Finance and Inequality: A Tale of Two Tails *

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November 20, 2024

Abstract

We estimate the effects that the different financial deregulations in the U.S. have had on the country's income distribution. We find that the different reforms have moved inequality in drastically different directions. On the one hand, during the late 1970s and early 1980s, the removal of intra- and inter-state branching restrictions and the elimination of state-varying rates ceilings decreased inequality, as they mostly enhanced the incomes of workers in the lower tail of the income distribution. On the other hand, the repeal of the Glass-Steagall Act in 1999 substantially increased inequality, as it mostly –and by large amounts– increased the incomes of workers in the upper tail of the distribution. To explore the mechanisms underlying the different effects, we also examine the responses within and across individuals in different age groups, and compare finance vs non-finance workers. Our findings indicated that models based solely on capital skill complementarities (CSC) are insufficient because they would imply similar responses to all reforms. We construct a model that emphasizes the endogenous changes in the heterogeneous access (and choices) of households' financial products. The model naturally explains how the different deregulations impacted the opposite tails of the income distribution by capturing the changes in the financial markets available to households of different incomes and characteristics.

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All views and opinions expressed here are the authors' and do not necessarily reflect those of the Federal Reserve Bank of St. Louis or the Federal Reserve System. We thank conference and seminar participants at various places for helpful comments, and gratefully acknowledge financial support from various sources: Alexander Ludwig of Research Center SAFE, funded by the State of Hessen initiative for research LOEWE; Ctirad Slavík of the Grant Agency of the Czech Republic, grant number 17-27676S, as well of Charles University, PRIMUS project Primus/HUM/37; Alexander Monge-Naranjo and Ctirad Slavik of the EUI Widening Grant 2024.

1 Introduction

Income inequality across American workers has increased substantially over the last decades. As a matter of fact, the Gini coefficient on total earnings climbed from just 0.31 in the early 1960s to a much higher 0.38 in 2016.[1] In the meantime, the finance sector in the U.S. also grew dramatically. For instance, the share of finance and insurace (FI) firms of the total profits in the U.S. was only 10% in the 1950s. Today, their share is almost 30%.[2] The growing trends of finance and inequality and their relationship to the different waves of financial deregulation observed in the country since the late 1970s has motivated an extensive and seemingly conflicted literature.[3] In this paper, we revisit the evidence, provide novel results, explore the alternative mechanisms linking finance with overall income inequality and construct a theoretical model that embeds the different mechanisms underlying the conflicting results in the literature.

Instead of just a singular episode, in this paper we look at the three major waves of financial deregulation that have taken place in the U.S. economy from the mid-1970s to the early 2000s. The first major wave of deregulation is the removal of branching restrictions (RBR). During a period spanning from the mid- 1970s until the mid- 1980s, the U.S. states removed restrictions on both intra- and inter-state bank branching.[4] Notably, as we discuss below, RBR was inherently cross-state heterogeneous, because different states enacted the policy at different times. The second wave of deregulation took place in the 1980s, when a federal law removed the state-level ceilings (RSC) on interest rates for all states. Interest rate ceilings aim to preclude lenders to abuse monopoly power and charge usury rates on the different types of loans or borrowers. Prior to 1980, interest rates ceilings for most types of consumer and commercial loans were set by each state. The overall surge of inflation and nominal interest rates in the country during the 1970s led to these interest rate ceilings to be binding in some states but not in others.[5] In 1980, a federal policy preempted the states to impose those ceilings, replacing the state-specific ceilings for country-wide uniform, federal ceilings. With RSC, the country moved from a situation with cross-state heterogeneity, as the interest rates ceilings were binding in some states but not in others, to a situation in which this cross-state heterogeneity was eliminated. The third major deregulation took

[1] See Section 2 for a detailed discussion of the data sources and additional measures.

[2] See de la Grandville (2017).

[3] Some researchers argue that financial deregulation decreased inequality (cf., e.g. Beck, Levine, and Levkov (2010)), while others argue that it increased it (cf., e.g., Philippon and Reshef (2012) and Jerzmanowski and Nabar (2013))

[4] Strahan (2003) details how these deregulations varied from allowing intra-state bank branching via mergers and acquisitions to unrestricted branching across states.

[5] For a summary on the impact of usury ceilings, see Vandenbrink (1982) and the references therein.

place in 1999, when the Gramm-Leach-Bliley Act repealed the Glass-Steagall Banking Act of 1933 (RGS), allowing commercial banking to be integrated with investment banking and insurance activities. While RGS took place in the same year for all states, its impact must have been heterogenous in light of the substantial variation in the incidence of FI across the U.S. states.

We exploit cross-state variation to identify the effects of these major deregulations on the income distribution in the U.S. economy. First, the effects of RBR on the income distribution and on the income of different workers can be naturally identified exploiting the fact that different states enacted the removal of branching regulations at different times. The variation on measures of income dispersion associated with cross-state RBR variations can be separated from state and year effects, as already done by Beck, Levine, and Levkov (2010). Second, the effects of RSC on the incomes of different workers can also be identified by exploiting the fact that the interest rate ceilings were binding in some states but not in others. We focus on usury rate ceilings on mortgage loans in 1980 as reported in Vandenbrink (1985) and compare these with the 30-year mortgage rate to determine whether an interest rate ceiling was binding. The movement from heterogenous to common interest rate ceilings allows use to separate the impact of RBR by comparing the variation of similar workers across states, after controlling for fixed-state and common-year effects. Finally, for RGS, we exploit the substantial variation in the employment share in the FI sectors across states as observed in 1999, prior to the reform. Our identification assumption in this case is that the effect of the RGS on the incomes of workers or on the measure of inequality is directly related to the share of employment of the state in FI. Under this assumption, we can separate the effect of RGS from other variations driven by fixed-state and common-year effects. Obviously, the validity of our identification of the causal effects of the three reforms on inequality requires that the indicators of financial deregulation in each state are not determined by the income inequality in the state. We verify that this condition holds in the data.

Our main source of data on incomes (and control variables) is the U.S. Current Population Survey (CPS). Our measurement of an individual's income is based on his total pre-tax annual earnings, i.e. including all income sources except asset income. We use standard measures of income inequality, such as the Gini coefficient, the Theil index, and the logs of the ratio between the incomes of individuals in the top 90^{th} percentile and the bottom 10^{th} percentile. To measure top-income inequality we use the log of the ratio of incomes between the 90^{th} and the 75^{th} percentile individuals; to measure bottom-income inequality, we use the log of the ratio of the incomes at the 25^{th} and the 10^{th} percentiles. We also use more disaggregated measures, including the incomes of individuals within narrowly defined categories, e.g. income percentiles, deciles or quartiles. For both, overall measures of inequality and for the impact on incomes of narrowly defined groups of workers, we conduct panel regressions using dummy variables for the reforms—or, in case of RGS, on interactions between the RGS dummy with the state FI employment shares. All regressions control for a number of variables—discussed below— including fixed-state and common-year effects.

We find that different reforms have moved inequality in opposite directions. First, the removal of branching restrictions, i.e. RBR, significantly reduced income inequality. We find a significant and substantial reduction in all overall measures of inequality. We show that the implied reduction in inequality is driven by a positive impact in the incomes of workers in the lower tail of the distribution, while leaving unaffected the incomes of workers in the upper tail of the distribution.[6] Second, the removal of interest rate ceilings at the state level, i.e. RSC, had a positive effect for all workers, but the effects were decreasing with income of the worker. In general, there is some decrease in inequality associated with RSC, but the effects are not statistically significant. Third, the repeal of the Glass-Steagal act, RGS, increased overall income inequality. We find that RGS has a substantial and statistically significant positive effect on the incomes of workers in the upper percentiles of the income distribution.[7] To gauge a general sense of the quantitative impacts of those reforms, RBR can be associated to a reduction in the Theil index of 3.7%, RSC to a reduction in the Theil index of by 3%, and RGS to an rise in the Theil index by 7.5%. All in all, the rise associated to RGS more than compensates the joint reductions associated to RBR and RSC, but concluding that financial liberalization is necessarily associated to higher income inequality would be a substantial mistake. Instead, we argue that the specifics of the different reforms must be fully accounted for to understand whether the effects of a financial market deregulation would affect more the lower or the upper tails of the distributions.

We investigate the underlying mechanisms by which the different reforms have impacted the income distribution. First, we look whether the effects are simply driven by a direct effect on the workers in the industry that is being deregulated, finance. To this end, we group workers into two groups: workers in FI and workers in all other sectors (which we label NFI.) For each year and state, we decompose the Theil index of inequality into between and within group components. In general, we find that the major impact of the reforms is on within-group inequality, and not between FI and NFI. Yet, we find that the relative importance of between- vs within-groups effects varies across the reforms. While the between-group effects are very small for RBR and RSC, they account for a more sizeable 22% of the total

[6]Thus, as we discuss further below, our results confirm the earlier findings by Beck, Levine, and Levkov (2010).

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increase in inequality associated to RGS.[8] Aa a first general conclusion, we argue that general equilibrium mechanisms are crucial to explain the responses for workers outside finance and must be operating, for example, to rationalize the positive effect of RBR observed on the lower tail of the income distribution within NFI, as well as the positive effect of RGS observed in the upper tail of the distribution of NFI. Hence, focusing only on workers in FI would potentially miss the key impact of finance on inequality. A second general conclusion is that the specifics of the different reforms must explain the difference not only in the direction of the impact on inequality but also on the relative importance of the shifts in the demand for different types of workers and their incentives to accumulate labor market skills.

All in all, our empirical estimates indicate that capital-skill complementarity (CSC), a leading mechanism in the literature on inequality, is not only insufficient but also misleading for understanding the effects of financial liberalization on the distribution of income distribution. Under CSC, changes in the access and cost of capital for firms would lead to changes in the relative demand and equilibrium prices of the different labor market skills. Thus, models based solely on CSC predict that all deregulations would have increased the incomes in the right tail of the distribution and overall inequality. CSC can explain the observed response to the third deregulation, RGS, but would be at odds with the responses to the other two, RBR and RSC.

We construct a general equilibrium model with two production sectors—finance and non-finance—and many different types of workers. Financial markets not only affect the capital and labor demand decisions of firms but also the workers' labor market skill formation. Workers of all types are endogenously sorted out across different occupations, and all occupations are employed by both sectors but with different intensities. Thus, the general equilibrium of the model can account for the changes in the relative size of the financial sector, can account for the differential impact of capital across the different occupations and allows for rich worker heterogeneity to account for the differential responses to the different reforms. A key component of our model is that workers endogenously sort out among the different financial contractual options, and, on the basis of this endogenous selection, the predicted response of the model for the different forms of deregulation varies for workers in different segments of the income distribution.

In our model, the production in both finance and non-finance takes place according to nested CES production functions. For each sector, the outer CES function determines the intensity in the use of a large but finite number of tasks. For each task, the inner CES functions combine one type of labor with physical capital. An expansion of finance relative to non-finance would drive upwards the relative price of the tasks intensively used in finance,

[8] As shown below, the between-effect is even higher if we look 5 years after the RSC reform.

i.e. a Stolper-Samuelson mechanism. A decline in the cost of capital would drive upwards the price of worker skills that complement capital and drive downwards those of the skills that substitute capital, i.e. a multidimensional CSC mechanism.

The aggregate supplies of labor market skills are determined by investment and occupation choices of workers. We allow for rich worker heterogeneity along two dimensions: absolute and comparative advantage of their talents or pre-determined skills. Absolute advantage determines a fixed component of the earnings that a worker would obtain across all of the many occupations. Comparative advantage determines a vector of components specific to each worker type and occupation. We assume that each worker draws iid idiosyncratic productivity shocks for each occupation. By assuming that these shocks are Type II extreme distributed, we end up with fairly tractable expressions for the propensity of each worker to be assigned into each occupation and sector, as well as for the aggregate supply of skills and for the distribution of income.

In our environment, finance firms intermediate capital to non-finance firms and to workers. Factor prices and financial market regulations endogenously determine the operation costs of financial firms, and these costs are transferred to non-finance firms and workers. To capture the U.S. credit markets in the early 1970s, we assume a simple dual local and national structure for financial markets. Specifically, all households have direct contact with a local bank that acts as a monopolist in that market. Households—and firms—only participating in local markets are offered contracts that are designed to maximize the expected net payoff of the bank. In the opposite extreme, national markets are competitive, and households and firms receive contracts that maximize their expected utility subject to the condition that banks break even in expectation. To access national markets, however, households or firms must incur a fixed cost. Finally, lending contracts can vary in their complexity. We assume two simple extremes. On the one hand, contracts can be 'generic': based on limited information, their payout structure is simple and non-contingent, and hence, subject to default. On the other hand, contracts can be 'personalized': by investing more on acquiring information and monitoring the outcomes of the borrower, the payout of these loans can be made state-contingent. In both cases, financial contracts are subject to limited commitment.

The general equilibrium of the model endogenously generates the financial markets participation of workers and the type of contracts chosen. These choices will also determine the probability distribution of the labor market skills and the occupation choices of all workers, as well as the aggregate levels and the equilibrium price of skills. The equilibrium also determines the assignment of workers across finance and non-finance sectors, the cost of capital and all other terms of the financial contracts. Since the model allows for rich heterogeneity of in the absolute and comparative talents of workers, it can be calibrated so that, its equilibrium replicates the income distribution observed in the U.S. in years before each of the three main deregulations.

The richness of the model allows us to examine its equilibrium responses to regulatory changes that closely mimic the ones observed in the U.S. from the mid-1970s to the early 2000s. First, as discussed already and expanded further below, the key aspect of the RBR is that it enhanced the competitiveness of local banking markets. We model this change by assuming that those markets moved from monopolistic to competitive. Then, in the model, local financial contracts move from giving all the surplus to the banks to giving it to the lenders. Second, the key aspect of RSC is that it eliminates an upper limit on the in the interest rate on contracts. In the model, this is a constraint that, if at all, would bind for local, generic lending contracts, and this would happen more often when local markets are monopolized. Third, the RGS would reduce the cost of introducing insurance and investment banking features into banking contracts. We capture this change in the model with a reduction in setup cost of personalized contracts.

At a qualitative level (quantitative work is ongoing), our model easily replicates responses in line with our estimated effects. First, RBR impacts mostly the income of workers in the lower tail of the distribution. In equilibrium, those were the workers who ended up in monopolized local markets. When those markets become competitive, the better terms in their lending contracts induce these workers to boost the formation of skills and other income-enhancing activities. Workers at the higher income levels, certainly those in the upper tail of the distribution, are not directly impacted since they were either already in the national competitive markets or considering moving there.[9]

Second, the impact of RSC on the distribution of income can be very minor in the model because of two reasons. First, interest rate ceilings may bind only sparingly. Second, if binding, the removal of the ceiling may have minor and even ambiguous effects on the skill accumulation. Moreover, the relevance of RSC may be been diminished in light of the fact that RBR was already implemented in some states and foreseen in others, and hence, local banking markets may have been already more competitive.

Third, the impact of RGS is mostly on the upper tail of the income distribution. In equilibrium, high-income workers self-select into national competitive markets, and those in the very top of the distribution are already in personalized contracts. When the cost of personalized contracts go down, then more of the rich workers choose them, and those who were already there would get better terms. In both cases, the key result is that their skill formation and any other income-enhancing activities will be increased for those workers.

[9]The participation constraint of very poor is autarky; the participation constraint of a richer worker would be paying the cost and moving to a competitive market.

Naturally, RGS does not directly affect workers in the lower tail of the distribution when they are not close to choosing a personalized contract.

In all those cases, our model predicts an expansion of the finance sector. Since finance is high-skill intensive, the general equilibrium response is an increase in the revenue of high-skill workers. Moreover, if these deregulations also carry a reduction in the cost of intermediation, then capital deepening would unleash the forces of capital-skill complementarity. These general equilibrium forces in the demand for skills would interact with the skill decisions of workers. They reinforce the direction of impacts for RGS and but only partially counteract those of RBR and RSC.

Related Literature This paper relates to a vast literature on the economic effects of financial deregulation, which studies the impact of banking deregulation on economic growth (Jayaratne and Strahan 1996; Huang 2008; Freeman 2002) entrepreneurship (Black and Strahan 2002; Kerr and Nanda 2011; Wall 2003), economic volatility and insurance (Morgan, Rime, and Strahan 2004; Demyanyk, Ostergaard, and Sørensen 2007), the wage gap between men and women bank executives (Black and Strahan 2001), CEO behavior and turnover (Hayes, Tian, and Wang 2015) and the banking industry more generally (Granato 2017). Strahan (2003) is an excellent summary article regarding the implications of banking deregulation.[10]

More closely related to our paper is the literature on the relationship between banking deregulation and measures of income inequality. For instance, Philippon and Reshef (2012) document that the level of education as well as relative wages and educational premia in the financial sector correlate strongly with measures of financial deregulation and follow a u-shape over the course of the 20th century.[11] Our perspective is broader in the sense that we focus on inequality measures in the whole economy, similar to Beck, Levine, and Levkov (2010), who studies only the causal effects of bank branching deregulation on income inequality.[12] We extend their analysis by also considering the removal of usury rate ceilings and the repeal of the Glass-Steagall Act. These two reforms have been emphasized by Philippon and Reshef (2012), but their causal impact on income inequality has not previously been studied.

[10] Kroszner and Strahan (1999) study the political determinants of bank branching deregulation, while Keller and Kelly (2015) focus more broadly on the political determinants of financial regulation.

[11] Boustanifar, Grant, and Reshef (2017) provide similar evidence for other countries. Boustanifar (2014), in contrast, argues that wages in the finance industry did not rise in response to bank branching deregulation, but started rising across U.S. states in the 1980s, irrespective of the particular state's deregulation date.

[12] Darcillon (2016) analyzes the relationship between financial regulation and inequality for a sample of 18 OECD countries. Tanndal and Waldenström (2016) provide a similar analysis for the Great Britain and Japan and Luo and Zhu (2014) for China.

Our findings for the repeal of the Glass Steagal Act confirm those of Philippon and Reshef (2012), who find significant effects of deregulation on the upper tail of the income distribution. Philippon and Reshef (2012) construct an index that factors the three different reforms in the same direction. A central argument of our paper is precisely that different forms of liberalization move inequality in different directions. Ignoring this, one would make the misleading conclusion that financial liberalization necessarily increase inequality.

This paper also relates to a large and growing literature on the general trends in income inequality and its sources. Autor and Dorn (2013) emphasize job and wage polarization, i.e., increases of employment shares and hourly wages at both ends of the distribution relative to the middle from the 1980s to 2005. One hypothesis explaining polarization is specialization of labor markets caused by automation, which led to an increase of low-skill service occupations. A related literature exclusively focusses on the rise in top income inequality (the share of income going to the top 10%, 1%, 0.1% of the workforce) since the 1980s, cf., Piketty and Saez (2003) and Atkinson, Piketty, and Saez (2011), most of which can be attributed to increasing labour income inequality.[13] Explanations include the so-called superstar phenomenon (Scheuer and Werning 2017), and entrepreneurial activities (Jones and Kim 2015).

Our contribution to both these strands of literature is to emphasize the role of financial market liberalization for the dynamics of inequality in both tails of the income distribution. One important difference to the literature on job and wage polarization stands out. Unlike that literature—where one event (automation) causes incomes in both tails of the distribution to increase relative to the middle because of spillovers—we emphasize that one group of reforms (bank branching deregulation and the removal of interest rate ceilings) increased incomes in the left tail, whereas another reform (the repeal of the Glass-Steagal Act) increased incomes in the right tail. For neither of these reforms we find spillovers from one tail to the other.

The remainder of this paper proceeds as follows. Section 2 describes our data and Section 3 our empirical strategy. Our main results are presented in Section 4 and Section 8 concludes the paper. A separate appendix contains additional analyses.

[13]See the Top Income and Wealth Database at http://wid.world/.

2 Data on Incomes and Financial Market Reforms

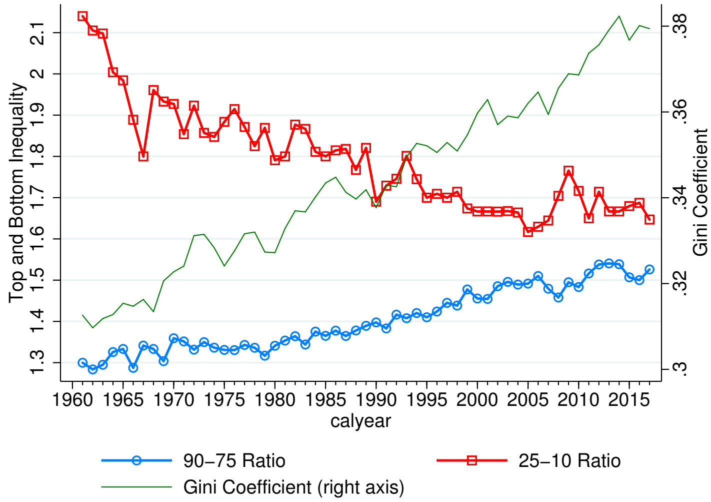
2.1 Income Distribution

Our analysis is based primarily on the March Supplement of the Current Population Survey (CPS). This data includes survey responses from households surveyed annually in March and records information on demographics, labor force status, income, occupation and industry. Our measure of income is total pre-tax annual earnings. We restrict the sample to include employees between the ages of 25 and 55 who report positive earnings and are not in the armed forces. The top and bottom percentile of income earners in each year are dropped along with those having negative sample weights. With these restrictions our final sample includes 2.55 million observations covering information between 1961 and 2017. State of residence information for all states is only consistently available after the 1977 survey. So, our empirical analyses focus on the years 1977 through 2017.[14] Consistent with the literature, see, for example, Black and Strahan (2001), we exclude South Dakota and Delaware from our analysis as the financial sector in these states was heavily influenced by the presence of a large credit card industry.[15] We compute several measures of income inequality including the Gini coefficient, Theil index and ratios of percentiles of income earners. Figure 1 plots the evolution of income inequality in our sample. Top inequality is measured as the ratio of incomes at the top 90^{th} to top 75^{th} percentile, whereas bottom inequality by the ratio of incomes at the bottom 25^{th} to the bottom 10^{th} percentile. While top income inequality has increased since the mid-1980s, bottom income inequality declined sharply in the 1960s declined more steadily to reach a similar level as top income inequality by the late 2000s. The scale on the right axis shows the evolution of the Gini coefficient which has steadily increased in our sample. Table 1 includes summary statistics of the measures of inequality in our sample.

[14] CPS data is retrieved from the Integrated Public Use Microdata Series (IPUMS) and the IPUMS variable `inctot` is our preferred measure of income. Data for 11 states; California, Connecticut, District of Columbia, Florida, Illinois, Indiana, New Jersey, New York, Ohio, Pennsylvania and Texas is consistently available starting 1962. We repeat our empirical analysis on this subsample of states for the longer time period in the appendix.

[15] South Dakota and Delaware are notable for removing interest rate ceilings following the 1978 Supreme Court decision, *Marquette vs. First of Omaha*. This ruling preceded the 1980 federal removal of usury rates, discussed below, and attracted the credit card industry to set up headquarters in these two states.

Figure 1: Evolution of Income Inequality



Note: The figure reports top and bottom income inequality in the U.S. between 1961 and 2017 as measured in the CPS. Top income inequality is defined as the ratio of earnings at the 90^{th} percentile to earnings at the 75^{th} percentile in the income distribution. Bottom income inequality is defined as the ratio of earnings at the 25^{th} percentile to earnings at the 10^{th} percentile. The Gini coefficient is plotted on the right axis.

Table 1: Summary Statistics of Inequality Measures

					Standard Deviation			
	Obs.	Mean	Min	Max	No Controls	State Controls	Year Controls	State-Year Controls
Log Gini Coefficient	2,058	-1.053	-1.251	-0.884	0.055	0.043	0.050	0.035
Log Theil Coefficient	2,058	-1.604	-2.002	-1.271	0.115	0.084	0.105	0.070
Log 90-10 Ratio	2,058	1.797	1.404	2.240	0.118	0.113	0.101	0.095
Log 25-10 Ratio	2,058	0.549	0.324	0.937	0.084	0.069	0.079	0.063
Log 75-25 Ratio	2,058	0.347	0.148	0.562	0.056	0.040	0.053	0.035

Notes: The table reports summary statistics for five measures of inequality. The standard deviations reported are those from the residuals of regression which controls for state, year, and both state and year fixed effects.

2.2 Financial Deregulation

While there have been a number of reforms to financial market regulation in the last few decades, we focus on three.[16] These reforms have been emphasized previously in the literature, most notably by Philippon and Reshef (2012). We briefly describe the nature of each reform as well as the relevant data used to identify them below:

1. *Removal of Branching Restrictions, RBR*: In the 1970s, U.S. states began removing restrictions on both intra and inter-state bank branching. Our data, based on Stra-

[16]See Komai and Richardson (2011) for a review of the history financial market regulation in the U.S. since the late 18th century.

han (2003), document these deregulations which varied from allowing intra-state bank branching via mergers and acquisitions to unrestricted branching across states. Importantly, different states enacted these policies at different times allowing researchers to identify a causal impact of this form of deregulation on various measures of interest. Consistent with Beck, Levine, and Levkov (2010), we consider the date of deregulation to be the year in which a state removes restrictions on intra-state bank branching. [17] Panel (a) of figure 2.2 shows the distribution of years of deregulation across states.

2. *Removal of State-level Ceilings, RSC*: Usury rates specify limits on interest rates that can be charged by lenders. Prior to 1980 these limits were determined by each state. During the 1970s interest rate ceilings in many states became binding. In 1980, this prompted a federal policy which preempted the state interest rate ceilings by federal ceilings.[18] The federal policy effectively removed interest rate ceilings for most types of both consumer and commercial loans after 1980. Although this deregulation took place in all states at the same time, different states imposed different rate ceilings which were not always binding. We focus on usury rate ceilings on mortgage loans in 1980 as reported in Vandenbrink (1985) and compare these with the 30-year mortgage rate to determine whether a rate ceiling was binding. Panel (b) of figure 2.2 plots the number of states that have a binding interest rate between 1976 and 1990. Notice that following the removal of rate ceilings in 1980, no state had biding rates. By exploiting this state-year variation in whether a usury rates were binding, we aim to identify the effects of removing interest rate ceilings on the income distribution.[19]

3. *Repeal of the Glass-Steagall Act, RGS:* The Banking Act of 1933, more commonly known as the Glass-Steagall Act, mandated the separation of commercial banks, and insurance companies and investment banks. In 1999, the Gramm-Leach-Bliley Act, repealed the Banking Act and permitted commercial banks to undertake investment and insurance activities. Since the repeal took place in the same year across all states, it is not possible to separately identify it's impact with year effects. To proxy for the extent to which this reform might impact a state, we consider state-level variation in the level of employment in the finance and insurance sector in 1999. Panel (c) of Figure 2.2 shows the distribution of the employment shares in the finance and insurance sector

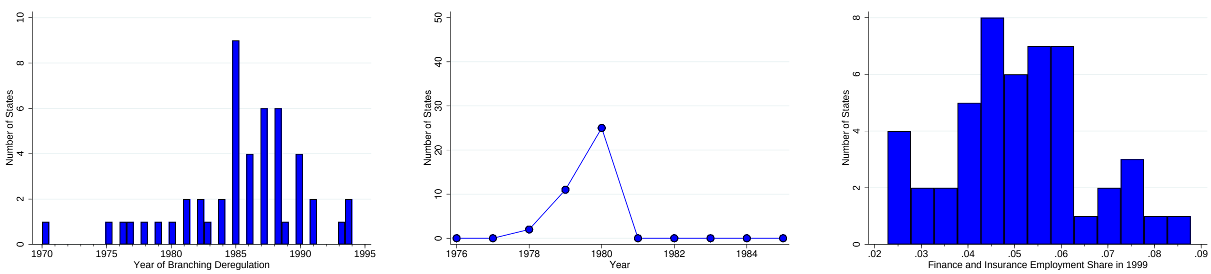
[17] Iowa did not pass any laws removing restrictions on intra-state bank branching so we take 1994, the year in which the Riegle-Neal Interstate Banking and Branching Efficiency Act was passed, as the year in which Iowa's bank branching restrictions were removed. This federal act aimed to equalize the benefits of a bank's state relative to a federal charter.

[18] For a summary on the impact of usury ceilings, see Vandenbrink (1982) and the references therein.

[19] As of 2019, several states maintain maximum usury rates for some forms of consumer debt, notably credit cards.

across U.S. states in 1999. We thus postulate that a reform in the financial sector has a larger impact in those states that have a larger share of their economy in the financial sector. We exploit the variation in the employment share of finance and insurance prior to the repeal of Glass-Steagall to establish a causal link between deregulation and the income distribution.

Figure 2: Measures of Financial Deregulation



(a) Year of RBR

(b) States with Binding Usury Rates

(c) Finance and Insurance Employment Share in 1999

Note: Panel(a) shows the number of states that had removed restrictions on bank branching for a given year. Panel (b) shows the number of states that have a usury rate on home mortgage loans that is lower than the market 30 year mortgage rate. Panel (c) shows the distribution of the employment share in Finance and Insurance, across states, in 1999.

3 Empirical Strategy

3.1 Approach

To quantify the impact of the financial deregulation reforms on inequality, we follow Beck, Levine, and Levkov (2010) and use a difference in differences approach which exploits the variation in either timing or extent of deregulation across states for identification. In particular, the analysis is based on regressions of the form

$$\ln\left(I_{st}(y)\right) = \alpha + \Sigma_i \beta^i D^i_{st} + \delta X_{st} + \mathbf{A_s} + \mathbf{B_t} + \epsilon_{st}, \tag{1}$$

where $I_{st}(y)$ is the respective index of income inequality in state s in year t, $\mathbf{A_s}$ and $\mathbf{B_t}$ capture state and year fixed effects respectively, X_{st} includes control variables that vary across states and over time while ϵ_{st} is the error term.[20] The term D^i_{st} captures each deregulation—bank

[20]The control variables include the shares of females, blacks, high school dropouts in the labor force, the unemployment rate and the log level of state GDP per capita in state s in year y.

branching deregulation (BB), the removal of interest rate ceilings (IC), and the repeal of the Glass-Steagall Act (GS)—and thus $i \in \{BB, IC, GS\}$. More precisely, these three types of variables are encoded as follows:

- The variable D_{st}^{BB} is equal to 1 after a state removes restrictions on bank branching, and 0 otherwise.
- The variable D_{st}^{IC} is equal to 1 whenever a state's interest rate ceiling is non-binding and 0 when it is.[21]
- Finally, D_{st}^{GS} is equal to 0 prior to the 1999 repeal of the Glass-Steagall Act. In all years after 1999 it is equal to the state employment share in FI relative to the U.S. employment share in FI in 1999 (before the reform).[22] Thus, the variable is given by:

$$D_{st}^{GS} = \left(\frac{EmploymentShare_{s1999}^{FI}}{EmploymentShare_{US1999}^{FI}}\right) \cdot \mathbb{I}(t > 1999),$$

  where the indicator $\mathbb{I}(t > 1999)$ is equal to 1 after 1999 and 0 otherwise.

3.2 Identification

Our empirical strategy relies on the assumption that our indicators of financial deregulation are unaffected by income inequality in a state. In this section, we test this assumption and show that it holds.

The exogeneity of the timing of bank branching deregulation and the income distribution has been previously discussed in Beck, Levine, and Levkov (2010) and Kroszner and Strahan (1999). Since we consider a slightly different timing of branching deregulation and are also interested in top and bottom inequality we reconfirm their findings with our measures. Following Beck, Levine, and Levkov (2010), we regress the year of deregulation on i) the average level and ii) the growth in income inequality prior to deregulation. We find no relationship between either the level or growth of inequality in any of our measures of inequality. The first row of table 2 reports the t-statistic from these regressions and indicates no statistically significant relationship between the year of branching deregulation and any measure of inequality.

Since the removal of interest rate ceilings and repeal of Glass-Steagall took place in a single year, we are not concerned about endogeneity between the timing of deregulation and

[21] For those states that never had a maximum interest rate ceiling, D_{st}^{IC} is accordingly set to 1 in all periods.

[22] Scaling by the U.S. Employment share in FI in 1999 allows us to interpret the coefficient associated with D_{st}^{GS} as representing the average impact of the repeal of Glass-Steagall across states.

inequality. Instead, we test whether our measure of each policy is correlated with the level or growth of inequality prior to deregulation. Since our measure of interest rate ceilings depends on whether a ceiling is binding, we test whether lagged inequality is predictive in determining whether a state's rate ceiling is binding. In particular, we consider all states from the start of our sample in 1976 to 1980 and perform a probit regression on whether state's usury rate is binding and the previous year's level or growth of income inequality. We control for year fixed effects in each estimation. The second row of table 2 shows the t-statistics from these regressions and indicates that inequality was unrelated to whether or not a state's usury rate was binding.

Next, we test whether the employment share in Finance and Insurance in 1999, our measure of the extent of impact of the repeal of Glass-Steagall, is correlated with the average level or growth of inequality in the three years prior to 1999. The third row of table 2 reports the t-statistics on each measure of inequality and finds no statistically significant relationship between the employment share in FI and inequality levels or growth.

These results are robust to fitting quantile regressions or a logit model for the indicators of financial deregulation. Taken together, they validate our identifying assumption and support an interpretation of the coefficient β^i in equation (1) as capturing the impact of deregulation on income inequality.

4 A Tale of Two Tales in the Data

4.1 Impact on Inequality

Table 3 reports the results from estimating equation (1) on various measures of income inequality. Panel A reports the results when excluding the state-year controls X_{st} while panel B includes five such controls; share of high school dropouts, share of black population, share of females, the unemployment rate, and growth in real gross state product. Coefficient estimates on these control variables are repored in Table A.1 of the Appendix. Year and state fixed effects are included in all specifications, and the standard errors are obtained by clustering at the state level. The first three columns of table 3 show the impact of deregulation on overall inequality, measured by the natural logs of the Gini coefficient, Theil index, and the 90-10 ratio.

First, we find that bank branching deregulation *reduces* overall income inequality. For example, in our specification with control variables, the Theil index declines by 3.7% following bank branching deregulation. Comparing this measure to the standard deviation of the Gini coefficient when controlling for state and year fixed effects alone, cf. Table 1, shows

Table 2: Testing the Exogeneity of Measures of Financial Deregulation

	Levels					**Growth**				
	Gini	Theil	90/10	90/75	25/10	Gini	Theil	90/10	90/75	25/10
Branching Deregulation	-0.26	-0.27	-0.13	0.99	-0.43	-0.94	-0.84	-0.64	0.57	-1.21
Interest Rate Ceilings	0.90	0.89	0.42	-0.10	0.02	1.23	1.35	0.67	0.33	-0.44
Repeal of Glass-Steagall	-1.61	-1.68*	-1.50	-0.25	0.38	0.14	-0.12	0.44	0.34	-0.21

Notes: The table reports the t-statistic from regressions on the measures of financial deregulation and both levels and growth of income inequality prior to deregulation. The regressions are on the natural logarithm of the level of each measure of income inequality. The first row shows the t-statistics from a regression on the year of bank branching deregulation in a given state and the average level and growth of inequality prior to deregulation. The second row reports the t-statistics from a probit regression on whether a state's usury rate is binding and the previous year's level and growth of inequality while controlling for year fixed effects. The third row reports the t-statistic from a regression on the employment share in finance and insurance in each state in 1999 and the average level and growth of inequality in the prior three years.
*the associated p-value is 0.1004.

that the branching deregulation led to a 57% decline in the variation of income inequality. We also document a statistically significant decline in *bottom* income inequality following branching deregulation with no significant change in top income inequality. Indeed, the 25-10 ratio declined by around 3.0% after this reform which accounts for a 47% reduction in the variation in bottom inequality not accounted for by state and year effects.[23] This shows that the reform decreased the dispersion of incomes in the left tail of the distribution.

Second, non-binding interest rate ceilings generally result in lower overall income inequality with no statistically significant impact on either top or bottom inequality, cf. Table 3. For example, the Theil index declines by 3% when interest rate ceilings are not binding. This accounts for a 37% reduction in the variation in income inequality beyond state and year effects. The effects are thus quantitatively smaller than those found for branching deregulation and are also statistically weaker in significance.

Third, the repeal of the Glass-Steagall Act, however, led to an *increase* in income inequality. Recall that the state specific employment share in FI in 1999, the year of the repeal, is our proxy for the extent to which this repeal might affect a state. The coefficient

[23]These results on bank branching are both qualitatively and quantitatively consistent with those of Beck, Levine, and Levkov (2010).

estimates thus measure the average impact on inequality from increasing a state's 1999 FI employment share by one unit. To compare the impact of this reform with bank branching deregulation and the removal of interest rate ceilings, we report in Table 3 the product of the coefficient estimates and the national employment share in FI in 1999.[24] With this transformation, the impact of repealing the Glass-Steagall Act is a 3.4, 7.5, and 8.2% *increase* in the Gini coefficient, Theil index and 90-10 ratio respectively. Including time varying state characteristics makes this impact statistically weaker but of a similar magnitude. There is no statistically significant relationship between either top or bottom inequality and the repeal of the Glass-Steagall Act. Thus, the removal of the Glass-Steagall Act increased inequality and the effects are largely symmetric within the right tail. Taken together, this most recent reform had an impact on inequality that was opposite in direction and twice as large in size than that of bank branching deregulation and almost three times the size of the removal of usury rate ceilings.

We perform a number of robustness checks. Our main results hold and are stronger when we restrict the sample to from 1977 to 2006, the same period as in Beck, Levine, and Levkov (2010), the inclusion of the level of real Gross State Product (GSP) per capita, lagged unemployment, and lagged measure of inequality. We also check for robustness by including time varying state employment shares in all industries, as well as controlling for the age composition of a state. Importantly, these results hold when considering conditional income inequality which controls for education, gender and race. This suggests that the impact of financial deregulation is not explained by demographic characteristics or education alone. Table A.2 in the appendix reports these results on conditional inequality.

4.2 Income Groups

We now study the impact of the reforms on incomes along the entire income distribution. To do so, we follow (Beck, Levine, and Levkov 2010) and regress our indicator of financial reform on the level of income $y(j)_{st}$ earned by each percentile j of the income distribution in state s in year t by the the following specification:

$$y_{st}(j) = \alpha + \Sigma_i(\beta^i D^i_{st}) + \mathbf{A_s} + \mathbf{B_t} + \epsilon_{st}(j), \tag{2}$$

where $\mathbf{A_s}$ and $\mathbf{B_t}$ are state and year fixed effects respectively and the above is performed for each percentile j and the financial reforms are indexed by i.

Figure 3 reports the coefficient β^i for each reform and indicates whether it is significant

[24] The U.S. employment share in FI in 1999 is 5.4 %.

Table 3: Impact of Financial Deregulation on Income Inequality

	(1) log(Gini)	(2) log(Theil)	(3) log(90/10)	(4) log(25/10)	(5) log(90/75)
			Panel A: No Controls		
RBR	-0.020***	-0.039***	-0.070***	-0.033***	0.000
	(0.005)	(0.009)	(0.015)	(0.008)	(0.005)
RSC	-0.011	-0.026	-0.023	-0.013	-0.010
	(0.009)	(0.016)	(0.017)	(0.013)	(0.009)
RGS	0.037**	0.073**	0.080*	-0.000	0.015
	(0.017)	(0.032)	(0.043)	(0.014)	(0.011)
Year Fixed Effects	Y	Y	Y	Y	Y
State Fixed Effects	Y	Y	Y	Y	Y
Additional Controls	N	N	N	N	N
Observations	2,058	2,058	2,058	2,058	2,058
R^2	0.524	0.565	0.154	0.377	0.550
			Panel B: With Controls		
RBR	-0.020***	-0.038***	-0.067***	-0.030***	-0.002
	(0.004)	(0.007)	(0.012)	(0.008)	(0.005)
RSC	-0.014	-0.030*	-0.027	-0.012	-0.011
	(0.008)	(0.016)	(0.019)	(0.013)	(0.009)
RGS	0.033*	0.063*	0.071*	-0.002	0.011
	(0.017)	(0.033)	(0.042)	(0.013)	(0.011)
Year Fixed Effects	Y	Y	Y	Y	Y
State Fixed Effects	Y	Y	Y	Y	Y
Additional Controls	Y	Y	Y	Y	Y
Observations	2,058	2,058	2,058	2,058	2,058
R^2	0.557	0.592	0.193	0.386	0.568

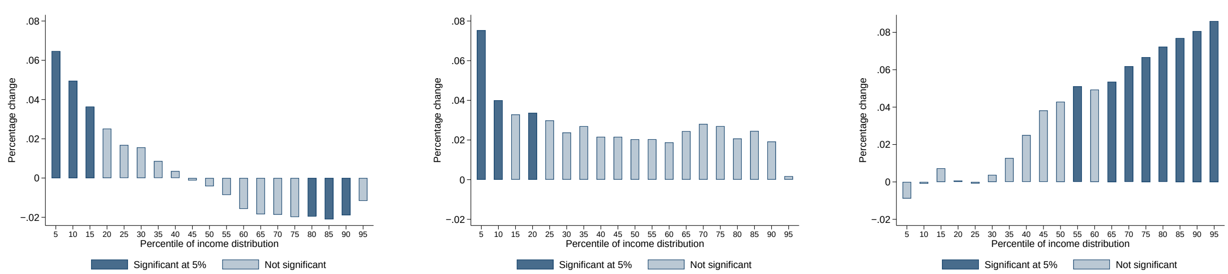
Notes: The table shows the results from the regression in equation 1. Results on control variables, and state and year fixed effects are not reported. Information on 49 states is used from 1976 to 2017. Data on Gross State Product (GSP) is from the Bureau of Economic Analysis (BEA). The reported coefficients and standard errors for the repeal of Glass-Steagall are the coefficient estimates multiplied by the national employment share of FI in 1999. Standard errors are clustered at the state level and are reported in the parentheses; *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

at the 5% level.[25] Panel (a) shows that branching deregulation increased incomes for those in the bottom quartile of the income distribution and lowered them for workers in the top quartile. As before, these results are consistent with Beck, Levine, and Levkov (2010).[26]

The removal of interest rate ceilings, shown in panel (b), led to a (significant) increase in incomes in the bottom quartile of the income distribution. This is consistent with empirical evidence finding that binding usury rates results restricted credit provision to low income, high risk borrowers.[27] Hence, the removal of such ceilings should largely benefit low income individuals. While not statistically significant, the gains from nonbinding interest rate ceilings appear to be positive for all but the highest percentile earners. This results in higher incomes across the income distribution but not necessarily a change in income inequality as shown in Table 3.

