# Financial Globalization and Inequality

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**Abstract**

This paper investigates how financial globalization and financial development affect income inequality within a country. We demonstrate that when a country is financially closed to the world market, the Gini coefficient is monotonically decreasing with respect to the degree of financial development, whereas when a country becomes so small due to financial globalization that financial development in the country does not affect the world interest rate, the Gini coefficient is monotonically increasing with respect to the degree of financial development. A simple quantitative analysis for the Gini coefficients shows that income inequality in the United States is negatively affected by its financial development. In the United States, income inequality has widened since the late-1970s probably due to financial globalization and financial development.

**Keywords**: Income inequality; Financial globalization; Financial development; Gini coefficient; Heterogeneous agents.

**JEL Classification Numbers**: E24 F43 O16

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# 1 Introduction

Since the late-1970s, income inequality in the United States has been increasing almost persistently as illustrated in figure 1.[1] This phenomenon is *inconsistent* with Kuznets' inverted-U hypothesis, according to which, at early stages of economic development, inequality in a country goes up, whereas at some point in a process of development, it starts to decline as an economy matures. In contrast with Kuznets' hypothesis, income inequality in the United States has widened for the last three decades in spite of the maturity of the economy.

Income inequality in the United States has been explained empirically by many researchers. As discussed in Goldberg and Pavcnik (2007), in the first strand of the literature, skill-biased technological innovation is emphasized (e.g. Katz and Murphy (1992) and Autor, et al. (1998)). There is a theoretical foundation for this empirical explanation. Galor and Moav (2000) establish a model that explains income inequality not only between skilled and unskilled workers but also within each category. Aghion, et al. (2002) provide a model in which income inequality originates in the enlarged generality of new technologies. In the second strand of empirical explanations, authors attribute income inequality to trade globalization (e.g., Wood (1995, 1998)). The idea that income inequality stems from trade globalization is based on the traditional Hechscher-Ohlin model. According to the Hechscher-Ohlin model, in a country with abundant skilled workers, trade globalization benefits skilled-workers and disadvantages unskilled-workers. Consequently, income inequality in the country widens. Since skilled workers are abundant in the United States relative to underdeveloped countries, this hypothesis does not disagree with the situation in the United States.

While these two explanations are not inconsistent with the recent phenomenon in the United States, whether financial globalization widens or reduces inequality within a country is an open question theoretically and empirically. Complementing the above two hypotheses, this paper provides another explanation for income inequality in the United States, investigating effects of financial globalization on it.

Since the early-1980s, capital flows have been growing not only between developed countries and but also between developed and underdeveloped countries. The ongoing financial globalization results from financial liberalization executed by a large number of newly industrializing and developing countries. Chinn and Ito (2006, 2007) create the index for financial open-

[1] The data for the Gini coefficient in figure 1 are assembled from the Luxembourg Income Study. See also Piketty and Saez (2003) for detailed investigation into the recent income inequality in the United States.

ness for more than 160 countries. In order to observe the degree of financial globalization, figure 2 plots the number of countries whose index values are greater than 1.9 (called "integrated countries" henceforth) from 1974-2004.[2] As seen in the figure, there is a remarkable increase in the number of integrated countries. Obviously, figure 2 illustrates financial globalization.

[Figure 1 around here]

[Figure 2 around here]

In addition to financial globalization and income inequality, we have the other stylized facts for the circumstances that the United States faces. First, as seen in figure 3, the real interest rate in the United States (which is a proxy for the world real interest rate) has been declining since the mid-1980s.[3] In 2000, the real interest rate is around 2 percent. Second, figure 4 gives a simple scatter plot of the ratios of private credit to the GDP in the United States (henceforth we call the ratios *Private Credit*) versus the ratios of the current account to the GDP. *Private Credit* is used as a measure for financial development in the literature (Levine, et al. (2000) and Aghion, et al. (2005)). The ratios of the current account to the GDP have been declining since the late-1960s and are negative since the mid-1970s, whereas *Private Credit* has been increasing.[4] Therefore, there is a negative relationship between them by and large.[5] Meanwhile, according to the financial index score created by the International Monetary Fund in 2006 (IMF (2006)), the United States is one of the countries whose financial sectors are the most fully developed. Judging from these facts, it is likely that as a financial sector develops relative to the other countries, an economy becomes a net borrower in the world financial market.

[Figure 3 around here]

[Figure 4 around here]

[2] The minimum index value in the whole of the data points is -1.79 and the maximum is 2.53. The reason for choosing 1.9 as a cutoff is that the minimum value in 2006 for the OECD countries is 1.99.

[3] The data set for the real interest rate in the United States is created from the federal funds rate and the inflation rate. The federal funds rate is obtained from the *International Financial Statistics 2008*. The inflation rate is computed from the *GDP* deflator (which is also obtained from the *International Financial Statistics 2008*).

[4] The data set for *Private Credit* had been created by Levine, et al. (1999) and it was updated in 2006. The data for the current account are processed. In subsection 5.2, we will explain how to process them.

[5] If both variables follow random walks, then this negative relationship might be spurious: in order to confirm that, we need a more elaborate time-series analysis.

This paper demonstrates that the above stylized facts are not separate things but they are closely related. In particular, we reveal that income inequality in the United states relates to financial globalization and financial development. Whether financial deepening widens or shrinks income inequality within an economy is an open question as well (Levine (2005)). According to our model, the answer to this question depends upon whether an economy is financially open to the world market or not.

The main result is as follows. When an economy is closed to the world financial market, the Gini coefficient is monotonically decreasing with respect to the degree of financial development, whereas when an economy is open and becomes so small due to financial globalization that the world interest rate is not affected by the degree of financial development in the economy, the Gini coefficient is monotonically increasing with respect to financial development. Our calibration shows that income inequality in the United States is negatively affected by its financial sector development. In the United States, financial development has widened income inequality since the 1980s probably due to financial globalization.

In our model, an economy consists of heterogeneous agents. The heterogeneity comes from the productivity differences in creating intermediate goods, which are used for the final production. Due to the heterogeneity, savers and investors endogenously appear. More precisely, less capable agents become savers because their marginal products for creating intermediate goods are less than the market interest rate. By contrast, more capable agents become investors to create intermediate goods because their marginal products are greater than the interest rate. In general equilibrium in a closed economy, the interest rate is determined by the degree of financial development. As the financial market approaches a perfect one, the market interest rate goes up. This is because as a financial sector develops, more capable agents use more production resources. Accordingly, the production resources are efficiently used and thus the interest rate becomes high.

An increase in the interest rate along with the degree of financial development affects income inequality in two conflicting manners. On the one hand, investors (i.e., borrowers) are disadvantaged if the interest rate goes up, whereas savers benefit. Consequently, income inequality shrinks. On the other hand, since the number of investors decreases due to the increase in the interest rate, more production resources are used by more talented agents than when the interest rate is low. As a result, talented agents benefit and thus income inequality widens. In the case of a closed economy, the first effect dominates the second effect: inequality shrinks without fail.

What would happen to income inequality in a multi-country model? Suppose that countries are financially integrated. As long as the number of countries integrated into the world financial market is small, financial development in an economy positively affects the world interest rate. In this case, financial development reduces inequality because the economy behaves like a closed one. However, when many countries are integrated into the world financial market, financial development in an economy has no effect on the world interest rate. If the financial sector develops in an economy more fully than in the rest of the world, then production resources flow into the economy and thus investors benefit from the inflow of the production resources even though the world interest rate is constant. In this case income inequality widens if financial development in the economy proceeds.

To the best of my knowledge, there is no formal analysis that sheds light on an impact of financial globalization on income inequality within a country with an exception. Mendoza, et al. (2007) investigate how financial liberalization affects the dynamics of wealth inequality when there are differences in the degrees of financial development between countries. They show that after financial liberalization, a country with a fully developed financial sector experiences an increase in wealth inequality. However, they do not examine how financial deepening affects inequality after financial liberalization. By contrast, our model demonstrates that when the financial markets in each country are integrated into the world market, financial deepening in a country widens inequality.

The current paper is allocated to the literature that addresses a question about the relationship between financial development and inequality within a country. Writers have tried to answer this question theoretically; however, the claimed results conflict with each other. For instance, Greenwood and Jovanovic (1990) investigate how financial deepening interacts with economic development and drive an "inverted U-shaped" relationship between income inequality and financial development. Meanwhile, Galor and Zeira (1993) and Banerjee and Newman (1993) demonstrate that, due to asymmetric information, poor agents face credit constraints and they are prevented from starting their optimal investment projects. As a result, income inequality remains as long as the economy faces asymmetric information. As credit market imperfections are resolved, income inequality shrinks, i.e., there exists a "negative linear" relationship between financial development and income inequality. None of these authors consider an impact of financial globalization on inequality. Financial globalization is important when we consider the relationship between financial development and inequality because it changes the ways how financial development affects inequality as shown in this paper.

