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Finance and Inequality: A Tale of Two Tails *

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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 emphasize 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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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 having 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 to understand whether the effects of a financial markets 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 in 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).

[7] Thus, as we discuss further below, our results confirm the earlier findings by Philippon and Reshef (2012) and Jerzmanowski and Nabar (2013).

increase in inequality associated to RGS.[8] 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 on 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 workers 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, 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 6 concludes the paper. A separate appendix contains additional analyses.

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

2 Data

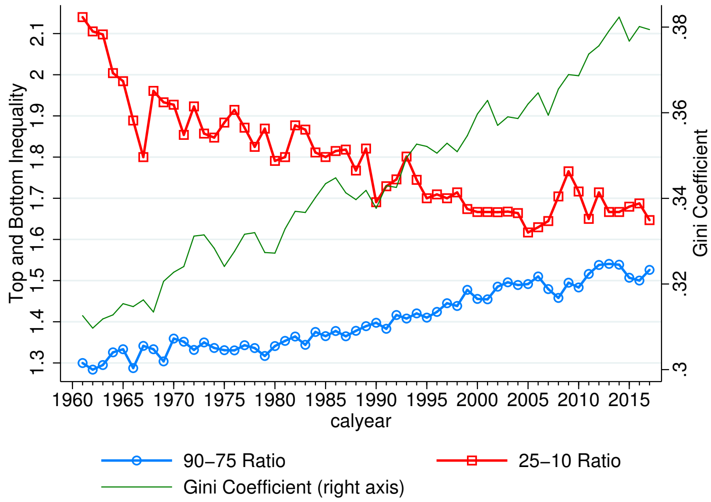
2.1 Income Distribution

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

	Obs.	Mean	Min	Max	Standard Deviation			
					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

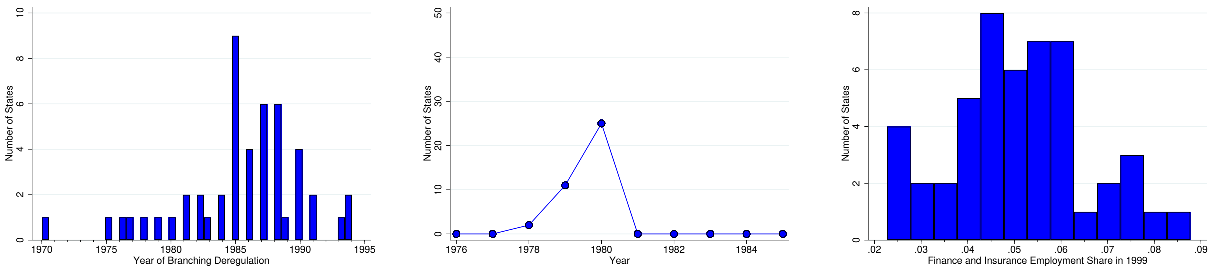
[17] Iowa did not pass any laws removing restrictions on intra-state bank branching so we take 1994, the year in which the Riegle-Neal Interstate Banking and Branching Efficiency Act was passed, as the year in which Iowa's bank branching restrictions were removed. This federal act aimed to equalize the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

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

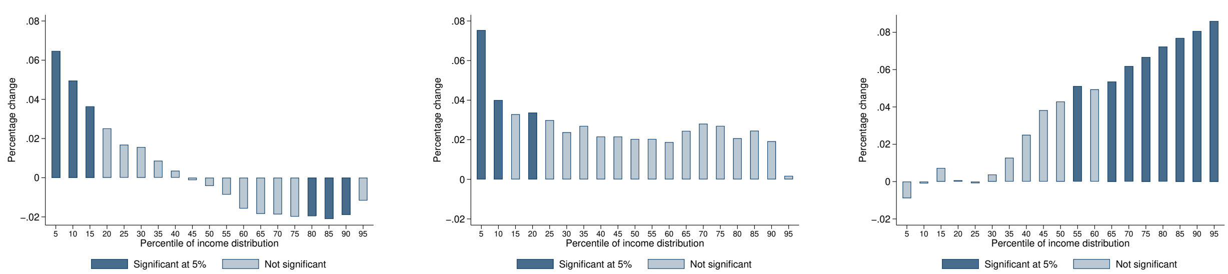
Notes: The table shows the results from the regression in equation 1. Results on control variables, and state and year fixed effects are not reported. Information on 49 states is used from 1976 to 2017. Data on Gross State Product (GSP) is from the Bureau of Economic Analysis (BEA). The reported coefficients 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.

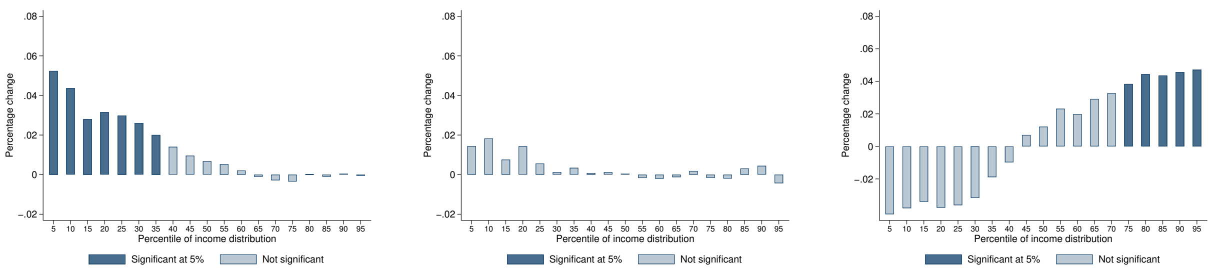
[27] See for example, Phaup and Hinton (1981) and Shay (1972).

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

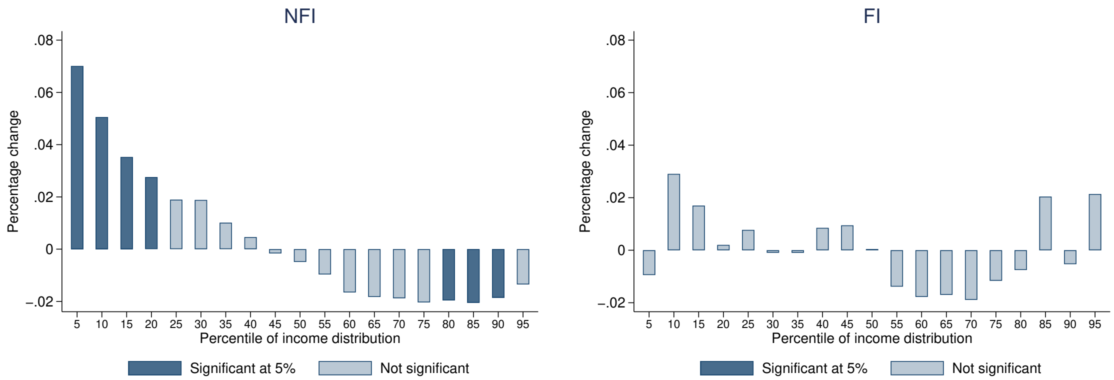
$$y_{st}^{k}(j) = \alpha^{k} + \Sigma_i(\beta^{i,k} D_{st}^{i}) + \mathbf{A_s}^{k} + \mathbf{B_t}^{k} + \epsilon_{st}^{k}(j), \tag{4}$$

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.

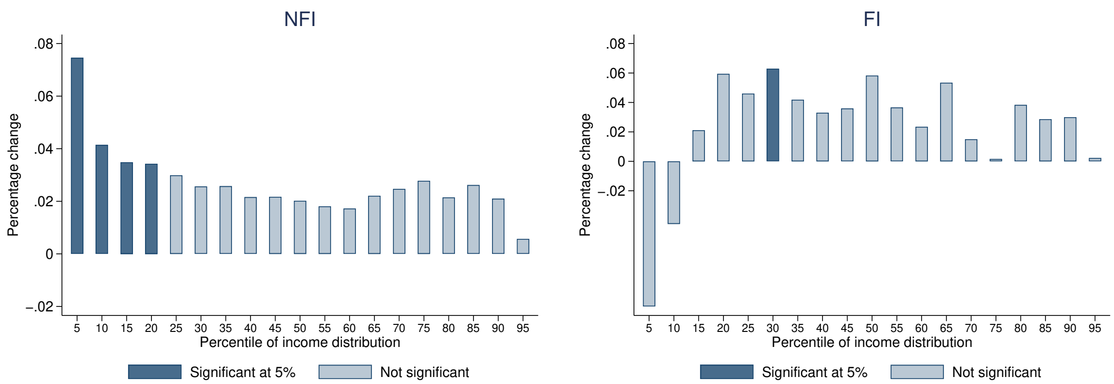
Figure 5 shows the results. Both RBR and RSC increased incomes of workers in NFI and more strongly in the left tails thus reducing inequality whereas there is no or overall insignificant changes of incomes in FI. This shows that our previous findings of the reduction in inequality by the reforms RBR 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.