The repeal of the Glass-Steagall Act, as shown in panel (c), did not change incomes for those at the bottom tercile of the income distribution. However, it led to higher incomes for the top two terciles, with higher gains for higher income earners. In other words, the repeal of the Glass-Steagall Act led to a stretching of the right tail of the income distribution with relatively small changes in the left tail. This is in direct contrast to both bank branching deregulation and usury rate reforms, potentially supporting the view that the repeal of the Glass-Steagall Act not only had a direct effect by increasing wages of high skilled workers in the financial sector, as emphasized by Philippon and Reshef (2012), but also increased the wages of other high skilled workers in other sectors, as we investigate below.

Figure 3: Impact of Financial Deregulation by Income Group



(a) Bank Branching Deregulation (b) Removal of Rate Ceilings (c) Repeal of Glass-Steagall

Notes: The figure reports the coefficients β^i for percentiles of the income distribution from specification 2. Panel (c) reports the product of the coefficient and the national employment share of Finance and Insurance sectors in 1999. Darker bars indicate that the coefficient is statistically significant at the 5% confidence level.

[25]For the repeal of Glass-Steagall, the product of the coefficient β^{GS} and the national employment share in FI in 1999 is shown.

[26]With one qualification: we find a statistically significant decline in incomes at the top quartile whereas they do not.

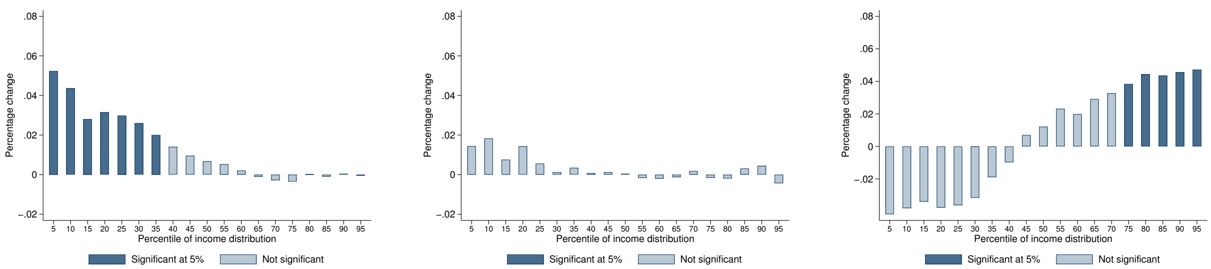
[27]See for example, Phaup and Hinton (1981) and Shay (1972).

We now repeat the previous analyses by estimating the effects of the respective reforms on inequality and income percentiles in the medium run, i.e., 5 years after the reforms. Appendix A.4 summarizes our results on the inequality indices. Here, we summarize in Figure 4 the results of the regressions

$$y_{st+5}(j) = \alpha + \Sigma_i(\beta^i D^i_{st}) + \mathbf{A_s} + \mathbf{B_t} + \epsilon_{st+5}(j). \tag{3}$$

Our findings confirm that bank branching deregulation led to reduction of inequality by increasing incomes in the lower tail of the distribution, and that the repeal of the Glass-Steagall act increased inequality by increasing incomes in the top of the distribution. The removal of interest rate ceilings, however, has no effect in the medium run.

Figure 4: Impact of Financial Deregulation on 5 Years Lead Income



(a) RBR (b) RSC (c) RGS

Notes: The figure reports the coefficients β^i for percentiles of the income distribution 5 years into the future from specification 3. Panel (c) reports the product of the coefficient and the national employment share of Finance and Insurance sectors in 1999. Darker bars indicate that the coefficient is statistically significant at the 5% confidence level.

4.3 Mechanisms

As established above, the removal of usury rates and branching restrictions *lowered* income inequality by increasing incomes at the left end of the income distribution. On the other hand, the repeal of Glass-Steagall *increased* income inequality by increasing income levels at the right tail of the income distribution. In this section, we provide additional empirical results that point to the economic mechanisms driving these findings.

In particular, we interpret each of the three financial market reforms as either alleviating financial frictions and/or improving the productivity of the financial sector. So, deregulation not only impacts incomes of workers in FI—a direct effect—but also the demand for labor in other sectors and areas of the income distribution—an indirect effect.[28] The direct impact of deregulation on the levels of incomes of employees in FI may lead to an indirect or spill-over effect as it drives up wages for workers that are well suited to employment in FI sectors due to their relative scarcity. Another indirect effect might take place on the production side. Financial deregulation lowers the costs of capital, which may increase capital demand. This will increase the capital stock employed in production and, if capital and high skilled workers are complements in production, high skilled workers will disproportionately benefit from the expansion of the capital stock.

Accordingly, in the following sections, we first investigate the difference in the effects of deregulation on workers in FI (finance & insurance) and NFI (not in finance & insurance). Next, we investigate more closely how inequality is affected by the reforms both between and within these two groups. Subsequently, we look at evidence for spill-overs. Finally, we complement this analysis on mechanisms by investigating the heterogeneity of the reforms across age.

4.3.1 Finance & Insurance and Non-Finance & Insurance Sectors

We repeat our regressions in (2) for the two groups of workers $k \in \{FI, NFI\}$, i.e., we run the following regressions

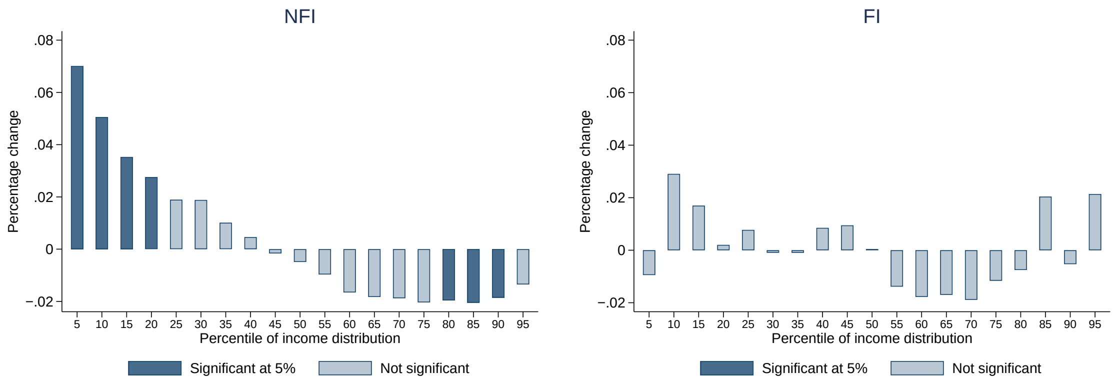
$$y^k_{st}(j) = \alpha^k + \Sigma_i(\beta^{i,k} D^i_{st}) + \mathbf{A_s}^k + \mathbf{B_t}^k + \epsilon^k_{st}(j), \tag{4}$$

where, as above, $\mathbf{A_s}^k$ and $\mathbf{B_t}^k$ are state and year fixed effects, respectively, and the regression is performed for each percentile j and the financial reforms are indexed by i.

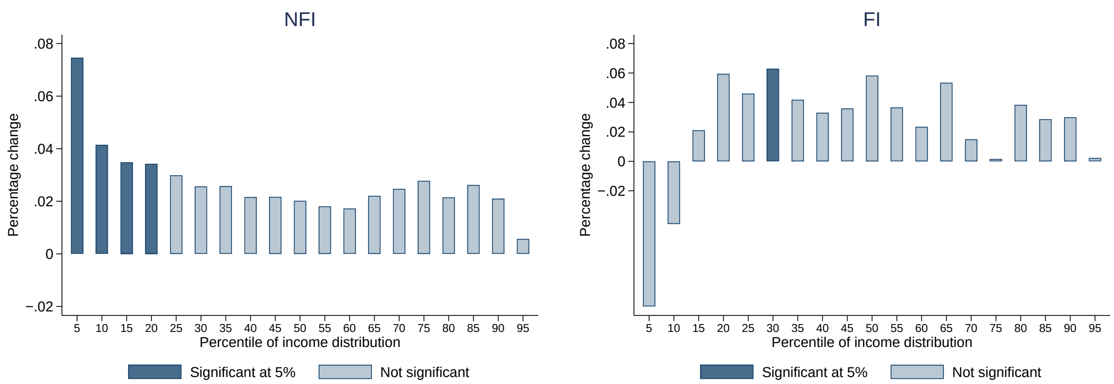
Figure 5 shows the results. Both RBR and RSC increased incomes of workers in NFI and more strongly in the left tails thus reducing inequality whereas there is no or overall insignificant changes of incomes in FI. This shows that our previous findings of the reduction in inequality by the reforms RBR and RSC is driven by the developments in NFI and not in FI. On the other hand, RGS increased incomes for *all* workers in FI and we find a relatively small increase for highly paid workers in NFI. Also notice that the impact of RGS is more that twice the size for FI employees than for employees in NFI.

[28] Improved access to financial services can also benefit poorer workers disproportionately as it allows them to obtain more education and pursue entrepreneurship. However, our sample excludes the self-employed and, as shown in table A.2, the impact of deregulation on conditional income inequality is consistent with that of unconditional inequality. Further, regarding branching deregulation, Beck, Levine, and Levkov (2010) only find evidence supporting a labor demand channel. This motivates our consideration of a labor demand effects alone.

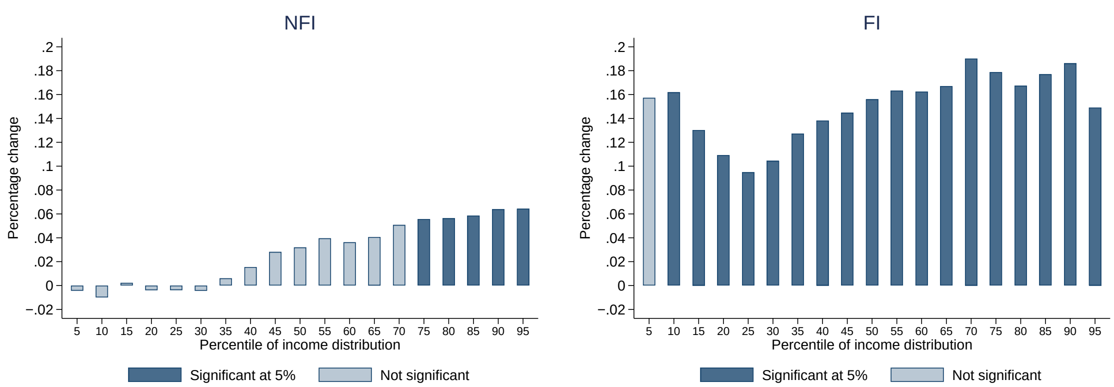
Figure 5: Impact of Financial Deregulation on Income for NFI and FI Employees



(a) RBR



(b) RSC



(c) RGS

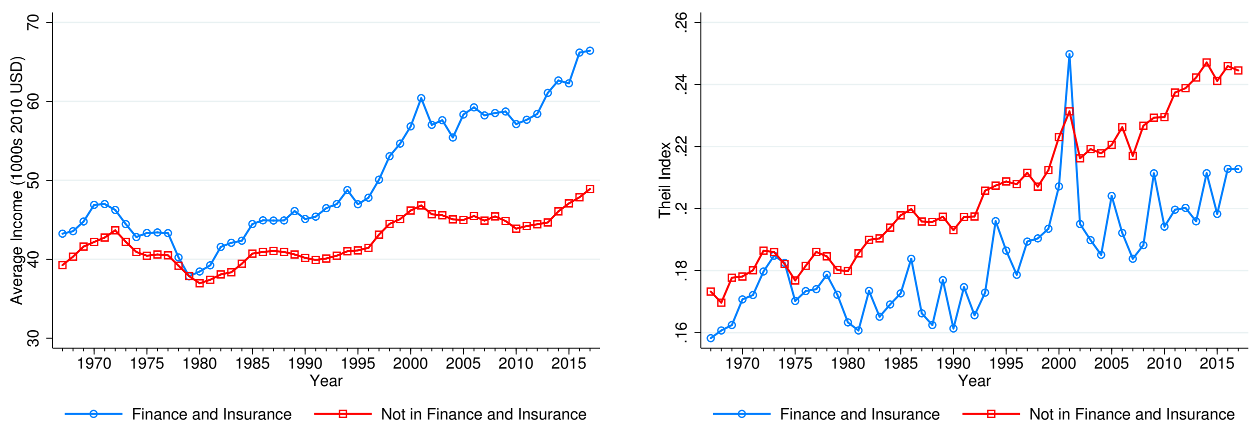
Notes: The figure reports the coefficients β^i for percentiles of the income distribution from specification **??**. Darker bars indicate that the coefficient is statistically significant at the 5% confidence level.

4.3.2 Between and Within Group Inequality

The previous analysis suggests that the reduction of inequality through RBR and RSC is mainly due to increases in incomes in the lower tail in sector NFI. In contrast, the increase of inequality is mainly due to an increasing income gap between NFI and FI workers. This section tests this hypothesis in a number of steps.

Figure 6 documents the time paths of average incomes in Panel (a) and the Theil indices of inequality in Panel (b) in the two sectors of the economy over time. We observe that the gap in average incomes was constant before the 1980s and starts increasing thereafter. Interestingly, income inequality in FI is lower than in NFI. Again, the gap is roughly constant before 1980 and slightly increasing thereafter, but less pronounced than for average incomes.[29]

Figure 6: Average Incomes and Income Inequality in FI and NFI



(a) Average Income (b) Theil Index

Notes: The figure shows the evolution of average income and the Theil index in the two sectors, FI and NFI.

Table 4 repeats our main specification in (1) taking average incomes, respectively the log of the Theil index, in the two sectors as the respective left hand side variable. Bank branching deregulation and the removal of interest rate ceilings left average incomes in both sectors roughly unchanged. In contrast, the repeal of the Glass-Steagall Act increased average incomes. The effect is much stronger in FI. With regard to inequality, the reforms had no effects on the Theil index within FI, but bank branching deregulation and the removal of rate ceiling decreased it in NFI, whereas the removal of the Glass-Steagall Act increased it. Again, the effect is much stronger than for the other two reforms.[30]

[29]Results for median incomes and for the Gini coefficient are very similar.

[30]Again, results for median incomes and for the Gini coefficient are very similar.

Table 4: Impact of Deregulation for Employees in FI and not in FI

	Average Income		log(Theil)	
	Non-FI	FI	Non-FI	FI
RBR	-0.007	0.001	-0.038***	0.000
	(0.010)	(0.018)	(0.009)	(0.036)
RSC	0.020	0.026	-0.028*	0.006
	(0.014)	(0.038)	(0.016)	(0.050)
RGS	0.0422*	0.1546***	0.0658**	-0.0121
	(0.0222)	(0.0356)	(0.0320)	(0.0526)
Year Fixed Effects	Y	Y	Y	Y
State Fixed Effects	Y	Y	Y	Y
N	2,058	2,058	2,058	2,058
R^2	0.733	0.581	0.548	0.083

Notes: The table shows the results from the regression in equation 1 using average income, respectively the log of the Theil index, as dependent variable. The reported coefficients and standard errors for the repeal of Glass-Steagall are the coefficient estimates multiplied by the national employment share of FI in 1999. State and year fixed effects are not reported. Information on 49 states is used from 1976 to 2017. Data on Gross State Product (GSP) is from the Bureau of Economic Analysis (BEA). Standard errors are clustered at the state level and are reported in the parentheses; *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

These results underscore the importance to distinguish between direct effects within sectors and indirect effects across the sectors. To shed further light on this we now decompose the *level* of the Theil index for each year and state into between and within group components. We consider two groups, those employed in FI and all others (not in FI, accordingly labelled as NFI). These within and between group components are then regressed on the indicators of financial deregulation along with state and year fixed effects. Thus, we take total income inequality as measured by the Theil index in levels, $T^t_{st}(y)$, and decompose it into it's within and between group components, $T^w_{st}(y)$ and $T^b_{st}(y)$. Then we perform the regression

$$T^k_{st}(y) = \alpha + \Sigma_i(\beta^i D^i_{st}) + \mathbf{A_s} + \mathbf{B_t} + \epsilon_{st},$$

where $k \in \{t, w, b\}$ indexes *t*otal, *w*ithin and *b*etween group inequality and i indexes each form of deregulation. As above, state and year fixed effects are $\mathbf{A_s}, \mathbf{B_t}$, respectively. The coefficients β^i capture the impact of deregulation on inequality. We also perform this regression for total inequality within each group.

Table 5 reports the results from this exercise when partitioning workers into those employed in Finance and Insurance sectors and those that are not. The first column reports the total change in inequality resulting from each of the three reforms. The second and third columns report the impact on between and within group inequality while the last two columns report the total impact of deregulation on inequality within the two groups ("NFI" and "FI"). For a strong direct effect, we expect that the impact of deregulation is largely due to changes in between group inequality. However, the table shows that for all reforms, the majority of the total impact on inequality is driven by changes in within group inequality. Further, these changes are concentrated among workers that are not employed in FI. This suggests that deregulation uniformly impacted the income distribution of workers in FI and had a heterogeneous impact on workers not employed in FI. However, 22% $(= 0.0032/0.0147 \cdot 100\%)$ of the total impact following the repeal of Glass-Steagall is due to an increase in between group inequality, suggesting a strong direct effect following the repeal. Taken together, the decomposition exercise suggests that the branching and usury rate reforms' impact on inequality is not due to direct effects of higher incomes for employees in FI whereas the repeal of Glass-Stegall provides stronger support for a direct effect.

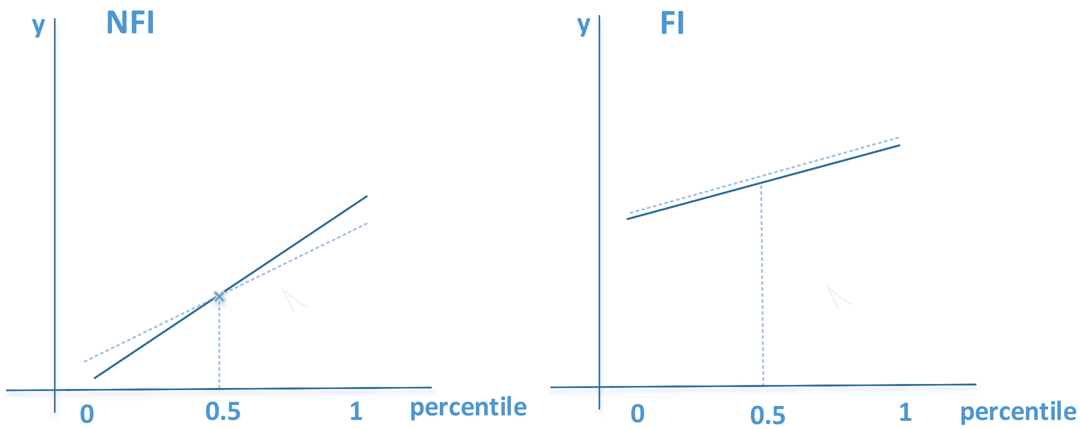
Table 5: Decomposition of Impact of Financial Deregulation on Income Inequality Within and Between Groups

				Sector Groups	
	Total	Between Group	Within Group	NFI	FI
RBR	-0.0074***	-0.0005	-0.0069***	-0.0073***	-0.0009
	(0.0021)	(0.0003)	(0.0019)	(0.0019)	(0.0051)
RSC	-0.0049	0.0001	-0.0049*	-0.0050*	-0.0007
	(0.0029)	(0.0003)	(0.0029)	(0.0029)	(0.0075)
RGS	0.0147**	0.0032***	0.0115*	0.0130*	-0.0045
	(0.0068)	(0.0007)	(0.0064)	(0.0068)	(0.0056)

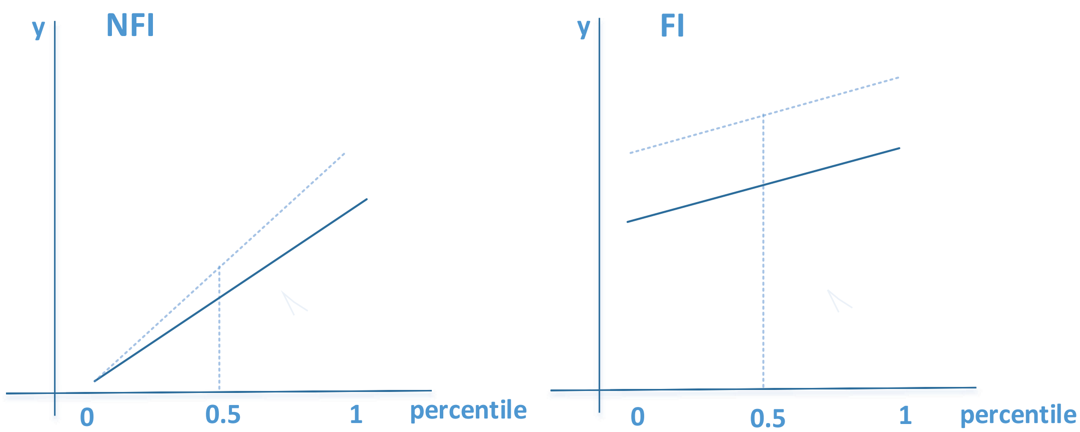
Notes: The table reports the impact of financial deregulation on components of inequality. Workers are grouped into those employed in Finance and Insurance (FI) and those not employed in FI. The total, between and within group inequality are regressed on indicators of financial deregulation, year and state fixed effects. The reported coefficients and standard errors for the repeal of Glass-Steagall are the coefficient estimates multiplied by the national employment share of FI in 1999. Standard errors are reported in parentheses; *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Figure 7 summarizes these findings in a stylized representation of the main facts. Panel (a) shows the results for RBR and RSC and panel (b) for RGS. In this stylized representation we assume that incomes y on the ordinate are linearly increasing in the relative position p in the income distribution on the abscissa. Consequently, average incomes $\bar{y}$ are at $p = 0.5$. The solid line represents the dispersion of incomes prior to the respective reform, the dashed line after the reform. The left graphs in each panel show the effects in NFI, the right graph in FI. RBR and RSC decreased inequality within NFI but the mean has not changed, whereas all incomes in FI were basically unchanged so that the difference in average incomes across the two sectors, the between group difference, is the same before and after the reform. In contrast, RGS increased average incomes and inequality within NFI and shifted all incomes in FI upward more strongly than the average income change in FI so that inequality between NFI and FI also increased.

Figure 7: Between and Within Group Effects



(a) BB & IC



(b) GS

Notes: This figure is a stylized illustration of the results on between and within group effects from Table 5. We assume that incomes are linearly increasing in the income position. Panel (a) shows the effects of reforms BB & IC (bank branching deregulation and removal of interest rate ceilings), panel (b) for reform GS (removal of the Glass-Steagall Act). The income distribution before the respective reform is depicted as a solid line, and after the reform as a dashed line.

In Table 6 we repeat the analysis of the sectoral decomposition of the Theil index by estimating the effects five years after the respective reforms. The size of the coefficient estimates is similar and our results confirm that most of the effects are indirect effects within groups. Furthermore, we also confirm that about 22% ($= 0.003/0.0135 \cdot 100\%$) of the effect of the removal of the Glass-Steagal act is due to a direct effect on between group inequality.

However, in the medium run, we also identify a strong direct effect of bank branching deregulation: about 11% (= $0.0007/0.0061 \cdot 100\%$) of the total effect of the reduction of inequality caused by this reform is due to a reduction of between group inequality.

Table 6: Decomposition of Impact of Financial Deregulation on Income Inequality Within and Between Groups in the Medium Run

				Sector Groups	
	Total	Between Group	Within Group	Not in FI	FI
RBR	-0.0061**	-0.0007**	-0.0054**	-0.0057**	0.0009
	(0.0024)	(0.0003)	(0.0021)	(0.0022)	(0.0053)
RSC	-0.0007	0.0007*	-0.0014	-0.0013	0.0042
	(0.0040)	(0.0004)	(0.0040)	(0.0042)	(0.0094)
RGS	0.0135**	0.0030***	0.0105**	0.0124**	-0.0078
	(0.0054)	(0.0007)	(0.0051)	(0.0056)	(0.0094)

Notes: The table reports the impact of financial deregulation on components of inequality 5 years after the respective reform (medium run perspective). Workers are grouped into those employed in Finance and Insurance (FI) and those not employed in FI. The total, between and within group inequality are regressed on indicators of financial deregulation, year and state fixed effects. The reported coefficients and standard errors for the repeal of Glass-Steagall are the coefficient estimates multiplied by the national employment share of FI in 1999. Standard errors are reported in parentheses; *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

4.3.3 Spillovers

Next, we test for evidence for an indirect or spillover effect following financial deregulation. In particular, we ask whether changes in incomes in response to deregulation are concentrated among workers that are most suited for employment in FI sectors. Intuitively, the increased demand for FI workers, following a reform, would decrease the relative supply of NFI workers. This relative scarcity should lead to an increase in incomes. If this was the case, then we should observe that incomes of workers that are most suitable for employment in FI rise faster than those workers that are not as suitable.

To investigate this hypothesis, we require a measure of suitability of employment in FI. We do this by estimating the probabilities for employment in FI by running a probit regression of an indictor for employment in FI on a number of control variables:

$$\mathbb{I}(k = FI)_{a,c,t,o} = \alpha + \beta X_a + \mathbf{A_c} + \mathbf{B_t} + \mathbf{C_o} + \epsilon_{a,c,t,o}, \tag{5}$$

where $\mathbb{I}(k = FI)_{a,c,t,o}$ is a indicator variable which is equal to 1 if individual a is a FI employee and 0 otherwise (i.e., if in NFI). The variable X_a includes individual specific control variables which include education, a quartic in years of experience, gender, race and interaction dummies.[31] $\mathbf{A_c}$, $\mathbf{B_t}$, $\mathbf{C_o}$ captures census area c, year t and occupation o fixed effects, respectively. Notice we do not control for state or income of an individual. Based on this regression we then predict probabilities of employment in FI as $\hat{\mathbb{I}}(i = FI)_{k,c,t,o}$.

To test whether employees with a higher probability of employment in FI, who are employed in NFI experienced a larger increase in incomes following reforms we perform the following regression for the sample of NFI individuals a in state s at time t:

$$y_{astd} = \alpha + \gamma p_a + \Sigma_i \beta^i D^i_{st} + +\Sigma_i \delta^i [(p_i - \bar{p}) \times D^i_{st}] + \mathbf{A_s} + \mathbf{B_t} + \mathbf{C_d} + \epsilon_{astd} \tag{6}$$

where $\mathbf{C_d}$ controls for industry fixed effects and p_a is the propensity score for individual a, and $\bar{p}$ is the average propensity score of everyone in the sample. That is, it is the average of propensity scores across time and states for all workers.

γ captures the average change in incomes of individuals when the probability of employment in FI increase by one unit. β^i captures the impact of the reform i for those NFI workers that have the average propensity score $\bar{p}$.[32] δ^i captures the change in incomes associated with a unit increase in propensity scores (relative to the mean propensity score) following reform i. If those with above average propensity scores experience larger increases in income following reform these coefficients will be positive. Taken together, the impact of reform i on a worker of propensity score $\Delta + \bar{p}$ is given by $\beta^i + \delta^i \Delta$.

Table 7 reports the results from this regression. First, the coefficient on the propensity scores γ is positive and statistically significant indicating that NFI workers with higher propensity scores earn higher incomes.[33]. Second the impact of the each of the three reforms on NFI workers with the average propensity score (i.e. coefficient β^i) is small and statistically insignificant for each reform. Finally, the interaction term δ^i is positive for each of the three reforms indicating that those with above average propensity scores experienced larger increases in income following reform i. In particular, from specification (4), NFI workers that have the same average propensity score as all FI workers (i.e. 0.12) experienced a 2.5, 4.3, and 4.1 % increase in incomes relative to the average NFI worker following RBD, RSC, and RGS respectively.

4.3.4 Heterogeneous Effects in Age

This section investigates whether financial deregulation had a differential impact on the incomes of young versus old workers. First, we test the immediate impact of financial

[31] Table A.3 in the appendix reports summary statistics of the control variables X for employees in FI and NFI for the entire sample from 1976 to 2017.

[32] In our sample, $\bar{p}$ is around 0.07.

[33] Recall that the construction of propensity score does not control for income of an individual.

Table 7: Impact of Deregulation by Propensity Scores

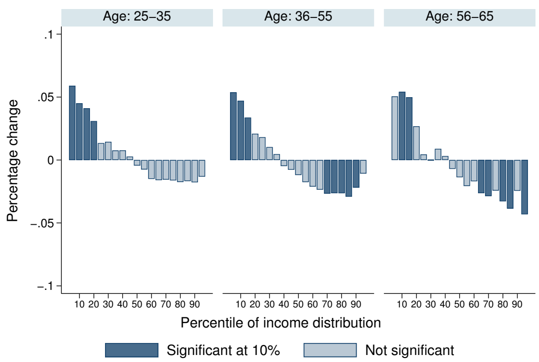
	(1)	(2)	(3)	(4)
	log(Income)	log(Income)	log(Income)	log(Income)
Propensity Score (p)	0.745***	0.372***	1.115***	0.327***
	(0.109)	(0.100)	(0.084)	(0.102)
RBD	0.001			0.002
	(0.009)			(0.008)
RBD $\times(p-\bar{p})$	0.923***			0.354***
	(0.123)			(0.120)
RSC		0.029*		0.025
		(0.016)		(0.016)
RSC $\times(p-\bar{p})$		1.222***		0.611***
		(0.136)		(0.109)
RGS			0.002	0.003
			(0.025)	(0.026)
RGS $\times(p-\bar{p})$			0.754***	0.589***
			(0.070)	(0.039)
State FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
N	1,986,870	1,986,870	1,986,870	1,986,870
R^2	0.099	0.099	0.099	0.099

deregulation on the earnings of workers of difference ages. On the one hand, as documented in Figure 8, branching deregulation has a homogeneous impact on the earnings of workers of all ages, which is consistent with Beck, Levine, and Levkov (2010). On the other hand, the removal of usury rate ceilings tends to benefit younger workers the most. This accords with the intuition that rate ceilings ration credit away from riskier consumers, who are early in their careers. Finally, the immediate impact of the repeal of Glass-Steagall appears to benefit older, richer workers more than the younger workers.

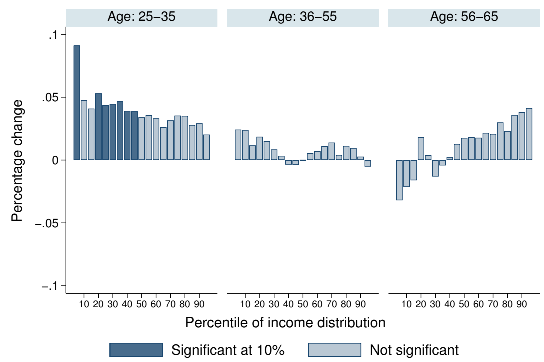
While instructive, this analysis ignores the potential dynamic impact of financial deregulation.[34] It may be the case that gains from deregulation are realized in the future if, for example, young workers become more selective in their job search in response to greater access to credit or higher wages earned in the financial sector. To test for the dynamic impact across age groups, we estimate the impact of deregulation on the 5-year lead earnings distribution, which we refer to as the medium run. Figure 9 shows that branching deregulation has a strong positive impact on incomes for the youngest workers in the medium run, much stronger than on incomes of older workers. In contrast, the removal of interest rate ceilings does not appear to have any strong, significant impact on the earnings of workers of different age groups in this medium run. Finally, the repeal of Glass-Steagall appears to be harmful to low income and young workers, while not having a significant impact on the income distribution of older workers in the medium run; yet, the effects are still positive throughout the income distribution for this oldest age group.

[34] Beck, Levine, and Levkov (2010) show that the impact of branching deregulation is strongest immediately following deregulation (see their figure 3). However, since the other two reforms took place in the same year across states, we cannot identify their dynamic impact of the reforms by using the number of years from the reform as an explanatory variable.

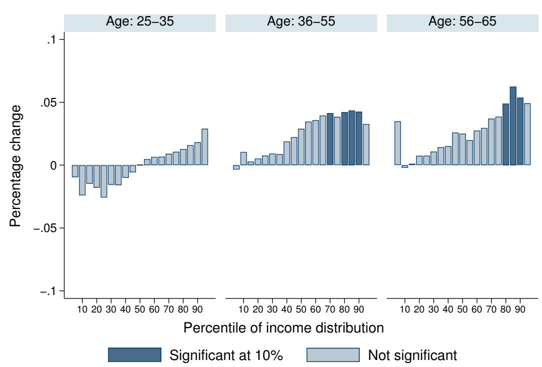
Figure 8: Immediate Impact of Financial Deregulation by Income and Age Groups



(a) RBR



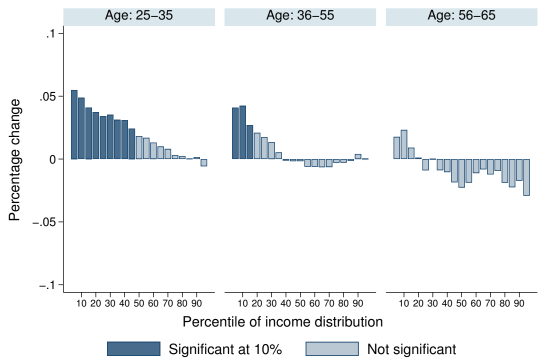
(b) RSC



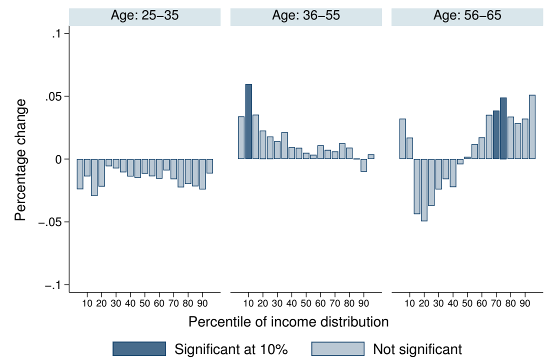
(c) RGS

Notes: The figure reports the coefficients β^i for percentiles of the income distribution from specification 2. Panel (c) reports the product of the coefficient and the national employment share of Finance and Insurance sectors in 1999. Darker bars indicate that the coefficient is statistically significant at the 5% confidence level.

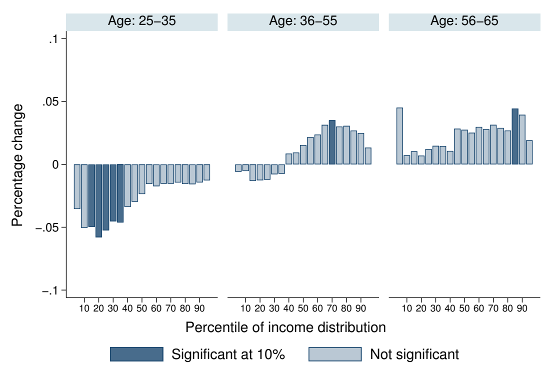
Figure 9: Impact of Financial Deregulation by Age Groups and 5 Years Lead Income



(a) RBR



(b) RSC



(c) RGS

Notes: The figure reports the coefficients β^i for percentiles of the income distribution 5 years into the future from specification 2. Panel (c) reports the product of the coefficient and the national employment share of Finance and Insurance sectors in 1999. Darker bars indicate that the coefficient is statistically significant at the 5% confidence level.

5 The Model

In this section we construct a general equilibrium model that incorporates multiple mechanisms by which financial markets influence the distribution of income. In addition to capital-skill complementarities in production, the model highlights cross-sector and cross-occupation factor-intensity differences and the equilibrium allocation of workers that are heterogenous to different financial markets and contracts. Responses in human and financial capital accumulation of the different households to financial liberalizations or deregulations change the equilibrium conditions in financial and labor markets. We explicitly consider reforms that change the competitiveness and intermediation restrictions across financial markets.

Our baseline general equilibrium model has a limited time horizon, making it as analytically tractable as possible while still being able to capture multiple margins by which financial reforms can impact the resulting distribution of income in an economy.

5.1 The Environment

We consider a two-period production economy. Households decide on their first period consumption and their investments, both in human capital (labor market skills) and in financial markets. In these decisions, households choose one among multiple financial arrangements available, which we explain below. In the second period, households realize their earnings opportunities and choose across occupations, obtain or repay their financial obligations and consume. Firms hire capital and labor for different occupations. Financial firms collect capital from a capitalist and households and distribute it to non-financial firms (and possibly to other financial firms). Capital is also used by financial firms for their operations. Non-financial firms produce consumption goods—of households, the capitalist and monopolists, if any—in the second period.

Preferences. The economy is populated by heterogenous workers, grouped in types $e \in \{1, 2, ...E\}$. Each type has a fraction $\Psi(e) \geq 0$ and we normalize the population so that $\sum_{e=1}^{E} \Psi(e) = 1$. Denoting by c_0, c_1 consumption in the current and future period, respectively, the preferences of all workers are given by

$$U_0 = \frac{(c_0)^{1-\sigma}}{1-\sigma} + \beta E\left[\frac{(c_1)^{1-\sigma}}{1-\sigma}\right],$$

where $\sigma > 0$ is the coefficient of relative risk aversion and $\beta \in (0, 1)$ is the discount factor. Below, we discuss the units of consumption for c_t, $t \in \{0, 1\}$.

Endowments. The type e delineates a worker's earnings in both periods. First, an 'absolute ability' $\alpha(e) > 0$ affects the level of earnings of the worker in both periods.[35] Second, a 'comparative ability', captured by a matrix $\gamma(e,j) \geq 0$, determines the average productivity of the worker across the different occupations $j = 1, ..., J$ in the second period of life.[36]

Workers' earnings are also determined by human capital investments and random shocks. In the first period, workers can invest $h \in [0,1]$ units of their time endowment in human capital, e.g.: on-the-job-training (OJT) or other future-earnings-enhancing activities such as general entrepreneurial activity. That is, we interpret 'human capital' in this model very broadly. This investment reduces current earnings but increases future earnings. In particular, we assume that first period earnings are given by

$$y_0 = \alpha(e)\,(1-h)\,.$$

In the second period, workers human capital is h^{ψ}, where ψ is the elasticity of earnings with respect to human capital investments h.[37] In addition to the absolute advantage $\alpha(e)$ and the comparative advantage $\gamma(e,j)$, earnings of a worker in occupation j comprise of to more element, first, an occupation specific unitary wage w_j, which each worker takes as exogenously given and, second, a vector of idiosyncratic productivity shocks $\{\eta_j\}$ across all occupations. Thus, second period earnings across the different occupations are given by

$$y_1\,(j) = h^{\psi}\alpha(e)\gamma(e,j)w_j\eta_j.$$

We assume that η_j is a Frechet (extreme value type II) distributed shock with curvature parameter θ and occupation specific scale parameter 1 so that

$$\Pr\left[\eta_j \leq z\right] = e^{-(z)^{-\theta}}.$$

This distributional assumption will have a number of useful implications, rendering the model analytically very tractable.

