DNB Working Paper

No. 689 / June 2020

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DeNederlandscheBank

EUROSYSTEEM

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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

Working Paper No. 689

June 2020

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Abstract

This paper links the debate on the decrease in competitiveness and business dynamism with that on rising inequality. We build a framework with entry, imperfect competition, heterogeneous households, and incomplete markets. Recent trends in markups, factors' share, and business dynamism are explained through an increase in barriers to entry for new firms, which restrict competition. Those trends account for 11% to 22% of the increase in income inequality observed between 1989 and 2007 and for 10% of the increase in wealth inequality. Just 16% of the population experiences a welfare gain during the transition from a high to a low competition environment. These are either the wealthy, or agents with low productivity relative to their asset holdings.

Keywords: inequality, entry, oligopoly, markups, incomplete markets.

JEL Classification: E2, L1

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[†]Update version of "Competition and Inequality: Aiyagari meets Bertrand and Cournot" (DEMS WP, February 2019). We thank Alice Albonico, Guido Ascari, Florin Bilbiie, Pierpaolo Benigno, Corina Boar, Paolo Bonomolo, Davide Debortoli, Federico Etro, Francesco Furlanetto, Gabriele Galati, Jordi Galì, Basile Grassi, Jakob de Haan, Bart Hobijn, Keith Kuster, Marco Maffezzoli, Kostas Mavromatis, Virgiliu Midrigan, Lorenza Rossi, Emiliano Santoro, Petr Sedlàček, Patrizio Tirelli, Antonella Trigari, Razvan Vlahu, Sweder van Wijnbergen and Gabriele Zinna for helpful discussions and comments. We also thank conference and seminar participants at the University of Antwerp, De Nederlandsche Bank, ERMAs conference, the University of Milano Bicocca, the Catholic University of Milan, the University of Crete, the University of Lancaster and Oxford University.

1 Introduction

In the last few decades, the vast majority of U.S. industries experienced a broad growth in profit rates, sales concentration, and price-cost margins. These upward trends have been accompanied by persistent drops in firm entry rates, the number of publicly traded firms, the labor share of income, and an increase in the stock market capitalization to GDP ratio. Moreover, income inequality has significantly increased over this period. The Current Population Survey (CPS) reports an 11.8% increase in the Gini coefficient of income between 1989 and 2017. Kuhn, Schularick, and Steins (2018) refer to the Survey of Consumer Finance (SCF) and show that the overall income Gini has risen from 0.53 in 1989 to 0.58 in 2016, a rise of 9.4%. This evidence suggests that the United States is no longer the dynamic and competitive economy it was 30 years ago, and led to a renewed interest in the macroeconomic effects of market power.

As argued by Autor (2014), returns to education and the wage differential between high-skilled and low-skilled labor contributed substantially to the rise in income inequality. Yet, there is consensus that several other factors contributed to the rise in inequality. Stiglitz repeatedly suggests that an increase in monopoly rents could be one of the drivers of the rise in income and wealth inequality documented in the United States over the last forty years (see Stiglitz (2012, 2015, 2016)). Baker and Salop (2015) argue that wealthy shareholders and top executives benefit disproportionately from the returns spreading from market power.

The contribution of this paper is to provide a quantitative framework that links the debate on the decrease in competitiveness and business dynamism with that on rising inequality. The environment consists of a variety-based, dynamic, general equilibrium model enriched with aspects of industrial organization, and characterized by heterogeneous households and incomplete financial markets. Most of the studies featuring incomplete markets assume perfect competition. Notable exceptions are Brun and González (2017) and Boar and Midrigan (2019), who provide incomplete market models with monopolistic competition. In contrast to them them, we explicitly model the strategic behavior of an endogenous number of firms. In our model, there is oligopolictic competition between market participants. Oligopolistic competition establishes a link between the intensity of competition and price markups. Specifically, it implies that a higher number of market competitors translates into a lower price-cost margin. The level of the price markup, in turn, affects the distribution of income between labor and profits. Our framework features Cournot competition, but we show that results do not depend on the specific form of competition by considering Bertrand competition in an extension.

As in the seminal contributions by Melitz (2003) and Bilbiie, Ghironi, and Melitz (2012), a new firm entering the market is equivalent to the creation of a new variety. Product creation, or more broadly entry, takes place subject to sunk product development costs. As in idea-based growth models, where economic growth is proportional to the number of researchers, the number of new products is proportional to the quantity of labor used for product development purposes. As a result, the sunk cost is measured in units of labor and it is proportional to the real wage. Free entry equates the expected value of a newly created product to the sunk cost, which is paid by investors in expectations of future profits. After entry, the per-period profits fluctuate endogenously. Firms produce output using only labor. However, the number of active firms in each period can be interpreted as the capital stock of the economy, with the decision of households to finance the entry of new firms akin to their decision to accumulate physical capital in the neoclassical incomplete markets model à la Aiyagari (1994).

Besides imperfect competition, an additional difference between the neoclassical framework and ours is that in the former, absent capital adjustment costs, the price of physical capital is constant and the return on investment equals the marginal product of capital. In our framework, the return on investment is determined by oligopolistic profits, which change endogenously in response to changes in competition.

We describe an environment with no aggregate uncertainty and calibrate it to resemble the 1989 U.S. economy.[1] In our baseline framework, we calibrate the units of labor required to set up a firm/variety so that the implied stationary equilibrium price markup equals the one estimated for 1989 by De Loecker, Eeckhout, and Unger (2020). However, given the debate about price markup estimation, that we discuss in section 2, we substantiate the robustness of our results by considering the estimates by Edmond, Midrigan, and Xu (2018).[2]

The implied endogenous ergodic distribution of wealth matches the concentration characterizing the bottom 99% of the actual U.S. wealth distribution and assigns a large fraction of the total wealth to the richest 5%, but it falls short of explaining the fraction of wealth held by the top 1%. Given the high concentration of stock ownership, dividend income disproportionately benefits a restricted group

[1] We focus on 1989 because it is the first year for which SCF is available.

[2] Both estimates are consistent with the aggregate production function approach that we adopt in the paper.

of households. As a result, the oligopolistic framework matches the concentration of the bottom 99% of the income distribution.

With these realistic distributions of wealth and income in hand, we jointly explain the macroeconomic trends described above through an increase in sunk costs required to develop a new variety. Sunk cost and regulatory barriers are usually regarded as the main sources of entry barriers. There is substantial empirical evidence, that we discuss in Section 2, suggesting an increase in barriers to entry in recent years. However, there is no direct measure of entry barriers, besides measures of the administrative burden on start-ups. For this reason, we discipline the increase in barriers to entry through two alternative experiments. In our baseline exercise, motivated by the evidence in Bloom, Jones, Van Reenen, and Webb (2017), we make the simple assumption of a one-time, unanticipated, and permanent increase in the units of labor necessary to set up a firm so that, in 2007, the endogenous markup implied by the model is exactly equal to the one estimated in 2007 by De Loecker, Eeckhout, and Unger (2020). In an alternative experiment, discussed in the Appendix, we assume that a series of unexpected permanent entry costs shocks hit the economy between 1989 and 2007, implying a gradual increase in both entry costs and markups.

In our model, higher barriers to entry dampen the startup rate and restrict competition. The reduction in the number of market competitors in the final goods market raises the price markup. Quantitatively, the reduction in the number of listed firms is comparable to that in the data. A higher price markup translates in a fall in the labor share of income, and a rise in both the profit share of income and the ratio of stock market capitalization to GDP.

These outcomes impact on income and wealth inequality. Specifically, those trends account for 11% to 22% of the increase in income inequality observed between 1989 and 2007, and for 10% of the increase in wealth inequality.[3] The increase in income inequality is permanent, while that in wealth is temporary. These dynamics are the result of two forces. The rise in the price markup leads to a permanent shift in the distribution of income from the less concentrated labor income to the more concentrated profit income, which explains the permanent in-

[3]As we explain in Section 2, we consider two surveys to measure the Gini coefficient of income inequality: the Survey of Consumer Finance (SCF) and the Current Population Survey (CPS). The two surveys adopt slightly different definitions of households. For this reason, the change in the Gini coefficient differs between the two surveys. We explain 10.8% of the change in the Gini coefficient extracted from the CPS and 22% of that obtained from the SCF.

crease in income concentration. Turning to wealth, the unexpected jump in stock market values of firms causes a temporary decline in stock returns. This deters stock market participation, making profit income even more concentrated in the hands of few. Initially, this further adds to income inequality. However, this effect is only temporary. A permanent increase in the price markup implies a similarly permanent increase in profits, and thus in stock market returns. As a result, stock market participation rises over time leading to a slight decline in the Gini coefficient of wealth inequality in the long run. The analysis suggests that the evolution over time of stock market prices shape wealth concentration dynamics, as pointed out by Kuhn, Schularick, and Steins (2018).

The evidence suggests that the increase in income inequality spreading from the reduction in the labor share of income is sizeable. Jacobson and Occhino (2012) refer to the calculations by the Congressional Budget Office and argue that each percentage point decline in the labor share of income implies an increase in the Gini coefficient of approximately 0.15 to 0.33 percentage points. The corresponding figure in our analysis is on average a 0.25 percentage point increase between 1989 and 2007.

We find that the welfare costs deriving from a decrease in competition are large and unevenly distributed across households. This comes as a direct consequence of the highly concentrated wealth distribution implied by our model. Only a minority of the population (16%) enjoys a small welfare gain in response to lower competition and higher price markups. These households are either the wealthy or have low productivity relative to their asset holdings. In both cases, financial income represents their main source of earnings and an increase in markups has a positive impact on their total income and consumption.[4]

Eggertsson, Robbins, and Wold (2018) argue that a neoclassical model augmented with monopolistic competition and a declining natural rate of interest can quantitatively mimic observed trends in markups, asset prices, and factors' income in response to a change in agent preferences. De Loecker and Eeckhout (2018) show that an increase in price markups can explain the declining labor and capital shares as well as the decline in labor market dynamism observed over the last 30 years. Nevertheless, to the best of our knowledge, our paper is the first to explain these facts simultaneously, and to connect them to the trends in income and wealth inequality.

[4] To isolate the effects of market power on the distribution of wealth and income, we hold the technology level constant during the transition from the initial to the final steady state.

The New Keynesian literature, starting with Bilbiie (2008) and more recently with Kaplan, Moll, and Violante (2018), stresses the key role of profits and their distribution for the aggregate demand side and the response of the economy to monetary policy shocks. Our work points out that profits and their distribution, and their connection with business dynamism and markups, are important aspects to consider in order to explain the evolution of inequality over time.

The decline in the number of competitors is not the only driver of the rise in the aggregate markup. De Loecker, Eeckhout, and Unger (2020) find that the rise in the average U.S. markup has also been driven by a reallocation of demand in favor of few high-markup firms. In our framework all agents hold the market portfolio, and thus obtain the same return from wealth. As a result, the evolution in the distribution of markups across firms would have no impact on the evolution of income inequality. However, introducing a mechanism consistent with the evidence, such that wealthier agents enjoy higher returns, would strengthen the effects of a rise in markups on income and wealth inequality.