The paper proceeds as follows. In the next section, we describe our model and derive a closed form for the Gini coefficient. By using the Gini coefficient obtained in section 2, in section 3 we study income inequality in a closed economy. Likewise, in section 4, an open economy is investigated. Section 5 gives a simple quantitative analysis for the U.S. economy. The simulated Gini coefficients capture income inequality in the United States very well. Section 6 concludes with remarks on by-product testable claims and future research.

# 2 Model

Piketty and Saez (2003) provide empirical evidence for the recent income inequality in the United States. According to them, the income inequality in the United States since the 1970s stems from the differences in salaries. As demonstrated in Galor and Moav (2002), the differences in salaries must originate in the differences in capabilities of agents. We focus on this point, omitting the income inequality arising from bequests, initial wealth distribution, and so forth.

An economy continues one period, and consists of a financial intermediary called the Bank, a continuum of agents whose measure is equal to $L$, and a firm that is engaged in the final production. Agents in the economy trade with each other financially and indirectly via the Bank.

## 2.1 Credit Market

We begin by the investigation for a credit market. Since there is asymmetric information between savers and borrowers or between the Bank and borrowers, the credit market is imperfect. By modifying a model of Aghion, et al. (1999), we provide a microfoundation for credit constraints imposed on each agent.

Suppose that each agent is endowed with $w$ units of wealth at his birth. The initial wealth is going to be investment resources. If he borrows $-b > 0$, his total resources are $k := w - b$. Let the (gross) return on one unit of investments be $R$. The Bank monitors borrowers only when they default. When the Bank monitors a borrower, it has to pay costs $-rbC(p)$ to collect $-prb$, where $r$ is a (gross) market interest rate and $p \in (0, 1)$ is the probability with which the Bank can collect the repayment. It is assumed that $C : [0, 1) \to \Re_+$ is twice continuously differentiable, $\frac{\partial C(.)}{\partial p} > 0$, $\frac{\partial^2 C(.)}{\partial p^2} > 0$, $C(0) = 0$, $\lim_{p \to 1} C(p) = \infty$, and $C'(0) < 1$. As the Bank takes on more costs, the probability to succeed in monitoring goes up.

If borrowers want to default, they have to pay default costs $\theta rk$. We assume that $0 < \theta < 1 - C'^{-1}(1) < 1$ and due to this assumption, every borrower faces credit constraints that are severer than the natural debt limit.

The closer is $\theta$ to $1 - C'^{-1}(1)$, the more nearly the credit market approaches a perfect one. The default costs are considered as fines or social sanctions.

Under this loan contract, the incentive compatibility constraint so as for a borrower not to default is given by:

$$Rk + rb \geq (R - \theta r)k + prb, \tag{1}$$

which is rewritten as:

$$b \geq -\frac{\theta}{1-p}k. \tag{2}$$

The left-hand side of Eq.(1) is the gain when the borrower starts a project, whereas the right-hand side is the gain when the borrower defaults. Eq.(2) is independent of the return on one unit of investments $R$. In the next section, we will introduce the heterogeneity of the returns between agents, depending upon the agents' talents.

In order to choose an optimal probability, the Bank solves its maximization problem such that:

$$\max_p \quad -prb + rbC(p),$$

which is rewritten as:

$$\max_p \ p - C(p).$$

From the first-order condition, we have:

$$p = C'^{-1}(1). \tag{3}$$

Substituting Eq.(3) into Eq.(2) gives:

$$b \geq -\frac{\theta}{1 - C'^{-1}(1)}k. \tag{4}$$

Since $\theta < 1 - C'^{-1}(1)$, we can let $\mu := \frac{\theta}{1-C'^{-1}(1)} \in (0, 1)$ and thus:

$$b \geq -\mu k, \tag{5}$$

which is a credit constraint. $\mu$ is the measure of financial development. We can say that a financial sector is fully developed in an economy if the monitoring costs are low, i.e., if the function $C(p)$ shifts down so that $C'^{-1}(1)$ increases. In addition, financial development must be related to the social sanctions when an agent defaults. That is to say, a financial sector in an economy is fully developed if $\theta$ is large.

## 2.2 Individuals

As already mentioned, an agent is born at the beginning of the period endowed with $w$ units of wealth. $w$ does not vary between agents. Since we want to focus on inequality stemming from agents talents, we assume that each agent is endowed with the same amount of the initial wealth. The objective of each agent is to maximize his income at the end of the period. In order to obtain income at the end of the period, each agent has to start an investment project or deposit his wealth in the Bank. If an agent is engaged in a project, he creates intermediate goods used for the final production. The intermediate goods are sold to the final production firm. At the beginning of the period, each agent may borrow from the Bank if he wants; however, the Bank imposes a certain limitation on the borrowing, i.e., the Bank imposes credit constraints on borrowers in order to avoid default. If an agent wants to borrow from the Bank, he can do so up to some proportion of his capital holding. The constraints an agent faces are as follows:

$$b + k \leq w \tag{6}$$

$$b \geq -\mu k \tag{7}$$

$$k \geq 0, \tag{8}$$

where $k$ is capital to start a project. $b$ is a deposit if positive and a debt if negative. Eq.(6) is a budget constraint. As mentioned above, each agent can choose to start a project using his wealth and borrowing from the Bank or to deposit his wealth in the Bank. Eq.(7) is a credit constraint: each agent can borrow from the Bank up to $\mu$ times his capital. As investigated in the previous subsection, the parameter $\mu \in (0, 1)$ is the measure of financial development. If $\mu$ is close to zero, there is no financial sector in this economy. In this case, no one can borrow nor deposit. Each agent has to start a project no matter what talent he has. If $\mu$ is sufficiently close to one, the credit market is perfect, implying that every agent can borrow from the Bank as much as he wants.

An agent's income $y$ at the end of the period is given by:

$$y = rb + q\phi k, \tag{9}$$

where $r$ is the gross interest rate. $\phi k$ is intermediate goods created by the agents, where $\phi$ is the marginal product of the agent and $q$ is the price (relative to the final goods) of the intermediate goods. In this economy, there is no uncertainty and then each agent just maximizes his income $y$ by choosing how much he invests in a project and/or how much he deposits in the Bank.[6]

Let us introduce the heterogeneity of agents. Agents are heterogeneous in terms of their talents in creating intermediate goods. An agent receives a stochastic shock for his productivity $\phi$ at his birth. When he solves his maximization problem, he knows his own productivity; however, since it is private information, no other agents including the Bank know his productivity. $\phi$ has a time-invariant distribution $G(\phi)$ whose support is $[0, a]$, where $a > 0$.

**Assumption 1**

- *$\int_0^a \phi dG(\phi) < \infty$.*
- *$G(\phi)$ has a continuous density $g(\phi)$ on $[0, a]$.*

The production function for the final goods is given by:

$$Y = AH, \tag{10}$$

where $H = \int_0^a \phi kLdG(\phi)$ and $A$ is the productivity parameter, which is constant. Since the final production sector is competitive and the production function is linear with respect to $H$, it holds that $q = A$ in equilibrium.[7] We may think of investors as business elites managing this firm. The rewards for their work depend upon their talents $\phi$. While in the current model, each business elite gets into debt, we may think that this firm owes the Bank on an accounting book instead of them.

Lemma 1 provides a solution to an agent's maximization problem.

**Lemma 1**

- *If $r > A\phi$, then $k = 0$ and $b = w$.*
- *If $r < A\phi$, then $k = \frac{w}{1-\mu}$ and $b = -\frac{\mu w}{1-\mu}$.*

[6]One might argue that there might be a case in which it is better for agents to preserve the initial wealth without any economic activities. In order to avoid this case, we assume that $r > 1$. If $A$ and $a$ (that appear below) are sufficiently large relative to $\mu_H$ and $\tilde{\mu}$ (that appear below as well), this assumption holds. Alternatively, we can assume that the initial wealth is perishable during the period without any economic activities.

[7]Our model is silent on the depreciation of intermediate goods because that does not matter. If we let $\delta$ be a depreciation rate of intermediate goods and $\tilde{A}H$ be value creation by the final production, the firm maximizes: $\tilde{A}H + (1-\delta)H - qH$. Letting $A := \tilde{A} + (1-\delta)$, we have $q = A$ in equilibrium.

