Macroprudential policies, capital controls, and income inequality

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Abstract

This paper investigates the impact of macroprudential policies, capital controls, and their joint effect on income inequality. Using a panel dataset covering 60 countries from 2000 to 2019, we find that macroprudential policies and capital controls can mitigate income inequality, which are robust to various subsets of policy indexes. However, the effectiveness of macroprudential policies on income inequality depends on the tightness of capital controls. We verify that macroprudential policies affect income inequality through private sector leverage, and both capital controls and macroprudential policies have significant influences on gross capital flows and net capital flows to affect income inequality.

Keywords: Macroprudential policies; Capital controls; Income inequality

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I. Introduction

Since the last wave of economic globalization and the 2007-2009 global financial crisis (GFC), income inequality has re-emerged as a hot issue again in the past two decades, drawing attention from all over the world. A key stylized fact in the literature is that income inequality has widened in most countries, especially in high-income

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countries (Bourguignon, 2015; Milanovic, 2016). Piketty in his seminal book *Capital in the Twenty-First Century* (2014) argues that the main driver of inequality is the tendency of returns on capital to exceed the rate of economic growth. Karl Marx's insightful conclusion on the deep structures of capital and inequality is essentially not altered. As the main channel for credit and capital resources allocation, the financial market itself favors efficiency over equality, and is blamed as the main culprit for rising inequality, especially in the aftermath of the GFC. Therefore, people turn to seeking government intervention as one of the few feasible options to address enlarging inequality.[1]

Another notable change in the aftermath of the GFC is the implementation of new regulations in financial markets across countries to ensure the future stability of financial markets. The two most popular sets of government policies are macroprudential policies and capital controls. Macroprudential policy, as a tool set to promote financial stability and mitigate systemic risks within the economy, aims to prevent or reduce the accumulation of risks and vulnerabilities that could potentially lead to widespread disruptions in the financial system.

Figure 1 illustrates the adoption of macroprudential policies across the world. In Panel A, we present an overall index of macroprudential policy usage. A higher value of the index indicates a more widespread use of macroprudential policies on a global scale. In Panel B, we depict the number of countries implementing macroprudential policies, which also exhibits a rising trend, especially in the post-2008 period.

[Figure 1 about here]

Macroprudential policy typically involves a combination of tools and instruments that can be applied to different sectors of the financial system, including banking, insurance, and capital markets. These measures are designed to address various types

1 One may argue that inequality is of less concern as long as there is enough social mobility. The "American dream" is certainly the most telling story. However, a recent influential work by Chetty et al. (2017) shows that the "American dream" may be diminishing over the past century. This fact intensifies the ongoing debate about income inequality as greater inequality within a generation could reduce social mobility (Krueger, 2012; Chetty et al., 2014).

of risks, including excessive credit growth, asset price bubbles, leverage, liquidity risks, and interconnectedness. Alam et al. (2019) categorize these policies into 17 subgroups.[2] Among these policies, those that limit borrowers' leverage level, such as loan-to-value ratio (LTV) and debt-service-to-income ratio (DSTI), may directly affect households' consumption and investment decisions, impacting households' wealth distribution (Frost and Stralen, 2018; Carpantier et al., 2018), and deserve a closer attention.

Figure 2 displays the frequency of macroprudential policy usage in the 17 subcategories from our studied sample, with combined LTV and DSTI. As observed, LTV-type policies rank second after liquidity-type policies, where the latter appear to have less relevance to inequality. Therefore, in the following theoretical section, we model macroprudential policy as an LTV-type policy. However, it's important to note that we cannot rule out the potential indirect impact on inequality of other types of macroprudential policies. Consequently, we consider both overall macroprudential policy and the LTV-type policy for empirical examination.

[Figure 2 about here]

Capital control policy refers to a set of measures implemented by governments or central banks to regulate the flow of capital across national borders. These measures involve imposing restrictions or regulations on the movement of funds, investments, and assets in and out of a country. The primary objective is to manage and stabilize a country's financial system and economy by influencing the inflow and outflow of capital.

Figure 3 shows the change in the index of capital control policies across various countries from 2000 to 2019. Before the outbreak of the financial crisis in 2008, countries were progressively relaxing their capital control policies year by year. However, after the outbreak of the financial crisis, the downward trend of capital control policies has reversed.