The unitary wage w_j is a composite of earnings in the two sectors $\ell \in \{F, N\}$,

$$w_j = w_j^F l_j^F + w_j^N l_j^N \tag{7}$$

where l_j^{ℓ} is the supply of labor of the household to the respective sector. To allocate labor

[35] Our setting can be generalized to $\alpha(e)$ being non-degenerate random variables.

[36] This is similar to the propensity score from the empirical analysis of workers of type e in occupations j.

[37] Notice that in our framework, all other factors that enhance earnings in the second period but do not reduce earnings in the first period would be subsumed in the term $\gamma(e,j)$, possibly as a uniform shifter.

supply we assume a non-standard time constraint on the household side to capture imperfect labor mobility in each occupation j across the two sectors ℓ according to

$$1 = g(l_j^F, l_j^N) = \left(\sum_{\ell \in \{F,N\}} l_j^{\ell^{1+\frac{1}{\epsilon}}} \right)^{\frac{1}{1+\frac{1}{\epsilon}}} \tag{8}$$

where $\epsilon > 0$ is the elasticity of substitution. $\epsilon = \infty$ implies perfect labor mobility across the two sectors. We assume $\epsilon < \infty$ which implies a well-defined equilibrium on the market for human capital such that in each occupation there exists an equilibrium wage vector $[w_j^F, w_j^N]$, which clears the market for human capital such that the aggregate supply of human capital to occupation j and sector ℓ by households, $H_j^\ell = l_j^\ell H_j$, coincides with the firm demand in both sectors $\ell \in \{F, N\}$.

Earnings y_0 and $y_1(j)$ are measured in units of capital goods of periods 0 and 1, respectively. We explain below the optimal human capital and occupation choices of workers and how their earnings are converted into consumption in the goods and financial markets.

We describe details of the human capital investment and consumption decisions below when introducing financial markets because the household problem differs by the type of financial contract the household chooses to finance its human capital investment and second period consumption decisions.

Production. Note that in the first period, $t = 0$, households have endowments of $t = 0$ capital goods that can be either consumed or invested (capital) for production in $t = 1$. In the second period, $t = 1$, competitive firms can produce non-finance output, Q_N, or finance-intermediation output, Q_F. The output Q_F is used to provide capital for the production of Q_N, which in turn is used for the consumption of workers, the capitalist and, potentially, monopolistic intermediaries (see blow) in period $t = 1$.

Denote by $\mathbf{H}^\ell = \left\{H_j^\ell\right\}_{j=1}^J$, $\mathbf{K}^\ell = \left\{K_j^\ell\right\}_{j=1}^J$ the vector of aggregate skills and capital in each of the occupations $j \in \{1, \ldots, J\}$ and sectors $\ell \in \{F, N\}$ and by $Z^\ell > 0$ total-factor-productivity (TFP) levels. The production functions for the sectors $\ell = \{F, N\}$ are then

$$Q_\ell = Z^\ell \mathcal{Q}^\ell \left(\mathbf{H}^\ell, \mathbf{K}^\ell\right), \tag{9}$$

where the terms $\mathcal{Q}^\ell(\cdot)$ are constant returns to scale (CRS) production functions.

Specifically, we assume that $\mathcal{Q}^\ell(\cdot)$ are nested CES production functions. At the outer nest we augment occupation specific output Q_j^ℓ in both sectors $\ell \in \{F, N\}$ with occupation specific weights λ_j^ℓ, where $\sum_{j=1}^J \lambda_j^\ell = 1$ and a common curvature parameters $-\infty < \rho_0 < 1$—

so that $\frac{1}{1-\rho_0}$ is the substitution elasticity across occupational outputs. In sector N we additionally assume production with land L

$$\mathcal{Q}^{\ell}\left(\mathbf{H}^{\ell},\mathbf{K}^{\ell}\right)=L^{1-\varsigma_{\ell}}\left[\sum_{j=1}^{J}\lambda_{j}^{\ell}\left(Q_{j}^{\ell}\right)^{\rho_0}\right]^{\frac{\varsigma_{\ell}}{\rho_0}} \tag{10}$$

and throughout we have $\varsigma_F = 1$ and $0 < \varsigma_N = \varsigma \leq 1$. Furthermore, without loss of generality, we normalize $L = 1$ and drop it in our notation.

Second, output of each occupation j is given by CES production functions with occupation specific human capital share parameters $\mu_j \in (0,1)$ and inner-elasticity parameters $-\infty < \rho_j < 1$, both of which are common across both sectors:

$$Q_j^{\ell}\left(H_j^{\ell},K_j^{\ell}\right)=\left[\mu_j\left(H_j^{\ell}\right)^{\rho_j}+\left(1-\mu_j\right)\left(K_j^{\ell}\right)^{\rho_j}\right]^{\frac{1}{\rho_j}} \text{ for } \ell\in\{F,N\}. \tag{11}$$

Despite the restrictions that inner-CES share and elasticity parameters $\left\{\mu_j,\, \rho_j\right\}$ and the outer elasticity parameter ρ_0 are common across F and N, our specification allows for considerable flexibility. Cross-sector differences between the sector and occupation-specific output share parameters $\left\{\lambda_j^{\ell}\right\}_{j=1}^{J}$ allow for occupation- and skill-intensity differences that have been highlighted between finance and non-finance sectors. Moreover, cross-occupation variations in the human capital share parameters $\left\{\mu_j,\, \rho_j\right\}$ can easily capture capital-skill complementarity in a much richer setting where workers can be reallocated across occupations.

Capitalist. We assume an exogenous perfectly inelastic supply of capital of amount $\bar{K}$ by a capitalist lender. The capitalist lends part of this financial capital, amount L^k, to the finance sector F for production and uses the remainder to finance its own first period consumption c_0^k. Therefore, the first-period budget constraint of the capitalist is

$$c_0^k + L^k = \bar{K}.$$

Lending to the finance sector is at endogenous interest factor R, which the capitalist takes as given. In the second period, the capitalist consumes c_1^k goods produced by the non-finance sector N at relative price p^N. The second period budget constraint is accordingly

$$p^N c_1^k = R \cdot L^k.$$

The capitalist maximizes utility from consumption in the two periods and, making the same parametric and functional form assumptions as for households and since the capitalist does not face any risk, life time utility of the capitalist is

$$U_0^k = \frac{c_0^{1-\sigma}}{1-\sigma} + \beta \frac{c_1^{1-\sigma}}{1-\sigma},$$

and utility maximization gives the familiar inter-temporal Euler equation

$$c_1^k = \left(\frac{\beta R}{p^N}\right)^{\frac{1}{\sigma}} c_0^k.$$

Landowners. The owners of land receive share $1-\varsigma$ of valued output $p_N Q_N$ for consumption c_1^L of the output good Q_N. The budget constraint for landowners is thus

$$p^N c_1^L = (1-\varsigma) p^N Q_N.$$

Intermediation Services. Financial firms fulfill a dual role. They provide intermediation services for production—to both finance and non-finance firms—and for household finances. Specifically, firms in finance receive the deposits L^k by the capitalist and a total amount of aggregate savings S from households which they distribute to the sectors finance, F, and non-finance, N, for production. From this total amount of deposits $L^k + S$ they further have to finance all lending to households, i.e. the aggregate amount of household borrowing B, and the aggregate transaction costs of all household finance intermediation services Υ. Denote by $K^\ell = \sum_{j=1}^J K_j^\ell$ the total capital stock employed for production in sector $\ell \in \{F, N\}$. Then, the period 0 aggregate *lending resource constraint* for financial firms is

$$L^k + S = K^F + K^N + B + \Upsilon \tag{12}$$

We further assume that for providing these services, i.e. for each unit of capital lent to sector N and to private households, firms in finance need servicing resources of the same amount.[38] In addition, financial firms may need to self-finance a fraction $\chi \in [0,1]$ of their own capital stock. For this self-financing activity they have to provide financial services of amount $\chi \left(K^F + \Upsilon\right)$ with the underlying assumption that the transaction costs of self-financing are proportional to the aggregate transaction costs of household finance Υ because it is the same pool of financial services that sector F draws from. In one extreme, if $\chi = 0$, financial firms can directly finance their operations from the capitalist at price R. In the other extreme, $\chi = 1$, finance and non-finance firms are in equal footing in the sense that both

[38] We thus assume a Leontief structure of financial services.

need finance services to utilize each unit of physical capital. Denoting by Q^F the aggregate production of sector F, financial firms therefore additionally face the overall period 0 *financial intermediation resource constraint*

$$Q^F \geq K^N + B + \chi \left(K^F + \Upsilon\right). \tag{13}$$

The setup costs of financial contracts to households vary with the degree of sophistication of the respective contract. Specifically, there are two forms of contracts that financial firms can offer to households: 'generic' or 'personalized.' Setting up a generic contract entails a fixed cost $\kappa_g \geq 0$ of units of the $t = 0$ good. In these contracts, the financial intermediary and the household transfer resources at time $t = 0$ in exchange of a promise for a fixed transfer at time $t = 1$. These transfers can be set as functions of observable information at $t = 0$ but not made contingent on the then unknown realizations at $t = 1$. Setting up a personalized contract entails a fixed cost $\kappa_p \geq \kappa_g$ of units of the $t = 0$ good. In these contracts, the financial intermediary and the household transfer resources at time $t = 0$ in exchange of a promise of fully state-contingent transfer at time $t = 1$. These transfers can be set as functions of observable information at $t = 0$ and the realizations of the worker's labor market outcomes at $t = 1$ because the additional resources $\kappa_p - \kappa_g$ are meant to cover the costs of setting up the communication and verification mechanisms needed for the intermediary to set those contingent payments.

Finance contracts with households are subject to limited commitment: Workers always have the option to default on repayments at the cost of losing a fraction $\zeta \in [0, 1]$ of their $t = 1$ income. These temptations are fully understood by financial intermediaries and are thus incorporated in the design of both generic and personalized contracts as detailed in the next section.

Timing. The timing in this model economy is as follows. In period $t = 0$ households decide on the type of contracts, the amount of borrowing or savings in the respective contract, on period 0 consumption and on investments in human capital. Financial intermediaries use resources to pay for the setup costs of the financial contracts for the households customers and for the capital goods used by non-financial firms and, perhaps, for financial firms they service. Thus, both $\left\{K_j^F\right\}$ and $\left\{K_j^N\right\}$ need to be set at $t = 0$, by the financial firms, and therefore need to pay the time-costs, i.e. the respective interest rates R^F and R^N as defined below. In period $t = 1$, firms receive the contracted capitals $\left\{K_j^F\right\}$ and $\left\{K_j^N\right\}$, hire workers $\left\{H_j^F\right\}$ and $\left\{H_j^N\right\}$ across occupations and deliver factor payments. In that period, households realize their idiosyncratic productivity outcomes, decide occupations, collect earnings and decide on period 1 consumption and, conditional on borrowing, their debt repayments.

5.2 Equilibrium

Given the interest rate R charged by the capitalist for lending to the finance sector, and endogenously determined unitary intermediation costs, denoted by p^F, the total costs of operating capital for non-finance firms N are $R^N = R + p^F$. Since finance firms only self-finance fraction χ of their operations, the total costs of operation capital for finance firms are $R^F = R + \chi \cdot p^F$. These prices are in units of the consumption/finance good of $t = 0$, our chosen numeraire. The equilibrium price system also includes the price of consumption goods, p^N, and the unitary skill prices $\{w_j\}_{j=1}^{J}$, which, for convenience we denominate in units of the finance good at $t = 1$. Aside from these prices, an equilibrium determines individually optimal choices of households and firms. For households, these decisions are: at time $t = 0$: (a) the selection of autarky, savings, or lending in generic or personalized financial contracts; and, (b) the amount of period 0 consumption, saving, borrowing and human capital investments, which are conditional on the financial arrangement chosen; at time $t = 1$: (c) the occupation choices and (d) whether to repay or default, conditional on borrowing, as well as period 1 consumption. For firms the decisions are in the amount of capital and labor skills to hire across the different occupations. In this section we develop each of these decisions and then derive the aggregate market clearing conditions required for a competitive equilibrium.

5.2.1 Household Financial Arrangements

At $t = 0$, each household optimizes in their choice among four available financial arrangements: autarky, borrowing in generic contracts, borrowing in personalized contracts or saving (in generic or personalized contracts). We overlay this set of arrangements with two types of market regimes for generic contracts, one with a monopolistic competition, the other under perfect competition. In the first regime, households choose between (i) autarky (aut), (ii) *b*orrowing in *g*eneric contracts under *m*onopolistic competition (bgm)—mimicking the economy in the U.S. before bank branching deregulation—, (iii) *s*avings in *g*eneric contracts (sg), (iv) *b*orrowing in *p*ersonalized contracts (bp), and (iv) *s*aving in *p*ersonalized contracts (sp). In the second regime—mimicking the economy in the U.S. after bank branching deregulation—*b*orrowing in *g*eneric contracts takes place in *c*ompetitive markets (bgc) rather than under monopolistic competition. To formalize this discrete choice problem, we write choices as $m \in \mathcal{M}$, where it is understood that $\mathcal{M} = \{aut, bgm, sg, bp, sp\}$ before bank branching deregulation and $\mathcal{M} = \{aut, bgc, sg, bp, sp\}$ after those reforms. Furthermore, we argue below that it will not be optimal for households to borrow and save at the same time, so that these choices are exclusive options in the respective regime. Conditional on the contract decision $m \in \mathcal{M}$, each household decides on human capital investments in the first period of live and on the occupation to work in as well as potential default on borrowing in the second period.

Financial Autarky, $m = aut$**.** Households always have the option of not engaging in financial markets at all. If so, the only decision in the first period is how much human capital to accumulate so that $c_0 = \alpha(e)(1-h)$. In the second period, households decide on their occupation so that their consumption expenditures in occupation j and for realized income shock η_j are $p^N c_1(j, \eta_j) = \alpha(e) h^\psi \gamma(e, j) w_j \eta_j$. Thus, the optimization problem in period 0 is

$$\max_h \frac{[\alpha(e)(1-h)]^{1-\sigma}}{1-\sigma} + \beta \frac{E\left[\frac{\alpha(e)h^\psi}{p^N} \cdot \max_j \left\{\gamma(e,j) w_j \eta_j\right\}\right]^{1-\sigma}}{1-\sigma}.$$

The worker can foresee the optimal occupation choice at $t = 1$ and that this choice is neutral to the level of h. Define by

$$y \equiv \max_j \left\{\gamma(e,j) w_j \eta_j\right\},$$

the random component of earnings in the second period under the optimal occupation choices. This is a random variable that depends not only on the random shocks $\{\eta_j\}$ and equilibrium prices $\{w_j\}$ but also on the worker's type e. The first order condition for h is

$$[1-h]^{-\sigma} = \beta \psi h^{\psi(1-\sigma)-1} E\left[\frac{y}{p^N}\right]^{1-\sigma}.$$

It is straightforward to show that there is a unique, positive level $h(e; m = aut)$ that solves this equation: The LHS is strictly increasing, while the RHS is strictly decreasing since $\psi(1-\sigma) < 1$. The associated discrete contract choice specific utility in autarky is accordingly

$$U(e; aut) = \frac{[\alpha(e)(1-h(e;aut))]^{1-\sigma}}{1-\sigma} + \beta \frac{\left[\frac{\alpha(e)(h(e;aut))^\psi}{p^N}\right]^{1-\sigma} E[y]^{1-\sigma}}{1-\sigma}.$$

The utility $U(e; aut)$ is always an option. It also defines the participation constraint for monopolized markets.

Generic Contracts. We now consider the allocations attained under 'generic' contracts, where the loan repayments cannot be made contingent on $t = 1$ labor market realizations y. As suggested above, such a restriction can be conceptualized as the decision of a lender of not setting up the information gathering mechanisms required to collect and verify the information on the borrower's realizations y but only on the household type e and its human capital investment h. Recall that setting up each of these contracts entails a fixed cost $\kappa_g \geq 0$ of $t = 0$ goods.

Borrowers, $m = gbm$ and $m = gbc$: These generic contract are characterized by two numbers: A lending amount $b > 0$, that the lender gives to the borrower at time $t = 0$, and a "promise" of the borrower to repay the lender a constant amount $d > 0$. The borrower retains the option to default, i.e. consuming a fraction $(1 - \zeta)$ of his earnings in period $t = 1$. With uncontingent repayments, limited commitment, and the full-support Frechet distribution of earnings, default occurs with positive probability for any positive repayment d.[39]

The contract can be seen as entailing two transactions: A transfer $b > 0$ to the household at $t = 0$ in exchange for a promised repayment $d > 0$ to the financial firms at $t = 1$. The two numbers (b, d) must balance multiple trade-offs, not only that the financial firms must recover its investments in expectation, but also balance the worker's incentives to repay and also to invest in human capital h. Given the limited commitment to repay and the lack of contingencies, default emerges as a costly option to partially provide insurance against low y realizations.

For a worker of type e investing h in human capital and borrowing b, the consumption at period $t = 0$ will be

$$c_0 = \alpha(e)\,(1 - h) + b.$$

With a committed repayment d the consumption at $t = 1$ is a random variable

$$c_1 = \max\left\{\frac{\alpha(e)h^{\psi}y \ - d}{p_N}, \frac{(1-\zeta)\,\alpha(e)h^{\psi}y}{p_N}\right\}.$$

The left branch applies in the states in which the household repays d; the right branch applies when the household defaults. For a household the optimal repayment/default decision is defined by a threshold: It is optimal to repayment when the realization y equals or exceeds

[39] For simplicity, lenders do not recover any income when borrowers default.

the threshold

$$\bar{y}^{\text{def}} \equiv \frac{d}{\zeta\alpha(e)h^{\psi}},$$

where, for brevity, we write $\bar{y}^{\text{def}}$ as a number but it is a function $\bar{y}^{\text{def}}(d,h,e)$ that depends on the worker's debt, human capital and type.

The probability of default, $\varrho(d,\cdot)$ is determined by the cumulative probability of the realizations below this threshold

$$\varrho(d,h;e,\mathbf{w}) = \Pr\left[y < \bar{y}^{\text{def}}\right] = e^{-\left(\frac{\bar{y}^{\text{def}}(d;h,e)}{\Phi(e;\mathbf{w})}\right)^{-\theta}}.$$

This formula arises since y has a Frechet distribution with curvature θ and location $\Phi(e;\mathbf{w}) \equiv \left[\sum_{j=1}^{J}\left[\gamma(e,j)w_j\right]^{\theta}\right]^{\frac{1}{\theta}}$. The term $\Phi(e;\mathbf{w})$ endogenously change with the wages $\mathbf{w} = \{w_j\}_{j=1}^{J}$ and depends on e because it determines the worker's comparative advantage across occupations j.

The probability of default is: (i) increasing in the repayment amount d, (ii) decreasing in human capital investments h, (iii) decreasing in the income factor $\alpha(e)$ and (iv) decreasing in the expected average earnings $\Phi(e;\mathbf{w})$. These factors are fully internalized by the lender at the time of offering a contract to the household, which we assume that can be made conditional on h, i.e. the lender can direct the household how much to invest in h. For risk-neutral lenders, the $t=1$ net payoff from this borrowing in the generic contract is

$$P(b,d,h;e;bg) = -\kappa_g \cdot R^F - b \cdot R^N + d \cdot (1 - \varrho(d,h;e,\mathbf{w})).$$

The negative terms, i.e. the costs for the bank, are in terms of the set-up cost of the generic contract, κ_g and the cost of the resources b lent. The costs to set up the contract, κ_g, is compounded at the rate R^F, because that is the cost of capital for the operations of financial intermediaries; in contrast, R^N compounds the costs of the funds lent to households since they need to use the services of financial intermediaries. The positive term is expected period $t=1$ revenue given by the promised repayment d which will be received only with probability $1-\varrho(d,h;e,\mathbf{w})$.

Given a pair (b,d), the expected utility for a household from borrowing in a generic contract and investing human capital h is

$$U\left(b,d,h;e;bg\right)=\frac{\left[\alpha(e)\left(1-h\right)+b\right]^{1-\sigma}}{1-\sigma}$$
$$+\frac{\beta}{\left(p^{N}\right)^{1-\sigma}}\left\{\int_{0}^{\bar{y}^{\text{def}}}\frac{\left[\left(1-\zeta\right)\alpha(e)h^{\psi}y\right]^{1-\sigma}}{1-\sigma}f\left(y\right)dy+\int_{\bar{y}^{\text{def}}}^{\infty}\frac{\left[\alpha(e)h^{\psi}y-d\right]^{1-\sigma}}{1-\sigma}f\left(y\right)dy\right\}.$$

In our quantitative exercises, we consider economies that have one of two possible extremes degree of competitiveness in the market of generic lending contracts. The first case is when the markets are *competitive*. If so, financial firms offer the best contract that maximizes the expected utility of the borrower as long as in expectation the lender breaks even, i.e.:

$$\left\{b\left(e;bgc\right),d\left(e;bgc\right),h\left(e;bgc\right)\right\}\in\arg\max_{(b,d,h)\geq0}\left\{\ U\left(b,d,h;e;bg\right)\ \text{ s.t.: }\ P\left(b,d,h;e;bg\right)\geq0\right\}.$$

The second extreme is when these markets are *monopolized*. Here, financial firms offer the contract that maximizes their expected net payoffs. Thus:

$$\left\{b\left(e;bgm\right),d\left(e;bgm\right),h\left(e;bgm\right)\right\}$$
$$\in\arg\max_{(b,d,h)\geq0}\left\{P\left(b,d,h;e;bg\right)\ \text{ s.t.: }\ U\left(b,d,h;e;bg\right)\geq U\left(e;aut\right)\left(e\right)\right\}.$$

We denote the according (maximized) contract choice specific utilities by $U(e;bgc)$ and $U(e;bgm)$, respectively, and by $P(e;bgm)$ the according maximized monopolistic profits. In both cases, if the feasible set for the maximizations that define these maximized utility levels is empty, then they are set to $-\infty$.

Lenders, $m=sg$: Instead of borrowing, some households might opt to save. If so, default is not an issue and *generic savings* contract would be simple to characterize: for savings $s\geq0$ the bank offers a return $z\geq0$. Given a triplet $(s,z,h)\geq0$, the expected utility of a generic saver is

$$U\left(s,z,h;e;sg\right)=\frac{\left[\alpha(e)\left(1-h\right)-s\right]^{1-\sigma}}{1-\sigma}+\frac{\beta}{\left(p^{N}\right)^{1-\sigma}}\left\{\int_{0}^{\infty}\frac{\left[\alpha(e)h^{\psi}y+z\right]^{1-\sigma}}{1-\sigma}f\left(y\right)dy\right\}.$$

Generic savings contracts might also entail a fixed setup cost, κ_{g}^{s}, albeit lower than those of generic borrowing contracts, i.e.: $0\leq\kappa_{g}^{s}<\kappa_{g}$. Then, the net payoffs for the financial intermediary are simply

$$P(s, z; sg) = -\kappa_g^s \cdot R^F + s \cdot R - z.$$

Notice here that the lower rate R is the relevant rate for savings since the household would not be collecting the costs of intermediation that is included in R^N, when households are borrowing.

We assume that markets for savers are competitive. Then, the allocations are given by

$$\{s\left(e; sg\right), z\left(e; sg\right), h\left(e; sg\right)\} \in \arg\max_{(s,z,h)\geq 0} \{U\left(s, z, h; e; sg\right) \text{ s.t.: } P(s, z; sg) \geq 0\}.$$

We denote by $U\left(e; sg\right)$ the expected utility attained by households that opt for generic savings contracts. If $\{P(s, z; sg) \geq 0\}$ is the empty set, then $U\left(e; sg\right) = -\infty$.

Personalized Contracts. We now consider the allocations and attained utilities under personalized contracts. These arrangements involve higher setup costs, $\kappa_p \geq \kappa_g$, but can be substantially more sophisticated since the repayments can be made contingent on the realization y in $t = 1$. Financial markets for personalized contracts are assumed to be competitive.

The expected utility of a household with borrowing b and savings s, at time $t = 0$, and repayments, $d\left(y\right)$ to/from the bank in $t = 1$ is

$$U\left(s, b, d\left(\cdot\right), h; e; p\right) = \frac{\left[\alpha(e)\left(1-h\right) - s + b\right]^{1-\sigma}}{1-\sigma} + \beta \int_0^\infty \frac{\left[\frac{\alpha(e) h^\psi y - d(y)}{p^N}\right]^{1-\sigma}}{1-\sigma} f\left(y\right) dy,$$

while the net payoff for the intermediary in personalized contracts is

$$P(b, s, d(\cdot); p) = -\kappa_p \cdot R^F - b \cdot R^N + s \cdot R + \int_0^\infty d\left(y\right) f\left(y\right) dy,$$

where the differences in the rates of return of savings s and borrowing b would make them mutually exclusive in equilibrium. Observe that set up costs are compounded using R^F, savings are compound using R and borrowing using R^N, for the same reasons as explained above.

Recall that workers can renege on a payment. Since they can always consume a fraction $(1-\zeta)$ of their income, the repayment $d\left(y\right)$ is limited by the no-default constraint:

$$\frac{\zeta \alpha(e) h^\psi y - d\left(y\right)}{p^N} \geq 0, \quad \text{for all } y.$$

Denote $\lambda(y)$ the (normalized) Lagrange multiplier associated to these infinitely many repayment constraints. Then, the Lagrangean associated with the optimal competitive contract, i.e. the one that maximizes the expected utility of the household is given by

$$\mathcal{L} = \max_{s,b,d(y)} \frac{[\alpha(e)(1-h)-s+b]^{1-\sigma}}{1-\sigma} + \beta \int_0^\infty \frac{\left[\frac{\alpha(e)h^\psi y - d(y)}{p^N}\right]^{1-\sigma}}{1-\sigma} f(y)\,dy$$
$$+ \mu\beta P(b,s,d(\cdot);p) + \beta\left[\int_0^\infty \lambda(y)\left[\frac{\zeta\alpha(e)h^\psi y - d(y)}{p^N}\right] f(y)\,dy\right]. \quad (14)$$

From the corresponding first-order conditions derived in Appendix B.3, we get the following two cases:

Borrowers, $m = bp$: For $d > 0 = s$ we obtain by rearranging the first-order conditions for b and $d(y)$

$$c_0^{-\sigma} = \frac{\beta R^N}{p^N} c_1(y)^{-\sigma} + \beta R^N \lambda(y).$$

Therefore, if $\lambda(y) = 0$, then the no-default constraint does not bind and

$$c_1(y) = \left(\frac{\beta R^N}{p^N}\right)^{\frac{1}{\sigma}} c_0.$$

For those realizations y there is perfect smoothing in consumption between $t = 0$ and $t = 1$, given the prices R^N and p^N. If however, $\lambda(y) > 0$, then the no-default constraint binds, repayments are limited to $d(y) = \zeta\alpha(e)h^\psi y$ and consumption will be increasing in y:

$$c_1(y) = \frac{(1-\zeta)\,\alpha(e)h^\psi y}{p^N} > \left(\frac{\beta R^N}{p^N}\right)^{\frac{1}{\sigma}} c_0.$$

The optimal human capital can be characterized using the optimality conditions for h and b. Define

$$\Theta\left(\lambda; p^N\right) \equiv \frac{1}{p^N}(1-\zeta)\int_0^\infty y\lambda(y) f(y)\,dy,$$

which is a measure of how tight the non-default constraints are. Using the properties of the Frechet distribution and the optimal $t = 1$ occupation choices, after some algebra, we can derive the optimal investment in human capital

$$h(e; bp) = \left\{\left(\frac{\psi}{R^N}\right)\left[\Gamma\left(1-\frac{1}{\theta}\right)\Phi(e;\mathbf{w}) - \frac{\Theta\left(\lambda;p^N\right)}{\mu}\right]\right\}^{\frac{1}{1-\psi}}.$$

Notice that without limited commitment, $\lambda(y) = 0$ for all y, then $\Theta\left(\lambda; p^N\right) = 0$ and then the optimal human capital would at the first best level.

Having pinned down the optimal consumption level $c_0(e; bp)$, the amount of borrowing is

$$b(e; bp) = c_0(e; bp) - \alpha(e)\left(1 - h(e; bp)\right)$$

and the income contingent repayments are

$$d\left(y; e; bp\right) = \begin{cases} \alpha(e)h(e; bp)^{\psi}y - p^N\left(\frac{\beta R^N}{p^N}\right)^{\frac{1}{\sigma}}c_0(e; bp) & \text{for } y \leq \frac{p^N\left(\beta R^N/p^N\right)^{\frac{1}{\sigma}}}{(1-\zeta)\alpha(e)h(e;bp)^{\psi}}c_0(e; bp) \\ \zeta\alpha(e)h(e; bp)^{\psi}y & \text{otherwise.} \end{cases}$$

Savers, $m = sp$: For $b = 0 < s$, after rearranging the first order conditions for s and $d\left(y\right)$, we obtain:

$$c_0^{-\sigma} = \frac{\beta R}{p^N}c_1\left(y\right)^{-\sigma} + \beta R\lambda\left(y\right).$$

Therefore, if $\lambda\left(y\right) = 0$, then the no-default constraint does not bind and we get

$$c_1\left(y\right) = \left(\frac{\beta R}{p^N}\right)^{\frac{1}{\sigma}}c_0.$$

For those realizations y there is perfect smoothing in consumption between $t = 0$ and $t = 1$, given prices R and p^N. If however, $\lambda\left(y\right) > 0$, then the no-default constraint binds, repayments are limited to $d\left(y\right) = \zeta\alpha(e)h^{\psi}y$ and consumption will be increasing in y:

$$c_1\left(y\right) = \frac{\left(1-\zeta\right)\alpha(e)h^{\psi}y}{p^N} > \left(\frac{\beta R}{p^N}\right)^{\frac{1}{\sigma}}c_0.$$

Notice that therefore, even if a household has positive savings in $t = 0$, for high realizations of income in $t = 1$, it would be required in the optimal contract to make a payment to the financial intermediary.

The optimal human capital can be characterized using the optimality conditions for h and s as before

$$h\left(e; sp\right) = \left\{\frac{\psi}{R}\left[\Gamma\left(1 - \frac{1}{\theta}\right)\Phi\left(e; \mathbf{w}\right) - \frac{\Theta\left(\lambda; p^N\right)}{\mu}\right]\right\}^{\frac{1}{1-\psi}},$$

where $\Theta\left(\lambda; p^N\right)$ is defined as above. The same useful property that the entire contract can be written in terms of $c_0(e; sp)$ and $h(e; sp)$ still holds. Given those, the amount of saving is

$$s(e; sp) = \alpha(e)\left(1 - h(e; sp)\right) - c_0(e; sp).$$

and the repayments would be

$$d\left(y;e;sp\right)=\begin{cases}\alpha(e)h(e;sp)^{\psi}y-p^{N}\left(\frac{\beta R}{p^{N}}\right)^{\frac{1}{\sigma}}c_0(e;sp) & \text{for } y\leq\frac{p^{N}\left(\beta R/p^{N}\right)^{\frac{1}{\sigma}}}{(1-\zeta)\alpha(e)h(e;sp)^{\psi}}c_0(e;sp)\\ \zeta\alpha(e)h(e;sp)^{\psi}y & otherwise.\end{cases}$$

We denote by $U\left(e;bp\right)$, respectively by $U\left(e;sp\right)$, the expected utilities attained by households that opt for borrowing or savings in personalized contracts. If the feasible set for the maximizations that define these maxima is empty, e.g. if κ_p is too high, then $U\left(e;bp\right)=-\infty$, respectively $U\left(e;sp\right)=-\infty$.

Households Occupation Choices and Aggregation. In addition to the attainable utility values in these alternative $m\in\mathcal{M}$, we assume that households draw i.i.d. preference shocks $\varepsilon(m)$ for each option. We include these shocks to smooth out the contract choices of households, and for tractability we assume that these shocks are extreme value Type I distributed with parameter $\varkappa>0$. Thus, a household of type e would choose a contract m with probability

$$\xi\left(e;m\right)=\frac{\exp\left\{\frac{U(e;m)}{\varkappa}\right\}}{\sum_{\mathrm{i}\in\mathcal{M}}\exp\left\{\frac{U(e;i)}{\varkappa}\right\}};$$

obviously, if $U\left(e;m\right)=-\infty$, then these households will not choose contract m and this is indicated by $\xi\left(e;m\right)=0$.

Then, from each group e, there is an aggregate investment in human capital

$$\Psi(e)\sum_{\mathrm{m}\in\mathcal{M}}\xi\left(e;m\right)h\left(e;m\right).$$

Since investments in h only shift the absolute productivity of workers across occupations j, these investments do not influence the $t=1$ occupation choices of these workers. Since the shocks $\left\{\eta_j\right\}$ are Frechet distributed, it can be shown that, regardless of the contract m chosen, the probability that a worker of type e chooses occupations j is solely determined by the wages $\{w_j\}$ and the comparative advantages of the workers $\gamma(e,j)$:

$$\pi\left(e,j\right)=\frac{\left[\gamma(e,j)w_j\right]^{\theta}}{\left[\sum_{k=1}^{J}\left[\gamma(e,k)w_k\right]^{\theta}\right]}.$$

Likewise, the Frechet distribution allows for correcting for selection in closed form. The average level of skills provided by those workers is given by

$$\Gamma\left(1-\frac{1}{\theta}\right)\alpha(e)\left[h(e;m)\right]^{\psi}\gamma(e,j)\cdot\left[\pi\left(e,j\right)\right]^{-\frac{1}{\theta}},$$

and thus influenced by the contractual arrangement m. Since each group e submits $\Psi(e)\pi(e,j)$ to occupation j, then the aggregate skills provided from all the worker types to each occupation j is

$$H_j=\Gamma\left(1-\frac{1}{\theta}\right)\sum_{e=1}^{E}\Psi(e)\alpha(e)\left\{\sum_{\mathrm{m}\in\mathcal{M}}\xi\left(e;m\right)\left[h(e;m)\right]^{\psi}\right\}\gamma(e,j)\cdot\left[\pi\left(e,j\right)\right]^{1-\frac{1}{\theta}}. \tag{15}$$

Finally, household consumption in period 1 is

$$C_1=\sum_{e=1}^{E}\Psi(e)\sum_{m\in\mathcal{M}}\xi\left(e;m\right)c_1\left(e;m\right), \tag{16}$$

cf. Appendix B.4 for the derivations of $c_1(e;m)$ for all $m\in\mathcal{M}$.

In terms of financial markets, before the reforms of bank branching deregulation, the demand of financial services from the household aggregate borrowing, saving and the use of resources for setting up their contracts at $t=0$ as well as profits in the finance sector and thus consumption of the monopolists in period 1 are, respectively,

$$B=\sum_{e=1}^{E}\Psi(e)\left[\xi\left(e;bgm\right)b\left(e;bgm\right)+\xi\left(e;bp\right)b\left(e;bp\right)\right], \tag{17a}$$

$$S=\sum_{e=1}^{E}\Psi(e)\left[\xi\left(e;sgm\right)s\left(e;sgm\right)+\xi\left(e;sp\right)s\left(e;sp\right)\right], \tag{17b}$$

$$\Upsilon=\sum_{e=1}^{E}\Psi(e)\left[\xi\left(e;bgm\right)\kappa_g+\xi\left(e;sgm\right)\kappa_g^s+\left(\xi\left(e;pb\right)+\xi\left(e;ps\right)\right)\kappa_p\right] \tag{17c}$$

$$C_1^m=\sum_{e=1}^{E}\Psi(e)\xi\left(e;bgm\right)P(e;bgm). \tag{17d}$$

The corresponding objects after the financial market reform of bank branching deregulation are defined accordingly (where $C_1^m=0$).

5.2.2 Firms

Firms—the financial intermediary firm F and the final consumption goods producing firm N—maximize profits taking output output prices, p^ℓ, $\ell\in\{F,N\}$, and input prices, $\{w^j\}_{j=1}^{J}$ and

R^ℓ, $\ell \in \{F, N\}$, as given and solve:

$$\max_{\{H_j^\ell,\, K_j^\ell\}} \left\{ p^\ell Z^\ell \mathcal{Q}^\ell \left(\mathbf{H}^\ell, \mathbf{K}^\ell\right) - \sum_{j=1}^{J} w_j^\ell H_j^\ell - R^\ell \sum_{j=1}^{J} K_j^\ell \right\}.$$

The solutions to these problems are standard and determined by the first order conditions:

$$p^\ell Z^\ell \frac{\partial \mathcal{Q}^\ell \left(\mathbf{H}^\ell, \mathbf{K}^\ell\right)}{\partial H_j^\ell} = w_j^\ell \;\text{ and } p^\ell Z^\ell \frac{\partial \mathcal{Q}^\ell \left(\mathbf{H}^\ell, \mathbf{K}^\ell\right)}{\partial K_j^\ell} = R^\ell.$$

The nested-CES structure of the production functions leads to usable formulas for the relative demand of factors within and between the two sectors. To shorten notation define

$$\begin{aligned} M^\ell &\equiv \varsigma_\ell Z^\ell \left[\sum_{j=1}^{J} \lambda_j^\ell \left[\mu_j \left(H_j^\ell\right)^{\rho_j} + \left(1-\mu_j\right)\left(K_j^\ell\right)^{\rho_j}\right]^{\frac{\rho_o}{\rho_j}} \right]^{\frac{\varsigma_\ell}{\rho_o}-1} \\ &= \varsigma_\ell Z^\ell \left[\sum_{j=1}^{J} \lambda_j^\ell \left(\left[\mu_j + \left(1-\mu_j\right)\left(\frac{1}{\varphi_j^\ell}\right)^{\rho_j}\right]^{\frac{1}{\rho_j}} H_j^\ell \right)^{\rho_o} \right]^{\frac{\varsigma_\ell}{\rho_o}-1}, \end{aligned} \tag{18}$$

where $\varphi_j^\ell \equiv \frac{H_j^\ell}{K_j^\ell}$ for both sectors $\ell = \{N, F\}$ so that the first order conditions for H_j^ℓ and K_j^ℓ become

$$\begin{aligned} w_j^\ell &= p^\ell \cdot M^\ell \cdot \left[\mu_j \left(H_j^\ell\right)^{\rho_j} + \left(1-\mu_j\right)\left(K_j^\ell\right)^{\rho_j}\right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^\ell \mu_j \left(H_j^\ell\right)^{\rho_j - 1} \\ &= p^\ell \cdot M^\ell \cdot \left[\mu_j + \left(1-\mu_j\right)\left(\frac{1}{\varphi_j^\ell}\right)^{\rho_j}\right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^\ell \mu_j \left(H_j^\ell\right)^{\rho_o - 1} \end{aligned} \tag{19}$$

and

$$\begin{aligned} R^\ell &= p^\ell \cdot M^\ell \cdot \left[\mu_j \left(H_j^\ell\right)^{\rho_j} + \left(1-\mu_j\right)\left(K_j^\ell\right)^{\rho_j}\right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^\ell \left(1-\mu_j\right)\left(K_j^\ell\right)^{\rho_j - 1} \\ &= p^\ell \cdot M^\ell \cdot \left[\mu_j \left(\varphi_j^\ell\right)^{\rho_j} + \left(1-\mu_j\right)\right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^\ell \left(1-\mu_j\right)\left(K_j^\ell\right)^{\rho_o - 1}. \end{aligned} \tag{20}$$

Within each sector, the skill-to-capital ratios, φ_j^N, can be written from equations (19) and (20) in terms of the ratio of input prices and the inner-CES function of each j:

$$\varphi_j^\ell \equiv \frac{H_j^\ell}{K_j^\ell} = \left[\frac{w_j^\ell}{R^\ell}\frac{\left(1-\mu_j\right)}{\mu_j}\right]^{\frac{1}{\rho_j - 1}} \qquad \Rightarrow \qquad \varphi_j^N = \varphi_j^F \left(\frac{R^F}{R^N}\right)^{\frac{1}{\rho_j - 1}}. \tag{21}$$

Similarly, given total amount of capital K^ℓ utilized by sector ℓ, its allocation across all occupations j can be written from equation (20) as

$$K_j^\ell = \vartheta_j^\ell K^\ell$$

where

$$\vartheta_j^\ell \equiv \left[\frac{\theta_j^\ell}{\sum_{i=1}^J \theta_i^\ell}\right] \text{ for } \theta_j^\ell \equiv \left[\left[\mu_j \left(\varphi_j^\ell\right)^{\rho_j} + \left(1-\mu_j\right)\right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^\ell \left(1-\mu_j\right)\right]^{\frac{1}{1-\rho_o}}. \tag{22}$$

Likewise, given total amount of human capital H^ℓ utilized by sector ℓ, its allocation across all occupations j can be written from equation (19) as

$$H_j^\ell = \omega_j^\ell H^\ell \tag{23}$$

where

$$\omega_j^\ell \equiv \left[\frac{\nu_j^\ell}{\sum_{i=1}^J \nu_i^\ell}\right] \text{ for } \nu_j^\ell \equiv \left[\left[\mu_j + \left(1-\mu_j\right)\left(\frac{1}{\varphi_j^\ell}\right)^{\rho_j}\right]^{\frac{\rho_o}{\rho_j}-1} \frac{\lambda_j^\ell \mu_j}{w_j^\ell}\right]^{\frac{1}{1-\rho_o}}. \tag{24}$$

Falling short of closed-form solutions, these expressions are nonetheless quite useful for computing the general equilibrium of the economy.