**Proof:** The maximization problem is rewritten as:

$$\max_b \ y,$$

subject to:

$$-\frac{\mu w}{1-\mu} \leq b \leq w \tag{11}$$

$$y \leq (r - A\phi)b + A\phi w. \tag{12}$$

If $r > A\phi$, then the agent chooses $b = w$ and thus $k = 0$. If $r < A\phi$, then the agent chooses $b = -\frac{\mu w}{1-\mu}$ and thus $k = \frac{w}{1-\mu}$. $\square$

As seen in lemma 1, $\frac{r}{A}$ is a cutoff which divides agents into savers and investors. If an agent has sufficiently high productivity such that it is greater than $\frac{r}{A}$, he starts a project borrowing from the Bank, whereas if an agent has low productivity such that it is less than $\frac{r}{A}$, he becomes a saver depositing all his initial wealth in the Bank.[8]

## 2.3 Gini Coefficient

The virtue of the current model is that the Gini coefficient can be derived explicitly if the distribution of $\phi$ is provided. In what follows, the Lorenz curve and the Gini coefficient are derived. While in general equilibrium, $r$ will be endogenously determined, we assume that it is given for the time being.

**Lemma 2** *Suppose that $r$ is given, then per capita income $\tilde{y}$ of this economy is given by:*

$$\tilde{y} = \frac{r(G(r/A) - \mu) + AF(r/A)}{1-\mu} w, \tag{13}$$

*where $F(r/A) := \int_{\frac{r}{A}}^{a} \phi dG(\phi)$.*

**Proof:** From Eq.(12) and lemma 1, we have $y = \frac{(A\phi - r\mu)}{1-\mu} w$ for agents with $\phi > \frac{r}{A}$ and $y = rw$ for agents with $\phi < \frac{r}{A}$. Therefore,

$$\begin{aligned} \tilde{y}L &= \int_0^{\frac{r}{A}} rwLdG(\phi) + \int_{\frac{r}{A}}^{a} \frac{(A\phi - r\mu)}{1-\mu} wLdG(\phi) \\ \iff \quad \tilde{y} &= \frac{r(G(r/A) - \mu) + AF(r/A)}{1-\mu} w. \end{aligned} \qquad \square$$

[8] We ignore agents whose productivity is exactly equal to $\frac{r}{A}$ because they have no impact on the economy.

**Lemma 3** *The Lorenz curve $L(x)$ in this economy is given by:*

$$L(x) = \begin{cases} \frac{r(1-\mu)}{r(G(r/A)-\mu)+AF(r/A)}x & if \quad 0 \le x < G(r/A) \\ \frac{-AF(G^{-1}(x))-\mu rx+AF(r/A)+rG(r/A)}{r(G(r/A)-\mu)+AF(r/A)} & if \quad G(r/A) \le x \le 1, \end{cases} \tag{14}$$

*where $x := G(\phi)$.*

**Proof:** The income share up to the $G(\phi)$ quantile is given as follows. For agents with $\phi < \frac{r}{A}$, we have:

$$\frac{\int_0^\phi rwdG(\phi)}{\tilde{y}} = \frac{r(1-\mu)}{r(G(r/A)-\mu)+AF(r/A)}G(\phi).$$

For agents with $\phi > \frac{r}{A}$, we have:

$$\frac{\int_0^{\frac{r}{A}} rwdG(\phi) + \int_{\frac{r}{A}}^{\phi} \frac{A\phi - r\mu}{1-\mu}wdG(\phi)}{\tilde{y}} = \frac{-AF(\phi) - \mu rG(\phi) + AF(r/A) + rG(r/A)}{r(G(r/A)-\mu)+AF(r/A)}.$$

By continuity, agents with $\phi = \frac{r}{A}$ may be associated with this equation. Then, letting $x := G(\phi)$ gives Eq.(14). $\square$

The Lorenz curve obtained here is given in Figure 5. By using the Lorenz curve, we can obtain a Gini coefficient from the formula: $Gini := 1 - 2\int_0^1 L(x)dx$. For the rest of the current paper, we assume that $\phi$ has a uniform distribution in $[0, a]$ so that our investigation for Gini coefficients can be concrete. Since $G(\phi) = \frac{\phi}{a}$ and $F(\phi) = \frac{a^2-\phi^2}{2a}$, the Lorenz curve becomes:

$$L(x) = \begin{cases} \frac{2aAr(1-\mu)}{(aA)^2-2\mu raA+r^2}x & if \quad 0 \le x < \frac{r}{aA} \\ \frac{(aA)^2x^2-2\mu raAx+r^2}{(aA)^2-2\mu raA+r^2} & if \quad \frac{r}{aA} \le x \le 1, \end{cases} \tag{15}$$

Then, with $r$ given, the Gini coefficient is obtained as follows:

$$Gini = \frac{(aA)^3 - 3r^2aA + 2r^3}{3aA((aA)^2 - 2\mu raA + r^2)}. \tag{16}$$

[Figure 5 around here]

The literature dealing with inequality within an economy is divided into two kinds. In one genealogy, researchers examine whether inequality that is exogenously given widens or shrinks (e.g., Galor and Zeira (1993) and

Banerjee and Newman (1993)). In the other genealogy, researchers examine inequality that appears endogenously (e.g., Galor and Moav (2000) and Matsuyama (2000)). As in the second genealogy, inequality in our model endogenously appears due to the heterogeneity of agents' talents. If there is no financial sector in the economy, no one can borrow nor can lend initial wealth and thus everyone has to create intermediate goods by using their own resources. Therefore, in this case, inequality directly stems from the heterogeneous productivity. The merit of the current model is that we can investigate whether financial globalization and/or financial development widen or reduce endogenous inequality within a country. In the next section, we study effects of financial development on inequality in a closed economy.

# 3 Closed Economy

In this section, a closed economy is examined, where the financial market has to clear within the economy. The credit market clearing condition is given by:

$$\int_0^{\frac{r}{A}} bLdG(\phi) + \int_{\frac{r}{A}}^{a} bLdG(\phi) = 0. \tag{17}$$

From lemma 1, this is rewritten as:

$$G(r/A) = \mu. \tag{18}$$

The equilibrium interest rate is determined by the parameter for financial development $\mu$. As the financial sector matures and thus $\mu$ becomes large, most initial wealth is used by more talented agents. As a result, inefficiency stemming from the fact that less capable agents are engaged in production activities is corrected. The Bank can promise to pay savers the higher interest rates.

Since $G(r/A) = \mu$, from Eq.(13), per capita income in a closed economy is given by:

$$\tilde{y} = \frac{AF(r/A)}{1 - G(r/A)} w. \tag{19}$$

In this general equilibrium model, as a financial sector develops very well, less talented agents come to be able to utilize the abilities of more talented agents. This is an essence of financial development. In this economy, no matter what distribution $\phi$ has, per capita income increases as the financial sector develops.

**Proposition 1** *Suppose that an economy is closed. Then, as the financial sector fully develops, per capita income goes up, i.e.,* $\frac{\partial \tilde{y}}{\partial \mu} > 0$.

**Proof:** Thanks to Eq.(18), it suffices to show $\frac{\partial \tilde{y}}{\partial (r/A)} > 0$. Since $F(r/A) > (r/A)(1 - G(r/A))$, it holds that $\frac{\partial \tilde{y}}{\partial (r/A)} = \frac{g(r/A)[F(r/A) - r/A(1-G(r/A))]}{(1-G(r/A))^2} Aw > 0$. $\square$

Since now we assume that $\phi$ has a uniform distribution in $[0, a]$, it follows that $r = aA\mu$. In this case, the Gini coefficient is derived as follows in equilibrium.

$$Gini = \frac{(1-\mu)(2\mu+1)}{3(1+\mu)}. \tag{20}$$

We note that the Gini coefficient given by (20) is independent of $a$ (and $A$), i.e., only $\mu$ is crucial for it. Nevertheless, we cannot say that $a$ is unimportant: if there is no heterogeneity between agents, inequality cannot arise. With infinitesimal heterogeneity, we can define the Gini coefficient. In this sense, the positive value of $a$ is very important.

**Proposition 2** *Suppose that an economy is closed. Then, the Gini coefficient goes down as the financial sector fully develops, i.e.,* $\frac{\partial Gini}{\partial \mu} < 0$.

**Proof:** From Eq.(20), we have $\frac{\partial Gini}{\partial \mu} = \frac{-2\mu^2 - 4\mu}{3(1+\mu)^2} < 0$. $\square$

Proposition 2 says that inequality within a closed economy shrinks, as the financial sector matures. Intuitively, this happens by the mechanism that works with the interest rate. As the financial sector matures and $\mu$ goes up, the equilibrium interest rate increases (see Eq.(18)). An increase in the interest rate has two opposite effects on inequality. The first is that investors who borrow from the Bank are disadvantaged with an increase in the interest rate, whereas lenders benefit from that. As a consequence, inequality shrinks. The second is that as the interest rate increases, the number of investors goes down while the number of lenders goes up. This implies that as the financial sector matures, the initial wealth concentrates on a small number of investors. Then, each investor can obtain more income than before. Since the number of lenders increases, inequality might widen. In the case of a closed economy, the first effect dominates the second effect and thus inequality shrinks without fail.