[Figure 3 about here]

[2] Please refer to Appendix B2 for a detailed description of these policies.

Capital controls can be classified based on the direction of capital flows, including restrictions on capital inflow and capital outflow. Additionally, they can be categorized by asset types, such as equity restrictions, bonds restrictions, and direct investments restrictions. While capital controls are not implemented to address income inequality directly, they are likely to have a non-negligible impact on it. For instance, access to international capital markets provides domestic firms with additional credit opportunities, potentially increasing their profitability, which tends to favor wealthier individuals.

From a policymaker's perspective, capital controls and macroprudential policies work as complementary policies, not substitutes. On the one hand, the effectiveness of macroprudential regulation could be undermined by unrestricted international capital flows. The literature on macroprudential regulation leakage has documented that foreign banks can essentially negate the intended effects of the domestic macroprudential regulation by providing cross-border credit. On the other hand, macroprudential regulation, or even purely domestic-oriented policies, could affect cross-border capital flows. For instance, Forbes et al. (2017) find that increases in macroprudential capital requirements tend to reduce international bank lending. Engel (2016) provides an excellent survey of the rationale behind a joint use of macroprudential policies and capital controls. Therefore, it is crucial for policymakers to evaluate the combined impact of capital controls and macroprudential policies on income inequality. How does the joint use of macroprudential policies and capital controls affect income inequality? Are they complements or substitutes? These are intriguing questions that warrant investigation.

In this paper, we first construct a simple theoretical framework to explicitly model both macroprudential policy and capital control, and evaluate their separate and joint impacts on income inequality. Interestingly, our model uncovers important interactions between macroprudential policy and capital control, leading to the development of three hypotheses for empirical analysis.

Next, using a panel dataset covering 60 countries from 2000-2019, we empirically

test the three hypotheses and estimate the impacts of macroprudential policies and capital controls on income inequality. The key findings are as follows. First, either macroprudential policies or capital controls, when applied individually, can effectively reduce income inequality. These results are robust to different subsets of macroprudential policies and capital controls. Second, the effectiveness of macroprudential policies on income inequality is contingent on the level of stringency of capital controls. In situations where capital controls are relatively low, macroprudential policies have a noticeable impact in mitigating inequality. However, as the stringency of capital controls increases, the mitigating effects of macroprudential policies tend to diminish. Third, macroprudential policies can influence income inequality through their impact on leverage ratios. Fourth, both capital controls and macroprudential policies affect income inequality through their influence on both gross and net capital flows.

Our study contributes to the literature in several aspects. First, we provide a theoretical assessment of the effects of macroprudential policies and capital controls on income inequality, and empirically test our model implications with a large group of countries from 2000 to 2019. Moreover, we delve into the less-explored area of how legal restrictions on capital flows rather than de facto capital account liberalization affect income inequality. Second, given the joint use of macroprudential policies and capital controls by policymakers, we consider both capital controls and macroprudential policies in a unified framework. We not only compare their effectiveness but also shed light on their interactions, revealing novel insights that enrich the existing literature. Third, we examine the main channels outlined by our model through which macroprudential policies and capital controls affect income inequality.

The rest of the paper is organized as follows. Section 2 reviews the relevant literature. Section 3 layouts the theoretical model. Section 4 describes the empirical methodology and data. Section 5 presents the main results with robustness checks. Section 6 empirically examines the main channels through which macroprudential policies and capital controls affect income inequality. And section 7 concludes.

