital is unequally distributed, insurance becomes costly for individuals with high human capital, hence there is less support for redistributive policies.

The second relationship governs the process of human capital accumulation. Greater redistribution relaxes the credit constraint of the poor, allowing them to increase the educational attainment of their children which in turn results in a lower degree of long-run inequality. Since the two relationships are decreasing, and as long as one of them is not linear, they may intersect more than once and give rise to two stable equilibria for the same preferences and technology. One equilibrium is characterized by low inequality and high redistribution, while the other exhibits high inequality and low redistribution.

This approach has a number of implications. First, the equilibrium relationship between inequality and redistribution will be negative, since, paradoxically, more equal societies choose to redistribute more, a fact that is confirmed by data on high-income countries. Second, different sources of inequality have different impacts on the extent of redistribution. If inequality is mainly due to differences in human capital endowments, the support for redistributive policies will be weak. When inequality is largely due to random ability shocks, there will be a greater demand for redistribution. Third, either of the two equilibria may result in faster growth. It depends on the distortions created by redistribution – in terms of employment or effort – and the positive effect of a greater investment in education by the poor.

The model highlights that inequality can be pervasive, as a dispersed distribution of endowments can foster policies that entail little redistribution. It is a framework that can help us understand how in a number of countries the crisis entailed the dissatisfaction of large

fractions of the population which viewed the educated elites as imposing breaks to inclusive policies. As educational inequality grew during the 90s, the high-skill elites experienced less idiosyncratic risk (in relative terms) and this may have been a cause of the reduction in support for redistribution that has taken place in a number of countries.

3.4. Top incomes

A substantial body of work has examined changes at the very top of the income distribution; see Atkinson, Piketty and Saez (2011) and the references therein. The first question we should ask is what is meant by top incomes and whether they are different in any way from incomes at other points of the distribution. The evidence discussed by Atkinson, Piketty and Saez indicates that it is often the case that the incomes of this group follow different dynamics from those of the individuals between the 90th and the 99th percentiles of the distribution. For example, in India during the 1990s, the rate of growth of income was above that of GDP only for the top 0.1 percent, while in China the share of the top 1 percent rose from 2.6% in 1986 to 5.9% in 2003; see Banerjee and Piketty (2005) and Piketty and Qian (2009). Nevertheless, in some cases the differences are less marked, as in the case in the UK, where the incomes of the entire top vintile grew together in recent decades. Overall, for those countries for which long series exist, the data tend to exhibit a U-shaped pattern, while in economies with shorter time series we find an increase in top income shares in recent decades.

The causes of this upsurge of inequality at the top are still not fully understood. The evidence shows the appearance of a class of "working rich", yet these cohabit with rentiers who derive most of their income from wealth. This indicates that we need to explain both top wages and the intergenerational transmission of capital and the dynamics of wealth inequality.[13] We have seen that, in a number of countries and notably in the US, wage dispersion is largely explained in terms of skill-biased technical change. Although this is a suitable model for most of the earnings distribution, both across and within groups, it does not help understand what has happened at the very top and, in particular,

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13. See Alvaredo and García-Peñalosa (2018), Atkinson (2018) and the other articles in the same special issue on "Top incomes" for a discussion on the pressing questions on this topic.

the growth of the top percentile relative to the top decile. Here we need to focus on theories dealing with executive remuneration in hierarchies and with tournament theory; see Lazear and Rosen (1981). The basic idea in these models is that the more complex the task, the higher the risk of failure, and hence agents have to be compensated for this risk. Alternatively, a theory of superstars has been proposed, in which a winner-takes-it-all reward system generates a large gap between the earnings of the highest and the second highest earner; see Rosen (1981). Globalization, scale economies and the increased mobility of labour, have increased potential rewards and expanded the range of occupations in which the winner-takes-it-all reward system is used, thus raising top incomes. Marginal tax rates are also an important element in determining the (pre-tax) income of the very rich. Higher marginal tax rates reduce the net wage and hence the labour supply, which lowers earnings for a given gross hourly pay.

The data on top incomes has been used to try to establish common patterns. Using data for 16 countries over the 20th century, Roine, Vlachos and Waldenström (2009) find that faster growth of GDP per head is associated with increases in top income shares. Their evidence also indicates that financial development is pro-rich in a country's early stages of development. On the other hand, they find a correlation between falling top income shares and the progressivity of the tax system, although causation is unclear. Both could be the result of third factors, such as the loss of overseas territories and hence the reduction of both private incomes and tax revenue, or of changes in social norms that reduce top wages and/or payments to capital at the same time as taxes change.[14] Alternatively, causation can run from top incomes to taxation: increases in top incomes lead to more lobbying and political pressure that in turn reduce taxes. All these mechanisms can be understood in the framework developed by Bénabou (2005) and discussed above, where tax policy choices are endogenous.

To sum up, this literature indicates that in the late 20th century a substantial fraction of per capita income growth was reaped by those at the very top of the distribution. Nevertheless, earlier periods of growth were associated with falling top income shares. This indicates

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14. An example of this type of situation can be found in Scandinavian countries where highly progressive tax systems are accompanied by moderate pre-tax earnings inequality. Also, the economic policies of both Thatcher and Reagan were characterized by both lower taxes and an increase in deregulation and privatization, with the latter potentially resulting in higher top incomes

that the overall evolution of top incomes depends on both macroeconomic and global forces, but also on policy choices, and in particular on the degree of progressivity of the tax system and social norms about reward patterns.

4. What Have we Learnt and What Are we Still Missing?

In this paper I have argued that the relationship between growth and inequality is a complex one, due to causation going both ways but also to the fact that there are various possible mechanisms that link the two variables. There is hence a variety of approaches that the theory has proposed, and the empirical evidence is not always clear about which ones dominate. We can nevertheless draw some lessons.

The first one refers to the impact of inequality on growth. Both theory and evidence indicate that inequality at the bottom of the distribution, whether in income or in education, tends to lead to slower growth. The reason for this is that it curtails access to education by a fraction of the population. Inequality can also result in aggregate fluctuations when the consumption standards of those at the bottom of the distribution are maintained through unsustainable debt.

Concerning the effect of growth on inequality, two aspects seem to be particularly important. The first one is related to human capital accumulation. Education policies that expand the number of skilled individuals may be an equalizing or an unequalizing force. The overall effect on the distribution of earnings depends on various forces: the pure supply effect, which with decreasing returns to all kinds of labour tends to increase unskilled and reduce skilled wages, and the bias of technology that would tend to make earnings more unequal. In principle, either of these effects could dominate. A second key aspect is the evolution of top incomes. As I have discussed, there has been a global tendency for top incomes to rise in recent decades and in particular to rise together with growth. Part of this surge is probably linked to the opening up of an economy to trade and international competition, and to the access of highly skilled workers to a global labour market. Hence, fostering growth through openness is likely to lead to an increase in top earnings and hence call for suitable redistributive policies.

The literature I have just discussed have benefited from new data and new methods. These have led to enormous progress in our capacity to incorporate heterogeneity in macroeconomic models, both

because increased computational capacity allowed for more complex distributional dynamics, but also because the massive data collection inspired by the work of Anthony Atkinson has provided the information needed to calibrate these models. Nevertheless, several gaps remain.

First, we need further work on the distributional effects of macroeconomic policy. Although much of the literature I have discussed assess the impact of policy on distribution, it does so in a particular framework with, usually, a single type of heterogeneity. We consequently lack a canonical model of distribution that can be used by, say, central banks to assess the full consequences of policy choices. What is needed at this stage is a concerted empirical effort to assess which are the crucial mechanisms we should be focusing on, and which are secondary. I want to note, nevertheless, that following the Great Recession there has been an increased awareness of the importance of distributional questions in high-income countries, notably in the major international organisations. The OECD has published two volumes on inequality, in 2011 and 2015, and institutions such as the IMF have started to have research programs concerned with the distributional impact of fiscal policy, something that would have been inconceivable 15 years ago.[15]

A second aspect we need to address is that of firm size heterogeneity. Research on inequality across individuals or households has expanded, but the consequences of heterogeneity across firms has received little attention. The model developed by Melitz (2003) has been extremely influential in international trade, yet the implications of firm heterogeneity for the wage or income distribution remain understudied. Do large and small firms pay similar wages? Is the bargaining power of labour, and consequently the wage share, different in countries where local medium-size firms dominate than in those where production is mainly in the hands of multinationals? A few authors have recently examined to what extent wage inequality is due to greater inequality across firms or a more dispersed salary scale within firms, and have found that the first aspect dominates.[16] The next step is to understand what the aggregate implications of such a phenomenon are. Growth is often driven by firms that gain market share. These gains can, however, be driven by small, innovative firms, or by large

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15. See OECD (2011, 2015), Ball *et al.* (2013) and Woo *et al.* (2013).
16. Voir Barth *et al.* (2016) et Song *et al.* (2015).

enterprises that exploit increasing returns to cut costs. Do these two scenarios imply that growth will be accompanied by different distributional dynamics? These are questions that require our attention in the years to come.

Lastly, the Great Recession seems to have been accompanied by the appearance of jobs with both low hours of work and low hourly wages,[17] implying that the skill-poor have difficulty increasing their incomes by working harder. It is important to understand the causes and consequences of the appearance of such jobs. Are these jobs the result of the growth process? If so, what are the policies that would prevent them in being a major source of rising inequality in the decades to come?

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17. See Checchi *et al.* (2016).

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MACROECONOMICS AND THE ENVIRONMENT

Katheline Schubert[1]

Paris School of Economics, University Paris 1

This article examines the recent literature on macroeconomics and the environment from the perspective of the methodological approach, the questions asked and the types of responses given. It also reviews the place of the environment in textbooks and major macroeconomics journals. It shows that almost no space is given to environmental issues in short-term macroeconomics. Environmental issues are perceived as affecting the long-term and the structure of economies rather than the current situation. It can therefore be expected that studies on growth and the teaching of theories of growth would give them an important role. The article shows that while this is partly the case with regard to the literature, it does not hold at all with regard to teaching. The road ahead for truly integrating environmental issues into macroeconomics remains long.

Keywords: macroeconomics, environment, modelling, growth.

Herman Daly, one of the fathers of ecological economics, wrote in 1991: "*Environmental economics, as it is taught in universities and practiced in government agencies and development banks, is overwhelmingly microeconomics. The theoretical focus is on prices, and the big issue is how to internalize external environmental costs so as to arrive at prices that reflect full social marginal opportunity costs. Once prices are right the environmental problem is 'solved' – there is no macroeconomic dimension*" (Daly, 1991). This observation is still partially valid: environmental issues occupy a very small place in macroeconomic models, and their

study remains largely the prerogative of microeconomics and public economics. It could even be said that short-term macroeconomists are not interested in it, or more precisely, that whatever interest they have is confined to the question of the macroeconomic impact of oil shocks. The situation is different for growth macroeconomists. Indeed, environmental problems are perceived as long-term problems, affecting the structure of the economy and influencing its growth path, but having little relation to its current performance. And even in models of growth, environmental issues are mostly external, in the sense that they do not affect the drivers of growth such as education, public infrastructure, technology and institutions. They are perceived as constraints rather than as an essential dimension of our developmental choices.

This article examines the recent literature on macroeconomics and the environment from the perspective of the methodological approach, the questions asked and the types of responses given. It also reviews the place of the environment in textbooks and major macroeconomics journals. It shows that there is still a long road ahead for truly integrating environmental issues into macroeconomics.

1. Short-Term Macroeconomics and the Environment

A careful review of the literature and a hopefully exhaustive study of the most widely used short-term macroeconomics textbooks and macroeconomics journals unambiguously shows that they give almost no space to environmental issues.

1.1. The literature

The pre-crisis macroeconomic literature contains numerous studies on the macroeconomic effects of oil shocks, but this is almost the only angle from which environmental issues are addressed. This work, which is overwhelmingly empirical, started in the mid-1970s, and falls into the more general category of work on the impacts of commodity price fluctuations. This will not be examined in greater detail here.

The more recent literature can be reviewed quickly: there are, to my knowledge, only some dozen published papers that introduce the environment, in one form or another, into the tools of today's short-term macroeconomists, i.e. the Dynamic Stochastic General Equilibrium models (DSGEs). These articles are of two types: they are interested, like the above-mentioned older works, in the impacts of energy prices

and oil shocks on macroeconomic fluctuations, or, more innovatively, they evaluate the short-term costs of environmental policies.

In the first category, the article by Kim and Loungani (1992) stands out as a precursor. The authors introduced energy as a factor of production in a Real Business Cycle (RBC) model of the Kydland-Prescott-Hansen type in order to study the impact of energy price shocks on the economic cycle. Bodenstein *et al.* (2011), Schwark (2014) and Acurio-Vasconez *et al.* (2015) pursued the same goal using DSGE models.

Work in the second category belongs to recent literature that seeks to identify the least costly environmental policies in terms of economic activity. Indeed, if, in the long term, environmental protection and growth can, under certain conditions, go hand in hand and not come into conflict, the studies dealing with the short term put them in opposition. Protecting the environment is expensive, and it is important to analyse and quantify the terms of the trade-off with economic activity.

Angelopoulos *et al.* (2010, 2013), Heutel (2012), and Fischer and Springborn (2011) studied the performance of different types of environmental policy in RBC models incorporating pollution. The question asked is which environmental policy is the most efficient in terms of price (tax) or quantity (emissions permit market), from the point of view not only of well-being but also of the volatility of the macroeconomic variables, in a context where fluctuations are caused by productivity shocks (see Heutel and Fischer, 2013). Dissou and Karnizova (2016) did the same using a multi-sectoral RBC model incorporating sector-specific productivity shocks. They distinguished several imperfectly substitutable sources of energy that emit more or less CO_2. Annicchiarico and Di Dio (2015) also took an interest in how different environmental policies interact with the economy's response to nominal and real shocks. They constructed a New Keynesian macroeconomics model with Calvo-type nominal rigidities, incorporating different types of shocks: productivity shocks, public consumption shocks and monetary policy shocks. CO_2 emissions are a by-product of production. The reduction of emissions can have two sources in this type of model: environmental policy or a negative shock to production. Three environmental policies were examined: a carbon tax, an emissions permit market, and an emissions intensity target (i.e. an emissions ceiling per unit of production). The authors assessed the extent to which imperfect competition and nominal rigidities alter the conclusions of previous studies, namely, that the emissions trading market,

which sets a cap on emissions, is more likely than other environmental policies to smooth macroeconomic fluctuations. They showed that price rigidity significantly modifies the performance of environmental policies, and that the optimal response to environmental policy shocks depends heavily on the extent of price adjustment and the response of monetary policy. Annicchiarico and Di Dio (2017) continued this work by examining in greater depth the optimal response of monetary policy to shocks when an environmental policy is in place, as well as the way in which monetary policy and environmental taxation interact.

This work is interesting because it provides a short-term perspective on environmental policies that complements the usual insights provided by microeconomic models of static partial equilibria on the one hand, and growth models on the other hand.

Sachs (2009) explained that the new macroeconomics must be structural, but that "*both the neo-Keynesians and the free-market school regard structural issues such as energy, climate, and infrastructure to be of little macroeconomic significance. Perhaps these factors require a modicum of policy attention, but they are certainly not regarded as critical to restoring jobs, growth, and prosperity, and could even be a hindrance in the short term; for example, if climate-change policies hike up the price of energy*". We are very far from this ideal of a structural macroeconomics, and the crisis seems to have changed nothing. Blanchard *et al.* (2010), for example, in their frequently cited paper on the revival of macroeconomics after the crisis, did not say a word about the environment, climate, energy, health or education.

The point is not to introduce the environment everywhere. But it must be noted that short-term economic decisions have an impact on the environment and that, in turn, environmental degradation weighs on economic activity, so it is necessary to understand the interactions between environmental policies and other levers of economic policy. One particularly interesting juncture between short-term macroeconomics and the environment is the financing of the energy transition. How can savings be directed towards the financing of long-term projects to bring this transition to a successful conclusion and ensure investment in appropriate technologies and infrastructures? The most immediate response is to make these projects and investments profitable through the pricing of environmental externalities, in particular by introducing a carbon tax. A complementary response is to put in place proactive policies to direct funds towards low carbon projects. For

example, shoots of literature on smart unconventional monetary policy and green quantitative easing are beginning to sprout. This involves questioning the sectoral neutrality of corporate bond purchases by central banks in the context of quantitative easing in favour of a policy of buying green corporate bonds and abandoning the purchase of "dirty" corporate bonds, typically from the fossil fuel sector (Aglietta *et al.*, 2015). Campiglio (2016) presented other proposals for financing the transition. This literature still represents the work of a small number of environmental economists and has not yet penetrated the major macroeconomics journals.

1.2. The textbooks and macroeconomics journals

As far as education is concerned, to my knowledge short-term macroeconomics courses never include environmental considerations. Nor is there any place for the environment in short-term macroeconomic textbooks, neither new or old, neither basic or advanced. There is no reference in Romer (2011), Bénassy (2011), Krugman and Wells (2012), Wickens (2012), Ljungqvist and Sargent (2012), Abel *et al.* (2013), Blanchard (2017), Burda and Wyplosz (2017), or Uribe and Schmitt-Grohé (2017), to name only the most common post-crisis textbooks. The Acemoglu, Laibson, and List (2016) text does not talk about the environment either, but note that the authors have introduced an online chapter entitled "Economics of Life, Health and the Environment" (Web Chapter 2).

As for academic publications, a review limited to the top-level journals in France's CNRS ranking in macroeconomics from May 2016 for the period 2009-2016 reveals the following:

— *American Economic Journal*: Macroeconomics: 2 articles, out of a total of about 240 (30 articles in 2016, multiplied over 8 years);

— *Journal of International Economics*: 9 articles out of about 800;

— *Journal of Monetary Economics*: 4 articles out of about 540;

— *Journal of Money, Credit and Banking*: 6 articles, covering the macroeconomic impacts of oil shocks, out of about 480;

— *Journal of Economic Dynamics and Control*: 52 articles out of about 820, which makes this journal stand out, partly because many of the articles seriously address the long-term outlook and growth.

2. The Environment in Long-Term Macroeconomics

Since environmental matters are considered long-term issues, it would be expected that studies on growth and the teaching of theories about growth would give them an important role. As we shall see, this is partly the case with regard to the literature, but not at all with regard to education.

2.1. The literature

With the exception of Ricardian growth models in which the Earth is a scarce resource imposing physical limits on growth, modern growth theories have long ignored the environment, perceiving it as inexhaustible. They have focused on the study of a stylized world in which agents produce with the help of manufactured capital and labour, and derive satisfaction from the mere consumption of manufactured goods. The archetypes of this approach are Solow's model (1956) and Ramsey's optimal growth model (1928). Starting in the 1970s with the oil shocks, however, some economists have recognized the need to take various aspects of the natural environment into account in growth models. Events have driven them to focus first on non-renewable resources and in particular on fossil fuels. In the Ricardian tradition, they have sought mainly to understand the circumstances in which the finite nature of the environment and the scarcity of natural resources constitute a physical limit to growth, and at what rate non-renewable resources should be extracted. The founding articles in this line of research were all written by famous economists whose specialty was not the economics of the environment, which did not exist at that time as a specific field of research; many of these articles were published in a special issue of the 1974 *Review of Economic Studies* (Vol 41, No. 5, December), including seminal articles by Dasgupta and Heal (1974), Solow (1974) and Stiglitz (1974).

Very quickly, however, the introduction of environmental considerations into growth models became the preserve of environmental economists alone. The pioneering work of Dasgupta, Heal, Solow and Stiglitz had little impact on the vast majority of macroeconomists who, once the effects of the oil shocks faded, returned to focusing exclusively on traditional macroeconomic variables like inflation, output and employment, or on monetary and fiscal policies alone. The literature reviews by Xepapadeas (2005) and Brock and Taylor (2005) also verify this.

The lessons of the growth models that incorporate natural resources from this era are clear. The economy's growth depends partly on the characteristics of its technology and partly on the preferences of the agents that populate it. Depending on these characteristics, growth may or may not be sustainable, in the sense that well-being does not decrease over time.

Production is characterized by a certain intensity of use of natural resources as factors of production (fossil fuels, ores, but also air, water and renewable resources) as well as the pollutants emitted and the waste generated. The consumption of resources and environmental services for productive purposes depends on the characteristics of the technology used, and in particular on the substitutability between natural resources and manufactured capital that this allows. If it is easy to substitute natural resources for manufactured capital, that is, if the substitutability is great, the finiteness of the environment will not necessarily constitute a drag on growth. If, on the other hand, the substitutability is limited, the only way to push back the physical limits constituted by the finiteness of the environment is to change the technology and / or the resource, which amounts to replacing the natural resource with a non-rare equivalent, assuming that this is possible.

The preferences of the agents are distinguished by their character as more or less "green", reflecting the importance they attach to the environment, and by the discount rate, reflecting their impatience, i.e. how much weight they place on the present in relation to the future. Once again, a central issue is the extent to which agents are willing to substitute the consumption of goods for environmental quality. As for technology, these behavioural characteristics change over time along with changes in awareness of the seriousness of environmental problems and the need to pass on sufficient resources and a quality environment to future generations. Finally, when considering optimal growth, it is not only individual preferences that come into play but also social preferences. In particular, the value of the social discount rate is central when it comes to intergenerational equity and the sustainability of growth. Weitzman (2001) described the issue of the social discount rate as "one of the most critical problems in all of economics". It has given rise to extensive debate and controversy, and it is the subject of an extremely abundant literature, which seems very far from converging on a consensus.

Finally, public intervention is needed in order to implement the optimal growth path in decentralized economies. This is because natural resources are very often used inefficiently, as their market price does not reflect the full social cost associated with their use. This is particularly the case for renewable resources (problem of open access, tragedy of the commons) and fossil fuel pollutants. In this context, the literature examines the design and effects of environmental policy, extending the principle of Pigouvian taxation to a dynamic framework.

The literature on growth and the environment has seen a revival due to climate change. The focus has shifted from the question of the scarcity of non-renewable resources to that of the pollution associated with their use. The combustion of fossil fuels leads of course to CO_2 emissions that accumulate in the atmosphere. The increase in the carbon concentration in the atmosphere is in turn causing a worsening of the infamous greenhouse effect that is responsible for global warming. If we really want to avoid catastrophic warming, the amount of carbon we have left to emit is small, much less than what is contained in the fossil fuels still present in the earth's subsoil (see for example IPCC, 2014). The problem is therefore not scarcity, but the accumulation of carbon in the atmosphere.

In this framework, recent growth models have focused on how to replace fossil fuels with renewable energies and polluting technologies with clean technologies, so as to move from "growth to green growth" (Hallegatte *et al.*, 2011; Smulders *et al.*, 2014). The novelty of these models is that they deeply dissect technical progress, its orientation and the conditions for its emergence. They show that innovation is rarely spontaneous and has no reason to be spontaneously oriented in the desired direction. For example, since the industrial revolution, innovation has been largely aimed at saving labour. This has made it possible to equip people with better tools, first and foremost machines powered by fossil fuels. If society wants innovation to move in a different direction, so as to conserve natural resources and environmental services, then an economic policy is needed that provides researchers with the proper incentives. But this will have a cost in terms of growth, both directly, for example because of the rising cost of fossil fuels, and also in terms of the crowding out of technical progress aimed at increasing the productivity of labour, which is the engine of growth (Henriet *et al.*, 2014).

A more disaggregated approach that has generated a substantial literature is known as "directed technical progress" (see, for example, Smulders and de Nooij, 2003; Grimaud and Rouge, 2008; Di Maria and Valente, 2008; Acemoglu *et al.*, 2012). The economy has a "dirty" production sector and a "clean" sector, and research can be directed towards the development of new technologies in one or the other of these sectors. Innovations boost labour productivity in the sector where they occur. If there are more numerous innovations in the "clean" sector, the economy's share of the "dirty" sector gradually shrinks and the economy is on a green growth path. Environmental taxation and subsidies for research in clean technologies are key elements for initiating technical progress in this direction. These incentives must be particularly strong if there is a phenomenon of historical dependence in the growth path (Acemoglu *et al.*, 2012): innovation is more easily achieved in the most advanced sectors, for the goods with the largest market shares and lowest prices, yet currently the most advanced sectors are the "dirty" sectors.

The long-term benefits of moving to a clean growth model should not obscure the short-to-medium-term costs. The "marketing" discourse of green growth asserts that environmental policies not only reduce the consumption of natural resources, pollution and environmental degradation, but also stimulate growth in the medium term through innovation, the creation of new investment opportunities, the emergence of new trades and activities, etc. The theoretical studies make it possible to go beyond this type of discourse, which is intended to increase the acceptability of environmental policy but is often misleading, so as to examine the precise conditions for the emergence of spill-over effects from medium-term environmental policies and the obstacles to sustainable growth.

The applied tools used by climate change economists include Computable General Equilibrium Models (CGEs) and Integrated Assessment Models (IAMs). The methodology used by the former is either classic and well known, or ad-hoc or so-called hybrid models. This is examined in depth in the article by L. Gissela, A. Saussay, P. Maillet and F. Reynes in this issue. The focus here is on the second type. IAMs combine an economic model and a physical model describing the climate system in a simplified way. The latter models the ways in which the increase in the concentration of greenhouse gases in the atmosphere due to human activity, derived from the economic

model, result in raising the earth's temperature. The mechanism is complex and subject to multiple uncertainties, due to feedbacks between increased temperature and carbon uptake by oceans and forests and to other atmospheric phenomena such as cloud formation and precipitation. In turn, the rise in the Earth's temperature is causing damage, which is introduced in the economic model; these are sometimes production losses and sometimes direct losses in well-being. The "damage functions" are themselves very poorly understood, especially since a more aggregated level is being considered.

The first integrated assessment model, the culmination of a research programme that began in the late 1970s, was William Nordhaus's Dynamic Integrated Climate-Economy (DICE) model (1991, 1994, 2008). This remains the reference today, and it has had many avatars. It is a deterministic model of classical growth of the Ramsey type, with emissions arising from economic activity, a climate module and damage. DICE models are small in size, and the mechanisms they incorporate are transparent. The other IAMs do not all have such solid theoretical foundations. Some of them abandon microeconomic fundamentals and intertemporal optimization under perfect anticipation and introduce ad-hoc formalizations that are supposed to better represent the real world, or exogenous economic growth scenarios. They can be very large, so quite difficult to comprehend other than as black boxes.

Integrated assessment models are mainly used to calculate a social value for carbon in order to give public decision-makers an order of magnitude of the initial level and temporal profile of the carbon tax needed to bring the damage back to an optimal level or to contain global warming below a certain threshold. They are widely used in international circles and have a certain influence on the recommendations made in the field of climate policy. They are also subject to vigorous criticism, which is ultimately not so different from the criticism directed at other applied modelling exercises, such as the DSGE. Robert Pindyck, one of the most outspoken critics, wrote: "(Integrated assessment models) have crucial flaws that make them close to useless as tools for policy analysis" (2013). Or again: "IAM-based analyses of climate policy create a perception of knowledge and precision that is illusory and can fool policymakers into thinking that the forecasts the models generate have some kind of scientific legitimacy. Despite the fact that IAMs can be misleading as guides for policy, they have been

used by the US government to estimate the social cost of carbon (SCC) and evaluate tax and abatement policies" (2017).

The most recent studies seem to favour small, theoretically explicit IAMs, in the DICE tradition, that are solvable analytically (Golosov *et al.*, 2014; see also Hassler *et al.*, 2016) or no longer deterministic but stochastic (Lemoine and Traeger, 2014; Crost and Traeger, 2014) or more like DSGEs (DSGE-IAM, Cai *et al.*, 2013). In this latter case, the numerical resolution is extremely complex, so much so that very few attempts of this type exist today.

Finally, it should be noted that there is nothing comparable either in terms of theoretical models or applied tools to analyse the issue of the loss of biodiversity and the appropriate economic policies. Yet this is the other major global environmental issue of our time, and for the moment macroeconomics is utterly without tools to deal with it.

2.2. The textbooks and growth journals

Strangely enough, from my point of view, textbooks on growth give very little space to environmental issues. At best there is a chapter at the end of the book dealing with the environment (from the perspective of natural resources) alongside geography and institutions, going into what the canonical models (the Solow and Ramsey models and the foundational models of endogenous growth) do not take into account.

Thus, among the pre-crisis textbooks, the reference text by Barro and Sala-i-Martin (1998) makes no mention of the environment. The text by Aghion and Howitt (1998) is an exception, with Chapter 5 entitled "Endogenous growth and sustainable development". The situation is nevertheless changing. Admittedly, the weighty text by Acemoglu (2008) has nothing on the environment, in almost a thousand pages. Nothing can be found either in La Granville (2009) or in Galor (2011). On the other hand, Aghion and Howitt's text (2009) includes a chapter entitled "Preserving the environment" (Chapter 16), Weil (2016) has two chapters on the environment, the last two (15 and 16): "Geography, Climate and Natural Resources" and "Natural Resources and Environment at the Global Level", and Jones (2013) introduces a chapter on the environment (Chapter 10, "Natural Resources and Economic Growth"), which was not present in the first editions of the book (see Jones, 1998).

As for academic publications, over the last ten years the Journal of Economic Growth has published five articles on natural resources or the environment in general, out of a total of about 120 published articles. The end of the period does not pick up: there is nothing between the article by Brock and Taylor (2010) on Solow's green model and the article by Peretto and Valente (2015) on the interactions between technical progress, natural resources and population dynamics

3. Conclusion

Awareness of the limits of the mode of growth initiated by the industrial revolution has been growing gradually, but it is real today. The developed countries have been able to solve some of the local environmental problems created by their production technologies, such as local air and water pollution, while creating new ones. They are still helpless in the face of the two major problems of our time, namely global warming and the erosion of biodiversity. Despite this growing awareness, macroeconomics is not very concerned with these issues, while there is a great need for analysis and work on environmental policy. We are still far from the structural macroeconomics called for by Sachs.

Integrating the environmental sphere into macroeconomic models does, however, open up exciting fields of research. At the centre of the analysis are now uncertainty, irreversibility, and a change of regimes. Uncertainty because the physical phenomena are uncertain, as is the damage. Irreversibility because environmental damage is often irreversible, in the sense that the original situation cannot be restored, nor can economic decisions be taken back (see, for example, Pommeret and Prieur, 2013). In a world where irreversibility is the rule, it is clear that the consequences of any decision are heavier than in a reversible world, and that it is necessary to act in a more precautionary way. Irreversibility can be both environmental and technological. Environmental irreversibility involves the existence of thresholds. Below these thresholds, the environment is reasonably resilient, and technologies and preferences can be characterized by a certain substitutability between the environment and manufactured goods. If the thresholds are crossed, substitutability is no longer possible, and nonlinearities and possibly catastrophic phenomena emerge. Irreversibility can also be technological: it is very expensive to develop a new technology that saves natural resources and to adopt it on a large scale, and it takes the

economy onto a new technological trajectory for a very long time. In the opposite direction, deciding on "dirty" infrastructure or capital today also has long-term consequences. Uncertainty and irreversibility are difficult to integrate into normal growth patterns. Their study requires dealing with changes of regimes, transitions and structural change. Because that's what it's all about: moving to a new mode of growth.

The global financial crisis of 2008 forced macroeconomists to question the dichotomy in their models between the real sphere and the financial sphere and to look for representations of the real world in which these spheres are deeply interconnected. As Carraro, Faye and Galleotti (2014) have asserted so forcefully, what kind of catastrophe is necessary for macroeconomists to decide to revise their models so as to genuinely integrate environmental issues?

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THE STATE OF APPLIED ENVIRONMENTAL MACROECONOMICS

Gissela Landa Rivera, Paul Malliet, Aurélien Saussay
Sciences Po OFCE
Frédéric Reynès
NEO (Netherlands Economic Observatory), TNO (Netherlands Organisation for Applied Scientific Research) and OFCE

To a large extent, environmental macroeconomics is developing outside of the theoretical debates taking place in other fields of research in applied macroeconomics. This is evidenced by the low representation of environmental issues in mainstream economics journals and in advanced macroeconomics textbooks. While the environment has not up to now been considered as a subject in itself for advancing knowledge in macroeconomics, since the 1990s it has at least been an important topic for applying macroeconomic models. These models have been used in particular to analyse and quantify the economic effects of the transition to a sustainable system of production and consumption. We propose to shed light on the state of the art in applied environmental macroeconomics. More specifically, we will endeavour to identify the specific features of this area of research that explain the theoretical and empirical choices made.

Keywords: environmental macroeconomics, macroeconomic modelling, IAM, CGE.

It should be emphasized first of all that in the vast majority of cases, environmental macroeconomics is primarily *climate* macroeconomics. The other major themes of environmental economics – the limitation of negative externalities, the management of the commons, the exploitation of renewable and non-renewable resources – are treated in other branches of the discipline of economics, such as microeconomics or experimental or behavioural economics. Conversely, the climate issue is largely a macroeconomics issue. Reducing greenhouse gas emissions is a sine qua non for limiting climate change and therefore for reducing

the associated risks for the environment and ecosystems (IPCC, 2014). This implies a profound change in behaviour related to the production and consumption of energy, which affects the entire economy. Likewise, the consequences of climate change, which are beginning to manifest themselves through an increase in extreme weather events and a continuous rise in the average temperatures observed, are leading to profound and abrupt changes in the ecosystem equilibrium on which all human economic activities depend.

The study of the economic aspects of climate change therefore requires taking into account all of these dimensions. The relevant models can be of help in the formulation and evaluation of public policies aimed at reducing the greenhouse gas emissions responsible for climate change. These policies – carbon pricing, global or sectoral ceilings on emissions, regulatory standards or similar interventions – require a degree of guidance by the public authorities. This necessitates the use of applied macroeconomic models that can simulate realistic economic dynamics.

The primary use of the models produced by environmental macroeconomics is to provide support for public decision-making and for the continuous assessment of the transformations needed to achieve the environmental objectives that society has set itself. This role imposes an applied approach. The intention is in this sense quite comparable to the role of Dynamic Stochastic General Equilibrium (DSGE) models in the implementation of monetary policy. Central banks use these to help answer concrete macroeconomic and monetary policy issues. Environmental macroeconomic models are intended to play a similar role in the fight against climate change. However, their task seems more difficult than that of DSGEs, which are nevertheless the subject of intense debate over the nature of the tool, its real explanatory power and its complementarity with other tools.[1] Environmental macroeconomic models face similar challenges but with a higher degree of complexity. As will be seen, this stems from a lack of consensus concerning the theoretical framework of the model, and the need to take into account the heterogeneity of the agents and to incorporate modelling techniques borrowed from other disciplines (physics, engineering, climatology), but also from the diversity and complexity of the economic policies that must be taken into consideration.

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1. See in particular the recent vigorous exchanges concerning the article by Christiano *et al.* (2017).

This article describes the main features of the contemporary macroeconomic models that deal with the climate issue and sheds light on the controversies surrounding them. In particular, we review existing models in order to present their main characteristics, in terms of both the structure and object of study. Finally, we propose a number of improvements that could deal with certain criticisms, both in approaches to modelling and in methods of dissemination.

1. Integrated Assessment Models (IAM)

As is pointed out, and regretted, by Katheline Schubert (see her article in this issue), the problem of climate change, and more generally of the increasing use of natural resources, is largely ignored by advanced research in macroeconomics, which often favours analytical coherence to the detriment of applied research. This is evidenced by the low representation of environmental issues in mainstream economics journals and in advanced macroeconomics textbooks. Thus, recent works that are part of the neo-Keynesian synthesis and use DSGE models do not deal with these issues, preferring to focus instead on short-term matters. And while neoclassical growth models regularly incorporate environmental components, these do not affect the structural determinants of growth, unlike education, public infrastructure, technology, or institutions. While the environment is not considered a topic that can in itself advance knowledge in macroeconomics, it is nevertheless a subject for which there is a strong social demand and for which economics has proven to be relevant for highlighting existing trade-offs by determining the costs and benefits to be considered.[2] It has also been the subject of numerous applications of macroeconomic models since the 1990s. These have been used in particular to analyse and quantify the economic effects of the transition to a system of sustainable production and consumption. Two main classes of macroeconomic models are used: Integrated Assessment Models (IAMs) and Computable General Equilibrium (CGE) models, which will be discussed in the next section.

The IAMs include PAGE (Hope, 2006) and FUND (Waldhoff *et al.*, 2014) models as well as the suite of models developed under the Integrated Assessment Modelling Framework (IIASA).[3] But the DICE model

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2. See on this subject the article "Acid Rain" (Newberry *et al.*, 1990).
3. See http://www.iiasa.ac.at/web/home/research/researchPrograms/Energy/IAMF.en.html.

developed by Nordhaus (1991, 2013) is still today the flagship of this class of models. While IAMs can be very complex due to the interdependence of many economic and technical modules, the success of DICE is probably due in large part to its transparency and relative simplicity. DICE is composed of a climate module and a macroeconomic module. The first represents the relationship between the increase in the concentration of greenhouse gas emissions (measured in CO_2 equivalent) and the rise in global temperature over time. The second converts this rise in temperature into economic damages (using a damage function). The macroeconomic module also determines the link between economic activity and emissions as well as the cost associated with their reduction (*via* an abatement curve). Assuming that a representative economic agent maximizes his or her inter-temporal utility under the assumption of perfect expectations, DICE endogenously determines the social cost of carbon as measured by an "optimal" carbon tax. The latter is defined by the trade-off between short-term profits and the long-term costs of economic growth for well-being. While the standard version of DICE is deterministic, recent research has been developing stochastic IAMs to account for the uncertainty surrounding the model's key parameters.[4] Despite the relative simplicity and transparency of the DICE model, it is still subject to the virulent criticism of Pindyck (2017) against IAM: "In a recent article, I argued that integrated assessment models (IAMs) 'have crucial flaws that make them close to useless as tools for policy analyses'. In fact, I would argue that calling these models 'close to useless' is generous: IAM-based analyses of climate policy create a perception of knowledge and precision that is illusory, and can fool policy-makers into thinking that the forecasts the models generate have some kind of scientific legitimacy. IAMs can be misleading – and are inappropriate – as guides for policy, and yet they have been used by the government to estimate the social cost of carbon (SCC) and evaluate tax and abatement policies." Pindyck (2017) criticizes IAM for the arbitrary calibration of some of their parameters, even though they are crucial for the model's properties and results. These include the discount rate, the damage function and climate sensitivity (the link between temperature and concentrations of greenhouse gases).[5]

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4. See, for example, the applications and the literature review of Hwang *et al.* (2013, 2017).

This calibration problem amounts to a criticism that is generalizable to almost all economic models used in different fields. But beyond this criticism, Pindyck especially blames IAM's developers and users for their lack of humility and scientific honesty about the limitations of their model, out of a desire to feign expertise and hide their ignorance behind mathematical abstractions. Another underlying criticism is the largely normative nature of the main area where IAMs are applied, namely the endogenous estimation of the social cost of carbon. But the determination of the social cost of carbon goes far beyond the scope of economics, as in essence it reflects our degree of altruism vis-à-vis future generations and therefore is more akin to a question of moral ethics than it is a simple calculation of inter-temporal optimization. The way in which this question is translated into economic terms in IAMs leads to questionable simplifications. While it offers a useful abstraction, maximizing an inter-temporal utility under the assumption of a discount rate does not capture the full complexity of our trade-offs with the well-being of future generations. It reflects only one possible way (among many) to resolve the conflict posed by climate change over distribution between present and future generations.

To overcome this limit, Pindyck outlines a more positive approach to determining the social cost of carbon. The first step is to define an emissions trajectory that is compatible with some desired result. Pindyck proposes as a criterion the avoidance of the catastrophic consequences of climate change. Other criteria could be bequeathing the environment to future generations in a certain state of conservation. The second step involves deducing the economic costs associated with one or another objective. The economist no longer claims to give an optimal trajectory of emissions. Instead this trajectory primarily reflects a sovereign choice (preferably *via* a democratic process) and is recognized as such. This trajectory is therefore a constraint to be respected that needs to be defined outside the model, on the basis of diverse scientific expertise, but also through political and social compromise. While IAMs cannot be used to define such a trajectory, they have nevertheless made it possible to gain policy makers' interest and to shed light on the climate issue, as shown for example in the work on the social

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5. In particular, the publication of the Stern Report (2006) sparked a broad debate on the very issue of the discount rate but also on taking into account uncertainty, especially that relating to the occurrence of extreme events. See Beckerman and Hepburn (2007), Nordhaus (2007), Weitzman (2007, 2009) and Dasgupta (2007, 2008).

cost of carbon of the Quinet Commission (2008) in France or of the working group under the Presidency of the United States (Environmental Protection Agency and Change Division Council, 2016).

2. Computable General Equilibrium (CGE) Models

Computable General Equilibrium (CGE) models make up the second category of macroeconomic models being applied to the environment. These models are often relatively large, because they have a sectoral representation calibrated on the Input-Output data from the national accounts. Unlike IAMs, CGE models do not incorporate intertemporal optimization behaviour. They are not trying to derive optimal trajectories for a carbon tax or emissions. Indeed, the trajectory of emissions is often an exogenous target defined outside the model. The carbon tax and other economic policy instruments are used to hit this target, and the model measures the associated economic impacts. For some scenarios, the CGEs seek to take into account policies that promote social acceptability (e.g. redistribution of part of the carbon tax revenue to the poorest households) but also possible technical or temporal constraints related to the reduction of emissions. The CGEs are therefore based on a more positive approach than IAMs. They seek more to understand and quantify the consequences of certain economic policy choices rather than to determine the economically optimal environmental policies. Their specification is the result of a trade-off between complexity, internal and external coherence, and the possibility of answering the questions posed. They are thus often criticized for their lack of transparency. There are basically three reasons for this.

The first arises from the lack of consensus on the theoretical underpinnings of the model. Although subtleties exist, one can subdivide the literature into two classes of CGEs. There are the neoclassical CGEs, which assume that the perfect flexibility of prices and quantities ensures the full use of the factors of production at all times. These include (but are not limited to) the following models: OECD ENV-Linkages multi-country (Chateau *et al.*, 2014); Centre for Global Trade Analysis (GTAP, 2014); GEM-E3 (Capris *et al.*, 2013); and the multiregional RHOMOLO (Brandsma *et al.*, 2015).

Other models use neo-Keynesian-inspired hypotheses by introducing friction: price, capital and labour adjustments are assumed to

be slow because of empirically observed rigidities and adjustment costs. Neo-Keynesian CGEs applied to environmental issues include the E3ME macroeconometric models (Cambridge Econometrics, 2014), GINFORS (Lutz *et al.*, 2010) and NEMESIS (ERASME, n.d.).[6] The latter estimate the elasticities and adjustment times of the main behavioural equations. The ThreeME model developed by the OFCE in collaboration with the ADEME is also a CGE of neo-Keynesian inspiration.[7] Note that it is not easy to classify some CGEs because some models combine neo-classical and neo-Keynesian assumptions. For example, FIDELIO (Kratena *et al.*, 2013) uses slow adjustments on consumption whereas they are instantaneous for the price-setting and the demand for inputs.

The coexistence of models applied with divergent theoretical foundations is a source of confusion, even of mistrust, especially for the policy makers for whom the results of these models are intended. The theoretical choices are important since these condition the results obtained. The disagreement between models over whether a double dividend (economic and environmental) exists in relation to climate change mitigation policies is typical in this respect. Substantial differences may arise with regard to orders of magnitude, the sign of effects and the underlying economic mechanisms. While the neoclassical CGEs often conclude that there are negative macroeconomic impacts due to crowding out effects, the neo-Keynesian-inspired models highlight the existence of multiplier effects for public investment in the energy transition, which give rise to favourable economic dynamics. The existence of a double dividend in a neo-classical model thus generally results from a positive impact on supply (improvement of competitiveness or increase of the labour supply), while the neo-Keynesian-inspired models will also highlight demand-driven mechanisms (increased consumption and investment).

The choice of a neo-Keynesian framework seems preferable because the assumptions on which it is based are more realistic than those of the neoclassical framework. The fact that frictions are taken into account also makes it possible to take on board phenomena of

6. The authors of the E3ME and GINFORS models define their macroeconometric model in opposition to the CGE models. However, from a technical point of view, the difference between the standard CGEs and the macroeconometric models depends on the calibration procedure used and the feedback rules adopted. For this reason, we consider that macroeconometric models belong to the category of CGE models.