# 4 Multi-Country Model

In this section, we develop a multi-country model and address a question about inequality within a country when financial globalization proceeds. In the multi-country model, financial development in a country has a spillover effect on another country via the world interest rate. We assume that the initial wealth and the final output can move freely in the world market, whereas the intermediate goods cannot.

For a country open to the world financial market, the left-hand side of Eq.(17) is not equal to zero. If the country is a net lender (borrower), the left-hand side is greater (less) than zero. Let $B$ be net foreign wealth held by the country. Then it follows from lemma 1 that:

$$\frac{G(r/A)-\mu}{1-\mu}wL = B. \tag{21}$$

We note that each country faces the common world interest rate.

If the financial sector in a country is so poorly developed that $\mu$ is smaller than $G(r/A)$, then the country is a net creditor in the world financial market. In this case, the initial wealth flows out of the country. Meanwhile, if the financial sector is so fully developed that $\mu$ is greater than $G(r/A)$, then the country is a net borrower and the extra wealth flows into the country. Caballero, et al. (2006), Mendoza, et al. (2007), and Willen (2004) address a question about how the differences in the degrees of credit market imperfections or incompleteness of financial markets affect the determination of the current account imbalances.[9] They drive similar results to the one obtained here. And also, figure 4 exposes a fact in the United States that is consistent with our consequence.

We assume that there exists a home country whose measure is naturally assumed to be one. Likewise, we assume that there exists a continuum of small foreign courtiers except for the home country. The parameter of the degree of financial development in the home country is $\mu_H$. For simplicity, we assume that the foreign countries have a common value of the financial development parameter $\mu_F$. A domestic agent must borrow from the Bank when he wants to do so in the world financial market and he faces a credit constraint associated with $\mu_H$. That is to say, each agent is subject to institutional restrictions in his own country.

We can say that financial globalization proceeds if the measure of a continuum of the foreign countries increases, implying that the number of the foreign countries that participate in the world financial market goes up. In what follows, we focus our analysis on the case in which $\mu_H > \mu_F$, regarding the home country as the United States.

Let $B_H$ and $B_i$ be net foreign wealth in the home country and the foreign country $i$, respectively. The market clearing condition in the world financial

[9]Precisely speaking, a country's current account balance is equal to the change in its net foreign wealth.

market is given by:

$$B_H + \int_{i \in \mathcal{C}} B_i di = 0, \tag{22}$$

where $\mathcal{C}$ is a set of the foreign countries. By using Eq.(21), Eq.(22) is rewritten as:

$$\frac{G(r/A) - \mu_H}{1 - \mu_H} w_H L_H + \frac{G(r/A) - \mu_F}{1 - \mu_F} \int_{i \in \mathcal{C}} w_i L_i di = 0,$$

where $w_H$ and $L_H$ ($w_i$ and $L_i$) are the initial wealth and population in the home country (the foreign country $i$), respectively. Letting $M := \frac{1}{w_H L_H} \int_{i \in \mathcal{C}} w_i L_i di$ yields:

$$G(r/A) = \frac{\frac{\mu_H}{1-\mu_H} + \frac{M\mu_F}{1-\mu_F}}{\frac{1}{1-\mu_H} + \frac{M}{1-\mu_F}} := \tilde{\mu}. \tag{23}$$

The parameter $M$ expresses the size of the world financial market relative to the one in the home country. Financial globalization proceeds if $M$ increases, again implying that the number of countries and/or the number of people that participate in the world financial market go up.[10]

**Lemma 4** *As $M$ increases from zero to infinity, $G(r/A)$ decreases from $\mu_H$ to $\mu_L$.*

**Proof:** We have $\frac{\partial G(r/A)}{\partial M} = \frac{\mu_F - \mu_H}{(1-\mu_F)(1-\mu_H)(\frac{1}{1-\mu_H} + \frac{M}{1-\mu_F})^2} < 0$, implying that $G(r/A)$ is a decreasing function with respect to $M$. And also, if $M = 0$, then $G(r/A) = \mu_H$ and $\lim_{M \to \infty} G(r/A) = \lim_{M \to \infty} \frac{\frac{\mu_H}{M(1-\mu_H)} + \frac{\mu_F}{1-\mu_F}}{\frac{1}{M(1-\mu_H)} + \frac{1}{1-\mu_F}} = \mu_F$. $\square$

In the case of a closed economy, it holds that $M = 0$. As shown in the previous section, in a closed economy, the interest rate is determined by $G(r/A) = \mu_H$, which is consistent with lemma 4. However, as financial globalization proceeds, i.e., as $M$ goes up, the interest rate declines. This result agrees with the stylized facts that are shown in figures 2 and 3 as underdeveloped countries with poorly developed financial sectors have entered the world financial market since the mid-1980s.

[10] One might ask whether a foreign country is willing to enter the world financial market. As long as a policymaker in a foreign country cares about only per capita income, he prefers to enter the world financial market since $G^{-1}(\mu_F) < G^{-1}(\tilde{\mu})$ and the right-hand side of Eq.(13) is an increasing function with respect to $r/A$. In our model, since only intermediate goods are used in the finial production, per capita income in a foreign country after entering the world financial market is greater than before entering it. If we assume that domestic labor is used for the domestic production, foreign countries might not prefer to enter the world financial market. Investigating this is beyond the scope of this paper.

As $M$ increases from zero to infinity, $\tilde{\mu}$ decreases from $\mu_H$ to $\mu_F$. Therefore, the interest rate $r$ goes down. There is a caveat with this claim. That is to say, we do not consider positive effects of financial globalization on financial development. Chinn and Ito (2006) provide empirical evidence that financial globalization has a positive effect on financial development. If their result is robust, then as financial globalization proceeds, $\mu_F$ and $\mu_H$ go up and thus $\tilde{\mu}$ goes up as well. Accordingly, the world interest rate might go up. In what follows, we examine inequality within the home country. On the one hand, we inquire whether inequality widens or narrows when financial globalization proceeds with $\mu_H$ given. On the other hand, we inquire a same question when financial development in the home country proceeds with $\tilde{\mu}$ given.

As in the previous sections, we assume that $\phi$ has a uniform distribution in $[0, a]$. In this case, from Eq.(23), the equilibrium interest rate is given by $r = aA\tilde{\mu}$. Inserting this into Eq.(16), we have the Gini coefficient of the home country as follows:

$$Gini = \frac{1 - 3\tilde{\mu}^2 + 2\tilde{\mu}^3}{3(1 - 2\mu_H\tilde{\mu} + \tilde{\mu}^2)}. \tag{24}$$

In order to examine the effect of financial globalization on inequality, we investigate Eq.(24). By taking a derivative of $Gini$ with respect to $M$, we obtain:

$$\begin{aligned} \frac{\partial Gini}{\partial M} &= \frac{2(\tilde{\mu}^4 - 4\mu_H\tilde{\mu}^3 + (3\mu_H + 3)\tilde{\mu}^2 - 4\tilde{\mu} + \mu_H)}{3(1 - 2\mu_H\tilde{\mu} + \tilde{\mu}^2)^2}\frac{\partial\tilde{\mu}}{\partial M} \\ &= \frac{2(1 - \tilde{\mu})(-\tilde{\mu}^3 + (4\mu_H - 1)\tilde{\mu}^2 + (\mu_H - 4)\tilde{\mu} + \mu_H)}{3(1 - 2\mu_H\tilde{\mu} + \tilde{\mu}^2)^2}\frac{\partial\tilde{\mu}}{\partial M}. \end{aligned} \tag{25}$$

**Proposition 3** *Suppose that $\mu_H$ and $\mu_F$ are given. Then the following hold:*

- *If $\mu_F$ is small, then there exists an $\bar{M}$ such that for $M \in [0, \bar{M})$, $\frac{\partial Gini}{\partial M} > 0$ holds and for $M \in [\bar{M}, \infty)$, $\frac{\partial Gini}{\partial M} < 0$ holds.*
- *If $\mu_F$ is large, then $\frac{\partial Gini}{\partial M} > 0$ for any $M \in [0, \infty)$.*