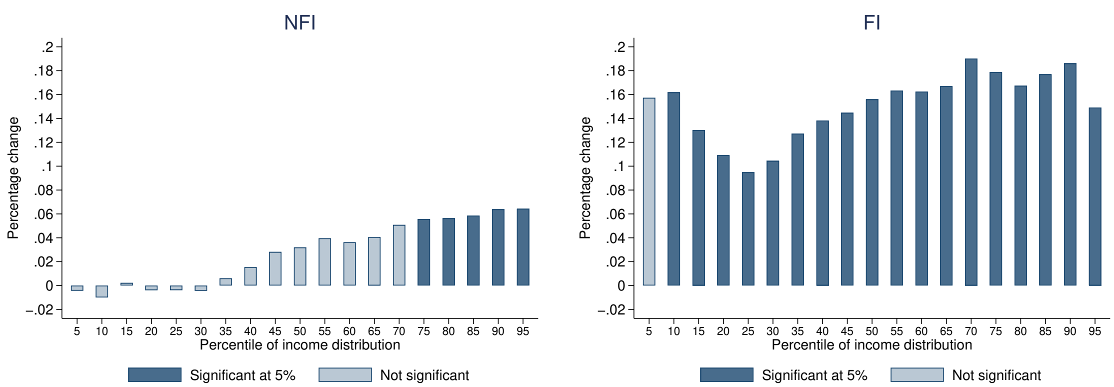
Figure 5: Impact of Financial Deregulation on Income for NFI and FI Employees



(a) RBR



(b) RSC



(c) RGS

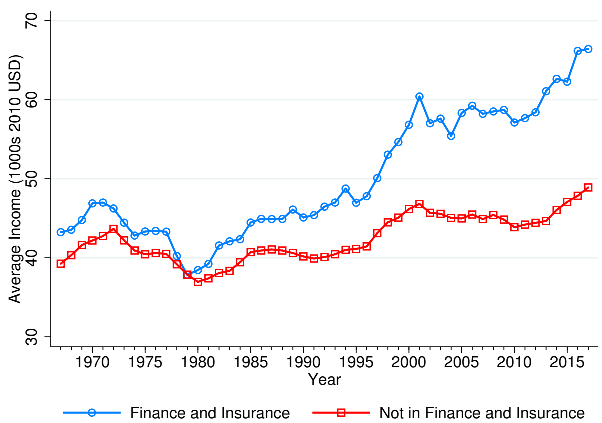
Notes: The figure reports the coefficients β^i for percentiles of the income distribution from specification **??**. Darker bars indicate that the coefficient is statistically significant at the 5% confidence level.

4.3.2 Between and Within Group Inequality

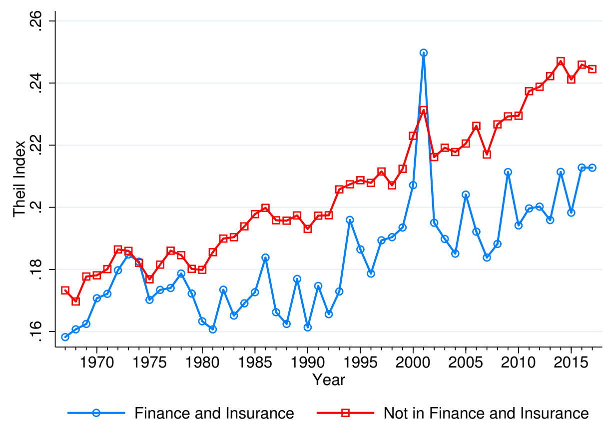
The previous analysis suggests that the reduction of inequality through RBR and RSC is mainly due to increases in incomes in the lower tail in sector NFI. In contrast, the increase of inequality is mainly due to an increasing income gap between NFI and FI workers. This section tests this hypothesis in 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 1980 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 total, within and between 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 ("Not in FI" 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 since 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.

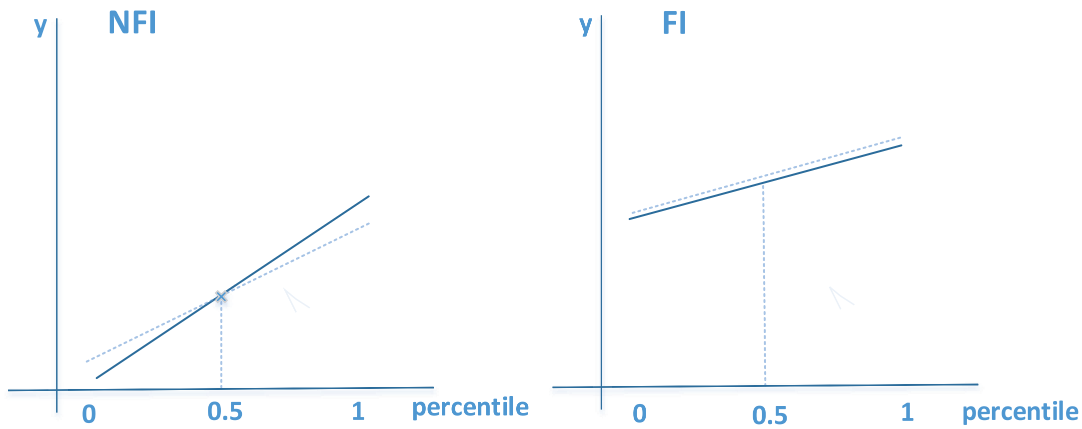
Table 5: Decomposition of Impact of Financial Deregulation on Income Inequality Within and Between Groups

				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)

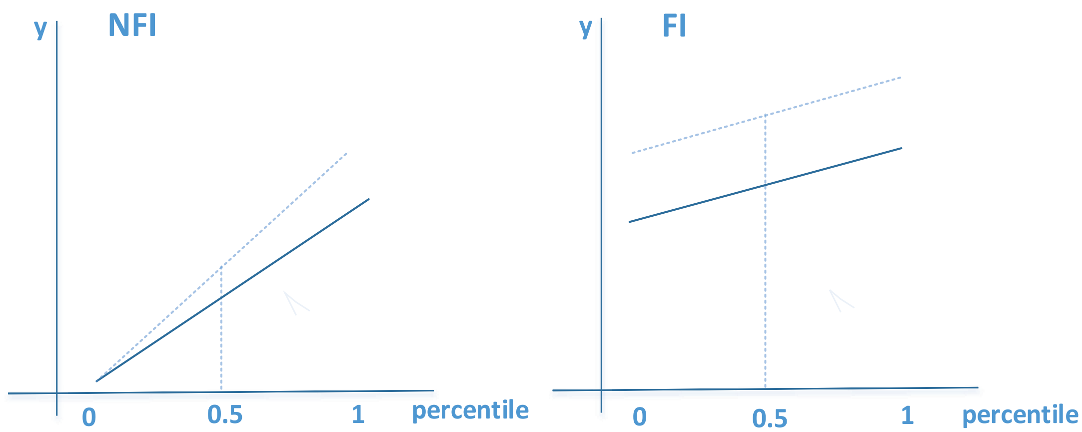
Notes: The table reports the impact of financial deregulation on components of inequality. Workers are grouped into those employed in Finance and Insurance (FI) and those not employed in FI. The total, between and within group inequality are regressed on indicators of financial deregulation, year and 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.

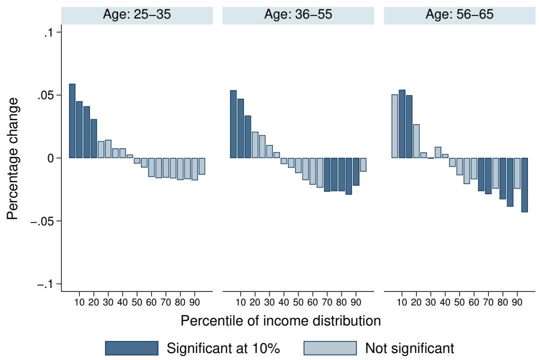
5 Model

Our empirical results show that the different reforms had different impacts on income inequality. Bank branching deregulation and the removal of interest rate ceilings decreased it, whereas the repeal of the Glass Steagall Act increased it. Furthermore, most of these effects are due to changes of income inequality within the sector NFI and not across sectors. A strong between group is only identified for the removal of the Glass Steagal Act: it increased incomes in both sectors, but more strongly in FI than in NFI.