7. See Callonnec *et al.* (2013 a, 2013 b, 2016) or Landa Rivera *et al.* (2016). ThreeME is calibrated so as to reproduce the econometrically estimated short-term dynamics.

particular interest to policy makers, such as the impact of a policy on (involuntary) unemployment or inflation. However, the environmental CGEs of neo-Keynesian inspiration do not integrate some specificities of the most advanced neo-Keynesian macroeconomic models, i.e. the DSGE. In particular, expectations are assumed to be adaptive (backward-looking) rather than rational (forward-looking). This choice is guided by the need to maintain a certain simplicity to the model's solutions, whereas the DSGE hypothesis of inter-temporal optimization with perfect information has not demonstrated its empirical robustness. Environmental CGEs thus favour the coherence and manageability of the model in order to take into account certain elements specific to the climate change issue.

The criticism of a lack of transparency also stems from the fact that the CGEs are often large models. Because of their detailed sectoral disaggregation, they include numerous parameters that are defined at the sectoral level, such as the elasticities of substitution between factors of production, whose calibration is not very well documented. Constituting the calibration database often requires modifying the raw data by implementing a series of hypotheses that are at the discretion of the modeller. Yet these are crucial to the model's properties. For example, the disaggregation of a sector such as electricity into several sub-sectors requires breaking down not only output but also the different factors of production between the sub-sectors. The data needed to perform this work correctly is not always available. When the model is multi-country, it is necessary to establish consistency between the national accounts and international trade data. This work, already difficult at the aggregate macroeconomic level, can be very complex when taking the sectoral component into account. At the impetus of projects such as GTAP (www.gtap.agecon.purdue.edu), EXIOBASE (www.exiobase.eu), and WIOT (www.wiod.org), great progress has been made in building international and multi-sector Input-Output (IO) databases. In addition to developing consistent national economic and international trade data, these databases provide environmental extensions (CO_2 emissions or the use of various natural resources) that are very useful for the construction of environmentally applicable CGEs. Better clarity is nonetheless still needed for these resources, and in particular the steps involved in constructing these databases are generally not accessible. They are based on the crossing of different occasionally contradictory statistical sources that more or less complex algorithms make consistent.

The third reason for criticizing the lack of transparency of environmental CGEs is that they are sometimes coupled with bottom-up techno-economic models. This approach is known as hybridization.[8] While the linking methods vary and can be more or less integrated into a coherent ensemble, they all aim to give a richer representation of reality in its different dimensions, by integrating in particular technical and sociological constraints specific to certain economic sectors or categories of households. Since these constraints are not sufficiently taken into account by the standard analytical tools used in the economic sciences (production or utility function), it is necessary to include them if one wishes to propose a suitable policy that includes this complexity in its analysis.

For example, in a standard CGE, the representative household maximizes a utility function under an income constraint. Depending on the assumed value of the elasticity of substitution, the consumption of each good follows income more or less proportionally. This representation has the advantage of being relatively simple, but it may be problematic for energy consumption. As theoretically formulated by Lancaster (1966a, 1966b) and applied in some hybrid models (Laitner and Hanson, 2006), a household does not consume energy for its direct utility, but rather for the service it provides when its consumption is combined with the use of an equipment, such as a car or a dwelling. Indeed, it is useless to buy gasoline if you don't have a vehicle. A more realistic theoretical representation is to assume that energy is an "input" used in combination with different types of capital in the household's production function. This represents the fact that some services are produced directly (rather than purchased) by households, such as transport, for example. Households can purchase this service directly from the public transport sector. Alternatively, they can invest in the purchase of a vehicle and then buy the amount of gasoline they need for their mobility. This is for example the assumption used in the hybrid version of ThreeME (see Callonnec *et al.*, 2013, 2016). This representation has several advantages. Energy consumption is no longer mechanically related to income but to the stock of housing and equipment. The use of the equipment (and therefore energy consumption) can increase with income, but it is possible to impose saturation

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8.   For an overview of this method, see the special issue edited by Hourcade *et al.* (2006) in *Energy Journal*. IMACLIM (Crassous *et al.*, 2006; Sassi *et al.*, 2010) is one of most advanced hybrid CGE models.

thresholds on the basis of physical criteria. Rising energy prices no longer lead to higher consumption of all other goods but only to the purchase of less energy-intensive capital goods.

While the aim of hybridization is commendable, this approach has several disadvantages. It increases the complexity of the model, especially if the CGE is hybridized with multiple bottom-up modules. It is a potential source of instability because it introduces non-linearities or threshold phenomena that disturb the solution algorithms. Finally, the results are based on the calibration of certain parameters such as the sensitivity of investment choices to energy prices in the example provided above. And the calibrated value sometimes has little empirical evidence.

3. Towards Greater Transparency and Tractability of Models

Applied environmental macroeconomic models aim to serve as support tools for policy decision-making. It is therefore essential that they succeed in generating sufficient confidence to overcome the transparency issue. A first commonly proposed approach would be to aim at simplification by adopting the dominant practice in theoretical environmental economics, which relies on small models in order to derive properties analytically. This is the approach adopted by the DICE model. Because of its small size and open source nature, its results are easy to replicate. But is it really desirable to transpose the constraints of theoretical modelling onto applied economics?

The simplifying hypotheses retained in theoretical models generally make it possible to obtain an analytical solution. This solution has the advantage of unambiguously demonstrating the mechanisms at work and confirming or invalidating certain intuitions or economic rationales indisputably. But these simplifications have a cost. Their use sometimes comes from a "technical" choice by the modeller, namely facilitating the derivation of closed-form solutions, without any justification in the economic reality being modelled. The dominance of neoclassical approaches in environmental economics is a clear illustration: certain hypotheses (e.g. inter-temporal optimization with perfect information, or full use of the factors of production) continue to make up the foundation of many models, even though they have been rejected empirically.

While the use of simplified models for applied purposes allows for a more analytical rather than numerical approach to environmental policy analysis, it can also lead to questionable conclusions. The empirical failure of the Real Business Cycle (RBC) models, which assume that unemployment is always voluntary and reflects the inter-temporal trade-off between work and leisure, is a typical example of possible shortcomings related to the use of overly simplified models for applied purposes.

As we have seen above, Pindyck reproaches IAM (and the DICE model in particular) for using mathematical formalism to benefit from a scientific validation, when these models are in fact often based on unrealistic assumptions. Thus, while the modelling of the damage function and the role of the discount rate are analytically simple in DICE, they do not have a solid empirical foundation. In addition, recent research on the DICE model and other IAMs is essentially theoretical (introduction of uncertainty into the model, analysis of properties on the basis of a reduced form). They rarely try to make the model more realistic. Pindyck draws the harsh conclusion that IAMs are of virtually no benefit to policy makers.

In an applied approach, the realism of the model's assumptions is crucial, especially since the results are intended to support policy decisions. The subject of environmental macroeconomics requires a relatively faithful representation of the complexity of the phenomena at stake. It is important to integrate a broad set of dimensions such as technological changes, market failures, the structure of production, heterogeneities between countries or in consumer behaviour, divergences of interest or the economic characteristics of existing infrastructure such as the irreversibility of investments. Since some dimensions fall within disciplines – physics, engineering, climatology – external to economics, there is often a need for dialogue between environmental macroeconomic models and their counterparts in the "hard" sciences based on common objects – energy and materials flows in physical units or stocks of energy-consuming capital, including buildings, vehicles and equipment for industrial production. It is also important to be able to take into account the various supporting policies, since climate issues are essentially multi-sectoral issues that generate inequalities. They require compensation policies or programmes that can be rolled out on fine scales. These are all points for which a realistic representation is necessary if one wishes to propose a relevant analysis.

Shedding light on public decision-making about the energy transition requires explicitly representing the economic and environmental heterogeneity of the different sectors of production. Using a sectoral segmentation of economic activities, Howitt (2006) describes how the use of a representative agent in the main macroeconomic models constitutes a fallacy of composition, which limits their explanatory power. Colander *et al.* (2008) come to similar conclusions about models applied to decision-making. In their view, it is important to go beyond this synthetic representation of the agents' behaviour by introducing heterogeneity.[9] They also propose the use of a non-parametric approach that is closer to the engineering sciences, adopting an agnostic position as to the model's theoretical foundations.

While the multi-sectoral structure of CGEs already reflects a certain heterogeneity in the data, the introduction of differentiated behaviours for certain types of agents forms part of this approach. This hybridization process is aimed at capturing the behaviours specific to energy use by basing them on technical engineering models particular to certain economic activities, such as the structure of energy networks. The search for the micro-foundations of key behaviours and comparisons with empirical data leads to more complex models. However it seems to be the best way to inform public decision-makers. It is up to the modellers to limit this complexity to the very essential so as to make it as easy as possible to read and understand.

To paraphrase a quote attributed to Albert Einstein, the models should be as simple as they can be, but not simpler. It must be accepted that applied macroeconomic models require a certain minimum complexity. Otherwise, they lose their realism and cannot aspire to be tools for political decision-making. It is obvious that when simplifications are possible they must be implemented. But simplifying the models is not an end in itself.

On the other hand, developers of tools to support policy decision-making need to make a major effort in terms of transparency. Ideally, economic modelling applied to the environment should comply with a

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9.   Note that DSGE models are currently at the heart of an economic debate about their (in)ability to predict financial crises. In a recent article, Christiano *et al.* (2017) defended DSGEs by arguing that while these criticisms might apply to pre-2008 crisis models, recent developments that in particular take into account frictions and introduce heterogeneity into agents' behaviour now enable these models to represent non-linearity phenomena specific to the appearance of crises in a faithful and realistic way. A summary of these debates proposed by the Bruegel Institute is available here: http://bruegel.org/2017/12/the-dsge-model-quarrel-again/

standardized protocol that facilitates comparison, and thus greater transparency of models. We will briefly discuss three points on which this approach could be based.

First, economic modelling should focus on measuring the effects of a given policy using specific economic indicators such as employment, inflation, GDP, income and so on. Given the state of current knowledge about economics, a model that claims to calculate the optimal tax policy or the optimal level of CO_2 emissions as an endogenous variable is not credible to policy makers. On the other hand, a model can help the latter to identify economic policies that would facilitate achieving a given emissions reduction target by measuring the economic impact of each policy, by integrating different types of instruments and by identifying the redistributive effects. From the perspective of developing modelling tools to support decision-making, the approach taken by the CGEs seems to be preferable to that of the IAMs.

Second, it is necessary to try to rationalize the complexity of the models, in other words, to make them more tractable in order to make their properties more transparent. The advances made in the last 25 years in terms of computing capacity have favoured the development of large-scale models. The temptation is great for the modeller to integrate as many dimensions as possible into a single model. This temptation is strengthened by a "marketing" factor: a model's apparent exhaustiveness often helps to obtain funding from research or consulting contracts. Applied models have thus experienced a significant increase in their level of disaggregation based on sectors of activity, geographical zones or types of consumer. Furthermore, hybridization techniques have been developed with techno-economic models, which further complicate the understanding of the model's properties. While complexity can have the benefit of improving a model's realism, it also has disadvantages. For example, a model's level of detail may be only fictitious when the data used for the disaggregation is of poor quality and actually does not provide information relevant to the analysis. In addition, complexity increases the risk of error and often makes the results more difficult to interpret. It is therefore important to have a clear justification for the level of disaggregation used in a model by showing what it adds compared to a simpler analytical framework. Ideally, the level of complexity of an applied model should be scalable to the issue being studied so as not to incorporate a superfluous level of detail that would obscure the analysis of the results.

Third, it seems that making economic models applied to the environment more transparent demands better collaboration between modelling teams. At present, exchanges are generally limited to comparing the different approaches or the results of simulations of common scenarios. Due to a lack of time and resources, these comparisons are often limited to taking note of the differences rather than trying to resolve them. Collaboration between modelling teams upstream of model construction is almost non-existent. One could, however, imagine pooling certain types of knowledge through the use of modelling platforms, as is the practice in other disciplines (for example, climate models). The collaborative construction and use of databases would thus allow economies of scale while above all ensuring that the models are based on hypotheses that are discussed and accepted by different research teams. This approach would also make it easier to compare the results of scenarios that are based on standardized assumptions. Ideally, full transparency would imply the possibility of being able to replicate the results of another model, but that would mean overcoming problems of confidentiality. As a start, pooling blocks of models seems like a more realistic goal. In the longer term, we can hope that open source models become the benchmarks in the field.

4. Conclusion

This article provides an overview of the main macroeconomic models that deal with environmental issues. The limits of these models are all the more problematic as they are destined to be used more and more as decision-making tools, as evidenced by their increasing use in the so-called grey literature (reports from government agencies, think tanks and supranational institutions). In the context of the fight against climate change, it is important to have tools for evaluating economic policies. The energy transition leads to important economic structural changes. It is therefore essential to be able to anticipate their effects in order to determine a trajectory that is achievable. To do this, developers of applied models must make significant progress in terms of transparency. We have outlined a possible strategy that could help. It is all the more urgent to put in place such a strategy as the questions posed to applied environmental macroeconomics are constantly widening. Beyond the climate change issue, it should in particular analyse the complete environmental footprint of our production systems.

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IS THE STUDY OF BUSINESS-CYCLE FLUCTUATIONS "SCIENTIFIC?"

Édouard Challe
CREST, École polytechnique, OFCE

The study of macroeconomic fluctuations assumes that the behavior of the whole (aggregates) cannot be reduced to the sum of the parts (agents, markets). This is because interdependencies between markets can substantially amplify, or on the contrary dampen, shocks that at any time disturb the equilibrium. The understanding of general-equilibrium effects, on which direct evidence is limited, which are empirically blurred by multiple potential confounding factors, and for which controlled experiments are almost impossible to design, is necessarily more conjectural than the study of individual behavior or of a specific market. However, ignoring these effects because they do not have the same degree of empirical certainty as a directly observed microeconomic effect can lead to serious policy mistakes

Keywords: theory of fluctuations, general equilibrium, fiscal multipliers.

Business-cycle macroeconomics has been the subject of much criticism in recent years, to the point that it is often perceived from the outside as a field in an irremediable state of crisis[1]. I will focus here on the criticism, or rather the cluster of criticisms, potentially the most destructive, which consists of questioning the mere "scientificity" of business-cycle macroeconomics, not only with regard to other sciences (criticism which, whatever one thinks about it, is old) but in light of the recent evolution of the economics itself, especially as regards its closer relationship to data. There are two main sides to this general criticism:

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1. See, for example, Reis (2017) or Romer (2016). Much of this criticism predates the Great Recession, though the latter has contributed COMPLETE.

— The study of macroeconomic fluctuations would not have achieved the "empirical turn" characteristic of mature disciplines, even though examples of such a turning point are numerous in related fields such as labor economics, development economics, as well as in many areas of microeconomics such as industrial organization or corporate finance. Having missed this empirical turn, business-cycle macroeconomics would still consist of speculating on plausible causalities, conjectures, imaginary worlds that are potentially far removed from the one in which we live;

— Moreover, and this is partly a variation of the previous point, the theory of macroeconomic fluctuations would face an almost insurmountable problem of falsification: to the extent that too few data is available to choose among too many macroeconomic models, the stock of available models supposedly accumulates without limit over time without any effective sorting taking place. To borrow Noah Smith's expression, macroeconomists would tend to "cover all the bases" (Buchanan and Smith, 2016), demultiplying models and their associated sets of assumption indefinitely, instead of selecting a small number of relevant models.

These criticisms are severe, but are they truly justified? In any case, they do not seem to take into account an essential dimension of the study of fluctuations, which distinguishes it from other fields of economics: the importance it attaches to the strategic interactions between agents as well as to the general-equilibrium effects that take place across different markets. This is what makes macroeconomics in general, and business-cycle macroeconomics in particular, truly special: it is based on the mere notion that the behavior of the whole (macroeconomic aggregates) cannot be reduced to the sum of the parts (the agents, the markets). This is because the various interdependencies between agents and between markets can substantially amplify, or on the contrary dampen, shocks that at any moment disturb the equilibrium. The understanding of strategic interactions and general equilibrium effects, on which direct evidence is limited, which are empirically blurred by multiple potential confounding factors, and for which controlled experiments are almost impossible to design, is necessarily more conjectural than the study of individual behavior or of a specific market. However, ignoring these interdependences on the grounds that we cannot reach about them the same

degree of empirical certainty as about an isolated microeconomic mechanism would not only prevent us from understanding certain complex and large-scale phenomena (such as the "Great Recession"), but can also lead to misguided economic policy recommendations. In what follows I develop these two points by relying on a critical discussion of the recent literature.

1. Strategic Interactions and General Equilibrium Effects: Between Amplification and Dampening of Aggregate Shocks

In most cases, we do not observe a "macroeconomic shock" that alone can explain the extent of an economic crisis. The Great Depression of the 1930s was preceded by a modest stock market crash, of which no one could have anticipated the effects. The Great Recession that followed the 2008 crisis followed a major financial shock but was quickly contained by the concerted action of the major central banks; this shock alone cannot explain the depth and duration of the Great Recession, even in the United States. More generally, we do not have direct evidence of large shocks along the business cycle that alone could explain its amplitude. If production and employment vary so much over the business cycle, it must be that the economic system contains the seeds of its own instability, by amplifying the impact of small disturbances. Such amplification mechanisms are difficult to identify empirically because they generally involve several mechanisms simultaneously set in motion and generate co-movements of all macroeconomic variables. Understanding such intricacies is usually impossible without a fully specified general-equilibrium model, which explains why business-cycle analysis gives a prevalence to macroeconomic theory over a more inductive, empirical approach. Let me illustrate this point using the main three propagation mechanisms that have be argued to have contributed to the depth and duration of the Great Recession.

1.1. The liquidity trap and the deflationary spiral

The liquidity trap is defined as a situation in which the abundance of reserve money within the banking system causes the nominal interest rate on the interbank market to fall to the level of the interest rate on the excess reserve that private banks hold on their account with the central bank. This occurs precisely when the central bank is attempting to implement the maximum level of monetary accommodation, so in a

situation where the interest rate on reserves is itself kept close (and potentially slightly below) the rate of return on bank notes, namely zero (abstracting from the cost of storing bank notes). At this point "conventional" monetary policy becomes inoperative and any macroeconomic shock is magnified by the deflationary spiral depicted in Chart 1: a falling aggregate demand depresses output and inflation; at a given nominal interest rate, these deflationary pressures cause a rise in the real interest rate, thereby reinforcing the initial fall in aggregate demand, and so on. This feedback loop has been the subject of a large literature since the pioneering contribution of Krugman (1998) and is today one of the main explanatory model for the depth and duration of the Great Recession in the United States and the euro area.[2]

Chart 1. The liquidity trap and the deflationary spiral

Low future inflation

High real interest rate

Negative shock

Low current inflation

Low output
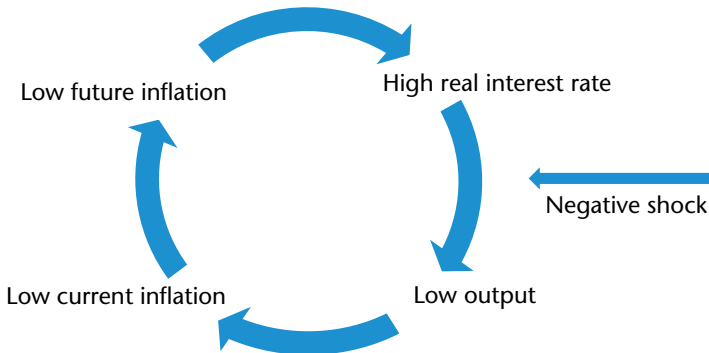
The deflationary spiral depicted in Chart turns out to be particularly difficult to directly measure empirically – far more than the effect of limited disruption in a particular market. This spiral involves a number underlying macroeconomic blocs (the Phillips curve, the Fisher relation, demand-determined output), each of which with its own identification challenges. Given the inherent complexity of the economic mechanism at work, attempts at empirically evaluating this deflationary spiral have essentially adopted one of the following approaches:

— The first approach is to test a specific implication of the propagation mechanism under consideration, which clearly distinguishes

2.   See, for exemple, Eggertsson and Krugman (2012), Christiano *et al.* (2015), and Gust *et al.* (2015).

it from alternative propagation mechanisms. In the present context, the so-called paradox of toil (Eggertsson, 2010), according to which negative supply shocks become expansionary in a liquidity trap (because of their inflationary impact), provides the needed crucial experiment.[3] In this spirit, Wieland (2017) rejects the liquidity trap hypothesis by showing that negative productivity shocks (earthquakes, oil price shocks) are contractionary even at the zero lower bound. In contrast, Datta *et al.* (2017) find strong co-movements between oil and equity returns at the zero lower bound, which is supportive of the liquidity trap hypothesis. Even if the issue is not yet empirically settled, it remains that the impact of supply shocks at the zero lower bound provides a clean test of the feedback loop described in Chart 1.

— The second approach is to specify a complete general-equilibrium model, in which the deflationary spiral mechanism is present, and then to estimate it empirically (see, for example, Christiano *et al.*, 2015, Gust *et al.*, 2017). This approach makes it possible to measure the full causal chain postulated by the theory and potential then to build alternative scenarios ("counterfactuals") which describe how the economy would have behaved if this causal chain had been broken (say, if the bank central could have implement very negative interest rates).

It is clear that in both cases economic theory plays a preponderant role. In the first case, a complete dynamic general equilibrium model is necessary to formulate a testable implication of the considered mechanism; in the second, the full same model (potentially augmented with addition features) is itself estimated on historical data. In any case the deflationary spiral does not spontaneously show up in macroeconomic time-series: it is primarily a theoretical construct and therefore, from the outset, an interpretation of these time-series.
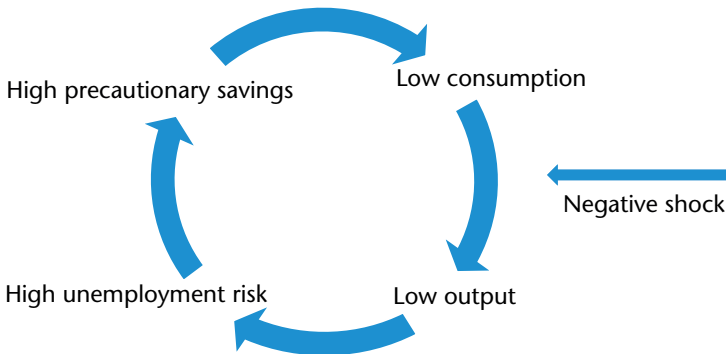
1.2. The precautionary-saving feedback loop

A second amplification mechanism, which can play simultaneously or independently of the previous one, involves the precautionary saving

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3. Eggertsson (2010) introduced the paradox of toil by studying the impact of labor supply shocks on equilibrium employment in a liquidity trap (he showed that a positive labor supply shock could actually lower employment, due to the inflationary impact of the shock on nominal wages and prices). Since then the same expression has been used to qualify the paradoxical effect of any supply shock on output in a liquidity trap.

behavior of households and the way in which it interacts with unemployment risk over the business cycle. This spiral is summarized in Chart 2. Intuitively, a fall in output that causes employment to fall back raises households' precautionary savings (in anticipation of the increased risk of unemployment); the induced fall in aggregate demand reinforces the initial drop in output and employment, increases the risk of unemployment, and so on. This spiral involves three basic mechanisms. First, output must respond in one way or another to aggregate demand (for example because nominal prices are sticky). Second, labor-market flows and the unemployment risk that they generate must respond endogenously to output changes; this requires a representation of the labor market in terms of worker flows (between employment and unemployment) and not simply in terms of stock (employment). Finally, and perhaps most importantly, households need to be imperfectly insured against the risk of unemployment – otherwise there would be no precautionary motive in the first place and therefore no time-variations in precautionary savings. These three mechanisms are present in various forms, and thus generate the precautionary-saving spiral, in the works of Challe *et al.* (2017), Chamley (2014), Den Haan *et al.* (2017), Heathcote and Perri (2017), Ravn and Sterk (2017) and Werning (2015), among others.

Chart 2. The precautionary-saving feedback loop

High precautionary savings

Low consumption

Negative shock

High unemployment risk

Low output

Empirically measuring the feedback loop depicted in Chart 2 is, again, challenging. Quantitative assessments of the precautionary-saving spiral require from the outset the formulation of a complete dynamic general-equilibrium model in which the three ingredients

described above are introduced. Ravn and Sterk (2017) calibrate such a model, paying particular attention to the dynamics of the labor market. Challe *et al.* (2017) propose a structural estimation of a related model in order to evaluate the amplifying role of the precautionary motive during the last three recessions in the United States. As far as I know, there is no crucial experiment (of the kind of the paradox of toil in models of the liquidity trap) that would make it possible to directly test the existence of the precautionary-saving spiral: when one departs from the structural estimation of the full general-equilibrium model, only indirect evidence about a particular dimension of the loop is available (relating, for example, to the effect of fluctuations in employment on consumption demand). Thus, just as in the case of the liquidity trap, the precautionary-savings spiral is a plausible propagation mechanism, the amplitude of which can be measured in the data *only through the lens of a fully-specified general-equilibrium model*. For this reason, the precautionary-saving spiral is best understood a particular way of interpreting the joint dynamics of aggregate demand and unemployment during a recession, which can (and should), be confronted (and possibly associated) with alternative plausible amplification mechanisms.

Note that the work on imperfect insurance and the precautionary motive fully integrates individual heterogeneity into macroeconomic dynamics, recognizing from the outset that different households (in terms of wealth, income, labor market perspective etc.) behave differently, notably in terms of consumption and asset accumulation choices. In particular, a typical result in this literature is that poorer households (that is, households that are close to their own debt constraint) have an individual consumption response to macroeconomic shocks that is stronger than that of richer households, and hence their presence is more likely to set in motion the precautionary-saving feedback loop described in Chart 2. This approach makes it clear that the amplitude of the business cycle and the level of inequalities within a particular economy are fundamentally intertwined. For this reason, this approach allows studying some important economic policy issues that can not otherwise be addressed. Among those issues are the aggregate demand effects of redistributive policies (through taxes or unemployment insurance), which is the focus of the recent work of McKay and Reis (2016, 2017).

1.3. The credit cycle

A third feedback loop, which is thought to have played an important role in the propagation of the Great Recession, is the so-called "credit cycle" depicted in Chart 3. The modern formulation of the credit cycle dates back to Kiyotaki and Moore (1997). The theory was later on operationalized into an estimated DSGE model by Iacoviello (2005), who focused on the joint fluctuations of credit and house prices. More recent contributions such as Jeanne and Korinek (2010) have looked more closely at the welfare impact of the feedbackloop. This line of works points out to the fact that fire-selling assets during a crisis entails a negative externality, since the implied fall in asset prices tends to tighten the credit constraints of all the other agents - thereby making them more likely to also sell their own assets. As a consequence, a benevolent policymaker may be willing to restrict agents' borrowing ex ante in order to limit the risk of fire sale. This theory provides one possible justification for imposing a "macroprudential" regulation, in addition to the more traditional banking regulation.

Chart 3. The credit cycle
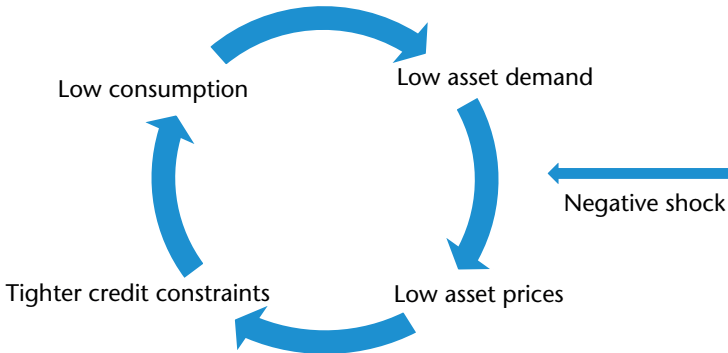
1.4. General-equilibrium dampening of aggregate shocks

The discussion above illustrates the fact that general-equilibrium feedbacks can dramatically amplify the impact of "small" aggregate shocks, and stresses that such feedbacks can only be measured in the data by means of a theoretical model that incorporates them in the first place. But it is worth stressing that general-equilibrium effects do not necessarily manifest themselves through amplification: they can

equally *dampen* the impact of aggregate shocks, relative to what a naïve partial-equilibrium analysis (holding prices constant) could suggest. To illustrate this, let us push the line of argument of Angeletos (2018). Angeletos (2018) wonders what classes of models can rationalize the Keynesian narrative that low aggregate demand can depress output. To frame the discussion in modern language, suppose that individual consumers suddenly value current consumption less than future consumption (say, marginal utility falls exogenously relative to future marginal utility). Holding prices constant, and aggregating over all consumers, this preference shock must translate into lower aggregate consumption demand, hence it is indeed a "negative demand shock". In a partial equilibrium setting with constant prices, this would translate into lower consumption. But prices cannot be considered constant in general equilibrium. As stressed by Angeletos (2018), in a Real Business Cycle model the drop in consumption generates an equal rise in savings and a fall in the real interest rate that boosts investment demand. Now let's take this reasoning one step further and assume that output uses labor only, so that there is no demand for capital on the part of firms. Still, if markets are complete households can potentially trade bonds between themselves, instead of lending capital to firms. But someone needs issue the bonds that the savers are willing to purchase, and no household hit by a negative marginal utility shock is willing to borrow. In general equilibrium, the (shadow) price of bonds must fall until households are again happy consuming the very same level of consumption that was planned before the marginal utility shock occurred: general-equilibrium adjustments in relative prices have completely eliminated the partial-equilibrium effect of the consumption shock. Of course, aggregate demand and output may fall after a consumption shock if prices are sticky and output is demand-determined; in this case actual output may fall below natural output, which is formally equivalent to a rise in monopolistic distortions (Woodford, 2003). But here again, endogenous price adjustments, even muted, tend to reduce the direct (partial-equilibrium) effect of the consumption shock, except in the extreme case of constant nominal prices.

To summarize, partial-equilibrium intuitions or empirical evidence are uninformative about the likely effects of aggregate shocks, since we should expect those shocks to be amplified (due to strategic complementarities and feedback effects) or buffered (due to endogenous price adjustments) or both at once.

2. What Lessons for Macroeconomic Policy? The Example of Fiscal Multipliers

The importance of general-equilibrium effects implies that the impact of alternative macroeconomic policies cannot generally be estimated simply by extrapolating measures, however precise, based on "small", local policy shocks. The recent debates on the size of the fiscal multipliers, and notably the government spending multiplier, illustrate this point and deserve further discussion.

Formally, the government spending multiplier is defined as the growth in GDP induced by an exogenous increase in government spending scaled by GDP before the policy change. The empirical literature on this multiplier is considerable. Its main challenge is to measure the causal effect that goes from public expenditure to output, while many other mechanisms may affect the empirical correlation between these two variables. To make this point clear, imagine that government spending has no causal effect on output whatsoever. However, government spending varies systematically with output since it is higher in recession than in expansion (due to the automatic stabilizers), hence there is a reverse causality going from output to government spending. The endogenous response of government spending to output induces a negative correlation between these variables that can be wrongly attributed to a causal effect running from expenditure to ouput. In practice causality goes both ways, and moreover a number of confounding variables may correlate government spending and output independently of any causal link. In this context, how can one isolate the variations in government spending that are truly exogenous, in order to measure their causal effect on output?

The recent empirical literature has mostly relied on two distinct identification strategies to answer this question. The first strategy is to focus on a particular type of government spending shocks that are arguably not themselves caused by changes in GDP. The most common way to proceed is to consider as exogenous shocks the increase in military expenditure due to sudden, unanticipated deteriorations of the geopolitical context. These events generate variations in public spending that do not depend on the business cycle (although the cycle depends on it) and thus constitute in principle a valid basis for measuring the public spending multiplier. The multipliers obtained using this method vary between 0.8 and 1.2 for the United States (Hall, 2009, Ramey, 2016).

A second approach to estimating the causal effect from public spending to output relies on variations in local public expenditures to average out their nation-wide component. The study by Suarez Serrato and Wingender (2016) provides a particularly telling illustration of this approach. Every ten years, the population of the United States is counted, so that the recorded population of each county changes. Following this, the federal government adjusts its financial allocation to adjust to these demographic changes: the counties whose population is revised upwards see their endowment increase, and those whose population is re-evaluated downward see it decrease. Unsurprisingly, this reallocation of federal funds between counties gives rise in each county to a variation in local public expenditure. By construction, these local variations are orthogonal to variations in US GDP as a whole as well as to other economy-wide factors (e.g., monetary policy) that are systematically related to GDP. Variations in local output generated by local variations in public spending thus form a valid basis for computing local spending multipliers. The authors find local multipliers close to 2, thus significantly higher than those obtained using macroeconomic data. The other studies adopting a similar approach also find high values of the multiplier, around 1.5.[4] In summary, the empirical literature on the public spending multiplier gives (for the United States):

— "nationals" multipliers between 0.8 and 1.2;

— "local" multipliers between 1.5 and 2.

From a strictly empirical point of view, the estimation of local multipliers has two advantages over that of national multipliers. First, the exploitation of geographical disparities in public expenditure eliminates by construction any effect of the aggregate business cycle on public expenditure, which in principle offers a more reliable identification strategy than those based exclusively on macroeconomic data. Second, local multipliers tend to be more precisely estimated, partly because they make use of a much larger set of data.

One question that naturally arises is the reliability of these multipliers in terms of *macroeconomic* policy. Indeed, by their very nature, the spending shocks under study are of low amplitude, and partly offset each other from one region to another. Therefore, it is unlikely

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4. See, for example, Acconcia *et al.* (2014) and Nakamura and Steinsson (2014), as well as Fuchs-Schuendeln and Hassand (2016) for a survey.

that these shocks will trigger the potentially powerful general-equilibrium effects of a large-scale shock at the level of a country as a whole. These general-equilibrium effects of public spending shocks have ambiguous consequences on the size of the multiplier: they can either lessen the direct microeconomic effects of the shock (for example, if the public expenditure shock is associated with a rise in the real interest rate, which reduces private expenditure), or instead amplify them (if for example one of the amplification mechanisms described in the previous section are set in motion). For the reasons explained above, we should expect both amplification and dampening effects to be simultaneously at work, leading them to partly offset each other. Unfortunately, this implies that local spending multipliers are of little help, on their own, in assessing the likely effect of a macroeconomic stimulus package – the ultimate question of interest.

Does this mean that local multipliers are of no interest to macroeconomists? Not so. As shown by Nakamura and Steinsson (2014) even if they do not directly inform us about the size of the aggregate multiplier, local multipliers (which they more accurately refer to as the "open-economy relative multipliers") offer a powerful way of evaluating alternative macroeconomic models. For example, under the New Keynesian model, the size of the economy-wide public spending multiplier is conditional (like any fiscal policy) on the response of monetary policy: a strict targeting of inflation can lead the central bank to raise the real interest rate (*via* an increase in the path of policy rates) following a government spending shock, with the effect of reducing the observed fiscal multiplier; in contrast, a more accommodative monetary policy response would reinforce the expansionary impact of the fiscal stimulus. In as much as local multipliers are independent of economy-wide monetary policy, the alternative models make unambiguous predictions as to the size of their relative open-economy multipliers, which can then be compared to their empirically estimated counterparts. Nakamura and Steinsson show that this exercise leads to the rejection of the neoclassical Real Business Cycle model in favor of the New Keynesian model, which turns out to imply a much larger closed-economy aggregate multiplier. Their analysis makes it clear that it needs a fully specified macroeconomic model to turn estimated local multipliers into a policy-relevant, economy-wide government spending multiplier.

3. Concluding Remarks

In a letter to Harrod in 1938, in response to his presidential address to the Royal Economic Society, Keynes discusses the nature of economics in these terms:

> "It seems to me that economics is a branch of logic, a way of thinking; and that you do not repel sufficiently firmly attempts à la Schulz to turn it into a pseudo-natural-science. [...] Economics is a science of thinking in terms of models joined with the art of choosing models which are relevant to the contemporary world" (J.M. Keynes, Letter to Harrod, July 4, 1938).

We cannot better summarize what remains an essential characteristic of the study of business cycles and crises, namely the primacy of economic theory over empirical analysis. This remains true today even though the relationship between theory and data (and, more recently, micro data) is much tighter than when Keynes wrote these lines. This primacy of the theory makes the discipline necessarily more conjectural than other fields of economics, because statistical inferences are always conditional on relatively complex general-equilibrium models whose relative performance is difficult to evaluate. This is not a lack of scientificity, but rather the way in which the scientific approach manifest itself in this field of investigation.

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THE WINTER OF OUR DISCONTENT
MACROECONOMICS AFTER THE CRISIS

Rodolphe Dos Santos Ferreira[1]

BETA, University of Strasbourg

The article discusses three reasons for dissatisfaction with regard to the core of contemporary macroeconomics and its inability to conceive the outbreak of the Great Recession. The first comes from the excessive importance given to the demand for microeconomic foundations to the detriment of treating the problem of the aggregation and coordination of individual behaviours, an imbalance that culminates in the frequent recourse to the figure of the representative consumer. The second concerns the usurpation by this same consumer of the role of decision-maker about employment and investment at the expense of firms, simple insignificant automata on markets governed by perfect or monopolistic competition. The third involves the simplistic way in which the rational expectations hypothesis has often been applied, treating agents as observers rather than actors who create the conditions for realizing their own forecasts. These three reasons lead to arguing for a macroeconomic modelling that takes the heterogeneity of agents seriously and restores to far-from-insignificant firms a driving role in the process of making decisions about employment and investment, in a context of strategic interactions.

Keywords: microeconomic foundations, aggregation, representative consumer, entrepreneurial decision to invest, oligopolistic competition, strategic indeterminacy, endogenous fluctuations.

M acroeconomics was widely criticized for not being able to predict the crisis, to such an extent that criticism quickly extended into a diagnosis of a crisis in macroeconomics itself. In reality, the outbreak of an economic crisis does not have the same nature as the coming of an eclipse, and if there is a reproach to be directed at contemporary macroeconomics, it is not so much its incapacity to predict the

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phenomenon as its lack of preparation to conceptualize it. It is well known that in his presidential address to the American Economic Association, Robert Lucas wrote in 2003 that the central problem of macroeconomics, namely the prevention of a depression, had been solved in practice for many decades (Lucas, 2003). Between the refutation of this thesis soon thereafter by the Great Recession and the diagnosis that the discipline itself is in crisis, there is a big step that I would not like to take. Macroeconomic theory has enjoyed ongoing progress for half a century and is not doing too badly, despite the equally ongoing announcements of an impending crisis. It is, however, difficult to deny that, as Caballero (2010) has written, the current core of the discipline "has become so mesmerized with its own internal logic that it has begun to confuse the precision it has achieved about its own world with the precision that it has about the real one". By pushing things a little further, we could say that the problem is also that the world the core of contemporary macroeconomics has constructed may not be a good approximation of the real world. And this has happened not because we are still far from the target, but because we have gone astray somewhere.

The point here is not to give an overview of all the developments in the discipline since the establishment in the 1970s of the reconstruction programme undertaken under the banner of microeconomic foundations and rational expectations by trying to identify if and when possible errors in orientation were committed. I will limit myself to sketching out a few reasons for dissatisfaction with the way that macroeconomics was reconstructed, resulting in its present core. I am particularly sensitive to three reasons for dissatisfaction. The first concerns the extreme attention paid to microeconomic foundations at the expense of the bridge that must be built between these foundations and the macroeconomic outcomes that are supposed to be theorized. This bridge supposes that we proceed at the same time to the aggregation of the behaviours of a priori heterogeneous individuals and to the conceptualization of the actual modalities for their coordination. The second reason for dissatisfaction stems from the subordinate status accorded to firms, relative to consumers, in the decision-making process that leads to the determination of employment and investment. This subordinate status stems quite naturally from the negligible weight attributed to each individual producer engaged in one or the other of the two forms of competition used by the overwhelming majority of macroeconomic models: perfect compe-

tition and monopolistic competition. The third reason concerns the reductionist way in which the rational expectations hypothesis has often been used. On the one hand, the self-fulfilling power of expectations, a source of multiplicity and even indeterminacy of equilibria, has been neglected, even if self-fulfilling prophecies arose as an important theme with the emergence of the new Keynesian economics and even though the endogenous fluctuations that they can generate are still studied by an active current in macroeconomic theory. On the other hand, we have underestimated the dispersion of the (incomplete) information available to heterogeneous agents who form expectations within the framework of an essentially interactive process.

I will discuss successively these three reasons for discontent with the world created at the heart of contemporary macroeconomics. It will be seen that all three concern, to varying degrees, the driving role wrongly attributed to the consumer by a vision of the economy rooted in Walrasian theory. It is also noteworthy that all three reasons signal points where contemporary macroeconomics diverges from its Keynesian source. Indeed, the General Theory gives a non-negligible role to the aggregation of goods and individual actions, places the entrepreneurs at the centre of the process of decision-making about employment and investment and confers a decisive role in equilibrium determination to the interplay between the expectations of entrepreneurs and speculators. I have already had an opportunity to address this historical aspect of the question (Dos Santos Ferreira, 2014), which I will not dwell on in the remarks that follow.

1. Microeconomic Foundations and Aggregation

My generation was born into macroeconomics under the newly proclaimed imperative of microeconomic foundations. Macroeconomic relations were no longer to be posed ad hoc but instead constructed by aggregating individual behaviours validated by rational choice theory. In principle, this programme consisted of two components: first the formulation of individual behaviours, and then their aggregation. In practice, the second component was usually trivialized by the use of composite goods and representative agents. The article by Kydland and Prescott (1982), which founded the now dominant theory of real business cycles and especially the dynamic stochastic general equilibrium (DSGE) modelling, provides an excellent example. The economy considered in this article is reduced to a representative

consumer whose intertemporal choices maximize, under technological and informational constraints, a utility function which, of course, is also a social welfare function. These choices are therefore, trivially, Pareto-optimal and, in the absence of externalities, constitute a competitive equilibrium. As a consequence, the macroeconomic equilibrium pertains entirely in this case to individual decision theory.

This fact is not in itself a criticism of a major contribution. The idea must be accepted that we cannot tackle all the difficulties at the same time and that taking intertemporal choices seriously, particularly in a context where preferences are not time-separable and where the production of capital is not instantaneous, is already such a heavy task that we must content ourselves with simplifying assumptions. And one would have hoped that, by proceeding by successive approximations, a more complex world of heterogeneous agents is subsequently found. However, the initial choice of bracketing aggregation issues is not without danger.

The first danger comes from the well-known Sonnenschein-Mantel-Debreu result according to which aggregation can destroy the essential properties of demand deduced from rational choice theory. Why then bother to establish the microeconomic foundations of macroeconomic relations if the implications of these foundations are lost at the global level? And, since aggregation can construct, as much as destroy, would it not have been wiser to focus on the second part of the programme for reconstructing macroeconomic theory – aggregation – rather than the first part? One could hope to use aggregation to obtain the deficient structure of global demand by exploiting the properties of the distributions of heterogeneous agents' characteristics. Indeed, the monotonicity of the aggregate demand function is for instance ensured when the frequency of individual incomes decreases with their amount, even if the individual demand functions are not themselves monotonic, as was shown by Hildenbrand (1983) in a pioneering article introducing a research programme that has largely been ignored by macroeconomists. This programme is in a way a return to Cournot (1838, §22), who used the variety of consumers' needs and fortunes to justify the assumption of continuity of the aggregate demand function, without worrying about its microeconomic foundations, which the economists of the next generation, Jevons, Menger and Walras, were on the contrary to put in the foreground.

But the main danger of the systematic use of the representative agent lies rather in the erasing of the interactions between agents and

therefore in the dismissal of the possible unintended consequences of these interactions. In an economy reduced to a representative agent, individual rationality and collective optimality are conflated. No room is left for suboptimal equilibria, which, it is true, are also absent from perfectly competitive economies, even peopled with heterogeneous agents, provided these economies are endowed with complete markets and deprived of externalities of any kind. Popular themes of the old Keynesian macroeconomics, such as the paradox of thrift and, more generally, anything related to the fallacy of composition, are excluded.

Even more serious is the exclusion of any coordination problem, which is undoubtedly the dominant theme of the General Theory. For instance, the downward rigidity of money wages, attributable to trade unions' defence of relative wages, is the consequence of a difficulty in coordination, which would disappear if the labour market were reduced to a bargain between a single firm and a single union, just as it would disappear "in a socialised community where wage policy is settled by decree", whereas in the real world there is "no means of securing uniform wage reductions for every class of labour" (Keynes 1936, 267). And, more fundamentally, the existence of what Keynes calls involuntary unemployment is the result of coordination failures across all markets, especially the financial markets, unable to effectively coordinate the plans of two categories of agents, investors and savers, largely because of the presence of a third category, speculators. It might be objected, in this instance, that the question of coordination is not completely put aside so long as there are at least two classes of agents, firms and households, even if each of them is reduced to a representative agent. However, the traditional modelling of the firm will in any case deprive it of an active role in such a configuration.

