Financial liberalization and income inequality: channels and cross-country evidence[1]

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Abstract

This article investigates the role of financial liberalization as a determinant of income inequality, both theoretically and empirically. The authors focus on two financial liberalization policies: lowering the reserve requirement of the banking sector and decreasing international capital controls. A tractable economic model features heterogeneous agents with different investment abilities. Only high-ability agents borrow and invest; others save. Profitability is fully reflected by the levels of financial liberalization and financial development. Savers and investors generate different levels of income, implying income inequality. The proposed model predicts that financial liberalization, in the form of reserve requirements, can lower income inequality, if the overall degree of financial liberalization is not too high. Moreover, financial development helps spread the proceeds of financial liberalization equally across the income distribution. However, in financially liberalized economies, further liberalizations will have a negative effect on income distribution. A cross-country empirical analysis supports these theoretical findings.

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1. Introduction

Financial liberalization has been a popular policy choice over the past four decades, though its impact on income inequality remains controversial. Developments related to the global financial crisis raised renewed concerns about the differential impacts of financial liberalization across income levels, leading to calls for more empirical and theoretical research into the financial liberalization–inequality nexus (e.g., Atkinson and Morelli, 2011).

In neoclassical economics literature (McKinnon, 1973; Shaw, 1973), removing reserve requirements drives savings and investment growth. This standard model assumes that assets take the form of deposits or cash balances. Rising interest rates due to the removal of reserve requirements gives savers an incentive to save more and offer resources for intermediation through banks. Credit availability increases, as does project quality, due to banks' better monitoring and screening capabilities. Ultimately, higher savings and enhanced resource allocations help the economy embark greater growth. The standard approach also assumes that the proceeds of financial liberalization are equally shared, because each representative agent optimally spreads her or his economic resources throughout the entire life span. If the total pie grows through financial liberalization, each representative agent is economically better off.

The standard view does not quite capture the whole truth. As we show in Table A.1 in Appendix A, estimates of income inequality and an index measure of financial liberalization for 1975 and 2000 reveal, across a wide range of countries, that substantial increases in the levels of financial liberalization have not led to a clear evolution in income inequality (as measured by the Gini coefficient; Galbraith and Kum 2005). In some countries, income inequality has increased considerably, in others it has remained relatively stable, and there seems to be little discernible evidence of a systematic pattern. This challenge to the conventional view that financial liberalization has a direct association with income inequality requires a more nuanced view of the topic.

Accordingly, by developing a theoretical model and presenting empirical estimates, we study the impact of financial liberalization on income inequality. We focus on two elements of financial liberalization policies, namely, the liberalization of reserve requirements and the removal of restrictions on foreign capital borrowing by commercial banks. In so doing, we can establish direct channels by which the banking sector affects income inequality and show that reserve requirement liberalization can either tighten or widen income distributions, depending on the interaction with capital account liberalization and financial development.

Regarding the impact of the banking sector, we consider agents that are heterogeneous in terms of their investment abilities. Only high ability agents find it profitable to borrow and invest. A profitability threshold separates agents into savers or investors, who are mediated by banks; the separation produces income inequality in our model.

Next, we note that investment profitability rises in the aftermath of financial liberalization, which benefits investors. However, if investment demand increases as the financial market develops, profitability gets undermined by rising interest rates. This effect may be weakened by capital account liberalization, which helps investors borrow at a lower foreign interest rate. Furthermore, distortions in the price system of the banking sector arise when a high degree of financial repression creates a wedge between the interest rates for deposits versus loans. In this case, financial liberalization induces higher interest rates that benefit savers. Thus, financial liberalization via lowering reserve requirements can lower income inequality, as long as the overall degree of financial liberalization is not too high. Moreover, financial development helps spread the proceeds of financial liberalization more equally.

We use dynamic generalized method of moments (GMM) panel estimation techniques to test the main theoretical predictions. For this empirical analysis, we use a new income inequality data set obtained from the University of Texas Inequality Project (UTIP), which appear more consistent and accurate than other available data. For capital account openness, we rely on a database of financial reforms (Abiad et al., 2010), and we compute a measure of reserve requirements with data from the International Monetary Fund's (IMF) International Financial Statistics. Our empirical analyses support the main predictions of our theoretical model.

After we review existing literature on financial development, financial liberalization, and income inequality in the next section, we present a simple model to illustrate the main mechanisms by which financial liberalization affects income inequality. Section 4 contains the econometric methodology, and Section 5 presents the data. Finally, we provide the results of our analysis in Section 6 and conclude in Section 7.

2. Review of Prior Arguments

Financial liberalization should drive economic growth, and as workers' marginal productivity increases through this growth, so do their wages, across the board. But more sophisticated models of financial liberalization show that it can create new sources of income inequality or sustain existing inequality trends. Accordingly, in this section we briefly define financial liberalization as distinct from financial development. We review both standard views of the link

between financial liberalization and income inequality, as well as extensions of this perspective, which lead into the arguments that ground our approach.

2.1. Concepts

Financial liberalization reflects an intervention by the government (McKinnon, 1973; Shaw, 1973) and thus is an exogenous policy shift. It traditionally comprises two aspects: the reduction of reserve requirements and the abolishment of ceilings on lending rates (Agénor and Montiel, 2008). However, five other types of policy reforms can be involved as well: the removal of entry barriers for new domestic banks, non-financial institutions or foreign financial institutions; privatization of financial institutions; lifted restrictions on capital accounts; supervision of financial institutions; and policies designed to encourage the development of security markets (Abiad et al., 2010; Agénor and Montiel, 2008). We focus on the liberalization of reserve requirements and capital accounts.

Financial liberalization thus has different implications for economic development and income inequality than financial development. The former represents policy shifts; the latter refers to a process that evolves endogenously. Thus financial development research investigates the emergence of financial structures in response to market frictions, such as information and transaction costs (Levine, 2005) or a revised legal or institutional framework (La Porta et al., 1997, 1998). Moreover, financial liberalization (Chinn and Ito, 2008) can induce financial development. However, this link is not necessarily positive, in that financial liberalization functions through various channels, some of which could hinder the process of financial development (Arestis and Glickman, 2002). Although our theoretical model features both financial liberalization and financial development, we do not assume that they are explicitly related. Instead, as we will show below, we analyze the impact of financial liberalization, given a certain level of financial development, to determine if financial development magnifies or counteracts the impact of financial liberalization.

2.2. Traditional View

Financial repression literature does not deal explicitly with inequality but instead seeks to understand how eliminating different forms of financial repression would affect savings, investment, and growth, which then affect economic conditions.[4] Other research instead indicates financial liberalization reduces income inequality through financial development.

[4] Financial repression literature also distinguishes two approaches, based on either non-optimizing models or optimizing frameworks (Gupta and Lensink, 1996). The former builds on the model suggested by McKinnon (1973), as summarized by Fry (1988), Gibson and Tsakalatos (1994), and Gupta and Lensink (1996). The latter is founded in basic endogenous growth models (Lucas, 1988; Romer, 1986), as extended by Bencivenga and Smith (1991),

According to advocates of financial liberalization (McKinnon, 1973; Shaw, 1973), the low levels of financial intermediation in developing countries are rooted in financially repressive policies, by which governments extract rents from the financial sector. A competitive financial system, with a laissez-faire government, instead could give rise to higher interest rates, increasing savings and funds for investment, which should allow the economy to grow.

Furthermore, financial liberalization might increase economic growth by lowering the amount of savings lost through the banking sector due to financial repression. In a typical banking scenario, some fraction of total savings goes to banks, as payment for their services. Banks also must hold some portion of their liabilities as reserves. In financially repressed economies, where governments extract resources, these reserves tend to be substantial. Financial liberalization, by reducing reserve requirements, would raise the proportion of savings transformed into investment. A liberalized financial sector also might be better able to identify the most productive investment projects (for a review, see Levine, 1997).

Alternatively, financial liberalization might improve income distribution directly through financial development. Financial development stimulates funding for poor individuals with good business projects, who previously faced binding credit constraints because they lacked collateral or credit history (Aghion and Bolton 1997; Aghion et al. 1999; Galor and Zeira 1993).

2.3. Criticisms and Extensions of the Traditional View

Vast literature challenges the assumption that financial liberalization triggers financial development. Even if financial liberalization were to induce a process of financial development and economic growth, we cannot necessarily assume that it will tighten the distribution of income.

First, a traditional view neglects the possibility of informal financial markets, with the implicit assumption that they are inefficient and characterized by monopolistic money lenders, such that they do not support or finance of investments. However, new structuralist theory argues that the informal financial sector is often very competitive and critical to the process of financial intermediation (Taylor, 1983; Van Wijnbergen, 1982). Financial liberalization policies such as interest rate deregulations or changes of reserve requirements thus might lead only to a reallocation of funds from the informal sector, though the total supply of funds available for investment does not change. Bencivenga and Smith (1992) affirm these predictions but also argue that financial liberalization still could be optimal, through its positive effect on risk

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Bernanke and Gertler (1990), Greenwood and Jovanovic (1990), Saint-Paul (1992), and Sussman (1991). Surveys of this approach are available from Pagano (1993), Sciantarelli et al. (1994), and Gupta and Lensink (1996).

sharing. In addition, from a financial restraint perspective (Hellmann et al., 1996), the financial sector exhibits pervasive market failures, because financial institutions confront asymmetric information, which gives rise to moral hazard and adverse selection problems. In such a setting, financial liberalization does not encourage financial deepening; instead, it might aggravate asymmetric information problems, such as when banks refrain from relationship lending, to compete with new and cheaper funding possibilities. A reduction of relationship lending also destroys information capital and creates new information asymmetries (Boot, 2000). In this sense, declining interest rate margins could encourage banks to economize on their screening and monitoring efforts. Similarly, they might accept higher risk exposure levels to increase profits or agree to opt for gambling strategies in their loan allocation decisions, putting less emphasis on risk and more on profit (Boot, 2000; Hellmann et al., 2000; Stulz, 1999). Financial liberalization can trigger crises if excessive risk taking results from increased competition (Arestis, 2005; Demirguc-Kunt and Detragiache, 1998). If asymmetric information problems persist, restrictions on competition and deposit rate controls would be needed to enhance banks' franchise value. Financial restraint literature thus argues that governments, rather than following a laissez-faire policy, should create rent opportunities that induce agents to take socially beneficially actions.