5.2.3 Market Clearing

Output Prices. Given the capitalists marginal rate R and the self-intermediation requirement χ, for any vector of $\{w_j\}_{j=1}^J$, profit maximization—respectively cost minimization—and competition imply the equilibrium price in sector F as

$$p^F\left(w, R^F\right) = \zeta_F^{-1} \cdot \left[\sum_{j=1}^J \lambda_j^{F\frac{1}{1-\rho_o}} \left(\mu_j^{\frac{1}{1-\rho_j}} w_j^{F\frac{\rho_j}{\rho_j-1}} + (1-\mu_j)^{\frac{1}{1-\rho_j}} R^{F\frac{\rho_j}{\rho_j-1}}\right)^{\frac{\rho_j-1}{\rho_j}\cdot\frac{\rho_o}{\rho_o-1}}\right]^{\frac{\rho_o-1}{\rho_o}}. \tag{25}$$

For sector N profit maximization instead implies

$$p^N(w, R^N) = \frac{1}{\varsigma}\zeta_N^{-\frac{1}{\varsigma}} \left[\sum_j \lambda_j^{N\frac{1}{1-\rho_o}} \left(\mu_j^{\frac{1}{1-\rho_j}} w_j^{N\frac{\rho_j}{\rho_j-1}} + \left(1-\mu_j\right)^{\frac{1}{1-\rho_j}} R^{N\frac{\rho_j}{\rho_j-1}}\right)^{\frac{\rho_j-1}{\rho_j}\cdot\frac{\rho_o}{\rho_o-1}}\right]^{\frac{\rho_o-1}{\rho_o}} \cdot Q_N^{\frac{1-\varsigma}{\varsigma}}. \tag{26}$$

and thus the optimal price depends on the amount of output produced, Q_N. See Appendix B.5 for details on the derivation.

Goods and Labor Market Clearing. On the goods market, the condition condition is that the financial services constraints holds with equality

$$Q^F = K^N + \chi K^F + B + \Upsilon, \tag{27}$$

since these services do not entail a consumption value. Fraction ς of goods produced in the non-finance sector are used for consumption—by private households (C_1), the capitalist (c_1^k) and the monopolistic producers (C_1^m)—in the second period

$$\varsigma Q^N = C_1 + c_1^k + C_1^m.$$

and fraction $1 - \varsigma$ of Q^N is used to finance consumption of landowners and thus

$$(1 - \varsigma)Q^N = c_1^L.$$

On the inputs markets, market clearing requires that, given wages $\{w^j\}_{j=1}^J$ the aggregate demand for skills equals the aggregate demand, i.e.

$$H_j = H_j^F + H_j^N,$$

for all $j = 1, ..., J$.

6 Calibration

We calibrate the model in a partial equilibrium. Specifically, we choose an external supply of capital by the capitalist lender, $\bar{K}$, such that the equilibrium interest rate is 3% annually. The technology level in sector N, Z^N is normalized such that the equilibrium price in sector N is $p^N = 1$, and the technology level in sector F is chosen such that the nominal output share in finance $\frac{p_F \cdot Q_F}{p_F \cdot Q_F + p_N \cdot Q_N}$.

6.1 Exogenously Calibrated Parameters

We assume that the length of a period in the model represented 10 years and we set the number of occupation J to 9 and the number of household types E to 8. We choose a subset of parameter values following the literature (or as a normalization). The remaining parameters are all jointly calibrated to match salient features of the data. Panel A of Table 8 summarizes the exogenously calibrated parameters.

Table 8: Parameters
Panel A: Exogenously Calibrated Parameters ($\Delta t = 10$)

Description	Parameter	Value	Basis
CRRA	σ	1	Standard (log utility)
Interest rate (annual)	$r = \rho$	0.03	Standard
Discount rate (annual)	$\beta = \left(\frac{1}{1+\rho}\right)^{\Delta t}$	0.7441	Standard
Depreciation rate (annual)	δ	0.07	Standard
Cost of capital	$R = (1+r)^{\Delta t} - 1 + 1 - (1-\delta)^{\Delta t}$	0.8599	Standard
Gumbel distribution parameter	σ^{Gumbel}	0.2	Standard
Frechet distribution parameter	θ	10	[TBC]
Curvature in human capital	α	0.62	**?**
Income loss from default	λ	0.2	[TBC]
Productivity in NF sector	$\zeta_N = 10$	10	Normalization
Financial integration parameter	ι	1	[TBC]

The parameter α, which governs the elasticity of income with respect to human capital, is set to be 0.62. This value implies a return to years of schooling of 12.5% which is consistent with the range of estimates documented in **?**.

[TBC]

We develop a simple method to estimate the key parameters of a nested constant-elasticity-of-substitution (NCES) production function for the U.S. economy. In particular, we consider an aggregate production function defined over the services of labor and capital allocated across different types of jobs or occupations, e.g., management, personal services, professional services, etc. The first (or outer) layer of the production function is a CES function over the multiple (intermediate) outputs of the different occupations The second (or inner) layer defines these intermediate outputs as CES functions of the workers' and capital services in each occupation. The CES functions in this second layer can exhibit different degrees of complementarity or substitution.

There are two main challenges for the estimation of such a production function at the aggregate level. First, the human capital allocated to each occupation can only be observed imperfectly. Skill prices cannot be directly observed either. Second, the allocation of physical capital across the different occupations are also unobservable. In this note, we focus on the second challenge, using different standard measurements of the aggregate provision human capital services for each occupation to proxy for the first challenge. Using the equilibrium conditions in production, we derive a simple set of equations that can be used to estimate all the elasticities of substitution and the outer share parameters. The equilibrium conditions conducts to a fairly transparent fixed point. All in all, the inferred variation in the data over the sample period provides the basis to infer the production elasticities, and the observed average levels in income shares provide the basis to infer the share parameters in the production function.

In the next section, we detail the production function and the optimality conditions we use to derive the observable conditions that we use with the data. In the subsequent section, we derive the iterative fixed-point algorithm that pins-down the unobserved allocation of capital and the different intermediate outputs of all the occupations. Finally, under the restriction of a common *share* parameter within all the inner CES functions, the final estimation step boils down to a unidimensional minimization problem.

In the fourth section we describe the data used. From the U.S. from 1975 until 2020, we use the total labor income shares and the relative income shares by occupation from the CPS. We also use CPS data to construct total Mincer (workers' experience, education, gender, etc.) hours for each occupation. We construct measures of the user cost of capital combining estimated ex-ante real interest rates from the Cleveland Fed and Riccardo Dicecciо's equipment prices from FRED.[40] We close this data section discussing the key observed time patterns across the different occupations in terms of income shares and total Mincer hours as well as the behavior of the total labor share of income and the cost of use of capital.

The fourth section describes the results. We report the resulting parameter values using different two measures for aggregate human capital across occupations, raw hours and total Mincer hours, and for two sample periods: our preferred baseline, which is from 1982 to 2020, and the extended period from 1975 to 2020. Yet, the results are fairly robust across all cases. Overall, our results indicate human-physical capital complementarity within those occupations for high-skilled intensive occupations (e.g.: management, professionals and technicians) and for the low-skilled occupations (e.g.: personal services.) while we obtain human-physical capital substitutability for the middle-skilled occupations. Interesting, we obtain an the outer elasticity of substitution across all occupations has a value around 3. This estimate, which is identified from a cross-equation restriction, is also stable across variations in sample periods and measurement of human capital services.

[40]The Cleveland Fed ex-ante interest rate is available only for 1982 onwards. We complement the series for 1975 to 1981 with the ex-post real interest rate.

6.1.1 A Nested CES Production Function

Consider a production technology described as follows: Given an exogenous (Hicks neutral) total factor productivity Z_t, final output Y_t is produced using structures and some other forms of capital, K_t, and a bundle of the outputs across occupations or tasks, Q_t^T, from workers and machines used along a fixed and finite set of occupations, $j = 1, 2, ...J$. The outputs of each of these occupations are denoted Q_t^j for each j. Each Q_t^j, arises from the inputs of the aggregate effective labor services, H_t^j, and of the capital or machines, M_t^j, allocated specifically to each of those occupations.

Concretely, the production function is defined by:

$$Y_t = Z_t \left(K_t\right)^{\alpha} \left(Q_t^T\right)^{1-\alpha}, \tag{28}$$

$$Q_t^T = \left[\sum_{j=1}^{J} \lambda_j \left(Q_t^j\right)^{\rho_0}\right]^{\frac{1}{\rho_0}}, \tag{29}$$

$$Q_t^j = \left[\mu_j \left(H_j\right)^{\rho_j} + \left(1-\mu_j\right)\left(M_j\right)^{\rho_j}\right]^{\frac{1}{\rho_j}}, \tag{30}$$

where the parameters $\mathbb{P} \equiv \left(\alpha,\, \rho_0,\, \left\{\mu_j,\, \lambda_j,\, \rho_j\right\}_{j=1}^{J}\right)$, the objects of interest in this exercise, satisfy the following restrictions: the share parameters α, $\left\{\mu_j,\, \lambda_j\right\}_{j=1}^{J}$ all lie between 0 and 1, and $\sum_{j=1}^{J} \lambda_j = 1$; the substitution parameters ρ_0, $\left\{\rho_j\right\}_{j=1}^{J}$ are all lower than one.

6.1.2 Demand Conditions

Facing skill prices $\left\{w_t^j\right\}_{j=1}^{J}$ and machine rental prices $\left\{r_t^j\right\}_{j=1}^{J}$, the first order conditions of firms are simply:

$$\begin{aligned}
[K_t]\colon\; r_t + \delta_K &= \frac{\partial Y_t}{\partial K_t}, \\
\left[M_t^j\right]\colon\; r_t^j &= \frac{\partial Y_t}{\partial Q_t^T}\frac{\partial Q_t^T}{\partial Q_t^j}\frac{\partial Q_t^j}{\partial M_t^j}, \\
\left[H_t^j\right]\colon\; w_t^j &= \frac{\partial Y_t}{\partial Q_t^T}\frac{\partial Q_t^T}{\partial Q_t^j}\frac{\partial Q_t^j}{\partial H_t^j}.
\end{aligned}$$

Using the functional forms, and rearranging and simplifying

$$
\begin{aligned}
[K_t]&: r_t + \delta_K = \alpha Z_t \left(\frac{Q_t^T}{K_t}\right)^{1-\alpha}, \\
\left[M_t^j\right]&: r_t^j = (1-\alpha) Z_t (K_t)^{\alpha} \left(Q_t^T\right)^{1-\alpha-\rho_0} \times \lambda_j \left(1-\mu_j\right) \times \left(Q_t^j\right)^{\rho_0-\rho_j} \left(M_t^j\right)^{\rho_j-1} \\
\left[H_t^j\right]&: w_t^j = (1-\alpha) Z_t (K_t)^{\alpha} \left(Q_t^T\right)^{1-\alpha-\rho_0} \times \lambda_j \mu_j \times \left(Q_t^j\right)^{\rho_0-\rho_j} \left(H_t^j\right)^{\rho_j-1}.
\end{aligned}
$$

These conditions provide the basis for the algorithm to estimate the parameters $\mathbb{P}$.

6.2 Estimation Algorithm

First, for any parameter values, $\mathbb{P}$, and: (i) measured human capitals $\left\{H_t^j\right\}$, (ii) measured cost of capital r_t^j, then, the conditions $\left[M_t^j\right]$ pin-down the amount of capital $\left\{M_t^j\right\}_{j=1}^J$ that would have been used in equilibrium across each of the occupations j. Second, I am going to use the conditions $\left[H_t^j\right]$ to construct the implied relationship between the observed shares of income across different occupations j.

Inferring $\left\{M_t^j\right\}_{j=1}^J$. In general, we assume that the depreciation rates are the same, $\delta_j = \delta$. Then, we have equalization of all rates of return r_t^j across machines across all occupations. Assume that we observe the ex-ante real interest rate r_t. Hence, $r_t^j = r_t + \delta$.

From the first order conditions for H_t^j and M_t^j we readily obtain

$$
\frac{w_t^j}{r_t^j} = \frac{\mu_j}{\left(1-\mu_j\right)} \left(\frac{M_t^j}{H_t^j}\right)^{1-\rho_j}.
$$

Therefore, if we have the parameters $\mathbb{P} = \left(\alpha,\ \rho_0,\ \left\{\mu_j,\ \lambda_j,\ \rho_j\right\}_{j=1}^J\right)$ and we know the relative factor prices w_t^j/r_t^j, then we could infer the machines by inverting the previous equation and get:

$$
{M_t}^{j,\mathbb{P}} = H_t^j \left[\frac{\left(1-\mu_j\right)}{\mu_j} \frac{w_t^j}{r_t^j}\right]^{\frac{1}{1-\rho_j}}, \tag{31}
$$

and therefore we can also infer

$$
Q_t^{j,\mathbb{P}} = \left[\mu_j \left(H_t^j\right)^{\rho_j} + \left(1-\mu_j\right) \left({M_t}^{j,n}\right)^{\rho_j}\right]^{\frac{1}{\rho_j}}, \quad \text{and} \quad Q_t^{T,\mathbb{P}} = \left[\sum_{j=1}^J \lambda_j \left(Q_t^{j,n}\right)^{\rho_0}\right]^{\frac{1}{\rho_0}}. \tag{32}
$$

We will proceed under the assumption that we observe r_t^j, which are obtained from the measuring equation discussed below that uses real interest rates, equipment prices and depreciation rates. However, we do not directly observe w_t^j. Hence, we proceed by imputing the equilibrium vector of skill prices w_t^j that is associated with a given parameter configuration, $\mathbb{P} = \left(\alpha,\, \rho_0,\, \left\{\mu_j,\, \lambda_j,\, \rho_j\right\}_{j=1}^{J}\right)$, rental rates $\left\{r_t^j\right\}_{j=1}^{J}$ and measured aggregate Mincer hours $\left\{H_t^j\right\}_{j=1}^{J}$ across occupations. To this end, normalize $Z_t = 1$ (since it is Hicks neutral, it can also be seen as a normalization in the units of physical capital K_t) and infer structures and other Hicks neutral capital components as:

$$K_t = \alpha \left(\frac{Y_t}{r_t + \delta_K} \right).$$

Then, we can compute the output

$$Y_t^{\mathbb{P}} = (K_t)^{\alpha} \left(Q_t^{T,\mathbb{P}} \right)^{1-\alpha}.$$

and equilibrium the wages must satisfy

$$w_t^j = (1-\alpha)\, \lambda_j \mu_j \times (K_t)^{\alpha} \left(Q_t^{T,\mathbb{P}} \right)^{1-\alpha-\rho_0} \left(Q_t^{j,\mathbb{P}} \right)^{\rho_0 - \rho_j} \left(H_t^j \right)^{\rho_j - 1}. \tag{33}$$

The first, inner loop is precisely that, given $\mathbb{P} = \left(\alpha,\, \rho_0,\, \left\{\mu_j,\, \lambda_j,\, \rho_j\right\}_{j=1}^{J}\right)$, rental rates $\left\{r_t^j\right\}_{j=1}^{J}$ and measured aggregate Mincer hours $\left\{H_t^j\right\}_{j=1}^{J}$, iterate until convergence, the equations (31, 33) to obtain the equilibrium wages $\left\{w_t^j\right\}_{j=1}^{J}$ and the machines $\left\{{M_t}^j\right\}_{j=1}^{J}$.

Inferring $\left(\rho_0,\, \left\{\mu_j,\, \lambda_j,\, \rho_j\right\}_{j=1}^{J}\right)$. Following the previous step, for any configuration of parameters $\mathbb{P}$ we can used the inferred machines $\left\{{M_t}^j\right\}_{j=1}^{J}$ and compute the occupation income shares as

$$S_t^j \equiv \lambda_j \left(1-\alpha\right) \mu_j \left(\frac{Q_t^{j,\mathbb{P}}}{Q_t^{T,\mathbb{P}}} \right)^{\rho_0} \left(\frac{H_t^j}{Q_t^{j,\mathbb{P}}} \right)^{\rho_j}.$$

In logs, this is becomes a linear relationship in parameters:

$$\ln S_t^j = \ln \left[(1-\alpha)\, \lambda_j \mu_j \right] + \rho_0 \ln \left(\frac{Q_t^j}{Q_t^T} \right) + \rho_j \ln \left(\frac{H_t^j}{Q_t^j} \right).$$

Restricting the case to $\mu_j = \mu$. If so, for each value μ, we have a simple regression

$$\ln S_t^j = \underbrace{\ln\left[(1-\alpha)\,\lambda_j \mu\right]}_{\equiv a_j} + \rho_j \ln\left(\frac{H_t^j}{Q_t^j}\right) + \rho_0 \ln\left(\frac{Q_t^j}{Q_t^T}\right). \tag{34}$$

Hence, given a value $\mathbb{P}$, we could use the data to obtain an update on the value of the parameters $\left\{\rho_0, \left\{\ \rho_j,\, \lambda_j\right\}_{j=1}^J\right\}$ from the intercepts and slope coefficients of the regression. In particular, if we have the values for μ_j, given estimates $a_j \equiv \ln\left[(1-\alpha)\,\lambda_j\mu_j\right]$ on the intercepts, then, we could recover:

$$\lambda_j = \frac{\exp(a_j)}{(1-\alpha)\,\mu_j}.$$

Since all the terms $\left\{Q_t^{j,\mathbb{P}}, Q_t^{T,\mathbb{P}}\right\}$ depend on the parameters we need to find a fixed point on $\left\{\rho_0, \left\{\ \rho_j,\, \lambda_j\right\}_{j=1}^J\right\}$ conditional on a vector of share values $\mu \in [0,1]^J$.

In what follows, I will make two assumptions. First, all the shares μ_j are the same, i.e. $\mu_j = \mu \in (0,1)\ \forall j$. Second, there is some classical measurement error in the observed shares $\ln S_t^j$ for the equations (34.) From there, we can construct an algorithm based on simple linear equations that could be used to iterate over the values of $\left\{\rho_0,\, \lambda_j,\, \rho_j\right\}$.

Define, for all $t = 1, 2, ..., T$,

$$s_t^j \equiv \ln S_\tau^j,\ \ q_t^j \equiv \ln\left(\frac{Q_t^j}{Q_t^T}\right), \text{ and } hq_t^j \equiv \ln\left(\frac{H_t^j}{Q_t^j}\right).$$

To stack this system of regressions, define the following vector and matrix, $\mathbb{Y}$ and $\mathbb{X}$:

$$\mathbb{Y}=\begin{bmatrix} s_1^1 \\ s_2^1 \\ \vdots \\ s_T^1 \\ \\ s_1^2 \\ s_2^2 \\ \vdots \\ s_T^2 \\ \\ \vdots \\ s_1^J \\ s_2^J \\ \vdots \\ s_T^J \end{bmatrix}, \quad \mathbb{X}=\begin{bmatrix} 1 & q_1^1 & 0 & 0 & 0 & & 0 & hq_1^1 \\ 1 & q_2^1 & 0 & 0 & 0 & \cdots & 0 & hq_2^1 \\ \vdots & \vdots & \vdots & \vdots & \vdots & & \vdots & \vdots \\ 1 & q_T^1 & 0 & 0 & 0 & & 0 & hq_T^1 \\ \\ 0 & 0 & 1 & q_1^2 & 0 & & 0 & hq_1^2 \\ 0 & 0 & 1 & q_2^2 & 0 & \cdots & 0 & hq_2^2 \\ \vdots & \vdots & \vdots & \vdots & \vdots & & \vdots & \vdots \\ 0 & 0 & 1 & q_T^2 & 0 & & 0 & hq_T^2 \\ \\ \vdots & \vdots & & & & & \ddots & \vdots \\ 0 & 0 & 0 & & 0 & 1 & q_1^J & hq_1^J \\ 0 & 0 & 0 & \cdots & 0 & 1 & q_2^J & hq_2^J \\ \vdots & \vdots & \vdots & & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & & 0 & 1 & q_T^J & hq_T^J \end{bmatrix}.$$

Then, the equations (34) can be stacked as $\mathbb{Y}=\mathbb{X}\mathbb{B}$. If we assume that there is a (presumed classical) measurement error, then let $\mathbb{U}$ to be a $TJ\times 1$ vector and then, the equations become $\mathbb{Y}=\mathbb{X}\mathbb{B}+\mathbb{B}\mathbb{U}$. Again, given a vector $\mu\in[0,1]^J$, the estimates of ρ_0, $\{\lambda_j,\,\rho_j\}_{j=1}^J$ can be directly read off the vector $\hat{\mathbb{B}}=(\mathbb{X}'\mathbb{X})^{-1}\mathbb{X}'\mathbb{Y}$. By design, the estimates force ρ_0 to be common for all j, while the estimates $(a_j,\,\rho_j)$ vary across j.

The imputed values for Q_{t+1}^j and Q_{t+1}^T all depend on the values of ρ_0, $\{\mu_j,\rho_j,\lambda_j\}_{j=1}^J$.

Now, imagine that for a given $\mu\in[0,1]$ we have iterated to convergence a fixed-point $\left\{\left\{\lambda_j^{\{\mu\}},\,\rho_j^{\{\mu\}}\right\}_{j=1}^J,\rho_0^{\{\mu\}}\right\}$. We can compute the distance of the model's shares $S_t^{j,\{\mu\}}$ to those in the data, $S_t^{j,\text{data}}$. We consider two options for this distance. The obvious measure would be the sum of squared residuals:

$$SSR(\mu)=\frac{1}{J\times T}\sum_{j=1}^J\sum_{t=1}^T\left[\ln S_t^{j,\{\mu\}}-\ln S_t^{j,\text{data}}\right]^2.$$

An alternative metric is the total labor share:

$$SSR^T(\mu)=\frac{1}{T}\sum_{t=1}^T\left[\ln\left(\sum_{j=1}^J S_t^{j,\{\mu\}}\right)-\ln\left(\sum_{j=1}^J S_t^{j,\text{data}}\right)\right]^2.$$

In either case, we could search for the best fit:

$$\mu_i^* \in \arg\min_{\mu \in \mathcal{M}} \left\{ \; SSR\left(\mu\right) \; \right\}.$$

Obviously, regardless of the metric $SSR^i\left(\mu\right)$ used, the associated estimates $\left\{ \left\{ \lambda_j^{\{\mu\}},\, \rho_j^{\{\mu\}} \right\}_{j=1}^{J}, \rho_0^{\{\mu\}} \right\}$ are entirely determined by μ_i^*.

6.3 Data

We use the total labor income shares for the U.S. from the BLS. Similarly, we use the relative income shares by occupation for the U.S. from 1975 to 2020 from the CPS. We construct aggregate Mincer hours for each occupation. These are estimated using the effect of workers' experience, education, gender, on hourly earnings. Using these estimates, we augment the hours provided by the different types of workers in each period. Finally, we construct measures of the user cost of capital combining estimated ex-ante real interest rates from the Cleveland Fed and equipment prices from FRED. The Cleveland Fed ex-ante interest rate is available only for 1982 onwards. We complement the series for 1975 to 1981 with the ex-post real interest rate.

The cost of use or rental rate of capital used for each occupation is computed as follows. With \$1 at time t, an investor gets $1/q_t^j$ machines for occupations j. For each of these machines, the investor obtains at time $t+1$ the rental rate ρ_t^j plus the then depreciated value of the machine, $\left(1-\delta^j\right) q_{t+1}^j$. Equating the resulting total return, $1/q_t^j \left(\rho_t^j + \left(1-\delta^j\right) q_{t+1}^j\right)$ with the financial return $1+r_t$ available to investors, where r_t is the ex-ante real interest rate, then the equilibrium rental rate is

$$\rho_t^j = \left(1+r_t\right) q_t^j - \left(1-\delta^j\right) q_{t+1}^j.$$

Figure 10 shows the implied rental rate for the U.S. from 1975 to 2020 under the assumption that $\delta^j = 0.125$ for all j. The rate is normalized in units of 1975, i.e. $q_{1975} = 1$ and the real interest rate is taken from the Cleveland Fed from 1982 until 2020 and completed from the ex-post rate in the WDI for 1975 to 1981. The figure clearly shows a substantial and sustained decline over the sample period in the cost of using machines. Figure 1 also shows, using the right vertical axis, the behavior of the labor share of output for the same period (data taken from FRED,) which, as discussed by much recent literature, has also declined.

Figure 10: Labor Share and Cost of Equipment Capital

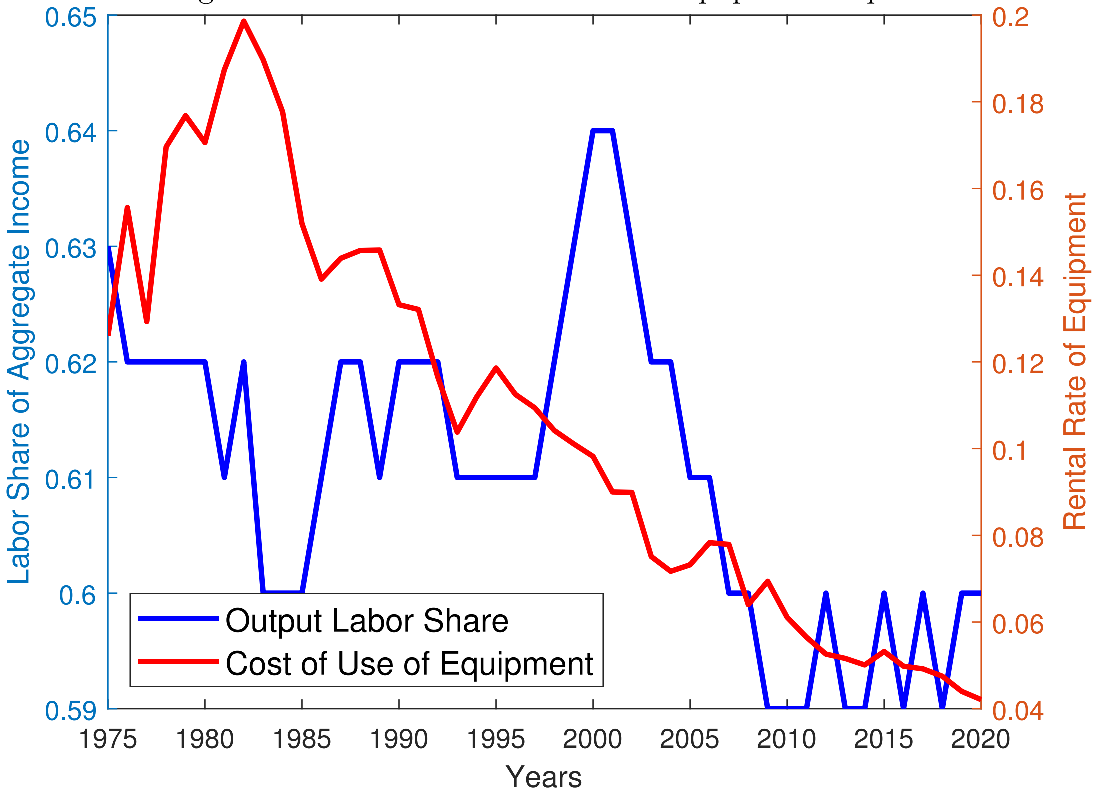
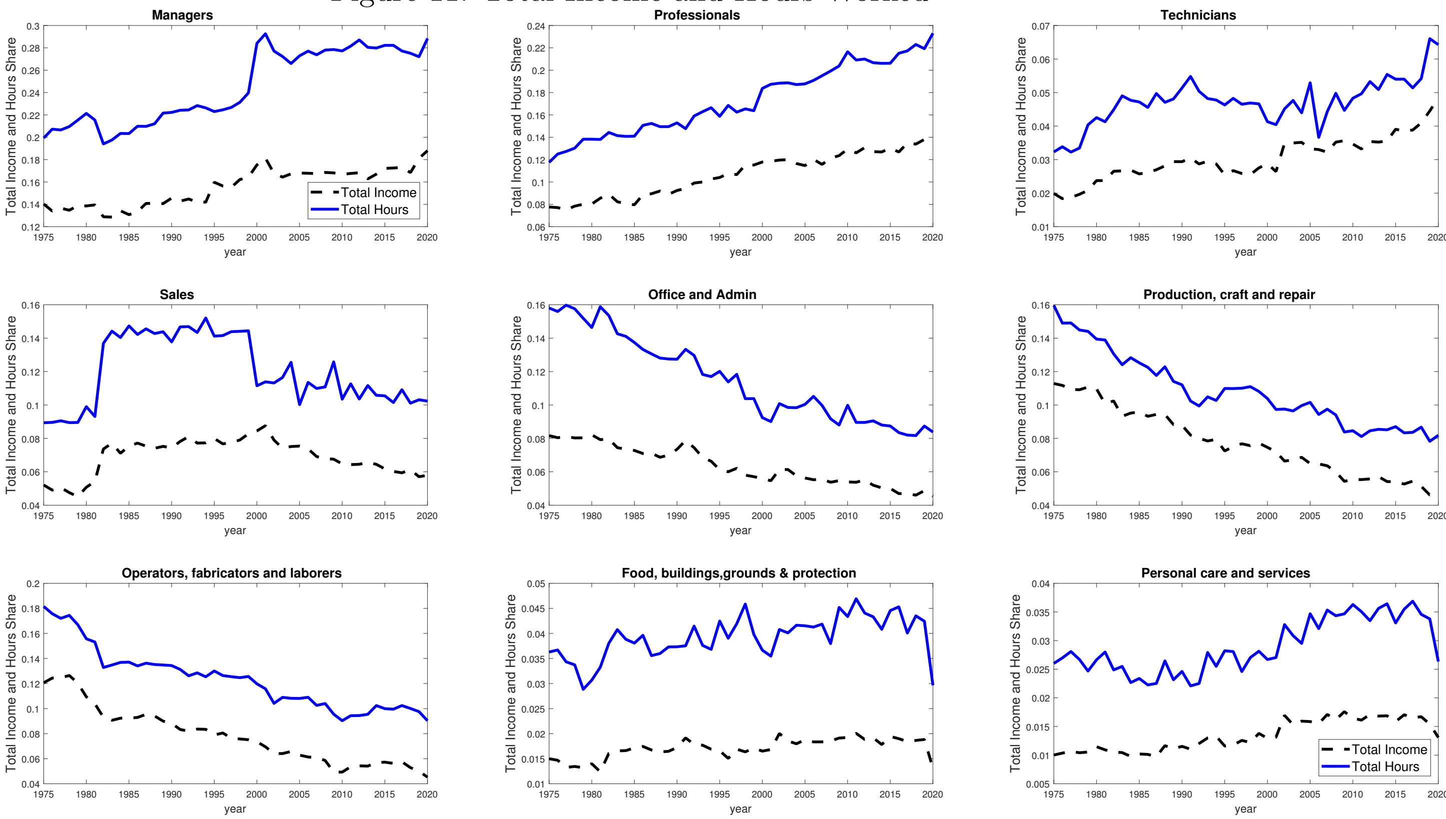


Figure 11 shows the total Mincer hours (left vertical axis) and the output shares of workers in the following occupation groups:

1. Managers
2. Professionals
3. Technicians
4. Sales
5. Office and Admin
6. Production, craft and repair
7. Operators, fabricators and laborers
8. Food prep, buildings and grounds+Protective services
9. Personal care and personal services

Figure 11: Total Income and Hours Worked



As mentioned already, aggregate Mincer hours are constructed using the number of hours provided by workers of different groups, augmenting them according to the worker's experience, education levels and gender. Output shares are constructed by multiplying the share of each occupation in the total labor income of the year times the labor income share from FRED. Figure 11 reproduces the well known disparate patterns across occupations in the last 45 years.

6.3.1 Results

Figure 12: Sum of Square Residuals

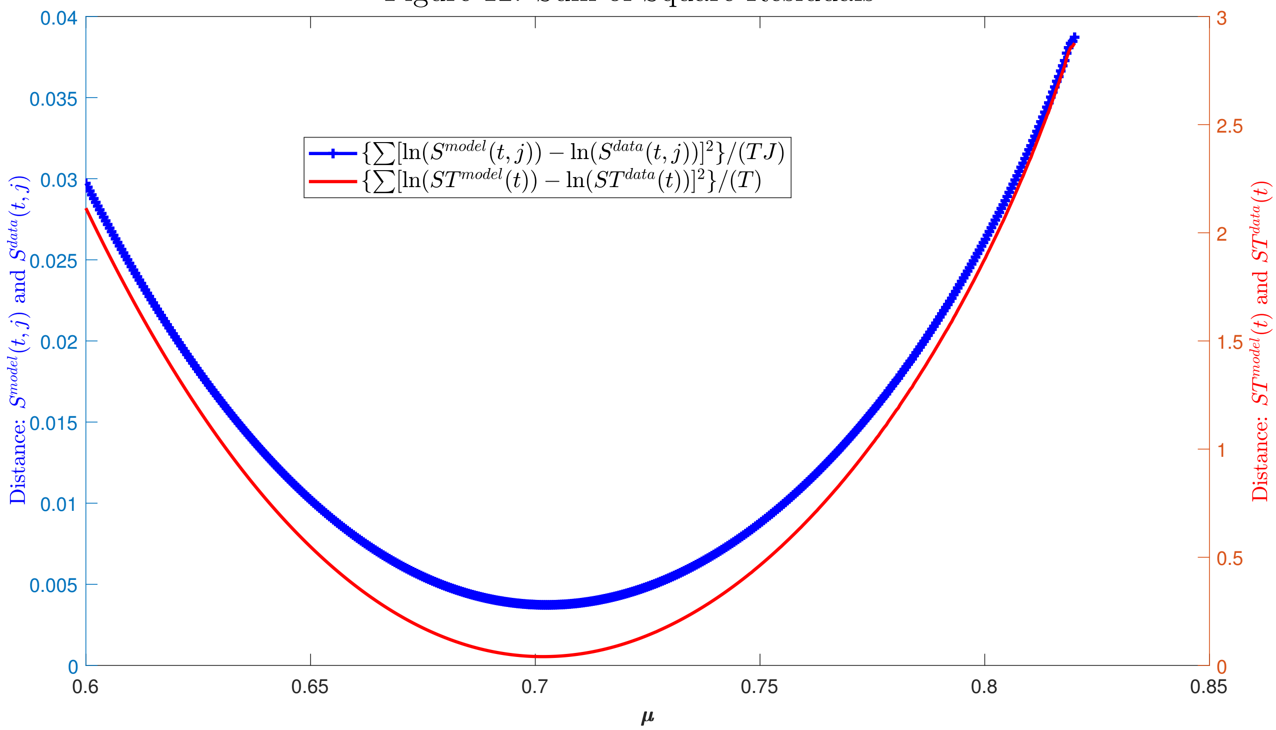


Table 9: Parameter Estimates: Various Samples and Definitions of Hours

	Mincer Hours				Raw Hours			
Parameter \ Sample	**1982-2020**		**1975-2020**		**1982-2020**		**1975-2020**	
	ρ_0	μ	ρ_0	μ	ρ_0	μ	ρ_0	μ
All Occupations	0.614	0.707	0.801	0.713	0.569	0.703	0.758	0.710
	ρ_j	λ_j	ρ_j	λ_j	ρ_j	λ_j	ρ_j	λ_j
Managers	−0.421	0.170	−0.211	0.144	−0.467	0.181	−0.241	0.156
Professionals	−1.299	0.151	−0.890	0.135	−1.519	0.159	−0.969	0.146
Technicians	−2.089	0.096	−2.640	0.110	−2.284	0.093	−3.157	0.108
Sales	0.029	0.118	−0.493	0.118	0.083	0.119	−0.450	0.119
Office & Admin.	0.281	0.106	0.036	0.109	0.272	0.101	0.050	0.104
Product., craft &repair	0.623	0.123	0.674	0.121	0.625	0.125	0.683	0.123
Operators, fabr.& lab.	0.621	0.113	0.664	0.111	0.592	0.110	0.617	0.108
Food, build's & protec.	−0.195	0.062	−0.302	0.076	−0.219	0.057	−0.381	0.070
Personal care & serv.	−1.100	0.061	−0.868	0.077	−0.998	0.054	−0.882	0.067

Figure 13: Fit of the Estimates: Occupation Shares

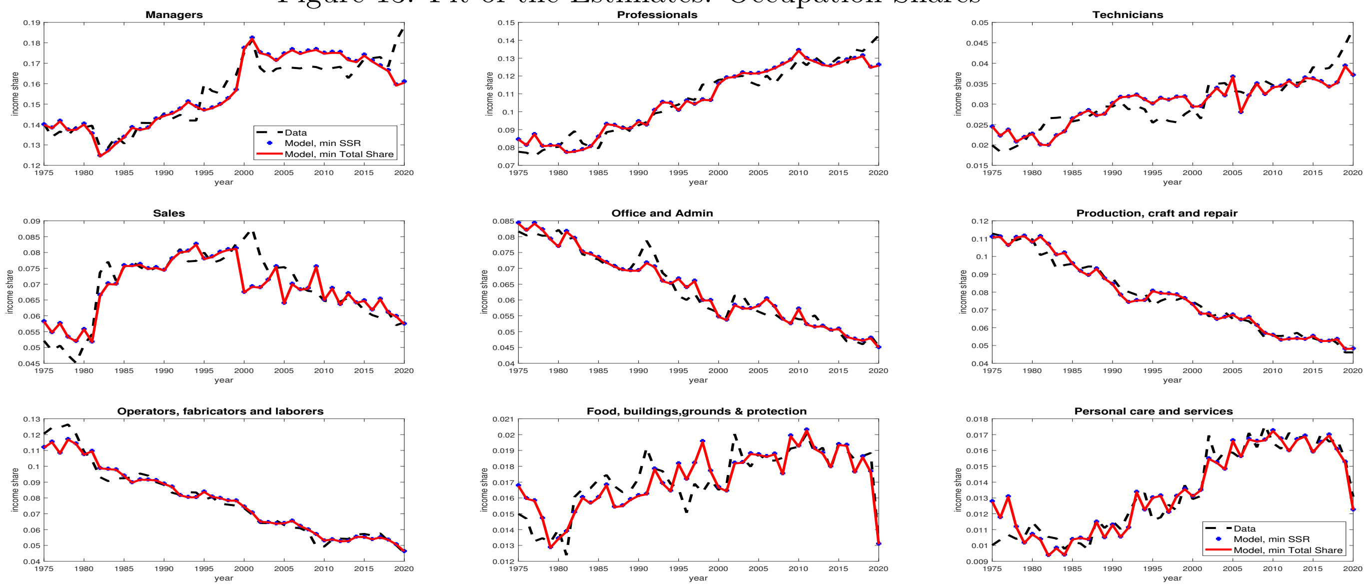
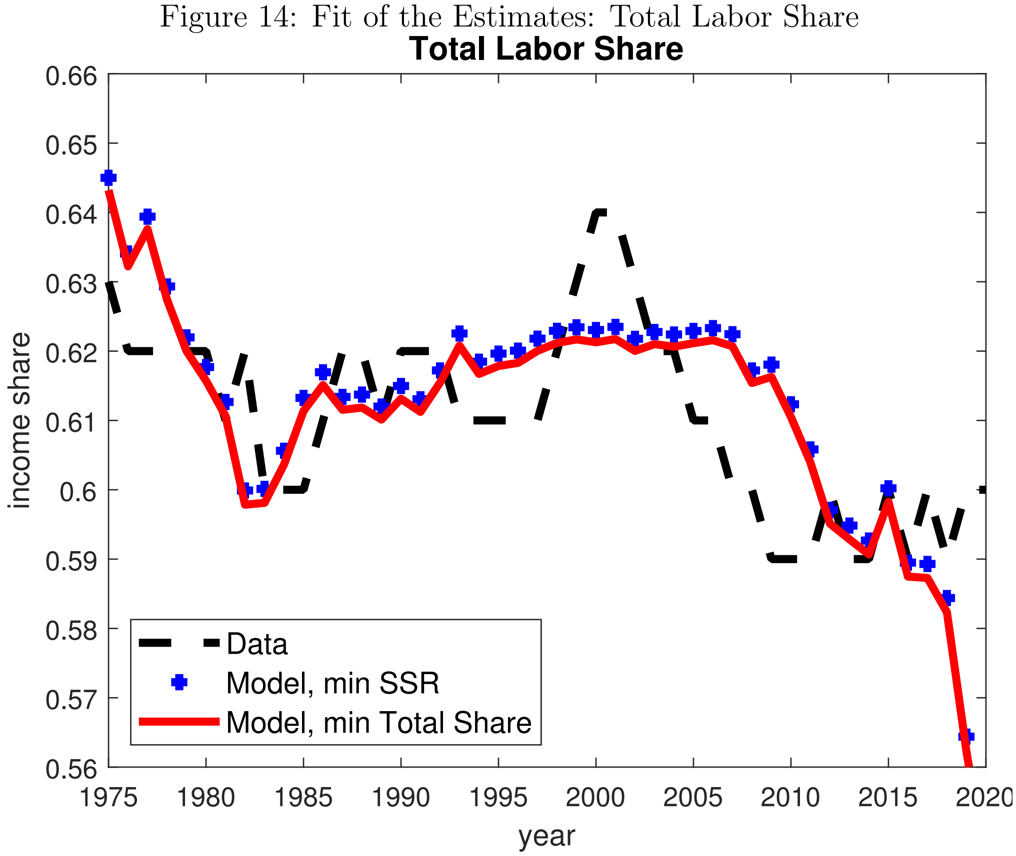


Figure 14: Fit of the Estimates: Total Labor Share



6.4 Endogenously Calibrated Parameters

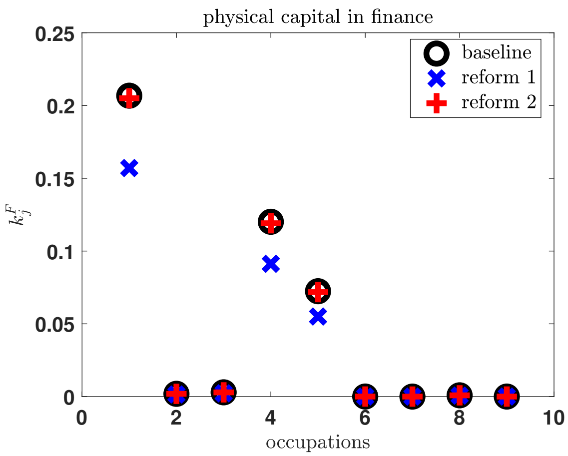
[TBC]

7 A Tale of Two Tales in the Model

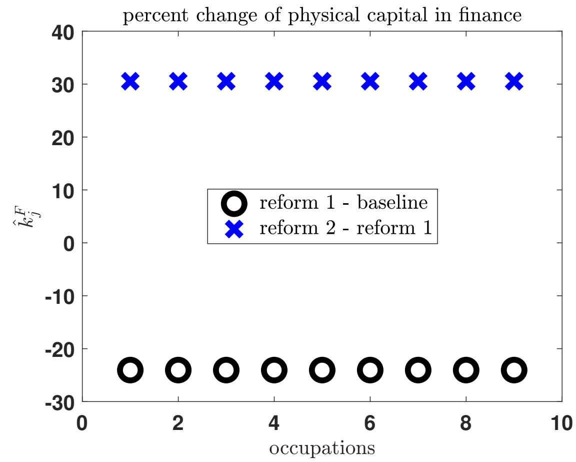
We present simulation results for a preliminary calibration of the model with 9 occupations a periodicity of 30 years, a target interest rate of $r = 3\%$ (annualized), $\beta = \frac{1}{1+r=0.03}$ (again annualized), $\sigma = 1, \alpha = 0.5, \gamma = 0.5$.

