

INEQUALITY IN MACROECONOMIC MODELS

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This article 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 article 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.

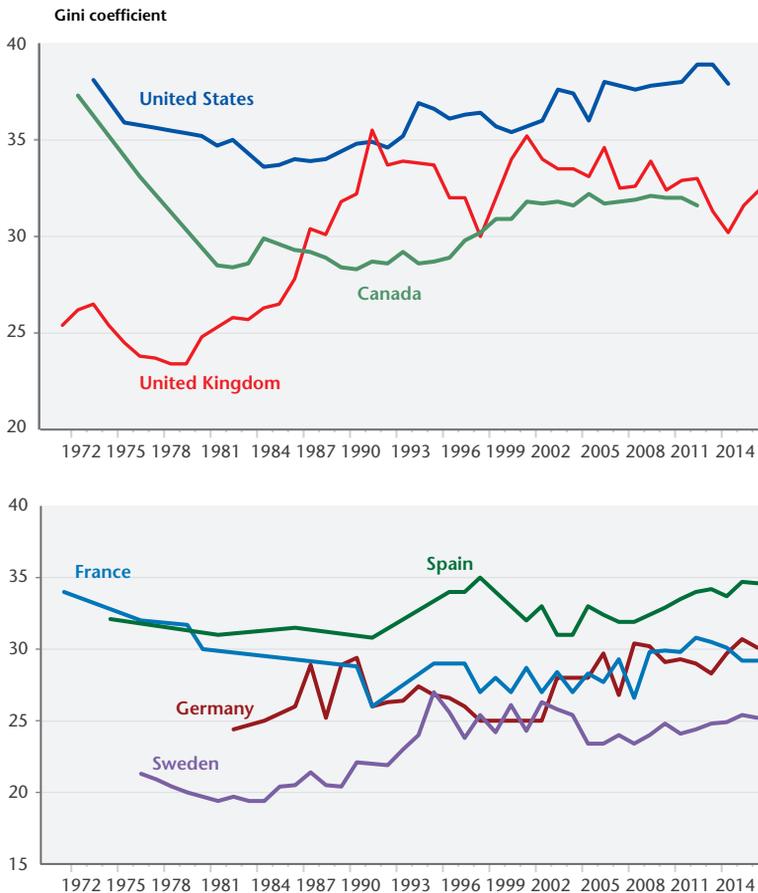
Macroeconomics has changed since the Great Recession. One of the aspects that has received most attention has been the role of rational expectations, but other traditional features of macro models are also under scrutiny, such as how to model the financial sector or the new role of aggregate demand. 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

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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

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 relationship between macroeconomics and distribution, focusing first on the impact of distribution on growth and cycles, and then on the determinants 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 macroeconomic 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 consideration 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 neoclassical growth model. I next consider the effect of inequality on growth and fluctuations, while section 3 reviews the literature on the macroeconomic 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 characterised 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 $\pi = (1 - s_L) \gamma / \kappa$. Assuming a proportional tax rate τ on all incomes, mean disposable income is then given by $\gamma_d = (1 - \tau)(\kappa \pi + n_s w_s + n_u w_u + (1 - e)T)$.

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 where 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

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

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, Ranci ere 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.

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

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

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

temporary collapse in world trade¹⁰ 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

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 to 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 in his

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 quintile 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,

13. See Alvarado 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

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

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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