Second, even if financial liberalization induces financial deepening, the impact on income distributions is not unequivocal. Demirguc-Kunt and Levine (2009) survey the mechanisms by which financial development can affect income inequality and note that the distributional effects of financial development depend on whether it operates on extensive or intensive margins. At the extensive margin, financial development increases the direct use of financial services by those who used to be excluded, such that it eventually reduces inequality. But financial development at the intensive margin primarily benefits households that already use financial services, leading to a concentration of funds held by rich individuals and increasing inequality, especially in the short run. Other studies also indicate a nonmonotonic impact of financial development on income distribution. For example, financial development might lead to lower inequality only past a threshold level of economic development (Greenwood and Jovanovic, 1990) or improves income distribution in closed economies but worsen it in open economies (Kunieda et al., 2013).

Beyond these two strands of criticism, broader literature examines the role of financial liberalization through channels other than financial development, in an effort to clarify the role of financial liberalization for income inequality through changing institutions. For example, financial liberalization, as a reflection of globalization policies, affects income distribution by changing the capital and labor shares in the economy. Globalization policies eventually increase

the capital share at the expense of the labor share, due to a weakening effect on labor institutions (Checchi and Garcia-Penalosa, 2010; Cornea, 2005). A greater capital share then is associated with increased inequality.

2.4. Focal Arguments

Because existing data cannot establish a clear relationship between income inequality and a coarse measure of financial liberalization, we focus on two financial liberalization policies that are arguably the most relevant forms: reserve requirements and the capital account. In 2010, according to IMF data, more than 90 percent of central banks required their commercial banks to maintain a certain proportion of assets as reserve balances (Gray, 2011).[5] Despite the prevalence of this common practice, the design of reserve requirement practices varies considerably over time and across countries, and the requirements themselves serve multiple purposes. Gray (2011) stresses the importance of reserve requirements for supporting prudential management to guarantee deposits, monetary control, and liquidity management. In developing countries, they are often imposed by weak governments that lack the power to raise sufficient tax revenues. Reserves imposed on banks thus can secure demand for low-interest paying government funds (Agénor and Montiel, 2008). However, reserve requirements also are tax-like in nature, and opponents argue that they reduce the level of financial intermediation (Gray, 2011).

Reserve requirement policies are often complemented by capital controls that seek to preclude investors from borrowing internationally, which would undermine governments' ability to exploit domestic funds (Agénor and Montiel, 2008). Although reserve requirements themselves can have similar effects, if banks increase lending rates without raising deposit rates, they might deter further capital inflows (Gray, 2011). In the wake of the global economic crisis, renewed interest also has focused on reserve requirements as stabilizing devices (Glocker and Towbin, 2012; Terrier et al., 2011). That is, reserve requirements might help contain financial cycles by limiting the amount of available credit (Glocker and Towbin 2012).

We also assess the link between reserve requirements and inequality and predict that reserve requirement liberalization affects income inequality if economic resources get reallocated in the wake of interest rate adjustments. Reserve requirement liberalization should reduce existing price distortions in the banking sector, such that savers take advantage of competitive, generally higher interest rates. Furthermore, investment projects become accessible to previously excluded borrowers (Agénor and Montiel, 2008). In contrast, in financially repressed economies, most

[5] According to the IMF 2010 Central Bank survey, 9 of 121 central banks had no reserve requirements: Australia, Canada, Mexico, New Zealand, Norway, Sweden, Timor-Leste, and the United Kingdom.

savings are reserved for the government, to finance its spending. With capital account liberalization, borrowers can use foreign funds, which makes them economically better off, assuming savers cannot send their savings abroad.

2.5. Empirical Studies

Unlike the extensive theoretical investigations of financial liberalization and income distribution, empirical studies are somewhat scarce. Cornea (2005) summarizes the impact of different forms of (financial) reform policies on income distribution by distinguishing external from internal liberalization policies. He shows that empirical studies provide evidence of a positive relationship between reforms and income inequality in many developing countries, potentially due to the lack of strong institutions, existing rigidities, or market imperfections. Yet beyond this pessimistic result, other studies indicate negative relationships between financial reforms and income inequality or financial development and income inequality. Beck et al. (2007a) conclude, on the basis of a rigorous empirical analysis of financial development and income distribution, that financial development tightens income distribution. Kai and Hamoni (2009) focus on sub-Saharan Africa and find that financial development improves income distribution, though their results also suggest that external financial liberalization is associated with more income inequality. Using different indicators of financial development, Asongu (2011) estimates its effect on income distributions in African economies and indicates that financial development improves income distribution through public and private investment channels. However, it also deteriorates income distribution through increased foreign direct investments. Azzimonti et al. (2012) provide theoretical and empirical evidence that inequality increases in developed economies if international financial markets become more integrated, because governments choose higher levels of public debt. Finally, according to Kunieda et al. (2013), the effect of financial development depends crucially on the degree of economic openness: It improves income distribution in closed economies but worsens it in open economies.

As this review demonstrates, existing studies address only external financial liberalization; to the best of our knowledge, no study has examined the link between domestic financial liberalization and income inequality. Although a few empirical studies investigate financial development and income inequality, they do not explicate how financial liberalization policies affect the results. Therefore, we deal explicitly with the impact of external and internal dimensions of financial liberalization, that is, with lowered reserve requirements and decreasing

international capital controls, respectively. Moreover, we compare these effects against the impact of reduced credit constraints, which reflects financial development.

3. Model of Income Inequality and Financial Liberalization

We propose a simple, two-period model to capture the impact of financial liberalization on income inequality. We extend Kunieda et al.'s (2013) model by adding a commercial banking sector, which enables to consider two important financial liberalization policies: a decrease in reserve requirements and a lowering of international capital controls. Furthermore, because banks mediate between savers and investors, our model helps reveal how financial liberalization alters the economic conditions of these two types of agents.

3.1. Banking Sector

To explain our model, we start by presenting the aggregate commercial banking sector. The liabilities of the banking sector consist of domestic deposits (D_t) and foreign deposits (F_t). Assets include loans to investors (L_t) and required reserves (R_t). Therefore, the balance sheet condition is

$$L_t + R_t = D_t + F_t \,. \qquad (1)$$

We incorporate the two types of financial policies. First, we assume that the public regulator sets required reserves, as is true in many countries. Because required reserves balances are not remunerated, they constitute an implicit tax on the domestic banking system (Agénor and Montiel, 2008). Some countries set reserve requirements on both domestic and foreign deposits, some only on domestic deposits. In our model, required reserves are a fixed fraction, 1 – h, of total domestic deposits,[6] such that

$$R_t = (1-h)D_t, \text{ with } 0<h<1. \qquad (2)$$

An increase in h implies decreased reserve requirements, that is, financial liberalization.

Second, we assume that the public regulator controls foreign capital flows, such that domestic residents cannot borrow directly from abroad. Because of their lack of knowledge about domestic projects, foreign lenders do not lend directly to domestic agents but instead make deposits at the domestic bank. All foreign capital flows thus take place through the domestic banking sector. In line with Von Hagen and Zhang (2008), we allow the public regulator to set the proportion of domestic loans that can be financed by foreign funds, such that

[6] Assuming that foreign deposits are subject to reserve requirements does not change the basic insights. Therefore, for computational ease, we limit reserve requirements to domestic deposits.

$F_t = aL_t$, with $0 \leq a < 1$, (3)

where the parameter *a* denotes the intensity of capital controls. An increase in *a* corresponds to financial liberalization, implying a reduction of the implicit taxation on banks. If $a=0$ the economy is closed, and all loans will be financed with domestic funds.

The interest rate on foreign funds ($r_{f,t+1}$) is exogenously given and always below the interest rate on domestic funds ($r_{d,t+1}$), such that domestic banks prefer to finance loans with foreign funds. However, because of capital controls, domestic banks may only borrow a fraction of their domestic lending from abroad.

Aggregate loans (L_t) and aggregate demand for domestic funds (D_t) equal the sum of individual agents' domestic borrowing and demand for funds ($l_{i,t}$ and $d_{i,t}$, respectively):

$$L_t = \int l_{i,t}\, di, \quad (4)$$

$$D_t = \int d_{i,t} di. \quad (5)$$

The banking sector generates zero profits. Because required reserves are not being remunerated,

$$r_{l,t+1}L_t = r_{d,t+1}D_t + r_{f,t+1}F_t, \quad (6)$$

where $r_{l,t+1}$ denotes average lending costs. Using Equations 1–3, we thus can derive

$$r_{l,t+1} = \frac{(1-a)}{h} r_{d,t+1} + a r_{f,t+1}. \quad (7)$$

As Equation 7 shows, changes in the parameters *a* and *h* for a given interest rate on foreign funds alter the wedge between the domestic deposit rate and the domestic costs of borrowing. Both lowering reserve requirements (increase in *h*) and international capital controls (increase in *a*) minimize the wedge, assuming the foreign fund rate is below or equal to the domestic fund rate. Equation 7 also implies that domestic lending costs equal the foreign interest rate in the case of full liberalization of foreign capital flows (*a* equals 1). We are not interested in the impact of changes in the foreign interest rate as such, and because the foreign rate is exogenously set, we assume for convenience that the foreign interest rate equals 0. Equation 7 thus simplifies to[7]

[7] The market clearing condition changes in the case of full liberalization of international capital controls, represented by a = 1 in our model. If a is strictly below 1 ($0 < a < 1$), the interest rate on domestic deposits exceeds that on foreign deposits ($r_{d,t+1} > r_{f,t+1}$). Thus all demand for deposits by domestic agents is held in the form of domestic deposits (*D)*, and the domestic deposit rate will clear the capital market. The total demand for foreign currency–denominated deposits is regulated by the government and set to aL_t. When $a = 1$, the interest rate on domestic deposits ($r_{d,t+1}$) is determined by the exogenously given interest rate on foreign deposits ($r_{f,t+1}$). Total demand for domestic deposits becomes 0. The corresponding demand for deposits by domestic agents can be met by foreign currency–denominated deposits (F_t). The capital market clears by adjustments in demand for foreign-denominated

$$r_{l,t+1} = \frac{(1-a)}{h} r_{d,t+1}. \quad (8)$$

The domestic fund rate and lending costs are jointly determined by Equation 8 and the capital market equilibrium condition, which we describe subsequently.