2. Firms and Markets

In the world of Cournot, all the action went to the producers, facing an aggregate demand issued from non-modelled individual behaviours. In the world of Keynes, the bulk of the action was still incumbent on the entrepreneurs, who were simultaneously producers – thus job-creators – and investors – thus creators of demand, multiplied by means of a propensity to consume that was in the main captured at the aggregate level. In the world of modern macroeconomics, the action is on the contrary monopolized by consumers who, through trading-off between consumption and leisure or between consumption and

saving, are both the employment and investment deciders. Perfect competition, which governs the markets imagined by neoclassical theory, transforms the firm into a simple automaton that keeps the economy right at the efficient frontier of the production set. The theory can in fact easily dispense with the firm by assuming – as did Kydland and Prescott (1982) – that the household directly integrates the technological constraint into its optimization programme.

If we want to be precise, we must keep in mind that it is not the consumers who are in the game but the representative consumer (or, what amounts to the same thing, a set of identical consumers), which immediately eliminates any consequence of wealth inequalities. In this regard, Caballero (2010) questions what happened to the specific role played in the supply of capital by Chinese bureaucrats or Gulf autocrats. As it is generally assumed that the stock of installed capital is directly held by households (Smets and Wouters, 2003; Christiano *et al.*, 2005), one might also wonder what has become of the role played by Amazon, Google and Microsoft in the formation of capital. We owe to Walras (1874, §184) the notion of an enterprise purchasing from the capitalist household, in a competitive market, the services of capital that the latter holds and accumulates, a conception that deprives the former of any active role in what is one of its main functions: to invest. Since the firm at all times is buying the services of a capital that is already constituted, it can content itself with a short-sighted calculation, leaving the responsibility for any intertemporal calculation to the saving household.

This marginalization of the firm's role is found in the new Keynesian economics, even though the latter, which has taken with Blanchard and Kiyotaki (1987) the path opened by Dixit and Stiglitz (1977), has broken with the hypothesis of perfect competition on the product markets, at least in a sector ruled by monopolistic competition. In monopolistic competition, producers of differentiated goods now have market power, but they still operate on a negligible scale relative to the size of the sector. The assumptions of symmetry and constant elasticity of substitution between differentiated goods (by the CES specification of the utility function of the representative consumer) lead in this context to a uniform and constant profit markup on the marginal cost, which itself is assumed uniform and constant. That this markup must be strictly positive is the only difference introduced by monopolistic competition compared to perfect competition. It is true that this differ-

ence, however minimal, is not insignificant, in that it makes it possible to accept the sub-optimality of the equilibrium and also to take into account the existence of price adjustment costs, which are fixed by the producers whenever they respond to exogenous shocks. This difference thus opens the door to a "Keynesian" differentiation of the theory compared with the new classical economics, while ultimately leading to a new neoclassical synthesis.

In this way one arrives at an extremely satisfying result, since the deep unity of the theory is preserved in the end. This result tends, however, to obscure the gap between the theory and the real world where we often encounter firms that are far from insignificant in relation to the size of the markets in which they operate – a real world where the average consumer (not the representative consumer) has a negligible influence on employment and investment decisions. Should we not therefore begin to explore more systematically than in the past what macroeconomic models with large firms, making strategic decisions about employment, production, prices and investment, could offer?

The option of importing oligopoly models directly from the theory of industrial organization may be discouraging, due to the extreme variety of these models, with none of them able to really impose itself. Nor are references to the few attempts to integrate imperfect competition into general equilibrium theory very reassuring, given the difficulty of obtaining sufficiently general conditions for the existence of an equilibrium. However, progress can be made if we stick to a fairly simple general equilibrium model, along the lines of those commonly used in macroeconomics.

The most natural choice is to stick to the structure of the economy conceived by Dixit and Stiglitz (1977) and taken up by the new Keynesian economics, with a production system consisting of two sectors, one – imperfectly competitive – producing differentiated goods, and the other – perfectly competitive – producing a homogeneous good. The difference with almost all existing models lies in the nature of imperfect competition: oligopolistic rather than monopolistic. In other words, firms producing differentiated goods are no longer considered insignificant in relation to the sector's size. Under very general assumptions about demand, an oligopolistic equilibrium can be obtained characterized by profit markups on the marginal cost whose expression remains simple and covers as a limit case the usual

markup prevailing in monopolistic competition (d'Aspremont and Dos Santos Ferreira, 2017).

The equilibrium markup of each firm in the oligopolistic sector appears as the inverse of the weighted arithmetic mean of the intra- and intersectoral elasticities of substitution of the good that it produces. The relative weight attributed to the intersectoral elasticity – which expresses a general equilibrium effect – increases with the market share of the firm and decreases with its aggressiveness towards competitors within the sector, that is to say, with the importance that it attaches to obtaining an increase in market share as opposed to an increase in market size. The equilibrium markup thus depends not only on structure – the market share – but also on conduct – the level of aggressiveness or, conversely, of collusiveness.

If the market share is negligible – the case of monopolistic competition – all the weight is put on the intra-sectoral elasticity, so that the general equilibrium effect vanishes, with the macroeconomic model degenerating into a sectoral model. We wind up with the same result if the aggressiveness towards competitors within the sector is maximal, a manifestation of the "Bertrand paradox": the existence of two very aggressive firms with no ability to cooperate is sufficient to ensure the competitive outcome (here that of monopolistic competition, given the differentiation of products). Thus, what will allow the model to regain a true general equilibrium structure is the presence of large firms whose conduct involves a certain degree of collusion (for example, that which is implicit in Cournot competition, where firms accommodate the quantitative targets of their rivals).

Thanks to the general equilibrium effects expressed through the intersectoral elasticity of substitution, the model makes it possible to exhibit markups that are neither necessarily uniform nor necessarily constant, even if the CES specification is maintained, with a constant intrasectoral elasticity of substitution. Since the relative weight given to this elasticity tends to vary over the business cycle – market share tends to decrease during expansions, due to the entry of new firms into the market, while the aptitude to collude weakens – profit markups tend to exhibit counter-cyclical behaviour, so long as the products of the oligopolistic sector are more substitutable with each other than with the competitive product, as Dixit and Stiglitz (1977) presume. We thus find the result of Rotemberg and Saloner (1986), which is obtained in a model of tacit collusion that echoes several contributions from the late

1930s that aimed at accounting for the pro-cyclical character of real wages. This was inexplicable under the "the first fundamental postulate of classical economics", which was taken up by Keynes in the General Theory (Rotemberg and Woodford, 1991; d'Aspremont *et al.*, 2011).

This is a first achievement of the switch from monopolistic to oligopolistic competition: to account for the cyclical properties of profit markups and real wages by drawing on the cyclical variability of structure (through the creation-destruction of firms) and conduct (more or less collusive). A second achievement lies in the weakening of the conditions for the emergence of endogenous fluctuations that such variability provides (Dos Santos Ferreira and Lloyd-Braga, 2005). I will come back in more detail to this second point, in particular to the role of the fundamental indeterminacy of the oligopolistic equilibrium, which hides in particular behind the arbitrary choice by the model maker of a particular form of competition (for example, in prices or in quantities) and which in itself is an important potential source of endogenous fluctuations.

3. Anticipations, Conjectures and Endogenous Fluctuations

The rational expectations hypothesis extends to the process of expectation formation the condition of coherence that is common to all reasoning in terms of equilibrium. It fits into Marshall's equilibrium approach and is found implicitly in the General Theory as regards short-term expectations and their role in a short period equilibrium. Like microeconomic foundations, this does not lead to any break with the Keynesian conception of macroeconomics, except as a call for greater analytical precision. So in what way is there a divergence? The divergence stems from the fact that the new classical economics tends to restrict the source of uncertainty to random shocks on the sole exogenous variables. To resort to the rational expectations hypothesis would then amount to excluding systematic errors on the part of agents with the status of observers. But the agents are also actors, whose actions, dependent on their expectations about the endogenous variables, contribute to the determination of the equilibrium value of these same variables. The rational expectations hypothesis is thus integrated into a concept of equilibrium, the multiplicity of which is not excluded, leading to additional uncertainty and a problem of coordination. This source of uncertainty is present even in the absence

of shocks on the exogenous variables and can therefore lead to purely endogenous fluctuations.

All this is quite well known and has been widely treated in the literature on endogenous fluctuations, which has continuously loosened the conditions for the emergence of these fluctuations, especially in the neighbourhood of a dynamically indeterminate steady state (Lloyd-Braga *et al.*, 2014; Dufourt *et al.*, 2017). These conditions essentially concern the utility function of the representative consumer, production externalities and market imperfections. They reach a reasonable level of empirical likelihood, even while their restrictive character cannot be ignored. In this situation, it is important to take into account the strategic behaviour of large firms. The essential indeterminacy of oligopolistic equilibria mentioned above in fact constitutes an additional source of uncertainty facilitating the emergence of fluctuations.

To take just one example, in a DSGE model without intrinsic uncertainty, where the dynamic indeterminacy of a steady state is excluded, and even by imposing a priori Cournot competition (and thus freezing firms' aggressiveness), the simple strategic indeterminacy that arises from the existence of potential entrants in each sector is sufficient to ensure the existence of endogenous fluctuations reproducing relatively well the properties of the American economy (Dos Santos Ferreira and Dufourt, 2006).

More generally, the shift from monopolistic competition to oligopolistic competition introduces a strategic uncertainty leading to a plurality of equilibria associated with the different configurations of conjectures that firms hold about the behaviour of their competitors. Naturally, these conjectures have a self-fulfilling power and are not rejected at equilibrium. This power is conferred on them by various forms of coordination, notably by referring to extrinsic public signals, conveying no relevant information about the fundamentals, i.e. sunspots. Referring to the image popularized by Keynes, we can also say that the entrepreneurial actions are dictated by "animal spirits", which push entrepreneurs "to action rather than inaction" and, more specifically, to more or less aggressive action.

In addition, if we restore to entrepreneurs their role as decision makers in the accumulation of capital, a role that was confiscated by Walrasian consumers, we can bring about a significant change in the dynamics of investment that is potentially favourable, once again, to the emergence of endogenous fluctuations. We have, for example,

been able to show such a result in a deterministic model with overlapping generations where the firms, living like the consumers for two periods, invest strategically in the first period and produce in the second, engaging in Cournot competition (d'Aspremont *et al.*, 2015). This result is achieved through the interplay of two opposing effects: on the one hand, investment boosts productivity and stimulates business creation, and on the other hand, business creation reduces profit margins and discourages investment. The latter is a Schumpeterian effect combining conjectures and expectations: it arises from the competition between entrepreneurs as producers, as this is anticipated by these same entrepreneurs acting as investors. It disappears when the market share of each company becomes negligible.

Finally, another source of uncertainty that can lead to endogenous fluctuations, even in a context of equilibrium uniqueness and determinacy, and this time independently of any imperfection in competition, is the heterogeneity of the information that is available to the agents engaged in the process of forming anticipations. This heterogeneity raises a problem of coordination, which can be analysed using as a framework the model of a beauty contest, with reference to the parable put in place by Keynes to account for the working of financial markets (Angeletos and Lian, 2016, s. 7-8). The basic idea is that the agents act under two motives when they form their expectations about an asset's value: a fundamental motive and a motive for coordination with each other. These motives converge in a situation of perfect information (or more generally information homogeneity), since the shared expectation of the fundamental value is a source of coordination. On the other hand, if the information is dispersed, with each agent receiving for example a private signal, a conflict between the two motives appears, and it can become optimal to coordinate using a public signal containing little or no information about the fundamental value (a sunspot), to the disregard of more precise, but purely private information, which is therefore irrelevant for the anticipation of the market value (Boun My *et al.*, 2017). The abandonment of the fundamental motive in favour of the coordination motive clearly reflects the prevalence of speculation over enterprise, as shown by Keynes.

We see that there are answers to the dissatisfaction about the core of contemporary macroeconomics already appearing in the periphery of the discipline, with no need to await a revolution. It can be hoped that they are harbingers of the end of a long winter of discontent.

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IMPERFECT INFORMATION
IN MACROECONOMICS

Paul Hubert
Sciences Po OFCE
Giovanni Ricco
University of Warwick and OFCE

This article presents some recent theoretical and empirical contributions to the macroeconomic literature that challenge the perfect information hypothesis. By taking into account the information frictions encountered by economic agents, it is possible to explain some of the empirical regularities that are difficult to rationalise in the standard framework of full information rational expectations. As an example, we discuss how the sign, size and persistence of the estimated effects of monetary and fiscal policies can change when the informational frictions experienced by economic agents are taken into account.

Keywords: informational frictions, imperfect information, economic policy.

How do economic agents form their expectations and make their decisions? How can these processes be modelled in a macroeconomic framework and what conclusions can be drawn from the analysis of economic time series? These methodological issues have long been among the most fundamental questions in macroeconomics. The dominant approach – since the work of Lucas, Sargent and their co-authors in the early 1970s – has adopted the joint hypotheses of model-consistent or rational expectations, and of full information.[1] Under these assumptions, economic agents know the structure of the economy precisely and can perfectly observe and process all economic information in real-time.

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1.   "Model-consistent or rational expectations".

These assumptions can be viewed as a theoretical benchmark whose introduction has enormously increased the sophistication of macroeconomic models. However, over time, there has been an accumulation of convincing evidence about phenomena that would be "anomalous" in the standard framework. Recently, models that incorporate deviations from the full information hypothesis in the form of "sticky information", "noisy information" or "dispersed information" have been proposed to explain some of the empirical regularities that are difficult to accommodate in the standard framework, such as the persistence of the response of macroeconomic variables to supply or demand shocks, the delayed response of inflation to economic policy shocks, and the autocorrelation of agents' forecast errors.

This article presents some of the ideas proposed to incorporate deviations from the hypothesis of full information in the standard framework. We also discuss some of the implications of models of imperfect information for the estimation of the impact of macroeconomic policy actions.

1. The Perfect Information Rational Expectations Framework

In his *General Theory* (1936), Keynes pointed out that private expectations can affect macroeconomic variables. Since then, it has been acknowledged that the expectations of private agents, households and firms are of fundamental importance in many macroeconomic models. In the 1960s, the direct introduction of expectations into macroeconomic models became widespread and led to efforts in ad-hoc modelling of the process through which agents were forming their forecasts. Among others, a common representation of this process was the adoption of "adaptive expectations", where agents are assumed to form expectations based on past experience. In contrast to this approach, Muth (1961) proposed modelling agents' expectations as being "model-consistent", i.e. as coherent with the economy model implied probability.

The experience of stagflation in the 1970s led to a reconsideration of the assumptions of the Keynesian models of the 1960s. In fact, these models, often supplemented with adaptive expectations, implied that macroeconomic stabilisation policies based on fiscal and monetary expansions could be used to reduce unemployment and increase

output at the cost of higher inflation (a relationship summarized by a causal interpretation of the Phillips curve).

To explain why policy actions were not delivering the expected results, Lucas (1972) proposed a schematic model of islands in which policy makers are not able to systematically exploit the relationship between inflation and real activity (the Phillips curve). What became known as the "Lucas critique" suggested that the use of parameters based on past experience is a misguided way of assessing the effects of changes in macroeconomic policies (Lucas, 1976). Indeed, when policies are changed agents incorporate the policy shift in their expectations. This in turn implies that policy analysis obtained from models calibrated with past data can deliver inconsistent results. Lucas and Sargent (1979) incorporated this intuition in a general equilibrium model featuring forward-looking agents with model-consistent rational expectations and perfect information. In such a setting, economic agents react to policy changes by re-optimising their decisions in light of the policy change. Since then, the hypothesis of full information rational expectations has become a fundamental building block in macroeconomic models supporting the assumption of market efficiency, the permanent income hypothesis, the "Ricardian" equivalence, and standard asset pricing models.

This revolution has not been limited to the academic sphere, and macroeconomic policy makers have also relied on the assumptions of full information and rational expectations in the macroeconomic policy models employed by central banks and finance ministries.

However, over time many empirical regularities at odds with the perfect information framework have been reported. Examples include the slow adjustment of prices, money non-neutrality, the delayed and smoothed links between macroeconomic time series and the booms and busts in financial asset prices. In addition, surveys of the expectations of households, firms and private forecasters have provided direct evidence against the full information rational expectations hypothesis (e.g. Pesaran and Weale, 2006).

One of the most striking implications of the rational expectations hypothesis concerns the Phillips curve. As private agents anticipate the effects of economic policy decisions (changes in money supply or in the policy interest rate for instance), they adjust their expectations (of future inflation in this example). Hence the impact of these policies is not real but only nominal. However, empirical work has shown that

monetary and fiscal policies can have real transitional effects. Various avenues for explaining these results have been proposed, including models of non-rational expectations and staggered contract models in which prices and wages are fixed for a given period.[2] As we discuss in the next section, a different approach has been to challenge the hypothesis of perfect information to explain the empirical findings.

2. Models of Imperfect Information

The lack of empirical support for the predictions of models of full information rational expectations has provided motivation to explore models in which rational agents are rational albeit limited in their ability to acquire and process information.

In models of "sticky information", proposed by Mankiw and Reis (2002), private agents cannot update their information at all times, but only infrequently. However, when they do, they can acquire full information. Alternative approaches, called "noisy information" or "rational inattention", assume that agents can only observe signals about economic variables polluted by observational errors (Woodford, 2002), or have limits in their ability to process information in real-time and hence have to rationally choose what information to monitor (Sims, 2003; Maćkowiak and Wiederholt, 2009; Paciello and Wiederholt, 2014).

The hypothesis of imperfect information in models with sticky information and noisy information may be micro-founded and linked to the inattention of economic agents to new information. This behaviour can be explained by the cost of accessing information (see, for example, Reis, 2006a, b) or by limited information-processing capabilities (see among others Sims, 2003; Matějka, 2016; Matějka and McKay, 2012).[3]

A common feature of all these models of imperfect information is that economic agents absorb and respond to new information only gradually. The response of economic variables to economic policy shocks or other structural shocks is therefore slow. This contrasts

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2.   Although private agents in neo-keynesian models form rational expectations and suffer no money illusion, the theory has simply shifted the non-neutrality of private agents' behavior to the constraints private agents are facing: the different types of frictions.

3.   The central idea of rational inattention models is that private agents have limited attention and therefore need to decide how to allocate their attention on the vast amount of information available. In this theory of rational inattention, however, private agents make their decision optimally.

sharply with the predictions of full information rational expectations models in which economic agents can process and respond to new information immediately.

Other classes of models proposing deviations from the hypothesis of rational expectations with full information have been proposed. One of these alternatives is the "bounded rationality" model proposed by Sargent (1999), where agents are limited in their knowledge of the economic model but are rational in their decision-making. Similarly, Gabaix (2014) proposed a model in which the economic agents adopt a simplified model of the economy and pay attention only to some of the relevant variables. This approach is motivated by the limited capacity of agents to monitor and understand macroeconomic variables and their interactions. The "natural expectations" model of Fuster *et al.* (2010) proposes a framework where economic agents use simplified models to predict a complex reality. Along the same line, "diagnostic expectations" refer to a different approach in which economic agents have imperfectly defined models of the economy. This type of expectations is justified by the representation heuristics of Kahneman and Tversky (1972), which describes the non-Bayesian tendency of economic agents to overestimate the probability of a characteristic in a group when this characteristic is representative or symptomatic of the group. Gennaioli and Shleifer (2010) and Bordalo *et al.* (2016) describe the formation of expectations based on this behavioural bias. Economic agents with diagnostic expectations overweight future events that become more likely based on the most recent data, which may explain both the excessive volatility of some markets and an excessive reaction to new information.

Finally, learning models (Evans and Honkapohja, 2012) offer a complementary approach to the issue. In these models, economic agents are rational and have full access to new economic information, however they don't know the parameters that govern the economic model. Agents thus act as econometricians and try to learn about the relations describing the economy's dynamics over time, given the observed data. Expectations are then formed by using tentative estimates. This type of model helps to explain the persistence of inflation expectations (Orphanides and William, 2005; Milani, 2007; Branch and Evans, 2006).

3. Empirical Evidence for Models of Imperfect Information

Models of sticky information, noisy information and rational inattention provide common emerging predictions, empirically documented by Coibion and Gorodnichenko (2012) using survey data.

In this class of model, following a macroeconomic shock the average forecast in the economy will respond less than the actual variable being forecast. Hence if, for example, a shock lowers inflation over a number of periods, economic agents' average expectation of inflation will not decline immediately as much as actual inflation does. In a sticky information model, this is due to the fact that some of the agents are unaware that the shock has occurred and do not change their expectations. In noisy information models, private agents receive signals indicating higher inflation but change their expectations only gradually because of their uncertainty about whether the higher signals represent noise or real innovations. In models of rational inattention, agents can only pay limited attention to inflation data hence do not fully adjust their expectations on impact.

Another prediction, common to all of these models, is that the average of the ex-post forecast errors is predictable from the ex-ante revisions of the average forecast. This contrasts with the full information case in which ex-post forecast errors cannot be predicted. In the sticky information model, this reflects the fact that some agents do not update their information and therefore their forecasts remain unchanged, which creates a correlation between the average forecasts at different times. In the noisy information model, the economic agents update their forecasts only gradually because of the presence of noise in the signals they receive.

Coibion and Gorodnichenko (2015) test these predictions on US data and Andrade and Le Bihan (2013) on European data, and they provide evidence of empirical regularities compatible with models featuring informational frictions.

Recent empirical research has also highlighted omnipresent and systematic deviations from the predictions of rational expectations models with full information using survey data. This empirical evidence is consistent with the predictions of imperfect information models. Among other contributions, Mankiw, Reis and Wolfers (2004), Dovern *et al.* (2012) and Andrade *et al.* (2016) use the dispersion of responses in survey data to assess the extent to which the persistent informational model can replicate some of the characteristics of the

expectations of private forecasters and consumers. Using epidemiological models, Carroll (2003) suggested that information is transferred from professional forecasters to consumers over time through the forecasters' publications. Carvalho and Nechio (2014) found that many households report expectations that are inconsistent with monetary policy measures.

Gourinchas and Tornell (2004), Bacchetta, Mertens and van Wincoop (2009), and Piazzesi and Schneider (2011) in turn identify the potential links between systematic forecast errors in survey expectations and empirical puzzles in asset markets.

Adam and Padula (2003) have shown that empirical estimates of the slope of the neo-Keynesian Phillips curve have the expected sign when using survey measures of inflation expectations, while this is not generally the case when one adopts empirical specifications based on full information assumptions. More recently, Coibion and Gorodnichenko (2015) and Coibion *et al.* (2017) tried to explain the missing disinflation following the Great Recession by the partial de-anchoring of consumers' and producers' inflation expectations between 2009 and 2011 due to large oil shocks.

4. Imperfect Information and the Identification of Structural Shocks

Most of the macroeconometric literature studying the effects of policy shocks – monetary and fiscal – is based on mechanisms and insights derived from models of full information and rational expectations. However, a number of empirical studies have argued that the presence of informational frictions could modify the identification problem along several dimensions.[4]

In an economy without informational frictions, the econometrician has to align the econometric model's information set to the representative agent's. Conversely, when the economic agents do not observe the structural shocks in real time, the econometrician, faced with the same data as the economic agents, may not be able to identify the shocks correctly (Blanchard *et al.*, 2013). In fact, in such a case, in order to

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4. Introducing too many variables into the model can be problematic because of the number of parameters to be estimated and the risk of collinearity. The literature suggests using factor models or Bayesian analysis to minimize these issues. While this method attempts to identify structural shocks in economic policy, a different but related issue is to analyze the consequences of forecasting errors by policy makers.

correctly identify structural shocks, the econometrician has to employ a superior information set. Also, crucially, when the economic agents have different sets of information, the concept of a representative agent could most definitely be misleading. Finally, the absence of a fully informed representative agent implies that economic policy decisions can reveal the policy maker's information about the state of the economy and transmit information to the economic agents. This mechanism is called the signalling channel of economic policy actions (see Romer and Romer, 2000, and Melosi, 2017).[5]

In models of rational expectations and full information, the economic agents immediately process new information and, consequently, their forecast errors are linear combinations of the contemporaneous structural shocks only. In contrast, in cases where information is imperfect, new information is only partially absorbed by the agents over time and, therefore, the average forecast errors are a combination of present and past structural shocks. This implies that the forecasting errors can no longer be considered as being in themselves a good proxy for structural shocks.

Some of these ideas have been applied to the empirical study of technology news shocks and non-fundamental fluctuations in the economic cycle (see for example Barsky and Sims, 2012; Blanchard *et al.*, 2013; and Forni *et al.*, 2013) and of the effects of conventional monetary policy shocks (Hubert, 2017; Hubert and Maule, 2016; Miranda-Agrippino and Ricco, 2017) and unconventional monetary policy shocks (Andrade and Ferroni, 2017), as well as of fiscal shocks (Ricco, 2015; Ricco *et al.*, 2016).

In the remainder of this section, we provide some empirical examples of how imperfect information may change the empirical identification problem, taken from the work of the authors of this article.

In the case of monetary policy actions, the information sets of the central bank and of private agents may differ. When the latter are surprised by a monetary policy decision, they have to consider whether this surprise is due to the central bankers' assessment of macroeconomic conditions or to a deviation from the monetary policy rule – i.e. a monetary policy shock. For example, a hike in the central bank's policy rate may signal to private agents that an inflationary shock will

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5. When private agents have different beliefs because of differences in their information sets, aggregation issues may arise and some caution is required to avoid aggregation bias.

affect the economy in the future, pushing private expectations of inflation up. Conversely, the same increase in the central bank's policy rate could be interpreted as a preference shock indicating that central bankers want to be more hawkish, which would reduce future inflation and output. More generally, whenever the central banker and private agents have different information sets, the monetary policy decision can transmit private central bank information about future macroeconomic developments to the agents.

Importantly, despite extensive research, there is still much uncertainty about the effects of monetary policy shocks (see Ramey, 2016). In particular, several studies have highlighted a counter-intuitive increase in production or in prices following a monetary tightening – also called output and price puzzles. In Miranda-Agrippino and Ricco (2017), the authors observe that the lack of robustness in the empirical results in the existing literature can be due to the implicit assumption that both the central bank and private agents enjoy perfect information about the state of the economy. Importantly, the transfer of macroeconomic information from the central bank to private agents can generate the price puzzle highlighted in the literature.

Private agents' interpretation of monetary policy surprises is therefore crucial in determining the sign and magnitude of the effect of monetary policies. Based on this intuition, Miranda-Agrippino and Ricco (2017) propose a new approach to study the effects of monetary policy shocks that takes into account the problem that agents face following central bank policy announcements. In the United States, after five years the Fed releases the macroeconomic forecasts of its economists (the Greenbook forecasts) that were used to inform past monetary policy decisions. This makes it possible to ex-post separate the reactions of the financial markets to information about the state of the economy (as reported by the Greenbook forecasts) revealed to the public through the central bank's action, from reactions to monetary policy shocks. The authors use these responses to study the effects of monetary policy on the US economy in a flexible econometric model that is robust to misspecifications.

In Chart 1, the approach described above is compared to methods that do not take into account the transfer of information between the central bank and the private agents. While these latter methods generate the price puzzle, the approach taking into account the

information transfer implies that monetary tightening simultaneously reduces both prices and output.

Chart 1. Responses of different macroeconomic variables to a restrictive monetary shock
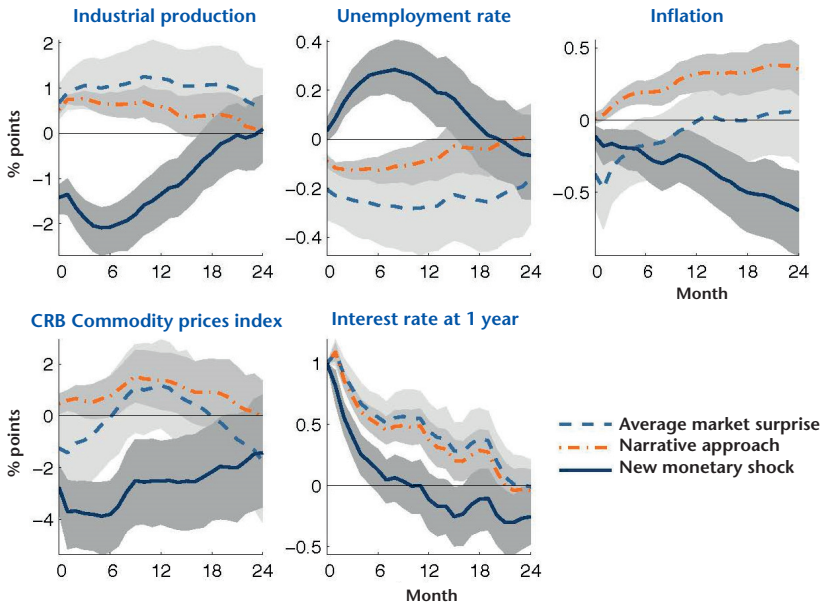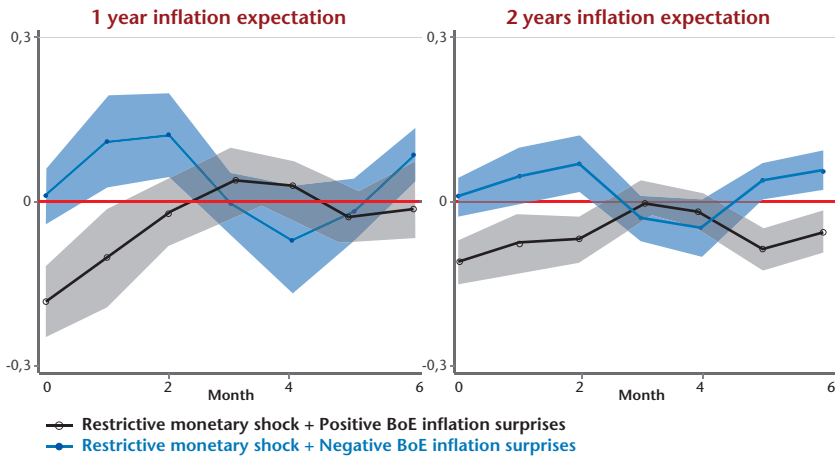

Reading note: The graph shows the impulse response of several variables, over 24 months, to a contractionary monetary shock. This monetary shock is identified in three different ways: via the average surprise of market operators on the day of the announcement (blue dots), via a narrative approach that consists of extracting the unexplained component of the central banks' forecasts of a change in interest rates (orange dots), and using the method of Miranda-Agrippino and Ricco (2017), which takes into account the transfer of information (blue line).
Source: Authors' calculations.

On the basis of these results and in order to study whether private agents' interpretation of monetary policy surprises depends on the information at their disposal, Hubert (2017) assesses whether the central bank's publication of its macroeconomic forecasts could affect how private agents understand monetary policy surprises, and therefore ultimately affect the impact of monetary policy decisions. More specifically, this work assesses whether the term structure of inflation expectations responds differently to decisions by the Bank of England (BoE) based on first whether these are accompanied by the publication of its macroeconomic forecasts (of inflation and growth) and second whether they are corroborated or contradicted by its forecasts.[6]

On average, private inflation expectations respond negatively to restrictive monetary shocks, as expected given the transmission mechanisms of monetary policy. The main result of Chart 2, however, is that central bank inflation forecasts modify the impact of monetary shocks. Monetary shocks (in this example, restrictive) have more negative effects when they interact with a positive surprise about the central bank's inflation forecasts. On the other hand, a restrictive monetary shock, which interacts with a negative surprise on inflation forecasts, has no effect on private inflation expectations.

Chart 2. Responses to a restrictive monetary shock

Reading note: The graph shows the 6-month change in 1 and 2-year inflation expectations following a restrictive monetary shock, when (a) it is corroborated by a positive surprise on the central bank inflation forecasts (black line) (b) when it is contradicted by a negative surprise on inflation forecasts (blue line).
*Source:* Authors' calculations

This suggests that, when monetary shocks and forecast surprises corroborate one another, monetary shocks have a greater negative impact on private inflation expectations, possibly because private agents can deduce the preference shock of the central bank and respond more strongly. When monetary shocks and forecast surprises

6.   This paper focuses on data UK because BoE projections have a specific feature that makes it possible to identify econometrically their own effects. Indeed, the research question studied requires that the central bank's projections are not a function of the current policy decision, so that monetary surprises and projection surprises can be identified separately. BoE projections are conditional on the market interest rate and not the policy rate, so the BoE projections are independent of monetary policy decisions.

contradict one another, monetary shocks have no impact (or less), possibly because private agents receive conflicting signals and are unable to determine the direction of monetary policy. They therefore also respond to the macroeconomic information disclosed.

These results show that informational questions, and in particular the central banks' publication of its macroeconomic information, which helps private agents to process the signals they receive, modify the responses to monetary policy decisions.

Chart 3. Responses of GDP and private investment to expansionary fiscal announcements conditional on the disagreement among private agents
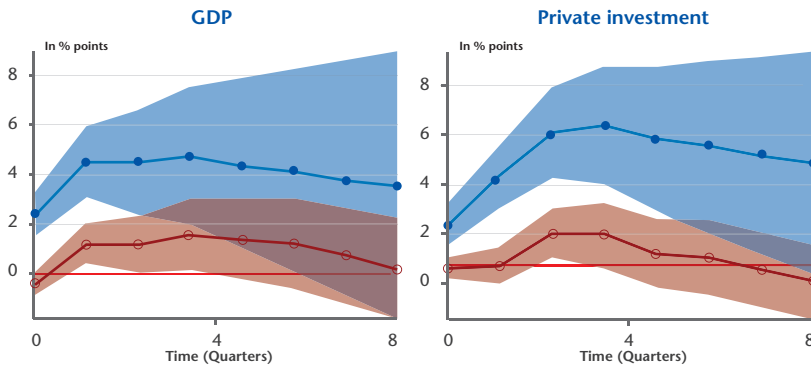
Reading note: Impact of budget announcements in a situation of high (red) and low (blue) disagreement. The shock corresponds to a difference of one standard deviation from the revisions of the 3-quarter forecast of public expenditure. The responses to the impulse have been normalized to have a similar increase in public spending over 4 quarters. The estimates are provided with a 68% confidence interval.
Source: Authors' calculations.

Imperfect information can also play a role in the transmission of fiscal shocks. For example, Ricco *et al.* (2016) propose a study of the effects of the communication of fiscal policy with respect to public expenditure shocks. To do this, they calculated an index measuring the coordination effects of policy makers' announcements on private agents' expectations. This index is based on the dispersion of the 3-quarter ahead public expenditure forecast of professional forecasters in the United States. The basic intuition is that communications about the future path of fiscal policy can act as a focal point for expectations and reduce informational frictions and thus the dispersion of forecasts among economic agents. The results (Chart 3) indicate that in times of low disagreement, the response of output to public expenditure shocks is positive and significant, mainly because of the strong response of private investment. Conversely, periods of high disagreement are

characterized by a low or no response of output. These results indicate that informational frictions can modify the effects of economic policy decisions.

5. Conclusion

Models with imperfect information have been widely used to study, among other questions, how economic agents make decisions on consumption and investment or select their asset portfolios. Another active area of research concerns the design of optimal policies in the presence of informational frictions. It is noteworthy that the implications of these models of imperfect information can be of great policy relevance.

For example, Ball, Mankiw and Reis (2005) show that a price level target is optimal in models with sticky information, while inflation targeting is optimal in models where the prices are sticky. Paciello and Wiederholt (2014) document how models of rational inattention modify the optimal monetary policy. Branch, Carlson, Evans and McGough (2009) examine how monetary policy decisions affect the optimal frequency for updates of information sets. They show that if the central bank is more concerned with inflation than with growth, firms' inflation expectations may be better anchored and this may decrease output and inflation variability. This mechanism may partially explain the 'Great Moderation'. Angeletos and Pavan (2007) examined issues of efficiency and optimal policy in the presence of imperfect information and the externalities that the use of the information by an agent imposes on other agents. Angeletos and La'O (2011) studied optimal monetary policy in an environment in which firms' pricing and production decisions are subject to informational frictions. They show that perfect price stability is no longer optimal. In this context, the optimal policy is to 'lean against the wind', that is to say, to target a negative correlation between the price level and real economic activity.

In the wake of the financial crisis, the attention was mainly focused on incorporating financial frictions in macroeconomic models. However, it is also important not to underestimate the importance of informational frictions. This article has tried to show that informational frictions have important implications for macroeconomic models' predictions as well as the measurement of economic policy shocks and their effects. If these frictions are not properly taken into account, then economic policy recommendations may be misleading.

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FINANCE AND MACROECONOMICS: THE PREPONDERANCE OF THE FINANCIAL CYCLE

Michel Aglietta

CEPII

The representation of macroeconomics, ostensibly rooted in microeconomic fundamentals, is that of a representative agent, equipped with perfect information, rationally anticipating the fundamental value of assets in a perfectly competitive market. In this model finance is efficient and as a corollary money is neutral. This set of assumptions makes it logically impossible to have an endogenous systemic crisis, which involves instead a generalized flaw in market coordination.

An alternative foundation involves grounding macroeconomics in the mimetic competition that makes money the primary institution of the economy. In this model, coordination through finance is not based on fundamental values, but on liquidity. But the liquidity of the markets is itself the polarizing effect of a mimetic process. It is established by a market convention that is inherently unstable.

As a result, the financial systems organized by markets propagate shocks according to a momentous logic produced by the interaction of indebtedness and the movement of asset prices. Its macroeconomic expression is the financial cycle. In this dynamic, the opacity of the system fuels the financial vulnerabilities that remain hidden in the euphoric phase and are revealed by the endogenous crisis in the financial cycle.

The financial cycle has a considerable macroeconomic impact, through the financial accelerator, on the factors of production and the effective demand. Depending on the extent of the indebtedness and then the deleveraging within the cycle, a multiplicity of equilibria are possible.

Keywords: financial cycle, systemic crisis, liquidity, momentum.

Societies and therefore economies evolve and change over time. Finance is the brain of an economy, as it incorporates a representation of time. Two theoretical conceptions of time come face to face, expressing two irreconcilable streams of thought about economic time. One view is pure market economics, which postulates that time is homogeneous. As a result, money is neutral and finance efficient. The link to macroeconomics lies in Modigliani Miller's theorem (1958): choices about savings and investment are independent of the financial structures. The other view is money economics (Keynes, *General Theory,* Book IV, 1959). The future is affected by uncertainty, such that the pivot of behaviour over time is liquidity, which places money at the heart of macroeconomics. The difference in nature between the causal time from the past and the subjective time of the future leads to finance being driven by *momentum*, generating the financial cycle. The interaction between the financial cycle and macroeconomics depends crucially on financial structures.

In the first section we will address the question of the foundations, proceeding from the assumption of efficiency to the financial cycle. The second section will focus on the links between the financial cycle and macroeconomics. Finally, we will conclude on the possibility of a new growth regime based on the transformation of finance, emphasizing resilience for taking account of the long term.

1. Finance: From the Assumption of Efficiency to the Financial Cycle

Asset markets are about the future. These are markets that convey exchanges of promises and commitments that are usually contractual. The future is the time of expectations, and thus of beliefs about the future. Financial markets are therefore an organization through which individual beliefs about the future interact to give rise to a collective belief. Through the mediation of the financial markets, beliefs about the future influence the current actions of market participants.

This representation of time is based on the heterogeneity of the objective time of past economic actions and relations and the inherently subjective time of beliefs about the future. This observation is opposed to the edifice of the so-called fundamental value model,

which postulates a homogeneous time, since it asserts that the future prices of financial assets are defined by their fundamental values, which are pre-existing. This is nothing more than a generalization of the general equilibrium of perfect competition to an unlimited future where the behaviour of a single representative agent reigns supreme. The future is only known, of course, as a probability, but that doesn't change anything. What is essential is that economic agents are assumed to be capable of identifying all the possible future states, to which they apply objective probabilities, which are themselves supposed to be known to all. It is assumed that the expectations, bound up with this extraordinary knowledge about the future, are rational and that finance, which merely records the impact of these behaviours and expresses them in market prices, is efficient.

It has long been known that finance does not behave this way, and that systemic crises along the lines of the so-called subprime crisis not only are rare, but logically cannot occur at all under the assumption of pre-existing fundamental values and common knowledge, since a systemic crisis is a widespread failure of coordination by the markets. If economics were a paradigmatic science as its zealots claim, the paradigm of efficiency would fall foul of Karl Popper's principle of falsification. But that's not what takes place; the efficiency paradigm is posited as a dogma, and the phenomena to be analysed, which are obviously foreign to it, are treated as "frictions", making it possible to preserve the central hypothesis.

In any case I do not consider that the problems we must face in order to understand finance are "frictions". But the argumentation challenging this position goes much deeper. The efficiency of finance is merely an avatar of the general equilibrium of perfect competition, and it is based on the theory of utility value. The corollary of this theory is the neutrality of money. The assumption of efficient finance cannot hold without the neutrality of money. I thought that in this paper I would not have to return to the criticism of this theory because I had the opportunity to discuss it extensively (*La monnaie entre dettes et souveraineté* [*Money between Debt and Sovereignty*, Chapters 1 and 2). But Joseph Stiglitz's recent critique, "Where Modern Macroeconomics Went Wrong", gives me an occasion to do so.

1.1. From the hypothesis of mimetic competition to the power of money

Stiglitz stresses the failure of the attempt to reconcile microeconomics based on utility value theory and macroeconomics, proposed in the well-known dynamic stochastic general equilibrium (DSGE) models. The essential characteristic of the utility value that supports the existence of the general equilibrium is the independence of the agents' behaviours, which implies perfect knowledge of the characteristics of the goods and of the desires of each subject with respect to the goods, guaranteeing that individuals have a complete choice. Stiglitz shows that this cannot be the case because all individuals are dependent on a public good in the formation of their choices, i.e. *information*. It is expensive, asymmetrical and therefore generates power relations between individuals. If inefficiency exists, it is structural and produces multiple macroeconomic equilibria.

While fully accepting these results, I belong to a school of thought that draws on a foundation of the incompleteness of individual desires, which consequently implies the need for searching information. This is the hypothesis of mimetic competition. In considering two individuals, the origin of desire for an object is found in a model provided by the desire of the other. But the other is also a rival, because they are in the same search. That is why the convergence of the mirror game is endogenous; it is a creation of the mimetic interaction (A. Orlean, *The Empire of Value*, 135). The advantage of this hypothesis is that it makes innovation the engine of the market economy, because it endogenizes scarcity, making it an instrument of power. Utility is constantly redefined by social interaction to produce differentiation.

But how can a system of exchanges be coordinated to make a whole? In the context of utility value, it is the secretary of the Walrassian market, formalized as a fixed point thanks to the hypothesis of the convexity of choice. In the context of mimetic competition, it is a crucial institution that is the basis for the coordination of exchanges: *money*. It is what is desired by all, and consequently its possession gives power over any object of desire. It follows that market coordination is not an equilibrium, it is the finality of payments. Payment is the means by which society gives recognition to economic actors for what they brought it through their activities. The payments system is therefore the institution that realizes value. It is a pure social relationship. It is not a substance pre-existing exchanges and called "utility".

1.2. The pivot of the financial markets is not the fundamental value, but liquidity

Efficient finance in the context of a perfect competitive equilibrium removes uncertainty. Indeed, it is minimal since the prices of assets are assumed to incorporate an objective risk. There can be no hidden risk accumulating on the balance sheets. There is equivalence between all the means of financing the acquisition of assets, and thus indifference to the structure of the balance sheets, since all risks are valued accurately. Therefore, while we acknowledge frictions in order to submit to empirical reality, they are not necessary theoretically. It is incomprehensible why there can be credit rationing that has a great influence on the real economy. It follows that these frictions do not make it possible to move from a financial logic directed by exogenous fundamental value to the functioning of financial markets controlled by money. The key concept that guides behaviour on the financial markets is not fundamental value, but *liquidity*.