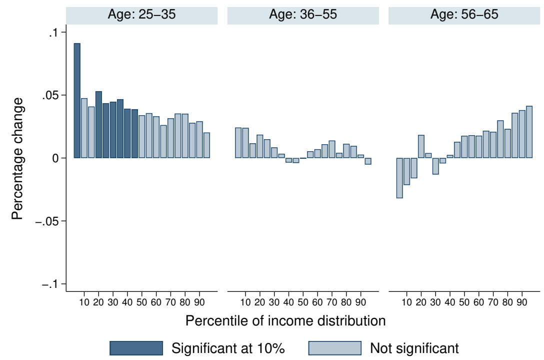
Models with capital skill complementarities would predict that all reforms have the same effect: an expansion of activity should increase inequality. We therefore argue that models of the effects on financial deregulation on inequality must take into account access to financial market products and how this access is affected by respective reforms. This is our approach

[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.

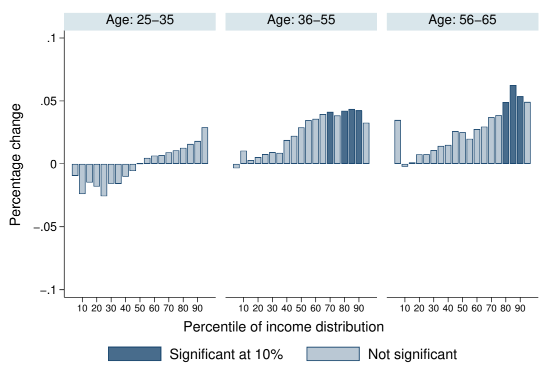
Figure 8: Immediate Impact of Financial Deregulation by Income and Age Groups



(a) RBR



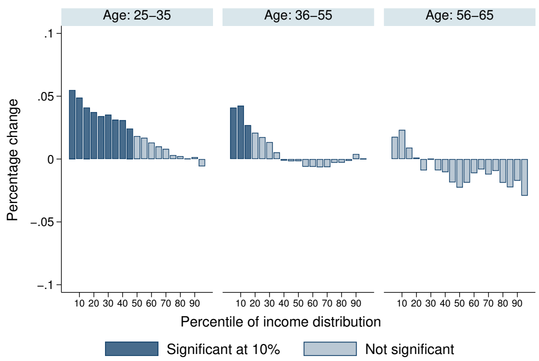
(b) RSC



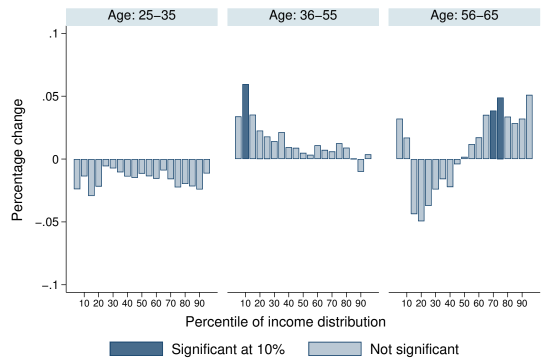
(c) RGS

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.

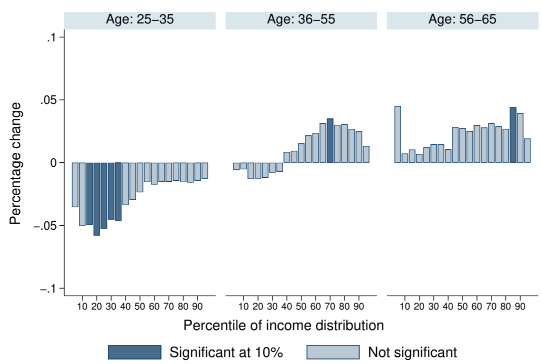
Figure 9: Impact of Financial Deregulation by Age Groups and 5 Years Lead Income



(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.

here. On the firm side, we model a nested CES production structure in the two sectors FI and NFI. On the workers side, we assume different forms of credit and an endogenous separation of the market according to the demand from low and high skilled households. This gives us an angle to model the differential impact of bank branching deregulation (through increasing competition), the removal of rate ceilings and the repeal of the Glass Steagall Act.

5.1 Firms

We assume that factors of production are used by two sectors, FI and NFI. NFI is final production, FI simply distributes capital to both firms for production and workers for financing human capital accumulation and insurance. In terms of the production side, we assume perfect competition and constant returns to scale. Therefore, no profits will attain in equilibrium.

We make the following

Assumption 1 *1. All capital used by firms in NFI must be distributed by financial firms.*[35]

2. Financial firms can access capital without the need of financial services for themselves.[36]

3. Financial firms need capital for two reasons:

- *to distribute, employing capital stock K_D and*
- *to operate, employing capital stock K_F.*

FI distributes capital to NFI

$$Y_F = \min \left\{ K_D, \zeta_F F_F \left[H_F, K_F \right] \right\}.$$

The key assumption is that capital K_D must be distributed by the financial sector to either non-financial firms or to households. To this end, the financial sector uses different types of labor $H_F = \left[H_F(1), H_F(2), ..., H_F(J) \right]$, and capital K_F. Since FI can access capital without having to pay for intermediation costs, the cost of capital for the sector is given by R, the rental price of capital from the primary suppliers (think of rentiers in the country). We assume that a term ζ_F is driven by productivity and by regulation. Finally, the production function is $F_F \left[H_F, K_F \right]$ is CES.

We assume that output in NFI is produced employing capital and labor according to

$$Y = \zeta_N F_N \left[H_N, K_N \right].$$

[35]This assumption could be relaxed.

[36]This assumption could also be relaxed.

5.1.1 Functional Forms

Factors of production, i.e. capital and labor of different types, are used by two sectors, finance and insurance (FI) and non-finance (NFI). NFI comprise all the final consumption goods. In the model, the role of FI is to distribute capital for the operation of firms in both sectors, and to households for consumption, human capital accumulation and insurance. We assume that both FI and NFI are perfectly competitive and all firms have constant returns to scale production functions.

The output of financial firms, whose main output is distribut∑ed capital, K^D, is as follows:

$$Y_F = \min \left\{ K^D, \, \zeta_F \cdot F_F \left[H^F, K^F \right] \right\}.$$

Therefore, we assume that in order for the finance firms to distribute an amount of capital K^D –to either non-financial firms, other finance firms (for their operation), or to households– they not only need the amount of capital K^D to be distributed but they must also use different types of labor, i.e. a vector $H^F = \left[H_j^F \right]$, for $j = 1, 2, ..., J$ and an amount of capital K^F to operate. These operations are given by the production function $F_F \left[H^F, K^F \right]$ that exhibits onstant returns to scale. Here, ζ_F is a productivity term that is driven by productivity and by regulation. Finally, we assume that financial firms must pay a cost R for the capital K^D that they intermediate from investors (to be described below) to firms and households in the economy. However, they must pay a cost $c_F \geq R$ for the capital K^F that they use for their operations.[37] We assume that

$$c_F = R + (1 - \iota) (p_F - R) \tag{7}$$

where $\iota \in [0, 1]$ is a parameter that stands in for the degree of financial liberalization. $\iota = 1$ reflects full liberalization such that the costs of finance is given by the exogenous interest rate R. $\iota = 0$ is full regulation such that the costs of finance is p_F. Given an assumed Leontief structure of production, the cost of intermediated capital, p_F, is then the sum of the return R and an intermediation cost ϕ_F, which is endogenously determined by the factor prices of all types of labor H_j and R.

With respect to the NFI firms, we assume their production function also exhibits constant returns to scale to workers and capital,

$$Y = \zeta_N \cdot F_N \left[H^N, K^N \right],$$

where $\zeta_N > 0$ is also a productivity shifter that may be driven by technological and regulation

[37] We discuss below the implications of relaxing these assumptions.

changes.