For reasons that we clarify subsequently, we formulate the following relationship between the deposit and the lending rate:

$$r_{d,t+1} = b r_{l,t+1} \text{ with } b \equiv \frac{h}{1-a}. \quad (9)$$

That is, the rate on funds and lending costs are related through the liberalization parameter *b*.

3.2. Private Agents

The economy is inhabited by a continuum of private agents. At the beginning of a period, all agents are endowed with wealth (w_t), and they differ in their ability to produce investment projects. Agents' ability is captured by the parameter , which is uniformly distributed over *[0,1]*. Each agent knows her or his own ability. An agent who invests k_t will be able to sell ϕk_t investments goods to the final production sector at price q_t. Thus q_t is the price of capital, equal to the marginal product of capital if the production sector features perfect competition. In turn, ϕ can be interpreted as the marginal product of investment of the private agent, that is, the private agent's investment ability. Each agent faces the following budget constraint:

$$w_t + l_t = d_t + k_t. \quad (10)$$

Investments are always positive:

$$k_t \geq 0. \quad (11)$$

In addition, information asymmetries between the bank and its clients give rise to credit constraints, such that the amount of lending (l_t) is linearly related to initial wealth:

$$0 \leq l_t \leq \nu w_t, \text{ with } \nu \geq 0. \quad (12)$$

Following Kunieda et al. (2013), we assume that agents aim to maximize consumption in the second period by choosing the optimal level of borrowing or demand for deposits in the first period. Consumption in this simple model equals net income obtained by selling investment goods to the production sector or depositing money at the domestic bank. Formally, each agent maximizes the following function:

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deposits by foreigners, such that $L_t = F_t$ (note that $R_t = 0$ and $D_t = 0$ if there are no controls on international capital). The model insights do not change with the assumption that $r_{f,t+1} = 0$; it only facilitates the calculations.

$$max_{d,l}\left(\phi q_{t+1}k_t + r_{d,t+1}d_t - r_{l,t+1}l_t\right). \quad (13)$$

For our continued analysis, we make two assumptions regarding parameter b,[8] to be able to consider two types of economies: a financially repressed economy where $b < 1$ and a financially liberalized economy with $b > 1$. A agents' choices are not the same in the two economies.

3.3. Case 1: Financially Repressed Economy, b < 1

Equation 13 can be maximized, subject to Equations 10–12. Thus we obtain two threshold values, namely, $\phi_{T_{1,t}} \equiv \frac{r_{l,t+1}}{q_{t+1}}$ and $\phi_{T_{2,t}} \equiv \frac{r_{d,t+1}}{q_{t+1}}$, which are functions of lending costs and the domestic funds rates, respectively, over the return on investment. The thresholds determine the ranges for three different types of agents. The relationship between the two thresholds is $\phi_{T_{2,t}} = b$. Therefore, allows us to rewrite the second threshold as $b\phi_{T_{1,t}} \equiv \frac{r_{d,t+1}}{q_{t+1}}$. We denote the two thresholds succinctly, using $\phi_t \equiv \frac{r_{l,t+1}}{q_{t+1}}$ and $b\phi_t \equiv \frac{r_{d,t+1}}{q_{t+1}}$.

Because the domestic funds rate is lower than the domestic costs of borrowing if $b < 1$, an agent will not borrow to increase demand for domestic funds. The demand for funds (d_t) cannot exceed initial wealth:

$$0 \leq d_t \leq w_t. \quad (14)$$

We also address three types of agents. First, if an agent's investment ability exceeds the ratio of the cost of borrowing to the return on investment, $\phi > \phi_t$, the agent chooses to maximize the amount borrowed. With this high ability, the agent can afford higher borrowing costs. The loan size is then set at the maximum level, demand for domestic deposits equals zero, and investment equals wage income plus total borrowing, because agents do not consume in the first period:

$$l_t = vw_t,$$
$$d_t = 0,$$
$$k_t = (1+v)w_t. \quad (15)$$

Second, if an agent's investment ability is below the ratio of the return on funds to the return on investment, $\phi < b\phi_t$, she or he saves all wealth in the form of domestic deposits:

$$l_t = 0,$$
$$d_t = w_t, \quad (16)$$

[8] If $b = 1$, financial liberalization has no impact through the banking sector; this case is of no further interest to us.

$k_t = 0.$

Third, if an agent's investment ability lies between the two thresholds, $b\phi_t < \phi < \phi_{t,}$ she or he will use wealth for investing but not demand any deposits, because the return on investment is higher than the return on savings. Moreover, the agent will not borrow, because borrowing costs are higher than the return on investment:

$$l_t = 0,$$
$$d_t = 0,$$
$$k_t = w_t. \qquad (17)$$

This last case results from the wedge between the deposit and the lending rate, as a result of reserve requirements and capital controls.

3.3.1. Aggregate financial market condition. Given the expressions for the demand for domestic funds, borrowings, reserves, and foreign funds, we derive aggregate financial market conditions. The total aggregate demand for funds is given by

$$L_t = \int_{\phi_t}^{1} \nu w_t d\phi = \nu w_t(1 - \phi_t) \qquad (18)$$

The total aggregate supply of supply of funds equals

$$D_t = \int_0^{b\phi_t} w_t d\phi = w_t b\phi_t. \qquad (19)$$

Taking required reserves and foreign funds into account, equilibrium in the aggregate capital market equals

$$\nu w_t(1 - \phi_t) + (1 - \hbar) w_t b\phi_t = b w_t \phi_t + a\nu w_t(1 - \phi_t). \qquad (20)$$

Each agent takes the interest rate as given, but at the aggregate level, the interest rate ensures that the capital market clears. Rearranging Equation 20 and substituting *b* for *h/(*1 – *a)* yields an expression for the threshold value as a function of the fundamental parameters of the model:

$$\phi_t = \frac{\nu(1-a)^2}{\nu(1-a)^2 + \hbar^2}. \qquad (21)$$

3.3.2. Income distribution. We derive our measure of inequality, expressed in terms of second period consumption (consumption equals income in period 2). Thus, we first compute the amounts consumed by each type of agent, then calculate the Gini coefficient. High ability agents

(type 1) with $\phi > \phi_t$ w, where $\left(\phi_t \equiv \frac{r_{l,t+1}}{q_{t+1}}\right)$, invest their entire wealth and borrow money. From Equation 15, we determine that their time *t* consumption is

$$c_t = \phi(1+\nu)w_{t-1}q_t - r_{l,t}\nu w_{t-1} = (\phi(1+\nu) - \nu\phi_{t-1})q_t w_{t-1}. \quad (22)$$

Low ability agents with $\phi < b\phi_t$ (type 2) store all their wealth at the bank in the first period. Therefore, using Equation 16, their consumption amounts to

$$c_t = br_{l,t}d_{t-1} = b\phi_{t-1}q_t w_{t-1}. \quad (23)$$

Finally, agents with intermediate investment ability, $b\phi_t < \phi < \phi_t$ (type 3), invest their income but do not save or borrow money. From Equation 17, we write

$$c_t = \phi q_t w_{t-1}. \quad (24)$$

Average consumption then is given by

$$\bar{c_t} = \int_0^{b\phi_{t-1}} q_t b\phi_{t-1}w_{t-1}d\phi + \int_{b\phi_{t-1}}^{\phi_{t-1}} \phi q_t w_{t-1} d\,\phi$$
$$+ \int_{\phi_{t-1}}^{1} (\phi(1+\nu) - \nu\phi_{t-1})q_t w_{t-1} d\,\phi. \quad (25)$$

After solving the integrals and collecting terms, we derive

$$\frac{\bar{c_t}}{q_t w_{t-1}} = \frac{1+\nu-2\nu\phi_{t-1}+\phi_{t-1}(\nu+b^2)}{2}. \quad (26)$$

Before computing the Gini coefficient, we need to derive the Lorenz curve (LC). In the Lorenz diagram, the Gini coefficient is the ratio of the area between the line of perfect equality (45-degree line) and the area under the LC. The closer the LC is to the 45-degree line, the more equal the income distribution. In other words, the LC plots the cumulative percent of total income against the cumulative percentage of people, ordered by income, so it indicates the y-percent of total income owned by the bottom x-percent of households. Formally,

$$LC(Y) = \frac{\int_0^Y x dF(x)}{\nu} = \frac{\int_0^Y x f(x) dx}{\nu},$$

where F(Y) is the cumulative distribution function of ordered individuals, and ν is average income. For our model, it boils down to the following expression:

$$LC(x) = \frac{\int_0^x c_t d\phi}{\bar{c_t}}. \quad (27)$$

Next, using Equation 25 for average consumption, we derive expressions for the LC of all three types of agents and compute the Gini coefficient, formally,

$$\text{Gini} \equiv 1 - 2\int_0^1 LC(x)dx.$$

It follows that the Gini coefficient is equal to (the detailed derivation is available on request):

$$\text{Gini} \equiv 1 - 2\int_0^1 LC(x)dx = \frac{2\phi_{t-1}^3(\nu+b^3)-3\phi_{t-1}^2(\nu+b^2)+1+\nu}{3(\phi_{t-1}^2(\nu+b^2)-2\nu\phi_{t-1}+1+\nu)}$$

$$= \frac{2\left(\frac{\nu(1-a)^2}{\nu(1-a)^2+h^2}\right)^3\left(\nu+\left(\frac{h}{1-a}\right)^3\right)-3\left(\frac{\nu(1-a)^2}{\nu(1-a)^2+h^2}\right)^2\left(\nu+\left(\frac{h}{1-a}\right)^2\right)+1+\nu}{3\left(\left(\frac{\nu(1-a)^2}{\nu(1-a)^2+h^2}\right)^2\left(\nu+\left(\frac{h}{1-a}\right)^2\right)-2\nu\left(\frac{\nu(1-a)^2}{\nu(1-a)^2+h^2}\right)+1+\nu\right)}. \quad (28)$$

In the first expression, the Gini coefficient is entirely determined by the threshold value that divides the agents into investors and workers ϕ, the financial development parameter ν, and the financial liberalization parameter b. If we substitute ϕ with Equation 21 and use $b \equiv \frac{h}{1-a}$, we can write the Gini coefficient in terms of the financial liberalization parameters *a* and *h* and the financial development parameter ν. We subsequently examine the comparative statics with respect to parameters *a* and *h*.