II. Related Literature

2.1 Macroprudential policy and income inequality

Research on the relationship between macroprudential policy and income inequality is increasing, however, their relationship remains complex and inconclusive. Rabitsch and Punzi (2017) employ in a DSGE model with heterogeneous borrowers including a low loan-to-value (LTV) ratio, and a high LTV ratio, argue that a decrease in LTV ratios leads to higher wealth inequality. Carpantier et al. (2018) utilize data from 12 European countries and discover that looser credit or higher LTV ratios does not reduce household wealth inequality; While LTV and DSTI limits can increase inequality at introduction, they can dampen the increase in inequality under adverse macroeconomic conditions. Mendicino et al. (2018) in a medium-scale general equilibrium model find that if capital requirement is below a certain threshold, it is welfare improving. However, once the requirements pass the threshold, savers continue to benefit from reduced financial fragility, while borrowers begin to suffer. Frost and van Stralen (2018) investigate the relationship between specific macroprudential policies and income inequality in a panel of 69 countries from 2000 to 2013. They find that countries with countercyclical capital buffers, concentration limits, or limits on credit growth experience higher income inequality, while countries with specific requirements for systemically important financial institutions experience lower income inequality. Zhai et al. (2023) construct an OLG model, and conduct an empirical analysis based on data from the China Household Finance Survey (CHFS) in 2017. They find that the influence of LTV on household wealth inequality is not constant. When the return on housing investment is higher than the return on liquid assets, the LTV ceiling generally has a negative impact on household wealth inequality; otherwise, it is more likely to be positive.

To summarize, the relationship between macroprudential policies and income inequality remains inconclusive and highly intricate, often dependent on various macroeconomic conditions. Moreover, most existing studies are constrained on a

limited number of countries.

2.2 Capital controls and income inequality

Two strands of literature are related to the relationship between capital controls and income inequality. One strand examines how capital account liberalization (financial integration or financial globalization) affects income or wealth inequality. Overall, this literature finds a robust positive relationship between capital account liberalization and inequality. Using aggregate and sectoral data, Larrain (2015) finds that opening the capital account increases the relative demand for skilled labor compared to unskilled labor, resulting in higher wage inequality. Employing an index of financial openness and a cross-country panel of labor shares available from the United Nations System of National Accounts, Jayadev (2007) finds a robust negative correlation between the degree of financial openness and the labor share. Furceri and Loungani (2018) find that episodes of account liberalization increase the Gini measure of inequality, based on a panel data covering 149 countries from 1970 to 2010. Based on both country- and industry-level data and difference-in-difference estimation, Furceri et al. (2019) find that policies liberalizing international capital flows have led on average to limited output gains while contributing to significant increases in inequality. Li and Su (2021) also arrive at a similar conclusion. Erauskin and Turnovsky (2019) employ a stochastic growth model to study the impact of international financial globalization on income inequality. Both empirical estimations and numerical simulations suggest that international financial globalization is a significant factor in the increase in income inequality. Liu et al. (2020), in a small open economy model with heterogeneous agents and financial frictions, show that a temporary decline in the world interest rate leads to a surge in capital inflows, benefiting entrepreneurs and hurting households. Raising inflow taxes or reducing outflow taxes mitigates this redistribution. Using five-year panel covers 106 countries over the time period 1973 to 2008 and generalized method of moments (GMM) estimator, Bumann and Lensink (2016) find that capital account liberalization only tends to lower income inequality if the level of financial depth is relatively high.

Another strand of literature focuses on how financial liberalization affects income

or wealth inequality. Financial liberalization encompasses various aspects, including eliminating financial repression, removing entry barriers, and opening the capital account (Galindo et al.,2002). Capital account openness is often one component of financial liberalization. Overall, the impact of financial liberalization on income inequality is inclusive. Based on a meta-analysis involving 23 empirical cross-country studies and a total of 556 estimates, Ni and Liu (2019) find a small negative relationship between financial liberalization and income inequality when considering potential publication bias and method heterogeneity. Claessens and Perotti (2007) point out that financial liberalization can improve income inequality only if a certain level of institutions is built up. Das and Mohapatra (2003) find that equity market liberalization leads to higher inequality. Specifically, almost all of the increase in income goes to the top quintile of the population, at the expense of the income of the "middle class". Delis and Kazakis (2014) find that bank regulatory policies result in differences in income distribution. The overall liberalization of banking systems decreases income inequality, but this effect becomes negligible for countries with low levels of economic and institutional development. Kim et al. (2019) argue that democracy plays a role in shaping the relationship between income inequality and financial liberalization. Their results suggest that financial reforms towards capital account openness and more liquid, stable stock markets mitigate income distribution, especially in less democratic countries.

In summary, while there is a substantial body of literature studying capital account liberalization and income inequality, few studies consider how capital account liberalization interacts with other government policies, and jointly affect income inequality in a more complex manner. In addition, most studies consider capital account liberalization in a de facto way, while few studies examine the effect of de jure capital control policies.