While the equilibrium conditions can be stated for the model along these generic lines, we will assume directly impose a flexible nested constant-elasticity of substitution (CES) technologies, a natural extension of Krusell, Ohanian, Ríos-Rull, and Violante (2000) to multiple types of workers, and sectors. The framework enables us to explicitly consider the assignment of workers to firms, allows to have differences in the complementarity and substitutability of capital and labor across different occupations. As a result, our framework can flexibly and realistically capture the impact of finance liberalization and capital deepening on the demand for different workers.

Specifically, we assume that the production functions $F_N\left[H^N, K^N\right]$ and $F_F\left[H^F, K^F\right]$ both have the following nested CES structure: First, the inner layers of production in each sector $i \in \{N, F\}$ are vector of tasks that are produced by the skills of workers H_j^i equipped with K_j^i units of physical capital. For each $j = 1, ..., J$, there is a CES production function $G_j\left(H_j^i, K_j^i\right)$ of the form

$$G_j\left(H_j^i, K_j^i\right) = \left[\mu_j \left(H_j^i\right)^{\rho_j} + \left(1 - \mu_j\right)\left(K_j^i\right)^{\rho_j}\right]^{\frac{1}{\rho_j}}, \tag{8}$$

that defines the production of services of type j that are the product of using labor services H_j^i with capital K_j^i. We assume that all the production functions $G_j(\cdot)$, $j = 1, ..., J$, are the same for both sectors, i.e. the production of tasks is described by the same distribution and curvature parameters, $\left\{\mu_j, \rho_j\right\}_{j=1}^J$, in both, finance and non-finance firms. Second, a pair of outer CES production functions are defined over vectors $\{G_j\}_{j=1}^J$ to define the output of finance and non-finance firms. In particular, for $i \in \{F, N\}$, we assume

$$F\left[\left\{G_j(K_j^i, H_j^i)\right\}_{j=1}^J\right] = \left[\sum_{j=1}^J \lambda_j^i \left(G_j(K_j^i, H_j^i)\right)^{\rho_O}\right]^{\frac{1}{\rho_O}}, \text{ with } \sum_{j=1}^J \lambda_j^i = 1. \tag{9}$$

Here, $\rho_O \leq 1$ is the curvature parameter that governs the elasticity of substitution, $\frac{1}{1-\rho_O}$, between the tasks G_j for final production. For simplicity, we assume that this curvature parameter is the same for the operation of finance and non-finance firms. However, we allow the distributional parameters $\left\{\lambda_j^i\right\}_{j=1}^J$ to differ across $i \in \{N, F\}$. It is precisely this difference in the outer CES that allows us to capture different skill-intensities between finance and non-finance sectors.

5.1.2 Profit Maximization

Sector FI Denoting by p_F the price of financed capital, the output of the firm, w_j the wages of each type of labor services $j = 1, ..., J$ and R, the rental rate of capital to capital owners, financial firms maximize the profits

$$\pi^F = \max_{K^D, K^F, \{H_j^F\}} p_F \min \left\{ K^D, \zeta_F \left[\sum_{j=1}^{J} \lambda_j^F \left[\left[\mu_j \left(H_j^F \right)^{\rho_j} + \left(1 - \mu_j \right) \left(K_j^F \right)^{\rho_j} \right]^{\frac{1}{\rho_j}} \right]^{\rho_o} \right]^{\frac{1}{\rho_o}} \right\} - \sum_{j=1}^{J} w_j H_j^F - RK^D - c_F \sum_{j=1}^{J} K_j^F,$$

where c_F are the cost of financial firms for their operations. We assume that

$$c_F = R + (1 - \iota) (p_F - R) \tag{10}$$

where $\iota \in [0, 1]$ is a parameter that stands in for the degree of financial liberalization, with $\iota = 1$ for full liberalization and $\iota = 0$ for full regulation.

The operative profits for the finance sector, i.e., net of the cost of capital RK_D are given by

$$\pi^F = \max_{\{H_j^F, K_j^F\}} p_F \zeta_F \left[\sum_{j=1}^{J} \lambda_j^F \left[\left[\mu_j \left(H_j^F \right)^{\rho_j} + \left(1 - \mu_j \right) \left(K_j^F \right)^{\rho_j} \right]^{\frac{1}{\rho_j}} \right]^{\rho_o} \right]^{\frac{1}{\rho_o}} - \sum_{j=1}^{J} w_j H_j^F - c_F \cdot \sum_{j=1}^{J} K_j^F$$

Using the Leontieff structure, the constant returns to scale and assuming competitive markets (free entry and zero profits) we have that the cost of intermediated capital, p_F, the price of financial services is

$$p_F = R + \phi_F (w, c_F), \tag{11}$$

where

$$\phi_F (w, c_F) = \min \sum_{j=1}^{J} w_j H_j^F + c_F \sum_{j=1}^{J} K_j^F \text{ s.t. } \zeta_F \left[\sum_{j=1}^{J} \lambda_j^F \left[\left[\mu_j \left(H_j^F \right)^{\rho_j} + \left(1 - \mu_j \right) \left(K_j^F \right)^{\rho_j} \right]^{\frac{1}{\rho_j}} \right]^{\rho_o} \right]^{\frac{1}{\rho_o}} = 1,$$

are the unitary (marginal and average) costs of intermediation. Notice here that we assume that operation capital inside firms must also be intermediated. Observe from (10) and (11) that therefore

$$c_F = R + (1 - \iota) \phi_F (w, c_F) \tag{12}$$

which is a fixed point problem in c_F.

We can break-down the intermediation costs $\phi_F(w, c_F)$ in two steps. First, solve for v_j^F, the unitary cost of equipped-labor j[38], i.e.,

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

Second, solve for the implied maximization

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

The solution for the first problem is

$$v_j^F(w_j, c_F) = \left[\left(\mu_j\right)^{\frac{1}{1-\rho_j}} \left(w_j\right)^{\frac{\rho_j}{\rho_j - 1}} + \left(1-\mu_j\right)^{\frac{1}{1-\rho_j}} \left(c_F\right)^{\frac{\rho_j}{\rho_j-1}}\right]^{\frac{\rho_j - 1}{\rho_j}}. \tag{13}$$

The solution of the second problem is in turn given by

$$\phi_F\left(w, c_F\right) = \left(\zeta_F\right)^{-1} \times \left[\sum_{j=1}^J \left(\lambda_j^F\right)^{\frac{1}{1-\rho_o}} \left(v_j^F(w_j, c_F)\right)^{\frac{\rho_o}{\rho_o - 1}}\right]^{\frac{\rho_o - 1}{\rho_o}}. \tag{14}$$

Sector NFI In sector NFI profits write as

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

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

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

which gives

$$v_j^N(w_j, p_F) = \left[\left(\mu_j\right)^{\frac{1}{1-\rho_j}} \left(w_j\right)^{\frac{\rho_j}{\rho_j - 1}} + \left(1-\mu_j\right)^{\frac{1}{1-\rho_j}} \left(p_F\right)^{\frac{\rho_j}{\rho_j-1}}\right]^{\frac{\rho_j - 1}{\rho_j}}. \tag{15}$$

[38] We can interpret v_j^F as the cost of one unit of G_j. $\sum v_j^F G_j$ then corresponds to total costs.