**Proof:** Let $f(\tilde{\mu}) := \tilde{\mu}^3 - (4\mu_H - 1)\tilde{\mu}^2 - (\mu_H - 4)\tilde{\mu} - \mu_H$. Then $f(\tilde{\mu})$ is monotonically increasing. Since $\frac{\partial\tilde{\mu}}{\partial M} < 0$, it follows that $sign(f(\tilde{\mu})) = sign(\frac{\partial Gini}{\partial M})$. Since $f(0) < 0$ and $f(\mu_H) > 0$, it is obvious that if $\mu_F$ is small, then there exists an $\bar{M}$ such that if $M \in [0, \bar{M})$, then $\frac{\partial Gini}{\partial M} > 0$ and if $M \in [\bar{M}, \infty)$, then $\frac{\partial Gini}{\partial M} < 0$. Meanwhile, it is also obvious that if $\mu_F$ is large, then $\frac{\partial Gini}{\partial M} > 0$ for any $M \in [0, \infty)$. $\square$

Even though the first part of proposition 3 tells us that if $\mu_F$ is small, then there exists a hump-shaped relationship between inequality and financial globalization, we can safely say that financial globalization by and large has a negative effect on inequality in the home country. This is because if $\mu_H$ is close to one and $M$ is close to zero, then the Gini coefficient is close to zero (See Eq.(20)), whereas if $\mu_F$ is close to zero and $M$ is very large, then the Gini coefficient is close to one third (See Eq.(24)). So far, the discussion is for the case in which financial globalization proceeds with $\mu_H$ given. In what follows, we study the case in which financial development in the home country proceeds with $\tilde{\mu}$ given.

**Proposition 4** *Suppose that $M$ is sufficiently large. Then, Gini increases with $\mu_H$.*

**Proof:** If $M$ is sufficiently large, then $\tilde{\mu}$ is independent of $\mu_H$. Hence, it obviously follows from Eq.(24) that $\frac{\partial Gini}{\partial \mu_H} > 0$. $\square$

If $M$ is so large that $\mu_H$ cannot affect $\tilde{\mu}$, then *Gini* becomes an increasing function with respect to $\mu_H$. We note that this case is a case in which the home country is a small open economy. When $M$ is small, the home country is a large economy or near to a closed economy. As demonstrated in the previous section, in this case, *Gini* is a decreasing function with respect to $\mu_H$. Therefore, as the financial sector develops, inequality shrinks. However, as financial globalization proceeds, the home country gradually approaches a small open economy. As a consequence, the effect of $\mu_H$ on the world interest rate becomes smaller and thus *Gini* becomes an increasing function with respect to $\mu_H$. In other words, due to financial globalization, the manner in which financial development in the home country affects the Gini coefficient changes. With the low degree of financial globalization, financial development in the home country narrows inequality, whereas with the high degree of financial globalization, financial development widens inequality. Which has a greater effect on the Gini coefficient, $\tilde{\mu}$ or $\mu_H$, in the multi-country model is a quantitative question. In the next section, we calibrate the Gini coefficients and investigate this.

# 5 Quantitative Analysis

In this section, we do a simple quantitative analysis, numerically deriving the Gini coefficients from our model. We keep assuming that $\phi$ has a uniform distribution in $[0, a]$. We have to pin down three parameters, $\mu_H$, $\tilde{\mu}$, and

$aA$.[11]

We do not investigate the effects of wealth distribution among agents on income inequality. As mentioned before, we focus our analysis on income inequality arising from agents' talents reflecting in the value of $a$, which is associated with the creation for intermediate goods. In other words, the heterogeneity of agents' talents is an only source of income inequality. Therefore, we predict that the Gini coefficient calibrated here is understated because we do not consider any other sources of income inequality. In order to compensate for this shortcoming, we examine the various values of $a$ (or equivalently $aA$).

## 5.1 Data

In order to determine the three parameters, $\mu$, $\tilde{\mu}$, and $aA$, we collect the data for *claims on private sector*, *gross fixed capital formation*, *gross saving*, *federal funds rate*, and *GDP deflator* from the *International Financial Statistics 2008*, which is a database created by the International Monetary Fund (IMF).

The assembled data set is processed so that we can compute the parameter values from it. The first step is that deflating the *claims on private sector*, *gross fixed capital formation*, and *gross saving* by the *GDP deflator*, we take the moving averages of them for eleven years so as to remove noises probably included in each data point. $PC$, $I$, and $S$ denote the "processed" *claims on private sector*, *gross fixed capital formation*, and *gross saving*, respectively. In order to create the increments of $PC$, we take the first differences of $PC$, calling this $DPC$. In order to obtain the data for the current account $CA$, we compute $CA := S - I$. For each year, the (gross) real interest rates denoted by $r$ are derived from the formula 1+*federal funds rate*−*inflation rate*. The inflation rates are computed from the *GDP deflator*. To be summarized, we create a yearly data set for $S$, $I$, $DPC$, $CA$, and $r$ from 1960 to 2002. The data set is inserted in appendix.

## 5.2 Parameter Determination

We have established a one-period model assuming that each agent is endowed with $w_H$ units of initial wealth. Hence, $W := w_H L_H$ is the total wealth in the home country, i.e., the United States.

We allow $\mu$ to vary depending upon years, implying that the degree of financial development is subject to the circumstances that the economy faces. From lemma 1, $K := \frac{1-G(r/A)}{1-\mu}W$ is the total capital stock existing in the home

[11] We do not have to distinguish $A$ from $a$.

country.[12] On the other hand, again from lemma 1, $PC = \frac{\mu(1-G(r/A))}{1-\mu} W$ is the *claims on private sector*. From these expressions, we obtain $PC = \mu K$. This formula is intuitive: the parameter of the degree of financial development $\mu = \frac{PC}{K}$ is the ratio of the *claims on private sector* to the total capital stock. The larger is $\mu$, the more fully developed is the financial sector in an economy. In the empirical literature, researchers often use *Private Credit* as an indicator for the degree of financial development. The indicator, *Private Credit*, has no theoretical foundation, whereas $\mu = \frac{PC}{K}$ has one.

While in our one-period model, we have $\mu = \frac{PC}{K}$, we do not have the data for the capital stock $K$. Then we assume that the increment of the credit provision, $\Delta PC$, is associated only with the new capital formation $\Delta K$. Under this assumption, $\Delta PC \approx \mu \Delta K$ holds. This assumption is acceptable if $\Delta\mu$ is so small relative to $\Delta PC$ and $\Delta K$ that it can be disregarded (where $\Delta x$ is the increment of $x$ between two adjoining years). Here, we note that $\Delta PC = DPC$ and $\Delta K = I$.

In order to determine $\tilde{\mu}$ from Eq.(23), ideally we should measure $\mu_L$ and $M$; however, it is impossible to do this, because we cannot know the exact number of countries that participate in the world financial market.[13] Instead, we use the real interest rate to calibrate $\tilde{\mu}$. That is to say, we utilize the indirect relationship between financial globalization and $\tilde{\mu}$ via the real interest rate, which is deduced from our model. $\tilde{a\mu}$ is a cutoff that divides agents into savers and investors when an economy is open to the world financial market. From figure 3, we recollect that since the mid-1980s, the real interest rate has been decreasing, even though the financial sector in the United States has been fully developing. Referring to our model, this phenomenon is because financially underdeveloped countries have entered the world financial market since then. Along with the real interest rate, the cutoff must have been reducing as well.

Since we assume $\phi$ has a uniform distribution in $[0, a]$, it follows that $r = aA\tilde{\mu}$. While $\tilde{\mu}$ is allowed to vary between years, it is assumed that $aA$ is time-invariant. From Eq.(21) and Eq.(23), it follows that $\frac{\tilde{\mu}-\mu}{1-\mu} W = B_H$. Substituting $r = aA\tilde{\mu}$ into this, we obtain $\frac{r/aA-\mu}{1-\mu} W = B_H$. We cannot obtain the data for $W$. So we assume that the increment of the net foreign wealth is associated only with the increment of wealth in the home country. This assumption holds if $\Delta(\frac{r/aA-\mu}{1-\mu})$ is so small relative to $\Delta W$ and $\Delta B_H$ that we

[12] We note that when an economy closed, $K = W$ holds, implying that the total wealth is accumulated as the form of the domestic capital stock.

[13] As Chinn and Ito (2006), for instance, create the index for financial openness, it is possible to know the degree of financial openness for each country. However, we cannot know the exact value of $M$ in our model.

can ignore it. Under this assumption, we have:

$$\mu + (1-\mu)\frac{\Delta B_H}{\Delta W} \approx \frac{1}{aA}r, \tag{26}$$

where we note that the increment of wealth is the total saving, i.e., $\Delta W = S$ and the increment of the net foreign wealth is the current account, i.e., $\Delta B_H = CA$. In order to obtain $\frac{1}{aA}$, we estimate Eq.(26) by the ordinary least squares estimation (OLS).[14] If we acquire $\frac{1}{aA}$, then $\tilde{\mu} = \frac{1}{aA}r$ can be determined.