The remainder of the paper is organized as follows: section 2 discusses the stylized facts we address and the related literature; section 3 spells out the model economy; section 4 defines the equilibrium concepts used in the paper and calibrates the initial steady state; section 5 provides the wealth and income distributions in the initial steady state; section 6 evaluates the macroeconomic and distributional effects of an increase in market power; finally, section 7 concludes.

2 Stylized Facts and Related Literature

There are five trends that are suggestive of a decline in competition in the United States: increasing industry concentration, lower levels of firm entry and labor market mobility, increasing price markups, and a reallocation of aggregate income from labor to profits. We discuss these trends below. Also, we discuss the increase in inequality and its relationship with those trends, which is at the heart of our work.

Business Dynamism, Market Concentration, and Market Power. A structural change has occurred in the competitive landscape of U.S. industries in the last 30 years. According to Grullon, Larkin, and Michaely (2019), more than 75% of U.S. industries experienced an increase in sales concentration.

At the same time, Gao, Ritter, and Zhu (2013), Doidge, Karolyi, and Stulz (2017), Grullon, Larkin, and Michaely (2019), and others show a significant decline in number of public firms since the late 1990s. Haltiwanger, Jarmin, and Miranda

(2013) show that the startup rate and other indicators of business dynamism, such as worker and job reallocation rates, have been decreasing in the non-farm private sector since 1980.[5] Decker, Haltiwanger, Jarmin, and Miranda (2015) show that the slowdown in U.S. business dynamism is due to the decline in the entry margin started in the 1980s, rather than to a surge in the exit margin. Thus, we observe an increase in concentration at the intensive margin and a decrease in the competitive pressure at the extensive margin.

There are two leading explanations of these phenomena. The first one is the superstar firms hypothesis, popularized by Autor, Dorn, Katz, Patterson, and Van Reenen (2017). According to this view, a restricted group of firms has become increasingly efficient relative to other firms in their respective industries. This could explain the rise in the market shares and profits of some large firms in the United States. Under this view, increased concentration is an efficient outcome and should be considered good news. In contrast, the second explanation ascribes the rise in concentration to higher barriers to competition. According to this hypothesis, a rise in concentration is associated to economic rents, it is thus bad news (Furman (2015) and Furman (2016)). As argued by Crouzet and Eberly (2018), these explanations are not mutually exclusive and do not need to play the same role in every industry.

The empirical evidence on rising barriers to entry is substantial. Gutiérrez and Philippon (2019) suggest that barriers to entry due to regulation contributed to the decline in business dynamism observed in the United States since the end of the 1980s. Gutierrez Gallardo, Jones, and Philippon (2019) build a model of the U.S. economy characterized by many industries and taking into account entry, investment, demand factors, and interest rates. Using Bayesian estimation methods, they recover annual industry-level entry cost shocks and compare them to measures of entry regulations and anti-trust activities computed from independent micro-data. They show that the model-implied entry cost shocks track closely empirical measures of entry regulations coming from entirely different data sources.

[5] Karahan, Pugsley, and Şahin (2019) argue that the slowdown in labor supply growth since the late 1970s, largely due to demographics, can be an important determinant of the secular decline in the startup rate. Gutiérrez and Philippon (2019) point out that demographics can explain the decline in the number of entrepreneurs, but cannot explain the negative correlation between the value of incumbent firms and entry rates, observed particularly after 2000. Even if demographic factors had restricted the pool of potential entrants, the few remaining ones should enter the industries where the value of entry is higher.

Another branch of the empirical literature focuses on entry barriers derived from increased R&D costs. In ideas-based growth models, economic growth arises from people creating ideas. For this reason Bloom, Jones, Van Reenen, and Webb (2017) decompose the long-run growth rate into the product of two terms: the effective number of researchers and their research productivity. Even assuming, as we do in this paper, that each variety has a productivity that cannot be improved at all, but that the number of varieties is the only margin that changes over time, they find that the number of researchers has risen enormously and that research productivity for the aggregate U.S. economy has declined at an average of more than 5 percent per year since the 1930s. This evidence holds across industries, products, and firms and suggests a substantial increase in sunk costs required to develop new products. Grullon, Larkin, and Michaely (2019) argue that if large firms are better at developing and implementing technology, then technological advancements may create barriers to entry for new firms, which are typically small. Using the patent database of Kogan, Papanikolaou, Seru, and Stoffman (2017), they compute the evolution of patent-based industry concentration from the share of the total patent activity of the largest four firms in the industry. They find that patent concentration follows a pattern almost identical to that of the sales-based Herfindahl–Hirschman index.

Significant barriers to entry may cause firms operating in increasingly concentrated industries to exercise market power (Bain (1956)). Syverson (2019) argues that the formally correct concept of market power is the price markup, that is, the ability of a firm to price its products above the marginal cost. Markups are not directly observable in the data, and to estimate them one needs data on prices and marginal costs. Data on prices are readily available, while data on costs are harder to find. However, the recent broad availability of microdata in many countries, especially data from firms' financial statements, facilitated the estimation of marginal costs and hence of markups. De Loecker, Eeckhout, and Unger (2020), De Loecker and Eeckhout (2018) and Edmond, Midrigan, and Xu (2018) are among the most influential studies in the macro market-power literature. These papers show that measured markups have grown since the early 1980s, in the U.S. as well as in many other countries around the world. De Loecker and Eeckhout (2018) go a step further and show that there is a positive correlation between firm-level measures of profitability and firm-level markups. They conclude that the contemporaneous increase in both markups and profitability provides evidence that market power has risen.

Not surprisingly, estimated price markups depend on the estimation technique.

A discussion of the econometric methodologies for markup estimation is beyond the scope of this paper. However, given the key role played by those estimates in our analysis, we consider two different estimated markups series. Figure 1 plots price markups in U.S. industries estimated by De Loecker, Eeckhout, and Unger (2020) and Edmond, Midrigan, and Xu (2018). Both papers exploit the production function estimation method first developed by Hall (1988) and use Compustat data on the universe of U.S. listed firms to obtain firm-level markups.[6] We report their costs-weighted average measures, that corresponds to the aggregate markup in the economy, as discussed in Edmond, Midrigan, and Xu (2015) and Grassi (2017).[7] The Figure displays yearly percentage deviations of price markups from values estimated in 1989, which we take as the baseline period in our analysis. Both series exhibit positive growth since 1989. However, both levels and growth rates differ substantially across the two series. De Loecker, Eeckhout, and Unger (2020) estimate a markup rising from 1.272 in 1989 to 1.327 in 2007, while Edmond, Midrigan, and Xu (2018) find a smaller increase, ranging from 1.217 in 1989 to 1.25 in 2007.

Entry barriers can retard, diminish, or entirely prevent the market's usual mechanism for holding market power under control: competitive pressure. An imperfect measure of competitive pressure is given by the number of competitors in the market. For this reason, the Figure also reports yearly percentage deviations in the number of U.S. listed firms. While we report the total number of listed firms (per million people), their reduction is common across industries.[8] As in the case of price markups, deviations are taken with respect to the values assumed by that variable in 1989. We focus on publicly traded firms because they tend to be much larger than private firms, and are typically the key industry players. In line

[6] The main difference in the two approaches regards the output elasticity of variable inputs used in computing markups. While De Loecker, Eeckhout, and Unger (2020) obtain the elasticity by estimating the associated production function, Edmond, Midrigan, and Xu (2018) rely on the measure provided by Karabarbounis and Neiman (2018).

[7] In a previous version of this paper, we used the time series estimated by De Loecker, Eeckhout, and Unger (2020) and depicted in Figure 1 of their paper. In that case, aggregate markups are a sales-weighted average of firm-level markups. This aggregation method results in a higher variation of the aggregate measure because firms with higher markups also tend to have a greater sales share than cost shares.

[8] As pointed out by Stulz (2018) If one computes the ratio of the number of listed firms to the number of private and public firms with more than 20 employees, this ratio decreases for all industries.

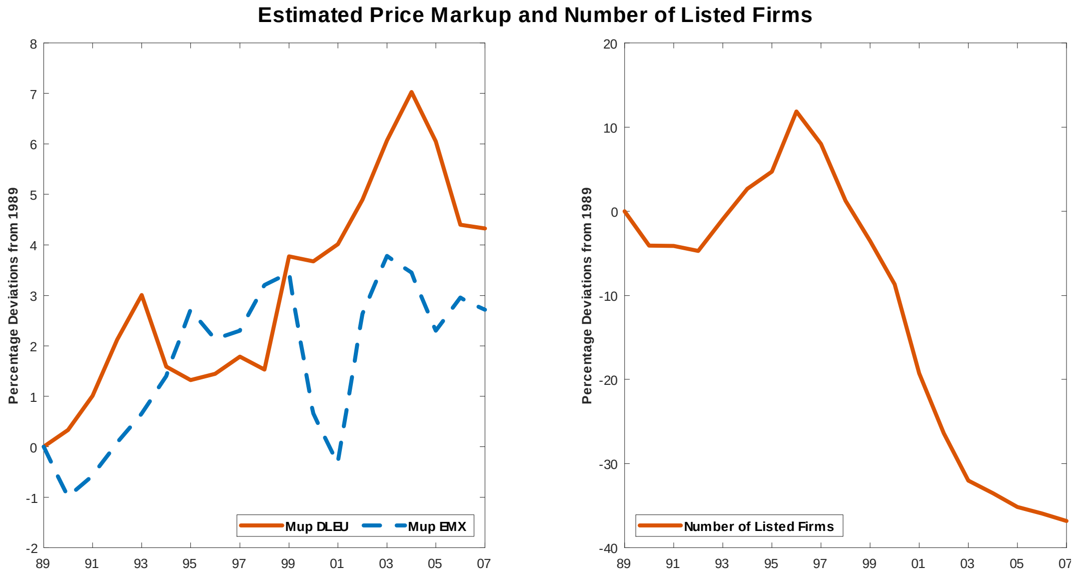

Figure 1: The left panel shows the price markup estimated by De Loecker, Eeckhout, and Unger (2020) (solid line) and Edmond, Midrigan, and Xu (2018) (dashed line). The right panel displays the number of listed firms (Global Financial Development Database, World Bank).

with this approach, our theoretical framework features publicly listed firms. Figure 1 suggests that the competition at the extensive margin and price markups are negatively correlated, as one would expect. Early works of the New Empirical Industrial Organization literature starting with Bresnahan, Reiss, Willig, and Stigler (1987) and more recent research by Manuszak (2002), Campbell and Hopenhayn (2005), Manuszak and Moul (2008) and others, have provided convincing evidence in support of a competition effect on markups spreading from the number of firms in the market.

Boar and Midrigan (2019) develop a framework with markups heterogeneity across firms and entrepreneurial choices. In their paper, dispersion in entrepreneurial ability gives rise to heterogeneity in the return on wealth, which helps to explain the skewness of both the income and the wealth distributions. In our model, investors hold shares in the market portfolio of all publicly traded stocks, hence there is no heterogeneity in the return on wealth across households. In this setting, the evolution in the distribution of markups across firms would have no impact on the evolution of income inequality. While this is a limitation of our analysis, it does not, in our view, diminish the message of the paper. Fagereng, Guiso, Malacrino, and Pistaferri (2020) show that returns are positively correlated with wealth. As argued earlier, if wealthier agents enjoyed higher returns, a rise in markups would have an even more sizeable effect on income and wealth inequality than in our framework.