3.4. Case 2: Financially Liberalized Economy, b > 1

If $b > 1$, the domestic funds rate exceeds the costs of lending. It is straightforward that the maximization problem in Equation 13 now leads to two types of agents. First, all agents whose investment ability is above the threshold $b\phi_t$ ($\phi > b\phi_t$) invest their entire wealth and borrow as much as possible. The demand for deposits equals zero. That is,

$$l_t = \nu w_t,$$
$$d_t = 0,$$
$$k_t = (1+\upsilon)w_t. \quad (29)$$

Second, if investment ability is below the threshold $b\phi_t$ ($\phi < b\phi_t \equiv \frac{r_{d,t+1}}{q_{t+1}}$), agents do not invest and instead store all their wealth in demand deposits. Because the deposit rate exceeds the costs of lending, these agents borrow as much as possible to hold borrowings in the form of deposits. Formally, the optimal decisions of low-ability agents can be summarized as

$$l_t = \nu w_t,$$
$$d_t = (1+\nu)w_t,$$
$$k_t = 0. \quad (30)$$

3.4.1. Aggregate financial market condition. Recall that the aggregate market clearing condition is $R_t + L_t = D_t + F_t$. The expressions for aggregate loans and deposits thus are

$$L_t = \int_0^1 \nu w_t d\phi = \nu w_t,$$
$$D_t = \int_0^{b\phi_t} (1+\nu) w_t d\phi = (1+\nu) w_t b\phi_t. \quad (31)$$

Taking reserves and foreign currency denominated deposits into account, it follows directly that capital market equilibrium implies:

$$\phi_t = \frac{\nu(1-a)}{(1+\nu)b\hbar} = \frac{\nu(1-a)^2}{(1+\nu)\hbar^2}. \quad (32)$$

3.4.2. Income distribution. On the basis of Equation 29, the consumption of agents with a high investment ability (type 1, $\phi > b\phi_t$) amounts to

$$c_t = \phi(1+\nu) w_{t-1} q_t - r_{l,t} \nu w_{t-1},$$
$$= ((1+\nu)\phi - \nu\phi_{t-1}) q_t w_{t-1}. \quad (33)$$

With Equation 30, we determine that the consumption of agents with low investment ability (type 2, $\phi < b\phi_t$) equals

$$c_t = r_{d,t} d_{t-1} - r_{l,t} l_{t-1},$$
$$= b\phi_{t-1}(1+\nu) w_{t-1} q_t - \nu\phi_{t-1} q_t w_{t-1},$$
$$= \phi_{t-1} w_{t-1} q_t \big((1+\nu)b - \nu\big). \quad (34)$$

In this case, average consumption is given by

$$\bar{c_t} = \int_0^{b\phi_{t-1}} \phi_{t-1} w_{t-1} q_t \big((1+\nu)b - \nu\big) d\phi$$
$$+ \int_{b\phi_{t-1}}^1 ((1+\nu)\phi - \nu\phi_{t-1}) q_t w_{t-1} d\phi. \quad (35)$$

It can be rewritten as

$$\frac{\bar{c_t}}{q_t w_{t-1}} = \frac{(1+\nu)\left(1 + b^2\phi_{t-1}^2 - 2\frac{\nu}{(1+\nu)}\phi_{t-1}\right)}{2}. \quad (36)$$

Also recall that for our model, the LC boils down to $LC(x) = \frac{\int_0^x c_t d\phi}{\bar{c_t}}$. Using Equation 36 for average consumption, we can derive expressions for the LC of the two types of agents, then compute the Gini coefficient. It can be shown that the Gini coefficient becomes

$$\text{Gini} = \frac{2b^3\phi_{t-1}^3 - 3b^2\phi_{t-1}^2 + 1}{3\left(b^2\phi_{t-1}^2 - 2\frac{\nu}{(1+\nu)}\phi_{t-1} + 1\right)} = \frac{2\left(\frac{h}{1-a}\right)^3\left(\frac{\nu(1-a)^2}{(1+\nu)h^2}\right)^3 - 3\left(\frac{h}{1-a}\right)^2\left(\frac{\nu(1-a)^2}{(1+\nu)h^2}\right)^2 + 1}{3\left(\left(\frac{h}{1-a}\right)^2\left(\frac{\nu(1-a)^2}{(1+\nu)h^2}\right)^2 - 2\frac{\nu}{(1+\nu)}\left(\frac{\nu(1-a)^2}{(1+\nu)h^2}\right) + 1\right)}. \quad (37)$$

The Gini coefficient is entirely determined by financial liberalization parameters, a and h, as well as the financial development parameter ν.

3.5. How the Parameters Affect the Gini Coefficient

Changes in financial liberalization, in terms of both reserve requirements and the capital account, affect the Gini coefficient across both cases.

3.5.1. Case 1, b < 1. According to Equation 28, the Gini coefficient is

$$\text{Gini} = \frac{2\phi_{t-1}^3(\nu + b^3) - 3\phi_{t-1}^2(\nu + b^2) + 1 + \nu}{3(\phi_{t-1}^2(\nu + b^2) - 2\nu\phi_{t-1} + 1 + \nu)}.$$

For the comparative statics, we express the Gini coefficient as $\text{Gini} = f[\phi(\nu, a, h), b(a, h), \nu]$. and thereby calculate derivatives with respect to h and a: $\frac{d\text{Gini}}{dh} = \frac{\partial f}{\partial b}\frac{\partial b}{\partial h} + \frac{\partial f}{\partial \phi}\frac{\partial \phi}{\partial h}$, and $\frac{d\text{Gini}}{da} = \frac{\partial f}{\partial b}\frac{\partial b}{\partial a} + \frac{\partial f}{\partial \phi}\frac{\partial \phi}{\partial a}$, respectively. It can be shown that $\frac{\partial f}{\partial b} < 0, \frac{\partial f}{\partial \phi} < 0, \frac{\partial \phi}{\partial h} < 0, \frac{\partial \phi}{\partial a} < 0$, $\frac{\partial b}{\partial a} > 0$and $\frac{\partial b}{\partial h} > 0$. (derivations available on request).

Noting the complex, nonlinear structure of the expression for the Gini coefficient, we continue by setting $a = 0$ to derive some instructive analytical results, then use simulations to determine how the results change if we relax the simplifying assumption. That is, we start by examining the impact of a financial liberalization in terms of relaxing reserve requirements, assuming a closed economy. Initially assuming that $a = 0$ makes sense for sequencing financial liberalization policies. That is, sequencing literature argues that the domestic financial system needs to be freed from repressive policies, including interest rate controls and extractive fiscal policies, before capital accounts can be opened. If this order is disrupted, an inflow of capital might produce investment inefficiencies, such that the rate of return on the investment may be below the funding cost, and domestic agents become worse off (Agénor and Montiel, 2008). Thus, in the simpler case with $a = 0$, the derivative of the Gini coefficient is given by

$$\frac{dGini}{dh} = \frac{2h\nu^2\left((1+\nu)h^4\left(2h^2 + 3\nu(2-h)\right) + \nu^3\left(h^3 + 3h - 4\right)\right)}{3\left(h^2 + \nu\right)^3\left(\nu + h^2\nu + h^2\right)^2}.$$

The sum in the nominator consists of two parts with opposite signs: the first part is always positive, and the second part is always negative. The denominator is positive. As the parameter

for reserve requirement liberalization approaches 1, the second part becomes negligible, such that the derivative $\frac{dGini}{dh}$ is positive. In other words, inequality increases. For values of *h* that are smaller than 1, inequality decreases if

$$\left|(1+v)h^4\left(2h^2+3v(2-h)\right)\right| < \left|v^3\left(h^3+3h-4\right)\right|, \text{ or}$$

$$\left|\frac{(1+v)}{v^3}\left(2h^2+3v(2-h)\right)h^4\right| < \left|h^3+3h-4\right|.$$

This expression shows that as the financial development parameter grows large, the term $\frac{(1+v)}{v^3}$ approaches 0, which implies that reserve requirements can be liberalized but *h* needs to be strictly below 1.