2.3 Macroprudential policy, Capital controls and income inequality

There is very limited investigation into the joint effects of macroprudential policy and capital control policy. The existing studies that do explore the interplay between these policies tend to concentrate on their impact on financial stability. For instance,

Korinek and Sandri (2014) find that the simultaneous implementation of macroprudential policy and capital control policy can significantly enhance financial stability. Similarly, Brunnermeier and Sannikov (2014, 2015) argue that capital control policy should be integrated into macroprudential policy to provide further safeguards for financial stability.

To the best of our knowledge, there has been no study focuses on the joint impact of macroprudential policies and capital control policies on income inequality, which is the focus and contribution of our study.

III. The Model

Following Huang and You (2019), we extend the framework of Rodrik and Velasco (1999) to construct a model that combines macroprudential policies and capital controls within a minimalistic framework.

3.1 Model Setup

The household

There is a continuum of households, which can be normalized to one. Each household possesses an initial endowment W_i, where the total endowment of the economy is fixed at W. Household i can draw an investment project with technology A_i, which follows a uniform distribution on $[0, A_{max}]$. The household has two occupation choices, being an entrepreneur to run this business, or becoming a depositor. The entrepreneur can borrow externally to finance the investment project, while the depositor does not have capital investment technology and saves in risk-free bank deposits. Liu et al. (2023) shows that income inequality primarily arises from capital income when both entrepreneur and worker earn similar labor income. For the sake of simplicity, we assume that income for all agents is derived from capital returns.

The entrepreneur with endowment W_i, seek to borrow L_i from the bank with a rental rate of R_L to finance the investment project. Thus, the total value of investment is

$$K_i = W_i + L_i \tag{1}$$

Therefore, the income of entrepreneur i is

$$Y_i^E = \pi_i = A_i K_i - R_L L_i \tag{2}$$

The income of depositor *j* comes from savings in the bank with R_D as the deposit interest rate

$$Y_j^W = R_D W_j \tag{3}$$

The household decides to become an entrepreneur if and only if

$$Y_i^E \geq Y_i^W \tag{4}$$

The financial market

There are commercial banks collecting deposits D and issuing loans L to entrepreneurs. The interest rate on deposits is denoted as R_D, and the loan rate is R_L. The assets of banks are subject to macroprudential regulations. Each loan issued by the bank has a loan-to-value (LTV) cap, λ, meaning that entrepreneur *i* can only borrow up to $L_i \leq \lambda W_i$.

Domestic banks have limited access to global financial market to trade bond with foreign financial institutions due to capital controls. Given foreign deposit rate R_F, we assume the equilibrium condition in the bond market is given by

$$R_F = \left(1 - \tau \frac{B}{W}\right) R_D \tag{5}$$

where $\tau \geq 0$ is a capital control measure, *B* is the net asset held by foreign institutions, and $\frac{B}{W}$ is the foreign/domestic asset ratio in the domestic market. If the domestic deposit rate is higher than the foreign rate, $R_D \geq R_F$, we have $B > 0$, which represents the amount of domestic bond held by foreign investors.

The total amount of loans issued by the bank is subject to a capital requirement ρ imposed by the government[3]

$$L \leq (1 - \rho)(D + B) \tag{6}$$

The bank intends to maximize profit

$$\pi_B = R_L L - R_D (D + B) \tag{7}$$

Therefore, the total amount of loans is given by $L = (1 - \rho)(D + B)$. To minimize the distribution role for the bank, we assume the bank's profit is zero. Thus, we have

[3] This capital requirement measure reflects regulations such as capital requirement, capital buffers, etc.

$$R_D = (1-\rho)R_L \tag{8}$$

The Government authority

We focus on two policy instruments in this model, a macroprudential instruments, the LTV cap λ, and a capital control measure τ. These instruments allow the government to achieve various objectives, such as regulating leverage ratio, control capital flows, and alleviating income inequality.

3.2 Equilibrium

A competitive equilibrium in the described economy consists of a set of allocations and prices, (1) each household makes an occupation choice $i \in \{E, W\}$ to maximize income; (2) the bank maximizes its profit; and (3) all markets are clear.