From the OLS, we obtain $\frac{1}{aA} = 0.275$, which is significant at the conventional level. Accordingly, we have $aA = 3.64$. As mentioned before, the Gini coefficient calibrated here must be understated relative to the actual one because the actual one is also affected by the other factors we omit. In order to compensate for the shortcoming, we examine the various values of $aA$: $aA = 4.5$, 5.0, 5.5 and 6.0.

## 5.3 Calibration for the Gini Coefficients

Now that we have obtained the values of $\mu_H$ and $\tilde{\mu}$, we can compute the simulated Gini coefficients by using Eq.(24). The benchmark case with $aA = 3.64$ is given in Figure 6. At the same time, we plot the actual income Gini coefficient created by the Luxembourg Income Study (LIS).[15] As predicted, the simulated Gini coefficient is understated. However, the time trend is consistent with the actual Gini coefficient except for the late-1990s. In this sense, the simulated Gini coefficient captures the actual one very well.

Until the late 1970s, the simulated Gini coefficient decreases. The simulated Gini coefficient in 1978 exhibits 0.266, which is a minimum value of all. From the late-1970s to the mid-1990s, the simulated Gini coefficient steadily goes up. After the late-1990s, there is relatively no increase in the simulated Gini coefficient. As a whole, the line of the simulated Gini coefficient is U-shaped. This consequence is not consistent with Kuznets' hypothesis. Figure 7 provides the cases in which $aA = 4.5$, 5.0, 5.5 and 6.0. The cases in which $aA = 5.0$ and 5.5 capture the actual Gini coefficient much better than the benchmark case.

[Figure 6 around here]

[14] In this estimation, the independent variable is $r$, while the dependent variable is $\mu + (1-\mu)\frac{\Delta B_H}{\Delta W}$. This is a reasonable setting because $r$ is exogenous under the assumption that $r$ is perfectly foreseeable when each agent in the home country makes a decision.

[15] The data points for the United States are only for years 1974, 1979, 1986, 1991, 1994, 1997, 2000, and 2004. In order to supplement the other years, we joined the two adjoining points by a straight line.

[Figure 7 around here]

In figure 8, we examine what would happen if the United States was a closed economy. In a closed economy case, the Gini coefficient does not depend upon the value $aA$ but upon only $\mu_H$. Also, the Gini coefficient decreases with $\mu_H$. As seen in figure 8, the simulated Gini coefficients in closed and open economies move in the opposite directions of each other. From the early-1960s to the late-1980s, both of the simulated Gini coefficients are relatively stable. However, since the early-1980s, the simulated Gini coefficient in a closed economy has been declining. In particular, in 2000, the difference in the Gini coefficients between closed and open economies is biggest ever. This outcome is due to financial development in the United States under the different situations for financial openness. This experiment demonstrates that financial openness changes the manners in which financial development affects inequality.

[Figure 8 around here]

As already noted, the Gini coefficient in the multi-country model is determined by the values of $\tilde{\mu}$ and $\mu_H$. Which has a greater effect on inequality? In order to address this question, we examine Eq.(24) as follows. Fixing $\mu_H$ to its average value, we compute a Gini coefficient ($Gini_1$) by using $\tilde{\mu}$s. In reverse, fixing $\tilde{\mu}$ to its average value, we compute a Gini coefficient ($Gini_2$) by using $\mu_H$s. Which captures the actual Gini coefficient better, $Gini_1$ or $Gini_2$? In figure 9, we plot the simulated Gini coefficient in the case in which $aA = 5.0$. Of course, we will obtain the similar results even if we use $aA = 3.64$, 4.5, 5.5, or 6.0. $Gini_2$ captures the actual Gini coefficients far better than $Gini_1$. This implies that financial development is a more important factor for the determination of income inequality in the United States than the world interest rate. Whether financial development widens or narrows income inequality within an economy is an open question as Levine (2005) points out. We note from our calibration that at least in the United States, financial development widens income inequality.

[Figure 9 around here]

# 6 Concluding Remarks

Whether financial globalization benefits integrated countries is an important question in international economics. This paper has studied how financial globalization and financial development affects inequality within a country. Depending upon whether an economy is closed or open to the world financial market, financial development in the economy has different effects on inequality. If an economy is closed, inequality narrows as the financial sector develops. By contrast, if an economy is open and if the world market is sufficiently large, then inequality widens as the financial sector develops. The calibration for the Gini coefficients shows that income inequality in the United States is negatively affected by its financial sector development.

Other than the main results for income inequality, we obtain two testable claims as by-products:

- The first is obtained from Eq.(21). Nowadays, there are big imbalances of the current account between countries. According to Eq.(21), those big differences are due to the differences in the levels of financial development. There are few empirical articles dealing with this claim with some exceptions. Mendoza, et al. (2007) provide preliminary evidence for this claim; however, they do not take into account reverse causalities. Chinn and Ito (2005) empirically examine the imbalances of the current account but they do not find out any significant result for this claim.

- The second originates in Eq.(23). As seen figure 3, the world interest rate has been decreasing recently. According to Eq.(23), this phenomenon is caused by the fact that many countries with poorly developed financial sectors have entered the world financial market. There is no empirical analysis that deals with the relationship between financial globalization and the world interest rate. In our calibration, the world interest rate has few effects on inequality in the United states. However, understanding the declined world interest rate in terms of financial globalization must be important because resource allocation within and between countries is subject to the world interest rate.

Under the recent circumstances in which financial integration has strengthened in the world economy, the two testable claims above are important open questions in macroeconomics and international economics.

We conclude this paper with remarks on future research. First, our quantitative analysis is applicable to the other countries. How well the simulated Gini coefficients capture the actual ones in the other countries is a question for future research. Second, in this paper, we have established a one-period model so that we omit the effects of initial wealth distribution between agents. Due to this simplification, we consider only one dimensional heterogeneity and derive a closed-form Gini coefficient. While our analysis is tractable, ignoring initial wealth distribution is a shortcoming. In order to take into account heterogeneous wealth endowments between agents, we have to extend our model to a dynamic general equilibrium model with infinitely-lived agents. This task is quite hard because we cannot obtain closed-form Gini coefficients at each point in time due to the difficulty with aggregation of agents' incomes. We need elaborate calibration to study this. This is future research as well.

# Appendix

[Table 1 around here]

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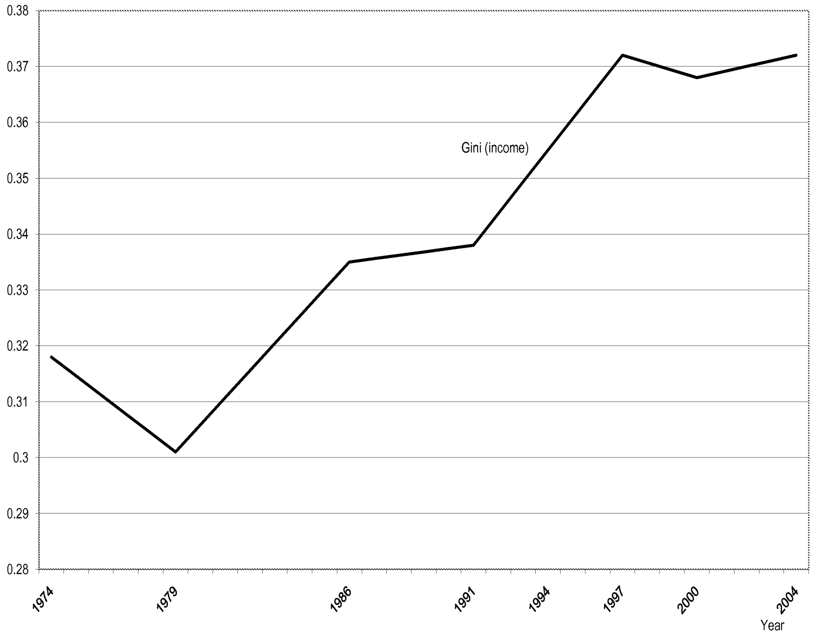