Second, solve for the maximization

$$p_N = \min \sum_{j=1}^{J} v_j^N G_j, \text{ s.t. } \zeta_N \left[\sum_{j=1}^{J} \lambda_j^N \left[G_j \right]^{\rho_o} \right]^{\frac{1}{\rho_o}} = 1$$

for which the solution is

$$p_N = \ (\zeta_N)^{-1} \times \left[\sum_{j=1}^{J} \left(\lambda_j^N \right)^{\frac{1}{1-\rho_o}} \left(v_j^N (w_j, p_F) \right)^{\frac{\rho_o}{\rho_o - 1}} \right]^{\frac{\rho_o - 1}{\rho_o}} . \tag{16}$$

First-Order Conditions In both sectors $i \in \{N, F\}$ let

$$M_i \ \equiv \ \zeta_i \left[\sum_{j=1}^{J} \lambda_j^i \left[\mu_j \left(H_j^i \right)^{\rho_j} + \left(1 - \mu_j \right) \left(K_j^i \right)^{\rho_j} \right]^{\frac{\rho_o}{\rho_j}} \right]^{\frac{1}{\rho_o} - 1} .$$

With these expressions the first order conditions for H_j^i and K_j^i, $i \in \{N, F\}, j \in \{1, \ldots, J\}$ are, respectively,

$$w_j \ = \ p_i \cdot M_i \cdot \left[\mu_j \left(H_j^i \right)^{\rho_j} + \left(1 - \mu_j \right) \left(K_j^i \right)^{\rho_j} \right]^{\frac{\rho_o}{\rho_j} - 1} \lambda_j^i \mu_j \left(H_j^i \right)^{\rho_j - 1} \tag{17a}$$

$$p_F \ = \ p_N \cdot M_N \cdot \left[\mu_j \left(H_j^N \right)^{\rho_j} + \left(1 - \mu_j \right) \left(K_j^N \right)^{\rho_j} \right]^{\frac{\rho_o}{\rho_j} - 1} \lambda_j^N \left(1 - \mu_j \right) \left(K_j^N \right)^{\rho_j - 1} \tag{17b}$$

$$c_F \ = \ p_F \cdot M_F \times \left[\mu_j \left(H_j^F \right)^{\rho_j} + \left(1 - \mu_j \right) \left(K_j^F \right)^{\rho_j} \right]^{\frac{\rho_o}{\rho_j} - 1} \lambda_j^F \left(1 - \mu_j \right) \left(K_j^F \right)^{\rho_j - 1} . \tag{17c}$$

Market-Clearing Conditions From the first-order conditions, the capital-labor ratios in each task/occupation j satisfy, for sector FI

$$\frac{w_j}{c_F} = \frac{\mu_j}{1 - \mu_j} \left[\frac{H_j^F}{K_j^F} \right]^{\rho_j - 1} \quad \Leftrightarrow \quad H_j^F = \psi_j^F K_j^F,$$

where $\psi_j^F \equiv \left[\frac{w_j}{c_F} \frac{1-\mu_j}{\mu_j} \right]^{\frac{1}{\rho_j - 1}}$. Likewise, for sector NFI we get

$$\frac{w_j}{p_F} = \frac{\mu_j}{1 - \mu_j} \left[\frac{H_j^N}{K_j^N} \right]^{\rho_j - 1} \quad \Leftrightarrow \quad H_j^N = \psi_j^N K_j^N,$$

where $\psi_j^N \equiv \left[\frac{w_j}{p_F} \frac{1-\mu_j}{\mu_j} \right]^{\frac{1}{\rho_j - 1}}$.

Within each Sector, given total K^i we can now write how is capital allocated across j. Using $H_j^i = \psi_j^i K_j^i$ in the conditions for K_j^i in all occupations j we can write the amount of capital used in each occupation/task l as a function of the total capital used by the sectors $i \in \{N, F\}$ as

$$K_l^i = \left[\frac{\theta_l^i}{\sum_{j=1}^J \theta_j^i}\right] \times K^i,$$

where

$$\theta_j^i \equiv \left[\left[\mu_j \left(\psi_j^i\right)^{\rho_j} + (1-\mu_j)\right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^i \left(1-\mu_j\right)\right]^{\frac{1}{1-\rho_o}}$$

Finally, using ψ_j^i rewrite the FOC for H_j^i as

$$w_j = p_i \cdot M_i \cdot \left[\mu_j^{\rho_j} + (1-\mu_j)\left(\frac{1}{\psi_j^i}\right)^{\rho_j}\right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^i \mu_j \left(H_j^i\right)^{\rho_o-1}$$

and thus

$$H_j^i = \left(\frac{p_i}{w_j} \cdot M_i \cdot \left[\mu_j^{\rho_j} + (1-\mu_j)\left(\frac{1}{\psi_j^i}\right)^{\rho_j}\right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^i \mu_j\right)^{\frac{1}{1-\rho_o}}$$

from which we get the ratio of human capital across the two sectors in occupation j as

$$\frac{H_j^N}{H_j^F} = \left(\frac{p_N \cdot M_N \cdot \left[\mu_j^{\rho_j} + (1-\mu_j)\left(\frac{1}{\psi_j^N}\right)^{\rho_j}\right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^N}{p_F \cdot M_F \cdot \left[\mu_j^{\rho_j} + (1-\mu_j)\left(\frac{1}{\psi_j^F}\right)^{\rho_j}\right]^{\frac{\rho_o}{\rho_j}-1} \lambda_j^F}\right)^{\frac{1}{1-\rho_o}} \tag{18}$$

5.2 Workers

5.2.1 Preferences, Endowments, Jobs and Earnings

We consider two period lived workers. Their preferences are given by

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

where c_0, c_1 are the consumptions on the current and future periods, respectively.

In the current period, they have earnings $y_0 > 0$. They can invest h units of on-the-job-training (OJT), which reduces current net-consumption in period 0 but increases earnings in the second period. On the job training is interpreted very broadly and can be thought of all activities, efforts that increase earnings in the second period. Furthermore, workers can borrow amount d (which is negative if lent). Accordingly, first period consumption is given by

$$c_0 = y_0 (1 - h) + d.$$

Human capital investments in the first period lead to an increase of second period earnings by h^α where α is the elasticity with respect to human capital investment. We further assume that workers are of type e standing in for fixed characteristics such as gender, race, age, and education level, and choose among j occupations. We assume that workers of type e have a comparative advantage of working in occupation j denoted by $C(e, j)$. This is similar to the propensity score from the empirical analysis. of workers of type e in occupations j. Finally, workers income in occupation j is subject to an idiosyncratic shock η_j. With these elements, second period income is given by

$$y_1 = y_0 h^\alpha \max_j \left\{ C(e, j) \cdot w_t(j) \cdot \eta_j \right\}.$$

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

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

This distributional assumption will have a number of useful implications, rendering the model analytically very tractable, cf. Appendix B.1.

5.2.2 Contracting Environments

We now consider alternative contracting environments, which will be the basis for our analysis of the impact of financial market liberalization.

Autarky Consider a worker that can only consume his earnings. Given our assumptions on OJT, the problem is to maximize

$$\max_h \frac{\left[y_0 (1 - h)\right]^{1-\sigma}}{1 - \sigma} + \beta E\left[\frac{\left[y_0 h^\alpha \max_j \left\{ C(e, j) \cdot w_t(j) \cdot \eta_j \right\}\right]^{1-\sigma}}{1 - \sigma}\right].$$

Notice that we can factor our the component h:

$$\max_h \frac{\left[y_0 (1 - h)\right]^{1-\sigma}}{1 - \sigma} + \beta \frac{\left[y_0 h^\alpha\right]^{1-\sigma}}{1 - \sigma} E\left[\left[\max_j \left\{ C(e, j) \cdot w_t(j) \cdot \eta_j \right\}\right]^{1-\sigma}\right].$$

The variable $\left[\max_j \left\{C(e,j)\cdot w_t(j)\cdot \eta_j\right\}\right]^{1-\sigma}$ is a Frechet$\left(\frac{\theta}{1-\sigma}, [\Phi(e;w)]^{1-\sigma}\right)$, therefore

$$E\left\{\left[\max_j \left\{C(e,j)\cdot w_t(j)\cdot \eta_j\right\}\right]^{1-\sigma}\right\} = \Gamma\left(1-\frac{1-\sigma}{\theta}\right)[\Phi(e;w)]^{1-\sigma}.$$

The first order condition writes as

$$[1-h]^{-\sigma} = \beta\alpha h^{\alpha(1-\sigma)-1}\Gamma\left(1-\frac{1-\sigma}{\theta}\right)[\Phi(e;w)]^{1-\sigma}.$$

and it is straightforward to show that there is a unique, positive level h^{aut} that solves this equation: The LHS is strictly increasing, while the RHS is strictly decreasing since $\alpha(1-\sigma)<1$.

Next, denote by associated utility in autarky by

$$U^{\text{aut}} = \frac{\left[y_0\left(1-h^{\text{aut}}\right)\right]^{1-\sigma}}{1-\sigma} + \beta\frac{\left[y_0\left(h^{\text{aut}}\right)^{\alpha}\right]^{1-\sigma}}{1-\sigma}\Gamma\left(1-\frac{1-\sigma}{\theta}\right)[\Phi(e;w)]^{1-\sigma}.$$

We will use this expression below to characterize the contract that a monopolist could offer a worker.