Liquidity is ambiguous because it is self-fulfilling, i.e. the creation of the desire for it. The motive that arouses one's desire is confidence in the institution of money. Under conditions of uncertainty, it constitutes both protection for everyone in a crisis situation and a desire for appropriation that is not subject to a condition of saturation, because the logic that operates in the financial markets is making money with money. As a result, the financial market does not operate at all like ordinary markets. In the latter, the two sides of the market have opposing interests with regard to prices, which guarantees a supply curve that rises with prices and a demand curve that falls. In the financial markets, on the contrary, any actor can be a seller or a buyer any time, which alternates euphoria and panic, whereby the demand curve rises with prices. A peculiarity of self-fulfilling processes is that they generate these kinds of dynamics, which as will be seen later, follow one another and form a financial cycle. These phase changes make financial markets inherently unstable, as was noted by Hyman Minsky, the best interpreter of Keynes's thinking on the role of finance.

There is total opposition between these conceptions. The hypothesis that the fundamental value is the pivot of the financial markets assumes that it is known before the markets open, which amounts to denying uncertainty. On the contrary, while the future does not exist prior to individual beliefs, the question of the organization of the financial markets consists of knowing how the disparities of individual beliefs

about the future bounce back onto the present in defining a convention reflected in the market price.

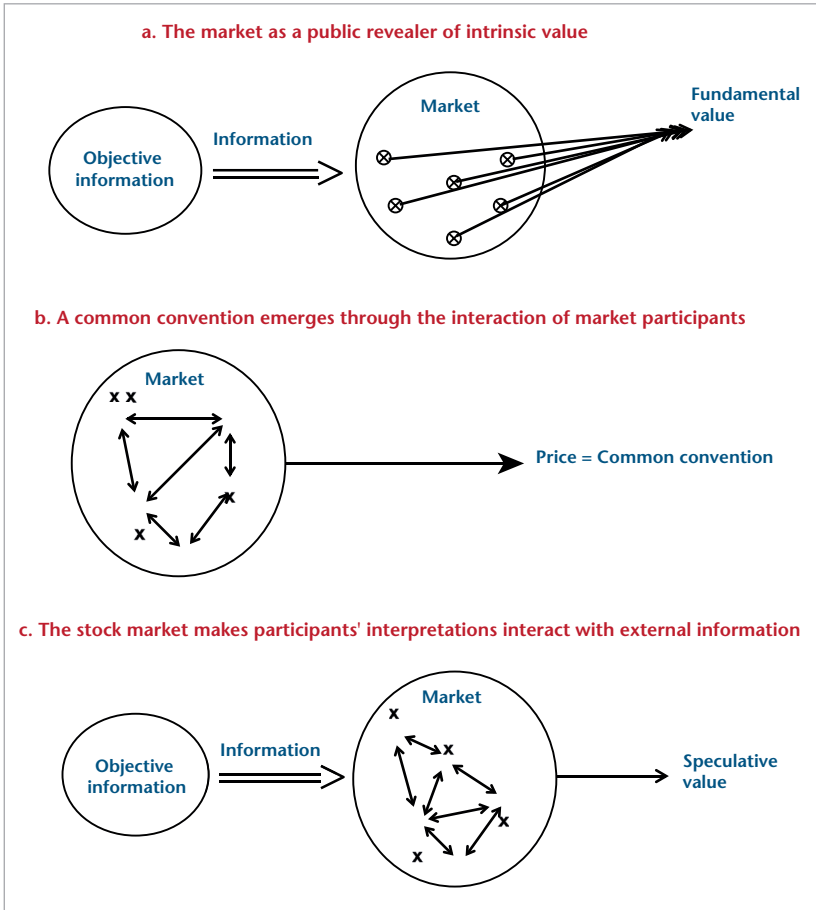## 1.3. The issue of efficiency vis-à-vis counterfactual time

In a financial relationship, the influence of the future on the present cannot be objective. An objective dependence is necessarily causal. It respects the arrow of time, that is, cause precedes consequence. The influence of the future on the present, by which my beliefs about the future affect my decisions today by interacting with the beliefs of others on the financial market, reflects time that is subjective, and therefore counterfactual. It is why economic time is necessarily heterogeneous. Through the mediation of the financial markets, it combines objective relations resulting from the observation of the way the economy has changed in the past with subjective beliefs about the future. In these circumstances, what is the meaning of the information efficiency of the financial markets?

Let's consider the stock market, which determines the value of companies, hence the most central measure of a capitalist economy. Following Walter (2003), we arrive at three alternative propositions for a valuation based on the hypothesis about the counterfactual influence of the future on the present (Schema 1).

In schema 1a, the value of the companies is assumed to be "objective", completely external to the stock market, which acts as a public revealer that has no influence on the intrinsic value itself. Market participants act independently of each other. However, having the same information transmitted by the companies is not enough. They must also have the same interpretation to transform this information into a single value, deemed "objective". Everything takes place as if there were only one representative agent in the market. The rational representative agent in this academic model possesses clairvoyance, intelligence and absolute prescience about the future.

In this representation of the way the market functions, speculation, that is to say, the incentive to discover the right information, does not exist. Indeed, no one at any moment, nor for any period of time however small, can make the least profit by obtaining information before others or by interpreting it better than others. This leads to the paradox of information efficiency identified by Grossman and Stiglitz (1980). Unless the information is a windfall from the sky, an efficient market, as defined above, cannot function. If the information is so inex-

Schema 1. The valuation of companies on the stock market

a. The market as a public revealer of intrinsic value

Objective information

Information

Market

Fundamental value

b. A common convention emerges through the interaction of market participants

Market

Price = Common convention

c. The stock market makes participants' interpretations interact with external information

Objective information

Information

Market

Speculative value

pensive to acquire, no one will look for it if they can't make a profit. It follows that the market price no longer contains any exogenous information! This is the *self-fulfilling* hypothesis illustrated in Schema 1b. It is as rational as the previous one (Orlean, 1999). But it escapes criticism because it is produced inside the market. This means that everyone believes in the judgment about the price of the market as a whole, that is to say, the community of all the participants. The "truth" of the price comes from self-validation. This means that each person's opinion of everyone's opinion converges on a common assessment. The belief is true because it is self-validated.

Schema 1c shows that it is possible analytically to combine the first two schemes when the market participants take external information into account. The opinions of the participants on exogenous information are diverse, and their transformation into a common opinion is the fruit of the intersubjectivity that comes from the effort of interpretation through the market.

There is one additional difficulty for the proposition that the formation of the market price reflects the fundamental value, which has been noted by Edouard Challe (2005): the fundamental "value" (*FV*) is supposed to result from a particular trade-off equation because it equalizes the return to equity with itself! This is written:

*(FV) (1 + risk-free interest rate + equity risk premium) =
rational anticipation of future dividends + expected capital gains.*

But the equity risk premium is just as unknown as the FV. It follows that the trade-off equation with two unknowns is undetermined. There are an infinity of evaluation models that are compatible with the trade-off equation according to one's interpretation of the equity risk premium. This, and hence the discounted rate of expected future dividends, is a belief held by market participants about the beliefs of others. So models 1b and 1c have operational significance. *The financial markets create the value of assets, they do not merely reveal a pre-established value*. It follows that beliefs about the future (counterfactual time) have a major influence on the trajectory of the real economy (objective time).

The fundamental value is therefore a statistical artefact of the trajectory of past market prices. While the market convention changes as a result of a change in the self-fulfilling perception of liquidity that will change the future market price, there is no certainty that the fundamental value might not change as well – but less or more than the instantaneous value of the market? This depends on the self-fulfilling interactions of the actors with respect to the interpretation of the change in liquidity. In a downward move of the market, there may be balancing speculation in anticipation of a turnaround in the market price. But there can be unbalancing anticipation by continuing downward pressure. It depends on the interactive judgment of the market participants. Interpretation is what matters in a non-stationary world. The strength of collective interpretation, when it is established in a convention, is that of a symbol. It is a powerful cohesive force, giving a sense of belonging to a community, as shown by Emile Durkheim who

sought the source of the cohesive force of the sacred. In converging to a convention of evaluation, a financial community becomes aware of itself as an institution.

1.4. The liquidity of financial markets, the interdependence of the participants and the multiplicity of equilibria

The logic of asset price formation is all the more influenced by inter-subjectivity (Schema 1b) than the interpretation of exogenous information becomes more uncertain, because the diversity of private opinions, resulting from the participants' own interpretations, becomes broad. Due to this heterogeneity in viewpoints, the participants doubt their interpretation; they become more sensitive to the opinion of others. Mimetism becomes a preponderant force in the market. Self-referencing brings out a market convention that becomes so increasingly detached from exogenous price factors that these become increasingly subject to extreme variations.

The opinion of others is preponderant because any financial market is subject to the empire of liquidity. But the liquidity of a financial market reflects by its very nature an interdependence of opinion. When a common agreement is established, in the sense of a belief shared on the opinion of others, the information flows that criss-cross the daily market exert a weak influence on the price. Since the sharing between buyers and sellers is only slightly affected, the market makers can act to counterbalance the endemic imbalances and continually establish an equilibrium price with small variations in the current price. The participants are then convinced that the market is liquid, because they can buy or sell at any time without pulling the market price in their direction.

This is no longer the case when the perception of balance sheet risks is triggered by changes that affect debt conditions or information that casts doubt on the convention theretofore taken for granted. The erosion of the convention creates divergences in opinion, which are reflected in the emergence of market volatility and possibly skewness. The calling into question of belief comes from a large-scale shock or from a series of shocks whose interpretation casts doubt on the estab-lished convention. The waning of the convention comes from the diversity of interpretations about the meaning of the shocks. When the unity of the belief is broken, without another one being firmly estab-lished, the diversity of opinion criss-crosses the market, resulting in

ephemeral market prices, as the interpretation of the shocks fails to converge on a stable common meaning (Chart 1).

Movements among different categories of opinion can lead to an aggregate demand function that increases with price over a range of its variations (Gennotte and Leland, 1990). In Chart 1, the agreement A1 is a high valuation. The shift $A_1 \rightarrow A'_1$ 1 indicates a continuous decline in price coming from pressure on the supply in the market. This produces a conflict of opinion about the meaning of this movement, leading to two possible equilibria A'_1, A'_2, leading to an increase in market volatility. If the force driving the supply intensifies, the market suffers a crash, which leads it to the low equilibrium A_2.

Chart 1. Multiple equilibria on the financial markets
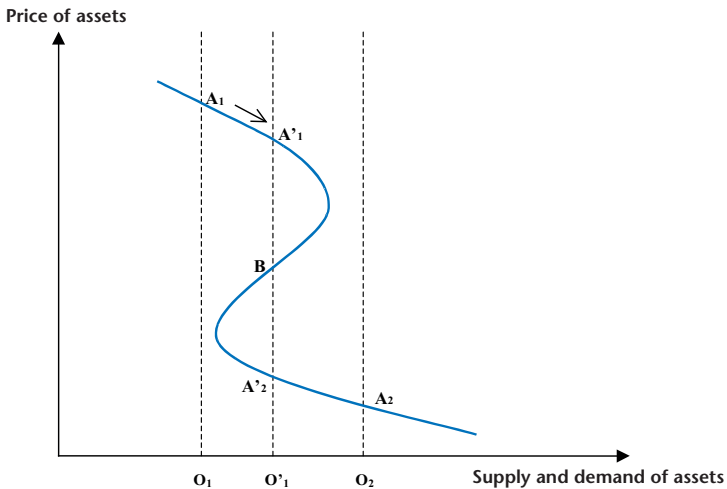
Source : auteur.

It follows that asset markets subject to the logic of *momentum* contain multiple equilibria. The main question is to understand how the possibility of multiple equilibria is transmitted from finance to the macroeconomy.

1.5. The logic of *momentum* and the financial cycle: the hypothesis of financial instability

Counterfactual time pertains to all asset classes that give rise to financial transactions, since it is inherent in the uncertainty of the future. It follows that perfect knowledge of the risk included in debt

contracts, which is essential for establishing the neutrality of the financial structure with regard to investment choices, does not hold. Debt-financed investment is not equivalent to equity-financed investment. Balance sheet risks depend on the structure of financing and influence the trajectories of capital accumulation.

The history of capitalism is punctuated by financial crises. The great historian Charles Kindleberger (1996) has shown that crises are critical moments, endogenous to the more general dynamic of financial cycles. This dynamic describes cycles that are on a larger scale with a longer periodicity than business cycles. Their logic is bound up with the interaction of changes in the indebtedness of private actors and the price of assets. This dynamic is a *momentum,* in the sense that it is self-reinforcing, because it does not involve an expected return on pre-established and known fundamental values. It was systematized by Hyman Minsky (1982).

The financial cycle can be described in five sequential phases: boom; euphoria; climax and crisis; ebb and the onset of pessimism; debt deflation and the restructuring of balance sheets. The boom phase generates behaviours that weaken the financial system, while the worsening of credit conditions is hidden from the actors, because the euphoria of the asset markets blurs the quality of price information. Fragility creeps in when borrowers, who perceive opportunities for capital gains on assets, resort to using increasing debt to maximize them.

For their part, lenders may be subject to the illusion of apparent solidity in a phase of steadily rising asset prices. They expect that the value of the assets that constitute the collateral for their loans will appreciate, thus guaranteeing their debts. In this situation, competition drives them to approach potential borrowers because the collateral is both a source of wealth for the borrower and insurance for the lender.

There is therefore a reciprocal feedback loop without mean reversion when the anticipation of the rise in asset prices is the primary determinant of credit expansion, because the simultaneous increase in both supply and demand for credit prevents the interest rate from rising when demand for credit increases. The cost of credit cannot therefore regulate the demand for credit by slowing its growth (Chart 2).

When credit applicants are motivated by the anticipation of increasing their wealth through the appreciation of assets, the shift to the right of the demand function is reflected in the supply curve in the same direction. Indeed, credit providers have the same optimistic

perception of the asset market. They therefore think that the collateral for their loans will increase in value faster than the amount of their loans (a decreasing loan-to-value ratio in the euphoric phase) and hence that the probability of a default on loans, based on the principle of Value-at-Risk as perceived by the banks, will decrease.

Chart 2. Interdependence of supply and demand for credit
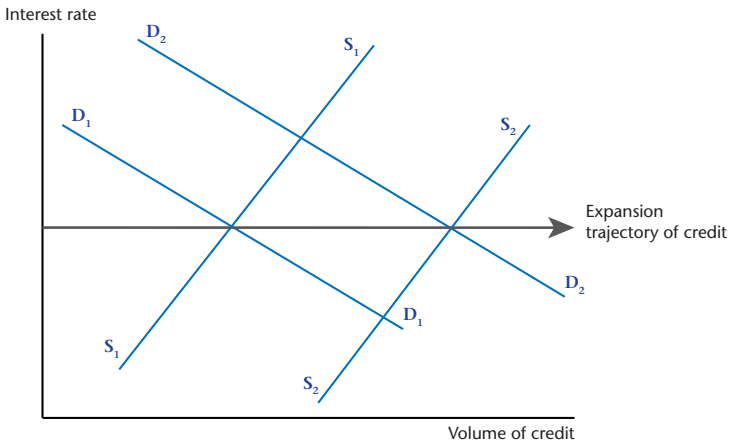
D_1D_1 and S_1S_1 : demand and supply of credit for an asset price P_1
D_2D_2 and S_2S_2 : demand and supply of credit for an asset price $P_2 > P_1$.
Source: Author.

Schema 2. The infernal circle of runaway euphoria
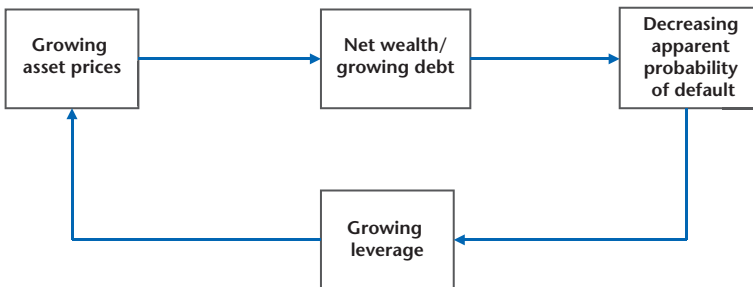
Since the balance sheet weaknesses that accumulate do not appear in the market indicators, the supply of credit increases with demand and the interest rate remains stable or even falls as indebtedness accelerates by crushing risk premiums. This phenomenon was seen in the large-scale real estate speculation from 2003 to 2006, as credit spreads

declined while the expansion of credit accelerated. This dynamic means that, when speculators have entered the bubble, they have an interest in staying there, and the price momentum attracts new players. The result is a runaway spiral of euphoria (Schema 2).

1.6. The dangers of balance sheet deflation

The downturn in the financial cycle is dominated by the deflation of the balance sheet. The behaviour driving the contraction of the private sector in this phase is the need for deleveraging (Fisher, 1933). But nothing is more difficult to achieve than an orderly reduction in debt leverage (Koo, 2003).

In the case of financial markets organized by liquidity, it has been shown that valuation agreements are institutions which, when they erode and eventually collapse under the effect of the resurgence of mimetic rivalry, cause enormous financial disturbances that spread through mimetic contagion. In these situations, credit constraints differentiated according to the categories of agents play a determining role in the duration and intensity of the financial crises – because the debt has a strong impact on the behaviour of the individual agents.

Systemic crises pose problems for the resilience of financial structures, problems not known to representative agent models, based on the exogeneity of fundamental values. Studying resilience requires developing what are called stock-flow consistent models (Battiston *et al.*), that is, models based on the interdependence of balance sheets and flow accounts between agents.

In a downturn in a market subject to an asset price bubble, the debt-to-market value ratio of assets increases sharply because the value of assets crashes, while the value of debt has not yet fallen. The financial situation of businesses and households deteriorates despite efforts to improve the balance sheet structure. The constrained rise in the weight of indebtedness in a recessionary phase is the crucial characteristic of financial deflation. There is clearly a "coordination failure".

Indeed, it is rational for each borrower to try to avoid bankruptcy, and so to seek to deleverage as quickly as possible. However, following a financial crisis that has reversed the cycle, many borrowers are in the same situation, meaning that the combination of their actions causes a decrease in economic activity, and hence in the income of those seeking to deleverage, which as a corollary no longer have the where-

withal to do it. The financial situation worsens as debt weighs heavier on income, due to the depressive effect of the thwarted deleveraging.

This is why the process of restructuring the balance sheets is long and fraught with difficulty, especially since the deterioration of borrowers' balance sheets has repercussions on the lenders. Given an unchanged economic policy, this leads to an increase in the cost of credit and a rationing in its volume, which makes it all the more diffi-cult to refinance debts and puts an immediate liquidity constraint on the indebted agents. Since the aggregated demand for one period determines the income for that period that is spent in the following period, the nominal growth rate declines as deleveraging outweighs efforts to relaunch private sector spending (Leijonhufvud, 2008).

Can economic policy halt or shorten the depressive phase of deleveraging? What is called unconventional monetary policy can lower and flatten the entire interest rate curve in order to encourage spending by the economic actors whose balance sheets are the least vulnerable. But the danger of re-instigating financial instability calls for a more comprehensive understanding of monetary policy, and hence research to include macro-prudential concerns.

Fiscal policy is more effective because it allows the state, as borrower of last resort, to spend in ways that offset the downturn in private spending. However, this offset requires vigilance when it takes the form of debt-financed spending, as outstanding private bank debt is replaced by outstanding public bond debt. While counter-cyclical fiscal policy has most often been designed while leaving aside any concerns about the financial cycle, the impact of such policies on finan-cial stability will differ significantly depending on whether the policy bears on current expenditure or capital expenditure and whether it takes the form of debt or equity. The complementarity of public and private investment, as well as public approaches that allow private actors to extend their time horizons to avoid being trapped by the *momentum*, are very important issues for research.

2. Financial Cycle and Macroeconomics

The cross-interactions between the financial cycle and the economy escape the economic theory of efficient markets, since balance sheets and the way they change play the primary role. It is the dynamics of

stocks that dominate the macroeconomy in the historical time of the financial cycle (16 to 20 years).

A synthesis of the views of the Bank for International Settlements (BIS), which has studied the financial cycle for 25 years, on the links between the financial cycle and the macroeconomy provides a useful framework (Borio, 2012). According to the theoretical hypothesis of momentum, which is inherent in finance and bathed in uncertainty, economic fluctuations are amplified by financial dynamics, which thus impart a pro-cyclical character to macroeconomic dynamics.

The interaction between the financial cycle and the macroeconomy stems from the five characteristics highlighted by the analysis of financial cycles. First, the financial cycle is described in terms of the joint dynamics of private credit and asset prices where real estate plays the preponderant role. Second, the financial cycle structures economic temporality in the medium term. The long term is the historical sequence of financial cycles. Third, the peaks of the financial cycle are closely associated with financial crises. Fourth, if one is able to measure the feedback loop between credit and asset prices in real time, the accumulation of weaknesses within the financial structures can be detected well in advance of the outbreak of the crisis. Fifth, the amplitude and duration of the financial cycle depend on the system of economic regulations.

These characteristics raise the problem of the interaction between the financial cycle and the macroeconomy. The first problem is the tragedy of the horizons. The decision-making horizons of those involved in finance and economic policy-making are not adjusted to the horizon of the financial cycle. On the contrary, the rise of systemic risk dramatically reduces the decision-making horizon by imposing the dictatorship of liquidity, for stocks dominate the macroeconomic dynamics, with all their balance sheet risks. The financial cycle determines fluctuations in the natural interest rate, as suggested by Wicksell. The natural medium-term rate varies with balance sheet imbalances, as stock imbalances have effects on flows (new credit / GDP) over long time periods in both phases of the financial cycle. This is behind the appearance of multiple medium-term growth equilibria.

With these channels of interactions in mind between financial and real phenomena, let's examine a few theoretical approaches to macroeconomics that are compatible with the financial cycle.

2.1. Wicksell (1907) and the financial accelerator

This theory, in which credit plays the leading role, ruptures with the metaphorical capital market based on so-called "strong" efficiency, which determines the equilibrium price between savings and investment. The symmetry between a savings supply function and an investment demand function does not exist. The investment behaviour of companies is decisive. It depends on the ratio between the expected rate of return on investment (marginal rate of return on capital) and the cost of capital, which is related to credit conditions. It is, in fact, credit that allows companies to carry out their projects by freeing themselves from having to make prior savings.

Wicksell thus defines a neutral interest rate for which the cost of capital is equal to the anticipated marginal rate of risk-adjusted capital. At this rate, aggregate supply and demand are progressing together, without any pressure on the savings-investment equilibrium due to an excess or insufficiency of loanable funds. But the movement of the real interest rate on credit above or below the neutral rate does not necessarily produce re-equilibrating forces. Waves of rising and falling capital and credit assets then generate long-term financial cycles.

The Wicksellian disequilibrium, generated by the effect of the creation of internal money on the accumulation of capital, can be represented by Schema 3.

Schema 3. Wicksellian disequilibrium: inside money creation and capital accumulation

| Monetary creation or de-hoarding | → | Excess of loanable funds | → | Interest rate on credit ↓ | → | Investment demand ↑ |
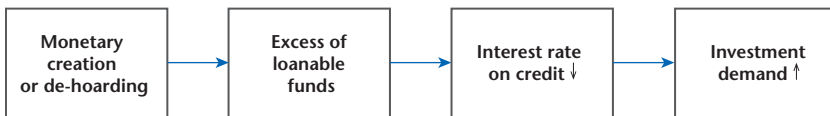
Credit allows companies to realize their investments through savings forced by inflation. This savings results from the swelling of corporate profits with the rise of the mark-up. It is a function that rises with inflation. Moreover, inflation lowers the real interest rate, reducing the cost of capital and stimulating investment, which is also a function that rises with inflation. The equilibrium inflation rate is the one that meets the expectations of company performance.

In a monetary economy, the current conditions of demand influence the structural conditions of production. There is therefore no definable normal rate. The anticipated marginal return on investment is an uncertain, essentially unstable variable. This conclusion brought together Hayek and Keynes. The indifference of monetary policy to financial dynamics, whether its key interest rate is inert or follows a Taylor rule, fuels the financial cycle. Variations in the return on capital lead to variations in accumulation, which are amplified by the elasticity of the credit supply. They are reflected in deformations in the relative prices of assets.

The pro-cyclical character of the capitalist credit-driven economy is formalized in the model of the financial accelerator (Bernanke, Gertler, Gilchrist, 1999). The financial accelerator has a Wicksellian inspiration, because credit plays a major role in it. It has a real sub-model and a financial sub-model. The main link between the two sub-models is investment. It influences the real economy through the channel of productivity and prices on the one hand, and through the income multiplier and aggregate demand on the other. This influence is complemented by wealth effects that affect household consumption. The financial sub-model is what explains how the determination of investment depends on financial variables that enhance the impact of demand prospects on investment – hence the name, the financial accelerator.

The principle of the financial accelerator is the broad channel of credit. In a Wicksellian economy, the supply of bank credit is elastic. Banks do not quantitatively ration credit. They thus do not influence the cycle by the narrow channel of credit, that is to say, by variations in the intensity of the quantitative rationing of their supply. This is the situation in finance today, where banks have multiple ways to finance their loans and multiple ways to transfer their risks.

The broad credit channel is the process by which credit stimulates investment by increasing the net worth of businesses through increases in the real price of equities. The increase in companies' net worth reduces the likelihood of default perceived on debt securities markets. This reinforces their incentive to increase credit leverage in order to invest in accordance with the rate of returns that they anticipate. There is therefore clearly an acceleration effect as long as the interdependence between credit and firms' net worth is mutually reinforcing (Schema 4).

In the phase of the euphoric boom, Wicksell's inflation can be countered by an increase in productivity brought by investment, which increases corporate profits and savings. In addition, the rise in the stock market, which boosts companies' net worth, is reinforced by the decline in the preference for liquidity in an optimistic market climate. This decline increases demand for equities and reduces demand for money or slows its growth relative to the other components of savings. This is because the joint rise in corporate net worth and household wealth changes the structure of savings. It is thus the shift in the structure of the balance sheets, for both productive investors and savers, which guides the financial accelerator to induce a cycle of real activity without any significant variation in inflation in the market for goods. It is as if inflation due to credit dynamics were displaced from goods and services to stock prices.

Schema 4. The financial accelerator
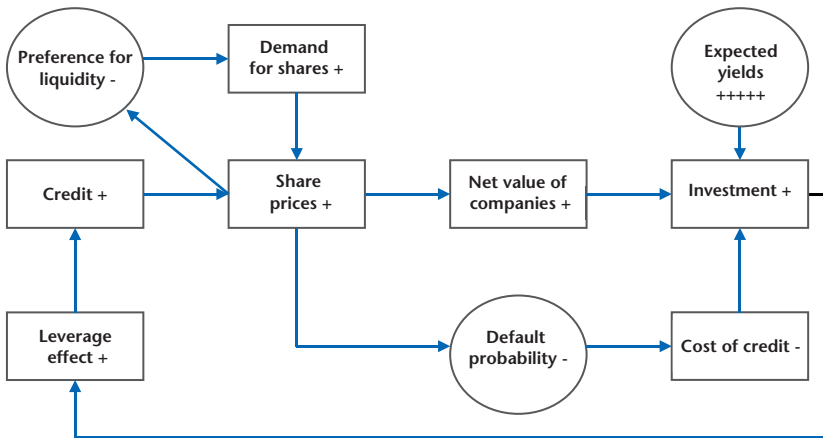
Several endogenous factors can cause the reversal of this process of expansion through credit and rising asset prices. In pure Wicksellian logic, it is the inflation required to bring about forced savings. In an economy with endogenous internal money, no market mechanism can lead it to a stable equilibrium. However, depending on the system for the regulation of the labour market, the growth in investment causes an increase in employment, which accelerates a rise in wages above the rise in the selling prices of goods. This increase in production costs then leads to lower margin rates. The deterioration in the operating accounts is reflected in stock prices. As firms' financial situation

becomes less favourable, investment turns around and causes the economy to slow down or even enter a recession. Moreover, it is enough for doubt to arise about corporate profitability for the stock market to be hit by a rise in the risk premiums on equities. This down-turn in the stock market is reflected in the assessment of the likelihood that borrowers will default, thus raising the risk premiums on credit and exposing the excess of debt.

2.2. The macroeconomic impact of the financial cycle in the Keynesian tradition

The structure of the capital / labour relationship, its dependence on the monetary institution and its macroeconomic implications form the core of Keynes' general theory. According to Keynes, capitalism is a monetary economy of production that secretes power and subordina-tion in its structuring relation: the wage relationship. The conditions of access to money in this relationship are unequal. It is the capitalists who have access to money to finance the acquisition of the means of production; the employees are those who have access to money by hiring out their capacity to work. What is called the employment contract does not exchange labour but rather the capacity to work in exchange for money. Individual employees are free to hire out their capacity to work to any enterprise owner – but they are subordinated to the hierarchical relationship in performing the contract.
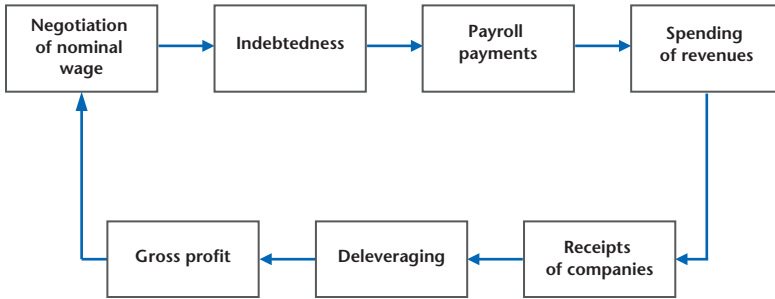
The demand of firms for the use of labour capacities at a given level of the monetary wage depends on the anticipation of their future sales (effective demand) and on their view of the rate of profit they hope for the accumulation of the capital they are seeking. But capital accumu-lates in many forms. Liquidity is the pivot of these opportunities. Assets not produced on the basis of the search for profit through speculation, the most important of which being real estate, changes in ownership (mergers and acquisitions) and share buybacks are essential compo-nents of the accumulation choices. Finally, there is productive investment for the creation of new value, which induces demand for new labour capacities. Finance, by determining the structure of asset returns, orients companies' strategies towards one or another form of capital accumulation.

The most faithful interpreter of Keynesian logic in macroeconomic modelling is Kalecki (2007, paperback). Savings and investment are not equilibrated by the real interest rate. The equalization of savings

and investment is an accounting identity that determines the aggregate amount of profit. The hierarchy of the wage relationship is reflected in the determination of overall expenditure: *companies earn what they spend; households spend what they earn.*

Company decisions are logically anterior to those of the other agents in the capital circuit (Schema 5).

**Schema 5. The capital circuit in the monetary economy of production**

Negotiation of nominal wage	→	Indebtedness	→	Payroll payments	→	Spending of revenues
Gross profit	←	Deleveraging	←	Receipts of companies		

They do not depend on it causally. They depend on it counterfactually through the impact of demand expectations on the decision to invest, thereby influencing the demand for credit. Investment and therefore the level of production are independent of savings within a period of circuit. But aggregate profit depends on it. The investment stems from management's expectations about the marginal return on capital (long-term expectations). The level of economic activity, and therefore employment, depends on the anticipated demand for the different price levels of the product. With this perceived demand curve, called effective demand, companies determine the supply price that allows them to maximize their profit. The supply price is the result of the mark-up, which is characteristic of the maximization of company profit in an oligopolistic market environment.

In the equilibrium of the period shown in Chart 3, where the capital stock is given, the aggregate supply curve (AS) depends on the nominal wage and the business mark-up, and is influenced by productivity and the rate of use of production capacities. The aggregate demand curve (AD) depends on the propensity to consume, which is itself influenced by the wealth effects of the different categories of consumers; it also depends, above all, on the expectations of corporate

profitability that link the present period to the future, and therefore on the accumulation of capital. The general level of prices *p** and the level of activity *Y** result from the intersection of (AS) and (AD) (Chart 3).

Chart 3. Aggregate supply and demand in the Keynes-Kalecki model
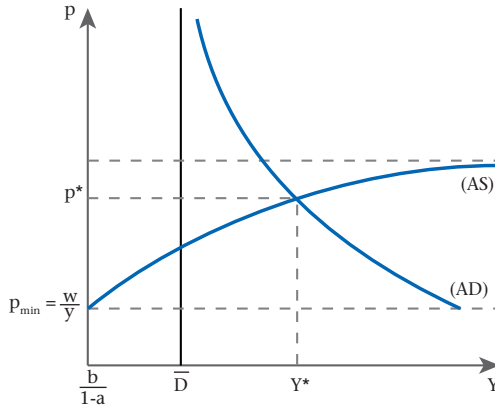
p varies between p_{min} and p_{max} *when the share of profits varies from* 0 to 1-a.

b/1-*a* is the breakeven point (net level of production for which the share of profits cancels out in overall net income).

(*p*, Y**) is the equilibrium of the period for a given level of K.

Source: Author

The role of indebtedness is very important. Companies have a need for working capital that is provided to them by monetary creation. The investments desired by companies do not match with the savings desired by the other agents. That's why investment can be low in a world of abundant savings. This point needs emphasizing; in the monetary economy of production, there is no capital market determining an equilibrium interest rate. The overall investment resulting from business projects determines the global savings through the realization of profit. Monetary policy acts on the cost of credit, and therefore on investment at given expectations of profitability. It also affects households' propensity to consume through consumer credit. Fiscal policy acts directly on the exogenous component of aggregate demand.

In this process, the medium-term supply curve (AS) depends on short-term displacements. The trajectory of the economy is path-dependent. Thus recessive shocks on aggregate demand foster hysteresis factors on the supply curve. A low level of activity can become a medium-term equilibrium with permanent unemployment. The shocks

most likely to cause hysteresis effects are severe financial shocks that affect balance sheets during downturns in the financial cycle. A medium-term equilibrium with underemployment, metaphorically called "secular stagnation" when it concerns the medium-term equilibrium associated with the depressive phase of the financial cycle, may result.

2.3. A Fisher-Minsky-Koo model of secular stagnation

The first feature of this model, proposed by Eggertsson and Krugman (2012) from the Keynes-Kalecki perspective, is that it dispenses with the hypothesis of the representative agent. There are two types of agents: those who borrow and those who save, this distinction being structural. Borrowers face a debt limit that cannot exceed the discounted value of their anticipated future income. This debt limit is set by the market convention resulting from the common opinion of the community of investors-savers about the debt level of purportedly secure borrowers.

This view changes over time in accordance with Minsky's perspective. Rising asset prices lead to euphoria, which fosters a lax attitude on the part of the investor community towards borrowers' debt leverage. There is therefore a high debt limit during the expansionary phase of the financial cycle. The Minsky moment, that is to say, the outbreak of the financial crisis that reverses asset prices, quickly plunges the debt limit to a low level. This implication results from a tightening of collateral constraints as the saver community suddenly realizes that assets have been overvalued. Deleveraging ensues as debtors strive to reduce their debt to the low limit. It follows that the natural interest rate becomes endogenous to the trajectory of the deleveraging. This is self-sustaining Fisherian debt deflation.

When the downturn in the financial cycle produces a systemic crisis, the natural rate becomes negative because the deleveraging required is very substantial. The subsequent fall in output lowers the price level in such a way that real indebtedness increases rather than decreases. Borrowers consume less and savers do not have an incentive to consume more since the market interest rate is stuck at zero. The thwarted deleveraging is therefore reflected in a demand curve (AD) that increases as a function of price. The inversion of the AD slope generates a stable underemployment equilibrium if the slope of AD is higher than that of the AS curve. This is because the slope of AD

increases with the decrease in the weight of borrowers in the total output (Charts 4a and 4b). It is therefore the gap between the upper limit and the lower limit of the debt that makes possible the transition to a dual equilibrium.

As Richard Koo points out, it is the fall in investment that produces the sufficiently strong contraction in aggregate demand when the difference in real debt $D^{high} - D^{low}$ is large. This fall is due to the widening of the spread provoked by the financial crisis.

Chart 4. Macroeconomic equilibrium according to the amplitude of the deleveraging shock
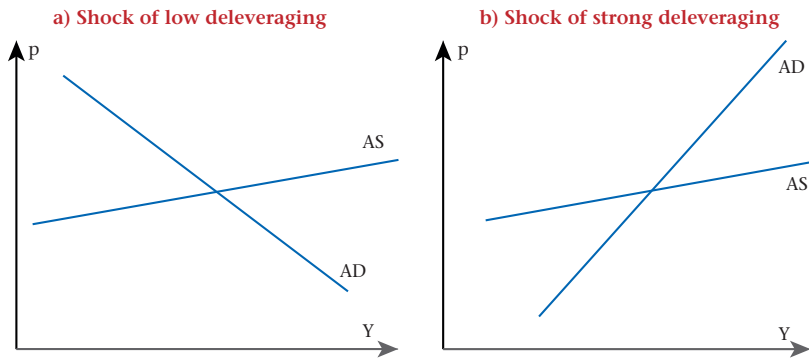
Source: Author.

The financial crisis that leads debtors' constraints to move from a high limit to a low limit of indebtedness is an uncertain event that suddenly changes attitudes towards liquidity. It pushes the interest rate sharply lower on the liquid securities that savers are rushing to and explodes the spread incurred by borrowers for a given level of debt above the new low limit. The thwarted deleveraging ensues. The Minsky moment happens when the spread jumps and forces borrowers to change their strategy. The characteristics of a systemic crisis then emerge: the rational behaviour of each borrower informed by the increase in the spread causes the deterioration of the situation of everyone in line with the Fisherian scheme described in Chart 4.

When the economy is settled into the low equilibrium, one can account for the famous Keynesian paradoxes of thrift, toil and flexi-bility. Keynes's "paradox of saving" says that if everyone tries to save, there will be less aggregate savings. The "paradox of toil" says that if everyone tries to work more there will be less aggregate work. The

"paradox of flexibility" says that increased price and wage flexibility can make it harder for borrowers to deleverage instead of increasing demand, since borrowers are more constrained and savers expect the fall in prices to continue (Fisher effect).

These paradoxes concern in particular the pitfalls encountered by fiscal policy in the low equilibrium of thwarted deleveraging. It is generally agreed that under normal circumstances, where nominal interest rates are positive, a policy of reducing taxes on labour is expansionary. This is not the case when nominal rates are null or negative. Tax cuts become recessive if they are designed to lower the marginal costs of labour or capital, because these tax cuts increase the real interest rate through the price reductions that they lead to, with the central bank being unable to offset this. This is Eggertsson's paradox: "The main goal of a policy, when base rates are zero, should not be to increase aggregate supply by changing the incentives. Instead, the goal should be to increase aggregate demand, in other words, the overall level of spending in the economy."

Budgetary policy is indeed the main tool for trying to pull the economy out of the low equilibrium. It is also necessary to consider its use in a context of a low pressure equilibrium. If there are significant deleveraging constraints, it means that a number of private actors, which is high enough to induce a macroeconomic effect, have a limited or no capacity for new borrowing. The importance of public investment, that is a borrower of last resort capable of extending horizons, cannot be underestimated. The additional liquidity, coupled with an increase in the stock of public assets in the economy, allows an expansion of private demand by relaxing the debt burden of these agents, as the increase in the stock of government securities raises the collateral on private loans. There is therefore a "crowding in" of private expenditure, that is to say, a multiplier effect.

2.4. Growth and stagnation: the dual equilibrium in the face of the intergenerational problem

Overlapping generations models (OLG models) have a double virtue. On the one hand, they require a public asset accepted by all to transfer the savings between generations, and on the other hand, by structure they get rid of the representative agent.

In a three-generation model, indebtedness is essential to the functioning of the economy. Generation 1 borrows from 2, which

saves for retirement. Generation 3 consumes all its income and sells all its assets. Young people are subject to a debt limit, which is linked to repayment constraints when they reach middle age. The size of each generation and thus population growth are taken into account. The equilibrium between the supply and demand for loans determines the "natural" interest rate in each period (G. Eggertsson, N. Mehrotra and J. Robbins, 2017).

This equilibrium rate falls as population growth slows, with the tightening of young people's debt limit and with the decline in the relative price of capital goods. The point is to study the effects of this last process associated with the financial cycle (variation $D^{high} - Dlow$) in the OLG model. The same configuration can be revealed: a negative real interest rate running up against the zero nominal rate barrier under the assumption of flexible prices in a model with endowments.

The greater constraint on youth indebtedness shifts the credit demand curve downward and lowers the equilibrium interest rate from point A to point B in Chart 5. If the tightening of the debt limit constraint is strong enough, the equilibrium rate can become negative. In the next period the young have become middle-aged savers. They must save more for their future retirement in order to offset the decline in income from the previous period because of the restriction on indebtedness. This is why the credit supply curve moves to the right and the equilibrium interest rate drops further from B to C. The natural rate becomes permanently negative.

Chart 5. Impact on the natural interest rate of credit constraint tightening on young people
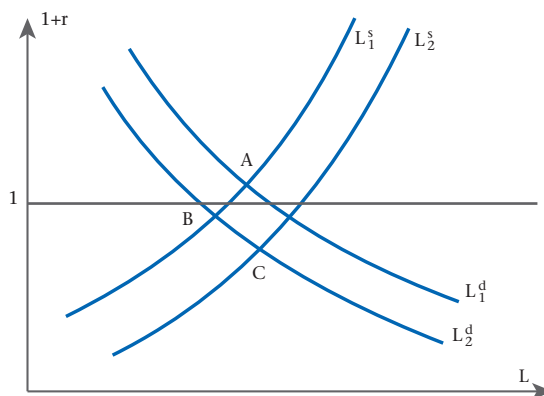
Source: Author.

The medium-term equilibrium will be "full employment" or "stag-nation", depending on the extent to which the debt constraint has tightened, because of the change in the slope of the aggregate demand curve in a model with the production and accumulation of capital.

3. Conclusion

Taking the financial cycle seriously in macroeconomic research on finance is an urgent priority. This approach is meeting fierce resistance, because it rejects a dogma, that of a unique fundamental equilibrium guided by the efficiency of finance. We have seen that what is at stake is the conception of homogeneous time in economics and of the repre-sentative economic agent.

Finance operates under the monetary constraint, which it seeks to circumvent and overcome by creating new forms of money. It involves a diversity of actors, goals and horizons in complex systems. The complementarity of flows in exchange networks is here just as essential as substitutability. What is needed is a theory of the viability of interde-pendent networks. The central concept is not efficiency, but resilience. This representation of finance must be concerned above all with finding the most appropriate modelling of systemic risk (Battiston *et al.*, 2012).

Such modelling will make it possible to define and measure the indi-cators of financial vulnerability and their power for contagion, which can be used to develop macroprudential policies that are integrated into monetary policy. It is only by developing such policies that central banks will be able to argue that they are taking into account the stability of finance as a system.

Another characteristic of resilient systems is the presence of "nodes", that is to say, actors who, through their aims and strategies, respect the self-referentiality of the financial markets. They are the long-term investors, those able to break out of the tragedy of horizons. In-depth studies on what constitutes long-term finance are essential to the effort to promote sustainable growth. This requires the comple-mentarity of public and private investment for new collective challenges with citizen support.

What are the criteria for long-term investment? This is an area of research that should be a priority. The horizon for covering the finan-cial cycle is 15 to 20 years. This allows an integrated management of

assets and liabilities that incorporates the investor's social commitments. But how can financial value be created that takes into account the sustainability of growth? Environmental, social and governance (ESG) criteria must be taken into account in the financial evaluation, which is still a relatively untouched area of research.

Behind this question lies the fundamental problem of the accounting and design of the firm. As long as the firm is considered the property of its shareholders, the definition of capital will necessarily be narrow. But a macroeconomy of sustainable growth requires a broad conception of capital as social wealth, along with corporate social responsibility that translates into accounting terms and involves stakeholder governance.

This new era of economic research will certainly demand social change.

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THE INSTABILITY OF MARKET ECONOMIES[1]

Franck Portier
University College London

The modern approach to macroeconomic fluctuations considers that the economy is fundamentally stable, and fluctuates around a stationary state because of exogenous shocks. This article presents some thoughts and avenues of research for a different approach in which the decentralised market economy may prove to be fundamentally unstable and thus fluctuates both endogenously and exogenously. This has implications for the conduct of macroeconomic stabilisation policies.

Keywords: cyclical fluctuations, endogenous cycle, non-linearity

Acommon narrative of recent macroeconomic history considers that from the mid-1980s onwards, OECD economies entered a period of "great moderation" during which macroeconomic volatility was significantly reduced (Cecchetti, Flores-Lagunes & Krause [2005]). This great moderation would be partly due to smaller shocks and partly to better policies, particularly monetary ones. According to the same narrative, the belief in the "end of economic history" would have been called into question by the 2007 crisis, which would have brought up to date the financial dimension of economies, as generating shocks and amplifying fluctuations. Another reading is possible, according to which the economy has not undergone any major change in its fluctuations since the end of the 1970s.