Competition, Profits, and Stock Market Capitalization. Using various industry definitions and data on both public and private U.S. firms, Grullon, Larkin, and Michaely (2019) find a positive correlation between changes in concentration levels and return-on-assets (ROA). Further, decomposing the ROA into operating efficiency and operating profit margins, they find that higher returns on assets are mainly driven by firms' ability to extract higher profit margins. These findings suggest that firms in concentrated industries are becoming more profitable thanks to their ability to extract rents rather than through higher efficiency. Crouzet and Eberly (2018) argue that the evolution of firms' profits could be explained by intangible capital deepening. Investments in intangible assets are prevalent in the early stages of fundamental research and experimentation, where sunk costs can be high. Large up-front investment requirements make markets less contestable.

The evolution of profits is reflected in the trends of the ratio between profits and GDP and in the ratio between stock market capitalization and GDP. Figure 2 reports the percentage deviations of both the profits to GDP and the market capitalization to GDP ratios from their 1989 values. Both ratios have grown over the period considered.[9]

McGrattan and Prescott (2005) document an increase in the value of corporate equity since the mid-1980s. They argue that changes in regulation are important factors to explain this trend. The evidence presented above supports the view that the rising profit share and market capitalization to GDP ratio are a by-product of lower competition and barriers to entry.

The Decline in the Labor Share of Income. The increase in the profit share of income discussed above has its mirror image in the decline in the labor share. Barkai (2020) shows that the decline in the labor share of income is not offset by a rise in the capital share but by an increase in the pure profit share. He provides evidence that the fall in both labor and capital shares is an inefficient outcome that can be attributed to the decline in competition.

As various observers, such as Elsby, Hobijn, and Şahin (2013), Karabarbounis and Neiman (2014), and Karabarbounis, Neiman, and Adams (2014), have pointed

[9]The profit share is computed considering the accounting profits provided by FRED (profits before tax without IVA and CCAdj). Notice that, as shown in Barkai and Benzell (2018), considering the accounting profits net of the interest received changes the level, but not the time pattern of the series.

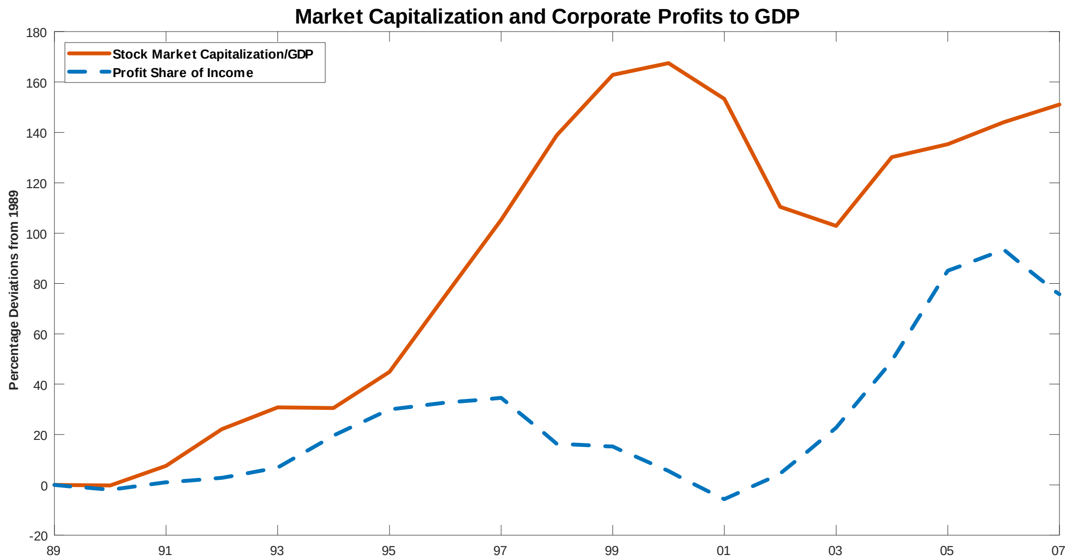

Figure 2: Stock Market Capitalization to GDP ratio (Global Financial Development database by World Bank) and Profit Share of Income (FRED) between 1989 and 2007.

out, the labor share of income in the United States has trended downward over the past quarter-century. Figure 3 reports two alternative measures of the labor share of income. The solid red line depicts the economy-wide labor share, measured as the ratio between the compensation of all U.S. employees and GDP. The dashed blue line in Figure 3 represents the labor share in the corporate sector, provided by Karabarbounis and Neiman (2014). While, the former series is affected by the methodology adopted to impute the labor income earned by entrepreneurs, sole proprietors, and unincorporated businesses, Karabarbounis and Neiman (2014) argue that the corporate labor share is immune to those measurement issues. Both measures suggest that the labor share of income has substantially decreased over the last 30 years.[10] Autor, Dorn, Katz, Patterson, and Van Reenen (2017) find that the fall in the labor share is explained by a composition shift towards establishments with low labor shares.

Evolution of Income and Wealth Inequality. Figure 4 Panel (a) displays the Gini coefficient of wealth inequality computed by Kuhn and Ríos-Rull (2016) based on the SCF, which runs every three years; Panel (b) reports the Gini coefficient of income inequality published by the U.S. Census Bureau and that

[10]Note that the corporate sectors account for 60% of the gross value added in the US, hence this measure can be regarded as representative of the whole economy.

Figure 3: Labor share of income between 1989 and 2007. The dashed blue line plots the labor share measured in the corporate sector (Karabarbounis and Neiman (2014)). The solid red line plots the ratio between the compensation of all US employees and GDI (FRED).

computed by Kuhn and Ríos-Rull (2016) based on the SCF data.[11] The solid line represents the time series of the Census's Gini coefficient. The circles represent the Gini coefficient values extrapolated from the SCF data. The dashed line is the linear time trend fitted through those points and highlights the time pattern of income inequality in the SCF. The quantitative difference in the levels of the Gini coefficients across the two surveys is likely due to a different definition of the statistical units of observation between the SCF and the US Census.[12]

Between 1989, the earliest year with publicly available Survey of Consumer Finances (SCF) data, and 2007, the year just prior to the financial crisis, income inequality in the United States increased substantially, while wealth inequality increased to a much lower extent. This has been pointed out, *inter alia*, by Kuhn,

[11]The Census figures are based on the Current Population Survey (CPS), sponsored jointly by the US Census Bureau and the US Bureau of Labor Statistics (BLS).

[12]Kuhn, Schularick, and Steins (2018) point out that the unit of analysis in the SCF is the primary economic unit (PEU), consisting of the persons in a household who share their finances. The Census definition of a household differs slightly from a PEU in that it groups people living together in a housing unit. In some cases, this definition may include several PEUs living together. However, the two concepts should lead to identical units of observation in most cases.

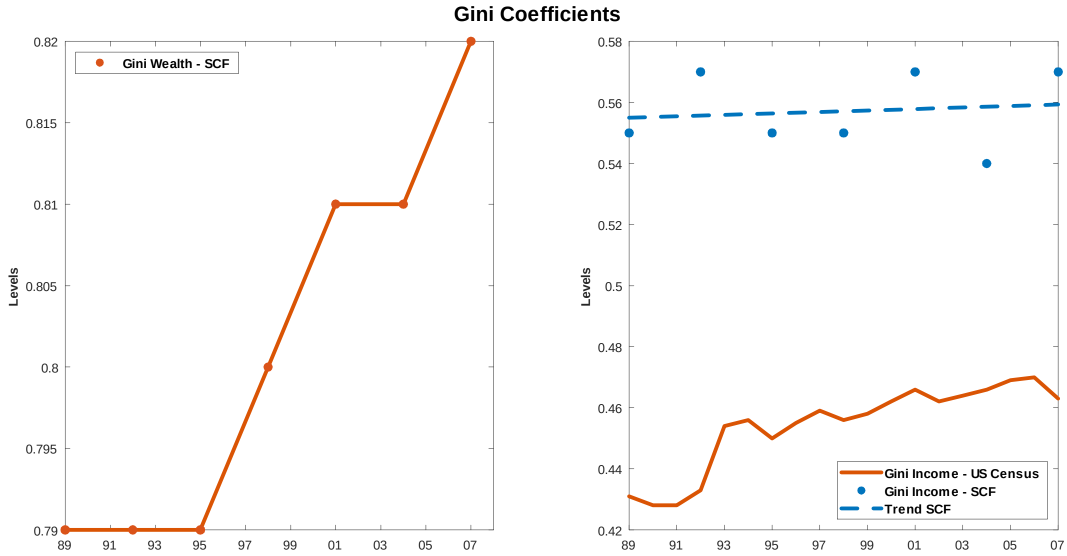

Figure 4: Panel a): Gini coefficient of wealth inequality. Source: Kuhn and Ríos-Rull (2016). Panel b): Two measures of the Gini coefficient of income inequality.

Schularick, and Steins (2018) using SCF data, and by Saez and Zucman (2016) using income tax data.

This paper is among the few studying the potential drivers of income inequality over time in a general equilibrium quantitative framework. We argue that a decrease in competition, originated by an increase in barriers to entry, contributed, through its effect on factor shares and stock market participation, to the observed increase in income and wealth inequality over the period of time that we consider. Karabarbounis, Neiman, and Adams (2014) observe that the share of aggregate income paid as compensation to labor is frequently used as a proxy for income inequality. If capital holdings are highly concentrated in the hands of high-income individuals, increasing their GDP share, *ceteris paribus*, will widen the gap between them and poorer workers. As discussed in the Introduction, we are aware that this is only one among many other factors affecting inequality. In Acemoglu and Restrepo (2018), high-skilled labor has a comparative advantage in new tasks over low-skilled labor. In this case, automation increases income inequality in the short run. In Favilukis (2013), the stock market plays a major role in explaining the increase in inequality in both income and wealth. Other factors that contributed to rising income inequality over the recent decades are the increased wage inequality documented by Katz and Murphy (1992), and job polarization as documented by Autor, Levy, and Murnane (2003) and Jaimovich and Siu (2019). Moll, Rachel, and Restrepo (2019) argue that automation could lead to higher wealth inequality, whereas Hubmer, Krusell, and Smith Jr (2016) find that the main driver of the increase in wealth inequality in the United States over the recent decades is the decline in tax progressivity. Higher wealth inequality leads to more concentrated capital income and thereby increase income inequality.