An alternative explanation relies on the two derivatives derivatives $\frac{\partial f}{\partial \phi}\frac{\partial \phi}{\partial h}$ and $\frac{\partial f}{\partial b}\frac{\partial b}{\partial h}$, which represent two distinct mechanisms (see Appendix B). The first mechanism implies that investment profitability rises in the aftermath of financial liberalization, benefitting investors, such that income inequality increases. This profitability effect is counteracted by financial development though. If investment demand increases as the financial market develops, profitability gets undermined by rising interest rates. The second mechanism reflects distortions in the price system of the banking sector. A high degree of financial repression creates a large wedge between the interest rates on deposits and loans, such that financial liberalization offers higher average interest rates and benefits savers. The price distortion effect thus tends to reduce inequality. With Figure 1, we illustrate the relative importance of investment profitability and price distortion effects.

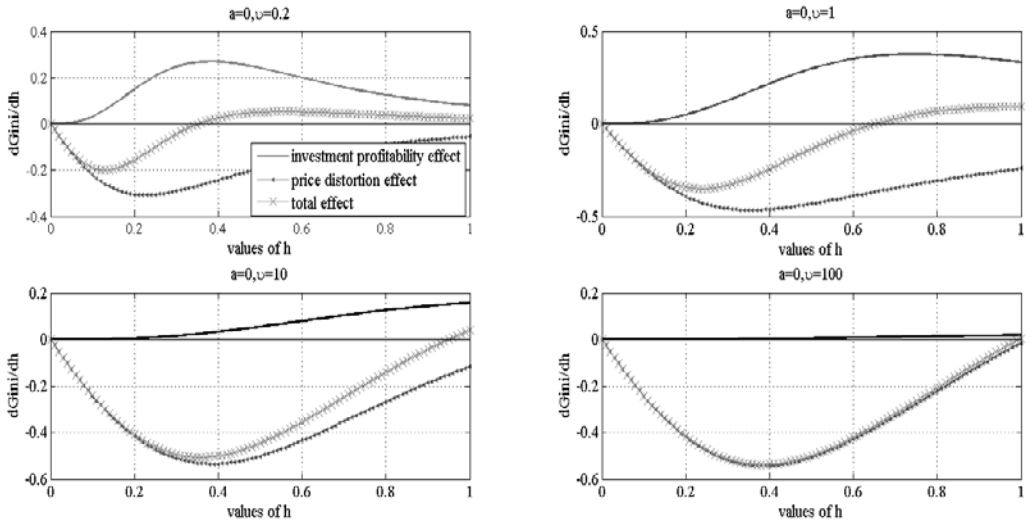

Figure 1: dGini/dh for different values of financial development, b < 1

The latter effect is weakened by capital account liberalization, because investors can borrow at the lower foreign interest rate, such as when *a* equals 0.5 in Figure 2. The sum of parameters *a* and *h* must be smaller than 1 to ensure $b < 1$. The value of the reserve requirement liberalization *h* at which $\frac{dGini}{dh}$ turns positive is smaller than in the closed economy. Again though, financial development counteracts the profitability channel; in other words, reserve requirements curtail the inefficiencies of the financial sector, captured by a low *v*. Similarly, DiGiorgio (1999) suggests a negative relationship between financial development and reserve requirements, which implies that reduced financial market inefficiencies related to information asymmetries (higher *v*) rationalize lower reserve requirements.

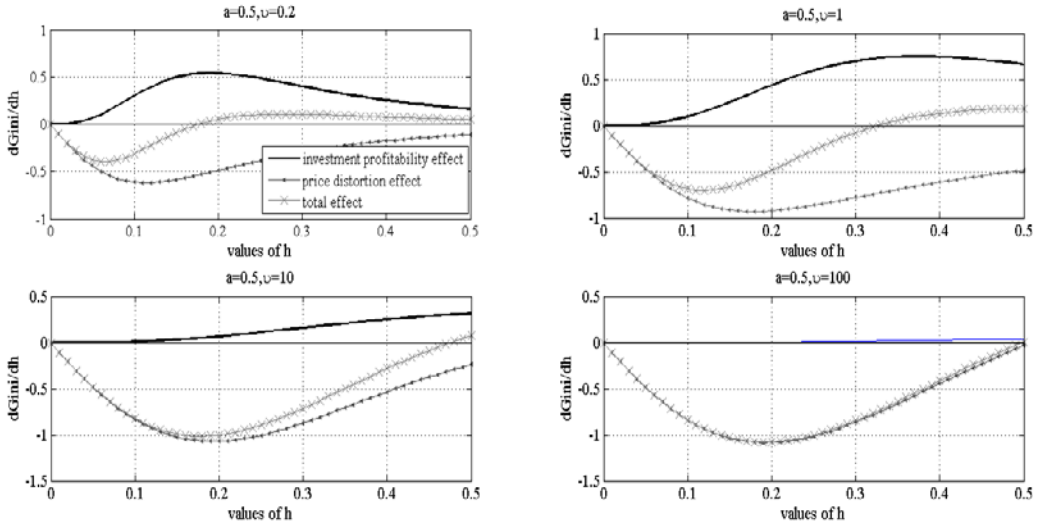

Figure 2: dGini/dh for different values of financial development, b < 1

For the effect of a change in capital account liberalization, we find that the Gini coefficient increases, implying more inequality in the case of very low values for financial development *v*. But the income distribution is tightened by capital account liberalization, if financial development is sufficiently high. These graphs appear in Appendix C.

3.5.2. Case 2, b > 1. Recall from Equation 37 that the Gini coefficient is

$$\text{Gini} = \frac{2b^3\phi_{t-1}^3 - 3b^2\phi_{t-1}^2 + 1}{3\left(b^2\phi_{t-1}^2 - 2\frac{v}{(1+v)}\phi_{t-1} + 1\right)}.$$

Using the same notation, we specify the derivatives as $\frac{dGini}{dh} = \frac{\partial f}{\partial b}\frac{\partial b}{\partial h} + \frac{\partial f}{\partial \phi}\frac{\partial \phi}{\partial h}$, and $\frac{dGini}{da} = \frac{\partial f}{\partial b}\frac{\partial b}{\partial a} + \frac{\partial f}{\partial \phi}\frac{\partial \phi}{\partial a}$. For $b > 1$, they boil down to simple expressions:

$$\frac{\mathrm{dGini}}{da} = \frac{2v}{3h(v+1)} - \frac{2hv(v+1)}{3(h+v-av+hv)^2} > 0,$$

$$\frac{\mathrm{dGini}}{dh} = \frac{2v^2(a-1)^2(2h+2hv+(1-a)v)}{3h^2(v+1)(h+v-av+hv)^2} > 0.$$

In a highly financially liberalized economy, further liberalization unequivocally generates higher income inequality. The graphs in Figure 3 display *dGini/dh* and show that the investment profitability effect is never offset by the price distortion effect. Therefore, investors gain disproportionally from financial liberalization. Unlike in the first case, financial development does not help counteract the adverse effects of financial liberalization. The same conclusions hold for *dGini/da.*

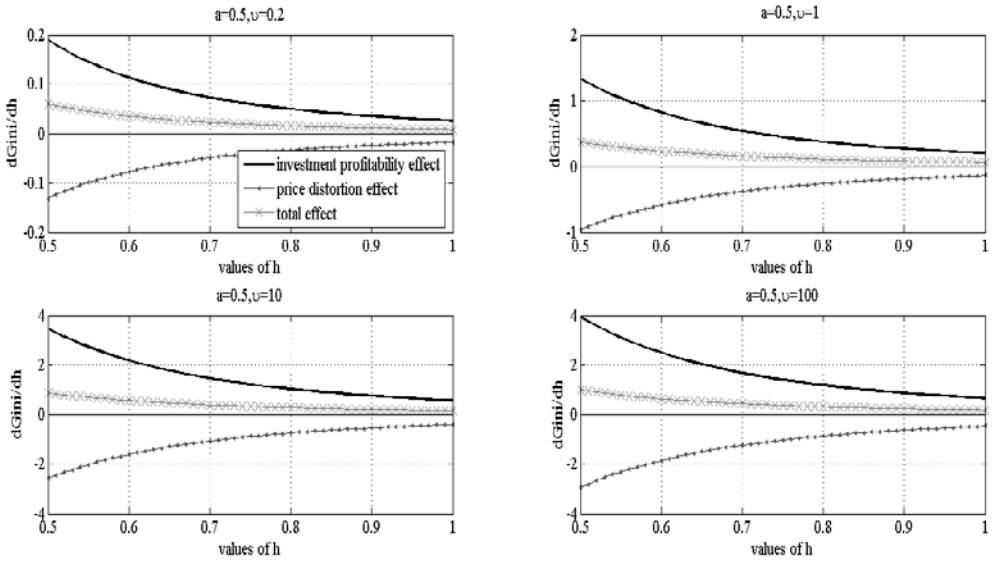

Figure 3: dGini/dh for different values of financial development, b > 1

In addition to the changes, it is of interest to determine the value of the Gini coefficient for different input parameters, as we detail in Table 1. Income inequality is highest for low values of financial development *v*; the opposite is true for high values of financial development. Moreover, intermediate income inequality occurs if $b < 1$ and investors can borrow up to the level of their wealth ($v = 1$). The income distribution is tighter for greater values of reserve requirement liberalization *h*, provided *v* is sufficiently large. However, if the overall degree of financial liberalization is high ($b > 1$) due to capital account liberalization, this last result does not hold.

Table 1: Gini coefficients for different parameter values

Gini	**b**	***v***	**A**	**h**
0.29	<1	0.2	0	0.3
0.3	<1	0.2	0	0.6
0.26	<1	1	0	0.3

0.2	<1	1	0	0.6
0.24	<1	10	0	0.3
0.1	<1	10	0	0.6
0.3	<1	0.2	0.5	0.3
0.32	>1	0.2	0.5	0.6
0.2	<1	1	0.5	0.3
0.25	>1	1	0.5	0.6
0.1	<1	10	0.5	0.3
0.12	>1	10	0.5	0.6

These results indicate that the effect of reserve requirements on income inequality can be positive or negative, depending on the overall degree of financial liberalization, as captured by the parameter *b*. In an economy characterized by a high degree of financial liberalization ($b > 1$), a further lowering of reserve requirements translates into more income inequality. Reducing reserve requirements can lead to less income inequality though if $b < 1$ and financial development is sufficiently high. In this case, both savers and investors gain from financial liberalization: Savers enjoy a smaller interest rate distortion, and investors take advantage of enhanced investment profitability. In our empirical analysis, we test this prediction by including an interaction term between capital account liberalization and reserve requirement liberalization. As a second important conclusion, we note that if financial development is depressed (low *v*), the degree of financial liberalization should be limited. Financial regulation thus can be justified if it acts as a restraint on financial market inefficiencies. We investigate measures of capital account liberalization, reserve liberalization, and financial development.