Before presenting this alternative view, let's ask ourselves how macroeconomic theory intends to explain fluctuations? One can identify two alternative approaches. According to the first, the economy is

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1. This article takes up considerations developed in my work with Paul Beaudry and Dana Galizia.

inherently stable, and market forces tend to place it along a relatively smooth growth path that fluctuates with technological, demographic and "societal" changes (such as the emergence of digital technologies, higher life expectancy or female participation to the labour market). Provided that the conditions for the proper functioning of markets are guaranteed, if necessary through "structural" policies, stabilisation policies are essentially useless. Under the second approach, market economies are fundamentally unstable, moving from expansions to crises, from periods of overheating to persistent episodes of high unemployment. Economic regulation is therefore essential to correct markets failures in the cycle.

1. The Modern Macro-Economic Approach to Fluctuations

Where do we place the modern macroeconomic approach, as exemplified by Smets and Wouter (2007) for its pre-financial crisis incarnation and Christiano, Eichenbaum and Trabant (2015) for its post-financial crisis one, on a line which goes from "laissez-faire" to the imperative need to regulate naturally unstable markets? Not surprisingly, somewhere in between. But we believe that these models, developed in universities and used by central banks and budgetary authorities are by nature closer to the former view than to the later. Indeed, these models are essentially based on the idea that a decentralised economy is stable and that market forces by themselves do not create expansions and recessions. If cycles are observed, it is because external forces, "shocks", destabilise a system whose natural tendency is the return to equilibrium. Why is such an approach dominant in contemporary macroeconomic thinking? For three main reasons. The first is that when we zoom out and look at market economies over a long period (say the last 100 years), the striking feature we observe is steady growth in real per capita income, not instability, as illustrated in Chart 1(a). If we exclude the two world wars, we certainly observe fluctuations around the growth path, but these appear relatively minor. The economy appears to be broadly stable. As Prescott (1999) writes,

> "*The Marxian view is that capitalistic economies are inherently unstable and that excessive accumulation of capital will lead to increasingly severe economic crises. Growth theory, which has proved to be empirically successful, says this is not true. The capitalistic economy is stable, and absent some change in technology or the rules of the economic game, the economy converges to a constant growth path with the standard of living doubling every 40 years.*"

We defend below the idea that there is a third interpretation, according to which the economy is globally stable but locally unstable.

Chart 1. GDP per capita and unemployment rates in four major developed economies

| (a) GDP per capita | (b) Unemployment rates |
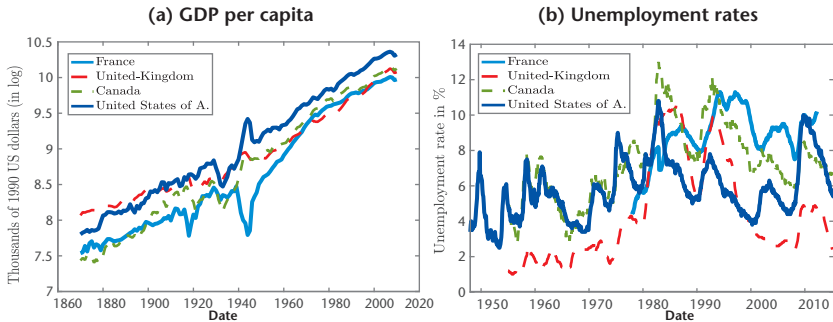
Sources: (a) Bolt et van Zanden (2014) and (b) FRED, Federal Reserve Bank of St. Louis.

The second reason to believe that economies are stable is that in general equilibrium, under certain regularity conditions that are generally verified by macroeconomic models, market forces tend to favour convergence (often monotonous) towards a stationary path (turnpike theorem). Finally, the third, more practical reason is that a view of the economy as stable and perturbed by shocks is compatible with linear dynamic modelling, which greatly facilitates the resolution and estimation of such models, especially when they are stochastic and with rational expectations. As Blanchard (2014) summarises,

> "*We in the field [of macroeconomics] did think of the economy as roughly linear, constantly subject to different shocks, constantly fluctuating, but naturally returning to its steady state over time.*"

2. Towards a Richer Cycle Modelling

To begin with, it seems to us that focusing on the evolution of real per capita income can be misleading when one considers cyclical fluctuations. Indeed, one must eliminate the trend to observe fluctuations, and there is not a indisputable statistical method to separate cycle and trend. If growth (the trend) is the place where factors of production (physical capital, knowledge, human capital, population) accumulate, the cycle is that of variations in the intensity of the use of these factors. Since Keynes, it is the possibility of under-utilisation of factors (under-utilisation of capital and unemployment) that distinguishes cyclical

fluctuations from growth. It seems therefore more relevant to consider the evolution of the employment rate, the capacity utilisation rate or the unemployment rate to understand the cycles. One advantage of such an approach is that we are then dealing with series that do not grow, which makes it possible to circumvent the difficulties inherent to the trend-cycle decomposition. This is what we do in Chart 1(b) by showing the evolution of the unemployment rate in Canada, the United States, France and the United Kingdom. What are we seeing? Two essential things.

First observation, economies alternate expansions and recessions, periods of low unemployment and periods of high unemployment in a quite regular way. We do not clearly see a great moderation from the 1980s onwards, and we do not see such an unprecedented recession from 2007 onwards. Thus, there is a great regularity in the alternation of expansion and recession phases, with a cycle length circa ten years. In a series of recent studies (Beaudry, Galizia and Portier, 2016a, 2016b), we have shown that this regular cycle statistically translates, for many developed economies, into a peak in the spectral density of unemployment and in the rate of capital utilisation. This strong cyclicality contrasts with the conventional wisdom since Granger (1969), according to which there are no peaks in the spectral density of the main macroeconomic aggregates. This absence of marked cyclicality observed by Granger lead Sargent (1987) to define cyclical fluctuations not as a cycle but as a set of co-movements between macroeconomic aggregates. One could rightly say that there are no cycles in the modern approach to business cycles; no cycles in the sense of no peak in spectral density, therefore no alternating phases of expansions and recessions explained by the same propagation mechanism, and independently of the shocks that may affect the economy. In contrast, a cyclical economy would indeed be an economy in which phases of expansion and recession are linked, caused by each other in the sense that recession is the bedrock of future expansion. As Schumpeter writes, "the only cause of depression is prosperity". There is an ancient tradition of endogenous cycle modelling (Kalecki, 1937; Kaldor, 1940; Hicks, 1950; Goodwin, 1951), but it is not found in contemporary macroeconomic models. The reason for this absence is most certainly related to the following second observation regarding Chart 1 (b).

Second obervation, if there is a regularity in the cycle, we are far from a deterministic cycle. A rich modelling of the cycle should there-

fore take into account the marked regularity of the cycle (as in the endogenous cycle approaches), but also its unpredictability. It was undoubtedly the deterministic nature of the cycle in the first generation of endogenous cycle models, and thus their complete predictability, that limited their appeal for quantitative macroeconomy. But combining strong endogenous cyclical forces with shocks, it is possible to propose an alternative view of the macro-economy of fluctuations. In this alternative view, the economy is inherently unstable, but probably not explosive, and hit by shocks that are responsible not for the cycles as such but rather for their unpredictability. This raises the following question: which market interactions are responsible for instability? Before discussing this issue, let us spend some time on a more technical but relevant question, namely the relationship between stability and instability in linear and non-linear models.

3. Stability, Instability and Non-Linearity

In this section, we present the concepts needed to understand instability in a non-linear world (see Beaudry, Galizia and Portier [2016b] for a rigorous discussion). It is convenient to think of macroeconomic modelling as a relationship between the present, the past and expectations of the future. Mathematically, let us write that an endogenous macroeconomic variable X_t, to fix ideas the hours worked per person, is determined by the equation:

$$X_t = E_t \left[F(X_{t-1}, X_{t+1}, \theta_t) \right], \tag{1}$$

where θ represents an exogenous stochastic variable, E_t is the operator of mathematical expectation and F summarises all the mechanisms of the model. The stationary state of the economy is defined as the value X that satisfies equation (1) when the exogenous variable is constant at the level θ, in other words in the absence of shocks – i.e. $\overline{X} = F(\overline{X}, \overline{X}, \overline{\theta})$. The steady state is stable if the economy tends to return to $\overline{X}$ when it is taken away from it (deterministic version of stability) or if when the economy is hit by recurrent shocks, it tends to remain in a neighbourhood of $\overline{X}$ (stochastic version of stability). In a linear world, that is, a world in which the function F is linear, these two concepts of stability are equivalent. To the extent that we do not observe explosive cycles in the data (see Chart 1 (b)), the estimation of a linear model such as (1) will lead to the conclusion that the stationary state is stable. However, the economy can be quasi-cyclical in a linear

world if, following on single shock, it returns to its stationary state with oscillations, creating periods of expansion followed by periods of recession. These oscillations will dampen with time, so that it will take a repetition of shocks to create fluctuations. The fluctuations will not be self-sustained, but they can be largely endogenous if the rate of convergence is slow. However, this is not what estimated macroeconomic models predict. For example, in Smets and Wouters (2017) model, convergence to the stationary state is essentially without oscillations. Why is that? Because these models do not have strong mechanisms linking expansions and recessions. A recession only follows an expansion when negative shocks hit the economy. But the fact that the economy is expanding today doesn't mean it has a higher probability of going into a recession tomorrow. There is no causal relationship between today's expansion and tomorrow's recession.

When strong cyclical mechanisms are introduced (as explained in the next section) and when the model is allowed to be non-linear, it is possible that the economy is found locally unstable, in the sense that it does not return to its stationary state, but globally stable, in the sense that it remains at finite distance from its stationary state. In such a configuration, which is the one we obtain in our estimates, there exists a limit cycle, so that the economy, even without shocks, can oscillate between phases of expansions and recessions. Without shocks, these oscillations would be perfectly predictable, and thus not very relevant to model actual economies. However, in this non-linear environment, shocks will cause variations in the phase and amplitude of the cycle, so that it will not be fully predictable. We now discuss which model structure is likely to generate such stochastic limit cycles.

4. A Macroeconomic Framework with Endogenous Cycles

In Beaudry, Galizia and Portier (2014, 2016b), we develop a theory that generates stochastic endogenous fluctuations. The basic mechanism is that there are incentives for economic agents to coordinate their decisions, that is to do the same thing at the same time. In particular, in an economy where consumers face an uninsurable unemployment risk, one has an incentive to spend more when the others are spending more, because higher aggregate spending reduces unemployment, thus reducing one's own risk of losing its jobs. When the others spend more, one can reduce its precautionary savings (or go deeper into debt) and spends more. In short, one spends more when

the others spend more. This mechanism, also recently modelled by Chamley (2014) and Challe and Ragot (2016), can generate cyclical instability when coupled with a decision to accumulate durable and real estate assets. The endogenous cycle comes from individually rational but socially costly behaviour, which justifies public stabilisation policy. The sequence of expansions and recessions is as follows: at the end of a recession, the stock of real estate and durable goods is depreciated, so that some agents decide to replete it (replace an old car, buy a larger or better located apartment), even if the risk of unemployment is still high. In doing so, increased spending tend to increase output, employment and thus tend to reduce the risk of unemployment, so that some other agents are encouraged to reduce their precautionary savings and spend more, thus creating a cumulative upward effect. This expansion does not stop when the socially optimal level of housing and durable goods is reached, because each economic agent has incentives to spend more, even if everyone rationally predict that the end of expansion is all the more likely when the aggregate stock of housing and durable goods is large. But when households eventually decide to slow down their accumulation by reducing their spending, they create an increase in unemployment that increases risk and further reduces spending. The economy then appears to be in demand deficient regime, and it slips into recession, until assets stocks are reduced enough to bring the recession to an end. The economy then enters again in an expansionary phase. The cycle can exist without shocks, and then be totally predictable. But it is likely that the economy is also affected by events such as changes in perceptions, expectations, technological change, *etc.*, so that the length and amplitude of the cycle vary in an unpredictable way. This stochastic limit cycle mechanism is not a simple theoretical curiosity, and we show in Beaudry, Galizia and Portier (2017) that estimation of such a model places it in a configuration where such limit cycles exist. Shocks are needed not to create fluctuations, but to make them less predictable.

5. Implications for Economic Policy

Such a modelling sheds a new light on what should be the best stabilisation policies in recession phases. Because expansion phases tend to be too long, the economy almost necessarily finds itself in a situation of over-accumulation (of capital, houses, durables) at the end of an expansion. There is therefore some truth in the Hayekian view

that recessions are needed to "liquidate" the excess capital in the economy. According to Hayek, supporting aggregate demand in recessions is inefficient, as it only delays the recovery. In support of that view, no one will argue that in 2008 it was necessary to support demand in the construction sector in Spain, when almost 30% of the 3.5 million houses built since 2001 were vacant. However, there is no guarantee that the pace of liquidation determined by market forces will be socially optimal. In the economy described in the previous section, it can be formally shown that recessions are inefficiently too severe, because the effect on unemployment of individual spending decisions is not internalised. Even if the decrease in expenditure must take place, the decentralized economy over-reacts, and places itself in a regime of deficient aggregate demand. A Keynesian policy that supports aggregate demand is desirable. While it will slow the liquidation and prolong the recession, its benefit will be to reduce unemployment on the way to the recovery. There is a trade-off between the length and severity of the recession and there is no evidence that the market is choosing the right balance between the two.

Such mechanisms, in a non-linear model, also contribute to the debate on "secular stagnation" launched by Summers in 2013. Decentralized economies work well when they are well below their balanced growth path: the capital stock (productive capital, housing and sustainable) is low relative to the level of technology, unemployment is low, the economy is growing. But when the economy becomes prosperous and fluctuates around its stationary growth path, needs are largely satisfied (not in absolute terms, but relative to the level of technology) and the economy then evolves in a very different area of high unemployment, hence insufficient demand and endogenous cycles. It is in a way the fate of prosperous economies to oscillate endogenously and be chronically in deficit of demand.

If the pace of technology decreases, the economy finds itself in excess of capital (relative to this new technology path), and thus by the mechanism previously described, in a situation of structural demand deficit. This structural demand deficit cannot however be absorbed by a policy that supports aggregate demand, since it is precisely the past level of demand and the large accumulation of assets that is the cause the recession: supporting demand means increasing accumulation, and thus ultimately aggravating the causes of the demand deficit.

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TOWARDS A NON-WALRASIAN MACROECONOMICS

Jean-Luc Gaffard[1]

OFCE Sciences Po, University Côte d'Azur, Institut Universitaire de France

This article aims to contrast modern macroeconomic analysis with a non-Walrasian or evolutionary macroeconomics. This debate, which returns to the forefront with each major economic crisis, concerns the nature of coordination problems and the means of resolving them. While modern macroeconomic models describe the inter-temporal optimization behaviour of consumers who are perfectly adapted to their environment and cleared markets, evolutionary macroeconomics focuses on market imbalances that require adaptive behaviours. This contrast affects monetary and fiscal policy as well as the nature of any structural reforms to be carried out. It also affects the type of modelling to be developed.

Keywords: imperfect knowledge, short-term, equilibrium, flexibility, long-term, structural reforms, rigidity.

Neither classical macroeconomics, which is oriented towards the examination of supply conditions, nor Keynesian macroeconomics, which focuses on demand constraints, are able to shed light on the development of market economies that by their very nature are systematically confronted with structural shocks, whether this concerns technologies, preferences or even institutional and organizational forms. Dealing with this challenge requires taking seriously the role of time and understanding how the short-term and long-term are articulated, not in the sense that short-term events might be controlled by a long-term equilibrium identified with an attractor, but because there is no long-term path other than the one resulting from the way in which

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short-term imbalances are linked one after another. In other words, the debate is not between a demand economics and a supply economics, but between equilibrium macroeconomics and disequilibrium macroeconomics, and more broadly between a Walrasian-inspired general equilibrium theory (dynamic and stochastic), now the paradigm of contemporary macroeconomics, and an evolutionary macroeconomics.

This debate, which inevitably brings back to the surface with every major economic crisis, deals with the nature of the coordination problems encountered and how to respond to them. For economists in the Walrasian tradition, markets are systematically cleared through the price mechanism. This is true of the *tâtonnement* mechanism elaborated by Walras as well as the renegotiation mechanism introduced by Edgeworth. This is also true of the mechanism of rational expectations according to which the errors are not correlated over time and do not call for a revision of the agents' plans. This is true, finally, of the coordination on a bad equilibrium, in a world characterised by the existence of multiple equilibria, which is revealing of bad institutions. Contemporary macroeconomics belongs to this framework. The economy described is, by definition, always in equilibrium. In counterpoint to this tradition, an *evolutionary* macroeconomics, which we will call *non-Walrasian*, or which could also be called Marshallian, retains as a coordination failure, not coordination on a bad equilibrium, but market imbalances that call for sequential adjustments in prices and quantities.

The purpose of the following is to establish the fragments of this non-Walrasian macroeconomics by walking in the footsteps of Smith, Ricardo, Wicksell, Marshall and Keynes as Hicks (1933, 1947, 1956, 1973, 1974 , 1979, 1990) and Leijonhufvud (1968, 1990, 1992, 2000, 2006, 2008, 2009) did: these references highlight that the question is not whether one is orthodox or heterodox, or whether one intends to join one school of thought or another, but rather the need to identify the appropriate methods for dealing with a given subject, in this case the *viability* conditions of a market economy confronted with recurrent structural shocks.

1. The Paradigm of Contemporary Macroeconomics

Contemporary macroeconomics, in whichever version, is the product of two analytical ruptures and of a sort of reconciliation. The first of these ruptures is that introduced between the short term and

the long term, between fluctuations attributed to changes in demand and supply-driven growth, be it demographic supply or technological supply. The second of these ruptures is that which dissociates the rate of inflation resulting from fiscal and monetary drifts, for which the government is responsible, and the rate of unemployment whose natural or structural level reflects the degree of imperfection that affects the markets for goods as well as the labour market. The reconciliation consists in defining a long-term equilibrium, entirely determined by technologies, preferences and institutions, which is the unique attractor, meaning that any deviation is absorbed, if not immediately, at least in the short term.

A doctrinal corpus was thus formed that is common to economists of the new classical school and those of the new Keynesian school; both retain real business cycles as a benchmark and predict that getting closer to it can only improve the overall well-being. What is new analytically and methodologically stems from the fact that the equilibrium is no longer associated with a steady state, but takes the form of cycles impelled by successive productivity shocks, to which consumers maximizing their utility and endowed with rational expectations respond.

The reference is that of a dynamic and stochastic general equilibrium, the modern version of the general market equilibrium analysed by Walras, characterized by perfect information communicated by the price system, full competition, the neutrality of money and the absence of government. In these conditions it is no surprise that the rules enacted to achieve such an equilibrium involve making markets more flexible through structural reforms, ensuring monetary neutrality, setting up an independent central bank dedicated at targeting a near-zero inflation rate, ensuring that the public budgets are strictly balanced, and even cutting both public taxes and expenditures in order to disrupt as little as possible what is deemed to be an optimal allocation of resources resulting from private choices.

The debate on the scope of structural reforms is a perfect illustration of what currently unites and divides economists who share this same vision of economic dynamics. For some, structural reforms are efficient in both the short and long term. They believe that the prospect of future gains associated with these reforms will on its own lead to an increase in permanent income, encouraging households to consume more and firms to invest more, even if the implementation of these

reforms is likely to reduce current income. Others believe that, while these reforms are still considered as appropriate in the long term, the possible fall in demand in the short-term could have an impact on the potential growth rate due to the destruction they induce of physical and human capital. They consider, then, that measures to prevent a recession are necessary, which imply additional public spending and the acceptance of a temporary increase in public debt. These hysteresis effects can, however, only really be put forward if we abandon the hypothesis of rational expectations – in other words, if we recognize that knowledge is imperfect rather than sticking to an interplay of frictions leading to price rigidity.

According to this approach, money and finance are neutral in the long term if not even in the short term. The dichotomy between a real sector and a monetary sector is *de facto* maintained. Monetary and financial failures are not ignored. But they are the result of the inappropriate behaviour of a central bank that complies with the injunctions of impecunious governments or of commercial banks that wind up granting loans regardless of the solvency of the public and private borrowers. The solution therefore lies in imposing rules on a now independent central bank and in developing financial markets which are opportunistically said to be efficient in that they set asset prices that are consistent with fundamentals.

The essence of this analytic corpus is to describe an economy *out of time,* represented as a system self-regulated by market forces and subject only to frictions attributable to bad behaviours. Present and future decisions are *de facto* synchronized and fully coordinated with each other. An objective reality is presumed to pre-exist justifying the hypothesis of rational expectations.

2. The Foundations of a Disequilibrium Macroeconomics

Recent experience, in particular in a Europe experiencing mounting disorder, shows that the self-regulating mechanisms of the market can be blocked, due not to exogenous shocks, but to a sequence of imbalances that are in the very nature of capitalist market economies, without needing to point out market imperfections or deviant behaviour, but simply recognizing that knowledge is imperfect. The attempt to reconcile microeconomics and macroeconomics, in short, to unify macroeconomics, which is at the heart of analysis in terms of real

cycles, is still an objective, but on the condition of proceeding with a radical reversal of perspective. This implies considering that the short-term disequilibria affect the long-term profile of the economy, that growth is not independent of fluctuations, and that a real economy is always in disequilibrium due simply to ignorance about future change (Hicks, 1933). In fact, two very different characterizations of economic dynamics need to be distinguished in the literature (Day, 1993). In one, the behaviour of agents *adapted* to their environment is described by optimal strategies with regard to technologies and preferences and all the possible future consequences of their actions. In the other, the issue is how an economy works in which agents *adapt*, prices evolve and exchanges take place *out of equilibrium*.

According to the latter approach, inputs are dissociated from outputs and costs from proceeds. These distortions are transmitted over time, making the evolution of the economy depend on what happens step by step. Let us consider the case of a major innovation characterized by the fact that the construction cost of a new productive capacity exceeds the replacement cost of the existing one, more than counterbalanced, of course, by a reduction of its utilization cost and an increase of its efficiency (Hicks 1973). With given resources, the investment measured in units of productive capacity is reduced due to the increase in the unit construction cost. If wages are fixed, at the end of the construction period of the new productive capacity there will be a lower productive capacity in general, which will result in a fall of gross output and then in employment. This, we may recall, is the case of Ricardo's machinery effect, which shows how the unemployment resulting from technical progress is not due to the specific features of the new technology introduced, superior by definition, but to the economic conditions of the transition process from the old to the new technology. With flexible wages, and full employment, the increase in construction costs will nevertheless bring about a fall of gross output, associated now with a fall in labour productivity, which will no longer measure the efficiency of the technology but the difficulties of the transition.

True, in the specific analysis carried out by Hicks, an *ad hoc* hypothesis, that of *full performance* of the economy, allows a continuous matching of supply and demand and the convergence to a new equilibrium, with the consequence that unemployment is fully reabsorbed, thus reducing the traverse to a predetermined mechanical trajectory.

However, this shortcoming should not hide the thorough analytical advance that the Hicks model implies. As a matter of fact the question is not to know whether it provides an analytical framework able to deal properly with all the features of qualitative changes, but whether it deals properly with one essential dimension of change characterized by the phenomena of novelty and hysteresis. The crucial point, here, is that unemployment is not the consequence of the specific properties of the new technology, but rather a feature of the very process of change: as a matter of fact, the result of the sequential interaction between the decisions and constraints sketching out this process. The simplifying hypothesis adopted by Hicks, which amounts to make specific reference to a perfect barter economy, doesn't actually affect the basic structure of the model. The effects of a distortion of productive capacity on productivity and employment, brought to light with the model, emerge in all circumstances and not only in the case of a perfect barter economy.

The distortions introduced in the temporal structure of production coupled with the lack of perfect knowledge produce variations in the apparent productivity of labour and profitability, inflationary or deflationary pressures, deficits or surpluses in trade balances, and budget deficits or surpluses. These imbalances are not reducible to market failures or deviant behavior. They are in the nature of the processes of change. It is illusory, if not dangerous, to want to eradicate them *ab initio*. They are transitory phenomena that are as necessary as they are compelled. The *viability* of the paths followed by the economy requires containing them through appropriate *institutions* that cannot be reduced to intangible rules.

Because there is a time needed to build a production capacity, choices cannot be simultaneous as is assumed in dynamic, stochastic general equilibrium models. It happens, as Keynes pointed out, that a decision to save today is not the same as a decision to consume tomorrow. Taking stock of the time needed to invest in productive assets does not dispense with examining the conditions that make it possible to do this. Firms may not want or be able to do the inter-temporal trade of expected revenues from future output for the factor services needed to produce this output. Sometimes they cannot and do not want to finance productive investment. This inter-temporal failure of demand cannot be resolved simply by cutting interest rates (Leijonhufvud, 2008).

Industrial strategy and economic policy that obey *adaptive* behaviours and are decided *en route* set the path followed, without it being predetermined. Growth – stronger or weaker, steadier or more fluctuating – depends on it. The inflation rate and unemployment rate are joint products and therefore cannot be dissociated from one another, even if the relationship between them is not stable. Money and finance are not neutral, neither in the short nor long-term. There is no natural interest rate, no natural unemployment rate, and no potential growth rate that obeys strictly real forces, but rather variables that respond to the conditions of adjustment on markets in disequilibrium (Tobin, 1972, 1995).

The path is created by walking it. There is therefore no attractor, nor can there be any rational expectations. Private choices do, of course, react to economic policy choices, but the reverse is equally true. In short, the acquisition of knowledge, which remains imperfect, is the result of out-of-equilibrium interactions, taking place step by step, between economic agents as well as the institutions regulating their behaviour. The challenge for all decision-makers lies in mastering clocks, indeed in their ability to project themselves over a sufficiently lengthy time.

In this perspective, stocks may act as buffers between physical inflows and outflows, and between financial income and expenditure flows (Leijonhufvud 1973). In particular, stocks of liquid assets allow expenditures to be maintained when revenues fall off. Thus real world economies could be more robust than pure flow models would suggest. However, if disturbances are of an unexpectedly large magnitude, buffer stocks may be exhausted and a tight income constraint takes over.

Moreover, the role of real and financial stocks is ambivalent. On one hand, they may effectively act as buffers. On the other hand, they may reinforce the multiplier effect. Debts may act as buffers as well as amplify demand constraints. Thus, deflation increases the real value of existing debt, and the price effects may themselves be deviation amplifying. An increasing indebtedness of households, which may hide, for a while, the effects on output of large displacements of potential demand, will end by affecting current spending, when it appears that these households are insolvent.

Clearly, given technologies and/or preferences cannot univocally determine production and consumption paths, and hence the evolu-

tion of the economy, as standard economic models purport. Because of ignorance of future changes in technologies and preferences and still more of the consequences of these changes, a long-term equilibrium is never attainable (Hicks 1933 p. 32).

3. Price Flexibility in Question

To deal with change in this way, by emphasizing the coordination failures and the means of dealing with them, inevitably leads to questioning the effects of a greater or lesser degree of price and wage flexibility. Variations in each of these play a role in medium-term developments in the economy due to the associated changes in income, and they dominate the course of events (Solow, 2000). Doing away with the principle of total flexibility, which would make prices instantly be equilibrium prices, rendering pointless any reflection about a coordination that is supposedly instantaneously achieved, raises the issue of the impact of the degree of price flexibility on the way the imbalances develop. It is commonly accepted that, by increasing the debt burden, a general fall in prices increases supply surpluses rather than reducing them. Leaving aside this deflationary situation, the discussion is still open. There is, nevertheless, a presumption that prices that are too brutally and excessively flexible are damaging. Marshall was fully aware of this when he insisted on the impact of adjustment speeds on market dynamics, emphasizing the possibility of chaotic fluctuations in the case of flexibility in prices and quantities, thereby making a case for short-term fixed prices in order to avoid this chaos (Leijonhufvud, 1994).

There are several dimensions to the problem. Excessive price changes are likely to create greater uncertainty, which affects the value of corporate assets, exacerbating fluctuations in overall output through the effects on production, hiring and investment decisions (Stiglitz, 1999).

Price variations, when they go in the wrong direction and become excessive, can contribute to amplifying disturbances that affect the structure of production capacity. They lead to alternating between the excessive destruction of capacity and bottlenecks, inevitably causing erratic fluctuations in output and consequently a fall in the growth rate (Amendola and Gaffard, 1988, 1998, 2006).

Price volatility reveals the inability of agents to make a reliable economic calculation, which leads them to react instantaneously to current events and to shelve investment plans made in the past. The

shortening of their time horizons and price volatility interact to destroy production capacity (Heymann and Leijonhufvud, 1996; Leijonhufvud, 1997).

In these circumstances, the criticism aimed at analyses that recognize the existence of imbalanced markets, i.e. that they violate the assumption of individual rationality by denying that agents are capable of exploiting the gains in exchanges, does not hold. Relative price rigidity comes from rational behaviour insofar as it is a factor of *viability* of an economy facing structural changes amidst an uncertain future.

The question of the impact of more or less price flexibility in a context of market imbalances and agent heterogeneity sheds light on the true costs of inflation (Heymann and Leijonhufvud, 1996; Leijonhufvud, 1977, 1997). These costs result from the disorder created, beyond a certain threshold, in relative prices, in the distribution of income and wealth, and in the temporal structure of production capacity, by resulting in preventing market mechanisms from functioning properly. The real problem that agents face is not that they take a change in the general level of prices for a change in relative prices, but that they are unable to correctly interpret the price signals that result from relative price changes due to the inflationary process. As a result, the necessary reallocations of resources are not made, while others are made that should not be. While excessively low inflation is costly in terms of lost jobs, which also makes the necessary structural adaptations more difficult, high inflation goes hand in hand with a shortening of the time horizon, a decline in investment and destruction that threatens the viability of the economy (Georgescu-Roegen, 1968). While sticky prices provide an anchor that helps stabilize the economy, excessively flexible and erratic prices lead to destroying inter-temporal stability, possibly creating the conditions for high inflation (Heymann and Leijonhufvud, 1996; Leijonhufvud, 1997).

What is true of the prices of goods holds just as much for wages. Wages are, if not rigid, then at least sticky, since employers are reluctant to raise wages too much because of a shortage of labour for fear of disrupting the established differentials, and they are just as reluctant to lower wages due to unemployment for fear of alienating those they employ. This rigidity is not a matter of a monetary illusion, it is a question of continuity as well as equity (Hicks, 1975). If excessive wage flexibility occurs, it could be the signal that behaviour is dominating that breaks up continuity, disrupts economic calculations and reduces the time horizon of economic agents to the detriment of growth.

4. Monetary Policy: Rules Versus Discretionary Choices

Out of equilibrium, it is difficult to maintain the proposition that monetary policy must be dedicated exclusively to maintaining stable prices, for two reasons: there is no evidence that it is necessary to systematically thwart inflationary pressures; and it may be necessary to conduct monetary policy with the aim of counteracting the risk of global instability. This affects the rules that must be applied.

When monetary policy responds to real shocks whose adverse effects are not countered by price flexibility, simply because the optimal prices are not known and because a high price flexibility is no guarantee of discovering them, fighting against any inflationary drift will not be sufficient to restore growth. On the contrary, inflationary pressures, in this case transitory, must be accepted in order to re-establish a quasi-steady state when the required investment results in a distribution of purchasing power without an immediate counterpart in terms of the supply of consumer goods. The reason is that building new production capacity *takes time*. This is the case in an economy undergoing reconstruction (Hicks, 1947), but also in an economy facing a technological shock that results in creative destruction. Combating these pressures systematically would simply wind up penalizing investment and preventing the transition from being successful (Amendola and Gaffard, 1998, 2006). A decision about how to weight the objectives of price and growth is not trivial. Price stability today does not guarantee growth tomorrow. There is no stable relationship between inflation and unemployment, due to structural disruptions, including variations in the resulting dispersion of net excess demand in different sectors (Tobin, 1972, 1995).

In these circumstances, monetary rules should not be rigid. Rules and discretionary choice must be combined. The credit system must be managed by a central bank whose operations need to be determined on the basis of an expediency judgment. Some *accommodation* of monetary policy in response to real cyclical growth is appropriate, although there is no simple criterion for knowing the exact dose of accommodation needed (Leijonhufvud, 1990). In a context of structural change, the adoption of rigid rules, supposedly in order to optimize under the false presumption that errors of perception concerning the natural interest rate or the potential growth rate are small, proves to be costly in terms of inflation and unemployment (Orphanides and Williams, 2002). The best strategy, then, is to make

adjustments to changes in the rate of inflation and to the level of activity, implying a certain degree of *inertia*. Inertia has a simple justification: raising the interest rate sharply to counteract inflationary pressures will undermine investment and may lead to a shortfall in future capacity, i.e. future inflationary pressures that can be anticipated. Keeping the interest rate too low due solely to the absence of inflationary pressures, despite a low unemployment rate, can lead to an excess investment in productive assets, and also an excess investment in financial and real estate assets. Thus, the quantitative easing policy enacted recently with a view to stimulating activity and returning to a positive inflation rate in order to escape the constraints of a zero interest rate has had the main if not sole effect of promoting the purchase of existing financial assets, at the risk of provoking a new financial crisis.

In fact, the problem goes beyond monetary policy that is defined without the need to refer to the behaviour of financial and non-financial actors to include the organization of the banks and the functioning of the financial markets. It is, of course, important to strengthen micro and macro-prudential measures, and equally so to ensure that firms benefit from patient capital.

To understand this, it must be remembered that liquidity is a complex notion, in the sense that it is not reducible to holding money or readily negotiable assets (Hicks, 1974). There are actually three types of financial assets: current assets, reserve assets and speculative assets. The first are essentially complementary to the real assets required to produce and therefore cannot be considered liquid. The second type, which refers to the ability to raise funds on the markets or to borrow from banks, is the liquidity required to pursue an investment activity with a long-term involvement. The third type are held for immediate gain and are not directly related to production and investment activity. This distinction, which is probably difficult to establish empirically with respect to the last two categories, is significant as to the meaning imparted to liquidity, in that it reflects a *sequence* of choices and not a one-off choice. The function of liquidity is to preserve a capacity for choice in the future, knowing that all investments are not equivalent, depending on whether or not they correspond to future demand.

Nevertheless, there is a dilemma. On the one hand, liquidity is a matter of a sequence of choices because market information is not immediately available whereas investments in real assets are irreversible,

which would imply delaying investment decisions in case of too much uncertainty, the social function of liquidity being that it gives time to think. But, on the other hand, learning is the result, not of the passing of time, but of a firm commitment, implying that finance commitment is a necessary condition for the other stakeholders to embark on an innovation process. Given that any investment has a gestation time that is longer as the expected productivity gains are higher, and that, in addition, successive investments are complementary to one another, which explains the weak influence of interest rate changes on the current investment rate (Hicks, 1989), firms must be able to benefit from a long financial commitment, i.e. from *patient capital*, whether this is provided by banks or by shareholders (Mayer, 2013). As a matter of fact, "there must usually be a practical distinction between 'inside' shareholders, who feel themselves to be closely associated with the company, so that (like established labour) they expect to go on holding for considerable periods, and the fleeting population of shareholders who are loosely attached. All shareholders alike will have to be paid the dividend, but while the outsiders are concerned with no more than the current dividend and with the market value of the shares, the insiders are concerned with the future of the company, and so with the dividends they expect, on their own information, to receive at future dates" (Hicks, 1989, pp. 87-88). Therefore, monetary analysis should focus on the coordination needed to make a credible commitment in irreversible investments, and monetary policy should aim at influencing investment decisions of this type rather than only targeting the inflation rate. Its effectiveness depends on its ability to affect the liquidity of firms and banks. The inefficiency of monetary policy is due not to the fact that the interest rate is at bottom but to the behaviour of the banks and, more generally, to the organization of the financial system whenever it prioritizes a rapid return on investment (Stiglitz, 2017).

5. Fiscal Policy: Rules Versus Discretionary Choices

In the world of dynamic stochastic general equilibrium models, if expected inflation exceeds the set target, the central bank sharply and abruptly raises its interest rate to quickly bring the inflation rate back to the required level. In such a world, the government should only reluctantly pursue an expansionary fiscal policy, as it will anticipate that any increase in aggregate demand driven by rising government spending will be offset by an equivalent reduction due to central bank action

when the latter is independent and applies the rule laid down. More-over, when monetary policy is tight and fiscal policy lax, the lack of monetary financing of the public deficit causes the public debt to rise. There comes a time when fiscal solvency is no longer assured. Unless the deficit is cut drastically, there is no alternative to monetizing the debt and, therefore, to high inflationary pressures (Sargent and Wallace, 1981). To escape this unpleasant arithmetic would simply require imposing a fiscal rule.

This arithmetic is, however, belied when it comes to a sequence of events *out of equilibrium* that is induced by the formation of distortions in the temporal structure of production capacity. Imbalances follow one after the other and can be amplified, resorbed or offset. Thus, excess supply and unemployment can be followed by excess demand and inflationary pressures. Therefore, increasing public spending today and correspondingly increasing public debt will reduce the excess supply and current unemployment, while taxing income later will reduce, also later, excess demand and inflationary pressures. In this case, the increase in public debt does not reduce current consumption, while the subsequent repayment of this debt will reduce future consumption to the benefit of the economy over the period as a whole. The *temporal* dimension of Keynesian policy is related here to the poor *temporal* distribution of excess demand that is left unadjusted by inter-temporal price adjustments (Leijonhufvud 1992). Needless to say, the Ricardian equivalence between borrowing and tax – meaning that fiscal policy is ineffective – does not hold. Out of equilibrium, no action is neutral. Only an active policy is likely to maintain the economy's stability. When a budget deficit follows a rise in private savings and a downturn in activity, the real question is how long must a budget deficit be accepted and what should be its amount before public spending can be boosted by private spending. The challenge is to maintain or re-establish a relative balance between supply and demand at each moment and over time.

When a restrictive monetary policy constrains investment, as was the case in Europe in the 1990s, it is the pattern of the fluctuations that is changed. The recurring shortfall in investment has the effect, cycle after cycle, of reducing the rate of growth compatible with price stability and of pushing up the unemployment rate that doesn't accel-erate inflation, which some people call the equilibrium unemployment rate, as lower investment *today* means a lower level of output

tomorrow, and hence reaching the inflationary barrier faster. Simultaneously imposing a constraint on the budget deficit maintains and aggravates the fluctuations. It leads to a fall in public spending during a recession, accentuating the slowdown and helping to reduce the duration of the subsequent recovery phase by undermining public investment. It leaves the door open to the possibility of lowering taxes without a corresponding decline in public spending during boom periods, creating inflationary pressures that can in turn lead to a tightening of monetary policy and a premature turnaround in the economy. No effective constraint is introduced in the expansionary phases of the cycle, but the recessions are amplified, which cannot be interpreted as deviations from a predetermined trend, but rather as a phase of an essentially endogenous development that the budget constraint helps to shape. The rules, which are supposed to avoid the unpleasant arithmetic described by Sargent and Wallace (1981), plunge the economy into a highly unpleasant series of imbalances.

When, as happened in the United States in the 2000s, the inflation rate is contained despite rising household indebtedness, in view of the rule, there is no need to raise the interest rate nor worry about lowering it. The strict application of the monetary rule did not, however, prevent the budget deficit from widening. Faith in the virtues of the rule and misjudging the true causes of price changes masked the unsustainable nature of private debt and prevented anticipating the outbreak of the financial crisis, which ultimately led to a further increase in the budget deficit.

When the budget deficit and the public debt have increased as a result of a fall in activity, and if, as was the case with the sovereign debt crisis in the euro area, it is impossible for the central bank to intervene as lender of last resort, the financial markets become the masters of the game and impose a rise in interest rates, in this case highly differentiated interest rates. It is these markets, and not the central bank, that, via the interest rate, enforce a form of fiscal discipline. This arithmetic is very likely to cause a further downturn in activity and a further widening of the budget deficit.

In all these situations, the unpleasant arithmetic of equilibrium gives way to the no less unpleasant dynamics of disequilibrium, which calls for a policy mix that takes into account the role of *time* in the face of the adjustments necessitated by structural shocks. This means that both inflationary pressures and budget deficits must be accepted

temporarily when they are a clear factor involved in the coordination of economies that are naturally in disequilibrium.

The impact of a fiscal stimulus is of course highly dependent on the state in which an economy is found. In a depressed economy, characterized by massive unemployment and excess capacity in all its sectors, which is what Keynes referred to, a decision by producers to hire and to raise wages would create a solvent demand to which producers would respond instantly. Nevertheless, coordination between aggregate supply and demand requires public intervention in the form of allowances paid to the unemployed or hiring for public works. A signal is thus sent to firms that a solvent demand exists. The multiplier effect on income and employment is then necessarily high because of the match between available capacity and the increased demand thus obtained.

The same does not hold in the case of a recessionary economy for several reasons. In general, the supply structure is not in harmony with the demand structure, and efforts to stimulate demand are usually hampered by bottlenecks resulting from a lack of available production capacity, including due to a lack of the required workforce skills. Second, an increase in demand leads firms to raise the utilization rate of their production capacity but not necessarily their investments, either because they are excessively indebted or because they do not have sufficient information on the nature and volume of future demand. This leads them to adopt a wait-and-see position, as they prefer to maintain liquidity by keeping their reserve assets or preserving their capacity to take on debt, with the aim of better identifying the type of investment to be made. The initially higher multiplier effect of public spending is, in all cases, reduced. Fiscal policy must be part of a policy mix that includes monetary policy, but also, as mentioned above, the organization of the financing system and, undoubtedly, the organization of the markets, with the objective of extending the time horizon of the firms.

6. Revisiting Structural Reforms

Structural reforms refer to a certain idea about what the microeconomic foundations of macroeconomics should be, in this case perfectly flexible markets that guarantee being on the best trajectory. However, far from leading to an increase in productivity, they can constitute real obstacles to innovation by generating forms of *dualism*. It is difficult, in

fact, to stick to the identification of configurations of the economy that are possible in the long term without having to worry about the chain of events that may occur as a consequence of structural reforms or simply as the already proven consequence of flexible markets. While it is possible to imagine rational behaviour guided by expectations of permanent income in the absence of the destruction of resources, this same hypothesis becomes untenable once economic agents are confronted, not only with a fall in their remuneration, but also with a narrowing of their time horizon due to such destruction and to the resulting hysteresis effects.

The destruction of jobs in declining activities requires that the employees concerned be mobile occupationally and geographically. Reducing job protection and lowering wages in these activities so as to encourage mobility is not a solution. Everything depends on what happens to the labour resources.

In fact, the resources released, far from being directed to higher-paying, high-tech activities, could well be compelled to move to activities where the jobs on offer are low-skilled, sometimes part-time and often precarious. This explains, moreover, why a situation of almost full employment does not go hand in hand with inflationary pressures, as can be seen currently in the United States.

The fall in the wages of workers made redundant in troubled industrial sectors and hired on precarious contracts in low-productivity protected sectors leads to the impoverishment of a large part of the population, which will result in a fall in domestic demand. This can be thwarted only by granting consumer loans to these impoverished households, which is not without risk if a lack of solvency were to push the economy into a crisis, as happened in the United States in 2008.

This form of reconversion, and the attendant fall in wages, also affect the accumulation of human capital and, consequently, potential growth. In the face of financial constraints, the workers will have neither the time nor the financial means to train themselves, even if they are encouraged to do so by the wage differential with skilled workers, especially since the credit market is imperfect and it is not possible for them to take out a loan against their future income.

The *dualism* that sets in, being synonymous with deepening inequalities and the decline of the middle class, affects the structure of demand. The wealthiest households buy luxury goods manufactured in small volumes, sometimes abroad, or use their abundant savings for

the purchase of existing financial and real estate assets. The poorest households turn away from domestic products and buy low-cost products made in low-wage countries. A form of deindustrialization takes place, which has the effect of reducing productivity gains, export capacity and the potential growth rate, unless the strategy set out by business and approved by the government leads to capturing external markets and to rooting growth in the export of industrial goods, as happened in the case of Germany.

In short, the clearest result of labour market flexibility may be a *polarization* between high-skilled, high-wage jobs and unskilled, low-paid jobs, with a fall in median wages. This would then look much like an internal devaluation, more appropriately called wage deflation, which is actually aimed at boosting the market shares of domestic firms in the hope that growth will be driven by exports.

It is not labour market rigidities that are directing investment and technological decisions in such a way that these investments have a negative effect on productivity and growth, but rather the development of dualism in the labour market accompanied by a fall in the median wage, which affects the structure of the economy and its capacity for medium-term growth. This is undoubtedly the reason why, in the most recent period, productivity gains were as weak in the United States as in the euro zone countries, despite significant differences in terms of job protection, the intensity of competition in the goods and services markets, the weight of the public sector, taxation and the innovation effort.