Models of Competition and Markups. Atkeson and Burstein (2008), Jaimovich and Floetotto (2008), and Etro and Colciago (2010) propose models in which oligopolistic competition leads to an inverse relationship between the intensity of competition and price markup levels. The literature presents alternative strategies, in addition to oligopolistic competition, that can achieve a negative relationship between markups and competition. These strategies can be as successful as the one we propose in this paper. Bilbiie, Ghironi, and Melitz (2012, 2019) consider a framework with monopolistic competition and endogenous variety. In their setting, a negative relationship between price markups and competition occurs from translog preferences, where the elasticity of substitution between varieties is increasing in the number of varieties. Edmond, Midrigan, and Xu (2015) consider monopolistic competition between heterogeneous firms, to find a negative relationship between price markups and competition under Kimball-style preferences, where the elasticity of substitution between varieties is decreasing in the relative quantity consumed. Edmond and Veldkamp (2009) link the cyclicality of price markups to the degree of income dispersion. Specifically, they develop a framework in which a higher degree of income dispersion, as observed during recessions, lowers the price elasticity of demand and increases the imperfectly competitive firms' optimal markups. Bertoletti and Etro (2016) consider monopolistic competition with non-homothetic preferences. Specifically, they consider monopolistic competition in the case of an additively separable indirect utility. Here, the relative demand for two goods does not depend on the price of other goods, but on income. They show that higher income and productivity increase price markups in the long run, which is consistent with the evidence that markups tend to be higher in richer countries.

3 The Model

The economy features a continuum of atomistic sectors, or industries, on the unit interval. Each sector is characterized by a limited number of firms producing different varieties of one good, with labor as the only input. Furthermore, sectoral goods are imperfect substitutes for one another and are aggregated into a final good. Oligopolistic competition and endogenous firm entry are modeled at the sectoral level. At the beginning of each period N_{jt}^{e}, new firms enter sector $j \in (0,1)$, while at the end of the period, a fraction $\delta \in (0,1)$ of market participants exit the market for exogenous reasons. Thus, the number of firms in the sector, N_{jt}, follows the equation of motion

$$N_{jt+1} = (1-\delta)(N_{jt} + N_{jt}^{e}). \tag{1}$$

As in Bilbiie, Ghironi, and Melitz (2012), we assume that new firms entering the market at time t will start producing only at time $t+1$ and that the probability of their exiting the market, δ, is independent of the period of entry, and identical across sectors. The assumption of an exogenous constant exit rate is adopted for tractability but has empirical support. Using the U.S. annual data of manufacturing, Lee and Mukoyama (2018) find the entry rate procyclical, but with similar annual exit rates across booms and recessions. Additionally, as mentioned in the Introduction, Decker, Haltiwanger, Jarmin, and Miranda (2015) argue that the relevant margin to take into account in order to explain the slowdown in U.S. business dynamism is that of entry.

We consider the oligopolistic competition approach developed by Jaimovich and Floetotto (2008) and Etro and Colciago (2010). As in Ghironi and Melitz (2005) and Bilbiie, Ghironi, and Melitz (2012), sunk entry costs are introduced to endogenize the number of firms in each sector. The nature and form of the entry costs are specified below. Households use the final good for consumption purposes, inelastically supply labor to firms, are subject to uninsurable labor income shocks, and choose how much to save for the creation of new firms through the stock market.

3.1 Firms and Technology

The final good is produced according to the constant elasticity of substitution (CES) aggregating function

$$Y_t = \left[\int_0^1 Y_{jt}^{\frac{\eta-1}{\eta}} \, dj \right]^{\frac{\eta}{\eta-1}}, \tag{2}$$

where Y_{jt} denotes the output of sector j and η is the elasticity of substitution between any two goods from different sectors, with the final good producer adopting a competitive behavior. Each sector j has $N_{jt} > 1$ firms producing differentiated goods, which are aggregated into a sectoral good by a second CES aggregating function, defined as

$$Y_{jt} = \left[\sum_{i=1}^{N_{jt}} y_{jt}(i)^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}, \tag{3}$$

where $y_{jt}(i)$ is the production of good i in sector j and $\theta > 1$ is the elasticity of substitution between the sectoral goods. As in Etro and Colciago (2010), a unit elasticity of substitution is assumed between goods belonging to different sectors. This allows for a realistic separation of limited substitutability at the aggregate level and high substitutability at the disaggregated level.

Each firm i in sector j produces a differentiated good with the production function

$$y_{jt}(i) = A l_{jt}^{c}(i), \tag{4}$$

where A represents a technology that is common across sectors and remains constant over time, and $l_{jt}^{c}(i)$ is the labor input of the individual firm for production of the final good. The unit intersectoral elasticity of substitution implies that the nominal expenditure, EXP_t, is identical across sectors. Thus, the final producer's demand for each sectoral good is

$$P_{jt} Y_{jt} = P_t Y_t = EXP_t, \tag{5}$$

where P_{jt} is defined as

$$P_{jt} = \left[\sum_{i=1}^{N_{jt}} (p_{jt}(i))^{1-\theta} \right]^{\frac{1}{1-\theta}} \tag{6}$$

and the demand the producer faces for each variety is

$$y_{jt}(i) = \left(\frac{p_{jt}(i)}{P_{jt}} \right)^{-\theta} Y_{jt}. \tag{7}$$

From (7) and (5), the individual demand for good i can be written as a function of the aggregate expenditure,

$$y_{jt}(i) = \frac{(p_{jt}(i))^{-\theta}}{P_{jt}^{1-\theta}} EXP_t. \tag{8}$$

Since technology, entry costs, and exit probabilities are identical across sectors, in what follows, we ignore the index j and consider a representative sector.

3.2 Households

Households have unit mass and are infinitely lived. Each household has an expected lifetime utility, given by

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{{c_t}^{1-\gamma}}{1-\gamma} \tag{9}$$

where $\beta \in (0,1)$ is a discount factor common across households, c_t is the consumption of the final good, and γ is the coefficient of relative risk aversion. The household inelastically supplies one unit of labor and is subject to idiosyncratic labor productivity risk, as in Aiyagari (1994). A household's idiosyncratic labor productivity, z_t, follows an AR(1) process in log, given by $\log(z_t) = \rho \log(z_{t-1}) + \varepsilon_t$, where ε_t is a mean zero $i.i.d.$ shock.

Households enjoy labor and dividend income. A household maximizes (9) by choosing how much to consume, $c_t(s_t, z_t)$, and how much to invest in stocks, $s_{t+1}(s_t, z_t)$. These consumption and investment choices depend on the current value of the idiosyncratic states: wealth (s_t) and productivity (z_t). In the remainder, we reduce the notation by omitting the dependence on current states whenever possible. The timing of investing in stocks is as in Bilbiie, Ghironi, and Melitz (2012) and Chugh and Ghironi (2011). At the beginning of period t, each household owns s_t shares of a mutual fund of N_t firms and paying dividend d_t. We discuss the fund in greater detail below. Denoting the value of a firm with V_t, it follows that the value of the portfolio held by the household is $s_t V_t N_t$. During period t, the household purchases s_{t+1} shares in a fund of these N_t firms as well as the N_t^e new firms created during period t, to be carried into period $t+1$. The total stock market purchases are thus $V_t(N_t + N_t^e)s_{t+1}$. At the very end of period t, a fraction of these firms disappears from the market.[13] Following the production and sales of the N_t varieties in the imperfectly competitive goods markets, firms distribute the dividend d_t to households. The household's total dividend income is thus $D_t = s_t d_t N_t$. Households' labor income consists of the real wage per efficiency unit w_t times the idiosyncratic productivity level z_t. The flow budget constraint of the household is

$$V_t \left(N_t + N_t^e\right) s_{t+1} + c_t = \left(d_t + V_t\right) N_t s_t + z_t w_t, \tag{10}$$

[13]Due to the Poisson nature of exit shocks, the household does not know which firms will disappear from the market, so it finances the continued operations of all incumbent firms as well as those of the new entrants.

where we impose the no short-selling constraint

$$s_t \geq 0, \ \forall t.$$

The first-order utility maximization condition with respect to s_{t+1} reads as

$$U_c(c_t) \geq \beta E_t \frac{(V_{t+1} + d_{t+1}) N_{t+1}}{V_t (N_t + N_t^e)} U_c(c_{t+1}). \tag{11}$$

The latter holds with equality when $s_{t+1} > 0$.

3.3 The Mutual Fund

Following Bilbiie, Ghironi, and Melitz (2012) and Gornemann, Kuester, and Nakajima (2016), we assume that a mutual fund owns all the firms in the economy. The fund collects firms' profits, $d_t N_t$, and distributes them to households in proportion to their stock holdings, s_t. The mutual fund has a dual role. It allows each household to invest in a single asset, instead of in a multiplicity of stocks of identical firms and provides a simple and intuitive way to aggregate the heterogeneous stochastic household discount factors.[14] Since the fund is owned by households, the factor that the fund uses to discount future profit is defined as the asset-weighted average of the households' individual stochastic discount factors:

$$\Lambda_{t,t+s} = \int s_{t+s} \left(\beta^s E_t \frac{U'(c_{t+s})}{U'(c_t)} \right) \mathtt{d}\lambda_t(s,z) \qquad s = 0, 1, .$$

where $\lambda_t(s, z)$ denotes the measure of households defined over possible values of wealth (s), and productivity level (z), in a given period t. Notice that Favilukis (2013).

3.4 Endogenous Entry

Since each firm produces a different variety, the creation of a new firm amounts to the creation of a new variety. Following Bilbiie, Ghironi, and Melitz (2012) and the literature of endogenous growth based on expanding varieties, we assume that the creation of a new firm requires workers. Specifically, we assume that the creation of a new firm requires ϕ_t units of labor. Thus, the sunk entry cost

[14] Note that households with positive stock holdings have identical stochastic discount factors. However, there is a positive mass of constrained households, characterized by heterogeneous stochastic discount factors, for whom the Euler equation does not hold.

required for the creation of a new firm is proportional to the real wage ($\phi_t w_t$). In each period entry is determined endogenously to equate the value of a firm, V_t, which is given by the expected discounted value of its future profits, to the entry cost. Firms will thus enter the market up to the point where

$$V_t = \phi_t w_t. \tag{12}$$

3.5 Strategic Interactions

In each period, the same expenditure for each sector EXP_t is allocated across the available goods according to the standard direct demand function derived from the expenditure minimization problem of households. Thus, the direct individual demand faced by a firm, $y_t(i)$, can be written as

$$y_t(i) = Y_t \left(\frac{p_t(i)}{P_t} \right)^{-\theta} = \frac{p_t(i)^{-\theta}}{P_t^{1-\theta}} Y_t P_t = \frac{p_t(i)^{-\theta} EXP_t}{P_t^{1-\theta}} \qquad i = 1, 2, ..., N_t. \tag{13}$$

The system of inverse demand functions can be derived as

$$p_t(i) = \frac{y_t(i)^{-\frac{1}{\theta}} EXP_t}{\sum_{i=1}^{N_t} y_t(i)^{\frac{\theta-1}{\theta}}} \qquad i = 1, 2, ..., N_t. \tag{14}$$

We can use the latter to characterize the Cournot equilibrium. Since firms cannot credibly commit to a sequence of strategies, their behavior is equivalent to maximizing current profits in each period, taking the strategies of other firms as given. We take Cournot competition as our baseline competitive framework and consider Bertrand competition in an extension.

Firms take as given their marginal cost of production and aggregate nominal expenditure.[15] We obtain equilibrium relative prices satisfying

$$\rho_t(i) = \mu(\theta, N_t) \frac{w_t}{A} \tag{15}$$

where $\frac{w_t}{A}$ is the real marginal cost and $\mu(\theta, N_t) > 1$ is the markup function.