Figure 1: Income Inequality in the United States

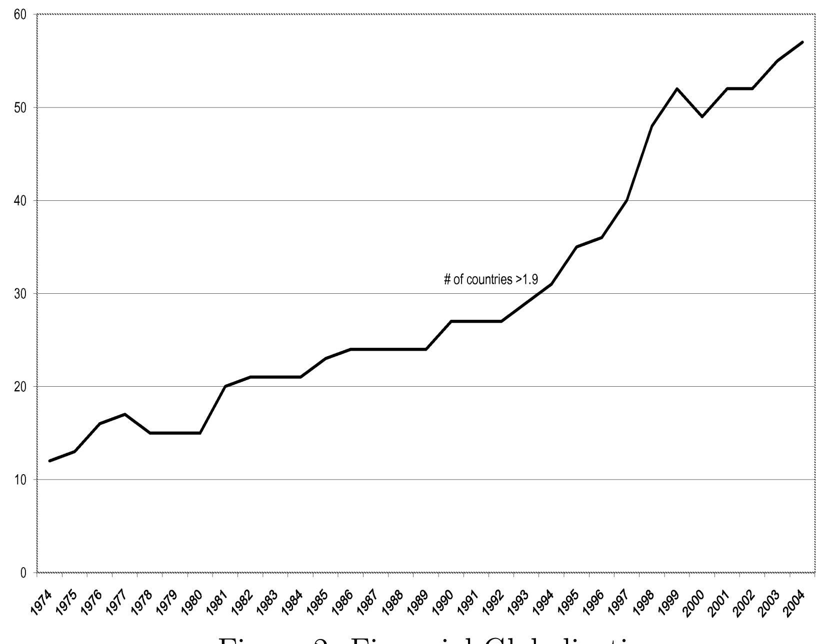


Figure 2: Financial Globalization

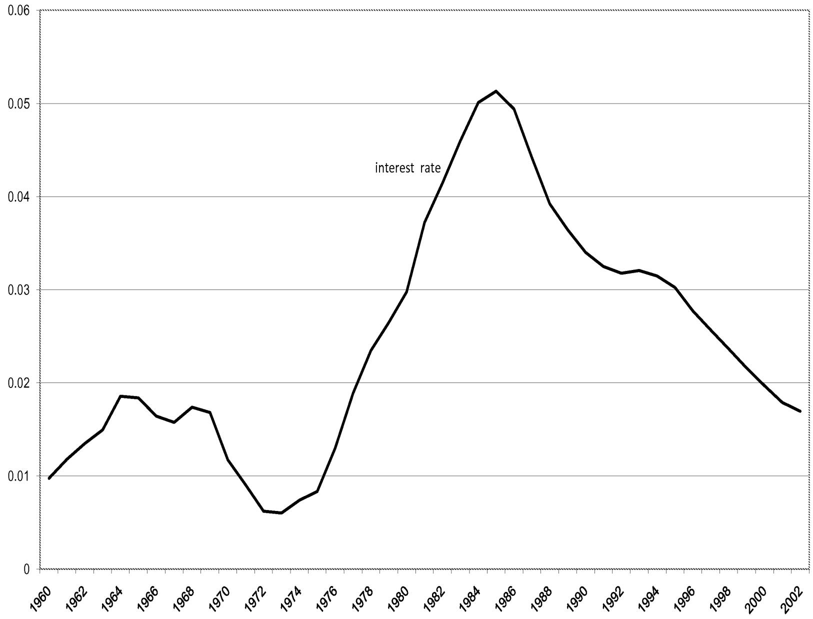


Figure 3: Real Interest Rate in the United States

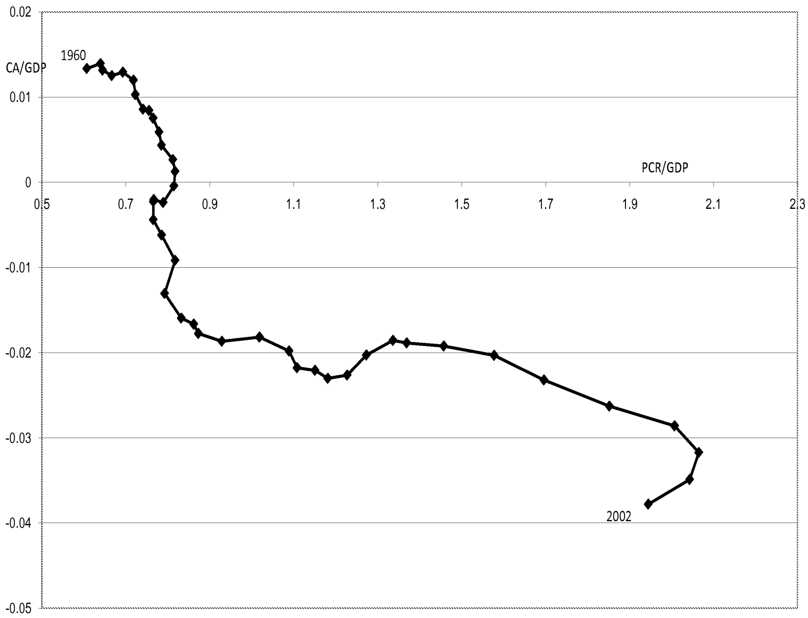


Figure 4: Private Credit vs Current Account

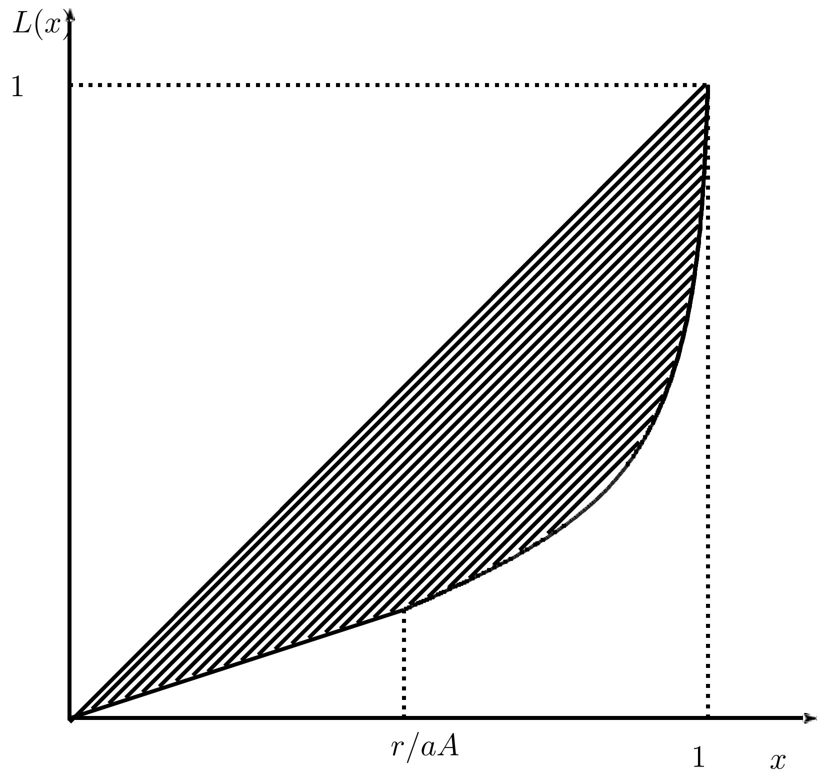


Figure 5: Lorenz Curve


Figure 6: Simulated Gini: benchmark case

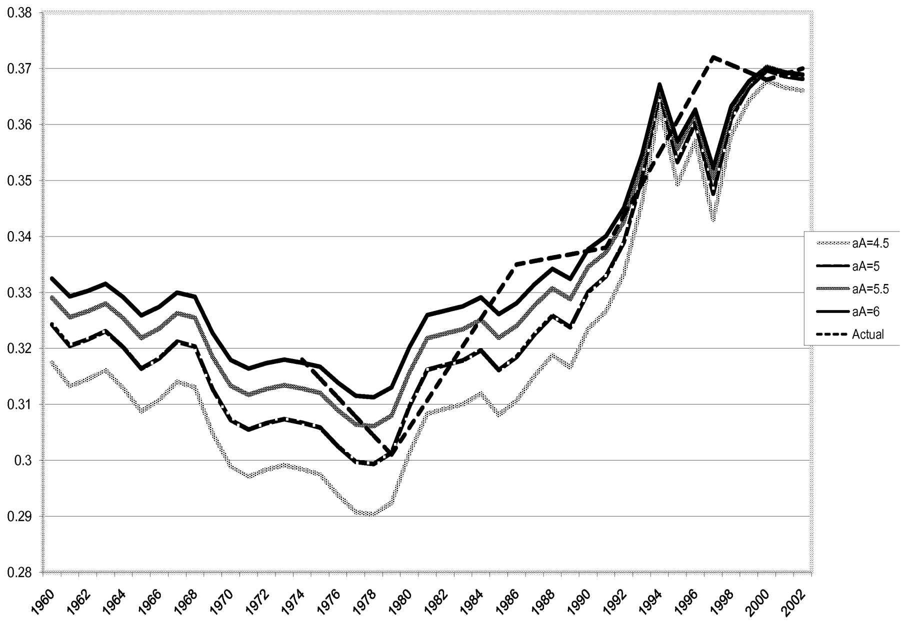


Figure 7: Simulated Gini: countervailed cases

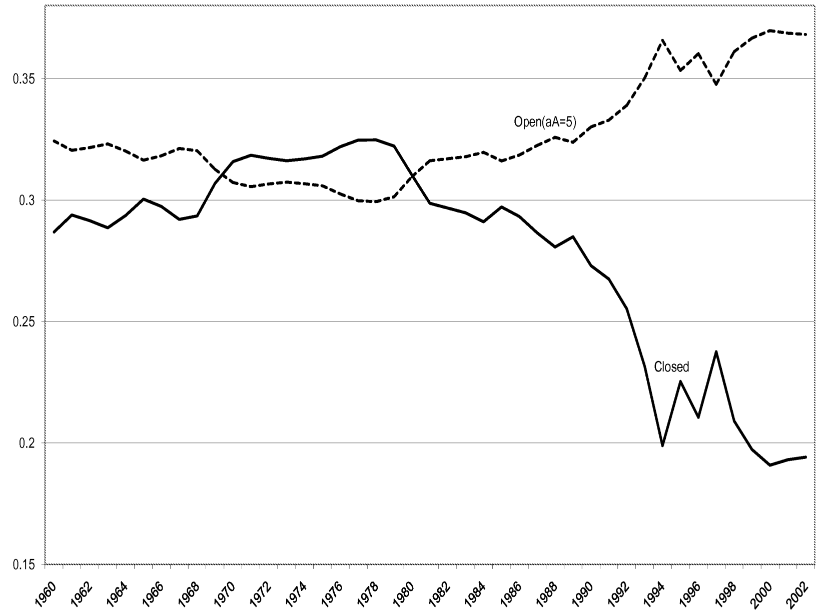


Figure 8: Simulated Gini: closed economy

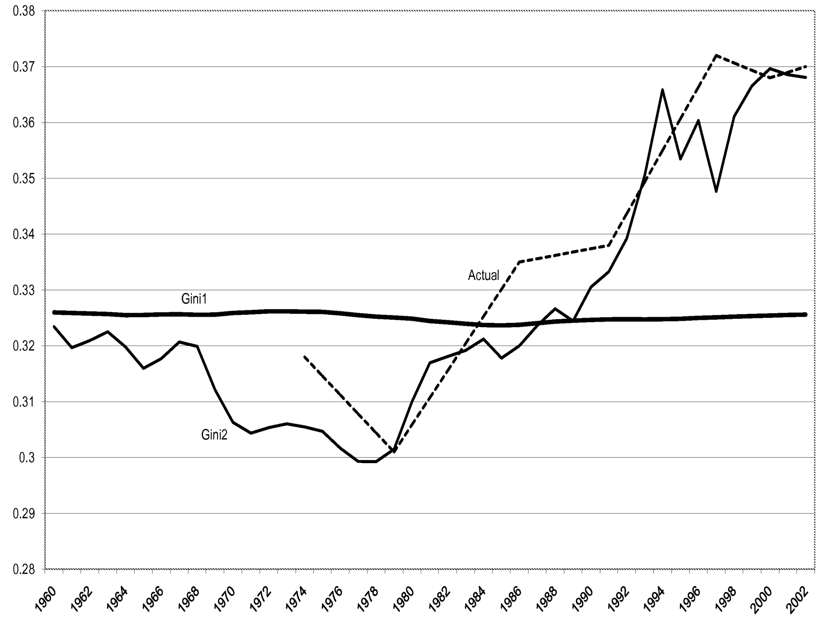


Figure 9: Effect Experiments

| | S | I | DPC | CA | r | GDP |
|---|---|---|---|---|---|---|
| 1960 | 549.250 | 514.878 | 155.079 | 34.372 | 1.010 | 2571.891 |
| 1961 | 572.738 | 535.401 | 147.215 | 37.337 | 1.012 | 2679.735 |
| 1962 | 591.010 | 554.273 | 157.305 | 36.737 | 1.013 | 2791.430 |
| 1963 | 612.219 | 575.736 | 169.746 | 36.483 | 1.015 | 2914.298 |
| 1964 | 640.884 | 601.471 | 165.901 | 39.412 | 1.019 | 3049.399 |
| 1965 | 657.970 | 619.985 | 154.022 | 37.985 | 1.018 | 3170.360 |
| 1966 | 675.564 | 641.642 | 167.376 | 33.922 | 1.016 | 3297.341 |
| 1967 | 698.308 | 668.805 | 188.561 | 29.503 | 1.016 | 3437.787 |
| 1968 | 728.997 | 698.823 | 193.165 | 30.174 | 1.017 | 3585.618 |
| 1969 | 752.374 | 724.399 | 159.488 | 27.975 | 1.017 | 3720.675 |
| 1970 | 764.528 | 741.899 | 130.460 | 22.629 | 1.012 | 3840.008 |
| 1971 | 777.985 | 760.764 | 122.425 | 17.221 | 1.009 | 3962.727 |
| 1972 | 796.349 | 785.447 | 132.251 | 10.902 | 1.006 | 4085.591 |
| 1973 | 826.458 | 821.123 | 142.832 | 5.334 | 1.006 | 4224.728 |
| 1974 | 858.531 | 860.353 | 145.918 | -1.822 | 1.007 | 4362.986 |
| 1975 | 882.005 | 892.658 | 145.884 | -10.652 | 1.008 | 4489.922 |
| 1976 | 919.057 | 928.485 | 129.374 | -9.428 | 1.013 | 4628.084 |