7.1 Partial Equilibrium

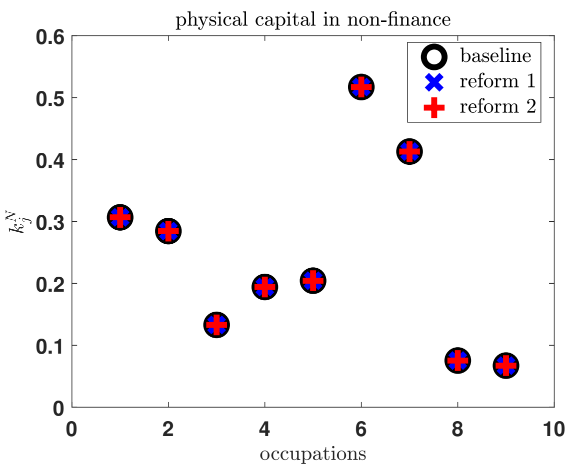
Figure 15: Physical Capital



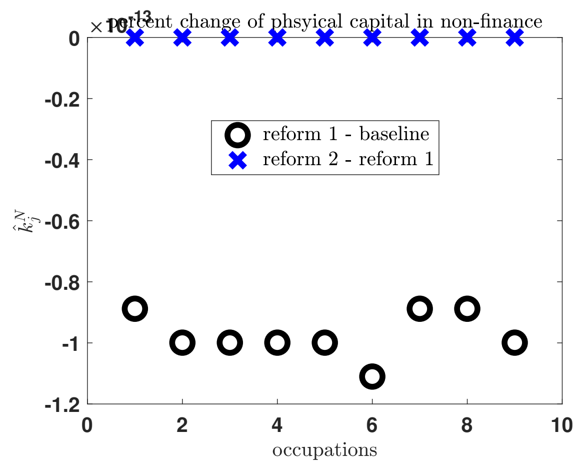
(a) K^F Across Occupations



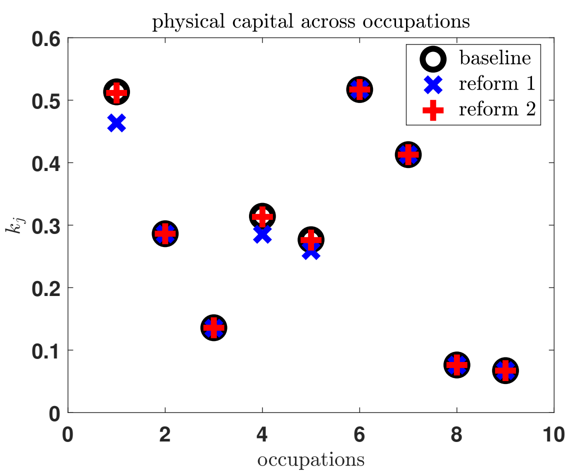
(b) $\hat{K}^F$ Across Occupations



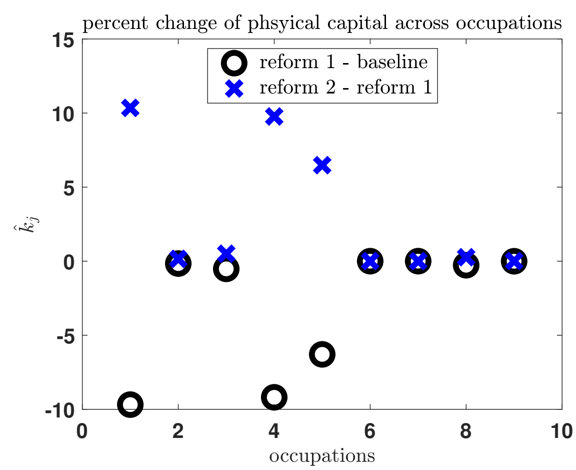
(c) K^N Across Occupations



(d) $\hat{K}^N$ Across Occupations



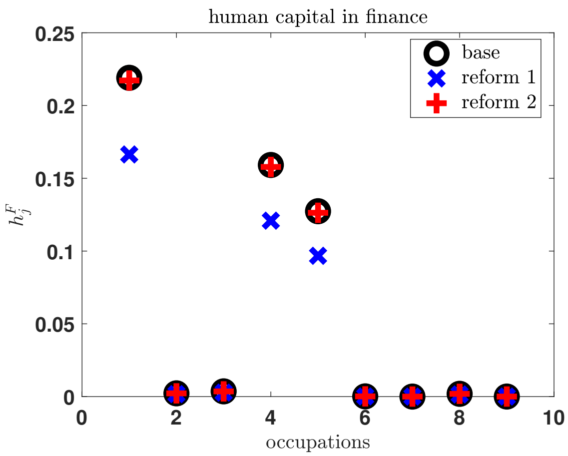
(e) K Across Occupations



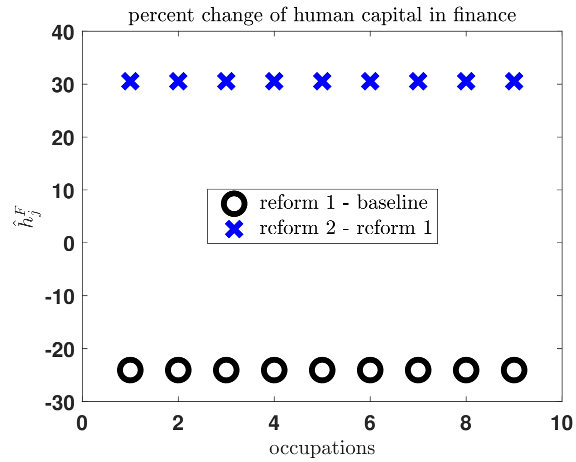
(f) $\hat{K}$ Across Occupations

Notes: TBC

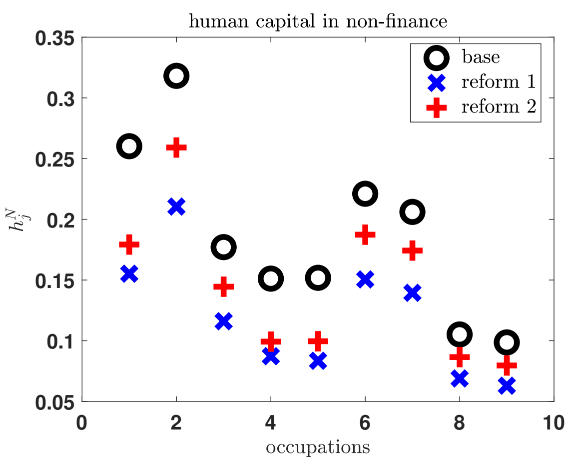
Figure 16: Human Capital



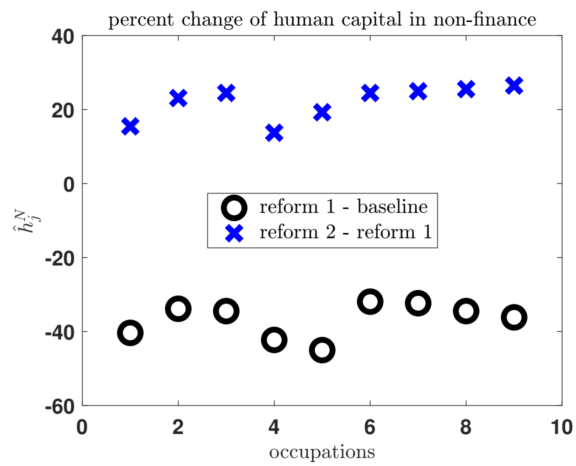
(a) H^F Across Occupations



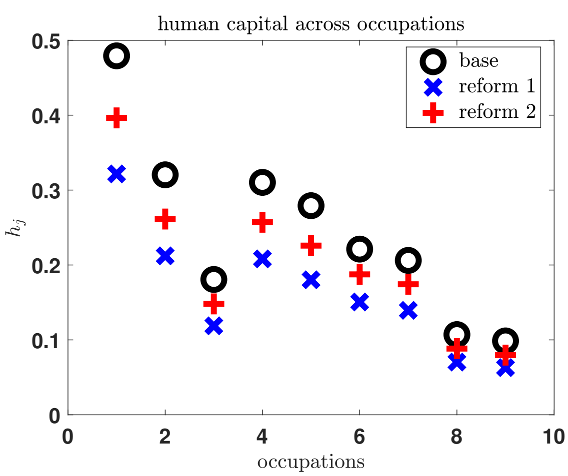
(b) $\hat{H}^F$ Across Occupations



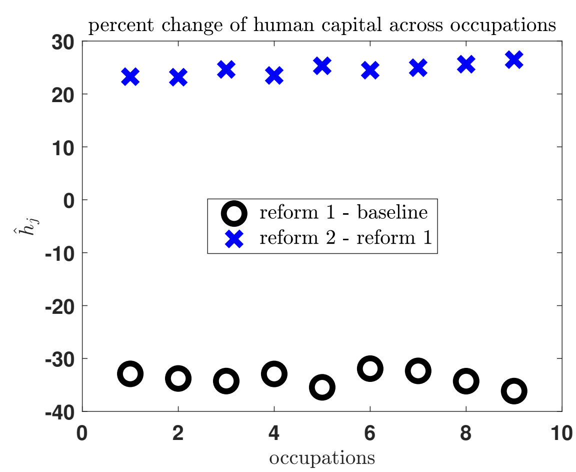
(c) H^N Across Occupations



(d) $\hat{H}^N$ Across Occupations



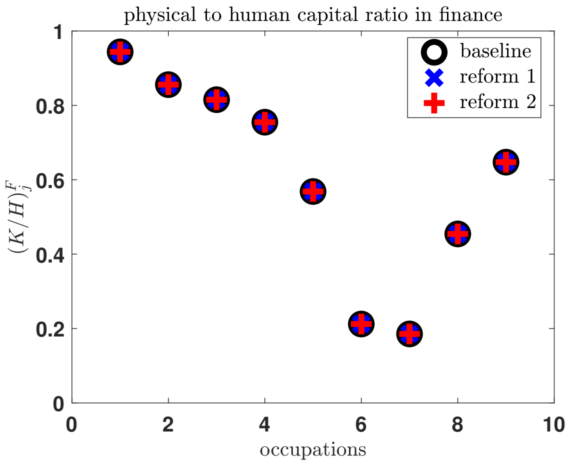
(e) H Across Occupations



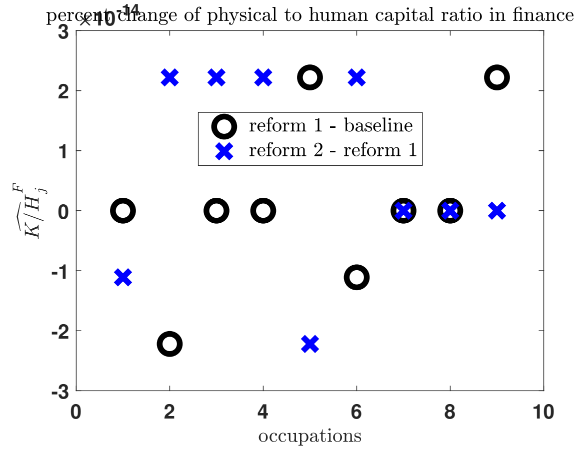
(f) $\hat{H}$ Across Occupations

Notes: TBC

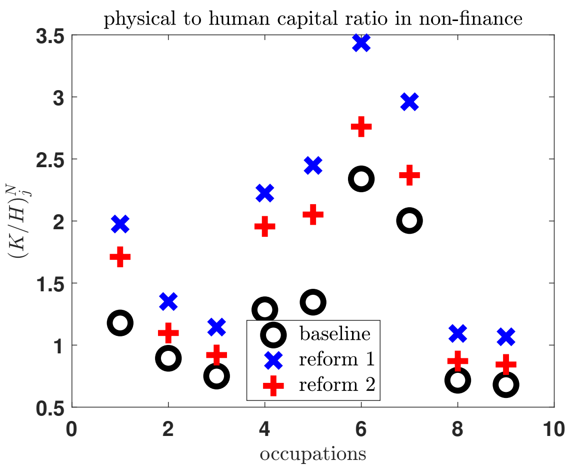
Figure 17: Physical to Human Capital Ratio



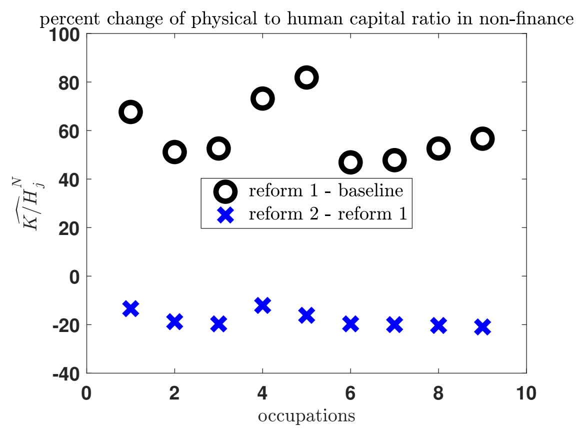
(a) K^F/H^F Across Occupations



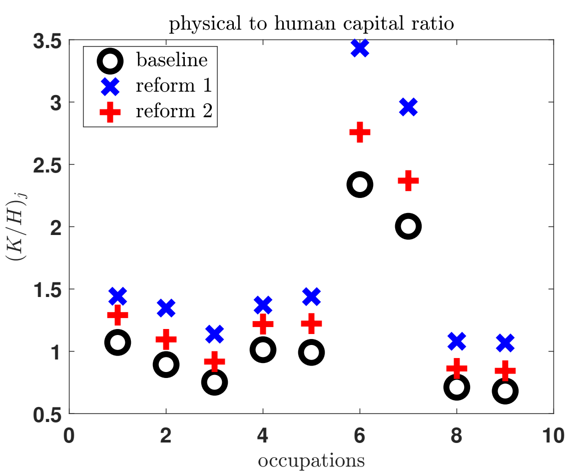
(b) $K^F\hat{/}H^F$ Across Occupations



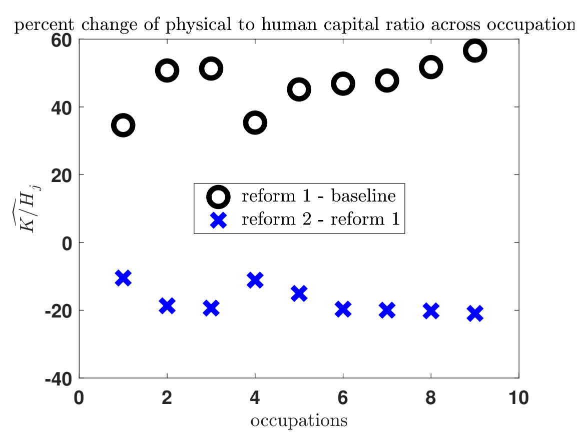
(c) H^N/K^N Across Occupations



(d) $H^N\hat{/}K^N$ Across Occupations



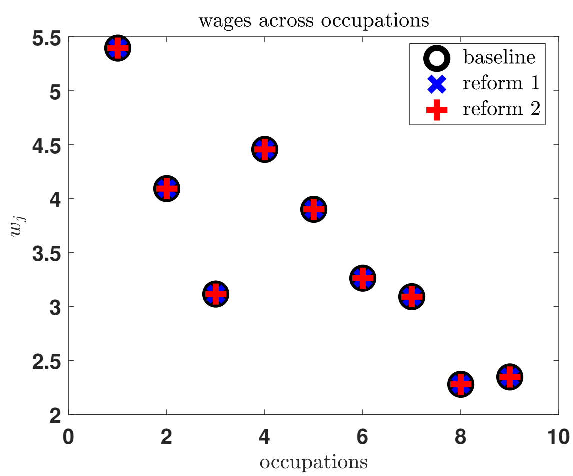
(e) K/H Across Occupations



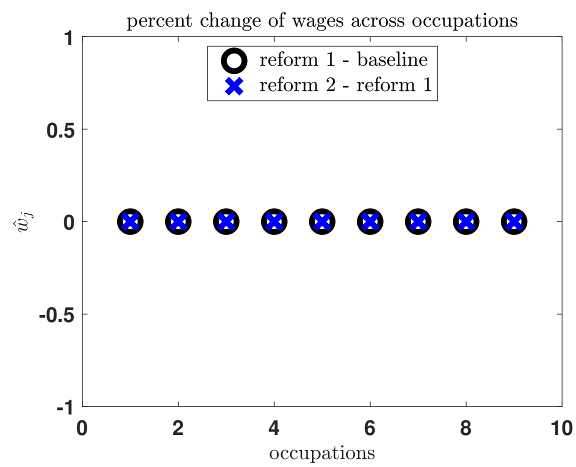
(f) $K\hat{/}H$ Across Occupations

Notes: TBC

Figure 18: Aggregate Wages



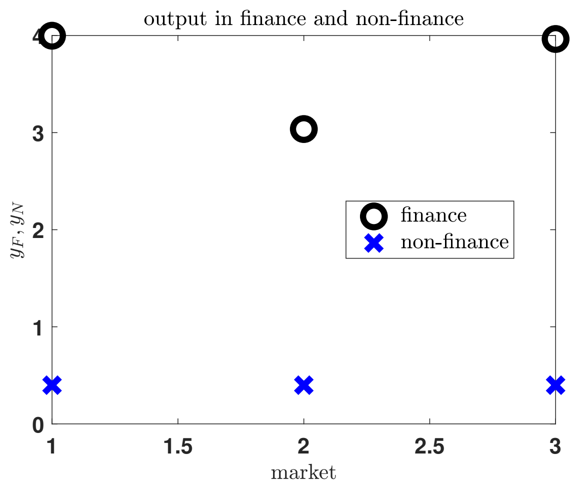
(a) w Across Occupations



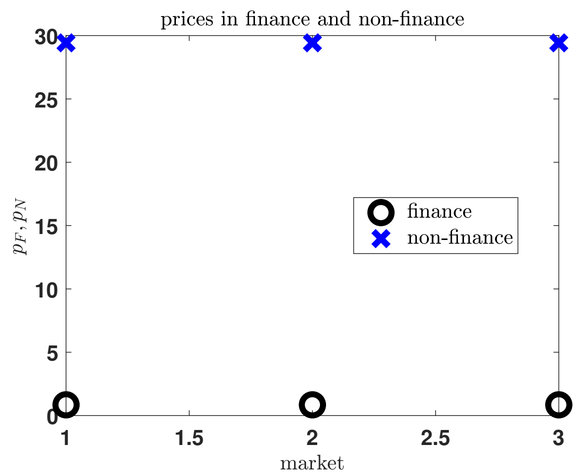
(b) $\hat{w}$ Across Occupations

Notes: TBC

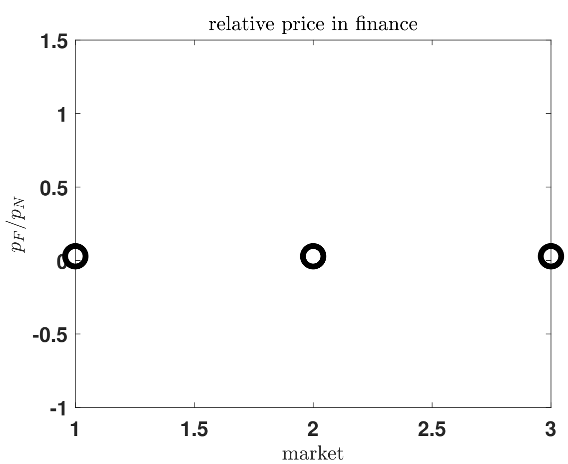
Figure 19: Output, Prices & Costs



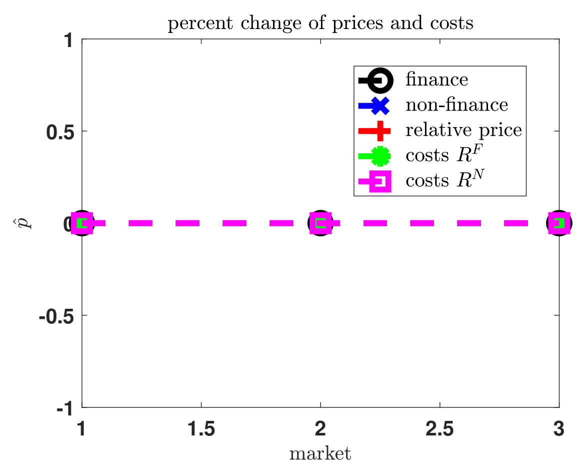
(a) y^F, y^N Across Reforms



(b) p^F, p^N Across Reforms



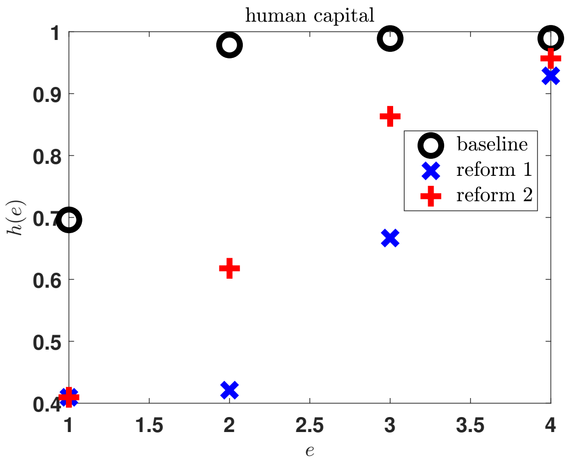
(c) p^F/p^N Across Reforms



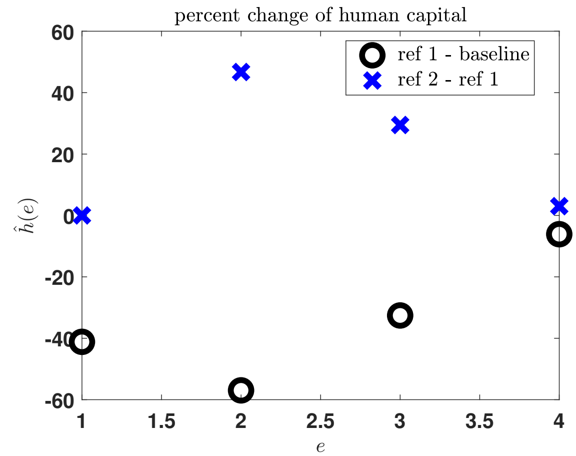
(d) $\hat{p}^i$ Across Reforms

Notes: TBC

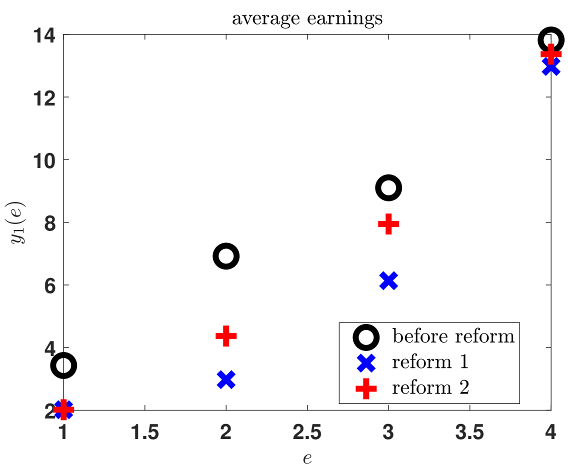
Figure 20: Human Capital, Incomes & CEV by Type



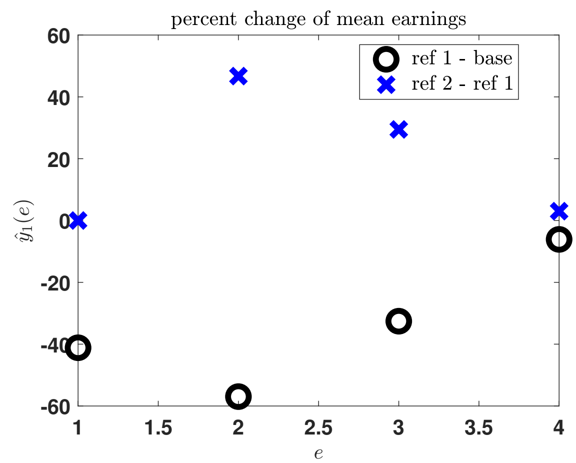
(a) H Across Types



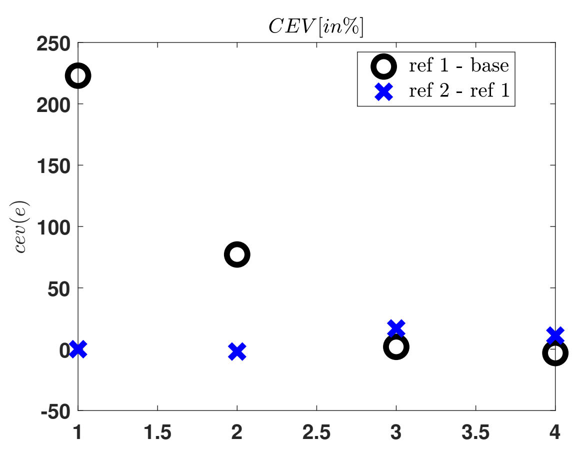
(b) $\hat{H}$ Across Types



(c) y Across Types



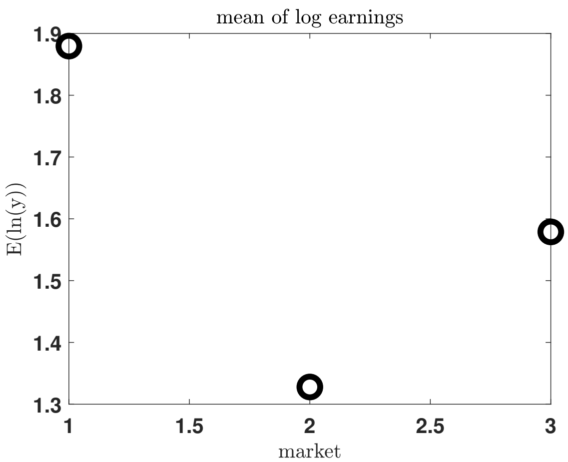
(d) $\hat{y}$ Across Types



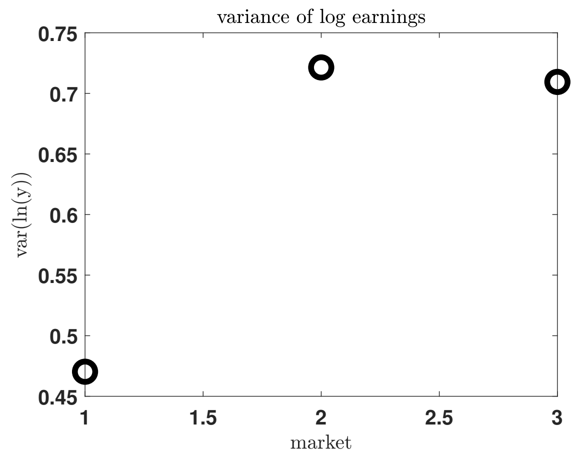
(e) CEV Across Types

Notes: TBC

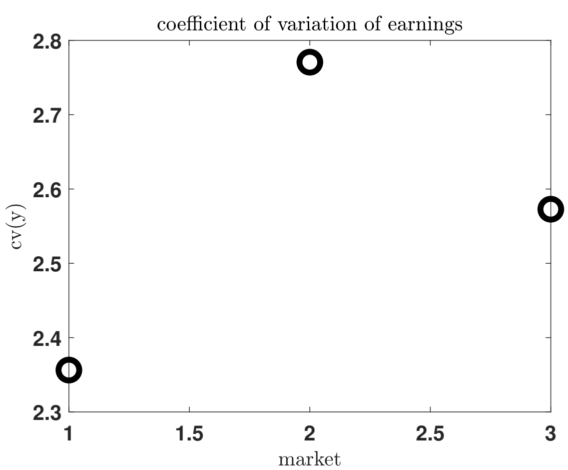
Figure 21: Summary Statistics



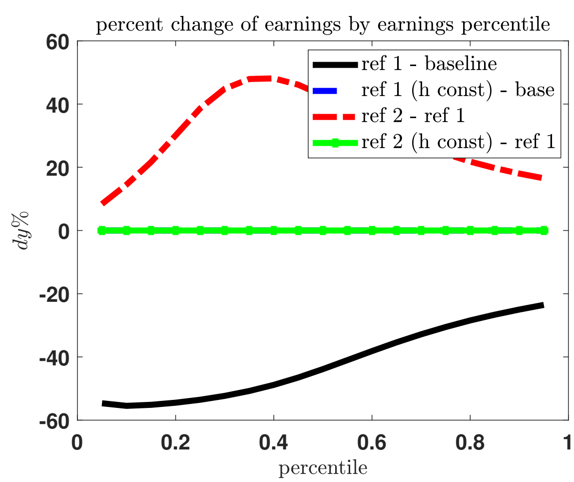
(a) Mean Log Earnings



(b) Variance of Log Earnings



(c) CV of Earnings

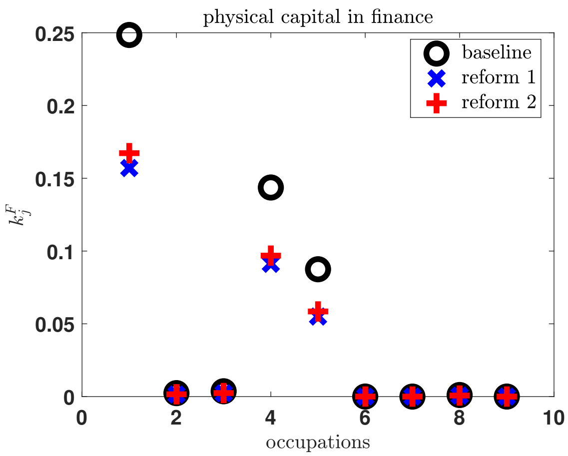


(d) Income Change by Percentiles

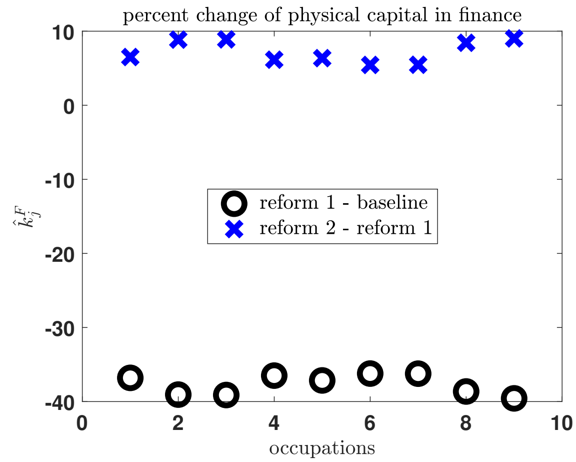
Notes: TBC

7.2 General Equilibrium

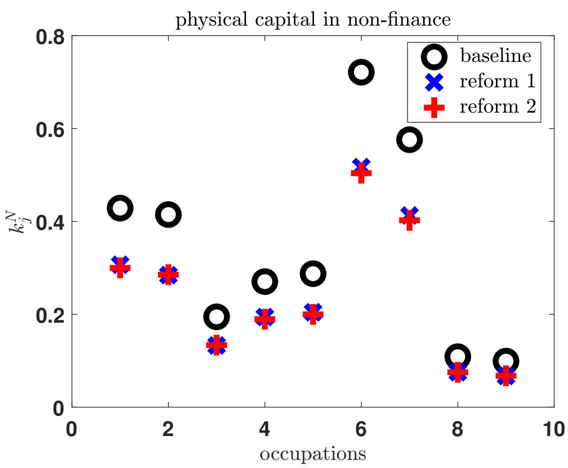
Figure 22: Physical Capital



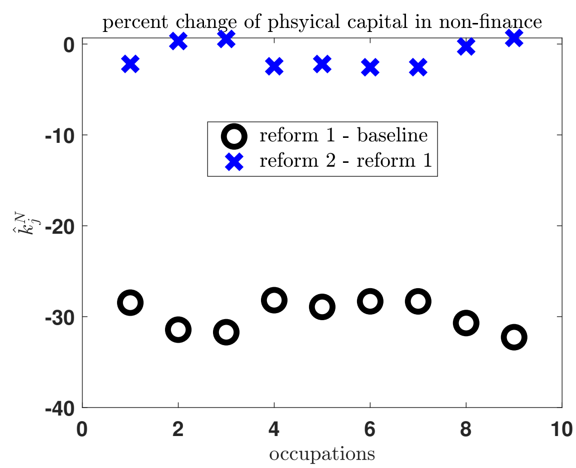
(a) K^F Across Occupations



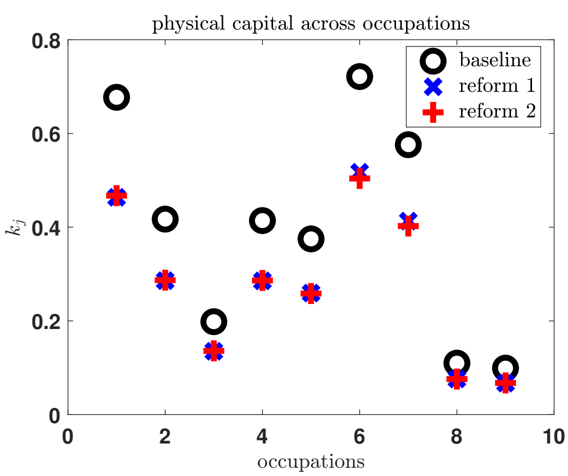
(b) $\hat{K}^F$ Across Occupations



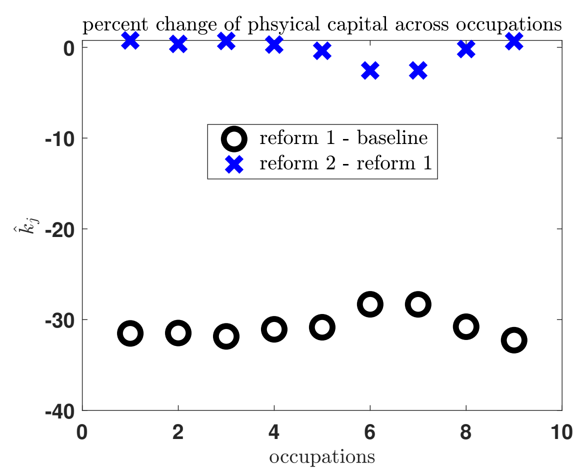
(c) K^N Across Occupations



(d) $\hat{K}^N$ Across Occupations



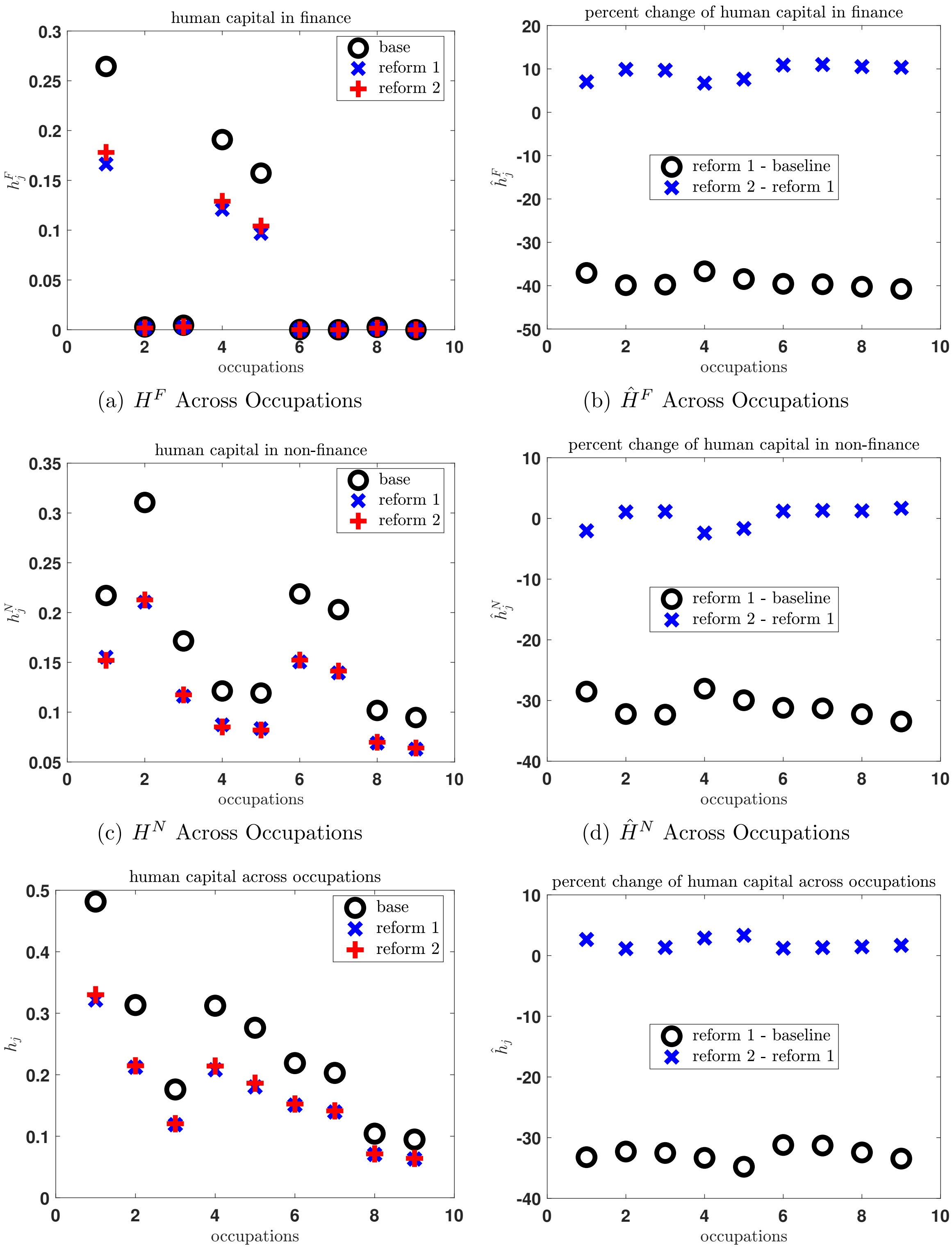
(e) K Across Occupations



(f) $\hat{K}$ Across Occupations

Notes: TBC

Figure 23: Human Capital



(a) H^F Across Occupations

(b) $\hat{H}^F$ Across Occupations

(c) H^N Across Occupations

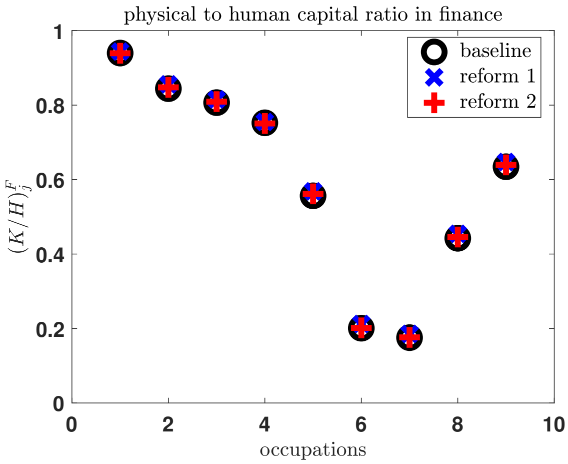
(d) $\hat{H}^N$ Across Occupations

(e) H Across Occupations

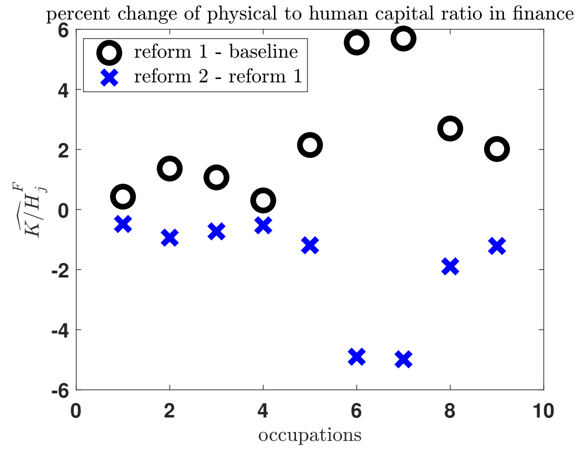
(f) $\hat{H}$ Across Occupations

Notes: TBC

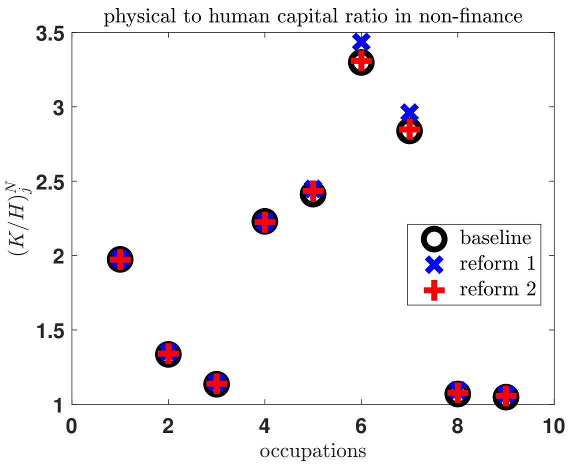
Figure 24: Physical to Human Capital Ratio