4. Empirical Methodology

The first equation we estimate is as follows:

$$inequality_{i,t} = \alpha_0 + \alpha_1 inequality_{i,t-1} + \alpha_2 flib_{i,t}^{reserves} + \alpha_3 flib_{i,t}^{capitalaccount} + \alpha_4 \left(flib_{i,t}^{reserves} \times flib_{i,t}^{capitalaccount}\right) + \boldsymbol{x}_{i,t}'\lambda + \eta_i + \varepsilon_{i,t} ,$$

where *t* and *i* denote the time period and country. The variable *inequality* represents our measure of income inequality, and *flib* indicates the financial liberalization of reserve requirements ($flib^{reserves}$) and the capital account ($flib^{capitalaccount}$), respectively. The regressor vector $\boldsymbol{x}$ is a $k \times 1$ column vector of control variables. The choice of control variables is guided by related literature (Beck et al., 2007a; Dollar and Kraay, 2002): We include *private credit* by deposit banks and

other financial institutions over gross domestic product (GDP), which serves as a proxy for financial development. We also note the annual growth rate of the GDP deflator (*inflation*), the ratio of imports plus exports to GDP (*openness*), and real GDP per capital growth (*gdp*). Parameter η is a time-invariant fixed effect. Appendix D specifies the data sources.

The second regression model is

$$
\begin{aligned}
inequality_{i,t} = \\
&\alpha_0 + \alpha_1 inequality_{i,t-1} + \alpha_2 flib_{i,t}^{reserves} + \\
&\alpha_3 flib_{i,t}^{capitalaccount} + \alpha_4 privatecredit_{it} + \alpha_5\left(flib_{i,t}^{reserves} \times \right. \\
&\left. flib_{it}^{capitalaccount}\right) + \alpha_6\left(flib_{i,t}^{reserves} \times privatecredit_{it}\right) \\
&+ \alpha_7\left(flib_{i,t}^{capitalaccount} \times privatecredit_{it}\right) + \alpha_8\left(flib_{i,t}^{capitalaccount} \times \right. \\
&\left. flib_{i,t}^{reserves} \times privatecredi_{it}\right) + \boldsymbol{x}_{\boldsymbol{it}}'\lambda + \eta_i + \varepsilon_{i,t} \,,
\end{aligned}
$$

where *privatecredit* denotes our measure of financial development.

Our focus is the consistent estimation of the coefficients of our main variables, as well as their interaction. We do not estimate the equation by ordinary least squares (OLS), for several reasons. First, the link between income inequality and financial liberalization might be governed by feedback effects. For example, a more unequal distribution of resources raises pressure to protect financial markets and control capital flows. Second, the set of control variables is not strictly exogenous. Third, unobserved country-specific fixed effects cause the OLS estimates to be biased. Fourth, the lagged dependent variables that enter the equation as explanatory variables are correlated with η. Instead, we use dynamic GMM panel estimation techniques (Arellano and Bover, 1995; Blundell and Bond, 1998) and take first differences of our regression equation to purge time-invariant fixed effects, then choose suitably lagged levels of the variables as internal instruments. To improve the finite sample properties of the estimator, we augment the first-differences equation with the equation in levels, such that the lagged first differences serve as instruments.[9] The validity of the second set of instruments rests on two assumptions: that error is serially uncorrelated and that the correlation of η and *inequality* with $\boldsymbol{x}$ is constant over time, such that there is no correlation between the first-differenced explanatory variables and the error term. The complete set of moment conditions is as follows:

1) For the equation in first-differences:

[9] Blundell and Bond (1998) show that if the explanatory variables are characterized by persistence and the number of time series observations is small, lagged levels are weak instruments for subsequent first differences.

$$E\left[w_{i,t-s}\Delta\varepsilon_{i,t}\right]=0 \qquad \text{with } w_{i,t}=\left(flib_{i,t}^{reserves}, flib_{i,t}^{capitalaccount}, flib_{i,t}^{reserves}\times flib_{i,t}^{capitalaccount}, \boldsymbol{x}_{i,t}'\right)' \text{ and } y_{i,t}=inequality_{i,t}$$

$$E\left[y_{i,t-s}\Delta\varepsilon_{i,t}\right]=0$$

for i=1,…N; $s \geq 2$;t = 3,…,T

2) For the equation in levels:

$$E\left[\Delta w_{i,t-1}\left(\eta_i+\varepsilon_{i,t}\right)\right]=0 \qquad \text{for } i=1,\ldots N;\ t=3,\ldots,T$$

$$E\left[\Delta y_{i,t-1}\left(\eta_i+\varepsilon_{i,t}\right)\right]=0$$

Following Blundell and Bond (1998), we report two specification tests, namely, the Sargan/Hansen test, which evaluates the validity of the instruments, and a test that the error term exhibits no second-order serial correlation. For the estimations, we average the data over five-year intervals, such that we have at most eight periods. Our data set includes gaps, so we follow Roodman's (2009) advice and use orthogonal deviations to purge fixed effects. In addition, we run regressions with and without time effects. Roodman (2009) suggests that time dummies should be included to control for correlation across individuals in the idiosyncratic error terms. Finally, we apply Windmeijer's (2005) correction to our standard errors to correct the finite sample bias in the two-step standard errors.

5. Data

Our goal is to include consistent data for as many countries as possible over the longest available time period. Substantial diversity has developed over time in the measures of financial liberalization (Bumann et al., 2013). We adopt a rather precise view of financial liberalization, focused on lifting restrictions on reserve requirements and capital account liberalization, and gather financial liberalization data in line with this clear demarcation. However, it proves more difficult to find consistent data on income inequality. A data set published by Galbraith and Kum (2005) on estimated household income inequality serves our purposes though. The data for our control variables are well developed and mostly available from standard sources such as the World Bank, as we detail in Appendix D.

5.1. Income Inequality

The inconsistency and varying quality of income inequality data make gathering them a challenging. No standardized income concept provides a foundation for income inequality data. Many studies have used a panel data set by Deininger and Squire (1996), which was incorporated into the World Income Inequality Database (WIID). However, Atkinson and

Brandolini (2001) question the validity of empirical results based on this data source, and studies identify three major deficiencies (Atkinson and Bourguignon, 2000; Galbraith and Kum 2005):

1) It contains large data gaps for many countries in Africa, Latin America, and Asia, leading to highly unbalanced panels. Researchers who investigate the evolution of inequality over time either must restrict themselves to shorter subsets or use interpolation methods.
2) The conceptual base underlying the Gini coefficient of income inequality varies considerably across observations, even within countries. The conceptual base serves as a framework for gathering and classifying income inequality data.[10] In general, observations that do not share a common conceptual base cannot be directly combined or compared; observations with similar conceptual bases are not automatically comparable though, due to differences in the underlying survey methodology.
3) The data set contains empirical inconsistencies and unreasonable fluctuations, which might be traced back to the varying conceptual bases. For example, the Gini coefficient for Spain plummeted by more than 10 percentage points between 1975 and 1980 when the income concept changed from household gross to household net income. Galbraith and Kum (2005) identify 30 similar cases. As an example of an empirical inconsistency, India and Indonesia indicate levels of inequality that are in the same range as those for Europe and Canada. According to Galbraith and Kum (2005), South Asian countries use expenditure surveys, whereas Europe focuses on income surveys, which partly explains such inconsistencies.

In response to these concerns, Galbraith and Kum (2005) attempt to measure income inequality by seeking out a more reliable data source on households' available cash, from which they derive more reliable, consistent income inequality data. They propose using manufacturing pay data from the United Nations International Development Organization (UNIDO) Industrial Statistics. However, to obtain reliable data, they confined themselves to the narrower concept of income in the first instance. Pay data is narrower, in that they do not include other income sources such as capital income or transfers. Yet these data offer accuracy, consistency, and coverage across countries, because they are based on a systematic accounting framework called the International Standard Industrial Classification (Galbraith and Kum, 2002). Manufacturing pay also is the largest component of income, and time patterns of manufacturing pay correlate

[10] The conceptual base includes the following issues: definitions of income or consumption/expenditure (the WIID distinguishes 10 definitions); the statistical unit, as either household or person; the income sharing unit, which can be household, family, tax unit, or person; and the adoption of equivalence scales to adjust for differences in the relative needs of differently sized and composed households.

closely with those of other sectors, such as services, so manufacturing offers a good approximation for changes in other parts of the economy too (Galbraith and Kum, 2005).

The procedure for deriving an estimated measure of income inequality based on manufacturing pay data involved three steps. First, Galbraith and Kum (2002) calculate the between-groups component of Theil's T statistic, using the different categories in the UNIDO industrial classification codes as groups.[11] Second, they regress the Gini coefficient from the Deininger and Squire data set on their measure of manufacturing pay inequality and some additional dummy variables that capture the conceptual base of an observation (household per capita, gross/net, income/expenditure), as well as the share of manufacturing employment to total population. Third, they extract the coefficients from the described regression model and compute the corresponding Gini coefficient of income inequality. Their data set thus comprises 4,539 (country-year) observations, covering 154 countries over the period 1963–2002, which we use in this study. In contrast, Dollar and Kraay (2002) rely on 935 observations of Gini coefficients covering 137 countries from 1950 to 1990.