Full Insurance (Complete Markets) Now, consider a model in which the worker can buy/sell Arrow-securities on his future income. It suffices to index each state of the world by the realized scale income of workers, $y \equiv \max_j \left\{C(e,j)\cdot w_t(j)\cdot \eta_j\right\}$. Let $q(y)$ be the price of one unit of the good in state y for period 1, all in units of goods in period 0. Let also $f(y)$ denote the probability (pdf) of each of those states.

The problem of the worker is

$$\begin{aligned} U_0 &= \max_{h,\, c_0,\, c_1(y)} \frac{[c_0]^{1-\sigma}}{1-\sigma} + \beta\int_0^\infty \frac{[c_1(y)]^{1-\sigma}}{1-\sigma} f(y)\,dy, \\ \text{s.t.} &: \\ c_0 + \int_0^\infty c_1(y)\,q(y)\,dy &= y_0(1-h) + y_0 h^\alpha \int_0^\infty y q(y)\,dy. \end{aligned}$$

With complete markets, the prices are $q(y) = \beta f(y)$. Letting μ denote the Lagrange multiplier for the participation constraint of the lender, then

$$L = \max_{h,\, c_0,\, c_1(y)} \frac{[c_0]^{1-\sigma}}{1-\sigma} + \beta \int_0^\infty \frac{[c_1(y)]^{1-\sigma}}{1-\sigma} f(y)\, dy +$$
$$\mu \left[y_0 (1-h) + y_0 h^\alpha \beta \int_0^\infty y q(y)\, dy - c_0 + \beta \int_0^\infty c_1(y) f(y)\, dy \right].$$

The first order conditions for this problem are quite standard:

$$\begin{aligned} [c_0] &: \quad [c_0]^{-\sigma} = \mu, \\ [c_1(y)] &: \quad [c_1(y)]^{-\sigma} = \mu, \\ [h] &: \quad y_0 = y_0 h^{\alpha-1} \beta\alpha\Phi(e; w). \end{aligned}$$

Obviously, these conditions lead to the full insurance result

$$c_1(y) = c_0,$$

and to the income maximizing investment

$$h^{\mathrm{FB}} = [\beta\alpha\Phi(e; w)]^{\frac{1}{1-\alpha}}.$$

Obviously, the attained utility for the first best is higher than in autarky. More interestingly, we can verify that $h^{\mathrm{FB}} > h^{\mathrm{AUT}}$.

Personalized Contracts: Complete Markets with Participation Constraints Now, consider the case in which workers can renege on a payment. For simplicity, let's assume that, in the second period, they can always consume a fraction $(1-\gamma)$ of their income. Likewise, for simplicity, assume that, if a worker defaults, the financial intermediary (lender) gets nothing.[39] There are infinitely many possible participation constraints, with associated multipliers $\lambda(y)$, all of the form

$$\lambda(y): \quad c_1(y) \geq (1-\gamma)\, y_0 h^\alpha y, \text{ for all } y.$$

In addition, consider that setting up these type of contracts entail a fixed cost $F > 0$.

[39] In the complete markets version, this assumption is not relevant, since default will not happen in equilibrium.

With those elements, the Lagrangian for this problem is

$$L = \max_{h,\, c_0,\, c_1(y)} \frac{[c_0]^{1-\sigma}}{1-\sigma} + \beta \int_0^\infty \frac{[c_1(y)]^{1-\sigma}}{1-\sigma} f(y)\, dy$$
$$+ \mu \left[y_0 (1-h) + y_0 h^\alpha \beta \int_0^\infty y q(y)\, dy - c_0 - \beta \int_0^\infty c_1(y) f(y)\, dy - F \right] +$$
$$\beta \int_0^\infty \lambda(y) \left[c_1(y) - (1-\gamma) y_0 h^\alpha y \right] dy$$

with FOCs

$$\begin{aligned}
[c_0] &: \quad [c_0]^{-\sigma} = \mu, \\
[c_1(y)] &: \quad [c_1(y)]^{-\sigma} = \mu - \lambda(y), \\
[h] &: \quad -y_0 + y_0 h^{\alpha-1} \beta\alpha \left[\Phi(e; w) - (1-\gamma) \int_0^\infty \lambda(y)\, y dy \right].
\end{aligned}$$

It is evident that full-insurance disappears. Moreover, the optimal investment in human capital is given by

$$h^{\text{PC}} = \left[\Phi(e; w) - (1-\gamma) \int_0^\infty \lambda(y)\, y dy \right]^{\frac{1}{1-\alpha}},$$

which, as long as constraints are binding, is less than first best.

Finally, note that the impact of the fixed cost F is on the level of consumption, and hence the final utility level, i.e., U^{PC} is a decreasing function of F.

Generic Contracts with Limited Commitment Now, consider a contracting environment with the added restriction that repayments cannot be made contingent on labor market realizations y. Such a restriction should be the result of the decision on behalf of the lender of not to set up all the information mechanisms required to collect and verify the information on the borrower. Here, we will assume that the lack of information will be only on the future outcomes y of the borrower.

Presumably, the setup costs of these contracts must be lower than setting up a full contingent contract, which in our environment, needs to be personalized to the idiosyncratic shocks of the borrower. Because of this, we will use the term "generic contract", and assume that setting up those contracts involve a fixed cost $f \geq 0$ which is strictly below the cost of having a full contingent contract, $0 \leq f < F$.

A generic contract is characterized by two numbers: A lending amount d that the lender gives to the borrower in time $t = 0$, and a "promise" of the borrower to repay the lender a constant amount D. However, the borrower retains the option to default. We model default by maintaining the assumption that the consumer always consumes a fraction $(1-\gamma)$ of his earnings in period $t=1$ giving rise to an optimal default threshold characterized below. Note that with uncontingent repayments, limited commitment, and the fact that the Frechet distribution of earnings y_1 has a full support, this option would be chosen with positive probability. In case of default we assume, for simplicity, that lenders do not recover any income when borrowers default.[40]

Even if all information about the distribution of risks, the initial earnings y_0 and the actual OJT investments h of the borrower are public information, the restriction on repayments drastically changes the resulting allocations. With incomplete contracts, the two numbers (d, D) must balance multiple trade-offs. One the one hand, the fact that contracts cannot provide explicit insurance against downside risks leaves the option of default to take on that role, at least partially. On the other hand, borrowers no longer have an incentive to default when they experience high earnings realizations, since the repayment amount does not increase with earnings. As a result, limited commitment with incomplete contracts may generate default from borrowers with low earnings as an implicit—and imperfect—form of insurance against downside labor market risks. This insurance is implicitly priced by lenders as they incorporate the probability of default in the amount of credit d that they offer in exchange for a defaultable promise to repay a given amount D.

To develop the optimal contract, consider a type e worker with initial earnings y_0, who makes OJT investments h. Moreover, assume that the worker borrows an amount d from a lender in exchange of repaying D in $t=1$. The consumption at period $t=0$ of this worker will be

$$c_0 = y_0\left(1-h\right)+d.$$

For period $t=1$, his earnings would be given by

$$y_1 = y_0 h^{\alpha} y,$$

where the scaled variable $y = \max_j \left\{C\left(e,j\right)\cdot w_t\left(j\right)\cdot \eta_j\right\}$ is Frechet distributed, exactly as in all the previous cases. With an amount of debt D, the decision of whether to honor the debt or default depends on the realization of y. If the borrower repays, his second period consumption is $c_1\left(y\right) = y_0 h^{\alpha} y - D$, while if he defaults, it is $c_1\left(y\right) = \left(1-\gamma\right) y_0 h^{\alpha} y$. The borrower is better off by repaying when the realization y equals or exceeds the threshold

$$\tilde{y} \equiv \frac{D}{\gamma y_0 h^{\alpha}},$$

[40] Assuming that the lender recovers a fraction of the default costs simply adds an additional term in the breaking even condition for the lender.

Notice that the probability of default, $\varrho(D,\cdot)$ is determined by the cummulative probability of the realizations below this threshold, which is given by

$$\begin{aligned}\varrho(D,h;e,w,y_0) &= \Pr[y<\tilde{y}] = e^{-\left(\frac{\tilde{y}}{\Phi(e;w)}\right)^{-\theta}}\\ &= e^{-\left(\frac{D}{\gamma\Phi(e;w)y_0h^{\alpha}}\right)^{-\theta}}.\end{aligned}$$

where $\Phi(e;w) \equiv \left[\sum_{j=1}^{J}\left[C(e,j)\,w_t(j)\right]^{\theta}\right]^{\frac{1}{\theta}}$, cf. Appendix B.1.