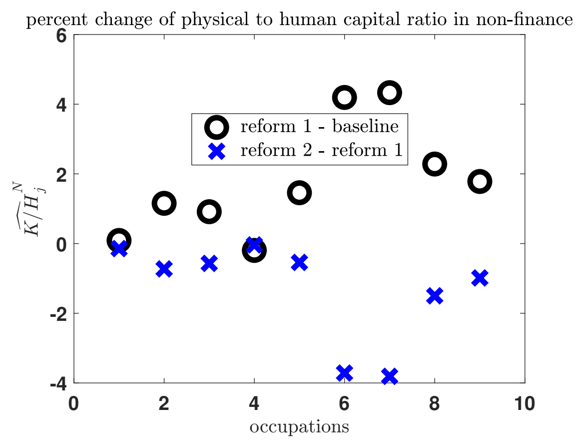
(a) K^F/H^F Across Occupations



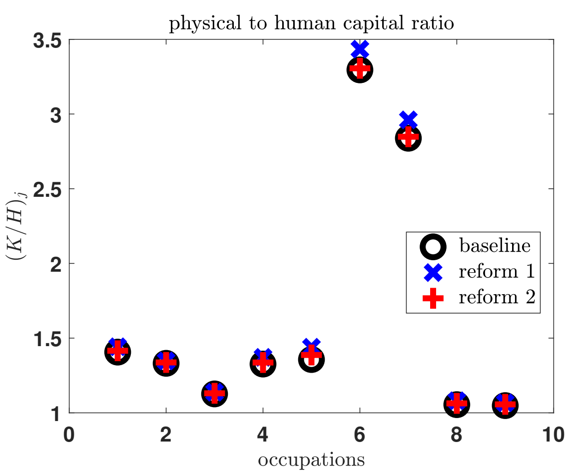
(b) $K^F\hat{/}H^F$ Across Occupations



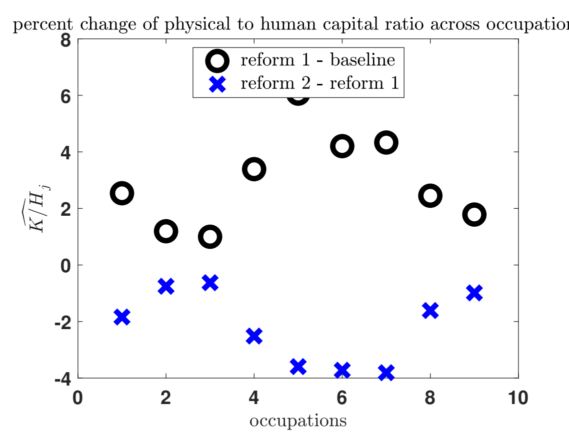
(c) H^N/K^N Across Occupations



(d) $H^N\hat{/}K^N$ Across Occupations



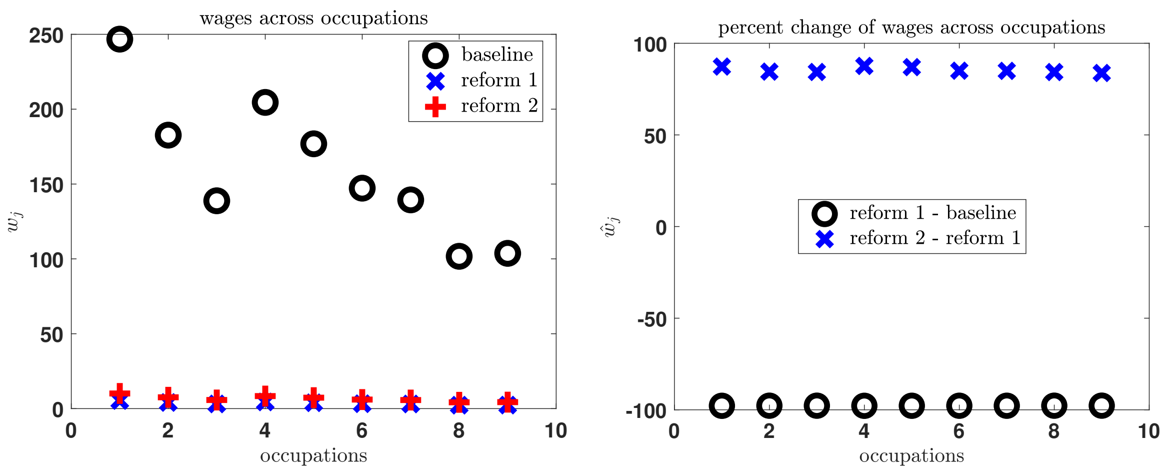
(e) K/H Across Occupations



(f) $K\hat{/}H$ Across Occupations

Notes: TBC

Figure 25: Aggregate Wages

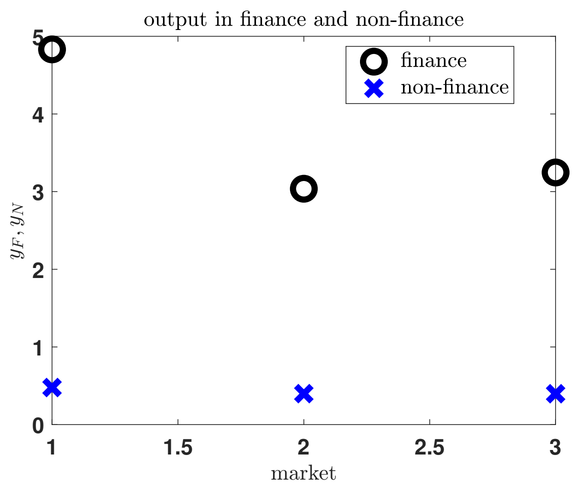


(a) w Across Occupations

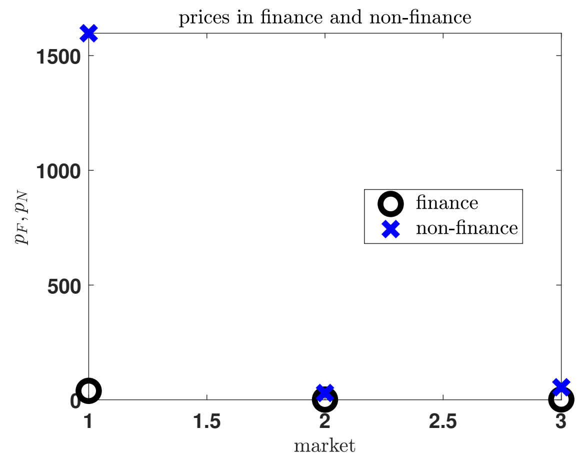
(b) $\hat{w}$ Across Occupations

Notes: TBC

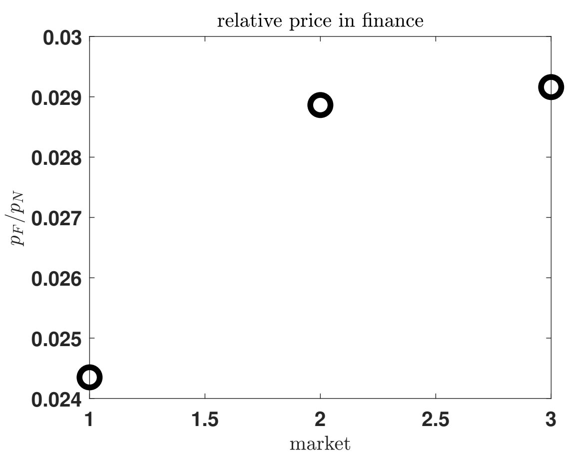
Figure 26: Output, Prices & Costs



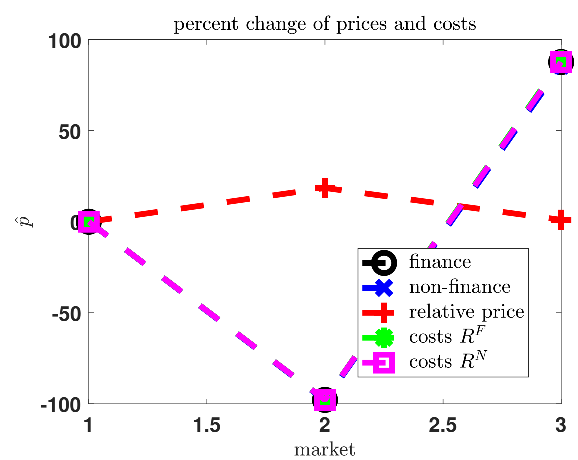
(a) y^F, y^N Across Reforms



(b) p^F, p^N Across Reforms



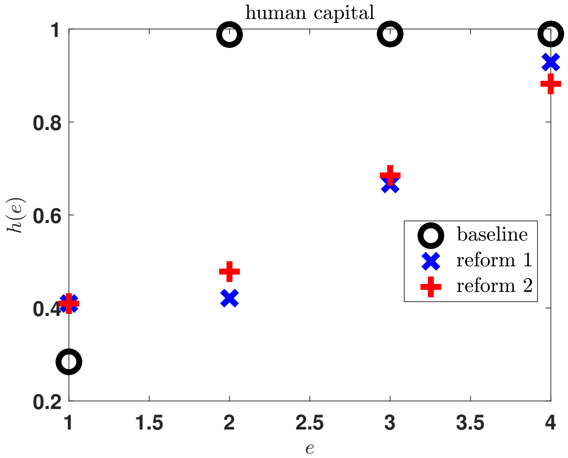
(c) p^F/p^N Across Reforms



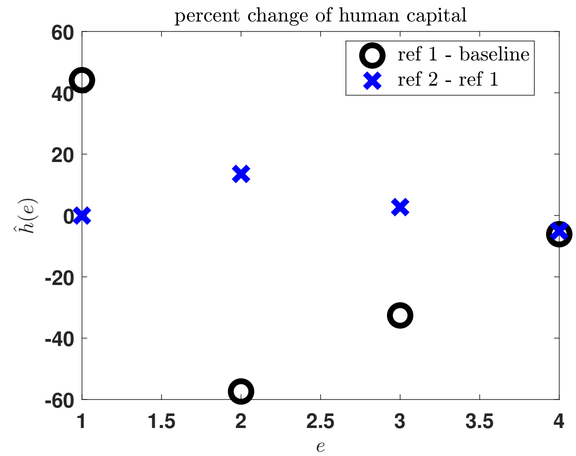
(d) $\hat{p}^i$ Across Reforms

Notes: TBC

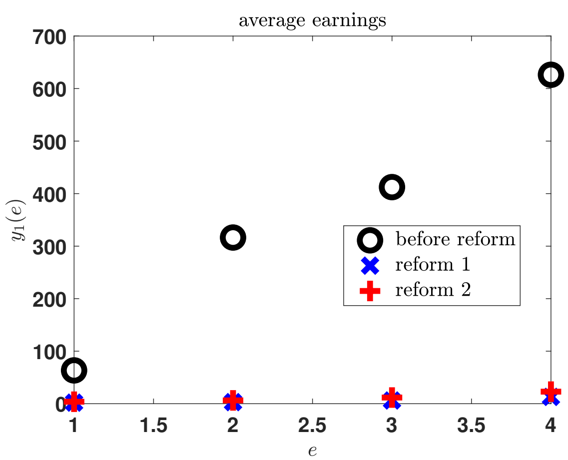
Figure 27: Human Capital, Incomes & CEV by Type



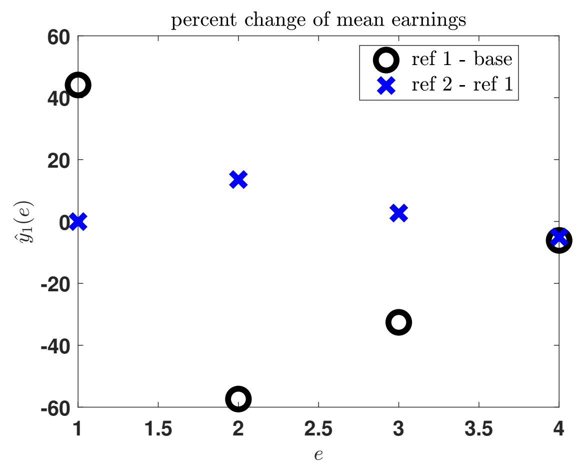
(a) H Across Types



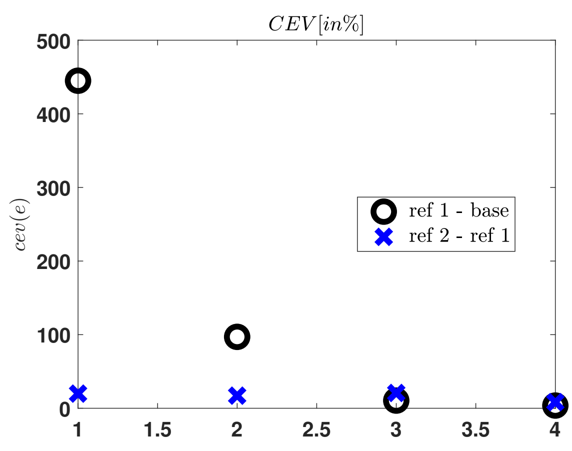
(b) $\hat{H}$ Across Types



(c) y Across Types



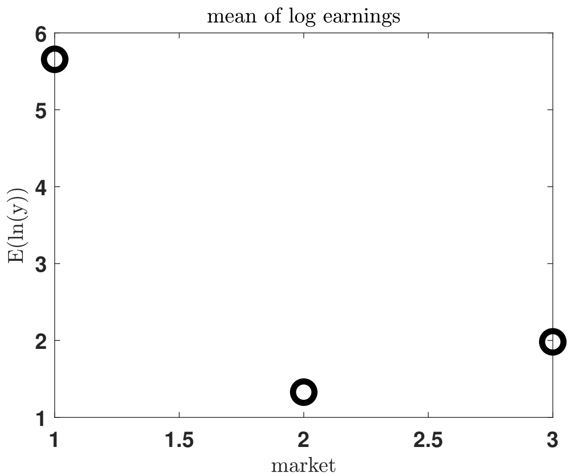
(d) $\hat{y}$ Across Types



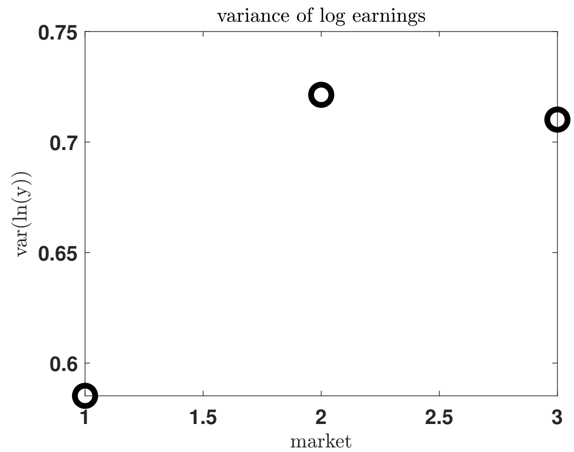
(e) CEV Across Types

Notes: TBC

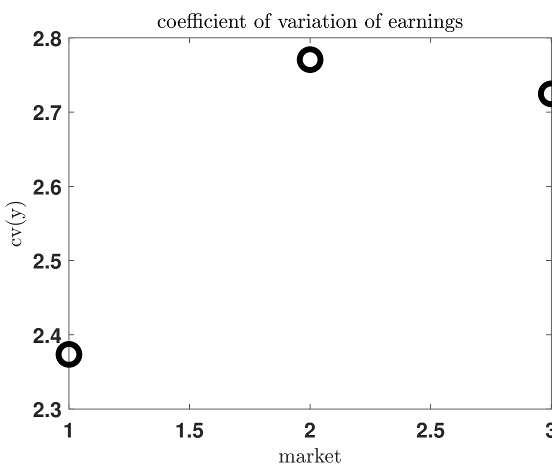
Figure 28: Summary Statistics



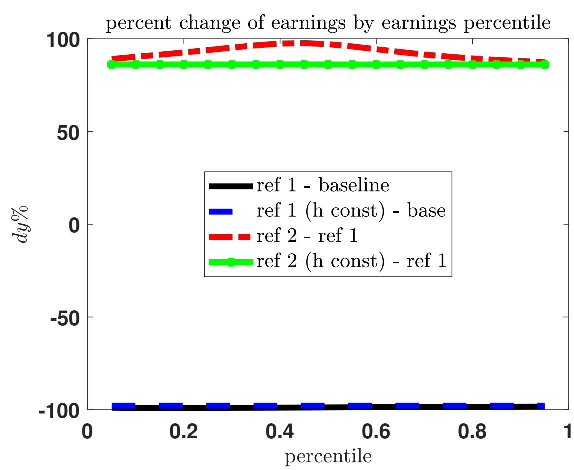
(a) Mean Log Earnings



(b) Variance of Log Earnings



(c) CV of Earnings



(d) Income Change by Percentiles

Notes: TBC

8 Conclusion

In this paper we investigate the role of financial deregulation on income inequality in the U.S. economy across time and states. We find that reforms to the financial sector in the 1970s and 1980s, namely bank branching deregulation and the removal of interest rate ceilings, have led to reductions of income inequality by increasing incomes mainly in the bottom of the distribution. In contrast, the 1999 repeal of the Glass-Steagall Act has increased income inequality by increasing incomes in the top of the distribution. Most of these changes in inequality are due to indirect effects, i.e., not caused by affecting incomes of employees in the Finance and Insurance (FI) sector. Yet, 22% of the increase of income inequality caused by the repeal of the Glass-Steagal act can be attributed to increasing incomes of workers employed in FI, relative to the rest of the economy.

Overall, our findings suggest that macroeconomic models on the effects of financial market deregulation on inequality have to accommodate mechanisms that reflect the heterogeneity of the impact of different types of reforms. For example, standard models with capital skill complementarities would predict that all reforms lead to an increase of incomes in the right tail of the distribution. We therefore develop a model of financial market reforms with two sectors, finance and non-finance, capital skill complementarities in production in the two sectors on the production side and differential financial products and access to these products on the workers' side. We conjecture (this paper is incomplete) that this structure will enable us to model flexibly the differential impact of reforms on the demand for credit, production and the distribution of incomes.

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A Data Appendix

A.1 Baseline Results: Control Variables

Table A.1: Impact of Financial Deregulation on Income Inequality: Control Variables

	(1) log(Gini)	(2) log(Theil)	(3) log(90/10)	(4) log(25/10)	(5) log(90/75)
High School Dropout	0.360***	0.648***	0.553**	-0.109	0.303***
	(0.099)	(0.188)	(0.244)	(0.093)	(0.084)
Share Black Population	-0.085	-0.129	-0.411	-0.135	0.091
	(0.061)	(0.096)	(0.392)	(0.250)	(0.104)
Share Female Population	-0.086	-0.101	-0.373	-0.036	0.077
	(0.154)	(0.314)	(0.478)	(0.263)	(0.170)
Unemployment Rate	0.329***	0.677***	1.005***	0.411***	-0.018
	(0.074)	(0.141)	(0.232)	(0.133)	(0.080)
Growth in GSP per capita	0.031	0.049	-0.132	-0.180*	0.128***
	(0.063)	(0.126)	(0.180)	(0.096)	(0.040)
Year Fixed Effects	Y	Y	Y	Y	Y
State Fixed Effects	Y	Y	Y	Y	Y
Observations	2,058	2,058	2,058	2,058	2,058
R^2	0.551	0.585	0.192	0.381	0.571

Notes: The table shows the results from the regression in equation 1. Results on state and year fixed effects are not reported. Information on 49 states is used from 1976 to 2017. Data on Gross State Product (GSP) is from the Bureau of Economic Analysis (BEA). Standard errors are clustered at the state level and are reported in the parentheses; *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

A.2 Conditional Income Inequality

Table A.2: Impact of Financial Deregulation on Conditional Income Inequality

	(1) log(Gini)	(2) log(Theil)	(3) log(90/10)	(4) log(25/10)	(5) log(90/75)
			Panel A: No Controls		
RBR	-0.033***	-0.062***	-0.003***	-0.002***	-0.000**
	(0.007)	(0.012)	(0.001)	(0.000)	(0.000)
RSC	-0.019**	-0.038*	-0.002**	-0.001*	-0.000
	(0.009)	(0.020)	(0.001)	(0.001)	(0.000)
RGS	0.619*	0.893	0.064*	0.004	0.016**
	(0.368)	(0.659)	(0.032)	(0.011)	(0.007)
Year Fixed Effects	Y	Y	Y	Y	Y
State Fixed Effects	Y	Y	Y	Y	Y
Observations	2,058	2,058	2,058	2,058	2,058
R^2	0.224	0.234	0.187	0.318	0.520
			Panel B: With Controls		
RBR	-0.029***	-0.055***	-0.003***	-0.002***	-0.000**
	(0.006)	(0.011)	(0.001)	(0.000)	(0.000)
RSC	-0.019*	-0.037*	-0.002**	-0.001*	-0.000
	(0.010)	(0.021)	(0.001)	(0.001)	(0.000)
RGS	0.502	0.668	0.055*	-0.000	0.016**
	(0.366)	(0.658)	(0.031)	(0.010)	(0.008)
Share High School Dropouts	0.071	0.116	0.010	0.000	0.006***
	(0.094)	(0.168)	(0.009)	(0.004)	(0.002)
Share of Black Population	-0.094	-0.204	-0.011	-0.004	-0.004
	(0.133)	(0.259)	(0.012)	(0.005)	(0.003)
Share of Female Population	-0.316	-0.626	-0.025	-0.010	0.005
	(0.236)	(0.449)	(0.023)	(0.013)	(0.005)
Unemployment Rate	0.686***	1.366***	0.054***	0.022***	0.005
	(0.104)	(0.208)	(0.010)	(0.006)	(0.003)
Growth in GSP per capita	-0.008	-0.043	-0.009	-0.013**	0.003
	(0.082)	(0.159)	(0.009)	(0.005)	(0.002)
Year Fixed Effects	Y	Y	Y	Y	Y
State Fixed Effects	Y	Y	Y	Y	Y
Observations	2,058	2,058	2,058	2,058	2,058
R^2	0.260	0.268	0.217	0.332	0.528

Notes: The table shows the results from the regression in equation 1 with measures of conditional income inequality. To measure conditional income inequality, we first retrieve the residuals from a regression on log income which controls for four categories of years of schooling, race and gender. Measures of inequality are constructed using these residuals. State and year fixed effects are not reported. Information on 49 states is used from 1976 to 2017. Data on Gross State Product (GSP) is from the Bureau of Economic Analysis (BEA). Standard errors are clustered at the state level and are reported in the parentheses; *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

A.3 Probability of Employment in Finance

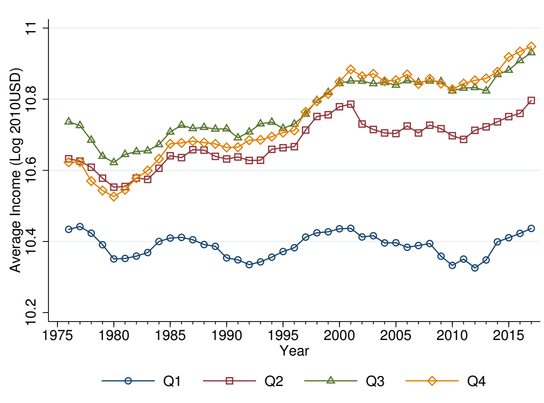
Table provides summary statistics for control variables used in regression (5).

Table A.3: Summary Statistics of Workers in FI and NFI

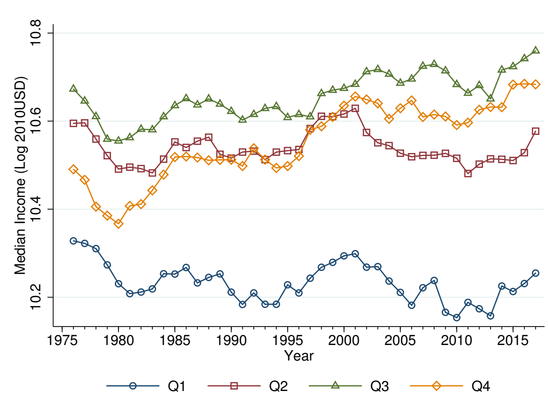
	FI	NFI			
		Q1	Q2	Q3	Q4
Male	0.62	0.29	0.35	0.54	1.65
White	0.83	0.79	0.82	0.84	0.83
Age	38.42	40.17	38.25	38.98	38.41
Yrs. Of Experience	18.00	23.20	18.34	18.38	17.83
Managers	0.37	0.00	0.00	0.11	0.43
Income (thousands)	52.90	32.47	43.85	48.38	47.84
$< HS$	0.01	0.38	0.01	0.06	0.00
HS	0.26	0.44	0.38	0.25	0.24
LTC	0.29	0.16	0.33	0.22	0.31
GTC	0.44	0.01	0.28	0.47	0.45
Propensity Score	0.12	0.00	0.01	0.05	0.14
N	116,462	519,445	519,356	517,365	519,925

Figure A.1 plots the average and median incomes of workers based on the quartiles of probabilities for employment in FI. The figure shows a clear positive relationship between income and propensity scores up to the third quartile of propensity score. The average (median) income of NFI workers in the 4th quartile of propensity scores are less than those in the third (and second) quartiles.

Figure A.1: Average and Median Income for NFI Employees by quartile of propensity score



(a) Average Income



(b) Median Income

Notes: The figure reports the average and median incomes of employees in NFI based on the quartile of their propensity scores.

We also compute the medium run impact as follows and report the results in table A.4. The results find qualitatively similar but smaller impact of reforms by propensity score.

$$y_{ast+5} = \alpha + \gamma p_a + \Sigma_i \beta^i D^i_{st} + +\Sigma_i \delta^i [(p_i - \bar{p}) \times D^i_{st}] + \mathbf{A_s} + \mathbf{B_t} + \mathbf{C_{ind}} + \epsilon_{ist} \tag{35}$$

Table A.4: Medium Run Impact of Deregulation by Propensity Scores

	(1) log(Income)	(2) log(Income)	(3) log(Income)	(4) log(Income)
Propensity Score (p)	1.035***	0.774***	1.342***	0.735***
	(0.104)	(0.090)	(0.092)	(0.096)
RBD	0.015	-	-	0.016
	(0.010)	-	-	(0.010)
RBD $\times(p-\bar{p})$	0.710***	-	-	0.314***
	(0.093)	-	-	(0.110)
RSC	-	0.003	-	-0.000
	-	(0.014)	-	(0.014)
RSC $\times(p-\bar{p})$	-	0.899***	-	0.461***
	-	(0.084)	-	(0.096)
RGS	-	-	-0.003	0.002
	-	-	(0.023)	(0.021)
RGS $\times(p-\bar{p})$	-	-	0.591***	0.436***
	-	-	(0.052)	(0.038)
State FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
N	1,794,197	1,794,197	1,794,197	1,794,197
R^2	0.099	0.098	0.099	0.099

A.4 Medium Run Impact

Here we consider the of impact on these reforms on income earned five year following the reforms. In particular, we change specification (1) to:

$$\ln\left(I_{st+5}(y)\right) = \alpha + \Sigma_i \beta^i D^i_{st} + \delta X_{st} + \mathbf{A_s} + \mathbf{B_t} + \epsilon_{st+5}. \tag{36}$$

Table A.5 shows the results on inequality measures, which confirms our results from Table 3 of the main text.

Table A.5: Impact of Financial Deregulation on Income Inequality

	(1) log(Gini)	(2) log(Theil)	(3) log(90/10)	(4) log(25/10)	(5) log(90/75)
	Panel A: No Controls				
RBR	-0.016**	-0.031***	-0.043***	-0.014*	0.004
	(0.006)	(0.012)	(0.015)	(0.007)	(0.005)
RSC	-0.002	-0.002	-0.014	-0.013	0.006
	(0.010)	(0.019)	(0.026)	(0.014)	(0.011)
RGS	0.665**	1.241**	1.557**	0.034	0.133
	(0.251)	(0.473)	(0.702)	(0.291)	(0.172)
Year Fixed Effects	Y	Y	Y	Y	Y
State Fixed Effects	Y	Y	Y	Y	Y
Observations	1,813	1,813	1,813	1,813	1,813
R^2	0.464	0.511	0.161	0.318	0.498
	Panel B: With Controls				
RBR	-0.016***	-0.032***	-0.042***	-0.012	0.004
	(0.005)	(0.010)	(0.015)	(0.008)	(0.005)
RSC	-0.004	-0.006	-0.017	-0.012	0.005
	(0.009)	(0.018)	(0.027)	(0.014)	(0.011)
RGS	0.564**	1.050**	1.381**	-0.003	0.059
	(0.225)	(0.421)	(0.665)	(0.282)	(0.158)
Share of High Shool Dropouts	0.333***	0.610***	0.439**	-0.157	0.232***
	(0.071)	(0.142)	(0.190)	(0.107)	(0.072)
Share of Black Population	-0.016	-0.032	-0.159	-0.047	0.042
	(0.081)	(0.131)	(0.452)	(0.242)	(0.105)
Share of Female Population	-0.374**	-0.679**	-1.085**	-0.569**	-0.154
	(0.164)	(0.328)	(0.448)	(0.261)	(0.134)
Unemployment Rate	0.021	0.055	0.230	0.157	0.030
	(0.063)	(0.131)	(0.182)	(0.133)	(0.069)
Growth in GSP per capita	-0.202***	-0.412***	-0.396***	-0.127**	-0.062
	(0.040)	(0.083)	(0.121)	(0.059)	(0.051)
Year Fixed Effects	Y	Y	Y	Y	Y
State Fixed Effects	Y	Y	Y	Y	Y
Observations	1,813	1,813	1,813	1,813	1,813
R^2	0.494	0.535	0.184	0.326	0.509

Notes: The table shows the results from the regression in equation 36. State and year fixed effects are not reported. Information on 49 states is used from 1984 to 2017. Data on Gross State Product (GSP) is from the Bureau of Economic Analysis (BEA). Standard errors are clustered at the state level and are reported in the parentheses; *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

A.5 Alternative Years of FI Employment Share

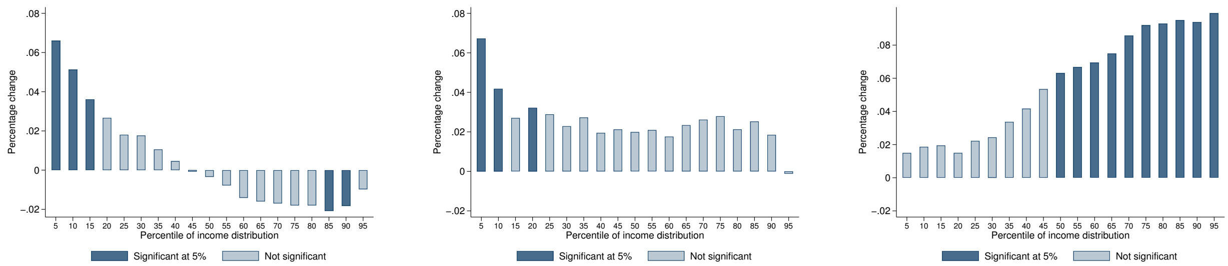
Here, we explore whether using FI employment share for alternative years rather than in the share in 1999.

Table A.6: Impact of Financial Deregulation on Income Inequality

	(1) log(Gini)	(2) log(Theil)	(3) log(90/10)	(4) log(25/10)	(5) log(90/75)
	Panel A: FI Employment Share in 1990				
RBR	-0.020***	-0.038***	-0.066***	-0.029***	-0.002
	(0.004)	(0.008)	(0.013)	(0.008)	(0.005)
RSC	-0.013	-0.029	-0.027	-0.012	-0.011
	(0.009)	(0.017)	(0.019)	(0.013)	(0.009)
RGS (1990 Emp. Share)	0.432	0.708	1.064	0.007	-0.037
	(0.259)	(0.508)	(0.686)	(0.257)	(0.169)
Year Fixed Effects	Y	Y	Y	Y	Y
State Fixed Effects	Y	Y	Y	Y	Y
Additional Controls	Y	Y	Y	Y	Y
Observations	2,058	2,058	2,058	2,058	2,058
R^2	0.554	0.588	0.191	0.386	0.567
	Panel B: FI Employment Share in 1995				
RBR	-0.020***	-0.037***	-0.065***	-0.029***	-0.002
	(0.004)	(0.007)	(0.012)	(0.008)	(0.005)
RSC	-0.012	-0.027	-0.024	-0.012	-0.011
	(0.009)	(0.017)	(0.019)	(0.013)	(0.009)
RGS (1995 Emp. Share)	0.350***	0.630***	0.528**	-0.113	0.302***
	(0.100)	(0.191)	(0.248)	(0.092)	(0.083)
Year Fixed Effects	Y	Y	Y	Y	Y
State Fixed Effects	Y	Y	Y	Y	Y
Additional Controls	Y	Y	Y	Y	Y
Observations	2,058	2,058	2,058	2,058	2,058
R^2	0.557	0.590	0.194	0.386	0.568

Notes: The table shows the results from the regression in equation 1 where the regressor for RGS captures employment share in 1990 (Panel A) and 1995 (Panel B). Standard errors are clustered at the state level and are reported in the parentheses; *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

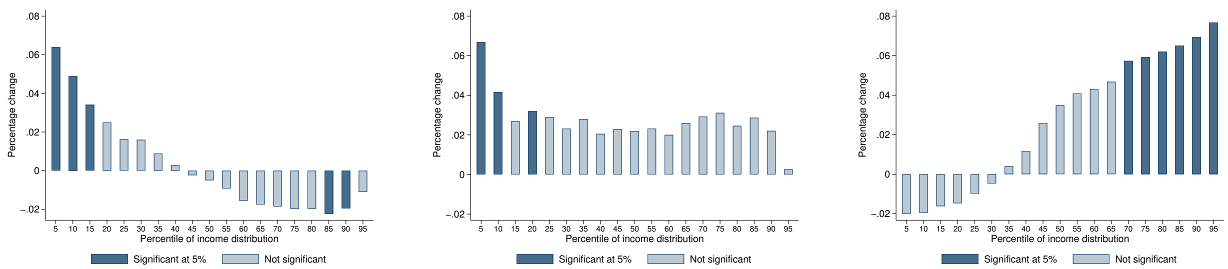
Figure A.2: Impact of Financial Deregulation by Income Group, 1990 Employment Share for RGS



(a) Bank Branching Deregulation (b) Removal of Rate Ceilings (c) Repeal of Glass-Steagall

Notes: The figure reports the coefficients β^i for percentiles of the income distribution from specification 2. Panel (c) reports the product of the coefficient and the national employment share of Finance and Insurance sectors in 1990. Darker bars indicate that the coefficient is statistically significant at the 5% confidence level.

Figure A.3: Impact of Financial Deregulation by Income Group, 1995 Employment Share for RGS



(a) Bank Branching Deregulation (b) Removal of Rate Ceilings (c) Repeal of Glass-Steagall

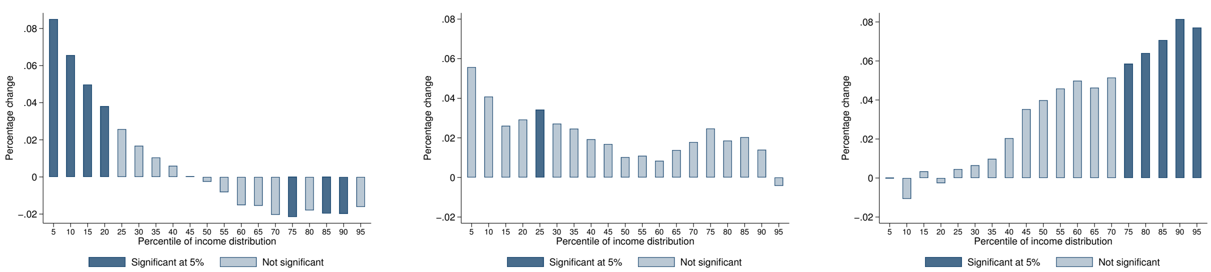
Notes: The figure reports the coefficients β^i for percentiles of the income distribution from specification 2. Panel (c) reports the product of the coefficient and the national employment share of Finance and Insurance sectors in 1995. Darker bars indicate that the coefficient is statistically significant at the 5% confidence level.

A.6 Alternative Measures of Income

Our primary analysis relies on total income (`inctot` in IPUMS) as the relevant measure of income which includes "...total pre-tax personal income or losses from all sources". Alternatively, we could also use labor income (`incwage` in IPUMS) which is the "total pre-tax wage and salary income - that is, money received as an employee". Or, we could use the difference between the two measures which would include all business income, capital income/losses, govt. transfers etc. Notice, that we exclude those with negative earnings and trim the top and bottom 1% of earners (in all measures). Below, we show our primary empirical results using these two alternative measures of income.