Using the inverse demand function (14), the nominal profit function of firm i can be expressed as a function of its output $y_t(i)$ and the output of all the other

[15] Both of them are endogenous in general equilibrium, but it is reasonable to assume that firms do not perceive marginal costs and aggregate expenditure as being affected by their choices.

firms:

$$\Pi_t\left[y_t(i)\right] = \left[p_t(i) - \frac{W_t}{A}\right] y(i) =$$
$$= \frac{y_t(i)^{\frac{\theta-1}{\theta}} EXP_t}{\sum_{j=1}^{N_t} y_t(j)^{\frac{\theta-1}{\theta}}} - \frac{W_t y_t(i)}{A}, \quad (16)$$

where W_t is the nominal wage. Assume that each firm chooses its production $y_t(i)$, taking the production of the other firms as given. The first-order conditions

$$\left(\frac{\theta-1}{\theta}\right) \frac{y_t(i)^{-\frac{1}{\theta}} EXP_t}{\sum_i y_t(i)^{\frac{\theta-1}{\theta}}} - \left(\frac{\theta-1}{\theta}\right) \frac{y_t(i)^{\frac{\theta-2}{\theta}} EXP_t}{\left[\sum_i y_t(i)^{\frac{\theta-1}{\theta}}\right]^2} = \frac{W_t}{A}$$

for all firms $i = 1, 2, ..., N_t$ can be simplified by imposing imposing the symmetry of the Cournot equilibrium. This generates the individual output:

$$y_t = \frac{(\theta-1)(N_t-1)\ A\ EXP_t}{\theta N_t^2 W_t} \quad (17)$$

Substituting into 14, one obtains the equilibrium price $p_t = \mu^C(\theta, N_t)\frac{W_t}{A}$, where

$$\mu^C(\theta, N_t) = \frac{\theta N_t}{(\theta-1)(N_t-1)} \quad (18)$$

is the markup under Cournot competition. Note that the markup is decreasing in the degree of substitutability between products θ, and in the number of competitors. Finally, only when $N_t \to \infty$ the markup tends to $\mu^{MC}(\theta) = \frac{\theta}{(\theta-1)}$, the markup under monopolistic competition.

3.6 Aggregation and Market Clearing

The aggregate supply of labor reads as $L_t^s = \int z_t l_t \mathtt{d}\lambda_t = 1$, where $l_t = 1$ for all households and in any t. The aggregate labor demand is, instead, the sum of the labor used for production purposes $L_t^c = N_t l_t^c$, where we impose symmetry of the firms' labor demand, and that used to create new firms $L_t^e = N_t^e \phi_t$. Thus, labor market clearing requires that

$$L_t^c + L_t^e = 1.$$

The equilibrium in the stock market requires $\int s_t \mathtt{d}\lambda_t = 1$. Finally, by aggregating the individual household budget constraints defined in equation 10 and imposing the clearing of labor and asset markets, we obtain the aggregate accounting relationship as

$$C_t + V_t N_t^e = w_t L_t + d_t N_t,$$

where $C_t = \int c_t \mathtt{d}\lambda_t$ is aggregate consumption. Note that $V_t N_t^e$ represents the value of total investment. The aggregate accounting relationship states that the sum of consumption and investment must equal GDP, that is, the sum between labor and dividend income.

4 Equilibrium and Calibration

The definition of equilibrium changes slightly depending on whether we consider the stationary or recursive equilibrium. A *stationary equilibrium* is characterized by two time-invariant policy functions $g^s(s,z)$ and $g^c(s,z)$, a set of constant aggregate variables $\Omega = \{N,\ N^e,\ V,\ \mu,\ \pi,\ Y,\ w,\ L^c,\ L^e\}$, and the distribution of agents $\lambda(s,z)$, such that

1. given the aggregate variables in Ω, the policy functions $g^s(s,z)$ and $g^c(s,z)$ solve the household problem defined by equations 11 and 10;

2. the aggregate variables in Ω satisfy the firms' optimality conditions; and

3. the markets clear and the entry condition 12 is satisfied.

Distribution $\lambda(s,z)$ is the ergodic distribution implied by the exogenous transition matrix for labor productivity Ψ and policy function $g^s(s,z)$. It contains the fraction of agents in each wealth-productivity state along the cross-sectional dimension and gives the share of time that each agent spends in each state along the time-series dimension.

To assess the aggregate and distributional implications of a rise in entry costs, we simulate the deterministic transition from the initial to the final stationary equilibrium, characterized by a higher sunk entry cost. The timing is as follows: at time $t = 0$, the economy is in the initial steady state, with the entry cost increasing at the end of the period, and at time $t = 1$, the economy starts transiting to the final steady state.

Given the deterministic sequence of units of labor necessary to set up a firm $\{\phi_t\}_{t=0}^{\infty}$ and the initial (steady state) distribution of agents $\lambda_0(s,z)$, the *recursive equilibrium* is characterized by a sequence of policy functions $\{g_t^s(s,z),\ g_t^c(s,z)\}_{t=0}^{\infty}$, aggregate variables $\Omega_t = \{N_t,\ N_t^e,\ V_t,\ \mu_t,\ \pi_t,\ Y_t,\ w_t,\ L_t^c,\ L_t^e\}_{t=0}^{\infty}$ and distributions $\{\lambda_t(s,z)\}_{t=0}^{\infty}$ such that, in every period t, we have as follows:

1. Given the aggregate quantities Ω_t, the policy functions $g_t^s(s,z)$ and $g_t^c(s,z)$ solve the household problem defined by equations 11 and 10,

2. the aggregate variables in Ω_t satisfy the firms' optimality conditions,

3. the markets clear and the entry condition 12 is satisfied, and

4. distribution $\lambda_t(s,z)$ evolves according to $\lambda_{t+1}(s,z) = P\ \lambda_t(s,z)$ where P is a transition function defined by the saving policy function $g_t^s(s,z)$ and the exogenous transition matrix for the productivity process Ψ.

We numerically solve for the stationary equilibrium of the model using a discretization of the state space. Specifically, we solve the households' problem by adopting the endogenous grid method developed by Carroll (2006) and approximating the policy functions through linear splines. Our solution algorithm takes into account non-linearities and uncertainty in idiosyncratic dynamics.[16]

Table 1 reports the parameters' value; note that a period corresponds to a year. The parameters affecting preferences take standard values. The discount factor is set to $\beta = 0.96$, and the risk aversion is $\gamma = 1.5$. The intrasectoral elasticity of substitution is $\theta = 9$, which, in the absence of strategic interactions, would lead to a markup equal to 12.5%.

The firms' exit probability, δ, is set to match the U.S. financial wealth to GDP ratio implied by the SCF in 1989, which is 3.14. The implied value is $\delta = 0.043$, which is midway between the average annual exit rate of firms, 0.068, and that of establishments, 0.037, in the Business Dynamic Statistics (BDS) database between 1976 and 2013.[17]

The parameters affecting the asset space are as follows. In agreement with the no-short selling constraint, the minimum individual number of shares is 0. The maximum (25) is chosen not to be binding in any state of the world. To approximate the policy functions, we use 500 exponentially spaced nodes in this interval; the grid used for the distribution is equispaced and finer (5000 nodes).

The parameters characterizing the AR(1) process for (the log of) labor productivity are the ones estimated by Krueger, Mitman, and Perri (2016) using the

[16] We provide a detailed description of the solution algorithm in the online appendix.

[17] The BDS database is provided by the US Census and covers approximately 98% of the US nonfarm private sector employment. This is based on the Longitudinal Business Database (LBD) and contains information on the establishment-level job flows and employment stock for continuing as well as entering and exiting establishments at an annual frequency for the 1976–2013 period.

Panel Study of Income Dynamics (PSID) data.[18] The autoregressive coefficient is $\rho = 0.9695$ and the variance of the earnings process is $\sigma^2 = 0.0384$. We choose the Rouwenhorst method to discretize the stochastic process for productivity.

Special care must be taken when calibrating entry costs, which represent one of the main determinants of the degree of market power and the forcing variable in our experiment at evaluating the macroeconomic implications of a rise in market power. We set the units of labor necessary to set up a firm so that the endogenous price markup equals the average price markup estimated across the U.S. industries for 1989.

Table 1: Model Parameters

Parameter	*Description*	*Value*
β	discount factor	0.96
γ	relative risk aversion	1.5
η	intersectoral elasticity of substitution	1
θ	intrasectoral elasticity of substitution	9
δ	exit probability	0.0429
ρ	persistence of the productivity process	0.9695
σ^2	variance of the productivity process	0.0384
ϕ^I	pre-reform entry cost	0.45
ϕ^F	post-reform entry cost	0.71

Notes: One period corresponds to one year

We then compute the ergodic wealth and income distributions implied by the model. We choose 1989 as the initial year because this is the earliest year when the Survey of Consumer Finances (SCF) is publicly available. The SCF is a special survey conducted by the National Opinion Research Center at the University of Chicago. This survey has several important features for our analysis. First, it is among the few datasets containing details about the wealth distribution. Additionally, as discussed by Kuhn and Ríos-Rull (2016), the survey's sample size of over 6,000 households is much smaller than that of other surveys, such as the Current Population Survey (CPS), which has a sample size of 60,000 households. Despite its small sample size, the SCF takes particular care to represent the upper tail of the wealth distribution by oversampling rich households. This unique sampling scheme makes the SCF particularly appropriate for discussing earnings,

[18] Given the inelastic supply of labor, the wage per efficiency unit is the same for every agent. Thus, the earnings and labor productivity processes have the same persistence and variance.

income, and wealth concentration. We consider the empirical distributions of income and wealth, as well as concentration indexes, from the analysis of the SCF conducted by Kuhn and Ríos-Rull (2016). In the case of income, we also report data coming from the CPS. We set entry costs in 1989 such that the price markup equals 1.27, which is the value estimated by De Loecker, Eeckhout, and Unger (2020) for the United States.

As mentioned above, we then simulate an increase in market power spreading from an increase in barriers to entry. Since we have no time series measuring entry costs, we do not have clear guidance to set them. For this reason, in the baseline scenario, we take a neutral approach and assume that the entry costs jumped once and for all at the end of 1989 so that in 2007 the implied price markup is equal to the one estimated by De Loecker, Eeckhout, and Unger (2020) for that year, which equals 1.32.

Edmond, Midrigan, and Xu (2018) provide alternative estimates for the evolution of the price of markup in the United States with respect to those by De Loecker, Eeckhout, and Unger (2020). According to their estimates, the markup was 1.22 in 1989 and increased to 1.25 in 2007. Using their estimates in the baseline experiment has just limited quantitative effects on our results.[19]

In an alternative experiment we, instead, impose more structure on the evolution of entry barriers over time and assume that entry costs increased gradually between 1989 and 2007.[20] We provide a detailed description of the alternative experiment and its results in the Appendix.

In the next section, we evaluate the ability of our model at matching the U.S. distributions of wealth and income observed in 1989. Then we will run our experiment and assess the macroeconomic, distributional, and welfare implications of a rise in entry costs.

The main analysis is carried out under Cournot competition. Notice that, for a given price markup, Bertrand and Cournot deliver the same distributions of wealth and income. The Appendix shows that holding fixed the entry costs across market structures, the price markup will be lower under Bertrand, which is a more

[19] Please see the Appendix for this robustness exercise.