Obviously, this formula shows that the probability of default is increasing in the amount of debt D of the worker, and decreasing in human capital investments h, and fixed income factor y_0 and expected average earnings $\Phi(e;w)$. The latter is determined both by the type of the worker and also by wages w.

We keep the assumption that lenders are risk neutral, and their stochastic discount factor is as before, determined solely by the raw time discount factor β and the probability distribution of y. Since for simplicity we are assuming that a lender recovers nothing when the borrower defaults, the expected net present value of setting up a contract with a borrower is given by

$$\begin{aligned}P_G(d,D;h,y_0,e,w) &= -f_G - d + \beta\cdot D\cdot\left[1-\varrho(D,h;e,w,y_0)\right]\\ &= -f_G - d + \beta\cdot D\cdot\left[1-e^{-\left(\frac{D}{\gamma\Phi(e;w)y_0h^{\alpha}}\right)^{-\theta}}\right],\end{aligned}$$

i.e., the costs are in terms of the set-up cost of the generic contract, f_G, and the cost of the resources d lent at $t=0$. The expected revenue is given by the promised repayment D which will be received only with probability $1-\varrho$. Indeed, we can write down that the interest rate implicit in the contract (d,D) is simply $D/d = \beta^{-1}[1-\varrho]^{-1}$, which is increasing in the probability of default.

Given a contract (d,D), the expected utility of the borrower who invests h in human capital, borrows d and "promises" to repay D is

$$\begin{aligned}U_G(d,D;h,y_0,e,w) &= \frac{\left[y_0(1-h)+d\right]^{1-\sigma}}{1-\sigma}\\ &+\beta\left\{\int_0^{\frac{D}{\gamma\Phi(e;w)y_0h^{\alpha}}}\frac{\left[(1-\gamma)\,y_0h^{\alpha}y\right]^{1-\sigma}}{1-\sigma}dF_y(y)+\int_{\frac{D}{\gamma\Phi(e;w)y_0h^{\alpha}}}^{\infty}\frac{\left[y_0h^{\alpha}y-D\right]^{1-\sigma}}{1-\sigma}dF_y(y)\right\}\end{aligned}$$

where $F_y(y) \equiv \left[e^{-\left(\frac{y}{\Phi(e;w)}\right)^{-\theta}}\right]$ is a Frechet distribution.

Monopolist Lenders (pre Intra- and Inter-State Branching Liberalization) Consider the case in which each borrower has access only to one lender, i.e., the local bank, which is immunized from competition by the regulation that no outside bank can establish a branch within the same state. Such a situation is best modelled as a situation in which the lender has a monopoly power. Hence, the contract would be one in which, in expectation, all the surplus is obtained by the lender, while, in the limit, the borrower would be pushed to his autarkic utility.

Let $U^{\text{aut}}(y_0, e, w)$ be the utility attained by a worker, as derived above. Then, the contract that a monopolist lender would provide to a borrower is given by

$$\begin{aligned} & \max_{d,D,h} P_G(d, D; h, y_0, e, w) \\ \text{s.t.} \quad : \quad & U_G(d, D; h, y_0, e, w) \geq U^{\text{aut}}(y_0, e, w). \end{aligned}$$

Competitive Lenders (post Intra- and Inter-State Branching Liberalization) Consider now the case in which each borrower has access to multiple lenders, i.e., not only the local bank is offering credit but also other banks from the same state and even from other states. Such a situation is best modelled as a competitive market. Hence, the contract would be one in which, in expectation, all the surplus is obtained by the borrower, while, in the limit, the lender simply breaks even in expectation. Then, the contract that a lender would provide to a borrower is given by

$$\begin{aligned} & \max_{d,D,h} U_G(d, D; h, y_0, e, w) \\ \text{s.t.:} \quad & P_G(d, D; h, y_0, e, w) \geq 0. \end{aligned}$$

Conjecture Monopolististic and competitive contracts are in different points of the same production possibilities frontier generated by the incomplete contract. While both generate similar first order conditions for consumption, the level of consumptions will be different, which would induce a different level of investment h. These differences in h will be translated into the implications for the impact of the reform, the removal of restrictions on banking branching.

- Rich workers would be paying the higher fixed cost $F > f \geq 0$ of personalized loans. Those workers would not be directly affected by the removal of branching restrictions.

- Poorer workers are the ones who would be facing cheaper contracts with generic features. For this workers, the competition induced by the removal of inter/intra-state branching restrictions would lead to an increase skill accumulation, and hence, to higher observed income levels. https://de.overleaf.com/project/5c98834e5dd9064104c773a8

- This should increase the fraction of workers with access to personalized loans.

5.3 Aggregation

We now let $y_0(e)$ be the first period income, which here we index by e, without risk of confusion. These terms indicate exogenous components of the absolute advantage of workers. Given the assumptions of the model, they do not directly affect the amount of OJT of workers $1-h$ unless they also affect the household financial markets decisions. As made clear below, neither $y_0(e)$ nor the optimal investments $h(e)$ will affect the ex-post occupation choices of workers, a fact that simplifies the aggregation results developed here.

The solution of the household model gives us human capital of type e, $h(e)$. Given $h(e)$ human capital of type e worker in the second period is

$$y_0(e)h(e)^{\alpha}$$

and overall productivity of a worker e in occupation j experiencing shock η_j is

$$y_0(e)h(e)^{\alpha}C(e,j)\eta_j$$

where η_j is Frechet distributed with curatuve parameter θ. For simplicity, for now on, we normalize the scale parameters of all η_j to be 1. Thus the average productivity of type e workers in occupation j is

$$\begin{aligned} \int_{\eta_j} y_0(e)h(e)^{\alpha}C(e,j)\eta_j d\Psi(\eta_j) &= y_0(e)h(e)^{\alpha}C(e,j)\int_{\eta_j} \eta_j d\Psi(\eta_j) \\ &= y_0(e)h(e)^{\alpha}C(e,j)\Gamma\left(1-\frac{1}{\theta}\right) \end{aligned}$$

where $\Gamma(\cdot)$ is the Γ-function.

Then we know from appendix B.1 given the Frechet distribution that the assignment probability of worker e to occupation j is

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

Given an exogenous or predetermined measure $\Pi(e)$ of workers of type e, then, the aggregate human capital in occupation j is

$$H_j = \sum_e \Pi(e) \cdot \pi(e,j) \cdot y_0(e) \cdot h(e)^\alpha \cdot C(e,j) \cdot \Gamma\left(1 - \frac{1}{\theta}\right).$$

5.3.1 Smoothing the Model by Adding Gumbel Shocks:

Denote by $U^g(e)$ expected life-time utility of a type e household under the generic contract, and correspondingly denote by $U^p(e)$ the expected utility under a personalized contract. Then the choice between the two contracts is

$$\mathbf{1}_p(e) = \begin{cases} 1 & \text{if } U^p(e) > U^p(e) \\ 0 & \text{otherwise,} \end{cases}$$

and the corresponding the upper envelope is given by

$$V(e) = \max\{U^g(e), U^p(e)\}$$

We smooth this choice problem by assuming Gumbel (extreme value type I) distributed taste shocks ϵ with scale parameter ς. Thus, the smoothed outer envelope becomes

$$\begin{aligned} \bar{V}(e) &= \max\{U^g(e) + \varsigma\epsilon, U^p(e) + \varsigma\epsilon\} \\ &= \varsigma \ln\left[\sum_{a\in\{g,p\}} \exp\left(\frac{U^a(e)}{\varsigma}\right)\right] \end{aligned}$$

and the choice probabilities for the two alternatives are

$$\begin{aligned} \pi^g(e) &= \frac{\exp\left(\frac{U^g(e)}{\varsigma}\right)}{\sum_{a\in\{g,p\}} \exp\left(\frac{U^a(e)}{\varsigma}\right)} \\ \pi^p(e) &= 1 - \pi^g(e). \end{aligned}$$

With this modification we now denote by $h^a(e)$ the human capital the household chooses under contract alternative $a \in \{g,p\}$ and correspondingly the second period human capital under this contract choice is

$$y_0(e)h^a(e)^\alpha$$

and overall productivity of a worker e in occupation j experiencing shock η_j is under contract a is

$$y_0(e)h^a(e)^\alpha C(e,j)\eta_j$$

and thus the average productivity of type e workers in occupation j under choice a is

$$y_0(e)h^a(e)^\alpha C(e,j)\Gamma\left(1-\frac{1}{\theta}\right).$$

and the aggregate human capital in occupation j taking into account the Gumbel choice probabilities is

$$H_j = \sum_{a\in\{g,p\}}\sum_{e\in E}\Pi(e)\pi^a(e)\cdot\pi\left(e,j\right)\cdot y_0(e)\cdot h^a(e)^\alpha\cdot C(e,j)\cdot\Gamma\left(1-\frac{1}{\theta}\right).$$