| 1977 | 944.534 | 955.328 | 115.062 | -10.794 | 1.019 | 4745.420 |
| 1978 | 957.909 | 979.258 | 117.678 | -21.349 | 1.023 | 4865.313 |
| 1979 | 978.486 | 1009.416 | 139.300 | -30.930 | 1.027 | 4999.145 |
| 1980 | 999.645 | 1046.918 | 213.336 | -47.273 | 1.030 | 5156.802 |
| 1981 | 1022.184 | 1091.765 | 279.018 | -69.581 | 1.037 | 5334.288 |
| 1982 | 1043.771 | 1131.595 | 298.270 | -87.824 | 1.041 | 5510.119 |
| 1983 | 1069.131 | 1163.960 | 315.803 | -94.829 | 1.046 | 5691.223 |
| 1984 | 1083.477 | 1187.682 | 339.256 | -104.206 | 1.050 | 5869.978 |
| 1985 | 1089.778 | 1202.666 | 314.645 | -112.888 | 1.051 | 6046.250 |
| 1986 | 1101.150 | 1214.316 | 336.596 | -113.166 | 1.049 | 6222.517 |
| 1987 | 1100.271 | 1227.216 | 371.286 | -126.946 | 1.044 | 6408.423 |
| 1988 | 1108.098 | 1252.262 | 404.778 | -144.164 | 1.039 | 6621.457 |
| 1989 | 1130.988 | 1282.026 | 395.178 | -151.038 | 1.036 | 6840.705 |
| 1990 | 1143.974 | 1306.053 | 456.374 | -162.079 | 1.034 | 7042.350 |
| 1991 | 1168.957 | 1333.067 | 489.869 | -164.110 | 1.033 | 7249.183 |
| 1992 | 1214.576 | 1366.135 | 554.237 | -151.559 | 1.032 | 7470.990 |
| 1993 | 1266.268 | 1409.394 | 668.572 | -143.126 | 1.032 | 7706.612 |
| 1994 | 1311.894 | 1462.016 | 820.322 | -150.123 | 1.031 | 7954.580 |
| 1995 | 1363.531 | 1521.411 | 748.087 | -157.880 | 1.030 | 8212.363 |
| 1996 | 1405.902 | 1577.961 | 837.723 | -172.059 | 1.028 | 8464.923 |
| 1997 | 1432.039 | 1634.815 | 747.991 | -202.777 | 1.026 | 8732.949 |
| 1998 | 1456.904 | 1693.411 | 905.713 | -236.507 | 1.024 | 9002.449 |
| 1999 | 1492.292 | 1757.909 | 993.307 | -265.617 | 1.022 | 9288.188 |
| 2000 | 1523.993 | 1827.687 | 1062.637 | -303.694 | 1.020 | 9576.186 |
| 2001 | 1552.677 | 1897.356 | 1092.234 | -344.678 | 1.018 | 9875.072 |
| 2002 | 1568.918 | 1953.267 | 1119.290 | -384.349 | 1.017 | 10169.425 |

Table 1: Processed Data (Scale: Billions)