This observation invites us to reconsider what might be the microeconomic foundations of macroeconomics. The *commitment* of the owners of capital to engage in long-term investment is a necessary but not sufficient condition for other stakeholders in the company – employees, suppliers and customers – to commit in turn. These different actors also need to benefit from mutual guarantees of their commitment. These guarantees are obtained through the conclusion of agreements that establish long-term relations, in the form of lengthy contracts (employment contracts, sub-contracting agreements, and distribution contracts) that structure industrial organization (Richardson, 1990). The search for immediate responsiveness to the current signals, which is hidden behind the current idea of flexibility, gives place here to an entrepreneurship dedicated to the creation of value rather than its diversion, a capacity at the heart of the process of competition through innovation.

7. Conclusion

With the stochastic dynamic general equilibrium model, anything can happen. This does not mean that we know why an event has happened, nor that we can conclude that it is the result of inter-temporal optimization behaviour. This modelling makes it possible to introduce all the *ad hoc* elements that one wants, whether this means different types of shocks (of supply and demand) or frictions (consumption habits, cost of adjustment of the capital stock), making it difficult to understand the sequence of events (Stiglitz, 2017) – but not without concluding that there is ultimately a final cause of what has happened, in this case market failures, understood as a lack of flexi-bility, implying that economic policy should be conducted in such a way as to correct these. The economy jumps instantly from one equi-librium to another, with no consideration of the dynamics engendered by the unexpected formation of real or financial stocks. Future markets are eventually considered, but without imagining that crises can make these disappear rather than creating them (Heymann and Leijon-hufvud, 1996). No temporal dependence phenomenon is considered, even when Markov processes are introduced according to which, if the present state makes it possible to predict the future state, the predic-tion is not improved by knowledge of past information.

In fact, in this type of model, *constant laws* govern the relations between events, which winds up with the economic agents being known, and corresponds to what Hicks (1979) calls *contemporary* causality. Nothing is said about the opportunity or the possibility of answering in one way or another to the signals emitted. The reference period is an accounting period that is, by definition, completely arbi-trary and whose duration has no influence on the final result.

The *sequential* causality that Hicks (1979) opposes to contemporary causality negates the existence of such constant laws. It means that multiple and varied evolutions are possible, conditioned by the variety of eligible choices taken *en route*. Decisions appear for what they are, that is, choices constrained by the heritage of the past (embodied in real and financial stocks) and creators of future constraints or, if you prefer, they are milestones along the causal chain. They call for an appreciation of the opportunity and possibility of the choices involved at each stage. Time periods become decisive in the course of evolution: the time that elapses between the signal (coming from the market or the authorities) and the decision-making; and the time that elapses

between the latter and its realization. These time periods can be quite variable. The reaction to the signal can be fast or slow. The same is true of the actual implementation of the decision taken. An increase in income does not necessarily result in an increase in consumption, both because consumers can wait to know more about the signal sent and because the goods they intend to demand are not immediately available. An increase in costs does not lead to an increase in prices, because entrepreneurs wait to find out what their competitors will do, or because they might be bound by medium-term contracts with their customers, or because they prefer to cut their margins. Holding stocks of assets, including liquidity, and access to credit are factors that influence the length of these time periods and, consequently, expectations that become essentially endogenous.

The evolutionary economic analysis thus conceived should be ordered in two parts: a theory of the elementary period, which must be completed by a theory of the continuation, which is concerned with the effects produced by the events of the earlier periods on the plans and expectations that determine the events of subsequent periods (Hicks, 1956, 1990).

The difficulty with such a dynamic analysis method stems from the fact that disequilibrium forces are much less reliable than equilibrium forces. Multiple paths can be taken with configurations that are the fruit of the sequence of disequilibria, in the centre of which are the stocks that are the expression and the vector of propagation. The path that will actually be taken is due not only to the animal spirits of the decision makers, but also and mainly to the role of institutions. However diverse these may be, they must have a major objective: to constrain the paths followed, to smooth out fluctuations by recognizing the need for certain forms of *rigidity* or *inertia,* with the aim of allowing the various actors to cope with the combined interplay of uncertainty and irreversibility and to be projected over a sufficiently long time.

The analytical approach thus sketched out is characterized as non-Walrasian in order to clearly indicate that it ruptures with models that persist in the description of equilibria, even if they are multiple, with their claim to novelty based on insisting on the complexity of relations, the multiplicity of agents and the shocks they suffer, and the asymmetries or incompleteness of information, but without recognizing the sequential dimension of economic processes and the *time dependence* of events rooted in real and monetary phenomena.

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A SHORT WALK ON THE WILD SIDE:
AGENT-BASED MODELS AND THEIR IMPLICATIONS FOR MACROECONOMIC ANALYSIS

Mauro Napoletano

Sciences Po, OFCE ; SKEMA Business School and University Côte d'Azur (GREDEG), and Institute of Economics, Scuola Superiore Sant'Anna Italy

This article discusses recent advances in agent-based modelling applied to macroeconomic analysis. I first introduce the building blocks of agent-based models. Furthermore, by relying on examples taken from recent works, I argue that that agent-based models may provide complementary or new lights with respect to more standard models on key macroeconomic issues like endogenous business cycles, the interactions between business cycles and long-run growth, and the role of price vs. quantity adjustments in the return to full employment. Finally, I discuss some limits of agent-based models and how they are currently addressed in the literature.

Keywords: agent-based models, macroeconomic analysis, endogenous business-cycles, short and long-run dynamics, monetary and fiscal policy, price vs. quantity adjustments.

This paper discusses recent advances in agent-based modelling applied to macroeconomic analysis. The main goal is to illustrate the main building blocks of agent-based models and to argue – with examples taken from recent works – that this new class of models can provide complementary or new lights with respect to more standard models on several issues.

Agent-based models (ABMs) represent an economy as a dynamical system of heterogeneous interacting agents. Heterogeneity involves agent's characteristics (e.g. the size of firms or the income of households) and/or the behavior of agents (e.g. their expectation rules). Agents in these models can interact globally *via* prices (as they typically do in traditional macroeconomic models) but also locally *via*

non-price variables (e.g. the imitation of a technology or of an expectation rule adopted by another firm in the economy). In addition, agents' heterogeneity and the structure of their interaction networks are not fixed, but *evolve* over time together with the dynamics of the whole system. Another important building block of these models is their non-exclusive focus on equilibrium states of the economy. In other words, these models also analyze the dynamics of the system in situations where some markets do not clear and/or where agents are not optimizing their behavior and thus have incentives to change it.[1] Accordingly, agent-based models also dispense with the assumption of perfect rationality of agents, in the sense of agents taking decisions out of the solution of an inter-temporal optimization problem. In contrast, these models assume bounded rationality of agents, i.e. in ABMs agents have very simple rules of behavior for coping with an environment that is too complex for anyone fully to understand (Howitt, 2011, Tesfatsion, 2006). Boundedly rational behavior may range from static or evolutionary optimization to more routinized rule-of-thumb behavior rooted on experimental or empirical evidence. Finally, one important concept associated to agent-based models is the one of *emergent property*. More precisely, an agent-based model typically lacks any isomorphism between aggregate properties of the system and specific assumptions on the characteristics or behavior of a single agent populating the system itself. Aggregate properties stem from the interaction of the agents populating the economy (Turrell, 2016). This *bottom-up* modelling philosophy echoes the one that has been applied for almost a century by quantum mechanics to study the physics of interacting particles.

One straightforward consequence of assuming evolving agents' heterogeneity and interaction structures is that the dimensionality and the non-linearity of the dynamical system that represents the economy become huge, and this precludes closed form solutions of the system. Thus agent-based models are typically analyzed via extensive Monte Carlo simulations, in a way similar to bootstrap analyses widely employed in econometrics and statistics.

Agent-based models have a long and established tradition in scientific disciplines different from economics like, for instance, physics,[2]

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1. Accounting for disequilibrium states also implies that the behavior of the system is not described by the evolution of state variables resulting from the solution of a system of equations. In agent-based models all variables are instead updated following a precise time-line of events.

biology, computer science. They have also become more and more diffused in social sciences like sociology and archeology. They have had a much harder life in economics, although the Great Recession, and the critiques to standard macroeconomics models that followed, have contributed to pull ABMs out of the far periphery of economic theorizing. Since then, ABMs have received increasing attention as useful tools for the analysis of key markets, like financial and energy markets (see e.g. Le Baron, 2006, Tesfatsion, 2006 and Weidlich and Weit, 2008), as alternative tools for the analysis of economic and climate change dynamics (see e.g. Balint *et al.* 2017), and for macroeconomic analysis (see Haldane, 2016).

This paper will not attempt to provide a survey of the state of the art of agent-based models in macroeconomics. Good and updated surveys can for example be found in Fagiolo and Roventini (2017) and in Turrell (2016), and recent collections of research works using agent-based macro models can be found in Delli Gatti *et al.* (2011), Gaffard and Napoletano (2012), and in Gallegati *et al.* (2017). This paper will instead try to explain, by means of examples taken from recent works by the author and co-authors, the consequences of some fundamental concepts of the agent-based models. It will then show how the use of these concepts generate results that offer *complementary if not totally new perspectives* on key issues in macro-economics, like the emergence of aggregate fluctuations from microeconomic idiosyncratic shocks, the persistent effects of business cycles (and of monetary and fiscal policies) in the long-run and the role played by prices in favoring the return of the economy to full-employment. Finally, it will discuss some of the critiques raised against macroeconomic agent-based models and how they have recently been addressed in the literature.

1. Agent-Based Models, Emergent Properties and the Generative Approach in Economics

We already mentioned in the introduction that one workhorse of agent-based models is the concept of emergent property, i.e. an aggregate property of the system (e.g. business cycles) that cannot be deduced from assumptions made on single components of the system itself (the household or the firms). Agent-based models thus take a

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2.   Interestingly, Turrell (2016) remarks that one of the first scientists to apply agent-based model techniques was Enrico Fermi, to solve problems involving the transport of neutrons through matter.

generative approach to science. In this perspective, the goal of the model provides a micro-specification regarding the nature of agents' heterogeneity and the nature of their interaction. The model is then validated – i.e. it provides an explanation of a given macro phenomenon – if it is able to grow up that phenomenon out the specified interaction among heterogeneous agents. As Epstein (2007, Chap. 1) puts it:

> "Agent-based models provide computational demonstrations that a given microspecification is in fact *sufficient to generate* a macrostructure of interest. Agent-based modelers may use statistics to gauge the generative sufficiency of a given micro-specification – to test the agreement between real-world and generated macro structures [...] A good fit demonstrates that the target macrostructure – the explanandum – be it a wealth distribution, segregation pattern, price equilibrium, norm, or some other macrostructure, is effectively attainable under repeated application of agent-interaction rules: It is effectively computable by agent society. [..] Thus, the motto of generative social science, if you will, is: If you didn't grow it, you didn't explain its emergence"

The generativist approach followed by agent-based models stands in sharp contrast with the reductionist approach, according to which the explanation of a phenomenon can be reduced to some fundamental laws governing the behavior of single components of the system. Reductionism is still very much popular in economics[3], and it is the candid opinion of the author of this paper that such a predominance explains a good deal of the diffidence towards agent-based models, and especially their perception as "black-boxes", i.e. models where the causes and mechanism driving results are blurred. In contrast, reductionism is rather questioned in other scientific disciplines like physics. The dissatisfaction is very well explained by the physics Nobel laureate Phillip Anderson (see Anderson, 1972):

> "The ability to reduce everything to simple fundamental laws does not imply the ability to start from those laws and reconstruct the universe. In fact, the more the elementary particle physicists tell us about the nature of the fundamental laws, the less relevance they seem to have to the very real problems of the rest of science, much less to those of society. [..] The behavior of large and complex aggregates of elementary particles, it turns out, is not to be understood in terms of a simple extrapolation of the properties of a few

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3. The popularity of reductionism resists despite key results in general equilibrium theory (the Sonneschein-Mantel-Debreu theorem) show the impossibility of obtaining well-behaved aggregate excess demand functions directly from assumptions about the micro-behaviour of agents (see Kirman, 1992, for an account).

particles. Instead, at each level of complexity entirely new properties appear, and the understanding of the new behaviors requires research which I think is as fundamental in its nature as any other."

It follows that in the generative approach (also known as "bottom-up" approach) one should not search for simple "causes" of a given phenomenon but rather check whether starting from simple assumptions about agents' behavior and their interaction structures the model is able to reproduce that phenomenon at the macro level or not. The approach is also close to the concept of "sequential causality" outlined by Hicks (1979). In that, a given "phenomenon" (e.g. a recession) may or may not be the direct consequence of a specific "cause" (e.g. an exogenous shock) according to the sequence of decisions (and of resulting constraints) that occur in the time lapse between the two. That sequence can change the path leading to the emergence of a given property in a fundamental way, so that it is not always possible to establish a direct link between the specific cause and its effects.[4]

Let us now provide an illustration of emergent property in a macro agent-based model, by means of the "Keynes+Schumpeter" (K+S) agent-based model developed in Dosi *et al.* (2010,2013,2015,2017).[5] In one of its most extended versions the micro-specification of the model portrays an economy composed of heterogeneous capital- and consumption-good firms, a labour force, heterogenous banks, a government, and a central bank. Capital-good firms perform R&D and produce heterogeneous machine tools. Consumption-good firms invest in new machines and produce a homogeneous consumption good. The latter type of enterprises finance their production and investments first with their liquid assets and, if these are not enough, they ask their bank for credit (which is more expensive than internal funds). Higher production and investment levels rise firms' debt, eroding their net worth and consequently increasing their credit risk. Banks, in turn, increase the level of credit rationing in the economy and force firms to curb production and investment, thus possibly triggering a recession. Bank failures can endogenously emerge from the accumulation of loan losses on banks' balance sheets. Banking crises imply

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4. The notion of sequential causality should be contrasted to the one of "contemporaneous causality", which is typical of standard models, and according to which a specific phenomenon can always be linked to a specific cause and the sequence of decisions and constraints occurring in between is irrelevant in that respect.

5. The K+S model has also been extended to analyze the consequences of different policies in the labor market (Napoletano *et al.* 2012, Dosi *et al.* 2016, 2017) and as a tool for integrated assessment analysis of the co-evolution of economic and climate change dynamics (see Lamperti *et al.*, 2018).

direct bailout costs on the public budget and may therefore affect the dynamics of Government deficit and debt. The latter can also vary with changes in tax revenues and unemployment subsidies over the business cycle.

The K+S model generates as emergent properties the main stylized facts at the macroeconomic level. For instance, it generates time series of GDP, consumption and investment displaying long-run growth (see Chart 1, left). As well as business cycle fluctuations in the short-run (see Chart 1, right). Furthermore, the list of stylized facts is not limited to the highest level of aggregation. The model also generates a wide array of facts characterizing the cross-sectional dynamics of firms, e.g. tent-shaped distributions of firm growth-rates.[6] It is important to stress that none of these properties is the direct consequence of specific assumptions on the behavior of firms. For instance, recessions and expansions are not generated from a specific response of firms to some aggregate shock. All the above properties are instead generated as the result of firm idiosyncratic technology shocks that diffuse from the capital good to the consumption good sector via investment interactions.[7]

Chart 1. Output, consumption and investment time series
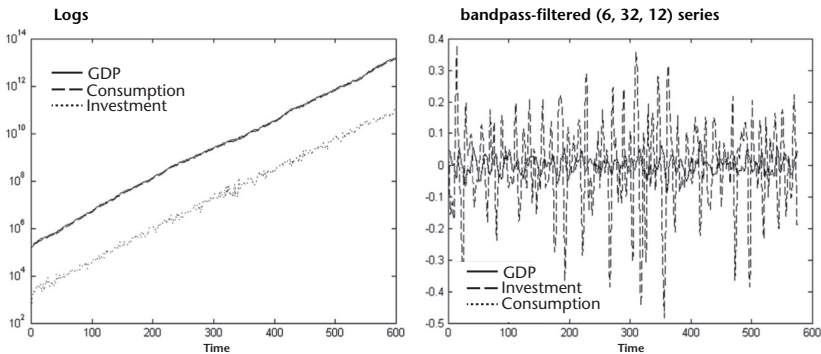
Source: Dosi *et al.* (2015).

The diffusion of technology is heterogeneous across firms as their investment levels differ because of different expectations about final demand and because of different levels of financial constraints. The

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6.   In that, the model follows the call of Anderson (1972) for providing explanations at different layers of complexity.

7.   Not even a mild cross-sectional agents' heterogeneity is imposed ex-ante. On the contrary, firms are assumed to be completely homogeneous at the beginning of each Monte-Carlo iteration..

resulting aggregate level of investment in turn affects the overall level of economic activity, but it also affects future credit availability because firms accumulate debt out of investment and production activities and may therefore become more financially fragile and even go bankrupt, thereby lowering aggregate credit supply and increasing credit rationing. The foregoing tension between change (induced by innovation and diffusion of new technologies) and coordination (induced by effective demand and by credit constraints) does not only set the long-run growth of the economy, but it also creates business cycles in the model.

In the next section I further develop the above points and discuss how agent-based models may provide new perspectives on several macroeconomic issues.

2. Some Implications of Agent-Based Models for Macroeconomic Analysis

Agent-based models have applied the generative approach discussed in the previous section to explain a wide array of phenomena in macroeconomics as well to test the impact of several macroeconomic policies (and of their combination). The list includes, but it is not limited to, the generation of business cycles and long-run growth out of the combination between Schumpeterian dynamics of innovation and Keynesian demand dynamics (the K+S model of Dosi *et al.*, 2010, 2013, 2015), the generation of business fluctuations out of evolving distributions of firms' bankruptcy risk (e.g. Delli Gatti *et al.*, 2005, 2010, Cincotti *et al.*, 2010, Mandel *et al.*, 2015), the analysis of the interactions between inequality and growth (Dosi *et al.*, 2013, Ciarli *et al.*, 2010, Cardaci and Saraceno, 2015, Caiani *et al.*, 2016), the analysis of combinations of fiscal and monetary policies (e.g. Dosi *et al.*, 2013, 2015), the analysis of structural policies affecting R&D and innovations (e.g. Dosi *et al.*, 2010, Russo *et al.*, 2007), the impact of labor market policies on aggregate dynamics (Napoletano *et al.*, 2012, Dosi *et al.*, 2016, 2017) and of cohesion policies on regional convergence (Dawid *et al.*, 2014), the impact of the combination of monetary and macroprudential policies (Ashraf *et al.*, 2017, Popoyan *et al.*, 2017).

The above long list reveals the great flexibility of ABMs to be used for both positive and normative analyses in macroeconomics. As I already mentioned above, providing an account of all the results obtained by macro agent-based models is beyond the scope of this article. I shall

rather focus on some examples that briefly illustrate the ability of ABMs to address some key issues in macroeconomics from a new perspective with respect to more standard macroeconomic models.

Chart 2. Frequency of full employment in the benchmark scenario (solid line) and in the scenario with zero fiscal policy (dashed line; 95% confidence bands in gray
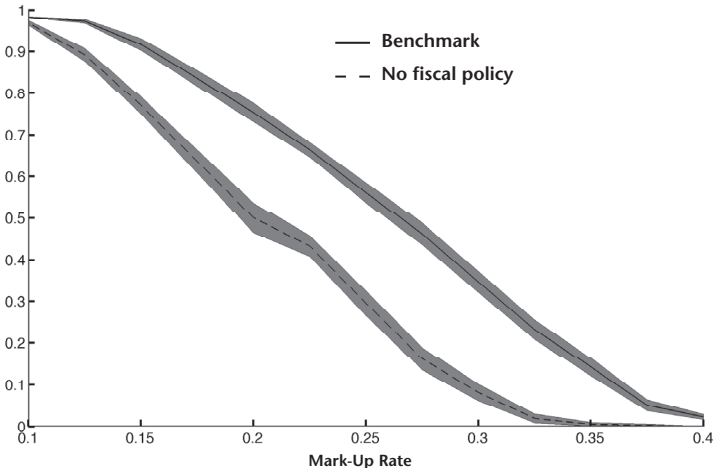
Source: Dosi *et al.* (2013).

Example 1: endogenous business cycles

Agent-based models have a clear advantage with respect to typical DSGE macro models, even those with heterogeneous agents. In those models, expansions and recessions are the result of respectively positive and negative aggregate shocks hitting a representative agent or (in more recent works) a set of heterogeneous agents. In contrast, in macro agent-based models, the system can generate both situations where the economy is in full employment as well as mild and deep recessions, *and it endogenously switches across them* (see Chart 1 and discussion in the previous section). Endogenous business cycles arise in agent-based models because agents' heterogeneity and interaction mechanisms introduce several non-linearities in the dynamical system that describes the economy. [8]

The ability of agent-based models to endogenously generate business fluctuations is not only important from a purely theoretical viewpoint. It also means that these models can be used as useful tools to explore (and possibly control *via* specific policies) the economic mechanisms that trigger instabilities during an expansionary phase and

put the seeds of a recession. For instance, the frequency of full employ-ment states of the economy can be linked to some key parameters capturing institutional and policy scenarios (e.g. the structure of inter-action in markets, the level of income inequality or the intensity of fiscal policy). For instance, in Dosi *et al.* (2013) the average frequency of full employment states, i.e. the time the economy spends on average in the full-employment equilibrium is inversely related to the inequality in the functional distribution between profits and wages (and captured by the level of the mark-up rate, see Chart 2). In addition, the incidence of full-employment equilibria falls for any level of inequality if fiscal policy is completely absent (no fiscal policy scenario).[9]

Another example that illustrates the role played by agents' heteroge-neity and interactions generating endogenous business cycles is provided by the work of Guerini *et al.* (2017). This paper analyzes the behavior of an economy under two different matching protocols: (a) a centralized matching scenario, where a fictitious auctioneer solves any possible coordination problem among the agents, and (b) a decentral-ized matching scenario, where agents locally interact in the markets. In such a regime, matching frictions and agents' heterogeneity may lead to imperfect allocations of goods and labor. Furthermore, households face liquidity constraints (their consumption is limited by changes in wealth). The authors initialize the variables of the model (consumption, wages, prices, production, firms' net worth, households' wealth, etc.) at values compatible with the full-employment, homogeneous-agents' equilibrium of the economy. They then let idiosyncratic (and auto-regressive) negative technology shocks hit the economy at the firm level and they study the stability of the full-employment equilibrium and the convergence properties of the model. The behavior of the model under

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8. Previous works showed that endogenous business cycles may emerge also in equilibrium models (e.g. Grandmont, 1985) or in models with infinitely-lived agents and rational expectations (see e.g. Baumol and Benhabib 1989 for a discussion, and the papers contained in Benhabib, 1992). All these models were however representative-agent models, or models where heterogeneity was small (e.g. like in overlapping generation models) and typically not evolving over time. These models also did not allow one to analyze how small perturbations of the system at the micro-level (e.g. because of a small exogenous shock) could be magnified via a network of agents' interactions. Agent-based models improve on all these aspects, because they allow one to generate endogenous business cycles in a framework with more realistic assumptions on agents' heterogeneity and mechanisms of interactions across agents.
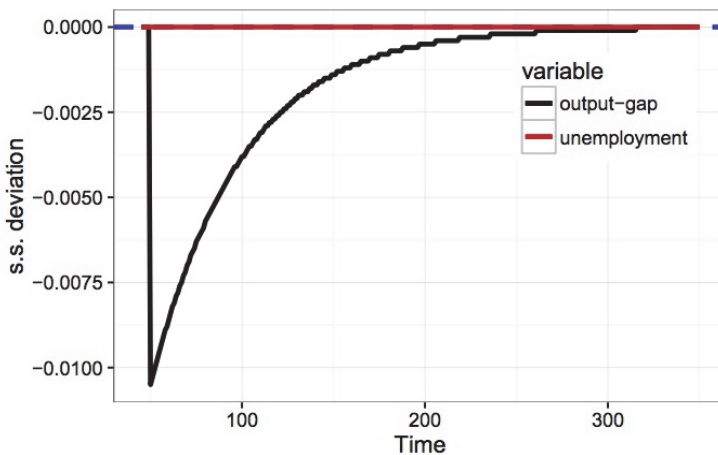
9. In a similar fashion, Gualdi *et al.* (2015) show the existence of multiple equilibria characterized, respectively, by high and low unemployment. The transition between the equilibria is induced by an asymmetry between the rate of hiring and the rate of firing of the firms. The unemployment level remains small until a tipping point, beyond which the economy collapses. Finally, if the parameters of the model are such that the system is close to this transition, any small fluctuation is amplified as the system jumps between the two equilibria.

the two matching protocol scenarios is very different. In the centralized scenario, the economic system is always able to get back to full-employment after the productivity shocks. In addition, the impulse-response functions generated by the model mimic the ones generated by standard DSGE models (see Chart 3) and, finally, agents' heterogeneity fades away. In contrast, in the decentralized scenario the economy fluctuates around an underemployment equilibrium (Chart 4) and it is characterized by persistent heterogeneity in firms and household behavior. This completely different outcome across the two scenarios is generated by the fact that the decentralized scenario produces frictional unemployment. Liquidity constraints faced by households amplify the effect of such a frictional unemployment an lead to lower aggregate demand in the goods market, which in turn feeds back in lower aggregated demand and higher unemployment in the labor market.

The last example shows quite well how the structure of interaction has a great effect on the properties of the aggregate dynamics of an economy and how it can greatly amplify even small degrees of heterogeneity across agents, e.g. due to the unemployment status created by frictions in the allocation of labor across firms.

3. Output and Unemployment

Chart 3. Impulse response of output and unemployment in the model of Guerini *et al.* (2017) under the centralized matching scenario
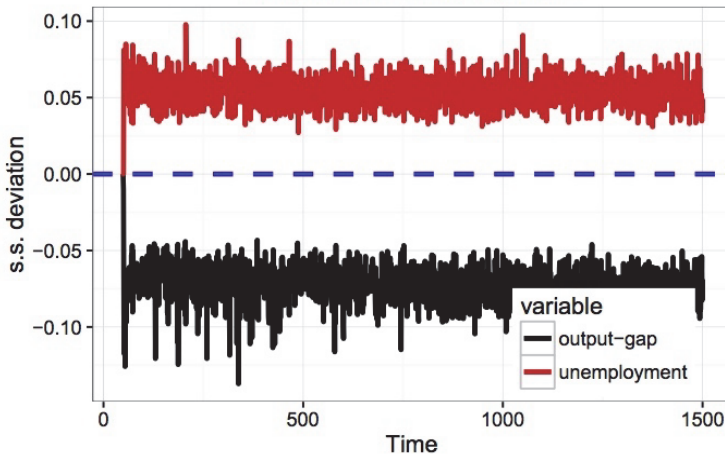
In the figure "s.s. deviation" stands for deviations from the full-employment equilibrium.
Source: Guerini *et al.* (2017).

In the figure "s.s. deviation" stands for deviations from the full-employment equilibrium.
Source: Guerini *et al.* (2017).

Example 2: Interactions between the short- and the long-run dynamics of an economy

Macroeconomic theory has been characterized by a sharp distinction between the analysis of long-run growth processes and the one of business cycles. This separation comes from the assumption that any coordination problem is solved in the long-run. It follows, that long-run growth mainly stems from supply factors, in primis technological change. In contrast, some coordination failures may arise in the short-run due to aggregate demand deficiencies. This framework has however several limitations, because it prevents the understanding of how technical change can map into higher growth and how the inherent instability of technical change processes can be mitigated. In one direction, technological innovations may impact upon the long-term rate of growth of the economy, as well as on the short-term evolution of output (and unemployment) over the business cycle. In the other one, macroeconomic conditions (i.e. aggregate demand, credit availability, etc.) are likely to modulate the creation and diffusion of technological innovations and the long-run performance of the economy (Dosi *et al.*, 2017). As it is argued at more length in the article by Jean-Luc Gaffard in this special issue, answering the above questions requires one to seriously consider the issue of time in economic

analysis, and to reject the idea of the presence of an equilibrium growth path towards which the economy converges in the long-run. In contrast, the long-run evolution of the economy is the results of a sequence of short-run states characterized by imperfect coordination[10] (see Gaffard, 2017, Dosi and Virgillito, 2017). Agent-based models are very good candidates for this type of analysis. This is because they do not have an exclusive focus on equilibrium states of the economy. They can therefore be used to understand how structural change (e.g. resulting from technology-induced structural changes) and/or coordination failures (e.g. resulting from aggregate demand shortages) may affect the long-run dynamics of an economy, and how different types of macroeconomic policies can intervene in this context. An example of this type of exercise is provided by the series of results obtained with the K+S model by Dosi *et al.* (2015) about the short- and long-run effects of the fiscal and monetary policy mix. Tables 1 and 2 – taken from Dosi *et al.* (2015) – show the effects of different combinations of fiscal and monetary policies on, respectively, the average growth rate of real GDP and the unemployment rate. The fiscal policies considered are an unconstrained fiscal policy (*norule*), two constrained fiscal policies (stability and growth pact, *SGP*, and fiscal compact, *FC*) and – finally – the same constrained fiscal policies but with escape clauses for recessionary phases (SGP_{ec} and FC_{ec}). The monetary policies considered are a conservative Taylor rule, targeting only the inflation rate (TR_π), a dual-mandate Taylor rule targeting both inflation and unemployment ($TR_{\pi,U}$), and the same dual-mandate rule but augmented with a government-debt dependent spread on bonds in order to account for possible feedbacks from high government debt levels on interest rates.

Values in the table are relative to the benchmark featuring an unconstrained fiscal policy and a pure inflation-targeting monetary rule. The striking results emerging from the analysis of the two tables is that both fiscal and monetary policies have not only significant real short-term effects, as captured by significant differences in unemployment rates across policy scenarios. They also matter for the determination of the long-rung growth rate of the economy. More precisely, constraining fiscal policy has a deleterious effect on both unemployment and the long-run growth rate of the economy, which is only mitigated by the introduction of escape clauses or by a dual-mandate monetary policy.

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10. This idea of long-run patterns emerging from a sequence of imperfect short-run adjustments is also very much in line with the generative approach discussed in the previous section.

Table 1. The effects of the interactions between fiscal and monetary policy on the average growth rate of GDP

Monetary policy	Fiscal policy		
	TR_π	$TR_{\pi U}$	Spread
Norule	1	1.019**	0.994
		(3.730)	(1.017)
SGP	0.527**	1.014	0.794**
	(6.894)	(1.157)	(3.982)
FC	0.572**	0.958	0.765**
	(6.499)	(1.296)	(4.863)
SGP_{ec}	0.995	1.013**	0.991*
	(0.876)	(2.572)	(1.665)
FC_{ec}	0.992	1.021**	0.997
	(1.388)	(4.169)	(0.524)

* significant at 10% level ; ** significant at 5% level.
Fiscal and monetary policy interactions. Normalised values of average GDP growth rates across experiments. Absolute value of simulation *t*-statistic of H_0 : "No difference between baseline and the experiment" in parentheses; *Fiscal policies:* no fiscal rule (*norule*); 3% deficit rule (*SGP*); debt-reduction rule (*FC*); SGP with escape clause (*SGP_{ec}*); FC with escape clause (*FC_{ec}*). *Monetary policies:* Taylor rule indexed on inflation only (*TR_π*); dual-mandate Taylor rule (*$TR_{\pi U}$*); bonds spread adjustment policy (*spread*).
Source: Dosi *et al.* (2015).

Table 2. The effects of the interactions between fiscal and monetary policy on the unemployment rate

Monetary policy	Fiscal policy		
	TR_π	$TR_{\pi U}$	Spread
Norule	1	0.322**	1.068
		(5.903)	(0.468)
SGP	5.692**	0.909	4.201**
	(8.095)	(0.555)	(6.842)
FC	5.706**	1.383	4.963**
	(7.585)	(1.350)	(7.443)
SGP_{ec}	1.419**	0.343**	1.680**
	(2.088)	(5.527)	(3.495)
FC_{ec}	1.948**	0.317**	1.679**
	(3.928)	(5.886)	(3.139)

* significant at 10% level ; ** significant at 5% level.
Fiscal and monetary policy interactions. Normalised values of average GDP growth rates across experiments. Absolute value of simulation *t*-statistic of H_0 : "No difference between baseline and the experiment" in parentheses; *Fiscal policies:* no fiscal rule (*norule*); 3% deficit rule (*SGP*); debt-reduction rule (*FC*); SGP with escape clause (*SGP_{ec}*); FC with escape clause (*FC_{ec}*). *Monetary policies:* Taylor rule indexed on inflation only (*TR_π*); dual-mandate Taylor rule (*$TR_{\pi U}$*); bonds spread adjustment policy (*spread*).
Source: Dosi *et al.* (2015).

Besides the effects arising from specific combinations of monetary and fiscal policies, the above results are important because they indicate the breaking down of the classical dichotomy which occupies a central stage in standard macroeconomic models, and they shed light on the effects that fiscal and monetary policies can have on long-run real drivers of an economy.

However, how do the above results emerge? The mechanism of transmission can be casted in a series of short-run adjustments mapping on the long-run rates of technological innovation and diffusion. The constraints imposed on fiscal policy reduce the ability of this policy to act as a parachute in case of demand shortages. Accordingly, the system becomes closer to one without fiscal policy, and the incidence of underemployment states rises (see also Chart 2 above). Higher unemployment and lower aggregate demand also imply a lower incentive of firms to invest (investment and production follow the principle of effective demand in the K+S model). In its turn, lower investment translates into a slower diffusion of new technologies, which are embodied in new machines sold by the capital-goods sector. In addition, by lowering demand for capital good firms, a decrease in in investment also reduces the incentives of those firms to invest in R&D, which maps into lower innovation rates.[11,12]

The next section briefly discusses a third example of macroeconomic issues where ABMs can bring new lights: the ability of price and wage adjustments to promote the return to full employment.

### Example 3: wage and price adjustments and unemployment

Since Keynes' General Theory (1936) one of the most debated questions in macroeconomics is whether changes in real wages are able to mop up or not disequilibria in the labor markets and to restore full employment. Nowadays, the idea of an inverse relation between real wages and unemployment is strongly embedded in standard macroeconomic models.[13] Recent results in the ABMs literature show that the shape of the relation between real wages and unemployment is instead very much context-dependent: it is determined by the specific rules

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11. See also Dosi *et al.* (2016) for a detailed examination of the effects on technological innovation and diffusion.

12. The better performance of the economy under the dual mandate monetary policy is instead explained by the beneficial effects that this policy has on Basel-like capital buffer requirements imposed on banks (see Dosi *et al.*, 2015, for more details).

used by firms in the market of goods and of labor, and by the specific protocols of interactions of agents in the two markets. Accordingly, the inverse relation between real wages and unemployment arises only in very specific cases. For instance, the plots in Chart 5 show that the inverse relation between real wages and unemployment depends on the specific rule used by firms to set the level of investment. The Chart is taken from the work of Napoletano *et al.* (2012) that uses the K+S model described in the previous sections to analyze the behavior of the economy under two scenarios for firm investment: a "profit-led" scenario where firm desired investment is a function of firm past profits, and "demand-led" scenario where desired investment depends instead on expected demand in the goods markets. Notice that the first archetype captures a scenario where investment is determined by financial constraints (profits affect cash flows in the model). The second archetype closely mimics Keynes' idea of effective demand.

Chart 5. The relation between the average unemployment rate and the mark-up rate in the K+S model
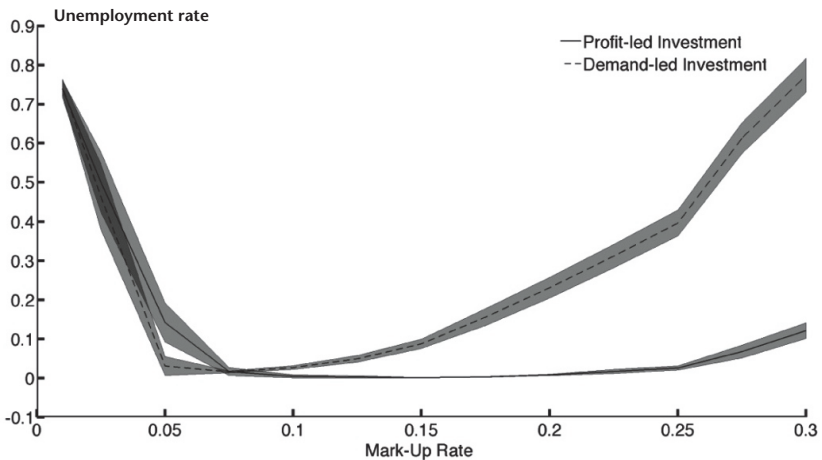
Source: Napoletano *et al.* (2012).

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13. This is for instance illustrated by the positive effects that a reduction in the real wage has on long-term unemployment of a closed economy in the WS-PS model (see e.g. Carlin and Soskice, 2016), which is a good simplification of the main functioning of the labor market of any standard DSGE model featuring unemployment.

The plots in the above Chart show the relation between unemployment and the mark-up rate set by firms in the goods market. As we move from left to right the mark-up rate increases. Accordingly, the share of output per worker that workers as real wages decreases. Unemployment decreases with the mark-up rate in the profit-led scenario. It follows that lowering real wages result into lower unemployment rates, as in the standard macroeconomic models. This is explained by the fact that a lower level of real wages increases profits of firms, thus resulting in a stronger incentive of firms to invest in new capacity and to hire workers.

The picture changes significantly if firms set investment based on expected demand. In this demand-led scenario the relation between the mark-up rate and unemployment is U-shaped. This indicates that both high and low real wages generate high unemployment. This seemingly surprising result is explained by the dual role that real wages play. On the one hand, real wages determine consumption and thus the final demand faced by firms. It follows that consumption demand decreases as we move from left to right in the Chart, which explains the low incentives of firms to invest and the high unemployment observed in correspondence of high mark-up rates. On the other hand, real wages affect profits and thus the ability of firms to internally finance investment. It follows that at low mark-up rates firms have strong incentives to invest, but their investment is hampered by the financial constraints they face because of low profits. It turns out that effective investment is low and unemployment high. Napoletano *et al.* (2012) also analyze the effects of flexibility in money wages on unemployment. They find that more flexible money wages are beneficial for unemployment in the profit-led scenario but not in the demand-led scenario. Dosi *et al.* (2017) generalize the above results by exploring a richer set of rules for wage and output determination.[14]

Agent-based models have also been used to show that the structure of interactions across agents matters much more for aggregate outcomes than wage and price adjustments. For instance, Howitt and Clower (2000) study a primitive exchange economy populated by

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14. The above results about the context-dependent role of real wage adjustments are not completely new to the literature. They had for instance been stressed by works in the so-called French "Régulation" school (see e.g. Boyer, 1988, Aglietta, 2000) and by works like Amendola *et al.* (2004) and Howitt (1986). The contribution of agent-based models is however to have obtained the above results in the context of fully microfounded models with heterogeneous interacting agents and that explicitly allow for the possibility of market disequilibrium.

people with no understanding of their environment other than what has been learned from random meetings with other people, and with a desire to exchange their endowments for something they might want to consume. Starting in an autarkic situation, with no trade organization, they show the emergence of a coherent network of trade facilities (the "shops") that allows almost all the potential gains from trade to be fully exploited. Howitt (2006) shows that the same economy generates a multiplier process, wherein the failure of one trading firm may trigger a cascade of other firm failures and cause a large aggregate output loss until a suitable set of replacement shops has emerged. In that situation, price or wage flexibility can do nothing to speed up the recovery process because what is needed is not different prices but the re-introduction of organizational structures that allow trade relations to orderly unfold. In a similar fashion, Guerini *et al.* (2017) study the effects on unemployment and the output gap of a better matching process in the market for goods and labor. They show that when search in labor and good markets is less the economy gets closer to full employment. This is because the economy gets closer to a centralized matching scenario where coordination problems are solved. Moreover, they show that such a result holds independently of the fact that real wages are fully flexible or completely fixed. The reason is that quantity adjustments matter much more than price adjustments. Accordingly, moving towards a centralized scenario reduces the frictions from the job allocation process as well as their amplification via demand feed-backs from the goods market.

4. By Way of Conclusion, Agent-Based Macroeconomics: A Summary of its Results and a Discussion of its Limitations

In this article, I have discussed the building blocks of agent-based macroeconomic models, and explained that these models employ a generative approach to the analysis of macroeconomic issues, which is different from the reductionist approach which is largely dominant in macroeconomics. I have also discussed examples that show how this new class of models can provide new insights on several central issues in macroeconomics. First, I illustrated how these models can generate endogenous business cycles out of the interaction among heterogeneous agents hit by idiosyncratic shocks. Second, I pointed out that these models can be used to analyze the interactions between the short- and long-run dynamics of an economy, as well as the persistent effects of monetary and fiscal policies. Third, I mentioned how these

models can be used to shed lights on the conditions under which wage and price adjustments can or cannot promote the return of an economy to full-employment in the aftermath of shocks.

All the above results are hard to obtain in more standard macro models, like DSGE ones. The latter models have recently been improved to incorporate agents' heterogeneity (e.g. the HANK model, see Kaplan *et al.*, 2017) and to study their effects for the transmission of fiscal and monetary policies (e.g. Algan and Ragot, 2010, Challe and Ragot, 2011). And recent versions of these models can also account for equilibrium multiplicity (e.g. Farmer and Serletis, 2016). Finally, these models have also been modified to introduce elements of bounded rationality (e.g. Gabaix, 2016, Woodford, 2013, and the papers surveyed in Assenza *et al.*, 2014). Still, business cycles in these models arise from exogenous aggregate shocks. In addition, these models incorporate a sharp separation between the analysis of the short- and long-run dynamics of an economy. Accordingly, they cannot analyze how interactions between heterogeneous agents can generate aggregate dynamics that switch endogenously between phases of full utilization of resources and mild and deep recessions, and study how all this have persistent effects on long-run growth. Furthermore, by being nested in a full general equilibrium framework, DSGE models can hardly investigate the role played by quantity adjustments – versus price adjustments – in the generation of recessions and of subsequent recoveries.

Agent-based models thus represent a valid tool for macroeconomic analysis. At the same time, they also have limitations, some of which are currently tackled by recent works. I shall briefly discuss four critiques raised towards ABMs and of how they are addressed: i) the fact of being "ad hoc" and of letting one being lost in the "wilderness of bounded rationality" (the "ad hocerism" critique); ii) the poor understanding of their causal mechanisms (the "black box" critique); (iii)the inability of agents to respond to policies (the "Lucas critique"), (iv) the poor link with data (the "data validation" critique).

Let me start with the critique that ABMs are completely ad hoc. First, one must probably acknowledge that a similar degree of ad hocerism plagues also models with optimizing agents, where various functional forms for production and utility functions are used to obtain – out of constrained maximization – the behavioral rule of interest. Second, ABMs microfound their behavioral rules either by using empirical or experimental evidence about true agents' behavior. Finally, agent-

based models typically undergo and indirect validation test, i.e. it must be able to reproduce – with the same values of parameters – a large set of stylized facts at the micro- and macroeconomic level.[15]

About the "black box" critique, I have already discussed above that this largely stems from the differences between the generativist approach used by ABMs and the reductionist approach traditionally used in economics. Furthermore, one must also remark that – even in very complicated ABMs – causal mechanisms can be detected through counterfactual analyses. More precisely, the structure of ABMs often allows one to control the presence of some dynamics in the model (through an appropriate setting of the parameters), and to test how results are different when such dynamics are switched off/on. Examples of this approach are the experiments with different types of fiscal and monetary policy discussed above or the example with different types of matching protocols in labor and goods markets or, finally, the phase diagram analysis performed in Gualdi *et al.* (2015). In addition, the counter-factual analysis can be pushed forward in ABM, up to build treatment and control groups and to apply the same methodologies used in econometrics to detect causal relations. The papers by Neugart (2008) and by Petrovic *et al.* (2017) are good examples of this approach.