6 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

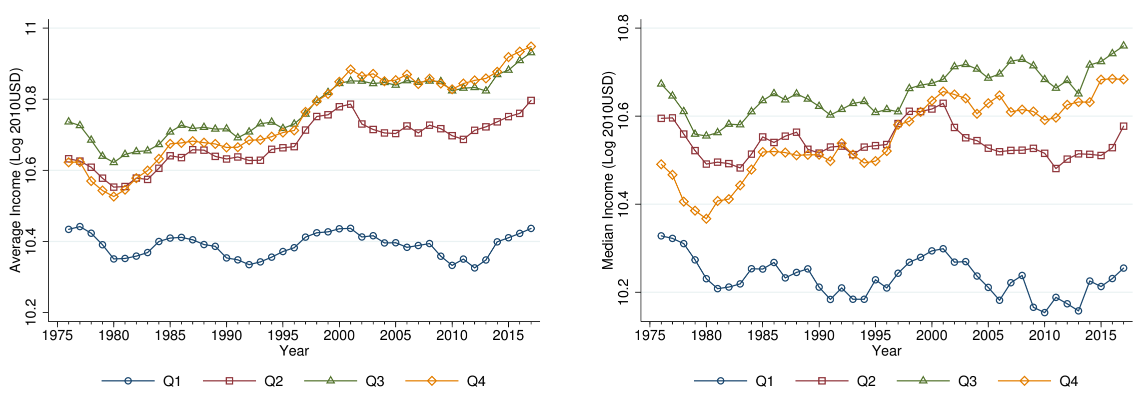
Table provides summary statistics for control variables used in regression (5).

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.

$$y_{ast+5} = \alpha + \gamma p_a + \Sigma_i \beta^i D^i_{st} + +\Sigma_i \delta^i [(p_i - \bar{p}) \times D^i_{st}] + \mathbf{A_s} + \mathbf{B_t} + \mathbf{C_{ind}} + \epsilon_{ist} \quad (19)$$

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:

$$\ln\left(I_{st+5}(y)\right) = \alpha + \Sigma_i \beta^i D^i_{st} + \delta X_{st} + \mathbf{A_s} + \mathbf{B_t} + \epsilon_{st+5}. \quad (20)$$

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 20. 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.

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 $y(e,j) \equiv C(e,j) \cdot w_t(j) \cdot \eta_j$ of a worker of type e in occupation j is given by

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

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

2. We are interested in the distribution of

$$\max_j \left\{C(e,j) \cdot w_t(j) \cdot \eta_j\right\}.$$

   It can be shown that

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

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

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

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

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

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

- Useful moments/expressions for scaled income $y = \max_j \left\{C(e,j) \cdot w_t(j) \cdot \eta_j\right\}$ (scaling $y_0 h^\alpha = 1$) 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 $w_t(j)$ is given by

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

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 Cobb-Douglas Production Functions

As a useful benchmark, we consider the special case in which $\rho_o = 0$. The production functions in both sectors defined by equation (9) are now modified to:

$$F\left[\left\{G_j(K_j^i, H_j^i)\right\}_{j=1}^J\right] = \prod_{j=1}^J \left(G_j(K_j^i, H_j^i)\right)^{\lambda_j^i}, \text{ with } \sum_{j=1}^J \lambda_j^i = 1. \tag{21}$$

Consider first the financial sector firms. The inner loop optimization problem is the same as before and hence will not be repeated here. As a result, the expression for $v_j^F(w_j, c_F)$ is the same as in equation (13).

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

Second, solve for the outer loop optimization problem:

$$\phi_F(w, c_F) = \min_{\{G_j\}_{j=1}^J} \sum_{j=1}^J v_j^F G_j, \text{ s.t. } \prod_{j=1}^J \left(G_j(K_j^i, H_j^i)\right)^{\lambda_j^i}, \text{ with } \sum_{j=1}^J \lambda_j^i = 1.$$

The solution to this problem is given by

$$\phi_F(w, c_F) = (\zeta_F)^{-1} \times \prod_{j=1}^J \left(\frac{v_j^F}{\lambda_j^F}\right)^{\lambda_j^F}.$$

Alternatively, we can derive this expression by taking limits in the original equation (14):

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

Remark 1: The statement in equation (11) should still be valid:

$$p_F = R + \phi_F(w, c_F).$$

In the NFI, equation (15) reads as before:

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

but equation(16) adjusts:

$$p_N = \ (\zeta_N)^{-1} \times \prod_{j=1}^{J} \left(\frac{v_j^N}{\lambda_j^N} \right)^{\lambda_j^N} .$$

Remark 2: With perfect substitutability ($\rho_o = 1$), there can be corners (some tasks might not be used in some sectors).

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

$$M_i \ \equiv \ \zeta_i \prod_{j=1}^{J} \left(G_i^j \right)^{\lambda_j^i} .$$

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),

$$\begin{aligned} w_j &= p_i \cdot M_i \cdot \left[\mu_j \left(H_j^i \right)^{\rho_j} + \left(1 - \mu_j \right) \left(K_j^i \right)^{\rho_j} \right]^{-1} \lambda_j^i \mu_j \left(H_j^i \right)^{\rho_j - 1} \\ p_F &= p_N \cdot M_N \cdot \left[\mu_j \left(H_j^N \right)^{\rho_j} + \left(1 - \mu_j \right) \left(K_j^N \right)^{\rho_j} \right]^{-1} \lambda_j^N \left(1 - \mu_j \right) \left(K_j^N \right)^{\rho_j - 1} \\ c_F &= p_F \cdot M_F \times \left[\mu_j \left(H_j^F \right)^{\rho_j} + \left(1 - \mu_j \right) \left(K_j^F \right)^{\rho_j} \right]^{-1} \lambda_j^F \left(1 - \mu_j \right) \left(K_j^F \right)^{\rho_j - 1} . \end{aligned}$$

In terms of the Market-Clearing Conditions, we can just plug in $\rho_o = 0$ and hence, no change in codes needed.

C Computational Appendix

TBC: need updating!

C.1 Description of Solution Algorithm

C.1.1 Equilibrium

The code loop over the equilibrium objects $\vec{x} = [\{w_j\}_{j=1}^{n_j}, \{\frac{H_j^N}{H_j^F}\}_{j=1}^{n_j}, c_F]'$, where w_j is the wage in occupation j and $\frac{H_j^N}{H_j^F}$ is the ratio of human capital in the non-finance sector relative to the finance sector in occupation j. We implement this as a Gauss-Seidel iteration with a dampening factor.

The core of the model is subroutine `func_sol_model` which takes as input vector x and spits out an update of vector x. The steps in this routine are as follows: For given $\vec{x}$

1. Given c_F compute p_F, cf. equations (11), and update c_F, cf. equation (2).

   Remark 2 *Accordingly, solving the fixed point () for c_F is done jointly in the outer loop. As an additional option, we may alternatively solve this fixed point problem within each outer loop iteration by setting* `opt.inloop=1`.

2. Compute p_N from (16)

3. Given objects $\{w_j\}_{j=1}^{n_j}, R$ we can now solve the household model in function `func_solhh`. This function returns the supply of human capital H_j in all occupations $j = 1, \ldots, n_j$.

4. For given outer loop variable $\{\frac{H_j^N}{H_j^F}\}_{j=1}^{n_j}$ split human capital across sectors N, F within each occupation j, i.e., compute

$$H_j^F = \frac{1}{1 + \frac{H_j^N}{H_j^F}} H_j, \qquad H_j^N = H_j - H_j^F.$$

5. Update the outer loop variable $\{\frac{H_j^N}{H_j^F}\}_{j=1}^{n_j}$ using (18).

6. From the FOCs (17a) update the outer loop variable wages $\{w_j\}_{j=1}^{n_j}$. This can be done by calling the FOCs in either sector but note that wages have to coincide.

7. Collect elements to update $\vec{x}$.

C.1.2 Household Model

[TBC: Add code here]