[20] Alternatively, we could have calibrated the evolution of entry costs to match the observed decline in the number of listed firms. However, our calibration strategy delivers a decline in the number of public firms which is quantitatively very close to that observed in U.S. data. Since the markup is a function of the number of firms in our model, the alternative calibration strategy would deliver very similar results to those implied by the benchmark one.

competitive market structure than Cournot.[21]

5 Income and Wealth Distributions

Tables 2 and 3 report the distribution of wealth and income implied by the model in 1989, and compare them to the actual ones provided by Kuhn and Ríos-Rull (2016), which are based on the SCF in 1989. In the case of income, we also consider figures from the CPS. We report the fraction of net worth and income held by the five quintiles, with more detailed information on the top 5% of the distributions. Finally, in both tables, we report the Gini concentration coefficients of the whole distribution under analysis (Gini All) and for the bottom 99% (Gini 99).

Table 2: Wealth distribution in 1989 - Cournot competition and US data.

Wealth	*Quintiles*					*Top 5%*		*Concentration*	
	Q1	*Q2*	*Q3*	*Q4*	*Q5*	*95-99%*	*1%*	*Gini 99*	*Gini All*
SCF 89	-0.2	1.2	5.2	13	80.7	24.3	29.9	0.72	0.79
Model 89	0	0.9	5.7	18.4	74.9	24.2	11.2	0.712	0.726

Matching the empirical wealth distribution and its concentration in Bewley-Aiyagari models is challenging. While these models can generate substantial differences in asset holdings, they fall short of accounting for the high concentration of wealth observed in U.S. data, specifically for the high fraction of wealth held by households in the top 1%.[22] Our framework is not exempt from this criticism. Indeed, while it essentially matches the wealth concentration of the bottom 99% of

[21] Vives (1999) provides the following intuitive explanation to support this view. In Cournot competition, each firm expects the others to cut prices in response to price cuts, while in Bertrand competition the firm expects the others to maintain their prices; therefore Cournot penalizes price-cutting more.

[22] De Nardi and Fella (2017) and Quadrini and Ríos-Rull (2015) discuss mechanisms which provide additional incentives to save, besides the precautionary savings motive, and enable the model to replicate the data. They argue that bequests are a key determinant of inequality, and careful modelling of bequests is vital to understand wealth concentration. Entrepreneurs constitute a large fraction of the very rich, and those models that explicitly consider the entrepreneurial saving decision succeed in increasing wealth concentration, especially at the top. The latter is the route taken by Boar and Midrigan (2019). Additionally, random capital gains, government programs to guarantee a minimum level of consumption, and changes in health and marital status are relevant factors to consider in order to reproduce the right tail of the empirical distribution of wealth in the United States.

the actual U.S. wealth distribution and assigns a large fraction of the total wealth to the richest 5%, it falls short of explaining the fraction of wealth held by the top 1%. In the data, the latter amounts to about 30% of the overall net worth, whereas the corresponding figure in the model is 11%.

Table 3: Income distribution in 1989 - Cournot competition and US data.

Income	*Quintiles*					*Top 5%*		*Concentration*	
	Q1	*Q2*	*Q3*	*Q4*	*Q5*	*95-99%*	*1%*	*Gini 99*	*Gini All*
SCF 89	2.6	7	12.5	20	57.8	15	17.1	0.46	0.53
CPS	3.8	9.5	15.8	24	46.8	18.9		-	0.43
Model 89	5.1	10.3	15.2	23.2	46.2	12.6	4.9	0.447	0.455

The model fits the distribution of income well. Households in the bottom three quintiles of the income distribution earn about 30% of total income, while those in the top quintile earn a fraction equal to 46.2%. These figures are remarkably close to those extracted from the CPS.

There is a non-negligible difference between the fraction of income assigned to the top 5% of earners between the SCF and the CPS. The former assigns to the top 5% a fraction of total income equal to 32.1%, while the latter a share of 18.9%, that our model gauges quite accurately. To understand this difference, recall that the two surveys adopt a different definition of a household and that the SCF oversamples among the very wealthy. In the next section, we assess the macroeconomic, distributional, and welfare effects of an increase in entry costs which restrict competition.

6 The Macroeconomic Effects of an Increase in Entry Costs

6.1 Macroeconomic Variables

We now evaluate whether, in response to an increase in entry costs, our model can account for the trends described in section 2 and the effects of those trends on income and wealth inequality. As mentioned above, we assume that the entry costs jumped once and for all at the end of 1989 so that in 2007 the implied price markup is equal to the one estimated by De Loecker, Eeckhout, and Unger (2020) for that year. Panels a)-d) in Figure 5 displays, respectively, the resulting trends in the price markup, the number of firms, the stock market capitalization to GDP

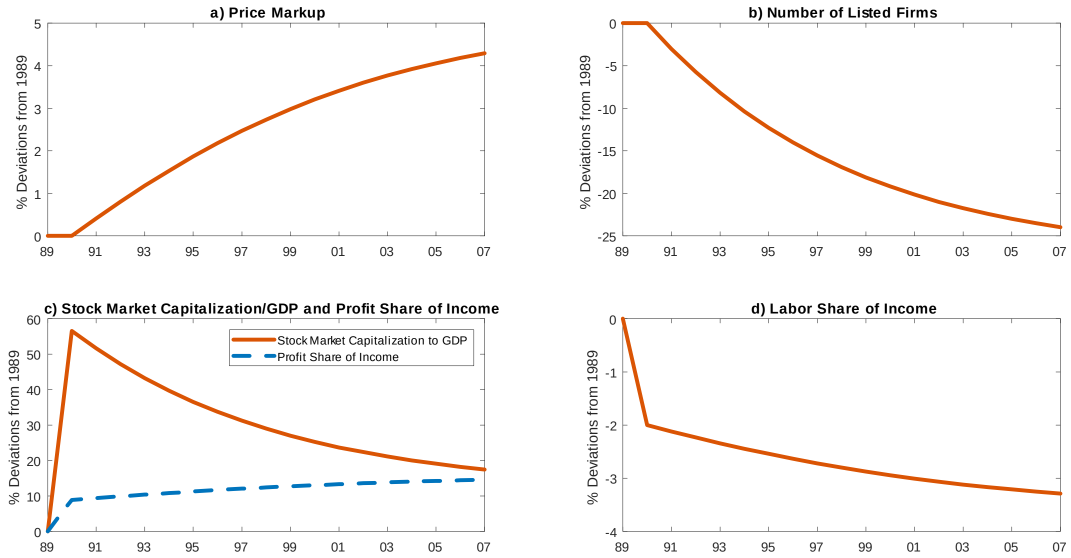

Figure 5: Dynamics of the main macroeconomic variables between 1989 and 2007 One-time increase in entry costs.

ratio and the profits share, and the labor share of income. They represent the model-equivalent of Figures 1-3, relative to U.S. data, reported in section 2.

The model successfully reproduces the pattern of the variables of interest. Panel b) of Figure 5 shows that a sudden increase in entry costs leads to a dampening of the startup rate and, given the constant exit rate, to a gradual reduction in the number of competitors in the market; panel a) shows that, as a result, oligopolistic competition implies a rise in the price markup.

Market power makes firms more profitable. Panel c) displays the trends in the profit share of income and in the ratio between stock market capitalization and GDP. The free entry condition translates the unexpected jump in entry costs into an immediate surge in stock market values. Over time, as profits gradually converge to their new steady state level, the stock market value slowly settles to its new, higher, long-run value. This time pattern stays in contrast with the gradual increase in stock market capitalization observed in the data. Assuming's a gradual, rather than a one-time, increase in entry costs, as we do in the Appendix, stock market values rise persistently, reconciling this model's prediction with the data.

Finally, as a result of the higher ability of firms of extracting profits, the economy experiences a decline in the labor share of income, as depicted in Panel d). Most of the available estimates support the view that the economy-wide labor share has experienced a decline included between 3 to 8 percent since the early

1980s. Our transition experiment features a reduction equal to 3.3 percent in the labor share between 1989 and 2007.

6.2 Distributional Effects

In this section, we evaluate the distributional effects of our transitional experiment. To this end, we first consider the evolution of wealth and income inequality between 1989 and 2007 and then report the long-run distributions implied by the model in response to the change in entry costs. Table 4 shows the distribution of wealth implied by the model in 2007, and compares it to that extracted by Kuhn and Ríos-Rull (2016) from SCF data for the same year.

Table 4: Wealth Distribution in 2007 - Cournot competition and US data.

Wealth	*Quintiles*					*Top*		*Concentration*	
	Q1	*Q2*	*Q3*	*Q4*	*Q5*	*95-99%*	*1%*	*Gini 99*	*Gini All*
SCF 07	-0.2	1.1	4.5	11.2	83.4	26.7	33.6	0.74	0.82
Model 07	0	0.7	5.4	18.2	75.7	24.6	11.4	0.715	0.729

A comparison with 2 shows that, both in the data and in our model, only the wealthiest 20% of the population experienced, between 1989 and 2007, an increase in the share of the total wealth held. The other quintiles of the distribution suffered a decrease in their wealth shares. The model-implied Gini coefficient of wealth concentration rises from 0.726 to 0.729, which represents 10% of the variation in the Gini coefficient extracted from the SCF over the same period.

Turning to income, Table 5 reports the distribution of income in 2007 and compares it to those coming from the SFC and CPS in the same year. The model predicts an increase of the Gini coefficient of income inequality between 1989 and 2007 that represents 20% of the variation in the Gini coefficient extracted from the SCF and 13% of that reported in the CPS.