Let me now turn to discuss the Lucas critique towards agent-based models. It is true that ABMs – in line with a vast amount of empirical and experimental evidence (see e.g. Assenza *et al.*, 2014) – do not assume rational expectations. In addition, many ABMs use agents with sticky behavioral routines and/or naïve expectations. This makes them more applicable to situations where agents face constraints in obtaining and processing relevant information about economic variables and/or to situations where financial and income constraints bind, and thus where agents' expectations are of little importance. At the same time, agent-based macro models have recently tried to address the Lucas critique and to introduce agents with more sophisticated expectation rules taken from the literature on learning in macroeco-

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15. The K+S family of models discussed in this paper (Dosi *et al.* 2010, 2013, 2015, 2017) is a good example of this type of microfoundation methodology. Notice that, as it is argued in Napoletano *et al.* (2012), it is not just a matter of reproducing just one stylized fact but many at once! Indeed, the number of stylized facts that an ABM tries to reproduce is typically much larger than in standard models, and this already puts a lot of constraints on the set of parameters' values that can be selected. Moreover, differently from polynomial data-fitting exercises, in ABMs it is required that parameters' values must be economically meaningful.

nomics (e.g. Evans and Honkapoja, 2012). The works of Arifovic *et al.* (2010), Salle (2015) and of Dosi *et al.* (2017) provide good examples of this new research stream in agent-based macroeconomics.

Finally, agent-based models have been criticized for the lack of validation using macroeconomic data, which is instead extensively applied in the macro DSGE literature to calibrate and estimate models. It is true that ABMs currently lag behind DSGE models in the use of more sophisticated data-validation techniques, and this despite the ability of ABMs to produce a vast amount of micro and macro simulated data.[16] Several contributions in the last years have tried to fill the above gap. This literature has applied a large ensemble of approaches, ranging from simulated minimum distance methods, to machine learning techniques to, finally, data-driven identification in VAR models, either to estimate parameters in ABM or to check the ability of ABMs to reproduce the features of empirical time-series[17] (Fagiolo *et al.*, 2017, contains a survey of this recent line of research). For instance, Guerini and Moneta (2017), apply independent-component analysis to compare the causal structure of VAR models estimated on empirical time-series and on time-series generated by a macro ABM model. Interestingly, they find that the agent-based model they employ can reproduce between 65% and 80% of the causal relations entailed by a SVAR estimated on real-world data.

To sum up, agent-based models constitute a new tool that allows macroeconomist to explore new research avenues that were not or that cannot be paved by using more traditional macro models, even with recent improvements. Agent-based models were severely criticized for being too much ad hoc or for not being following some standard practices in the macroeconomic literature. Nevertheless, much of this criticism either applies to standard models as well, or it is currently addressed in the recent literature. In conclusion, macroeconomics can safely take a longer walk on the purported "wild side" of agent-based models.

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16. Indeed, this critique applies only in part because, as we discussed above, ABMs already employ empirical (or experimental) evidence to microfound agents' behavior. In addition, ABMs are already indirectly calibrated, by checking their ability to reproduce moments of distributions both at the micro- and macro-models (see also above).
17. In addition, these validation techniques can also be applied to DSGE models. This open the way to the possibility of better comparisons between the performance of ABMs and of DSGE models.

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WHAT SHOULD MONETARY POLICY DO IN THE FACE OF SOARING ASSET PRICES AND RAMPANT CREDIT GROWTH?

Anne Épaulard
University Paris Dauphine

In the aftermath of the financial crisis macroeconomists once again took an interest in the options offered by monetary policy to deal with asset price bubbles. Empirical studies seem to show that the soaring debt of agents is more dangerous than the soaring prices of financial assets. Macroprudential tools now appear to be able to limit the amplitude of cycles of indebtedness. The debate is henceforth focusing on the last resort role left to monetary policy in cases where the implementation of macroprudential tools will not be sufficient.

Keywords: monetary policy, asset prices, financial cycle, macroprudential policy.

The financial crisis of 2008 renewed the debate over the rationale for a central bank to tighten financial conditions (i.e. raise the interest rate) to tame financial assets and / or real estate price dynamics, in times when neither inflation forecast nor economic conditions justify a monetary tightening.

The renewal of this debate stands in stark contrast to the pre-crisis consensus that a central bank should focus on its inflation target. At the time financial stability issues were considered the sole responsibility of the financial system's prudential regulators and supervisors. In most countries these regulators followed a micro-economic approach organized around the health of financial institutions taken individually, with no aggregate view of risk. From this perspective the main role of monetary policy was to maintain price stability. In the event of financial crises, central banks had first to provide the liquidity needed for the

functioning of the financial system, and then to implement accommodative policies to avoid rising unemployment and the collapse of inflation.

The magnitude of the 2008 financial crisis, the difficulty of reviving the economy after the crisis, and the likely permanent damage it has left have reopened the debate on the role of monetary policy in preventing financial crises. This debate has been organized around several interrelated issues: what level of indebtedness or asset prices can be considered as threatening financial stability? Are central banks the best placed to monitor financial stability when they have a single instrument (the interest rate) that they already use to target inflation and keep unemployment to its equilibrium level? Even if financial stability is entrusted to bodies other than the central bank (as is currently the case in most G7 countries), should central banks intervene as a last resort, in the wake of the macroprudential bodies, in order to counter a surge in asset prices and credit?

1. Prior to the Crisis: A Recurrent Academic Debate but a Central Bank Consensus

The debate over monetary policy and bubbles is recurrent. It had reemerged in the late 1990s, when valuations of companies in the digital economy seemed disproportional to their profits (really more often losses) and the press talked about the "dot.com bubble". We will return later to the role of academic contributions to this debate. In terms of the conduct of monetary policy, the debate was decided in favour of a "reactive" attitude of the central bank, i.e. to adopt a monetary policy to support activity after the bubble burst in order to limit damage to the economy (rising unemployment, lower inflation, weak demand). The role of the central bank was therefore reduced to that of "cleaning". This consensus among central banks to reject pro-active measures ("leaning against the wind") was clearly spelled out in a speech by Bernanke (2002), then a member of the Federal Reserve board of governors. The first argument is that it is not easy to detect an asset price bubble in real time. If the central bank does not have more information than the market about the "true" value of companies, how can it justify opposing the market by acting on the basis of valuations that it considers too high? The second argument is that a preventive policy (an increase in rates when the existence of a potentially dangerous bubble is suspected) translates fairly quickly into an

economic slowdown and an increase in unemployment, without having a very significant impact on the presumably overvalued market. The interest rate is too broad an instrument to be used to force a surging financial (or real estate) market back on track. It is therefore not certain that acting once a bubble has been spotted (leaning) is better than acting after it has burst (cleaning). Finally, the two arguments are combined: the gain expected from a preventive action falls the more uncertain it is that there is a bubble.

This pre-2008 consensus does not mean that the central bank is unconcerned about financial stability, but rather that financial stability is to be achieved by using other tools: regulation, supervision and the power of a lender of last resort (see Bernanke, 2002). In 1996, when Alan Greenspan (then Chair of the US Federal Reserve) spoke of irrational exuberance to describe what was happening in the US financial markets, he was trying to alert investors to dot.com valuations that he believed were much too high. However, in accordance with the doctrine of the Federal Reserve and the consensus of the day, the course of monetary policy went unaffected, with the central bank remaining committed to its dual mandate: price stability and low unemployment. After the dot.com bubble burst in 2001 the Federal Reserve lowered its rate: the damage to the real economy was limited and the post-crash economic slowdown relatively short.

The 1929 trauma

One further argument, heard less often but probably very present in the minds of central bankers, particularly in the United States, is that a preventive policy was used in the past with the most disastrous results. In 1928, the US Federal Reserve, worried about high valuations in the US financial market, raised its interest rate just as the US economy was emerging from a recession. The Federal Reserve even further tightened its already restrictive policy in July 1929. After the 1929 stock market crash, the bubble had been eliminated (in part), but the economy had collapsed. It is difficult to attribute the great recession of those times to the reverberations of the stock market crash. On the one hand, some authors hold that the economic recession was already underway, before the monetary tightening, which merely accentuated it, and that the bubble would have burst anyway.[1] On the other hand, the scale

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1. *Cf.* Bernanke, 2002.

and duration of the 1929 crisis also resulted from the lack of any reactive monetary policy measures until the middle of 1930 (after a brief episode of the large-scale provision of liquidity right after the crash in October)[2] and, more generally, a poor policy mix (or fiscal/monetary policy mix) in the years that followed. However, this failure of monetary policy (use of preventive and non-use of reactive) is still in the minds of monetary policy makers today.... and does not exactly encourage the use of pro-active monetary policy.

2. Private Debt and Surging Real Estate Prices – Potentially more Dangerous than Bubbles on the Financial Market

The 2008 crisis shook the consensus of the 1990s-2000s for several reasons. Not only did the post-crisis "cleaning" not really work, but the losses associated with the financial crisis were significant and lasting. It is also clear that the financial crisis was not a random event: it was preceded by a boom in the property market, a general rise in indebtedness, and the large-scale use of securitization, leading to the accumulation of systemic risks in the financial sector. All this took place in a low interest rate environment as central banks, including the Federal Reserve, were working to limit the negative effects of the burst *dot.com bubble.*

2.1. Better describing past financial crises

One focus of post-2008 empirical research has been on better describing past financial crises and developments in financial markets, indebtedness and the economy before, during and after the financial crises. An article by Schularick and Taylor (2012) focused on the outbreaks of financial crises in 14 economies (now developed) that took place from 1870 to 2008. It provides a wealth of information about financial crises that simply cannot be summarized here. With respect to the issue of the role of monetary policy before and / or after financial booms, their main conclusions were: (a) central banks were more inclined after the Second World War to intervene following financial crises so that the post-crisis period less often resulted in deflation (negative inflation) and a tightening of credit in the economy, but (b) the post-war crises were nevertheless more costly in terms of activity

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2.   The interested reader should consult Hamilton (1987).

and unemployment. They also note (c) that the credit growth pace is a good predictor of the imminence of a financial crisis, and that the probability of a financial crisis is greater when debt levels are high. Finally, Schularik and Taylor conclude (d) that a rise in the price of financial assets in the pre-crisis years does not really improve the ability to predict the coming of a financial crisis. Financial crises are therefore more episodes of credit booms going bad rather than episodes of runaway financial markets alone, a hypothesis that has been advanced before[3] but which is difficult to validate empirically for developed countries due to the relative rarity of financial crises. Expanding on this work using long historical data, Jorda, Schularick, and Taylor (2013) showed that the severity of a crisis is linked to the expansion of credit in the pre-crisis period, which had already been shown by Cerra and Saxena (2008) and Reinhart and Rogoff (2009).

These empirical studies, which are very useful for understanding the genesis and consequences of crises, also provide orders of magnitude for quantifying the macroeconomic gains associated with financial stability. Above all, they help to rethink the hierarchy of effects: it is the surge in credit to individuals (in particular household debt) that, in the past, has been the main trigger of financial crises. Spectacular as they are, record levels reached by the stock market indices and the bursting of the bubbles that sometimes follow them are far from being as devastating.

2.2. The credit accelerator and risk-taking: two explosive ingredients when interest rates are low

How can credit surges be explained? How do they arise? For credit to have a potentially destabilizing effect on the economy, there must be some imperfection that keeps the credit market from functioning optimally. In frictionless economies, an increase in credit reflects an improvement in fundamentals and is not destabilizing: monetary policy does not have any interest in countering the growth of credit (nor does any other policy). But in economies where frictions and imperfections exist, agents' behaviour can give rise to financial vulnerabilities. In these contexts, monetary and macroprudential policies can be useful if they manage to limit risky behaviour and, as a result, the likelihood and severity of crises.

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3. *Cf.* Minsky (1977), Kindelberger (1978), Reinhart and Rogoff (2009).

The first models used to measure the impact of monetary policy on credit and the opportunity to limit a surge in asset prices were based on the credit accelerator (Bernanke, Gertler, 2001), a consequence of imperfect information. More recently, the question of the desirability of pro-active policies has been studied in models that also incorporate banks' risk-taking behaviour arising from banks' limited liability (which limits shareholder losses) and/or deposit insurance (which limits bank depositors' losses).

The credit accelerator

Information is not perfect in the credit market: lenders are never certain that borrowers will pay them back, and collecting information on potential borrowers is expensive. To avoid some or all of these costs, banks may decide to grant loans on the basis of borrowers' wealth, with the idea that this wealth offers them guarantees of repayment (possibly in the form of explicit collateral in the loan contract). A fall in interest rates that increases (almost mechanically) the price of financial and real estate assets increases the borrowers' nominal wealth, with the banks then even more inclined to lend to them. This effect adds to the usual channels of monetary policy and amplifies it. When interest rates are low, not only do investment projects appear more profitable (interest rate channel) and agents feel richer (wealth effect) but also borrowers appear less risky to lenders who in turn reduce risk premiums. These transmission channels add-up to facilitate more debt, and hence the effect of the credit accelerator (Bernanke, Gertler, 2001). Numerous empirical studies have shown that agents who are initially financially constrained (that is, who do not manage to incur as much debt as they wish) are able to increase their debt level as a result of a shock to the value of their collateral[4], thus lending credence to the credit accelerator hypothesis.

The risk-taking channel

Even before the outbreak of the 2008 crisis, Rajan (2005) and Borio and Zhu (2008) had pointed out the accumulation of risk in the financial system. In their wake, several authors have studied the link between the monetary policy stance and the risk-taking of banks and other investors. At least two reasons for their risky behaviour can be

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4. See for example Almeida *et al.* (2006) and Lamont, Stein (1999) for households and Gan (2007) and Chaney *et al.* (2012) for firms.

traced to the activity of the banks and the environment in which they operate: first, their limited liability (common to all joint stock companies), which limits losses incurred by shareholders in the event of bankruptcies; and second, deposit insurance for clients in the event of their bank's bankruptcy. A protracted low interest episode exacerbates risk-taking. Banks are seeking yields, which encourages them (given the size of their balance sheet) to buy riskier assets (Rajan, 2005; Dell'Ariccia *et al.*, 2014). Jimenez *et al.* (2012) used a sample of Spanish banks to show that the search for yield is more apparent in less capitalized banks: the most vulnerable banks are those that take the greatest risk. In addition, when interest rates are low, banks tend to borrow to buy higher-risk assets (Adrian and Shin, 2009). Risk-taking can also be seen on the financing side: low interest rates increase the incentive for banks to engage in short-term financing (Stein, 2013) rather than long-term, heightening their exposure to sudden changes in financing conditions. In fact, Adrian and Shin (2010) showed that an increase in the Federal Reserve's monetary policy rate is associated with a decrease in short-term financing. Long periods of low interest rates thus leave banks more vulnerable to shocks: their balance sheets are both larger and riskier.

3. Macroprudential Tools

The destabilizing potential of finance was illustrated by the financial crisis of 2008. The question then arises of the tools available to the regulator and / or the central banks to contain this destabilizing potential without eliminating the positive effects of access to credit (and savings) for individuals and the economy as a whole. The first type of instrument is the prudential supervision and regulation of financial firms, including banks and insurance companies. This regulatory power can act on individual banks (microprudential regulation) or on the financial system as a whole (macroprudential regulation). Macroprudential regulation sets out stricter rules for the financial actors most likely to threaten the stability of the system (agents referred to as "systemic", usually the largest, and easy to spot) and/or modulates the rules according to the financial cycle so as to limit the risks of credit booms (which we have seen increase the likelihood of a financial crisis) and reduce the possibility that a single entity's difficulties will spread contagion throughout the financial system.

3.1. Powers and limits of macroprudential tools

If macroprudential tools were perfectly effective in limiting credit booms and asset price bubbles, there would be no question regarding the role of monetary policy in dealing with excess credit and these bubbles. It would then come down to macroprudential policy, which has sufficiently granular instruments to target a given market, institution or behaviour, and deal with the financial cycle and any glaring imbalances in specific markets, while monetary policy could concentrate on price stability, or even on reducing unemployment to a level compatible with price stability.[5] The empirical evidence available today, however, is not reassuring that macroprudential tools are fully effective.

Macroprudential instruments seem capable of reducing the debt cycle

The importance attached to financial stability since 2008 has led to a growing interest in studying the effectiveness of macroprudential policies. Even before the outbreak of the crisis, Borio and Shin (2007) studied the implementation of prudential measures to limit credit growth and rising real estate prices in some fifteen countries. Based on a study of events, they found that these measures reduce credit growth and property prices rapidly after they are introduced. On a broader panel of 49 developed and emerging economies observed from 1990 to 2011, Lim *et al.* (2011) identified 53 episodes of the use of at least one macroprudential tool. Only nine countries in the sample did not use any macroprudential tool over the period. They concluded that a number of macroprudential instruments are effective in terms of their ability to reduce the pro-cyclicality of credit, regardless of the country's exchange rate regime or the size of its financial sector. This is the case of limits on debt relative either to the value of the property it finances, the Loan to Value Ratio (LTV), or to income, the Loan to Income Ratio (LTI), banks' reserve requirement ratio, counter-cyclical capital requirements and dynamic provisioning (provisions grow more than proportionally to assets). On an even more extensive database in terms of both the number of countries (57) and years (from 1980 to 2011), Kuttner and Shin (2016) showed that the Debt Service to Income ratio (DSTI) is the most universally effective instrument for reducing the rise in mortgages. On the other hand, this tool does not seem to have any effect on the dynamics of real estate prices, which tend to respond

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5. Collard, F., Dellas, H., Bida, B. and Loisel O. (2017) propose a macroeconomic model that illustrates this divide between monetary policy and macroprudential policy.

instead to the taxation of real estate property. These results are consistent with what has been estimated for Hong Kong (He, 2014) and in emerging economies (Jacome and Mitra, 2015) where the use of LTV limits succeeded in containing household debt but had a limited impact on the rise in real estate prices, which are held down instead by higher transaction taxes.

It is worth noting the coarse nature of these impact assessments, which do not shed much light on the appropriate mix of macroprudential instruments. In most impact studies, policies are represented by discrete variables (e.g. 0 if no action is taken, +1 if the macroprudential tool is introduced or its intensity increased, and -1 if the use of the macroprudential tool is relaxed, as is the case in the analysis of Kuttner and Shin, 2016), with the intensity of the macroprudential measure itself not being taken into account.

Fewer empirical results for the impact o f macroprudential measures on the risks taken by banks

Claessens *et al.* (2013) analysed the use of macroprudential policies aimed at reducing vulnerabilities in banks. From a sample of 2,300 banks observed over the period 2000-2010, they concluded that debt limits (LTV and DSTI) are effective in reducing the banks' debt ratio and the growth of their debt in boom periods. Once again, the variable representing the use of the macroprudential tool is binary (0 or 1) and does not take into account the intensity with which the macroprudential policy is applied.

The use of macroprudential tools seems to have limits

One limitation on the use of macroprudential tools is probably the difficulty in using them. Direct intervention in specific markets can have a high political cost, especially when it affects specific interest groups. The limits on household debt (limits on LTV ratios, DTIs or DSTIs) that do appear effective when they are used are also largely unpopular, especially as they are likely to affect the poorest households more.

There is also a risk that macroprudential tools, which act through the imposition of rules, might be circumvented by regulatory trade-offs and/or creative financial engineering (Aiyar *et al.*, 2012; Jeanne and Korinek, 2014), especially when policies are not coordinated at the international level. This is the argument made by advocates of the use of monetary policy rather than macroprudential tools for ensuring

financial stability, whose ranks include Borio and Drehmann (2009), Cecchetti and Kohler (2012), and Stein (2014). For these authors, since the interest rate is a universal price, it hits regulated sectors and non-regulated sectors alike.

4. Monetary Policy: Last Rampart Against Runaway Credit and Asset Prices?

Can monetary policy play a role in promoting financial stability when macroprudential policy alone is not enough?

Cost-benefit analysis of pro-active policies (leaning against the wind)

In several articles and blog posts, Svensson has presented a cost-benefit analysis of monetary policies. The set of arguments is summarized in Svensson (2016) and illustrated in an easy-to-use calculation file.[6] Using this approach, four elements come into play in determining whether pro-active monetary policies are worthwhile:

— the extent of the tightening needed to curb indebtedness;
— the short-term macroeconomic cost of a rise in interest rates;
— the extent of the recession in the event of a financial crisis;
— the link between rising debt and the likelihood of a future financial crisis.

To quantify the first two elements, Svensson uses the results of the model developed by Sweden's central bank (where he was Governor from 2007 to 2013) to measure the effects of monetary policy. The results of the empirical study by Schularick and Taylor (2012) are used to quantify the last two elements above. Using these parameters, the cost (in terms of unemployment) of a pro-active policy appears much higher than that of a reactive policy. This is partly because it is very difficult for monetary policy to reduce the likelihood of a financial crisis: a 100 basis point increase in the short-term interest rate reduces the probability of a crisis by 0.02% per quarter. Similar simulations by the IMF (2015) show that even if the impact of a monetary tightening on the probability of crisis is multiplied by 15 (to 0.3% per quarter), pro-active policies are still overshadowed by reactive policies when the short-term costs to economic activity of the interest rate hike are taken

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6. http://larseosvensson.se/files/papers/svensson-simple-example-of-cost-benefit-analysis-of-leaning-against-the-wind-v3x.xlsx

into account. However, as Adrian and Liang (2016) have pointed out, the assumption that the magnitude of the crisis is independent of the level of debt when the crisis erupts is crucial to this outcome. But this hypothesis is contrary to the empirical evidence put forward by Jorda, Schularick and Taylor (2013), for whom the magnitude of financial imbalances (in this case household debt) before the crisis increases not only the likelihood of the crisis but also its magnitude (in terms of a reduction in activity and in growth in the post-crisis years).

Full-fledged macroeconomic models for evaluating the role of monetary policy in the face of an asset price boom

The cost-benefit approach outlined above has the merit of being clear and instructive. It does not, however, describe monetary policy choices throughout the cycle (and not just at a given point in time, as in Svensson's approach). Full-fledged inter-temporal dynamic models can identify the contribution of policies (monetary, macroprudential) to the functioning of the economy. As mentioned above, these models must incorporate the elements that give rise to credit surges if they want to describe the financial cycles.

Bernanke and Gertler (2001) were the first to look at the effects of a monetary policy targeting asset prices. In a model incorporating a financial accelerator, they concluded that a monetary policy rule that merely responds to inflation and economic activity prevails over (from the point of view of the stabilization of inflation and activity) a rule that also includes the price of financial assets. However, this approach does not take into account the risk-taking behaviour of financial players, an element that seems to have been a major factor in the origin of the 2008 crisis.

Research has thus been developed around models that integrate the risk-taking behaviour of banks as well as the possibility of a shift of the economy towards a state of crisis. In these models, the assumption is that the likelihood of a crisis depends on a financial variable, such as the debt ratio for Woodford (2012) or the growth in credit for Ajello *et al.* (2016): the shift to a financial crisis is never certain, and a drift in the financial variable does not necessarily lead to a financial crisis. Sufficiently strong or repeated shocks to agents' debt may, however, lead the central bank to opt for a pro-active policy, despite the short-term cost of this policy. For example, in a "neo-Keynesian" model with three equations (an "IS" equation, a dynamic supply equation, and a debt

accumulation equation), Woodford (2012) showed that the optimal monetary policy rule takes into account not only inflation and the output gap (as is usually the case) but also an indicator of financial imbalances (the debt ratio). The simulations proposed by Ajello *et al.* (2016) showed that the tightening of monetary policy will in any case be very small, around 10 basis points, unless we assume that policy makers take into account the uncertainty surrounding the effects of the tighter conditions on financial variables. In a DSGE model, Gourio *et al.* (2016) also identified instances where monetary policy may have an interest in acting preventively to avoid the build-up of financial imbalances and reduce the likelihood and magnitude of the crisis, a result that they attribute in part to the fact that crises can have permanent effects on the economy. Nevertheless, in these three studies, the conditions for using of monetary policy to reduce the probability of a financial crisis or the damage it would cause are rarely met.

5. Conclusion

The desire to understand the events that led to the 2008 crisis and avoid a new financial crisis have given rise to theoretical and empirical research on "financial macroeconomics". This research has already clarified several points. The first is that credit booms are dangerous for financial stability, far more so than stock market bubbles. These credit booms come from imperfections in the financial markets, in particular the excessive risk-taking of certain financial agents, notably the banks. Macroprudential policies, which are aimed precisely at ensuring that financial agents don't take too much risk, seem to be effective in fighting credit booms. Despite this, it is likely that they cannot guarantee complete financial stability: not only can the implementation of macroprudential measures be costly politically, but they may be circumvented either by financial innovations or by the behaviour of economic actors that are not covered by the regulator. Given this situation, can monetary policy offer a second line of defence? The representations of the economy that we have today identify the relatively rare conditions in which the use of monetary policy would be recommended to fight dangerous credit run-ups.

Research needs to make further progress. We have only qualitative knowledge about certain crucial phenomena: our understanding of the scale of the banks' risk-taking channel is poor, we don't have good measures of the effectiveness of macroprudential tools, nor are we

able to assess very well the capacity of rate rises to curb private indebtedness. These are empirical issues that, for the most part, need to be investigated using individual bank data. Central banks have this data. They are gradually allowing access to academic researchers (and not just their own researchers). New work should shed light on the key points.

In addition to these micro-economic questions about the behaviour of banks, there are macroeconomic issues that also condition the relevance and effectiveness of the interventions by macroprudential authorities and central banks: we are still uncertain about the long-term damage (loss in terms of growth) caused by a major financial crisis; and there are not good measures of the link between the level of private agent debt and the probability of a crisis occurring. Researchers have begun to look at these questions, but it is illusory to believe that they will dispel the uncertainties completely.

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WHAT ARE THE EURO ZONE'S MAIN DIFFICULTIES?

Patrick Artus
Natixis

We look at the euro zone's major structural difficulties and the ways to correct them. They are: the growing heterogeneity of the member countries' economies, due in particular to diverging productive specialisations and the fact that this heterogeneity is not corrected by federalism; the end of capital mobility between OECD countries; the lack of coordination of the economic policies that generate externalities between the euro-zone countries; the asymmetrical nature of adjustment mechanisms (fiscal policies, cost competitiveness), which are only implemented by the troubled countries; and the difficulty in managing fiscal policy and public debt.

Keywords: Euro zone, Heterogeneity, Economic policy coordination, Externalities.

We believe the euro zone's difficulties can be divided into three categories: the lack of mechanism to combat heterogeneities; the lack of economic policy coordination and the divergence in the functioning of labour markets; the errors of economic policies in their design and their implementation.

1. Lack of Mechanism to Combat Heterogeneity

The euro-zone countries' heterogeneity is not due to cyclical asymmetry between these countries (the correlation of cycles is strong between the euro-zone countries, (De Grauwe and Ji, 2017; Belke, Domnick and Gros, 2016; De Haan, Inklaar and Jong-A-Pin, 2008). The heterogeneity is due to structural asymmetries between the countries.

These structural asymmetries are explained by differences between productive specialisations. Chart 1 shows, for example, the weights of manufacturing industry in GDP, Chart 2 trade balances for tourism..

Chart 1. Value added in the manufacturing sector
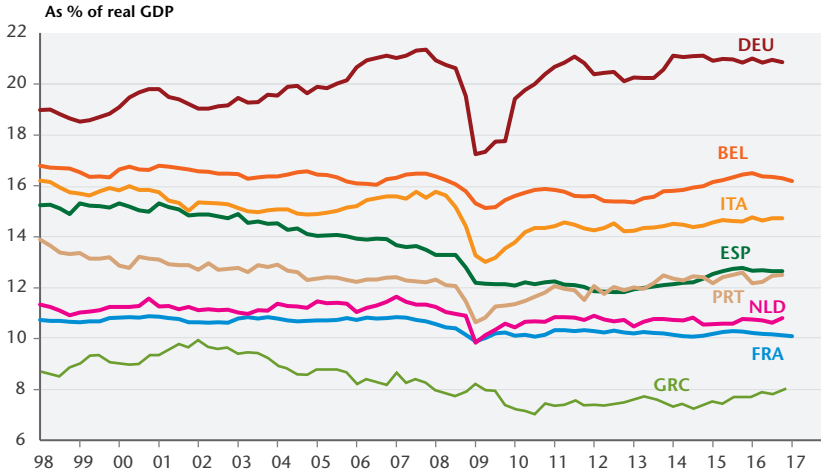
As % of real GDP

DEU: Germany, BEL: Belgium, ESP: Spain, FRA: France, GRC: Greece, ITA: Italy, NDL: Netherlands, PRT: Portugal.
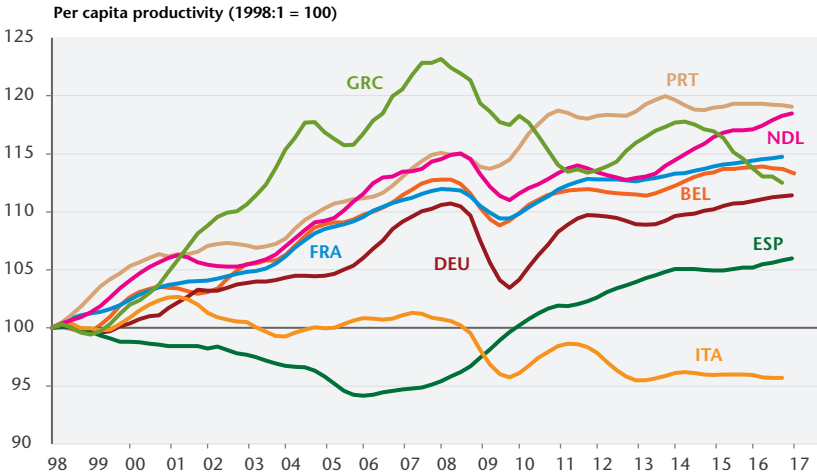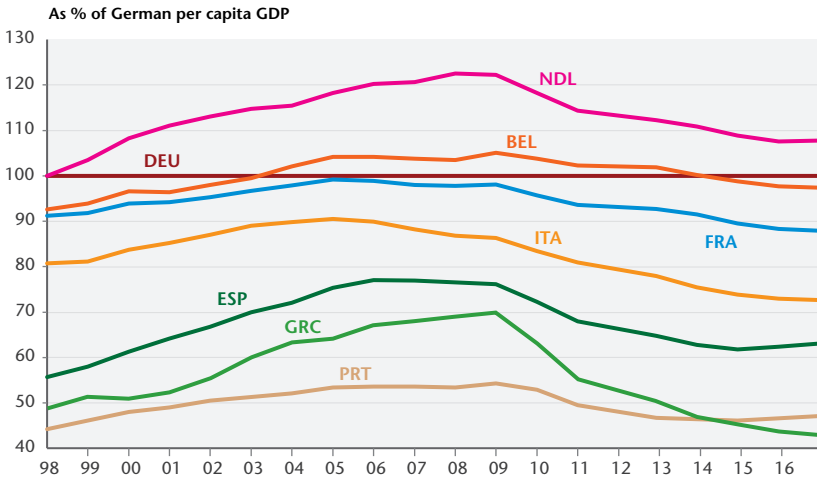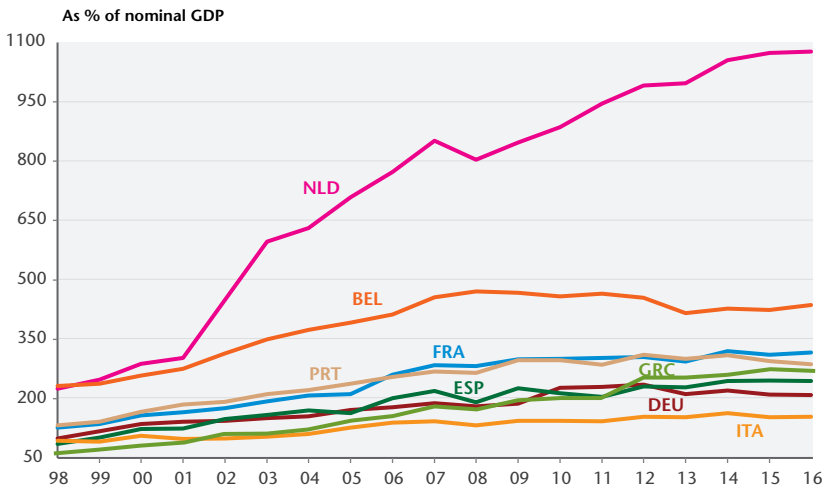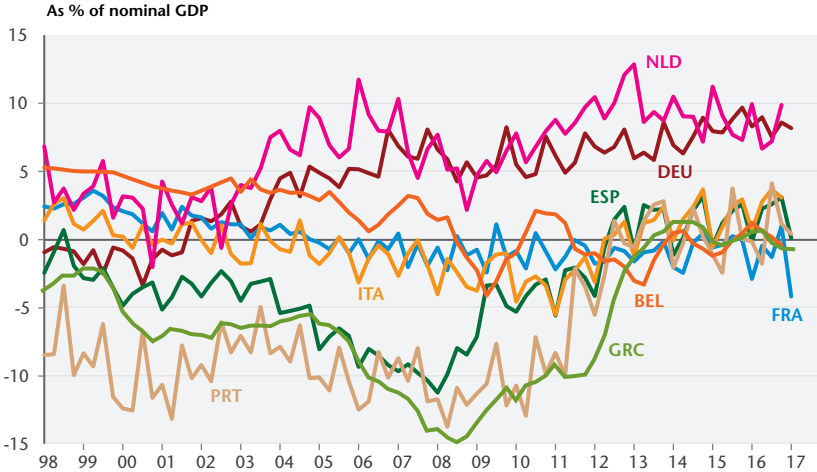*Sources:* Datastream, Eurostat, Natixis.

Chart 2. Trade balance in tourism
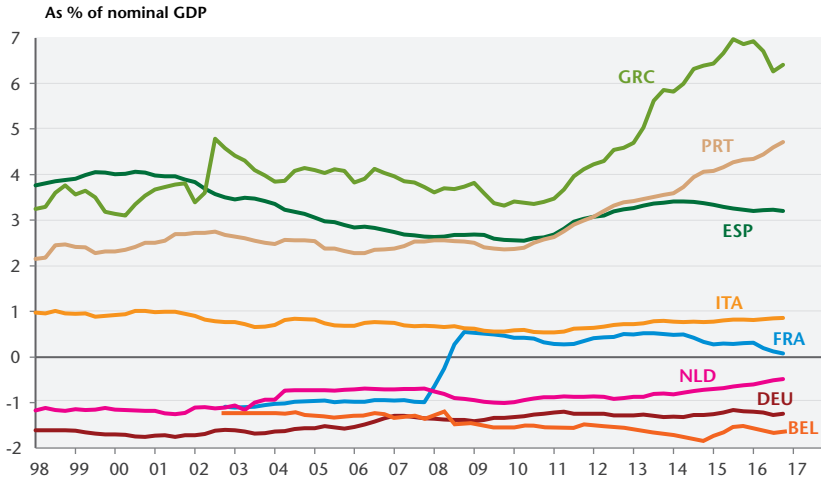
As % of nominal GDP

DEU: Germany, BEL: Belgium, ESP: Spain, FRA: France, GRC: Greece, ITA: Italy, NDL: Netherlands, PRT: Portugal.
Sources: Datastream, Eurostat, Natixis.

As productive specialisations are different, the result is diverging labour productivity (Chart 3) and therefore diverging per capita income (Chart 4).

Chart 3. Per capita productivity

Per capita productivity (1998:1 = 100)

DEU: Germany, BEL: Belgium, ESP: Spain, FRA: France, GRC: Greece, ITA: Italy, NDL: Netherlands, PRT: Portugal.
Sources: Datastream, Eurostat, Natixis.

Chart 4. Per capita GDP in euros

As % of German per capita GDP

DEU: Germany, BEL: Belgium, ESP: Spain, FRA: France, GRC: Greece, ITA: Italy, NDL: Netherlands, PRT: Portugal.
Sources: Datastream, Eurostat, Natixis.

In a federal state, heterogeneous income levels are corrected by income transfers from the richest to the poorest regions thanks to federalism. This is not the case in the euro zone, where nothing offsets the diverging income levels, which obviously creates a political and social risk in the longer term.

Since the monetary integration in the euro zone has gone very far (with massive external debts and assets in euros, Chart 5), the cost of leaving the euro would probably be huge (Guiso, Sapienza and Zingales, 2016).

Chart 5. Gross external debt

DEU: Germany, BEL: Belgium, ESP: Spain, FRA: France, GRC: Greece, ITA: Italy, NDL: Netherlands, PRT: Portugal.
Sources: Datastream, Eurostat, Natixis.

But the inability to correct income inequalities between the member countries definitely creates a risk of break-up. Some authors also mention that the centrifugal forces are not only of an economic nature, but are also due to asymmetries and cultural differences: role of the State, religion, role of women, solidarity (Guiso, Morelli and Herrera, 2016; Alesina, Tabellini and Trebbi, 2017). The diversity of productive specialisations also led to diverging current-account balances until the euro crisis (Chart 6).

The countries that had structural external deficits (Spain, Italy, Portugal, Greece) were then (from 2010) faced with a balance of payments crisis, a "sudden stop", as they were unable to finance their external deficits. This crisis forced these countries to reduce their
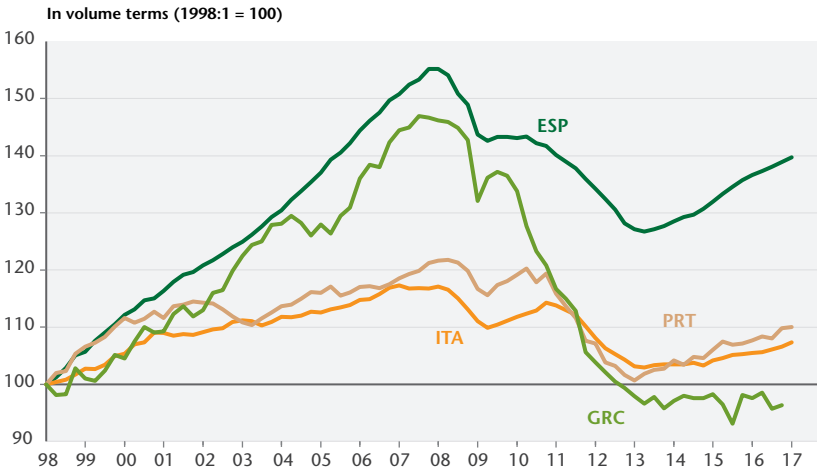
domestic demand (Chart 7), enabling them to eliminate their external deficits.

Chart 6. Current-account balance

As % of nominal GDP

DEU: Germany, BEL: Belgium, ESP: Spain, FRA: France, GRC: Greece, ITA: Italy, NDL: Netherlands, PRT: Portugal.
Sources: Datastream, Eurostat, Natixis.

Chart 7. Domestic demand

In volume terms (1998:1 = 100)

ESP: Spain, GRC: Greece, ITA: Italy, PRT: Portugal.
Sources: Datastream, Eurostat, Natixis.

The divergence of current-account balances until the euro crisis in 2010 was initially due to the divergence of productive specialisations. But it was worsened by the excessive growth in real estate investment (Lane and Pels, 2012), the lack of monitoring of external deficits at the time (Giavazzi and Spaventa, 2010), Blanchard and Giavazzi, 2002), the lack of market discipline (financial markets did not correctly value the risks related to indebted countries, Wickens (2016), Dellas and Tavlas (2012), Shin (2012), and the correlations between sovereign crises and banking crises, (Mody and Sandri, 2011, Reinhart and Rogoff, 2011).

We do not claim in this paper that the entire divergence between current-account balances is explained by a divergence of productive specialisations. There are obviously also the causes mentioned above, especially a poorly managed financial integration until 2009 (Delatte-Ragot, 2016): the countries that had surplus savings lent to the countries with a shortfall in savings, and these loans were partly used for speculative or unproductive purposes: financing of the real estate bubble and excessive household borrowing in particular.

But we believe it is clear that the divergence of productive structures played and will continue to play a major role, and we can now see that it cannot be corrected by "six-pack" rules: what is the point in imposing a maximum external surplus on Germany if this country concentrates industrial production in the euro zone?

It therefore seems that federalism is necessary for two reasons. First, to correct increasing standard of living disparities between the countries through income transfers; second, to correct the impacts of productive specialisation disparities on current-account balances: income transfers between the member countries would balance the current accounts, even with trade imbalances.

This finding seems obvious: so why is federalism not implemented in the euro zone? The current economic policy debate on the issue of institutional reforms in the euro zone clarifies this point. The "French" view is that the bases of federalism must be created (euro-zone budget, financed by common taxes or by issuing eurobonds).

The "German" view is that the countries' heterogeneity is primarily due to poor economic policies. It is therefore the responsibility of each euro-zone country to avoid excessive fiscal deficits and to implement the structural reforms that can restore potential growth and lower structural unemployment.

Our point here is that the countries' heterogeneity – beyond possible economic policy errors – is mainly explained by the inevitable, normal and even desirable divergence of productive specialisations.

This heterogeneity between countries cannot be corrected if it is due to a legitimate divergence of productive specialisations caused by the divergence of the countries' comparative advantages. Accordingly, it is permanent transfers from rich to poor countries that must be considered.

2. Lack of Economic Policy Coordination and Functioning of Labour Markets

In a currency area, differences between economic policies or gaps between production cost levels obviously cannot be corrected by exchange-rate fluctuations. This requires coordination of economic policies and wage policies when they generate externalities between the other countries.

Coordination of economic policies is nonexistent. We see, for example, that Germany lowered social contributions for companies in the first half of the 2000s, Spain has done so since 2009, and France is about to do so (Chart 8), with the clear objective of gaining market shares against other countries.
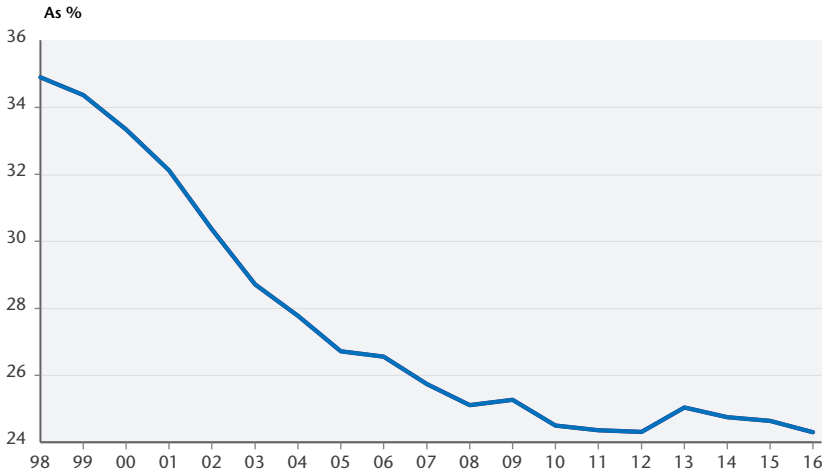
Chart 8. Companies' social contributions
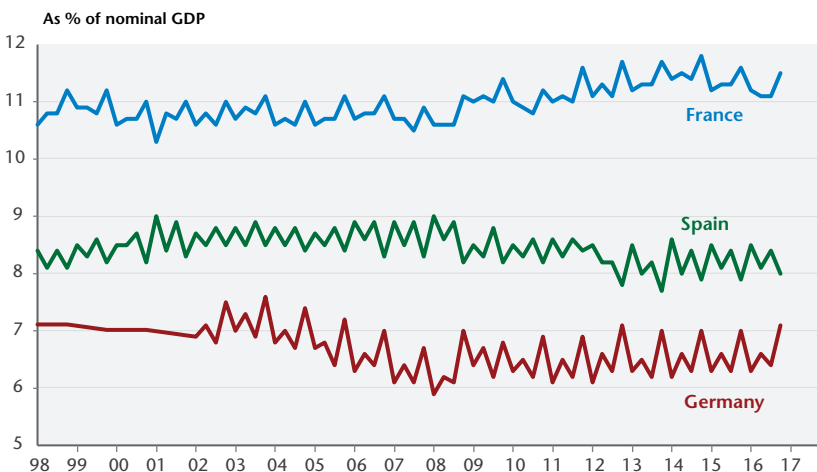
Sources: Datastream, Eurostat, Natixis.

We see that tax competition also works through a lowering of corporate taxes, and that this has led to a continuous fall in average tax rates on earnings in the euro zone (Chart 9).

Chart 9. Zone euro*: Average tax rate on corporate profits

As %

* Eu-10 average.
Sources: DG Taxation and Customs Union, OECD, Natixis.

The lack of tax policy coordination in the euro-zone countries leads to a risk of a "race to the bottom" (Mendoza, Tesar and Zhang, 2014): a convergence towards a very low tax rate in all countries with mobile production factors, requiring a sharp reduction in public spending and in the generosity of social welfare.

The same holds for wage formation. Labour markets function differently in the different euro-zone countries, and the wage formation models are not coordinated. This has led to diverging wages and labour costs since the creation of the euro (Charts 10 and 11).