A.6.1 Labor Income

Figure A.4: Impact of Financial Degregulation by Labor Income Group



(a) Bank Branching Deregulation

(b) Removal of Rate Ceilings

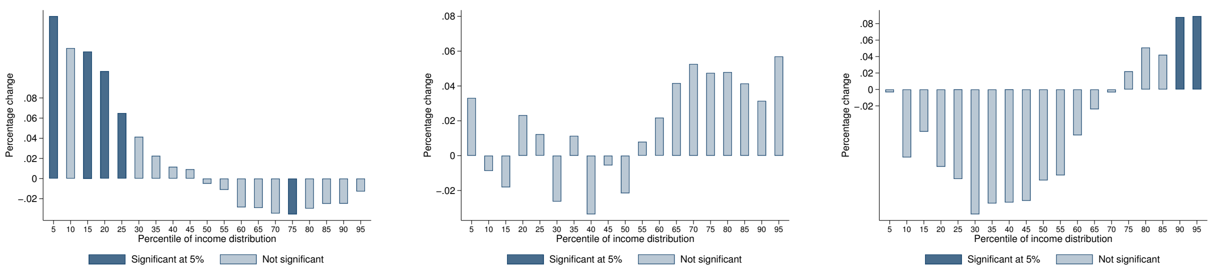
(c) Repeal of Glass-Steagall Income

Table A.7: Marginal Impact of Deregulation on Income Inequality

	(1) Gini	(2) Theil	(3) p90/p10	(4) p25/p10	(5) p90/p75
Branching Dereg	-0.022***	-0.043***	-0.077***	-0.034***	-0.000
	(0.005)	(0.009)	(0.014)	(0.007)	(0.005)
Rate Ceiling	-0.013*	-0.028**	-0.030	-0.006	-0.013
	(0.007)	(0.014)	(0.022)	(0.018)	(0.011)
Glass-Steagall	0.030*	0.061*	0.078*	0.010	0.020**
	(0.018)	(0.035)	(0.041)	(0.012)	(0.009)
Additional Controls	Y	Y	Y	Y	Y
N	2,058	2,058	2,058	2,058	2,058
R^2	0.457	0.518	0.338	0.489	0.504

A.6.2 Non-Labor Income Only

Figure A.5: Impact of Financial Degregulation by Labor Income Group



(a) Bank Branching Deregulation (b) Removal of Rate Ceilings (c) Repeal of Glass-Steagall Income

Table A.8: Marginal Impact of Deregulation on Income Inequality

	(1) Gini	(2) Theil	(3) p90/p10	(4) p25/p10	(5) p90/p75
Branching Dereg	-0.002	-0.001	-0.154**	-0.072	0.006
	(0.003)	(0.008)	(0.067)	(0.059)	(0.014)
Rate Ceiling	-0.002	-0.007	0.052	0.013	-0.015
	(0.006)	(0.016)	(0.055)	(0.044)	(0.023)
Glass-Steagall	0.278*	0.782*	2.644	-0.368	1.542**
	(0.164)	(0.419)	(1.704)	(1.555)	(0.640)
Additional Controls	Y	Y	Y	Y	Y
N	2,058	2,058	2,058	2,058	2,058
R^2	0.457	0.518	0.338	0.489	0.504

B Theoretical Appendix

B.1 Implications of Frechet Distribution

The implications of the Frechet distributional assumption on the idiosyncratic productivity shock η_j are as follows:

1. The probability distribution of the observing normalized earnings $y(e,j) \equiv \gamma(e,j) \cdot w(j) \cdot \eta_j$ of a worker of type e in occupation j is given by

$$\begin{aligned}
\Pr\left[\gamma(e,j) \cdot w(j) \cdot \eta_j \leq y\right] &= \Pr\left[\eta_j \leq \frac{y}{\gamma(e,j) w(j)}\right] \\
&= e^{-\left(\frac{y}{T_j \gamma(e,j) w(j)}\right)^{-\theta}},
\end{aligned}$$

   i.e., it also a Frechet distribution with the same curvature parameter θ but with scale parameter $[T_j \gamma(e,j) w(j)]$. For now on, we will assume that $T_j = 1$, so that all differences across occupations are subsumed in $\gamma(e,j)$.

2. We are interested in the distribution of

$$\max_j \left\{\gamma(e,j) \cdot w(j) \cdot \eta_j\right\}.$$

   It can be shown that

$$\Pr\left[\max_j \left\{\gamma(e,j) \cdot w(j) \cdot \eta_j\right\} \leq y\right] = e^{-\left[\sum_{j=1}^{J}[\gamma(e,j)w(j)]^{\theta}\right](y)^{-\theta}} = ,$$

   i.e., it is also a Frechet distribution with curvature parameter θ, but scale parameter

$$\Phi(e; w) \equiv \left[\sum_{j=1}^{J} [\gamma(e,j) w(j)]^{\theta}\right]^{\frac{1}{\theta}}.$$

3. Further useful observations are:

   - The probability that a worker e goes to j is independent of y_0 and h, as these are absolute advantage components. These probabilities are

$$\pi(e,j) = \frac{[\gamma(e,j) w(j)]^{\theta}}{\left[\sum_{k=1}^{J} [\gamma(e,k) w(k)]^{\theta}\right]}.$$

This expression can be linked to the propensity scores from the empirical analysis.

- Useful moments/expressions for scaled income $y = \max_j \left\{ \gamma(e,j) \cdot w_j \cdot \eta_j \right\}$ (scaling $y_0 h^{\psi} = 1$) are:

$$\begin{aligned}
\text{c.d.f.} \quad &: \quad F(y) = e^{-\left(\frac{y}{\Phi(e;w)}\right)^{-\theta}} \\
\text{p.d.f.} \quad &: \quad f(y) = \theta \Phi(e;w)^{\theta} (y)^{-(1+\theta)} e^{-\left(\frac{y}{\Phi(e;w)}\right)^{-\theta}} \\
\text{expectation} \quad &: \quad E[y] = \Gamma\left(1 - \frac{1}{\theta}\right) \Phi(e;w).
\end{aligned}$$

- The implied direct change in expected income of a worker, given a change in wage $w(j)$ is given by

$$\begin{aligned}
\frac{\partial \Phi(e;w)}{\partial w(j)} &= \left(\frac{1}{\theta}\right) \left[\sum_{j=1}^{J} [\gamma(e,j) w(j)]^{\theta} \right]^{\frac{1}{\theta}-1} \theta [\gamma(e,j) w(j)]^{\theta-1} \gamma(e,j) \\
&= \left[\sum_{j=1}^{J} [\gamma(e,j) w(j)]^{\theta} \right]^{\frac{1-\theta}{\theta}} [\gamma(e,j) w(j)]^{\theta-1} \gamma(e,j) \\
&= \left[\left[\left[\frac{\gamma(e,j) w(j)}{\Phi(e;w)} \right]^{\theta} \right]^{\frac{1}{\theta}} \right]^{\theta-1} \gamma(e,j) \\
&= [\pi(e,j)]^{\frac{\theta-1}{\theta}} \gamma(e,j),
\end{aligned}$$

  i.e., the direct impact on average earnings depends on the propensity of a worker to be assigned to that particular occupations.

  An additional impact will take place when these workers adjust their skill investments, which is something we discuss in each contracting environment.

- Last, but not least: If y is a Frechet distribution with parameters $(\theta, \Phi(e;w))$, then, for $0 \leq \sigma < 1$, $y^{1-\sigma}$ is distributed also Frechet but with parameters $\left(\frac{\theta}{1-\sigma}, [\Phi(e;w)]^{1-\sigma}\right)$.

B.2 Human Capital Allocation Across Sectors

The maximization of the household problem w.r.t. income can be split up into (i) a decision on the occupation to work in and (ii) conditional on occupation j on the amount of hours to supply in the respective sector. With that second decision, households in every occupation j

maximize (7) subject to the constraint (8). From (8) we obtain

$$l_j^N = \left(1 - l_j^{F^{1+\frac{1}{\epsilon}}}\right)^{\frac{1}{1+\frac{1}{\epsilon}}}. \tag{37}$$

Using this in (7) gives

$$w_j = w_j^F l_j^F + w_j^N \left(1 - l_j^{F^{1+\frac{1}{\epsilon}}}\right)^{\frac{1}{1+\frac{1}{\epsilon}}},$$

from which we get the FOC w.r.t. l_j^F as

$$w_j^F = w_j^N \left(1 - l_j^{F^{1+\frac{1}{\epsilon}}}\right)^{-\frac{\frac{1}{\epsilon}}{1+\frac{1}{\epsilon}}} l_j^{F^{\frac{1}{\epsilon}}},$$

which simplifies to

$$\frac{l_j^F}{l_j^N} = \left(\frac{w_j^F}{w_j^N}\right)^{\epsilon}, \quad \text{or,} \quad \left(\frac{l_j^F}{l_j^N}\right)^{\frac{1}{\epsilon}} = \frac{w_j^F}{w_j^N}. \tag{38}$$

and thus determines the relative labor allocation across the two sectors in dependence of relative wages. For $\epsilon < \infty$ therefore wages across the two sectors are not equalized.

B.3 First-order Conditions of Personalized Contracts

The first order conditions of the maximization problem (14) are:

$[s]$: $[\alpha(e)\,(1-h) - s + b]^{-\sigma} \geq \mu\beta R$, $s \geq 0$, & at least one with equality.

$[b]$: $[\alpha(e)\,(1-h) - s + b]^{-\sigma} \leq \mu\beta R^N$, $b \geq 0$, & at least one with equality.

$$[d\,(y)] : \frac{1}{p^N}\left[\frac{\alpha(e)h^{\psi}y - d\,(y)}{p^N}\right]^{-\sigma} = \left[\mu - \frac{\lambda\,(y)}{p^N}\right]$$

$$[h] : [\alpha(e)\,(1-h) - s + b]^{-\sigma} = \left(\frac{\beta\psi h^{\psi-1}}{p^N}\right)\left\{\int_0^{\infty} y\left\{\left[\frac{\alpha(e)h^{\psi}y - d\,(y)}{p^N}\right]^{-\sigma} + \zeta\lambda\,(y)\right\} f\,(y)\,dy\right\}.$$

B.4 Expressions for Second Period Consumption

1. Autarky

$$c_1 = \frac{\alpha(e)h^{\psi}y}{p^N},$$

where we define $y \equiv \left(\max_j \left\{\gamma(e,j)w_j\eta_j\right\}\right)$ which will be distributed Frechet with curvature/shape parameter θ and scale parameter $\left[\sum_j^J \left(\gamma(e,j)w_j\right)^{\theta}\right]^{\frac{1}{\theta}}$ (as discussed below). Therefore, for Frechet distribution $f(y)$:

$$c_1(e,aut) = \frac{\alpha(e)h(e,aut)^{\psi}y}{p^N}\int_0^{\infty} yf(y)dy = \frac{\alpha(e)h(e,aut)^{\psi}}{p^N}\Gamma\left(1-\frac{1}{\theta}\right)\Phi(e;w).$$

2. Generic borrowing contracts (with monopolistic or competitive lenders)

For $m \in \{bgm, bgc\}$, given default threshold defined in the main text $y^{\text{def}}(e,m)$ we obtain

$$c_1(e,m) = \frac{1}{p^N}\left\{(1-\zeta)\,\alpha(e)h(e,m)^{\psi}\int_0^{\bar{y}^{\text{def}}(e,m)} yf\left(y\right)dy + \int_{\bar{y}^{\text{def}}(e,m)}^{\infty}\left[\alpha(e)h(e,m)^{\psi}y - d(e,m)\right]f\left(y\right)dy\right\}.$$

3. Generic saving contract (with competitive lenders)

$$c_1 = \frac{\alpha(e)h^{\psi}y + z}{p^N},$$

and hence

$$c_1(e,sg) = \frac{\alpha(e)h(e,sg)^{\psi}}{p_N}\Gamma\left(1-\frac{1}{\theta}\right)\Phi(e;w) + \frac{z(e,sg)}{p_N},$$

where $z(e,sg)$ is the repayment amount by the lender to the household.

4. Personalized borrowing and saving contracts (with competitive lenders)

$$c_1 = \frac{\alpha(e)h^{\psi}y - d\left(y\right)}{p^N},$$

and hence for $m \in \{bp, sp\}$ we have:

$$c_1(e,m) = \frac{\alpha(e)h(e,m)^{\psi}}{p_N}\Gamma\left(1-\frac{1}{\theta}\right)\Phi(e;w) - \frac{1}{p^N}\int_0^{\infty} d(e,m;y)f\left(y\right)dy$$

where $d(e,m;y)$ is the state contingent repayment amount by the household to the lender (which can be negative).

Recall that depending on whether the no-default constraint binds we get

$$c_1(e,m;y) = \begin{cases} \left(\frac{\beta R^N}{p^N}\right)^{\frac{1}{\sigma}} c_0(e,m) & \text{if } y \leq \frac{p^N\left(\beta R/p^N\right)^{\frac{1}{\sigma}}}{(1-\zeta)\alpha(e)h(e,m)^{\psi}} c_0(e,m) \\ \frac{(1-\zeta)\alpha(e)h^{\psi}y}{p^N} > \left(\frac{\beta R^N}{p^N}\right)^{\frac{1}{\sigma}} c_0(e,m) & \text{otherwise.} \end{cases}$$

Let

$$\bar{y}^{\text{def}}(e,m) \equiv \frac{p^N\left(\beta R/p^N\right)^{\frac{1}{\sigma}}}{(1-\zeta)\alpha(e)h(e,m)^{\psi}} c_0(e,m)$$

denote the default threshold. We then get

$$c_1(e,m) = \left(\frac{\beta R^N}{p^N}\right)^{\frac{1}{\sigma}} c_0(e,m)\int_0^{\bar{y}^{\text{def}}(e,m)} dy + \frac{\left(1-\zeta\right)\alpha(e)h^{\psi}}{p^N}\int_{\bar{y}^{\text{def}}(e,m)}^{\infty} ydy.$$

B.5 Profit Maximization and Cost Minimization Problem

Sector F. To derive equation (25) we split the problem into two parts. We first solve for the unitary cost function in occupation j

$$v_j^F = \min_{\{H_j^F, K_j^F\}} w_j H_j^F + R_F K_j^F \quad \text{s.t.} \quad \left[\mu_j\left(H_j^F\right)^{\rho_j} + \left(1-\mu_j\right)\left(K_j^F\right)^{\rho_j}\right]^{\frac{1}{\rho_j}} = 1.$$

Second, we solve for the minimization

$$p_F\left(w, R_F\right) = \min_{\{G_j\}_{j=1}^J} \sum_{j=1}^{J} v_j^F G_j, \text{ s.t. } \zeta_F\left[\sum_{j=1}^{J}\lambda_j^F\left(G_j\right)^{\rho_o}\right]^{\frac{1}{\rho_o}} = 1.$$

The solution for the first problem is

$$v_j^F(w_j, R_F) = \left(\mu_j^{\frac{1}{1-\rho_j}} {w_j^F}^{\frac{\rho_j}{\rho_j-1}} + \left(1-\mu_j\right)^{\frac{1}{1-\rho_j}} {R^F}^{\frac{\rho_j}{\rho_j-1}}\right)^{\frac{\rho_j-1}{\rho_j}}. \tag{39}$$

and the solution of the second problem is in turn given by

$$p_F(w, c_F) = \zeta_F^{-1} \cdot \left[\sum_{j=1}^{J} \lambda_j^{F\,\frac{1}{1-\rho_o}} \left(v_j^F(w_j^F, R_F) \right)^{\frac{\rho_o}{\rho_o - 1}} \right]^{\frac{\rho_o - 1}{\rho_o}}. \tag{40}$$

with details for these solutions provided next. Using (39) in (40) gives (25).

Sector N. In sector N profits are

$$\pi^N = p_N \max_{\left\{H_j^N, K_j^N\right\}} \zeta_N \left[\sum_{j=1}^{J} \lambda_j^N \left[\mu_j \left(H_j^N\right)^{\rho_j} + \left(1 - \mu_j\right) \left(K_j^N\right)^{\rho_j} \right]^{\frac{\rho_o}{\rho_j}} \right]^{\frac{\varsigma}{\rho_o}} - \sum_{j=1}^{J} w_j^N H_j^N - R^N \sum_{j=1}^{J} K_j^N.$$

As in the finance sector, solve for v_j^N, the unitary cost of equipped-labor j in non-finance, i.e.,

$$v_j^N = \min w_j^N H_j^N + R^N K_j^N \text{ s.t. } \left[\mu_j \left(H_j^N\right)^{\rho_j} + \left(1 - \mu_j\right) \left(K_j^N\right)^{\rho_j} \right]^{\frac{1}{\rho_j}} = 1.$$

which gives

$$v_j^N(w_j^N, R^N) = \left[\left(\mu_j\right)^{\frac{1}{1-\rho_j}} w_j^{N^{\frac{\rho_j}{\rho_j - 1}}} + \left(1 - \mu_j\right)^{\frac{1}{1-\rho_j}} R^{N^{\frac{\rho_j}{\rho_j - 1}}} \right]^{\frac{\rho_j - 1}{\rho_j}}. \tag{41}$$

Second, solve for the maximization

$$p_N \zeta_N \left[\sum_{j=1}^{J} \lambda_j^N G_j^{\rho_o} \right]^{\frac{\varsigma}{\rho_o}} - \sum_{j=1}^{J} v_j^N G_j$$

for which the solution is

$$p_N = \frac{1}{\varsigma} \zeta_N^{-\frac{1}{\varsigma}} \left(\sum_{j} \lambda_j^{N\,\frac{1}{1-\rho_o}} v_j^{N\,\frac{\rho_o}{\rho_o - 1}} \right)^{\frac{\rho_o - 1}{\rho_o}} \cdot Q_N^{\frac{1-\varsigma}{\varsigma}} \tag{42}$$

Using (41) in (42) gives (26).

Cost Minimization for General Case. We consider general prices v_j and production factors G_j, for $j = 1, \ldots, J$ with substitution elasticity ϱ. The minimization problem then is

$$\min_{\{G_j\}_{j=1}^J} \sum_{j=1}^{J} v_j G_j \text{ s.t. } \zeta \left[\sum_{j=1}^{J} \lambda_j G_j^{\rho} \right]^{\frac{1}{\rho}} = 1,$$

with Lagrangian (for Lagrange multiplier ϖ)

$$\min_{\{G_j\}_{j=1}^{J}} \sum_{j=1}^{J} v_j G_j + \varpi \left(1 - \zeta \left[\sum_{j=1}^{J} \lambda_j G_j^{\rho} \right]^{\frac{1}{\rho}} \right)$$

giving the FOC for j

$$v_j - \varpi \zeta \left[\sum_{j=1}^{J} \lambda_j G_j^{\rho} \right]^{\frac{1}{\rho}-1} \lambda_j G_j^{\rho-1} = 0$$

and we thus get for any two i, j

$$\frac{v_j}{v_i} = \frac{\lambda_j}{\lambda_i} \left(\frac{G_j}{G_i} \right)^{\rho-1}$$

and thus

$$\begin{aligned}
& \lambda_i^{\frac{\rho}{\rho-1}} v_i^{\frac{\rho}{1-\rho}} G_i^{\rho} v_j^{\frac{\rho}{\rho-1}} \lambda_j^{\frac{1}{1-\rho}} = \lambda_j G_j^{\rho} \\
\Leftrightarrow \quad & \lambda_i^{\frac{\rho}{\rho-1}} v_i^{\frac{\rho}{1-\rho}} G_i^{\rho} \sum_{j=1}^{J} v_j^{\frac{\rho}{\rho-1}} \lambda_j^{\frac{1}{1-\rho}} = \sum_{j=1}^{J} \lambda_j G_j^{\rho} \\
\Leftrightarrow \quad & \left(\lambda_i^{\frac{1}{\rho-1}} v_i^{\frac{1}{1-\rho}} G_i \right) \zeta \left(\sum_{j=1}^{J} v_j^{\frac{\rho}{\rho-1}} \lambda_j^{\frac{1}{1-\rho}} \right)^{\frac{1}{\rho}} = \zeta \left(\sum_{j=1}^{J} \lambda_j G_j^{\rho} \right)^{\frac{1}{\rho}} = 1 \\
\Leftrightarrow \quad & \left(\lambda_i^{\frac{1}{\rho-1}} v_i^{\frac{\rho}{1-\rho}} v_i G_i \right) = \zeta^{-1} \left(\sum_{j=1}^{J} v_j^{\frac{\rho}{\rho-1}} \lambda_j^{\frac{1}{1-\rho}} \right)^{-\frac{1}{\rho}} \\
\Leftrightarrow \quad & v_i G_i = \zeta^{-1} \left(\sum_{j=1}^{J} v_j^{\frac{\rho}{\rho-1}} \lambda_j^{\frac{1}{1-\rho}} \right)^{-\frac{1}{\rho}} \lambda_i^{\frac{1}{1-\rho}} v_i^{\frac{\rho}{\rho-1}} \\
\Leftrightarrow \quad & \sum_{i=1}^{J} v_i G_i = \zeta^{-1} \left(\sum_{j=1}^{J} v_j^{\frac{\rho}{\rho-1}} \lambda_j^{\frac{1}{1-\rho}} \right)^{-\frac{1}{\rho}} \sum_{i=1}^{J} \lambda_i^{\frac{1}{1-\rho}} v_i^{\frac{\rho}{\rho-1}} \\
\Leftrightarrow \quad & \sum_{i=1}^{J} v_i G_i = \zeta^{-1} \left(\sum_{j=1}^{J} v_j^{\frac{\rho}{\rho-1}} \lambda_j^{\frac{1}{1-\rho}} \right)^{\frac{\rho-1}{\rho}}
\end{aligned}$$

which gives, with the appropriate prices and factors, equation (40). Equations (39) follows by letting $J = 2$, $\zeta = 1$, $v_1 = w^{\ell}$, $v_2 = R^{\ell}$, $\lambda_1 = \mu_j$ and $\lambda_2 = 1 - \mu_j$.

Profit Maximization for the General Case. To derive equation (42) note that a maximization problem of the form

$$p\zeta\left[\sum_{j=1}^{J}\lambda_j G_j^{\rho}\right]^{\frac{\varsigma}{\rho}} - \sum_{j=1}^{J} v_j G_j$$

gives the first-order condition for factor G_i as

$$p\varsigma\zeta\left(\sum_j \lambda_j G_j^{\rho}\right)^{\frac{\varsigma-\rho}{\rho}} \lambda_i G_i^{\rho-1} = v_i$$

and thus for any i, j we get

$$\frac{G_j}{G_i} = \left(\frac{v_j}{v_i}\frac{\lambda_i}{\lambda_j}\right)^{\frac{1}{\rho-1}} \tag{43}$$

Now rewrite the FOC to get

$$p\varsigma\zeta\left(\sum_j \lambda_j \left(\frac{G_j}{G_i}\right)^{\rho}\right)^{\frac{\varsigma-\rho}{\rho}} \lambda_i G_i^{\varsigma-1} = v_i$$

Use (43) in the above to get

$$\begin{aligned}
& p\varsigma\zeta\left(\sum_j \lambda_j \left(\frac{v_j}{v_i}\frac{\lambda_i}{\lambda_j}\right)^{\frac{\rho}{\rho-1}}\right)^{\frac{\varsigma-\rho}{\rho}} \frac{\lambda_i}{v_i} G_i^{\varsigma-1} = 1 \\
\Leftrightarrow \quad & p\varsigma\zeta\left(\sum_j \lambda_j^{\frac{1}{1-\rho}} v_j^{\frac{\rho}{\rho-1}}\right)^{\frac{\varsigma-\rho}{\rho}} \left(\frac{\lambda_i}{v_i}\right)^{\frac{\varsigma-1}{\rho-1}} = G_i^{1-\varsigma} \\
\Leftrightarrow \quad & (p\varsigma\zeta)^{\frac{1}{1-\varsigma}}\left(\sum_j \lambda_j^{\frac{1}{1-\rho}} v_j^{\frac{\rho}{\rho-1}}\right)^{\frac{\varsigma-\rho}{\rho(1-\varsigma)}} \left(\frac{\lambda_i}{v_i}\right)^{\frac{1}{1-\rho}} = G_i
\end{aligned} \tag{44}$$

Transforming further we get

$$
\begin{aligned}
& (p\varsigma\zeta)^{\frac{\rho}{1-\varsigma}} \left(\sum_j \lambda_j^{\frac{1}{1-\rho}} v_j^{\frac{\rho}{\rho-1}} \right)^{\frac{\varsigma-\rho}{(1-\varsigma)}} \lambda_i \left(\frac{\lambda_i}{v_i} \right)^{\frac{\rho}{1-\rho}} = \lambda_i G_i^{\rho} \\
\Leftrightarrow \quad & (p\varsigma\zeta)^{\frac{\rho}{1-\varsigma}} \left(\sum_j \lambda_j^{\frac{1}{1-\rho}} v_j^{\frac{\rho}{\rho-1}} \right)^{\frac{\varsigma-\rho}{(1-\varsigma)}} \sum_{i=1}^{J} \lambda_i^{\frac{1}{1-\rho}} v_i^{\frac{\rho}{\rho-1}} = \sum_{i=1}^{J} \lambda_i G_i^{\rho} \\
\Leftrightarrow \quad & \zeta \, (p\varsigma\zeta)^{\frac{\rho}{1-\varsigma} \cdot \frac{\varsigma}{\rho}} \left(\sum_j \lambda_j^{\frac{1}{1-\rho}} v_j^{\frac{\rho}{\rho-1}} \right)^{(1+\frac{\varsigma-\rho}{1-\varsigma})\frac{\varsigma}{\rho}} = \zeta \left(\sum_{i=1}^{J} \lambda_i G_i^{\rho} \right)^{\frac{\varsigma}{\rho}} = Q \\
\Leftrightarrow \quad & \zeta^{\frac{1}{1-\varsigma}} \, (p\varsigma)^{\frac{\varsigma}{1-\varsigma}} \left(\sum_j \lambda_j^{\frac{1}{1-\rho}} v_j^{\frac{\rho}{\rho-1}} \right)^{\frac{1-\rho}{1-\varsigma}\frac{\varsigma}{\rho}} = Q \\
\Leftrightarrow \quad & \zeta^{\frac{1}{\varsigma}} p\varsigma \left(\sum_j \lambda_j^{\frac{1}{1-\rho}} v_j^{\frac{\rho}{\rho-1}} \right)^{\frac{1-\rho}{\rho}} = Q^{\frac{1-\varsigma}{\varsigma}}
\end{aligned}
$$

and thus

$$
p = \frac{1}{\varsigma} \zeta^{-\frac{1}{\varsigma}} \left(\sum_j \lambda_j^{\frac{1}{1-\rho}} v_j^{\frac{\rho}{\rho-1}} \right)^{\frac{\rho-1}{\rho}} \cdot Q^{\frac{1-\varsigma}{\varsigma}}, \tag{45}
$$

which is equation (42).

B.6 Cobb-Douglas Production Functions

As a useful benchmark, we consider the special case in which $\rho_o = 0$. The production functions in both sectors are now modified to:

$$
Q_i = Z^i L_i^{1-\varsigma_i} \left[\prod_{j=1}^{J} \left(Q_j^i (K_j^i, H_j^i) \right)^{\lambda_j^i} \right]^{\varsigma_i}, \text{ with } \sum_{j=1}^{J} \lambda_j^i = 1. \tag{46}
$$

Consider first the financial sector firms, where we assume that $\varsigma = 1$. We define $v_j^F(w_j, c_F)$ the unitary costs of equipped labor in sector F, occupation j. The costs minimization implies the term

$$
v_j^F(w_j, R^F) = \left[\left(\mu_j \right)^{\frac{1}{1-\rho_j}} (w_j)^{\frac{\rho_j}{\rho_j-1}} + \left(1 - \mu_j \right)^{\frac{1}{1-\rho_j}} \left(R^F \right)^{\frac{\rho_j}{\rho_j-1}} \right]^{\frac{\rho_j-1}{\rho_j}}.
$$

which we find convenient to define here for deriving the respective limit expressions.

Second, solve for the outer loop optimization problem:

$$p^F\left(w,R^F\right)=\min_{\{Q_j\}_{j=1}^J}\sum_{j=1}^J v_j^F Q_j,\text{ s.t. } Z^F\prod_{j=1}^J\left(Q_j(K_j^F,H_j^F)\right)^{\lambda_j^F},\ \text{ with } \sum_{j=1}^J\lambda_j^F=1.$$

The solution to this problem is given by

$$p^F\left(w,R^F\right)=\ \left(Z^F\right)^{-1}\times\prod_{j=1}^J\left(\frac{v_j^F}{\lambda_j^F}\right)^{\lambda_j^F}.$$

Alternatively, we can derive this expression by taking limits in the more general expression

$$p^F\left(w,R^F\right)=\ \left(Z^F\right)^{-1}\times\left[\sum_{j=1}^J\left(\lambda_j^F\right)^{\frac{1}{1-\rho_o}}\left(v_j^F(w_j,R^F)\right)^{\frac{\rho_o}{\rho_o-1}}\right]^{\frac{\rho_o-1}{\rho_o}}.$$

In sector N, the equation for v_j reads as above:

$$v_j^N(w_j,R^N)=\left[\left(\mu_j\right)^{\frac{1}{1-\rho_j}}\left(w_j\right)^{\frac{\rho_j}{\rho_j-1}}+\left(1-\mu_j\right)^{\frac{1}{1-\rho_j}}\left(R^N\right)^{\frac{\rho_j}{\rho_j-1}}\right]^{\frac{\rho_j-1}{\rho_j}},$$

but equation(26) adjusts:

$$p^N=\ \varsigma^{-1}\left(Z^N\right)^{-\frac{1}{\varsigma}}\cdot\prod_{j=1}^J\left(\frac{v_j^N}{\lambda_j^N}\right)^{\lambda_j^N}\cdot Q_N^{\frac{1-\varsigma}{\varsigma}}. \tag{47}$$

In terms of the First-Order Conditions, in both sectors $i\in\{N,F\}$ let's redefine M_i either by inspection from the first order conditions or by taking limits as

$$M_i\ \equiv\ \varsigma_i Z^i\left[\prod_{j=1}^J\left(Q_i^j\right)^{\lambda_j^i}\right]^{\varsigma_i}.$$

The first order conditions for H_j^i and K_j^i, $i\in\{N,F\}, j\in\{1,\ldots,J\}$ are, respectively (in this case, one can actually plug in $\rho_o=0$, so no need to change the codes, not even for DRS in non-finance),

$$\begin{aligned}
w_j &= p^i\cdot M^i\cdot\left[\mu_j\left(H_j^i\right)^{\rho_j}+\left(1-\mu_j\right)\left(K_j^i\right)^{\rho_j}\right]^{-1}\lambda_j^i\mu_j\left(H_j^i\right)^{\rho_j-1}\\
R^\ell &= p^\ell\cdot M^\ell\cdot\left[\mu_j\left(H_j^\ell\right)^{\rho_j}+\left(1-\mu_j\right)\left(K_j^\ell\right)^{\rho_j}\right]^{-1}\lambda_j^\ell\left(1-\mu_j\right)\left(K_j^\ell\right)^{\rho_j-1}.
\end{aligned}$$

C Computational Appendix

C.1 Equilibrium Computation

The code loops over the marginal return factor of the capitalist lender R and wages by occupation, $\{w_j\}_{j=1}^{J}$. We denote by $m \in \{1, \ldots, M\}$ the iteration number. The description below thus focuses on the model version with perfect labor mobility ($\epsilon = \infty$), where wages are equalized across sectors.

We break the construction of equilibrium into an outer loop and three major inner loops, or inner blocks. At the *outer* loop, we determine the equilibrium interest rate factor p^F and the equilibrium price p^F to clear goods and international capital markets. In the first inner-loop, we use the CRS production structure in sector F to determine the vector of wages w^F and human-to-physical capital ratios that are consistent with R, p^F. At this stage, we enforce wage equalization across sectors. The second inner-loop, respectively inner-block, solves the household model for given wages and prices. As a result of this loop, we determine, among other equilibrium objects, the human capital supply across occupations H_j, as well as aggregate credit demand, aggregate consumption and savings, and intermediation costs and profits. The third inner-loop searches for the human to physical capital ratio such that wages are equalized across the two sectors thereby acknowledging the optimal split of human capital across occupations. At that inner-loop we thus take as given the supplies and in this sense we treat it, artificially at the inner loop only, as perfectly inelastic.

The inner loop to determine the split of human capital is illustrated in Figure **??**. In this figure, the supply of human capital in occupation j as determined from the solution of the household model is taken as given, $H_j = H_j^N + H_j^F$, but the split is to be determined. We also take as given the demand schedule from the firm model depicted as sector specific downward sloping lines. At equilibrium, wages in each occupation j are equalized across the two sectors. The graph depicts the equilibrium construction for one such occupation.

We next describe the full algorithm, which determines the location of the total supply $H_j = H_j^F + H_j^N$ as a solution of the household model in the outer loop iteration.

1. Start with initial guess of the outer loop variables $x^0 = \left[R^0, p^{F^0}, p^{N^0}\right]$.

2. In iteration m, for guess of outer loop variables $x^m = \left[R^m, p^{F^m}, p^{N^0}\right]$:

   (a) Compute $R^F = R + \chi p^F$ and $R^N = R + p^F$.

   (b) Inner loop to compute wages $\{w_j^F\}$ consistent with these prices: Using (24) in (18), rewrite M^ℓ as

$$
\begin{aligned}
M^\ell &= \varsigma_\ell Z^\ell \left[\sum_{j=1}^{J} \lambda_j^\ell \left(\left[\mu_j + (1-\mu_j) \left(\frac{1}{\varphi_j^\ell} \right)^{\rho_j} \right]^{\frac{1}{\rho_j}} \omega_j^\ell H^\ell \right)^{\rho_o} \right]^{\frac{\varsigma_\ell}{\rho_o}-1} \\
&= \varsigma_\ell Z^\ell \left[\sum_{j=1}^{J} \lambda_j^\ell \left(\left[\mu_j + (1-\mu_j) \left(\frac{1}{\varphi_j^\ell} \right)^{\rho_j} \right]^{\frac{1}{\rho_j}} \omega_j^\ell \right)^{\rho_o} \right]^{\frac{\varsigma_\ell}{\rho_o}-1} H^{\ell^{\varsigma_\ell - \rho_o}} \\
&= \Lambda^\ell H^{\ell^{\varsigma_\ell - \rho_o}}, \quad \text{where } \Lambda^\ell = \varsigma_\ell Z^\ell \left[\sum_{j=1}^{J} \lambda_j^\ell \left(\left[\mu_j + (1-\mu_j) \left(\frac{1}{\varphi_j^\ell} \right)^{\rho_j} \right]^{\frac{1}{\rho_j}} \omega_j^\ell \right)^{\rho_o} \right]^{\frac{\varsigma_\ell}{\rho_o}-1}
\end{aligned}
\tag{49}
$$

Use (49) in (19), using (24) to get

$$
\begin{aligned}
w_j^\ell = p^\ell \cdot \Lambda^\ell \left(\left\{ \omega_j^\ell \left(w_j^\ell, \left\{ w_j^\ell \right\}_{j=1}^J \right) \right\}_{j=1}^J \right) \cdot \left[\mu_j + (1-\mu_j) \left(\frac{1}{\varphi_j^\ell} \right)^{\rho_j} \right]^{\frac{\rho_o}{\rho_j}-1} \\
\cdot \lambda_j^\ell \mu_j \left(\omega_j^\ell \left(w_j^\ell, \left\{ w_j^\ell \right\}_{j=1}^J \right) \right)^{\rho_o - 1} \left(H^\ell \right)^{\varsigma_\ell - 1}
\end{aligned}
$$

Next, use (21) in the above to get

$$
\begin{aligned}
& w_j^\ell \left(\left\{ \omega_j^\ell \left(w_j^\ell, \left\{ w_j^\ell \right\}_{j=1}^J \right) \right\}_{j=1}^J, \omega_j^\ell \left(w_j^\ell, \left\{ w_j^\ell \right\}_{j=1}^J \right) \right) \\
&= p^\ell \cdot \Lambda^\ell \left(\left\{ \omega_j^\ell \left(w_j^\ell, \left\{ w_j^\ell \right\}_{j=1}^J \right) \right\}_{j=1}^J \right) \cdot \left[\mu_j + (1-\mu_j) \left[\frac{w_j^\ell}{R^\ell} \frac{(1-\mu_j)}{\mu_j} \right]^{\frac{\rho_j}{1-\rho_j}} \right]^{\frac{\rho_o}{\rho_j}-1} \\
&\qquad \cdot \lambda_j^\ell \mu_j \left(\omega_j^\ell \left(w_j^\ell, \left\{ w_j^\ell \right\}_{j=1}^J \right) \right)^{\rho_o - 1} \left(H^\ell \right)^{\varsigma_\ell - 1},
\end{aligned}
\tag{50}
$$

which, for $\varsigma_\ell = 1$, gives us $w_j^\ell(\{\omega_j^\ell\}_{j=1}^J, \omega_j^\ell, w_j^\ell)$, and thus for $\ell = F$ we have a fixed point in J equations in the J unknowns $\{w_j^F\}_{j=1}^J$. Therefore, at this inner-loop, we use guesses of $\{w_j^F\}_{j=1}^J$ to iterate until convergence.

Remark 1 *To test the FOCs, likewise use (49) in (20) to get*

$$
R^\ell = p^\ell \cdot \Lambda^\ell \left(\{ \omega_j^\ell (w_j^\ell(\omega_j^\ell)) \}_{j=1}^J \right) \cdot \left[\mu_j \left(\varphi_j^\ell \right)^{\rho_j} + (1-\mu_j) \right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^\ell (1-\mu_j) \left(K_j^\ell \right)^{\rho_o - 1} H^{\ell^{\varsigma_\ell - \rho_o}}
$$

Then, for $\varsigma_\ell = 1$ we can rewrite this as

$$\begin{aligned} R^\ell &= p^\ell \cdot \Lambda^\ell \left(\{\omega_j^\ell(w_j^\ell(\omega_j^\ell))\}_{j=1}^J\right) \cdot \left[\mu_j \left(\varphi_j^\ell\right)^{\rho_j} + \left(1-\mu_j\right)\right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^\ell \left(1-\mu_j\right) \left(K_j^\ell\right)^{\rho_o - 1} \left(\frac{H_j^\ell}{\omega_j^\ell}\right)^{1-\rho_o} \\ &= p^\ell \cdot \Lambda^\ell \left(\{\omega_j^\ell(w_j^\ell(\omega_j^\ell))\}_{j=1}^J\right) \cdot \left[\mu_j \left(\varphi_j^\ell\right)^{\rho_j} + \left(1-\mu_j\right)\right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^\ell \left(1-\mu_j\right) \left(\varphi_j^\ell\right)^{1-\rho_o} \left(\omega_j^\ell\right)^{\rho_o - 1} \end{aligned} \tag{51}$$

(c) Given wages $\{w_j\}_{j=1}^J$ and prices R^ℓ, p^ℓ, $\ell \in \{F, N\}$ solve the household problem.

(d) Aggregate across households to obtain total human capital in occupation j, $H_j = \sum_{\ell \in \{F,N\}} H_j^\ell$ as well as B from (17a), Υ from (17c) and C_1 from (16).