Table 5: Income distribution in 2007 - Cournot competition and US data

Income	*Quintiles*					*Top*		*Concentration*	
	Q1	*Q2*	*Q3*	*Q4*	*Q5*	*95-99%*	*1%*	*Gini 99*	*Gini All*
SCF 07	6.6	9.7	13.6	17.7	52.5	16.4	16.1	0.47	0.55
CPS	3.4	8.7	14.8	23.4	49.7	21.2		-	0.46
Model 07	4.9	10.3	15.3	23.2	46.2	12.7	4.8	0.451	0.459

The dynamics of the Gini coefficient of wealth inequality during the transi-

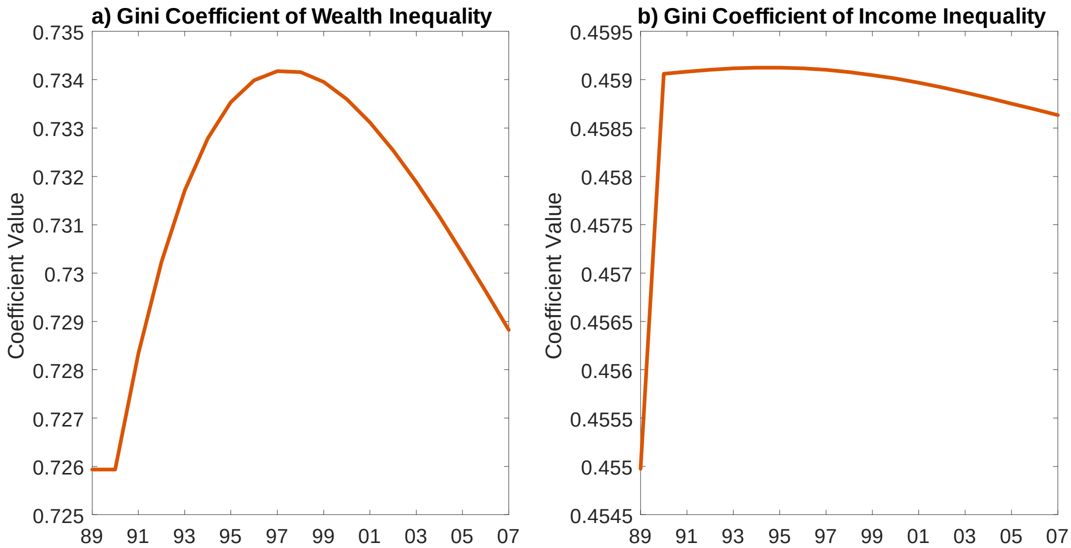

Figure 6: Dynamics of the Gini coefficients of wealth and income inequality between 1989 and 2007. One-time increase in entry costs.

tion between 1989 and 2007 is reported in Panel a) of Figure 6.The jump in the stock market value leads to an immediate fall in stock returns, which depend positively on future profits, and negatively on the current stock market value.[23] The dynamics of the rate of return impacts on wealth accumulation: a lower return, associated with a high stock market price, discourages poor households from saving, reducing stock market participation and further concentrating wealth in the hands of the few at the top. As the stock market value and dividends gradually converge towards their new steady state level, stock returns recover, and so does stock market participation. This explains the inverted U-shape path of the Gini coefficient of wealth inequality.

In the case of a gradual increase in entry costs, considered in the Appendix, the rise in the Gini coefficient of wealth inequality is long-lasting. This suggests that the evolution over time of stock market prices shape wealth dynamics, as pointed out by Kuhn, Schularick, and Steins (2018). Panel b) of Figure 6 shows the Gini coefficient of income concentration. In contrast with wealth inequality, income inequality jumps on impact and then adjusts to a slightly lower level. Notice that the pattern of the Gini coefficient of income inequality resembles that obtained from the CPS, with a sizeable increase at the beginning of the

[23]Remember that the households optimality condition is $U_c(c_t) \geq \beta E_t \frac{(V_{t+1}+d_{t+1})N_{t+1}}{V_t(N_t+N_t^e)} U_c(c_{t+1})$, hence the stock return is defined as $\frac{V_{t+1}+d_{t+1}}{V_t}$.

1990s, initially followed by a slight upward trend, and then by a decrease while approaching 2007. This pattern can be explained as follows. During the transition we described, there is a substantial decline in the labor share of income. This shifts the composition of income from the less concentrated labor income in favor of the more concentrated dividend income. Additionally, the latter becomes more concentrated at the beginning of the transition, since, as described above, wealth concentration initially increases. Both factors contribute to the increase in the overall Gini coefficient of income concentration. The partial reversal in wealth concentration described earlier, and thus in dividend income, explains the decline in the value of the Gini coefficient of income inequality while approaching the last year of the analysis, which is 2007.

Jacobson and Occhino (2012), on the basis of calculations by the Congressional Budget Office, argue that each percentage point decline in the labor share of income implies an increase in the Gini coefficient of approximately 0.15 to 0.33 percentage points. The corresponding figure in during or transition is, on average, 0.25.

Finally, table 6 shows the long-run distributions of wealth and income, assuming that entry costs remain constant at the level required to match the estimated 2007 price markup. The implied long-run price markup is 1.49. Income concentration increases permanently with respect to 1989, while the increase in wealth concentration that we described earlier is only temporary.

Table 6: Long-run income and wealth distributions - Cournot competition

Long Run	*Quintiles*					*Top*		*Concentration*	
	Q1	*Q2*	*Q3*	*Q4*	*Q5*	*95-99%*	*1%*	*Gini 99*	*Gini All*
Wealth	0	1.2	6.4	19.2	73.2	23.3	10.6	0.698	0.711
Income	5	10.2	15.2	23.2	46.4	12.7	4.9	0.45	0.458

6.3 Welfare effects

In this section, we identify winners and losers, in welfare terms, in the aftermath of the increase in barriers to entry. To do so, we compute individual welfare changes, their distribution across the population, and the welfare change experienced by the society as a whole during the transition from the initial to the final steady state.

The welfare level of an agent at time t is measured by her expected lifetime utility, defined as

$$V\left[c_t(s,z)\right]_{t=0}^{\infty} = E_0 \sum_{t=0}^{\infty} \beta^t u\left[c_t(s,z)\right].$$

Notice that consumption is conditional on the agent's states (wealth s, and productivity z). We denote the values assumed by variables in the initial steady state with the superscript 89, to emphasize that they are relative to the 89-calibration of the entry cost; we denote, instead, the values that variables assume during the transition to the new stationary state with the superscript tr, which stands for "transition".

Following Floden (2001), we express the individual welfare change in terms of Consumption Equivalent Variation (CEV), defined as the value of $\omega(s,z)$ that solves:

$$E_0 \sum_{t=0}^{\infty} \beta^t u((1+\omega(s,z))c^{89}(s,z)) = E_0 \sum_{t=0}^{\infty} \beta^t u(c_t^{tr}(s,z).)$$

The constant $\omega(s,z)$ measures the percentage change in lifetime consumption required to make an agent indifferent between remaining in the initial steady state forever and moving to the final steady state. A positive value of $\omega(s,z)$ implies that the rise in market power leads to a welfare gain for that particular individual and vice versa. Since the value of $\omega(s,z)$ is conditional on the initial states, we compute the consumption equivalent for each type of agent, to obtain a cross-sectional distribution of CEVs.

The main result is that the vast majority of households, independent of their initial productivity and wealth, lose during the transition to the high market power steady state associated with barriers to entry. A minority representing 15.8% of the population enjoys a welfare gain in response to lower competition. For those households, financial income is the main source of income, and so an increase in profits has a sizeable impact on their income and consumption.

Figure 7 reports the distribution of CEVs in the productivity-stock holdings space. The vertical axis measures the number of shares (s) held by each individual in the initial steady state, and the horizontal axis reports the productivity levels (z). Hence, each point in this space identifies an agent type. The space is divided into three areas. The areas in grey contain agents that suffer a welfare loss. The darker the shade, the larger is the loss. For the agents in the darkest area, the transition costs amount on average to 5% of their initial steady-state consumption. Although this area extends over a small portion of the productivity-wealth space, it is densely populated, and it comprises more than 40% of households.

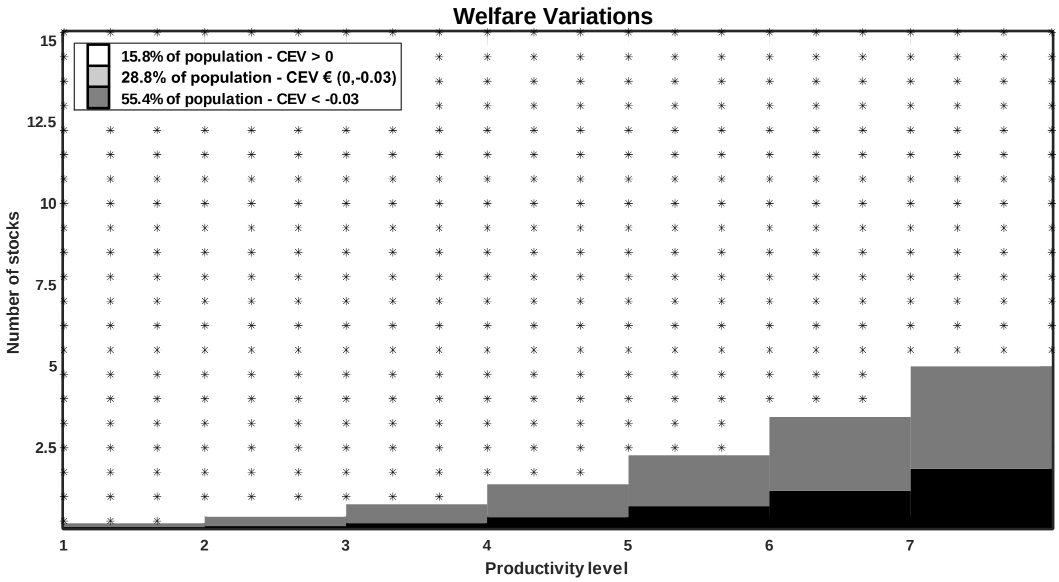

Figure 7: Distribution of CEVs. The white area marked with asterisks includes all agents experiencing a welfare gain. The gray-shaded areas, instead, contain all agents suffering a welfare loss. The darker the shade, the higher the welfare loss.

The white area denoted by a marker (*) includes agents that benefit from the increase in market power. While this area takes up a large portion of the productivity-wealth space, it contains just 15.8% of the population. These agents enjoy an average positive CEV equal to 1.8% of their initial consumption. They are either the wealthy or those with low productivity relative to their asset holdings. In both cases, financial income is their main source of income. For these agents, the increase in dividend income more than offset the decline in labor income and has a positive impact on their consumption.

An indicator of the effect of increased market power on the economy as a whole is given by the *utilitarian social welfare gain,* denoted by ω^u. This represents the average welfare gain in the economy, but can also be interpreted as the ex-ante welfare gain, which is the welfare gain of a newborn who does not yet know her position in the asset-productivity space. The utilitarian social welfare gain is the value of ω^u that solves the following equation:

$$\int E_0 V\left(\{(1+\omega^u)c_t\,(s,z)\}_{t=0}^{\infty}\right) \mathrm{d}\lambda(s,z) = \int E_0 V\left(\left\{(c_t^{tr}\,(s,z)\right\}_{t=0}^{\infty}\right) \mathrm{d}\lambda(s,z).$$

Notice that the term $\int E_0 V\left(\{c_t\,(s,z)\}_{t=0}^{\infty}\right) \mathrm{d}\lambda(s,z)$ represents the utilitarian social welfare, i.e. the average expected lifetime utility computed assigning to each agent the same weight. As additional evidence that an increase in market power is not beneficial for the economy, the social welfare variation attached to our experiment equals -4.5% of aggregate consumption.

The variation in the extent of competition among firms affects contemporaneously the level of aggregate consumption, the distribution of income among households, and the ability of individuals to self-insure against earning shocks through savings. For this reason, we follow Floden (2001) and Domeij and Heathcote (2004) and decompose the utilitarian social welfare variation in three components: an aggregate (or level) component ω_{lev}, an inequality component, ω_{ine}, and an uncertainty component, ω_{unc}.

To disentangle the three components one must compute individual certainty-equivalent consumption $(\bar{c}(s,z))$. This value is such that $V(\{\bar{c}(s,z)\}_{t=0}^{\infty}) = E_0 V(\{c_t(s,z)\}_{t=0}^{\infty})$. It represents the constant amount that an agent should consume in each period from t onwards in order to have the same expected utility as she gets during the transition to the final steady state. The uncertainty component is then measured comparing actual consumption during the transition, $c_t(s,z)$ to the certainty equivalent, $\bar{c}(s,z)$. The inequality component comes from the distribution of the certainty-equivalent across agents. Floden (2001) shows that, for separable utility functions, the following relationship between ω^u and the three components described above holds:[24]

$$1 + \omega^u = (1 + \omega_{lev})(1 + \omega_{unc})(1 + \omega_{inc}).$$

Table 7 displays the decomposition of ω^u in our model.