Some countries may therefore accumulate a significant cost competitiveness shortfall against the other countries (Spain until 2008, France and Italy currently), forcing them to implement an internal devaluation (a contraction in wages in a currency area), like Spain from 2009, with the associated costs: declining domestic demand, rising unemployment (Chart 12).

By depressing activity and inflation (since labour costs fall), internal devaluations also give rise to public debt crises by worsening countries'

fiscal solvency. To make progress, the euro zone should therefore coordinate the tax policies that generate externalities; it ought to introduce a form of "labour market union", to make wage formation between countries more similar and prevent cost competitiveness divergences.
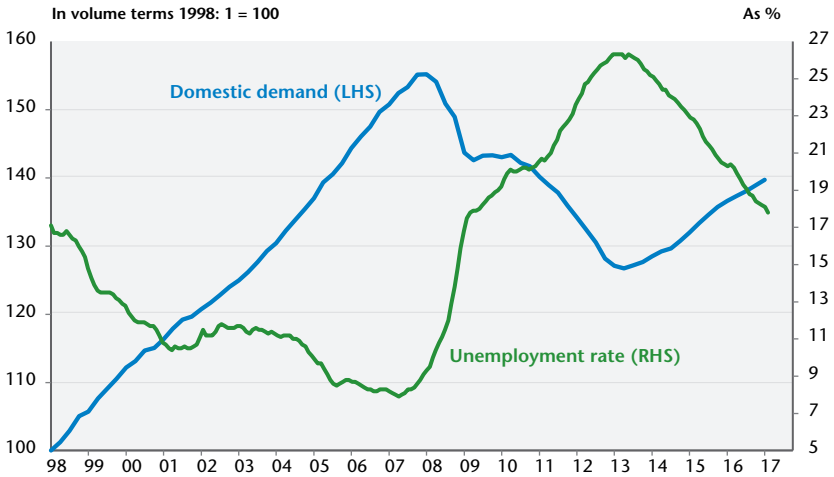
Chart 10. Nominal per capita wage

1998:1 = 100
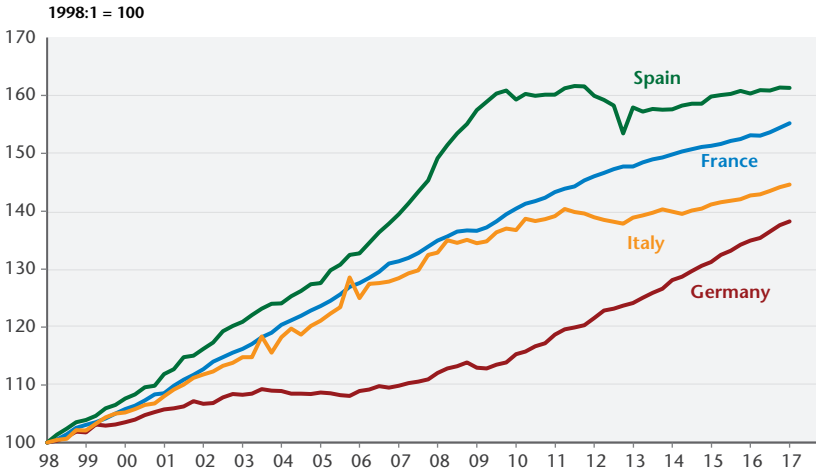
Sources: Datastream, Eurostat, Natixis.

Chart 11. Unit labour costs

1998:1 = 100
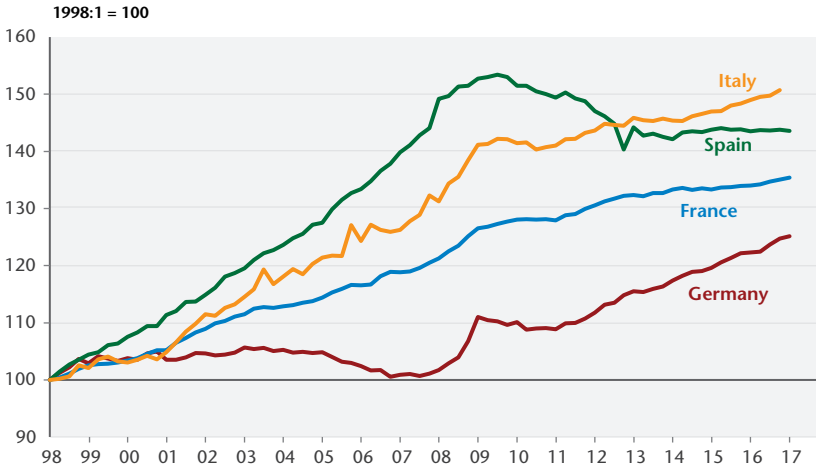
Sources: Datastream, Eurostat, Natixis.

Chart 12. Spain: Domestic demand and unemployment rate

In volume terms 1998: 1 = 100   As %

Sources: Datastream, Eurostat, Natixis.

This would require drawing up a list of all externalities that a euro-zone country's economic policies have on the other countries, and reactivating the concept of subsidiarity: as soon as there are significant externalities, economic policies should be coordinated; otherwise the principle of subsidiarity should apply: policies are better defined at the level of each country.

Admittedly, it may be difficult to identify externalities; if for example a country reduces social contributions paid by employers, it is logical to think that this will destroy jobs in the other euro-zone countries, but the magnitude of this negative externality would have to be quantitatively estimated. The problem here is obviously also political: in reality, no country will accept the abandonment of sovereignty that a coordination of the economic policies that generate externalities would require.

3. Economic Policy Errors in Terms of Design and Implementation

3.1. Design

We first believe there are two serious problems in the way euro-zone economic policies are designed.

The first concerns the asymmetry of adjustment processes. If a euro-zone country has a cost competitiveness problem, it has to reduce its

production costs without the other member countries increasing their costs (we saw above the case of Spain from 2009); if a country has a problem with its external deficit, it has to eliminate it while the countries that have external surpluses keep them (Chart 13 shows the contrast between Spain, Italy, Greece and Portugal on the one hand, and Germany and the Netherlands on the other hand).

Chart 13. Currente-account balance

As % of nominal GDP
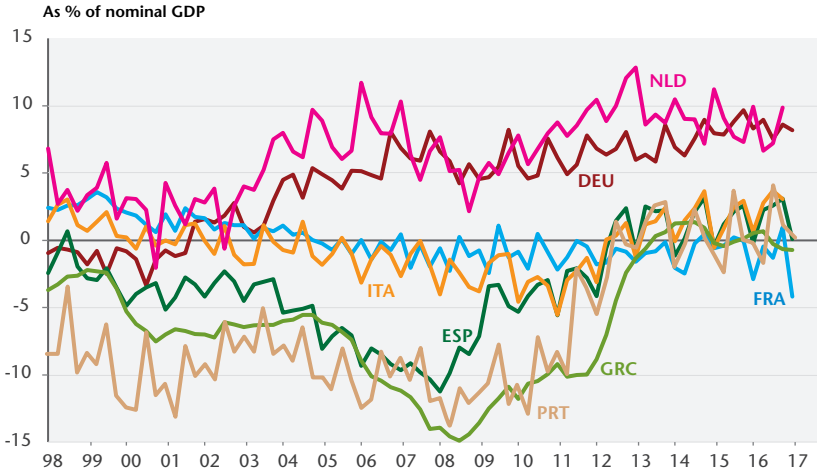
DEU: Germany, ESP: Spain, FRA: France, GRC: Greece, ITA: Italy, NDL: Netherlands, PRT: Portugal.
Sources: Datastream, IMF, Natixis.

If a country has a fiscal deficit, it has to eliminate it, while a country that has a fiscal surplus keeps it (Chart 14 shows the contrast between France, Spain, Italy, Greece and Portugal on the one hand, and Germany on the other hand).

So we see that when economic policy is adjusted in the euro zone, there is always a restrictive policy in the troubled countries and no expansionary policy in the healthy countries, which creates a permanent recessionary bias (Orphanides, 2017). The other error in terms of economic policy design in the euro zone is the management of risk related to sovereign debt. The ECB let some euro-zone government bonds lose their risk-free asset status from 2009 to 2014 (Chart 15 shows the surge in the interest rates on these bonds; De Grauwe-Yi, 2012, 2013; Aizenman, Hutchinson and Jinsarak, 2011), whereas savers need a large quantity of risk-free assets (Caballero and Farhi, 2014; Van Riet, 2017).

Chart 14. Fiscal deficit

As % of nominal GDPr
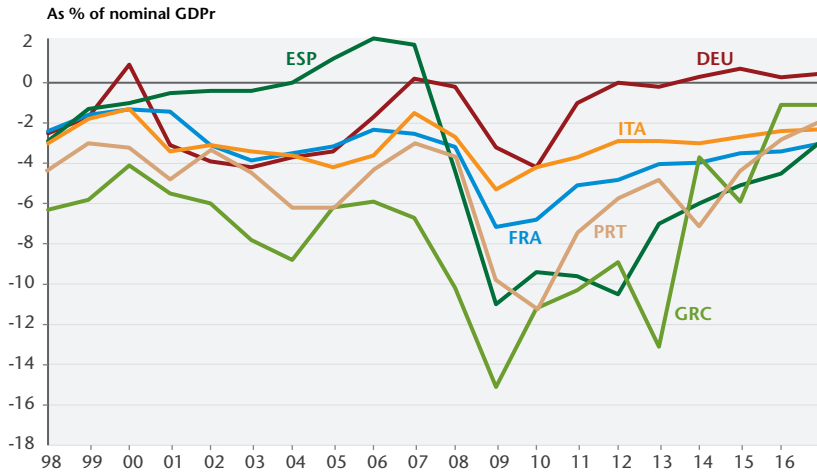
DEU: Germany, ESP: Spain, FRA: France, GRC: Greece, ITA: Italy, PRT: Portugal.
Sources: Datastream, prévisions Natixis.

Chart 15. Interest rate on 10-year government bonds

As %
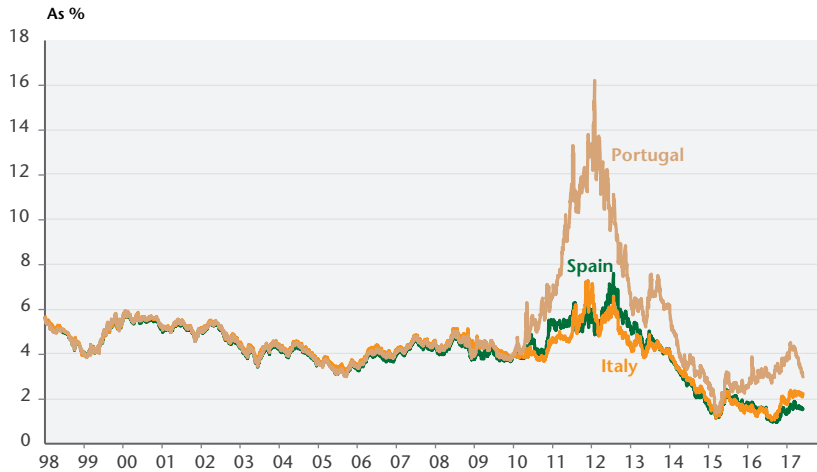
Sources: Datastream, Natixis.

Moreover, as soon as a country's public debt presents a default risk, a possibility of multiple equilibria for this debt appears, one of these equilibria being an increase in expectations of a possible default, leading to a rise in interest rates, and hence an actual increase in the default probability (Ayres *et al.*, 2015; Corsetti and Dedola, 2016; Jaro, cinski and Mackowiak, 2017).

There is no risk of a jump to an equilibrium with high default risk if there is a federal debt without default risk (eurobonds).

3.2. Implementation of economic policies

The key debate here concerns fiscal austerity. Many economists believe that euro-zone governments were wrong in reducing their fiscal deficits, especially the structural fiscal deficit, corrected for the effects of the economic cycle, in 2011 at a time when the unemployment rate and the output gap in the euro zone were still very high (Charts 16 and 17).

It is claimed that fiscal policy, which was restrictive too early, triggered the decline in activity in the euro zone from 2011 to 2014 (Chart 18) and the government bond crisis.

This takes us to the debate on the fiscal multiplier (impact of the fiscal deficit on GDP). Those who criticise the euro zone's fiscal austerity base their criticism on studies showing that the fiscal multiplier is high during recessions or when interest rates run into the zero lower bound (House *et al.*, 2017; Farhi and Werning, 2016).
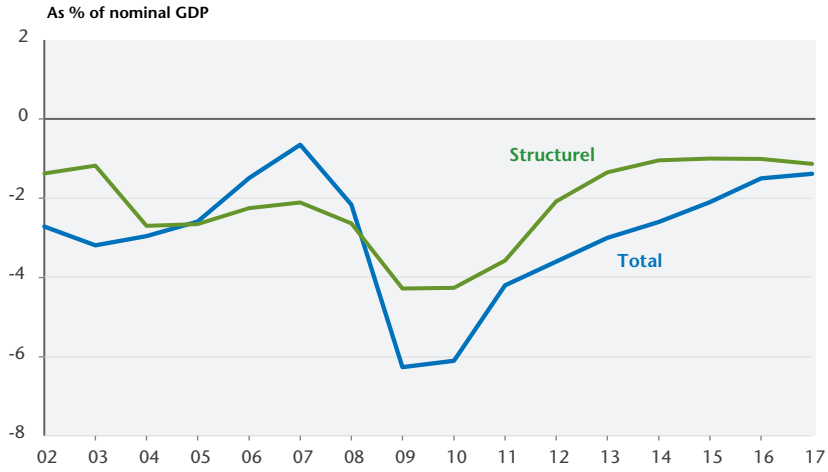
But other studies arrive at a very different conclusion, i.e. that the fiscal multiplier does not depend on the economy's cyclical position, but that it is high if public spending is reduced and low if government spending is cut (Alesina *et al.*, 2017; Alesina *et al.*, 2015).

If this second group of authors is right, the problem with the euro zone's fiscal policy was not the reduction in fiscal deficits from 2011, but some countries' use of an increase in the tax burden instead of government spending cuts to reduce the fiscal deficit (Charts 19 and 20).

It does not seem that the debate on fiscal multipliers is settled, given that the empirical studies have divergent results. A compromise is as follows: the euro zone's fiscal policy was procyclical from 2011 to 2014, and this is open to criticism, but the situation is different now; and the use of increases in the tax burden weakened corporate profitability and investment.in many countries.

In our opinion, this is no longer one of the euro zone's key problems: the European Commission has enough flexibility to ensure that fiscal policy can be used in the event of difficulties; the euro zone's structural fiscal deficit has increased slightly since 2014, which shows that there is probably less budgetary dogmatism now.
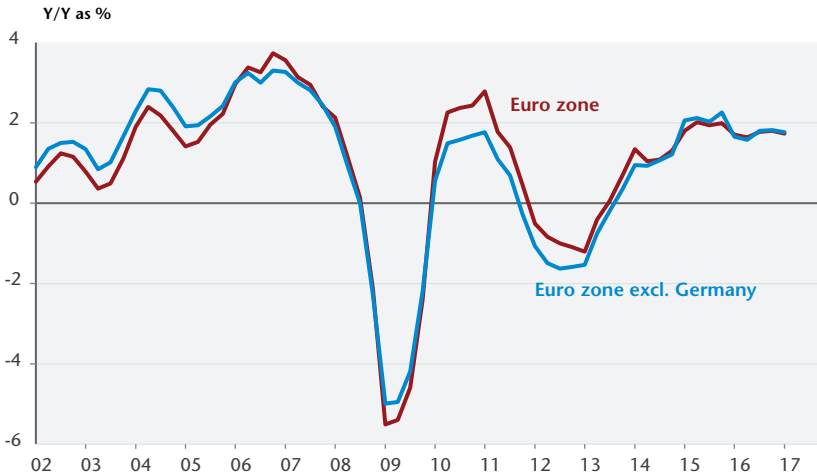
Chart 16. Euro zone: Fiscal deficit

As % of nominal GDP

Sources: Datastream, EC, Natixis.

Chart 17. Euro zone: Unemployment rate and output gap

As %
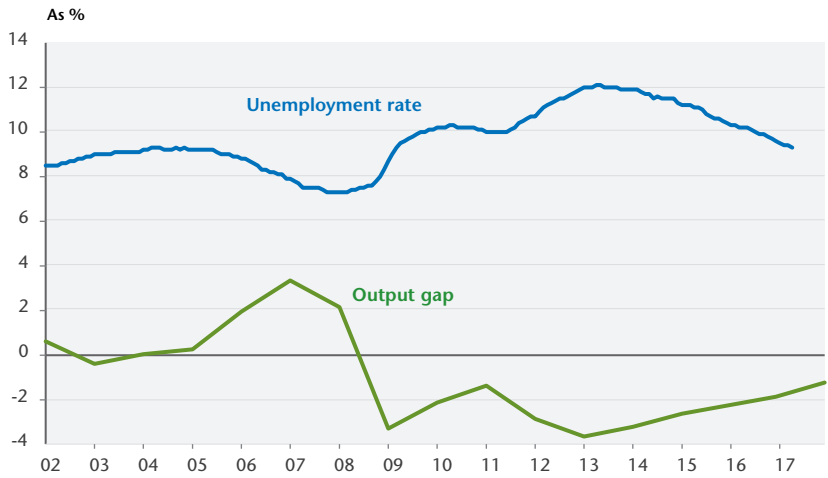
Sources: Datastream, Eurostat, OECD, Natixis.

Chart 18. Real GDP growth

Sources: Datastream, Eurostat, Natixis.

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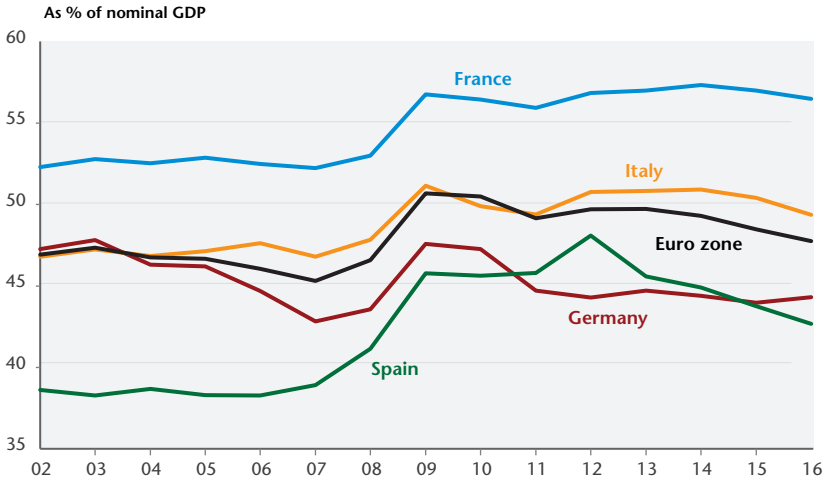
structural fiscal deficit has increased slightly since 2014, which shows that there is probably less budgetary dogmatism now.

Chart 19. Tax burden

As % of nominal GDP
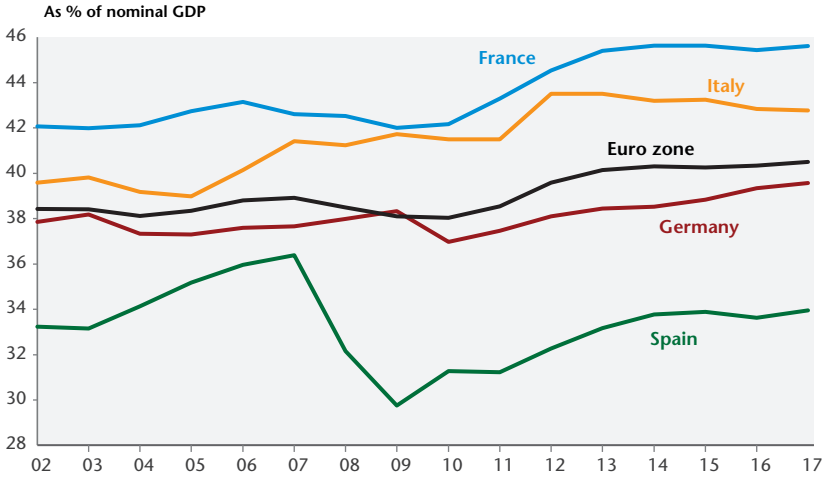
Sources: Datastream, EC, Natixis.

Chart 20. Public spending

As % of nominal GDP

Sources: Datastream, EC, Natixis.

4. Conclusion: Which Macroeconomic and Economic Policy Debates Are Relevant for the Euro Zone?

The above shows that a number of macroeconomic and economic policy debates are crucial to analyse the euro zone's situation:

1. The effect of monetary unification on the member countries' productive specialisation and heterogeneity (which we have called the endogeneity of the criteria to create an optimum currency area);

2. The need for federalism (systematic income transfers, federal public debt) to ensure the medium-term stability of a currency area, and the means to ensure a transition to federalism that is acceptable to all;

3. The possibility that there may be balance of payment crises (sudden stops) affecting the members of a currency area without federalism; and likewise the possibility that these countries may be hit by self-fulfilling public debt crises;

4. The need to coordinate economic and tax policies that generate externalities between the countries in a currency area, and a reactivation of the concept of subsidiarity;

5. The danger posed by heterogeneous functioning of labour markets in the countries in a currency area;

6. The feasibility of internal devaluations in a currency area despite their high costs in terms of activity and jobs;

7. The need to have symmetrical adjustment mechanisms in a currency area; mechanisms that do not merely consist in implementing restrictive policies in troubled countries;

8. The risk that the government bonds of some countries in a currency area may lose the status of bonds with no default risk;

9. The need to continue to study the fiscal multiplier to determine whether it primarily depends on the economy's cyclical position or primarily on causes related to changes in the fiscal deficit (public spending or tax burden).

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THE END OF THE CONSENSUS? THE ECONOMIC CRISIS AND THE CRISIS OF MACROECONOMICS[1]

Francesco Saraceno

Sciences Po, OFCE

The New Consensus that has dominated macroeconomics since the 1980s was based on a fundamentally neoclassical structure: efficient markets that on their own converged on a natural equilibrium with a very limited role for macroeconomic (mostly monetary) policy to smooth fluctuations. The crisis shattered this consensus and saw the return of monetary and fiscal activism, at least in academic debate. The profession is reconsidering the pillars of the Consensus, from the size of the multipliers to the implementation of reform, including the links between business cycles and trends. It is still too soon to know what macroeconomics will look like tomorrow, but hopefully it will be more eclectic and open.

Keywords: economic crisis, budget policy, reform, New Consensus.

1. The "New Consensus" and the Great Moderation

From the middle of the 1980s to the beginning of the crisis in 2007, the global economy experienced a period of strong growth, low and stable inflation, and limited macroeconomic uncertainty. The reasons for this period of "Great Moderation" remain unclear. Some explain it by competent management of the cycle by monetary institutions, coupled with reforms and deregulation that made markets more efficient (Bernanke, 2004).[2] This positive appreciation of central bank action explains why when the crisis started, in 2007, monetary policy

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1. This article reviews and summarizes the arguments developed by Saraceno (2018a, 2018b).
2. Others point to wage moderation, which is a factor in increasing inequality (Piketty, 2013), and which led to asset price inflation and a credit boom, both of which eventually were at the roots of the 2007 crash.

was the privileged tool in the attempt to counter the recession. It was only in 2009, when the economy became enmeshed in the liquidity trap and monetary policy lost traction, that fiscal stimulus packages were implemented by both advanced and emerging economies. The coordinated fiscal expansion has borne fruit and has been recognized as a determining factor for the recovery (Eichengreen and O'Rourke, 2009). But as soon as the worst of the crisis was over, fear of deficits and debt accumulation caused a sudden reversal of fiscal policy stances. The shift to austerity has been particularly brutal in Europe, where the crisis in the peripheral countries has been associated with a long history of fiscal laxity and inefficiency (Sinn, 2014), and was thus "cured" by means of austerity coupled with structural reforms. This was not due to hazard but rather was the result of the economic doctrine that dominated the profession and the major institutions in charge of coordinating economic policy. The "New Consensus" that developed in macroeconomics from the 1980s is based on a set of results that are independent of the individual characteristics of the different models:

1. The reference framework is the Real Business Cycles (RBC) model in which fluctuations are "natural", as they determined by the optimal reaction of agents to technological shocks. Market imperfections can make this natural equilibrium deviate from the Pareto equilibrium.

2. Market imperfections, especially nominal rigidities, also cause the economy to deviate from its natural growth rate in the short-term, i.e. to experience demand-led fluctuations.

3. The privileged instrument of economic policy is *structural reform,* which, by removing rigidities, increases the natural growth rate of the economy, bring it to converge with the Pareto optimum.

4. In the medium term, output gaps, deviations from the natural equilibrium, tend to be absorbed by markets.

5. Discretionary macroeconomic policies are ineffective in stabilizing economic activity. Following rules is preferable, because economic policy action becomes easier to integrate into agents' expectations (which are therefore "anchored").

6. Short-term fluctuations in production have no influence on the natural growth rate (there is a dichotomy between the short and long run, which is also reflected in standard macroeconomics textbooks).

Fiscal policy in particular was removed from policy makers' toolbox. On the one hand, in normal times, it would crowd out private expenditure. On the other hand, during Keynesian aggregate demand crises, it would be less effective than monetary policy in fighting the downturn, because of the inherent lags in decision-making and implementation, together with political biases and the risk of capture of fiscal policy by private interests. Although preferable to fiscal policy because of its technocratic character, monetary policy was also supposed to have a limited impact in the management of income fluctuations, which would mostly be taken care of by market flexibility.

2. The Return of Fiscal Policy and the Debate on Multipliers

The crisis that started in 2007 represented a major disavowal of the Consensus, not only because it was not equipped to analyze the imbalances that had their origin in the financial sector, but also because the policies put in place to counter the crisis have prolonged the recession and imposed a disproportionate cost on the population.

Economists have begun to question the ability of markets to absorb shocks within a reasonable time frame, which was the pillar around which the theoretical corpus of the Consensus had been built. Interestingly, much of the research reassessing the role of macroeconomic policy and regulation is being done by the international institutions in charge of economic policy guidance and crisis management. This reassessment of the Consensus is ongoing and wide-ranging: the reciprocal influence between income distribution and growth (Ball *et al.*, 2013; IMF, 2017; Kumhof *et al.*, 2015); the role of labour market institutions in supporting stable and inclusive growth (Jaumotte and Buitron, 2015; Loungani, 2017); and the role of capital controls and financial regulation (Blanchard, 2016a). In this article I have chosen to focus on the reassessment of fiscal policy.

The austerity plans implemented in Europe's peripheral countries were implemented based on the belief that the size of the fiscal multipliers was rather low, certainly less than one, and most probably around 0.5. This led to the belief that austerity would be mildly contractionary in the short-term,[3] but expansionary in the long run, when the State's withdrawal from the economy would unleash the potential of the markets.

Events did not unfold as planned: The fiscal stance reversal slowed the recovery globally, and in the euro zone austerity plunged the economy into a double-dip recession. The profession began to reassess the rejection of fiscal policy advocated by the Consensus. Blanchard and Leigh (2013) developed a box contained in a previous edition of the IMF's *World Economic Outlook,* arguing that during a deep recession, with monetary policy at the Zero Lower Bound (ZLB), the multipliers were closer to 2 than to 0.5. In their view this explained why the contractionary impact of austerity had been far greater than expected, and hence why fiscal contraction had eventually been self-defeating.

The debate around fiscal policy's effectiveness therefore has taken the form of empirical research on the size of the multipliers, which is far from being consensual. Nevertheless, the meta-analyses of Gechert and Will (2012) and Gechert (2015) managed to extract from the abundant literature a number of broad conclusions: *first*, taking the average of the many studies they analyze, public expenditure multipliers are close to 1; this value is significantly larger than the 0.5 value that was taken as the basis of the fiscal consolidation programmes in crisis-ridden euro zone countries. *Second*, consistently with the standard Keynesian argument, the spending multipliers are larger than the tax and transfer multipliers. *Finally*, the public investment multipliers are even larger than the overall expenditure multipliers (Bom and Ligthart, 2014). For investment, the short-term Keynesian effect is actually supposed to be accompanied by a positive impact on potential growth in the long term. This, via expectations, may crowd-in private expenditure (including investment). It is interesting to note that, as long as the economy is at the ZLB, the response of monetary policy to fiscal expansion is mitigated, and the only way to lower real interest rates is inflation. On the contrary, once time-to-build has elapsed and capital is in place, investment has a deflationary effect *via* its impact on productivity, and pushes up the real interest rate. Thus, in times of crisis, investment projects requiring longer time-to-build are to be preferred, because the negative effect of deflation on the real interest rate is postponed (Le Moigne *et al.*, 2016).

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3. Some even claimed that austerity would also be expansionary in the short-term, based on a seminal paper by Giavazzi and Pagano (1990) on "expansionary fiscal contractions". It has been proven that this claim is strongly linked to specific conditions and, therefore, substantially inaccurate (see e.g. Barry and Devereux, 1995; Perotti, 2011).

Nevertheless, these average values hide a very strong variability; this is not really surprising, as theoretically the value of the multiplier crucially depends on a number of factors: first, the degree of openness of the economy, which determines how much of the additional expenditure will be oriented towards domestic production, thus boosting GDP, and how much will benefit trading partners through increased imports. Then, the distance of the economy from the natural equilibrium, i.e. the "output gap". Regarding the latter, the debate on the effectiveness of macroeconomic policy often neglects that Keynesian theory applies only when there is slack in the economy, i.e. when market equilibrium leaves idle resources that public expenditure can mobilize. On the other hand, if the economy is at full employment, in Keynesian as much as in neoclassical theory, the value of the multiplier will be zero, and crowding out will be complete.

There have not been many attempts to estimate a time-varying value for the multiplier, which depends on the cyclical position of the economy. Creel *et al.* (2011) used a structural Keynesian model, and found that, consistently with intuition, when the output gap is significantly negative, the value of the multiplier is much larger than when the economy is working at near its full employment equilibrium. More recently, using a different model (an "a-theoretical" VAR model), Glocker *et al.* (2017) confirmed that even for the United Kingdom the multiplier is higher in periods of crisis; but they also found that the Zero Lower Bound does not have a significant impact on the effectiveness of fiscal policy (which according to Keynesian theory should instead be greater when monetary policy does not work as it should). Estimating a similar model for Germany, Berg (2015) found that the cyclical position of the economy has a marginal impact on the size of the multiplier, which nevertheless changes over time and tends to be larger when agents are pessimistic, or when governments can easily finance their expenditures (so that debt sustainability is not in doubt). Contradicting most of the previous literature, a very recent work Ramey and Zubairy (2018) based on US data found that the multiplier is generally less than unity even in periods of recession; only when the economy is at the Zero Lower Bound can it, in some cases, be much higher.

3. Reduce Public Debt no Matter what Happens?

The rejection by the Consensus of fiscal policy had naturally led economists and policy makers to argue in favour of reducing the public debt. Excessive indebtedness would result in crowding out private expenditure, rising interest rates and inefficiency in the economy. It is therefore not surprising that the increase in public debt following the 2008 crisis was and still is seen as the major problem faced by the global economy once the recovery was underway. The race to austerity and fiscal consolidation was based on the belief that over-indebtedness hurts growth. Reinhart and Rogoff (2010) quantified a "danger threshold", a red line not to be exceeded, at 90% of GDP, in a frequently quoted article that subsequently was proved to be flawed by calculation errors. But its main message, the existence of a universal threshold beyond which debt weighs on growth, has not disappeared from the public debate. Only recently, in its *Fiscal Monitor* (2016a), the IMF has provided a more nuanced view. The report shifts the attention from public to private debt, arguing that the deleveraging of house-holds and businesses, which will continue in the coming years, will require accompanying measures by the public sector. On the one hand, renewed attention to the financial sector is needed to ensure that the liquidity problems of firms (and of financial institutions) do not degenerate into solvency problems. On the other hand, increased activism is needed to address the macroeconomic consequences of private sector deleveraging, including the likely savings glut, through Keynesian aggregate demand support, implying that public debt could momentarily grow to support economic activity.

The need to accept temporary increases in public debt in order to ensure the long-term viability of the economy goes beyond the management of deleveraging and the crisis. In a chapter of its 2014 *World Economic Outlook*, the IMF (2014) focused on public investment, noting that there is room for increasing the stock of public capital both in advanced and developing countries. The IMF argues that with high public capital productivity (due to its historically low levels), and borrowing rates that will remain close to zero, public investment has never been so profitable, even if one were to neglect its social purpose. An increase in public investment, even if deficit financed, would support short-term economic activity, increase productivity and long-term potential growth and ultimately reduce government debt-to-GDP ratios. Public investment, argued the IMF, should be the main

tool to try to ensure that the world economy does not get stuck in secular stagnation.

4. Structural Reforms: When and How?

The defining feature of the New Consensus is the argument that the only way to permanently increase the potential growth rate of the economy is to reduce rigidities, especially on the labour market. This is why structural reforms are a pillar of the Consensus policy prescriptions. From the IMF's rescue programmes in Latin America and Africa, or the European Commission recommendation for European Monetary Union (EMU) countries in crisis, to privatizations, increased flexibility in the goods and labour market, and reducing the social protection that hampers market efficiency, these *one-size-fits-all* recommendations were considered essential to make markets more efficient and to avoid sluggish growth. The first doubts about the almost exclusive focus on reforms date back to the late 1990s, when the recommendations of the Washington Consensus failed to deliver the expected results. Criticism, however, remained circumscribed at first, as it especially highlighted the pernicious redistributive effects of structural reforms; furthermore, with some notable exceptions, the critiques came from unorthodox economists.

Things changed with the crisis. While most economists still believe that the long-run effect of reforms on potential growth is positive, their impact in the short-term and their effectiveness depends on the conditions in which they are implemented. For example, Rodrik (2013) argued that by definition reforms are successful if they trigger a process of "creative destruction": efficient and innovative sectors are supposed to absorb the resources released by inefficient sectors. But this only happens if they can anticipate a demand for their additional production. In times of recession, or slow and stagnant growth, capital withdrawn from inefficient sectors and the unemployment this process generates will not be absorbed by more dynamic activities. If implemented in the wrong conditions, reforms can be counterproductive and eventually lead to stagnation in productivity and growth.

Eggertsson *et al.* (2014) emphasized the importance of timing to ensure the success of reforms. In the long term, the expected effect of the reforms is to diminish market power, to obtain lower prices and improve consumer welfare. In times of recession, this expected deflation increases the real interest rate and further depresses private

spending. The central bank could accompany the reforms with an expansionary monetary policy to compensate for falling prices. But if the economy is stuck at the ZLB, monetary policy has no effect and reforms end up hurting the economy.

Recent empirical research shows that these mechanisms have been at work. The IMF (2016b), while arguing that reforms have long-term positive effects, warned of a number of undesirable consequences in the short term. Labor market reforms in particular could have a negative impact on growth and productivity, if implemented during periods of slow growth. Departing from the New Consensus, the report concludes that reforms are not "miracle solutions", and that they should be carefully designed and accompanied by other measures to support growth. Macroeconomic policies can maximize the chances of reforms' success both directly, through their effect on aggregate demand, and indirectly, by changing incentives. The report goes further, stating that "traditional" reforms advocated by the Consensus (primarily increased labour market flexibility) should be accompanied by more inclusive measures, for example in the areas of education and innovation, which could help to cushion the short-term negative impact of increased flexibility. The OECD (2016) reaches similar conclusions. In periods of low aggregate demand, prioritizing reforms is the key to their success. The OECD joins the IMF's analysis of labour market reforms, which are more likely to yield short-term costs that, if not carefully dealt with, lead to their ultimate failure. In times of crisis the reform package must also include measures to facilitate access to credit and investment, to reduce barriers to entry into the services sector, as well as pension and health care reforms. The OECD goes so far as to suggest the implementation of active employment policies and increased investment in public infrastructure as "reforms" broadly defined, which would of course require increased public spending. Finally, the OECD report argues that countries with limited fiscal space should prefer high-yield, or low-cost measures, and thus accept the idea that sequencing is a critical element for successful reforms.

On a similar note, commenting on the tax incentive package announced by the Japanese government in the summer of 2016, Adam Posen (2016) argued that fiscal policy can be a powerful tool for structural reform. He noted that tax policy was twisted to boost labour market participation (especially for women, through investment in childcare systems and tax cuts); these measures aim to boost potential

growth, thus establishing a new link between short-term stabilization policies and long-term growth.

In summary, reforms cannot be implemented with no regard for cyclical conditions and the interaction with other policies; it is essential to establish priorities (for example, focusing on product market reforms rather than labour market reforms), sequencing them and putting in place supportive macroeconomic policies. Finally, the short- and long-term effects of the reforms cannot be dissociated from each other, which is particularly important because another pillar of the New Consensus has been shaken by the crisis: the idea that governments could implement policies aimed at long-term growth without worrying about the short-term consequences. In Europe in particular, the recession was considered as a short-term side effect that would in no way affect the long-term gains associated with reforms and austerity. This interpretation was based on the presumed separation between cycle and trend, with demand factors affecting only the former and supply-side policies the latter. This is another certainty that was shattered by the Consensus.

5. Rethinking Macroeconomic Policy in Secular Stagnation

The severity of the recession cast doubt on the fact that it was just a cyclical slowdown, however severe. Economists then wondered whether the economy would one day be able to return to its old levels of activity. On the one hand, the debate over secular stagnation highlighted the reasons why the growth experienced between the 1950s and 1970s would no longer be achieved; on the other, some authors emphasized how prolonged crises could depress physical and human capital, causing irreversible damage to the economy.

In a widely cited paper, Delong and Summers (2012) took up an old intuition of Blanchard and Summers (1986), which highlighted the role of *hysteresis* linked to long-term unemployment: workers who remain unemployed for prolonged periods of time lose their human capital, and when (and if) they finally start working again, they will be less productive. Severe fiscal austerity can therefore be pernicious in the long term as well as the shortterm. Fàtas and Summers (2015) provided empirical evidence for this argument, showing that short-term shocks to the economy tend to impact potential GDP as much as they impact current GDP. Among these shocks, they focus specifically

on fiscal consolidations which, in times of crisis, when multipliers are particularly high, have a very negative effect on income, in both the short and long term. Fàtas and Summers thus join the literature that argues against fiscal consolidation and even add their two cents: austerity at the wrong time not only causes unjustified suffering in the short term, it can also be doomed to failure in the long run. Greece is not an exceptional case.

The depth, intensity and duration of the crisis led to new thinking about the possibility of recovering the growth rates of the second half of the twentieth century. In 2014, Larry Summers resurrected a term dating back to the 1930s, *secular stagnation*, to describe the dilemma faced by advanced economies. Hansen (1939) observed that population and capital tend to have similar growth rates over long periods of time. Having observed a decline in the population growth rate, he concluded that capital accumulation would slow too, inducing depressed growth after the economic turbulence of the 1930s. History has proven that Hansen was wrong, mainly because throughout the second half of the twentieth century, technological innovation generated high investment and increasing capital-labour ratios.

The current discussion around secular stagnation comes in a context that is similar to the one in which Hansen had written: an economy struggling to regain its dynamism after a devastating crisis triggered by a fall in demand.[4] Gordon (2012, 2016) looked for an explanation in supply-side factors, though differing from those mentioned by Hansen. Gordon argued (not without being criticized, see e.g. Phelps, 2013) that the technological revolution has had an increasingly weak potential impact, and that right now a flickering innovation faces six headwinds that keep potential growth subdued: (1) the reversal of the demographic dividend, which weighs on the public finances, because of aging; (2) the increase in inequality, which reduces the accumulation of human capital; (3) the combined effect of globalization and new technologies that has led to increased competition in the labour markets and thus to lower wages and productivity; (4) the rising cost of global warming; (5) the burden of debt (public and private) left by the crisis; and finally, (6) more specific to the United States, the deterioration of the educational level. These headwinds

4. See Le Garrec and Touzé (in this issue) for a discussion of the secular stagnation issue.

tend to reduce (mainly human) capital accumulation, and hence future potential growth.

Larry Summers (2014, 2016) focused on the demand side of the economy to explain the tendency towards secular stagnation: lower technical progress, slow demographic growth and high debt together tend to reduce the levels of investment. At the same time, the burden of debt, the accumulation of international reserves (public and private) induced by financial instability, and rising inequality (see also Fitoussi and Saraceno, 2011) would increase the level of savings. The natural interest rate decreased to close to zero, if not becoming downright negative, which tends to generate a structural excess of savings over investment. Summers argues that most factors exerting downward pressure on the natural interest rate are not cyclical, but structural, so that the current excess savings is bound to persist in the medium and long term. The natural interest rate could remain negative even beyond the current economic slowdown. This conclusion is not particularly reassuring, as politicians will have to navigate, in the next few years, between Scylla – accepting a constant excess of savings and slow growth (unable to dent unemployment) – and Charybdis – trying to fight the secular stagnation fueling bubbles that remove excess savings at the cost of increased instability and the risk of violent financial crises like the one we experienced in 2007. The recent crisis is an excellent textbook case in this respect, if we consider that the two most important central banks in the world were criticized for diametrically opposite reasons: the Fed accused of keeping interest rates low, thus contributing to a housing bubble (Rajan, 2010), and the ECB guilty according to some of having done too little and too late during the euro zone crisis (Saraceno, 2016).

Olivier Blanchard (2016b) pushed the lines further. Moving away from the Consensus that he helped to shape (Blanchard, 2009), he argues that the exclusive focus on monetary policy as a stabilization tool needs to be reassessed. With (a) low interest rates that make the issue of public debt sustainability irrelevant, (b) the deregulation of financial markets, which is likely to lead to greater variability in GDP and economic activity, and (c) monetary policy that in the future might often be constrained by the ZLB, fiscal policy should find a prominent role among the instruments of macroeconomic regulation.

Nevertheless, Blanchard stops one step before the conclusion that should be obvious: if the economy is doomed to remain tangled in a

semi-permanent situation of excess savings, and if monetary policy is unable to reabsorb the imbalance, there are only two ways to avoid that the *ex ante* excess savings depress the economy: either by a semi-permanent negative external surplus (that is to say, a surplus of the current account balance), or by semi-permanent public negative savings. The first option, the export-led growth model that Germany is today successfully generalizing at the EMU level, is not sustainable for the global economy. Not everyone can be a net exporter: export-led growth and non-cooperative strategies can be a solution for one country (or region), and in the short term only. The second option, a semi-permanent public deficit, needs to be further explored, particularly with regard to its implications for EMU macroeconomic governance. If it is true that deficit financing is not a problem as long as the excess of private savings persists, the actual way of channeling savings into public debt without creating instability needs to be explored. A first option could consist of issuing "debt for investment" reserved to residents to avoid or limit speculative capital flows (Koo, 2011; Fazi and Iodice, 2016). A more radical option would be debt financing through "perpetual bonds" (Flaherty *et al.*, 2016; Sachs, 2014), particularly suitable for financing long-term projects such as those linked to the energy transition; this would *de facto* constitute a debt monetization. Flaherthy *et al.* (2016) noted that the acceptance of these securities as collateral by the central banks would make them desirable even if the market return on investment was lower than the social return.

What "new" macroeconomics will emerge from the turmoil that we are witnessing today? Nobody knows. During the twentieth century, neoclassical and Keynesian schools took turns in being the dominant paradigm, each emerging from a crisis of the other. Each time the dominant school of thought tended to become more and more closed to external influences. The refusal to accept complexity has been the hallmark of every dominant paradigm, ultimately driving it, a victim of hubris, to its downfall.

Ideology certainly played a role in the transformation of the academic debate into a parochial quarrel. The identification of neoclassical economies with conservative political positions, and of Keynesianism with progressives, has further removed economists from accounting for the complexity of our economies. Over the last three decades in particular, when macroeconomics came to be seen as the result of the gradual accumulation of knowledge within the framework

given by neoclassical individual rationality, neither attempts to assess the validity of the theory depending on the historical context and institutions, nor the introduction of alternative approaches based on different assumptions, has found any space in the academic and political debate.

In the past, each crisis opened a possible path of contamination, because the dominant paradigm was weakened, while the alternatives had not yet confirmed their hold. The New Consensus is an example of contamination that, nonetheless, turned already starting from the 1980s into a fundamentally neoclassical mechanism. From the current crisis, we should emerge with the methodological principle that no theory is suitable for all seasons. *Pragmatism* should be the guiding principle of macroeconomics in the coming years. We should abandon attempts to reach a unified theory. There is no one-size-fits-all approach or "superior" policies; economists should stop selling this dangerous illusion to politicians.

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