With Figures 4 and 5, we compare the availability of Gini coefficients for OECD countries using data from the WIID, as Dollar and Kraay (2002) did, versus that in the UTIP data set. The countries appear in ascending order of their Gini coefficients along the x-axis. We note three trends from this comparison. First, the Gini coefficients seem more stable over time for each country in the UTIP data set. Second, the country ranking is more plausible in Figure 5. For example, the Scandinavian countries are situated toward the left, which means they have the lowest Gini coefficients on average. Third, the evolution of the Gini coefficients over time is more plausible; inequality is higher at the end than in the beginning of the sample period for most countries. The correlation coefficient between the two data sets is 0.41. Considering these differences, we chose to adopt the UTIP data set, which appears more consistent and accurate.

[11] Theil's t-statistic consists of a within-group and a between-groups component. The within-groups component is unobserved, but the between-groups component is a plausible lower-bound inequality measure.

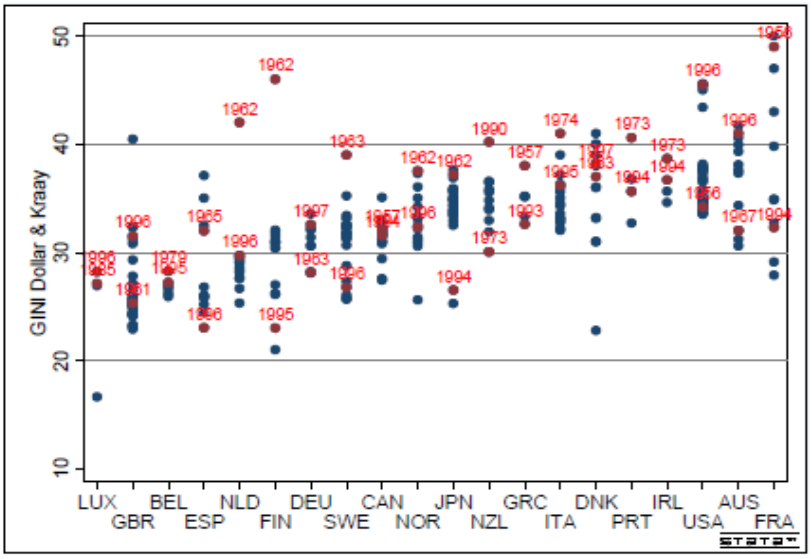

Figure 4: Dollar and Kraay (2002) data

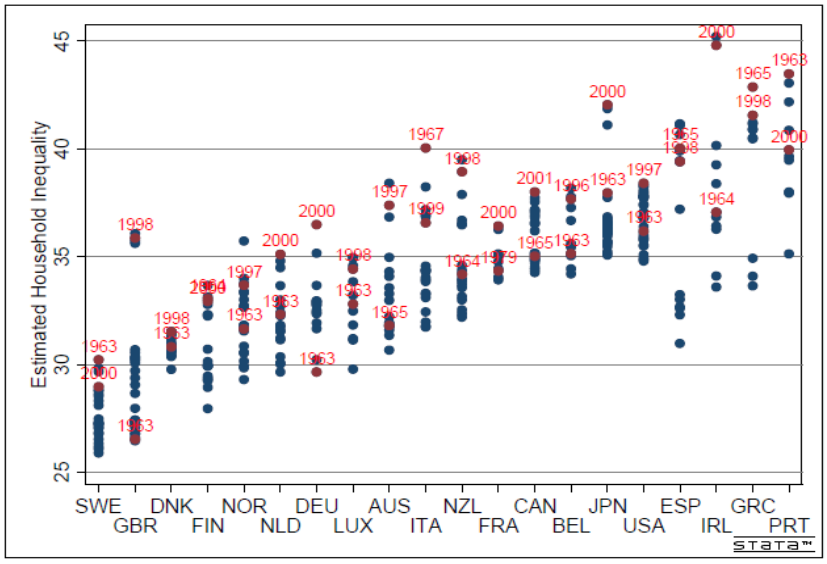

Figure 5: UTIP data

5.2. Financial Liberalization Data

The vast interest in the link between economic growth and financial liberalization has produced a range of measures, which can be divided into four broad categories: capital account liberalization, equity market liberalization, banking sector liberalization, and multidimensional measures that combine some aspects of the other three categories. Considering our relatively precise definition of financial liberalization, we need data that reflect our clear view. The theoretical model in Section 3 provides straightforward guidance for finding appropriate data. First, they must capture the extent of required reserves that banks need to hold against deposits.

Second, the data must describe capital account liberalization. Therefore, we turn to the data set established by Abiad et al. (2010), which has several benefits. It evaluates capital account liberalization on a graded scale, so it can take values between 0 and 3, where 3 is the highest level of liberalization, indicating that it includes the exchange rate regime, restrictions on capital inflows, and restrictions on capital outflows. The graded scale preserves more information about the nature of the liberalization process, and capital account liberalization tends to evolve gradually, such that binary dummy variables fail to account for smaller policy shifts. This unique data set includes 91 countries, over a period from 1975 to 2005. Furthermore, this data set by Abiad et al. (2010) offers a proxy for reserve requirements, though it is measured jointly with credit controls, so it could pick up the effect of financial development instead of reserve requirements. Therefore, we calculated the following measure, as also used in prior studies of financial repression (McKinnon, 1991)

$$\text{required reserves ratio} = \frac{\text{reserve money (line14 of IFS)-outside currency (line 14a)}}{\text{money (line 34)+ quasi-money (line 35)–outside currency (line 14a)}}.$$

The necessary data are retrieved from the International Financial Statistics database of the IMF. Thus, the final data set covers 64 countries, over the period (mostly) from 1973 to 2002.

5.3. Descriptive Statistics

In our data set, according to Table 2, income inequality is significantly and negatively correlated with capital account liberalization. In contrast, income inequality appears uncorrelated with reserve requirement liberalization. The correlations of income inequality with trade openness, GDP per capita growth, schooling, and private credit are significantly negative. Inflation does not exhibit a significant correlation with our dependent variable. It is noteworthy that the correlation between capital account liberalization and reserve requirement liberalization is relatively modest (0.26), which enables us to study their interaction. On average, financial liberalization seems to have a positive relationship with financial development, as measured by private credit. The correlations with the other control variables are small, except for schooling.

Table 2: Descriptive Statistics

		Mean	S.D.	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	**inequality**	0.41	0.07	0.22	0.64	1.00							
(2)	**flib of reserve requirements**	-0.17	0.15	-1.42	0.00	-0.02	1.00						
						(0.65)							
(3)	**flib of capital account**	1.61	1.08	0.00	3.00	-0.21	0.26	1.00					
						(0.00)	(0.00)						
(4)	**private credit**	0.44	0.36	0.02	1.88	-0.47	0.39	0.56	1.00				
						(0.00)	(0.00)	(0.00)					
(5)	**GDP per capita growth**	1.54	3.23	-12.92	13.13	-0.15	0.13	0.18	0.15	1.00			
						(0.00)	(0.00)	(0.00)	(0.00)				
(6)	**inflation**	0.49	2.88	-0.14	55.77	0.04	-0.17	-0.10	-0.13	-0.22	1.00		
						(0.34)	(0.00)	(0.04)	(0.00)	(0.00)			
(7)	**trade openness**	0.75	0.49	0.01	3.80	-0.12	0.12	0.31	0.24	0.19	-0.05	1.00	
						(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.26)		
(8)	**schooling**	0.28	0.18	0.01	0.77	-0.42	0.11	0.51	0.44	0.07	-0.01	0.21	1.00
						(0.00)	(0.02)	(0.00)	(0.00)	(0.09)	(0.86)	(0.00)	

Notes: Figures in brackets represent *p*-values. Data are averaged over five years.

6. Results

According to our theoretical model, the impact of a change in reserve requirements depends on the overall degree of financial liberalization. If reserve requirement liberalization generates more income inequality in an economy that is highly integrated with the international financial market, the interaction between reserve requirement liberalization and capital account liberalization should be positive. We therefore begin by presenting the results of the specification that includes an interactive term between our financial liberalization measures, plus the variables that constitute the interaction term, in Table 3.[12] The first column displays our baseline results, without further control variables and time dummies. It indicates that financial liberalization in reserve requirements has a significant reductive effect on income inequality, whereas capital account liberalization appears to significantly increase income inequality. The coefficient of the interaction term is positive and statistically significant at the 5 percent level, so the reductive effect of reserve requirement liberalization diminishes as the level of capital account liberalization increases. In the second column, we add time dummies. The coefficient on capital account liberalization becomes insignificant over time, mainly because this variable is highly collinear with the time dummies. The other results remain the same, though the size of the coefficient for reserve requirements decreases slightly. When we extend these regressions by including further control variables, the results remain largely unchanged. In all regressions, the Hansen/Sargan test statistics also suggest that the instrument set is valid (though its value naturally increases with the inclusion of time dummies).

Next, to examine the prediction that the adverse effects of financial liberalization can be curtailed by financial development, we interact both financial liberalization measures and the measure of financial development. Because the specification with time dummies is preferable, from an econometric perspective, we list only those results in Table 4. In the first column, we determine that financial development helps limit the adverse effects of capital account liberalization on income distribution: As financial development rises, capital account liberalization increases income inequality to a lesser extent. This finding is not robust to the inclusion of further control variables though.

Table 3: Estimation Results

	(1) **Sys. GMM**	**(2)** **Sys. GMM**	**(3)** **Sys. GMM**	**(4)** **Sys. GMM**
inequality(t-1)	0.936***	0.860***	0.776***	0.681***

[12] In principle, our theoretical analysis implies an alternative specification that includes quadratic terms. We used this specification to examine whether reserve requirement liberalization has a negative effect on income inequality up to a turning point, but the coefficient of the quadratic term was insignificant.