Table 7: Average welfare gain and its decomposition

	Decomposition of the average welfare gain		
Average welfare Gain ω^u	*Level* ω_{lev}	*Inequality* ω_{inc}	*Uncertainty* ω_{unc}
-3.5%	-2.2%	-1.9%	0.1%

Notes: All components are expressed in percentage of consumption

The level effect of the rise in market power is negative: there are fewer firms, aggregate output is lower and so are aggregate consumption and social welfare.

[24]Since in our model agents do not enjoy utility form leisure, the aggregate effect can also be computed directly comparing the utilitarian social welfare in 1989 to the utilitarian social welfare associated with the transition.

The inequality component is also negative: the shift in the composition of income in favor of financial income leads to a more unequal distribution of resources due to the highly concentrated stock ownership. The overall negative welfare effect is, however, partially mitigated by the positive effect coming from the reduction in consumption uncertainty. Financial income is not subject to risk in our framework. Thus, asset holders experience a reduction in uncertainty regarding their overall income and consumption.

7 Conclusions

This paper links the debate on the decrease in competitiveness and business dynamism in the United States with that on rising inequality. To do so, we build a quantitative framework with strategic interactions between an endogenous number of firms, heterogeneous households, and incomplete markets. The number of producers in each period can be interpreted as the capital stock of the economy, and the decision of households to finance the entry of new firms is akin to the decision to accumulate physical capital in the standard incomplete markets model à la Aiyagari (1994).

An increase in barriers to entry, like that recently documented in the empirical literature, dampens the entry of new firms and leads to a higher price markup, a lower labor share of income, and an increase in the profits share of income. The dynamics of these variables implied by the model in response to the increase in entry costs are consistent with those observed in the United States between 1989 and 2007. Our results support the hypothesis that an increase in market power, and the resulting shift in the distribution of income in favour of profits, contributed, together with other factors, to explain the increase in income and wealth inequality observed in the United States between 1989 and 2007. We find that the contribution is sizeable. Lower competition entails large welfare losses that are unevenly distributed across households. A minority of the population enjoys a welfare gain in response to lower competition. Appropriate fiscal policies, as those considered by Boar and Midrigan (2019) and Mechelli (2019), can reduce the distortions arising from market power and decrease inequality.

In this study, we focused on the extensive margin of competition, which is related to the number of competitors in the market. In ongoing research, we extend the framework to account for firms' heterogeneity, especially for large firms. This allows for disentangling the effects of variations in the intensive and extensive margins of competition on the distributions of income and wealth.

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A Robustness Appendix

In this Appendix, we provide some robustness checks. The first subsection discusses the results we obtain using as a benchmark the markup estimates by Edmond, Midrigan, and Xu (2018). In the second section we assume a gradual increase in barriers to entry rather than a sudden increase as in the main text. The third subsection considers Betrand competition.

A.1 Alternative Markups Estimates

In this Appendix we report the results of our baseline experiment using the alternative markup estimates provided by Edmond, Midrigan, and Xu (2018). As Figure A1 shows, our results are robust to the use of their markup series. While there are differences in the levels, the trends in the variables of interest are roughly identical to those in the main text.

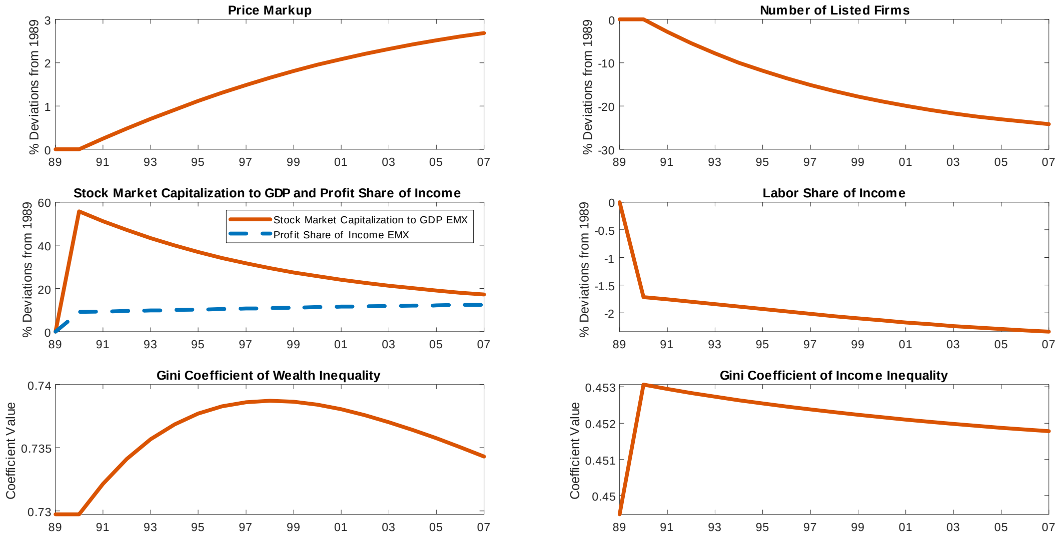

Figure A1: Dynamic of the main macroeconomic variables between 1989 and 2007. One-time increase in entry costs to replicate the markup estimates by Edmond, Midrigan, and Xu (2018).

A.2 Alternative Transition Experiment

This section displays the dynamics of the variables of interest in response to a gradual increase in the entry costs. We consider the markup estimates by De Loecker, Eeckhout, and Unger (2020) and assume that the price markup grew linearly over

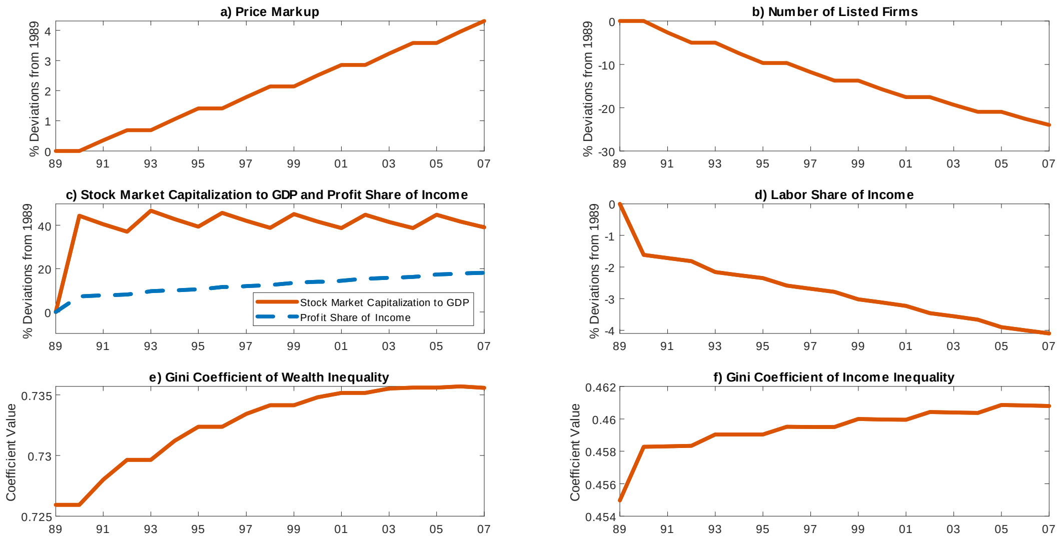

Figure A2: Dynamics of the main macroeconomic variables between 1989 and 2007. Gradual increase in entry costs.

time between the values estimated in 1989 and 2007. We then design a gradual increase in entry costs aimed at matching the linear time trend in the price markup starting from 1989. More specifically, we simulate shocks to the entry cost parameter every 3 years - i.e. at the end of 1989, end of 1992, end of 1995 and so forth. The shocks are such that the endogenous markup reaches the value predicted by the linear trend three years after the shock.[25] Notice that the two experiments, the one in the main text and the one here, feature the same price markups in 1989 and 2007, hence the distributions of wealth and income in those years are identical across experiments and are reported in Tables 2-5 in the main text. The main difference with respect to the dynamics reported in the main text concerns the path of the capitalization to GDP ratio. Differently to what observed in the baseline experiment, the stock market capitalization to GDP ratio raises persistently, as does the stock market value of incumbent firms. Thus, in line with the empirical evidence presented by Gutiérrez and Philippon (2019), during our transitional experiment the entry rate decreases as the value of incumbent firms increases. The Gini coefficients of wealth and income concentration, reported, respectively, in Panel e) and Panel f) of Figure A2, show dynamics similar to those observed in the main text. However, a relevant difference is in the persistence of the Gini coefficient of wealth concentration. The latter reverts to its steady state

[25] We cannot match the trend in the price markup every year since the model features state variables that require time to adjust after a shock.

value at a much lower speed with respedct to what experienced in the baseline experiment. This is, again, due to the persistent rise in stock market values implied by a gradual increase in entry costs.

A.3 Bertrand Competition

Under Bertrand competition, each firm i chooses the price $p_t(i)$ to maximize profits, taking as given the price of other firms. As in Cournot competition, the symmetric equilibrium price p_t must satisfy $p_t = \mu^B(\theta, N_t)\frac{W_t}{A}$ where the markup in this case reads as

$$\mu^B(\theta, N_t) = \frac{1 + \theta(N_t - 1)}{(\theta - 1)(N_t - 1)}$$

For a given price markup, Cournot and Bertrand imply the same steady state distributions of wealth and income. For a given entry cost, instead, Bertrand leads to a lower equilibrium number of firms and to a lower price markup than Cournot. This is so since Bertrand is a more competitive market structure. This implies a lower return from asset holdings, which in turn leads to lower financial market participation. For this reason, the fraction of wealth in the hand of the top 1% of the wealth distribution is slightly larger under Bertrand than under Cournot. The lower price markup implies a lower dividend income and thus a lower fraction of income accruing to the top of the income distribution. These effects are illustrated in Table 8, which reports the income and wealth distributions under Bertrand, assuming the same entry costs we calibrated under Cournot competition for 1989.[26] Thus, these distributions should be compared to the empirical ones in 1989 displayed in Table 2 and Table 3.

Table 8: Income and wealth distributions under Bertrand competition

Bertrand	*Quintiles*					*Top*		*Concentration*	
	Q1	*Q2*	*Q3*	*Q4*	*Q5*	*95-99%*	*1%*	*Gini 99*	*Gini All*
Wealth	0	0.4	3.9	16.2	79.5	26.4	13	0.75	0.76
Income	5.1	10.8	15.2	23.4	45.6	12.4	4.8	0.44	0.45

We do not report the dynamics of the main macroeconomic variables and the welfare analysis in response to an increase in entry costs under Bertrand since results are qualitatively and quantitatively similar to those obtained earlier under Cournot. Interested readers can find the material on the Authors' webpages.

[26] Assuming this value for the entry cost under Bertrand competition delivers a markup equal to 1.151 compared to the 1.272 under Cournot.

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