(e) Inner loop for determination and allocation of H_j^ℓ, K_j^ℓ across sectors, such that $w_j^F = w_j^N$ for all j, holding prices p^F, p^N and returns R^F, R^N constant, by iterating on φ_j^F, with initial guess of φ_j^F computed from (21):

   i. Compute φ_j^N from (21), ϑ_j^ℓ from (22), as well as ω_j^ℓ from (24) and Λ^ℓ from (49), for $\ell \in \{F, N\}$, $j \in \{1, \ldots, J\}$.

   ii. Given C_1, and $\varphi_j^\ell, \vartheta_j^\ell$, $\ell \in \{F, N\}$, note that

$$Q_j^\ell \left(H_j^\ell, K_j^\ell\right) = \left[\mu_j \left(\varphi_j^\ell\right)^{\rho_j} + \left(1-\mu_j\right)\right]^{\frac{1}{\rho_j}} \vartheta_j^\ell K^\ell.$$

and thus

$$\mathcal{Q}^\ell \left(\mathbf{H}^\ell, \mathbf{K}^\ell\right) = \Theta^\ell \left(K^\ell\right)^{\varsigma_\ell},$$

where

$$\Theta^\ell = \begin{cases} \left[\sum_{j=1}^J \lambda_j^\ell \left(\left[\mu_j \left(\varphi_j^\ell\right)^{\rho_j} + \left(1-\mu_j\right)\right]^{\frac{1}{\rho_j}} \vartheta_j^\ell\right)^{\rho_0}\right]^{\frac{\varsigma_\ell}{\rho_0}} & \text{if } \rho_0 \neq 0 \\ \left[\prod_{j=1}^J \left(\left[\mu_j \left(\varphi_j^\ell\right)^{\rho_j} + \left(1-\mu_j\right)\right]^{\frac{1}{\rho_j}} \vartheta_j^\ell\right)^{\lambda_j^\ell}\right]^{\varsigma_\ell} & \text{otherwise.} \end{cases} \tag{52}$$

Next, use the system of equations

$$c_1^k = \frac{R}{p^N} L^k \tag{53a}$$

$$L^k + S = K^F + K^N + B + \Upsilon \tag{53b}$$

$$Q^F = Z^F \Theta^F K^F = K^N + B + \chi\left(K^F + \Upsilon\right) \tag{53c}$$

$$\varsigma Q^N = \varsigma Z^N \Theta^N \left(K^N\right)^{\varsigma} = c_1^k + C_1 + C_1^m \tag{53d}$$

From equation (53c) we get

$$K^F = \frac{1}{Z^F \Theta^F - \chi} \left(K^N + B + \chi \Upsilon \right). \tag{54}$$

Use this in equation (53b) to rewrite

$$L^k = \left(1 + \frac{1}{Z^F \Theta^F - \chi}\right) \left(K^N + B\right) + \left(1 + \frac{\chi}{Z^F \Theta^F - \chi}\right) \Upsilon - S.$$

Next, use the above in equation (53a) to get

$$c_1^k(K^N) = \frac{R}{p^N} \left[\left(1 + \frac{1}{Z^F \Theta^F - \chi}\right) \left(K^N + B\right) + \left(1 + \frac{\chi}{Z^F \Theta^F - \chi}\right) \Upsilon - S \right]. \tag{55}$$

Finally, use the above in (53d) to obtain the non-linear equation

$$\left(K^N\right)^{\varsigma} = \frac{1}{\varsigma Z^N \Theta^N} \left(c_1^k(K^N) + C_1 + C_1^m \right)$$

where $c_1^k(K^N)$ is given by (55).
Let us rewrite this further so that the solution for $\varsigma = 1$ is nested (which is useful to generate starting values for the solver). Using (55) we get

$$\begin{aligned} & K^N \left(K^N\right)^{\varsigma - 1} \\ &= \frac{1}{\varsigma Z^N \Theta^N} \left(\frac{R}{p^N} \left[\left(1 + \frac{1}{Z^F \Theta^F - \chi}\right) \left(K^N + B\right) + \left(1 + \frac{\chi}{Z^F \Theta^F - \chi}\right) \Upsilon - S \right] \right) \\ &\qquad + \frac{1}{\varsigma Z^N \Theta^N} \left(C_1 + C_1^m\right) \end{aligned}$$

and thus

$$\begin{aligned} K^N &= \left[\left(K^N\right)^{\varsigma - 1} - \frac{1}{\varsigma Z^N \Theta^N} \left(\frac{R}{p^N} \left(1 + \frac{1}{Z^F \Theta^F - \chi} \right) \right) \right]^{-1} \cdot \\ & \frac{1}{\varsigma Z^N \Theta^N} \left(\frac{R}{p^N} \left[\left(1 + \frac{1}{Z^F \Theta^F - \chi}\right) \cdot B + \left(1 + \frac{\chi}{Z^F \Theta^F - \chi}\right) \Upsilon - S \right] + \left(C_1 + C_1^m\right) \right) \end{aligned}$$

From the last line above compute K^N (which is in closed form for $\varsigma = 1$). Use the result in (54) to compute of K^F.

iii. Compute output Q^ℓ, $\ell \in \{F, N\}$ using that $Q^\ell = \zeta^\ell \cdot \Theta^\ell \cdot \left(K^\ell\right)_\ell^{\varsigma}$.

iv. Given the aggregate capital stocks K^ℓ from the previous step and the distribution factors ϑ_j^ℓ, compute the distribution of capital in both sectors, $K_j^\ell = \vartheta_j^\ell K^\ell$.

v. Given H_j^ℓ and K_j^ℓ from step 2(e)iv update M^ℓ using the first line of equation (18) and compute wages from equation (19). Denote wages by $\left\{\left[\tilde{w}_j^F, \tilde{w}_j^N\right]\right\}_{j=1}$.

vi. Set up the distance function

$$d^w = \left\| \left\{\tilde{w}_j^F - \tilde{w}_j^N\right\}_{j=1}^J \right\|$$

and iterate on φ_j^F until $d^w < \epsilon$. Upon convergence, denote the updated wage vector by $\left\{\tilde{w}_j = \tilde{w}_j^F = \tilde{w}_j^N\right\}_{j=1}$.

(f) Update p^ℓ using

$$p^\ell = \frac{\sum_{j=1}^J w_j^\ell H_j^\ell + R^\ell K_j^\ell}{\varsigma_\ell Q_\ell} \tag{56}$$

(g) Use the system of equations

$$\varsigma Q^N = C_1 + C_1^m + c_1^k \tag{57a}$$

$$L^k = K^F + K^N + B + \Upsilon - S \tag{57b}$$

$$c_0^k + L^k = \bar{K} \tag{57c}$$

$$c_1^k = \left(\frac{\beta R}{p^N}\right)^{\frac{1}{\sigma}} c_0^k \tag{57d}$$

to update the interest rate. Specifically, compute c_1^k from (57a), L^k from (57b), c_0^k from (57c) and invert (57d) to get the update $\tilde{R}$.

Remark 2 *In the calibration of the model (i.e. in the baseline scenario), we instead fix the interest rate and endogenously compute the amount of exogenous capital by the capitalist lender required to implement that interest rate as a market equilibrium. We therefore compute c_1^k from (53d), L^k from (53b), c_0^k from (57d), and, finally, $\bar{K}$ from (57c). That is, in the baseline scenario, R is not an outer loop variable.*

(h) Collect the updated variables as $\tilde{x}^m = \left[\tilde{R}, \tilde{p}^F\right]$. Define the distance function $d(x^m) = x^m - \tilde{x}^m(x^m)$. If $|d(x)| > \epsilon$ compute an update x^{m+1} and continue with step 2. Otherwise, stop and report success.

C.2 Calibration

We calibrate the model in a partial equilibrium. Specifically, we choose an external supply of capital by the capitalist lender, $\bar{K}$, such that the equilibrium interest rate is 3% annually. The technology level in sector N, Z^N is normalized such that the equilibrium price in sector N is $p^N = 1$, and the technology level in sector F is chosen such that the nominal output share in finance $\frac{p_F \cdot Q_F}{p_F \cdot Q_F + p_N \cdot Q_N}$.

C.3 Household Model

C.3.1 Savers in Generic Contracts

We specify a grid for human capital, $\mathcal{G}^h$. For each $h_i \in \mathcal{G}^h$, since $c_0 > 0$ (by the lower Inada condition of the utility function) we require that

$$s_i < \alpha(e)(1 - h_i)$$

which gives the upper bound for an h_i-specific savings grid, $\mathcal{G}^s(h_i)$ with lower bound $\underline{s} > 0$ and upper bound $\bar{s}_i(h_i) = \alpha(e)(1 - h_i))$, thus $\mathcal{G}^s(h_i) = \{\underline{s}, \ldots, \bar{s}(h_i)\}$. Since we maximize utility subject to the constraint $P(s, z; sg) = -\kappa_g^s \cdot R^F + s \cdot R - z \geq 0$ and since we require $z \geq 0$, for each $s_j \in \mathcal{G}^s(h_i)$ we can then compute

$$z(s_j) = -\kappa_g^s \cdot R^F + s_j \cdot R.$$

If $z(s_j) < 0$, then $U(e; sg; h_i, s_j) = -\infty$, otherwise we store the according utility $U(e; sg; h_i, s_j)$. We then proceed as before, i.e., determine a maximum on the $h, s(h)$-grids and search in the neighbourhood of this grid for a global maximum.

D Household Model

Preferences, Endowments and Technology

Workers live for two periods and have preferences over consumption given by:

$$U = \frac{c_0^{1-\sigma}}{1-\sigma} + \beta \mathbb{E}\left(\frac{c_1^{1-\sigma}}{1-\sigma}\right)$$

where c_0, c_1 is consumption in the current and future period, respectively.

Workers are heterogeneous in two ability factors. They differ in an absolute advantage component $\alpha(e) > 0$ (which depends on their type e) that determines the absolute earnings in current and future periods. The second factor e captures a comparative advantage component that determines occupation specific earnings and hence drives occupational sorting in the second period.

In the first period, households use their absolute advantage $\alpha(e)$ for consumption and decide to invest time/resources h to improve their absolute advantage in the following period. For example, they can reduce their current earnings because of participating in formal or informal forms of of on-the-job-training (OJT). They can also borrow an amount b or save an amount s with corresponding repayment or savings with a particular return (to be discussed in more detail where appropriate).

So, first period consumption is given by

$$c_0 = \alpha(e)\,(1-h) + b - s \tag{58}$$

In the second period, decide which occupation $j \in J$ to work for. Human capital investment h made in the first period results in an increase in absolute advantage to $\alpha(e)h^{\psi}$ which then determines the earnings in employment. Furthermore, the comparative advantage e determines the earnings in occupation j by a scalar term $\gamma\,(e,j)$ (to be calibrated). Workers also draw occupation specific opportunity/productivity shocks η_j so earnings in a given occupation j are given by:

$$\frac{\alpha(e)h^{\psi}\gamma\,(e,j)\,w_j\eta_j}{p^N}$$

where $\eta_j \sim$ Fretchet with a scale parameter 1 and curvature parameter $\theta > 1$ so that

$$\Pr\left(\eta_j < x\right) = F(\theta, 1) \equiv e^{-(x)^{-\theta}}$$

We measure output in period 1 in units of the financial sector output. To convert this back to period 1 consumption units, we divide these by p^N.

Given this earnings structure, households must decide which occupation to work for given the realization of productivity shocks:

$$c_1 = \frac{1}{p_N}\alpha(e)h^{\psi}\max_j\left\{\gamma(e,j)w_j\eta_j\right\} \tag{59}$$

D.1 Autarky

Under autarky, households are unable to borrow and solve the following problem:

$$U^{\text{aut}} = \max_h \frac{c_0^{1-\sigma}}{1-\sigma} + \beta\mathbb{E}\left(\frac{c_1^{1-\sigma}}{1-\sigma}\right)$$

$$\text{subject to}$$

$$c_0 = \alpha(e)\left(1-h\right)$$

$$c_1 = \frac{\alpha(e)h^{\psi}}{p^N} \max_j \left\{\gamma\left(e,j\right) w_j \eta_j\right\}$$

This is equivalent to solving:

$$U^{\text{aut}} = \alpha(e)^{1-\sigma} \max_h \left\{ \frac{\left(1-h\right)^{1-\sigma}}{1-\sigma} + \frac{\beta h^{\psi(1-\sigma)}}{1-\sigma}\mathbb{E}\left(\left[\max_j \left\{\frac{\gamma\left(e,j\right) w_j \eta_j}{p^N}\right\}\right]^{1-\sigma}\right)\right\}$$

The corresponding first order condition for this problem is given by:

$$\left(1-h\right)^{-\sigma} = \frac{\psi\beta h^{\psi(1-\sigma)-1}}{\left(p^N\right)^{1-\sigma}}\mathbb{E}\left(\left[\max_j \left\{\gamma\left(e,j\right) w_j \eta_j\right\}\right]^{1-\sigma}\right)$$

Define $y \equiv \left(\max_j \left\{\gamma\left(e,j\right) w_j \eta_j\right\}\right)$ which will be distributed Frechet with curvature/shape parameter θ and scale parameter $\left[\sum_j^J \left(\gamma\left(e,j\right) w_j\right)^{\theta}\right]^{\frac{1}{\theta}}$ (see appendix). Then we are interested in calculating the expected value of $x \equiv y^{1-\sigma}$ which is,

$$x \equiv \begin{cases} \left(y\right)^{1-\sigma} & \text{for } 0 \leq \sigma \neq 1 \\ \ln\left(y\right) & \text{for } \sigma = 1. \end{cases}$$

From Alex's notes, x is distributed as follows,

$$x \sim \begin{cases} \text{Frechet}\left(\frac{\theta}{1-\sigma}, \left(\left[\sum_j^J \left(\gamma\left(e,j\right) w_j\right)^{\theta}\right]^{\frac{1}{\theta}}\right)^{1-\sigma}\right) & \text{for } 0 \leq \sigma < 1, \\ \text{Gumbel}\left(\frac{1}{\theta},\ \ln\left(\left[\sum_j^J \left(\gamma\left(e,j\right) w_j\right)^{\theta}\right]^{\frac{1}{\theta}}\right)\right) & \text{for } \sigma = 1, \\ \text{Weibull}\left(\frac{\theta}{\sigma-1},\ \left(\left[\sum_j^J \left(\gamma\left(e,j\right) w_j\right)^{\theta}\right]^{\frac{1}{\theta}}\right)^{\sigma-1}\right) & \text{for } \sigma > 1. \end{cases}$$

Then the expected value of x is given by,

$$\mathbb{E}(x) = \begin{cases} \Gamma\left(1 - \frac{(1-\sigma)}{\theta}\right)\left\{\left[\sum_j^J (\gamma(e,j)\, w_j)^\theta\right]^{\frac{1}{\theta}}\right\}^{1-\sigma} & \text{for } 0 \le \sigma < 1, \\ \frac{1}{\theta} + \gamma_{EM} \ln\left(\left[\sum_j^J (\gamma(e,j)\, w_j)^\theta\right]^{\frac{1}{\theta}}\right) & \text{for } \sigma = 1, \\ \Gamma\left(1 + \frac{(\sigma-1)}{\theta}\right)\left\{\left[\sum_j^J (\gamma(e,j)\, w_j)^\theta\right]^{\frac{1}{\theta}}\right\}^{\sigma-1} & \text{for } \sigma > 1. \end{cases} \tag{60}$$

where γ_{EM} is the Euler–Mascheroni constant (approx 0.577)

Then human capital in autarky solves the following equation,

$$-(1-h)^{-\sigma} + \frac{\psi\beta h^{\psi(1-\sigma)-1}}{(p^N)^{1-\sigma}}\mathbb{E}(x) = 0$$

D.2 Generic Contracts

Coding Strategy Taking (a, e) as given, the MATLAB code performs a grid search over b and h to solve for the optimal lending contract.

Lenders A generic contract is a tuple $\{d, b, h\}$ and entails the possibility of default. In particular, households will default if (p^N enters on both sides and hence can be ignored)

$$\alpha(e)h^\psi \max_j \{\gamma(e,j)\, w_j\eta_j\} - d < (1-\zeta)\,\alpha(e)h^\psi \max_j \{\gamma(e,j)\, w_j\eta_j\}$$

$$\max_j \{\gamma(e,j)\, w_j\eta_j\} < \frac{d}{\zeta\alpha(e)h^\psi} \equiv \bar{y}^{\text{def}}(d,h,e)$$

So, the probability of default is given by:

$$\varrho(d,h;e,\mathbf{w}) = \Pr\left(\max_j \{\gamma(e,j)\, w_j\eta_j\} < \frac{d}{\zeta\alpha(e)h^\psi}\right) = e^{-\left(\frac{\bar{y}^{\text{def}}(d;h,e)}{\Phi(e;\mathbf{w})}\right)^{-\theta}}.$$

This formula arises since y has a Frechet distribution with curvature θ and location $\Phi(e;\mathbf{w}) \equiv \left[\sum_{j=1}^J [\gamma(e,j)\, w_j]^\theta\right]^{\frac{1}{\theta}}$. Given type e and the wages $\mathbf{w}$ the probability of default is just a function of (h, d).

For risk-neutral lenders, the $t = 1$ net payoff from this generic borrowing contract is

$$P_G^B(b,d,h;e) = -\kappa_G \cdot R^F - b \cdot R^N + d\left[1 - e^{-\left(\frac{\bar{y}^{\text{def}}(d;h,e)}{\Phi(e;w)}\right)^{-\theta}}\right].$$

The negative terms, i.e. costs for the bank, are in terms of the set-up cost of the generic contract, κ_G and the cost of the resources d lent. The positive term is expected revenue is given by the promised repayment d which will be received only with probability $1-\varrho$.

Households Households' consumption in the first period is given by $c_0 = \alpha(e)\,(1-h)+b$. Period 1 consumption is given by:

$$c_1 = \max\left\{\frac{\alpha(e)h^{\psi}y \ - \ d}{p_N}, \frac{(1-\zeta)\,\alpha(e)h^{\psi}y}{p_N}\right\}.$$

where $y \equiv \max_j \left\{\gamma\,(e,j)\,w_j\eta_j\right\}$ is Fretchet as discussed above.

Given a pair (b,d), the expected utility for a household from borrower in a generic contract and investing human capital h is

$$\begin{aligned} U_G^B\,(b,d,h;e) &= \frac{\left[\alpha(e)\,(1-h)+b\right]^{1-\sigma}}{1-\sigma} \\ &+ \frac{\beta}{\left(p^N\right)^{1-\sigma}}\underbrace{\left\{\int_0^{\bar{y}^{\text{def}}}\frac{\left[(1-\zeta)\,\alpha(e)h^{\psi}y\right]^{1-\sigma}}{1-\sigma}f\,(y)\,dy+\int_{\bar{y}^{\text{def}}}^{\infty}\frac{\left[\alpha(e)h^{\psi}y-d\right]^{1-\sigma}}{1-\sigma}f\,(y)\,dy\right\}}_{\text{EUC}(h,d)}, \end{aligned}$$

where $f(y)$ is the pdf of the Fretchet dist. with shape parameter θ and scale parameter $\left[\sum_j^J\left(\gamma\,(e,j)\,w_j\right)^{\theta}\right]^{\frac{1}{\theta}}$. The first integral has a closed form solution while the second does not. Both are numerically integrated taking (h,d) as inputs.

D.2.1 Monopolist Lenders

A monopolist lender is able to extract all the utility from the household so that the household participation constraint holds with equality:

$$\begin{aligned} U^{\text{aut}} &= U_G^B \\ U^{\text{aut}} &= \frac{\left(\alpha(e)\,(1-h)+b\right)^{1-\sigma}}{1-\sigma}+\frac{\beta}{\left(p^N\right)^{1-\sigma}}\cdot\text{EUC}(h,d), \end{aligned}$$

where the second line follows from period-1 BC, which reads: $c_0 = \left(\alpha(e)\,(1-h)+b\right)$. Remember that we assume that the contract set-up costs are paid by the bank.

Given (h,d), we can solve exactly for the loan amount b:

$$b(h,d) = -\alpha(e)\,(1-h)+\left[(1-\sigma)\left(U^{\text{aut}}-\frac{\beta}{\left(p^N\right)^{1-\sigma}}\cdot\text{EUC}(h,d)\right)\right]^{\frac{1}{1-\sigma}} \tag{61}$$

Then, the optimal contract is the solution to the monopolists profit maximization problem:

$$
\begin{aligned}
P_G^B\left(b,d,h;e\right) = \quad & \max_{h,d}\ R^N\cdot\left\{\alpha(e)\left(1-h\right)-\left[\left(1-\sigma\right)\left(U^{\text{aut}}-\frac{\beta}{\left(p^N\right)^{1-\sigma}}\text{EUC}(h,d)\right)\right]^{\frac{1}{1-\sigma}}\right\} \\
& +\left(1-\varrho\left(d,h;e,\mathbf{w}\right)\right)d-\kappa_G\cdot R^F
\end{aligned}
$$

We can also take first order conditions with respect to this expression (ϱ_x denotes the derivative of the default probability ϱ wrt x):

$$
\begin{aligned}
h:\ & \left[\left(1-\sigma\right)\left(U^{\text{aut}}-\frac{\beta}{\left(p^N\right)^{1-\sigma}}\text{EUC}(h,d)\right)\right]^{\frac{1}{1-\sigma}-1}\cdot\frac{\beta}{\left(p^N\right)^{1-\sigma}}\text{EUC}_h(h,d)=d\cdot\varrho_h+\alpha(e) \\
d:\ & \left[\left(1-\sigma\right)\left(U^{\text{aut}}-\frac{\beta}{\left(p^N\right)^{1-\sigma}}\text{EUC}(h,d)\right)\right]^{\frac{1}{1-\sigma}-1}\cdot\frac{\beta}{\left(p^N\right)^{1-\sigma}}\text{EUC}_d(h,d)=\varrho+d\cdot\varrho_d(h,d)-1
\end{aligned}
$$

Both $\text{EUC}_h(h,d)$ and $\text{EUC}_d(h,d)$ are complicated objects but can be solved using Liebniz's Rule:

$$
\begin{aligned}
\text{EUC}(h,d) &= \frac{1}{1-\sigma}\left(\int_0^{\frac{d}{\zeta\alpha(e)h^{\psi}}}\left[\alpha(e)h^{\psi}y\left(1-\zeta\right)\right]^{1-\sigma}dF(y)+\int_{\frac{d}{\zeta\alpha(e)h^{\psi}}}^{\infty}\left[\alpha(e)h^{\psi}y-d\right]^{1-\sigma}dF(y)\right) \\
\text{EUC}_h(h,d) &= \frac{1}{1-\sigma}\int_0^{\frac{d}{\zeta\alpha(e)h^{\psi}}}\left(1-\sigma\right)\left(1-\zeta\right)\alpha(e)\psi h^{\psi-1}y\left[\alpha(e)h^{\psi}y\left(1-\zeta\right)\right]^{-\sigma}dF(y)+ \\
&\quad \frac{1}{1-\sigma}\int_{\frac{d}{\zeta\alpha(e)h^{\psi}}}^{\infty}\left(1-\sigma\right)\alpha(e)\psi h^{\psi-1}y\left[\alpha(e)h^{\psi}y-d\right]^{-\sigma}dF(y) \\
\text{EUC}_d(h,d) &= -\frac{1}{1-\sigma}\left(\int_{\frac{d}{\zeta\alpha(e)h^{\psi}}}^{\infty}\left(1-\sigma\right)\left[\alpha(e)h^{\psi}y-d\right]^{-\sigma}dF(y)\right)
\end{aligned}
$$

However, the expression for ϱ_h and ϱ_d are even more complicated and involve inverse-gamma function.[41] This is why I proceed with using a grid search over the (h,d) space. There must be some room for improving the code's efficiency here.

We penalize the monopolist in case $(1-\sigma)\left[U^{\text{aut}}-\frac{\beta}{\left(p^N\right)^{1-\sigma}}\text{EUC}(h,d)\right]<0$ since this involves raising a negative number to some power and is equivalent to $c_0<0$ under the contract, i.e. the borrower is receiving 'too much' utility in period 2.

Then, we can perform a grid search over the (h,d) space and solve for the contract that

[41]Recall $\varrho\left(d,h;e,\mathbf{w}\right)=\Pr\left(\max_j\left\{\gamma\left(e,j\right)w_j\eta_j\right\}<\frac{d}{\zeta\alpha(e)h^{\psi}}\right)=e^{-\left(\frac{\bar{y}^{\text{def}}(d;h,e)}{\Phi(e;\mathbf{w})}\right)^{-\theta}}$.

maximizes monopolist's returns.

D.2.2 Competitive Lenders

Under perfect competition, the profit for lender is 0 so that

$$P_G^B(b,h,d;e) = -\kappa_G \cdot R^F - b \cdot R^N + d\left[1 - e^{-\left(\frac{\bar{y}^{\mathrm{def}}(d;h,e)}{\Phi(e;w)}\right)^{-\theta}}\right] = 0$$

$$b(h,d) = \frac{1}{R^N}\left[-\kappa_G \cdot R^F + (1-\varrho)\, d\right)]$$

Given this, households then maximize utility by choosing (h,d) and solve:

$$\max_{h,d} \frac{\left[\alpha(e)\,(1-h) + \frac{1}{R}\left[-\kappa_G \cdot R^F + (1-\varrho)\, d\right)\right]\right]^{1-\sigma}}{1-\sigma} +$$

$$\frac{\beta}{\left(p^N\right)^{1-\sigma}(1-\sigma)}\left[\int_0^{\frac{d}{\zeta\alpha(e)h^\psi}} \left[\alpha(e)h^\psi y\,(1-\zeta)\right]^{1-\sigma} dF(y) + \int_{\frac{d}{\zeta\alpha(e)h^\psi}}^{\infty} \left[\alpha(e)h^\psi y - d\right]^{1-\sigma} dF(y)\right]$$

As before, the FOCs from this problem will be complicated, particularly the expression resulting from ϱ_h and ϱ_d. With grid search the problem of maximizing utility is straightforward.

D.2.3 Savers

Instead of borrowing, some households might opt to save. If so, default is not an issue and generic savings contract would be simple to characterize: for savings $s \geq 0$ the bank offers a return $z \geq 0$. Given a triplet $(s,S,h) \geq 0$, the expected utility of a generic saver is

$$U_G^S(s,z,h;e) = \frac{\left[\alpha(e)\,(1-h) - s\right]^{1-\sigma}}{1-\sigma} + \frac{\beta}{\left(p^N\right)^{1-\sigma}}\left\{\int_0^\infty \frac{\left[\alpha(e)h^\psi y + z\right]^{1-\sigma}}{1-\sigma} f(y)\, dy\right\}.$$

Generic savings contracts might also entail a fixed setup cost, κ_G^S, albeit presumably lower than those of generic borrowing contracts, i.e.: $0 \leq \kappa_G^S < \kappa_G^S$. Then, the net payoffs for the financial intermediary are simply $-\kappa_G^S \cdot R^F + s \cdot R - z$. Notice here that the lower rate R is the relevant rate for savings since the household would not be collecting the costs of intermediation that is included in R^N, when households are borrowing.

We will assume that for savers the markets are competitive. Then, the allocations are given by

$$\left\{s^{\text{G-sav}}\left(e\right),\, z^{\text{G-sav}}\left(e\right),\, h^{\text{G-sav}}\left(e\right)\right\} \in \arg\max_{(s,z,h)\geq 0} \left\{U_G^z\left(s,z,h;e\right) \text{ s.t.: } -\kappa_G^S \cdot R^F + s\cdot R - z \geq 0\right\}.$$

We denote by $U^{\text{G-sav}}(e)$ the expected utility attained by households that opt for generic savings contracts. If $\left\{-\kappa_G^S \cdot R^F + s\cdot R - z \geq 0\right\}$ is the empty set, then $U^{\text{G-sav}}(e) = -\infty$.

The maximization problem can be written as:

$$\max_{(s,z,h)\geq 0} \left\{ \frac{\left[\alpha(e)\left(1-h\right)-s\right]^{1-\sigma}}{1-\sigma} + \frac{\beta}{\left(p^N\right)^{1-\sigma}} \left\{ \int_0^\infty \frac{\left[\alpha(e)h^\psi y + z\right]^{1-\sigma}}{1-\sigma} f\left(y\right) dy \right\} \text{ s.t.: } -\kappa_G^S \cdot R^F + s\cdot R - z \geq 0 \right\}.$$

Plugging in from the no-profit condition for $s = (z+\kappa_G^S \cdot R^F)/R$ we can write

$$\max_{(z,h)\geq 0} \left\{ \frac{\left[\alpha(e)\left(1-h\right)-(z+\kappa_G^S \cdot R^F)/R\right]^{1-\sigma}}{1-\sigma} + \frac{\beta}{\left(p^N\right)^{1-\sigma}} \left\{ \int_0^\infty \frac{\left[\alpha(e)h^\psi y + z\right]^{1-\sigma}}{1-\sigma} f\left(y\right) dy \right\} \right\}.$$

For completeness, the first order conditions w.r.t. z and h are, respectively:

$$\begin{aligned} \frac{\left[\alpha(e)\left(1-h\right)-(z+\kappa_G^S \cdot R^F)/R\right]^{-\sigma}}{R} &= \frac{\beta}{\left(p^N\right)^{1-\sigma}} \left\{ \int_0^\infty \left[\alpha(e)h^\psi y + z\right]^{-\sigma} f\left(y\right) dy \right\} \\ \left[\alpha(e)\left(1-h\right)-(z+\kappa_G^S \cdot R^F)/R\right]^{-\sigma} \cdot \alpha(e) &= \frac{\beta}{\left(p^N\right)^{1-\sigma}} \left\{ \int_0^\infty \left[\alpha(e)h^\psi y + z\right]^{-\sigma} \alpha(e)\psi h^{\psi-1} y f\left(y\right) dy \right\} \end{aligned}$$

D.3 Personalized Contracts

D.3.1 Borrowers

With a higher cost $\kappa_{\text{P}} > \kappa_{\text{G}}$ a lender can construct a contract that are tailored to labor market outcomes. In other words, the repayment amount is a function of the random component of its earnings $y = \max_j \left\{\gamma\left(e,j\right) w_j \eta_j\right\}$.[42] So a personalized financial contract is specified by $\{h, d(y), d\}$ and since the possibility of default persists, we require that

$$\begin{aligned} \alpha(e)h^\psi y - d(y) &\geq \left(1-\zeta\right)\alpha(e)h^\psi y \\ d(y) &\leq \zeta\alpha(e)h^\psi y \end{aligned}$$

When this condition is satisfied the probability of default is 0 so the return to lenders is:

$$P(b,h,d(y);\alpha(e),e) = -\kappa_P R^F - R^N b + \int_0^\infty d(y)dF(y)$$

[42] It is straightforward to let this be a function of labor market earnings $\alpha(e)h^\psi y$.

With competitive lenders we know that this return is 0 so that

$$b = \frac{1}{R^N}\left[\int_0^\infty d(y)dF(y) - \kappa_P R^F\right]$$

Then, the problem for households is to maximize utility by choosing $\{h, d(y)\}$

$$U_0 = \max_{h,\ d(y)} \frac{\left[\alpha(e)\left(1-h\right) + \frac{1}{R^N}\left[\int_0^\infty d(y)dF(y) - \kappa_P R^F\right]\right]^{1-\sigma}}{1-\sigma} + \frac{\beta}{\left(p^N\right)^{1-\sigma}}\int_0^\infty \frac{\left[\alpha(e)h^\psi y - d\left(y\right)\right]^{1-\sigma}}{1-\sigma}dF\left(y\right)$$

subject to

$$\left[\lambda\left(y\right)\right]\ :\ \ d\left(y\right) \leq \zeta y\alpha(e)h^\psi$$

where $\lambda\left(y\right)$ is the multiplier to the no-default constraints.

The first order conditions for b and $d\left(y\right)$ imply:

$$\left[c_0\right]^{-\sigma} = \frac{\beta R^N}{p^N}\left[c_1\left(y\right)\right]^{-\sigma} + \beta R^N\lambda\left(y\right). \tag{62}$$

Therefore: If $\lambda\left(y\right) = 0$, then the participation constraint does not bind,

$$c_1\left(y\right) = \left(\frac{\beta R^N}{p^N}\right)^{\frac{1}{\sigma}} c_0.$$

For those realizations y there is perfect smoothing in consumption between $t = 0$ and $t = 1$, given the prices R^N and p^N. If however, $\lambda\left(y\right) > 0$, the no-default constraint binds, repayments are limited to $d\left(y\right) = \zeta\alpha(e)h^\psi y$ and consumption will be increasing in y:

$$c_1\left(y\right) = \frac{\left(1-\zeta\right)\alpha(e)h^\psi y}{p^N} > \left(\frac{\beta R^N}{p^N}\right)^{\frac{1}{\sigma}} c_0.$$

The limited commitment constraint does not bind for $y \leq \Omega(h, b)$ and binds for $y > \Omega(h, b)$. We define $\Omega(h, b)$ in what follows.

After some algebra that we do not need to repeat here, the optimal repayment amount $d(y)$ is given by:

$$d\left(y\right) = \begin{cases} \alpha(e)h^\psi y - p^N\left(\frac{\beta R^N}{p^N}\right)^{\frac{1}{\sigma}} c_0 & \text{for } y \leq \frac{p^N\left(\beta R^N/p^N\right)^{\frac{1}{\sigma}}}{(1-\zeta)\alpha(e)h^\psi}c_0; \\ \zeta\alpha(e)h^\psi y & \text{otherwise.} \end{cases}$$

Define the inflection point $y \leq \frac{p^N\left(\beta R^N/p^N\right)^{\frac{1}{\sigma}}}{(1-\zeta)\alpha(e)h^{\psi}}c_0$ as $\Omega\left(h,b\right)$:

$$\Omega(h,b) = \frac{p^N\left(\beta R^N/p^N\right)^{\frac{1}{\sigma}}}{(1-\zeta)\alpha(e)h^{\psi}}c_0 = \frac{p^N\left(\beta R^N/p^N\right)^{\frac{1}{\sigma}}}{(1-\zeta)\alpha(e)h^{\psi}}\underbrace{\left[\alpha(e)\left(1-h\right)+b\right]}_{c_0(h,d)}$$

Then for a given h, we can solve for a optimal loan amount b since

$$b = \frac{1}{R^N}\left[\int_0^{\infty} d(y)dF(y) - \kappa_P R^F\right]$$

$$b = \frac{1}{R^N}\left[\underbrace{\int_0^{\Omega(h,b)}\left(\alpha(e)h^{\psi}y - p^N\left(\frac{\beta R^N}{p^N}\right)^{\frac{1}{\sigma}}c_0\right)dF\left(y\right)}_{\text{Non-Binding Region}} + \underbrace{\int_{\Omega(h,d)}^{\infty}\zeta\alpha(e)h^{\psi}y}_{\text{Binding Region}} - \kappa_P R^F\right]$$

Taking h as given, we can solve for b by solving for the zero of the above equation (where c_0 is also a function of b as given by equation (1)).

The equation above gives the loan amount b as a function of h. We can thus solve for household utility as a function of human capital $\tilde{h}$:

$$U_0(\tilde{h}) = \frac{\left[\alpha(e)\left(1-\tilde{h}\right)+b(\tilde{h})\right]^{1-\sigma}}{1-\sigma} + \frac{\beta}{\left(p^N\right)^{1-\sigma}}\int_0^{\infty}\frac{\left[a\tilde{h}^{\psi}y - \overbrace{d\left(y\right)}^{\text{Depends on }\tilde{h}}\right]^{1-\sigma}}{1-\sigma}dF\left(y\right)$$

Notice, we need to ensure that a zero to d equation exists otherwise utility is very low. This can happen if no contract can be offered to the agent such that the lender breaks even.

Proceeding from here, we can perform a grid search over the h space to find the utility maximizing human capital level.

D.3.2 Savers

Savers are the same as borrowers, they just have a negative amount b called s. We do assume that the setup costs are still κ_P but the return that the bank receives on these savings is R. We still call $d(y)$ repayments (they can be positive or negative) and we require that

$$\alpha(e)h^{\psi}y - d(y) \geq \left(1-\zeta\right)\alpha(e)h^{\psi}y$$
$$d(y) \leq \zeta\alpha(e)h^{\psi}y$$

When this condition is satisfied the probability of default is 0 so the return to lenders is:

$$P(b,h,d(y);\alpha(e),e) = -\kappa_P R^F + Rs + \int_0^\infty d(y)dF(y)$$

With competitive lenders we know that this return is 0 so that

$$s = \frac{1}{R}\left[-\int_0^\infty d(y)dF(y) + \kappa_P R^F\right]$$

Then, the problem for households is to maximize utility by choosing $\{h, b(y)\}$

$$U_0 = \max_{h,\ d(y)} \frac{\left[\alpha(e)\left(1-h\right) + \frac{1}{R}\left[\int_0^\infty d(y)dF(y) - \kappa_P R^F\right]\right]^{1-\sigma}}{1-\sigma} + \frac{\beta}{\left(p^N\right)^{1-\sigma}}\int_0^\infty \frac{\left[\alpha(e)h^\psi y - d\left(y\right)\right]^{1-\sigma}}{1-\sigma}dF\left(y\right)$$

subject to

$$\left[\lambda\left(y\right)\right]\ :\ \ d\left(y\right) \leq \zeta y \alpha(e) h^\psi$$

where $\mu\left(y\right)$ is the multiplier to the no-default constraints.
As before, he optimal repayment amount $d(y)$ is given by:

$$d\left(y\right) = \begin{cases} \alpha(e)h^\psi y - p^N\left(\frac{\beta R}{p^N}\right)^{\frac{1}{\sigma}} c_0 & \text{for } y \leq \frac{p^N\left(\beta R/p^N\right)^{\frac{1}{\sigma}}}{(1-\zeta)\alpha(e)h^\psi}c_0; \\ \zeta\alpha(e)h^\psi y & \text{otherwise.} \end{cases}$$

Define the inflection point $y \leq \frac{p^N\left(\beta R/p^N\right)^{\frac{1}{\sigma}}}{(1-\zeta)\alpha(e)h^\psi}c_0$ as $\Omega\left(h,s\right)$:

$$\Omega(h,s) = \frac{p^N\left(\beta R/p^N\right)^{\frac{1}{\sigma}}}{(1-\zeta)\alpha(e)h^\psi}c_0 = \frac{p^N\left(\beta R/p^N\right)^{\frac{1}{\sigma}}}{(1-\zeta)\alpha(e)h^\psi}\underbrace{\left[\alpha(e)\left(1-h\right) - s\right]}_{c_0(h,s)}$$

Then for a given h, we can solve for a optimal saving amount s since

$$s = -\frac{1}{R}\left[\int_0^\infty d(y)dF(y) - \kappa_P R^F\right]$$

$$s = -\frac{1}{R}\left[\underbrace{\int_0^{\Omega(h,s)}\left(\alpha(e)h^\psi y - p^N\left(\frac{\beta R}{p^N}\right)^{\frac{1}{\sigma}} c_0\right)dF\left(y\right)}_{\text{Non-Binding Region}} + \underbrace{\int_{\Omega(h,s)}^\infty \zeta\alpha(e)h^\psi y}_{\text{Binding Region}} - \kappa_P R^F\right]$$

Taking h as given, we can solve for s by solving for the zero of the above equation, as before.

The equation above gives the savings amount s as a function of h. We can thus solve for household utility as a function of human capital $\tilde{h}$:

$$U_0(\tilde{h}) = \frac{\left[\alpha(e)\left(1-\tilde{h}\right) - s(\tilde{h})\right]^{1-\sigma}}{1-\sigma} + \frac{\beta}{(p^N)^{1-\sigma}} \int_0^\infty \frac{\left[\alpha(e)\tilde{h}^{\psi} y - \overbrace{d\left(y\right)}^{\text{Depends on } \tilde{h}}\right]^{1-\sigma}}{1-\sigma} dF\left(y\right)$$

D.4 Fretchet Distribution

The cdf of a Fretchet distribution with scale parameter ν, curvature/shape parameter θ and location parameter m is given by:

$$\Pr\left(\eta_j < x\right) = \bar{F}(\theta, \nu, m) \equiv \exp\left(-\left(\frac{x-m}{\nu}\right)^{-\theta}\right)$$

In out model, $m = 0, \nu = 1$ so we have

$$\Pr\left(\eta_j < x\right) = F(\theta, 1) \equiv \exp\left(-\left(x\right)^{-\theta}\right)$$

Then the probability that the earnings component $C_j\left(e\right) w_j \eta_j$ is less than some x is given by:

$$\begin{aligned} \Pr\left(C_j\left(e\right) w_j \eta_j < x\right) &= \Pr\left(\eta_j > \frac{x}{C_j\left(e\right) w_j}\right) \\ &= \exp\left(-\left(\frac{x}{C_j\left(e\right) w_j}\right)^{-\theta}\right) \end{aligned}$$

This is equivalent to a Fretchet distribution with scale parameter $C_j\left(e\right) w_j$.

Furthermore, the probability that $\max_j \left\{C_j\left(e\right)w_j\eta_j\right\}$ is less than some x is given by:

$$
\begin{aligned}
\Pr\left(\max_j\left\{C_j\left(e\right)w_j\eta_j\right\} < x\right) &= \prod_j^J \Pr\left(C_j\left(e\right)w_j\eta_j > x\right) \\
&= \prod_j^J \exp\left(-\left(\frac{x}{C_j\left(e\right)w_j}\right)^{-\theta}\right) \\
&= \exp\left(-\sum_j^J\left(\frac{x}{C_j\left(e\right)w_j}\right)^{-\theta}\right) \\
&= \exp\left(-\sum_j^J x^{-\theta}\left(C_j\left(e\right)w_j\right)^{\theta}\right) \\
&= \exp\left(-x^{-\theta}\sum_j^J\left(C_j\left(e\right)w_j\right)^{\theta}\right) \\
&= \exp\left(-\left(\frac{x}{\left[\sum_j^J\left(C_j\left(e\right)w_j\right)^{\theta}\right]^{\frac{1}{\theta}}}\right)^{-\theta}\right)
\end{aligned}
$$

This is equivalent to a Fretchet distribution with shape parameter θ and scale parameter $\left[\sum_j^J\left(C_j\left(e\right)w_j\right)^{\theta}\right]^{\frac{1}{\theta}}$. In the code, we define `Ty` as $\sum_j^J\left(C_j\left(e\right)w_j\right)^{\theta}$ and `mu_bar_y` as $\left[\sum_j^J\left(C_j\left(e\right)w_j\right)^{\theta}\right]^{\frac{1}{\theta}}$