	(0.20)	(0.19)	(0.13)	(0.14)
flib in reserve requirements	-0.144**	-0.114*	-0.097**	-0.061*
	(0.07)	(0.06)	(0.04)	(0.03)
flib in capital account	0.022***	0.014	0.023***	0.006
	(0.01)	(0.01)	(0.00)	(0.01)
flib in reserve requirements × flib in capital account	0.096**	0.092*	0.084**	0.075**
	(0.04)	(0.06)	(0.03)	(0.04)
private credit			-0.047***	-0.025
			(0.02)	(0.02)
GDP per capita growth			-0.007***	-0.004**
			(0.00)	(0.00)
inflation			-0.002	0.003
			(0.00)	(0.00)
trade openness			0.031**	0.018
			(0.01)	(0.01)
constant	-0.002	0.132	0.078	0.101*
	(0.08)	(0.24)	(0.05)	(0.06)
year dummies	no	yes	No	yes
no. of observations	264	264	233	233
no. of groups	68	68	61	61
no. of instruments	9	21	17	29
Sargan *p*-value	0.48	0.69	0.77	0.98
Hansen *p*-value	0.63	0.85	0.39	0.76
AR(1) *p*-value	0.00	0.00	0.00	0.00
AR(2) *p*-value	0.83	0.46	0.71	0.24

Notes: The dependent variable is inequality, as measured by estimated household income inequality. A higher value means more income inequality. Windmeijer-corrected standard errors are reported in brackets. For all explanatory variables (except the period dummies), the second lag is used as a GMM-style instrument. The collapse option is chosen, so the number of instruments for each variable is limited to 1. In all estimations, we used the orthogonal deviations transformation.
*$p < 0.10$. ** $p < 0.05$. *** $p < 0.01$.

Table 4: Estimation Results

	(1) Sys. GMM	(2) Sys. GMM
inequality(t-1)	0.867***	0.602***
	(0.06)	(0.10)
flib in reserve requirements	-0.455*	-0.123
	(0.26)	(0.14)
private credit	0.149	-0.032
	(0.10)	(0.08)
flib in capital account	0.046**	0.016
	(0.02)	(0.01)
flib in reserve requirements × private credit	0.826	0.163
	(0.57)	(0.31)
flib in capital account × private credit	-0.074**	-0.006
	(0.04)	(0.03)
flib in reserve requirements × flib in capital account	0.266	0.153**
	(0.16)	(0.08)
flib in reserve requirements × flib in capital account × private credit	-0.397	-0.188
	(0.27)	(0.17)
GDP per capita growth		-0.002
		(0.00)
inflation		0.003
		(0.00)
trade openness		0.014
		(0.01)
schooling		-0.122***
		(0.04)
constant	0.013	0.207**
	(0.07)	(0.08)
year dummies	yes	Yes
no. of observations	240.00	220.00
no. of groups	63.00	57.00
no. of instruments	29.00	37.00
Sargan *p*-value	0.83	0.88
Hansen *p*-value	0.91	0.91
AR(1) *p*-value	0.00	0.00
AR(2) *p*-value	0.20	0.30

Notes: The dependent variable is inequality, as measured by estimated household income inequality. A higher value means more income inequality. Windmeijer-corrected standard errors are reported in brackets. For all explanatory variables (except the period dummies), the second lag is used as a

GMM-style instrument. The collapse option is chosen, so the number of instruments for each variable is limited to 1. In all estimations, we used the orthogonal deviations transformation.
*$p < 0.10$. ** $p < 0.05$. *** $p < 0.01$.

These results paint a consistent picture in relation to our first theoretical prediction: In an economy with closed capital accounts, reserve requirement liberalization reduces income inequality. However, this effect diminishes with increasing capital account openness. In relation to our second prediction, our findings are less conclusive.

7. Conclusion

With this research, we have sought to investigate the relationship between financial liberalization policies and income inequality, both theoretically and empirically. We consider two policies frequently pursued by governments, namely, the relaxation of reserve requirements and capital controls. The virtue of this clear characterization of financial liberalization is that it permits us to pinpoint the channels through which income inequality is affected.

Our theoretical model reveals that the effect of financial liberalization differs between a financially repressed economy and a highly liberalized economy. Pursuing domestic financial liberalization, in terms of reserve requirements, in an environment that features a high level of capital account openness will likely increase income inequality. However, if the financial market exhibits high regulations, reserve requirements can lead to reduced income inequality, because savers can take advantage of increasing interest rates, due to the smaller wedge between deposit and loan rates. In addition, an investment profitability effect implies higher income inequality, but it is counteracted by financial development. If investment demand increases as the financial market develops, profitability gets undermined by rising interest rates.

In our empirical analysis, we confirm that the interaction term is statistically significant (at the 5% level), even when we include time dummies and other control variables that might be associated with income inequality. Thus, the empirical results are in line with an interpretation that states the relationship between income inequality and reserve requirement liberalization depends on the degree of capital account openness. Moreover, we find some evidence, though weak, that financial development can limit the adverse effects of capital account liberalization on income distribution.

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Appendix A

Table A.1: Income inequality and financial liberalization

		Income inequality	Financial reform index
Australia	1975	0.31	2
Australia	2000	0.37	21
Canada	1975	0.35	14
Canada	2000	0.38	21
Chile	1975	0.41	5
Chile	2000	0.47	18
Colombia	1975	0.43	1
Colombia	2000	0.44	15
Germany	1975	0.32	15
Germany	2000	0.36	19
Denmark	1975	0.32	7.5
Denmark	2000	0.32	20.25
Egypt	1975	0.31	0
Egypt	2000	0.46	15
Spain	1975	0.40	7.75
Spain	2000	0.39	21
France	1975	0.34	6
France	2000	0.36	21
United Kingdom	1975	0.27	10
United Kingdom	2000	0.37	21
Italy	1975	0.34	6
Italy	2000	0.36	19
Japan	1975	0.36	6
Japan	2000	0.42	18
Kenya	1975	0.48	5.75
Kenya	2000	0.46	14.5
Mexico	1975	0.40	7
Mexico	2000	0.44	19
Netherlands	1975	0.31	14
Netherlands	2000	0.35	20
Norway	1975	0.33	6.5
Norway	2000	0.34	18.25
Sweden	1975	0.26	6
Sweden	2000	0.29	20
Tunisia	1975	0.35	2.75
Tunisia	2000	0.50	14
United States	1975	0.36	13.25
United States	2000	0.38	21

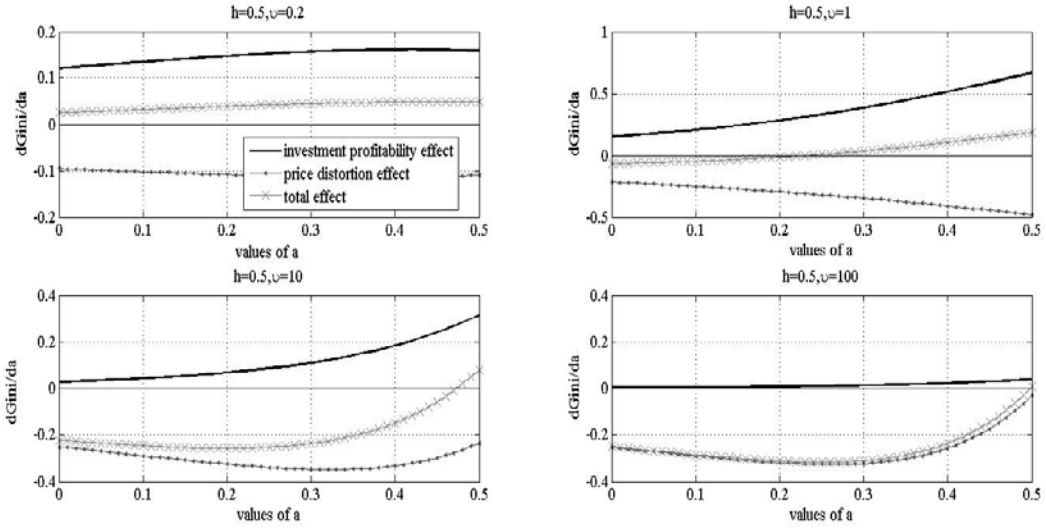
Sources: Income inequality data by the University of Texas Inequality Project; reform index by Abiad et al. (2010).

Appendix B: Derivatives

$$\frac{\partial f}{\partial b}\frac{\partial b}{\partial h} = -\frac{2hv^2\left(4h^6v+4h^6-3h^5v^2-3h^5v+6h^4v^2+12h^4v-h^3v^3-6h^3v^2+12h^2v^2-3hv^3+4v^3\right)}{3\left(h^2+v\right)^3\left(v+h^2v+h^2\right)^2}.$$

$$\frac{\partial f}{\partial \phi}\frac{\partial \phi}{\partial h} = \frac{4h^3v^2(h^2-vh+2v)}{\left(h^2+v\right)^3(v+h^2v+h^2)}.$$

Appendix C: dGini/da for case 1 at different values of financial development, h > 0



Appendix D

Table A.2: Variable Definitions

Variable	Variable Definition	Source
inequality	Estimated household income inequality	University of Texas Inequality Project
flib of reserve requirements	– (reserve requirements) = – (reserve money (line14)-outside currency (line 14a) / (money (line 34) + quasi-money (line 35) – line 14a)	IMF International Financial Statistics
flib of capital account	Measures capital account openness on a graded scale from 0 to 3: 3 means fully liberalized, 0 means fully repressed	Abiad et al. (2010)
private credit	Private credit by deposit money banks and other financial institutions over GDP	Beck et al. (2009)
GDP per capita Growth	Real GDP per capita growth	World Development Indicators
inflation	Annual growth rate of GDP deflator	World Development Indicators
trade openness	Ratio of imports plus exports to GDP	World Development Indicators
schooling	Secondary level of schooling of the total population ages > 25	Barro and Lee (2010)