Proposition 1. The condition of household to become an entrepreneur is given by

$$A_i \geq A_E = \frac{1-\rho+\lambda}{(1+\lambda)(1-\rho)} R_D \tag{9}$$

Proof: See appendix A.

According to proposition 1, the total deposit in the economy is $D = \int_0^{A_E} W_i f(x)dx$, and the loans demanded by entrepreneurs are $L = \int_{A_E}^{A_{max}} \lambda W_i f(x)dx$, where $f(x) = \frac{1}{A_{max}}$. The capital flows satisfy $R_F = \left(1 - \tau \frac{B}{W}\right) R_D$. Since the capital market is clear, we can derive the equilibrium deposit rate.

Proposition 2. The bank's deposit rate R_D at equilibrium is given by the following equation

$$\tau(1+\lambda-\rho)^2 R_D^2 + (1+\lambda)(1-\rho)(1-\rho-\tau\lambda)A_{max}R_D - (1+\lambda)(1-\rho)^2 A_{max}R_F = 0 \tag{10}$$

which yields the following loan rate R_D at steady state

$$R_D^* = \frac{-(1+\lambda)(1-\rho)(1-\rho-\tau\lambda)A_{max} + (1-\rho)\sqrt{((1+\lambda)(1-\rho-\tau\lambda)A_{max})^2 + 4\tau(1+\lambda-\rho)^2(1+\lambda)A_{max}R_F}}{2\tau(1+\lambda-\rho)^2} \tag{11}$$

Proof: See appendix A.

Proposition 2 characterizes the economic equilibrium, showing that the deposit rate R_D^* is positively correlated with the foreign deposit rate R_F and the productivity frontier A_{max}. The equilibrium technology threshold is

$$A_E^* = \frac{-(1+\lambda)(1-\rho-\tau\lambda)A_{max}+\sqrt{((1+\lambda)(1-\rho-\tau\lambda)A_{max})^2+4\tau(1+\lambda-\rho)^2(1+\lambda)A_{max}R_F}}{2\tau(1+\lambda)(1+\lambda-\rho)} \quad (12)$$

3.3 Policy Analysis

To analyze the impact of capital controls and macroprudential policies on income distribution, we calibrate our model and focus on two key policy instruments, the LTV cap λ, and the capital control measure τ. We use the income ratio of the top 10% over the bottom 50% as an income inequality index.

We begin with the selection of model parameters based on our dataset. We normalize the total economic endowment to one. We categorize the domestic country as a developing country, setting the maximum productivity at 2.23 to match the equilibrium deposit rate R_D^* =1.046 which corresponds to the sample average of developing countries in our dataset. The foreign deposit rate is set at 1.018, mirroring the average interest rate in the United States, while the capital requirement ratio is set at 0.025. Table 1 provides an overview of the benchmark parameter values.

[Table 1 about here]

The policy variables are set as the following. Regarding the capital control variable, we consider three different scenarios. First, we setup a benchmark case where the capital control measure is normalized to $\tau = 1$. Second, we consider an autarky economy in which the foreign asset position is held at $B = 0$, representing a closed financial market. Third, we assume the capital flow is completely free with $\tau = 0$, , indicating an open financial market. The LTV cap, which serves as our macroprudential policy instrument, is set to $\lambda = 0.93$ as the benchmark, which corresponds to the mean value in our sample. In addition, we explore a high leverage case by raising λ to 1. Overall, we have six policy pairs corresponding to these scenarios. For each scenario, we solve for the equilibrium deposit rate and calculate the income ratio of top 10% over the bottom 50%.

[Table 2 about here]

Table 2 presents the results of the calibration. Our first finding is that liberalizing capital controls tends to increase income inequality, while keeping the domestic loan-

to-value ratio constant. Capital liberalization in our model has three direct effects. First, in a fully open economy with no capital controls, domestic banks can sell more bonds to foreign investors, leading to lower deposit rates at equilibrium. As a result, domestic entrepreneurs can borrow at lower lending rates to boost profits. Second, as the cost of borrowing decreases, the proportion of the entrepreneurs in the population increases. Third, as saving rates fall, depositors' incomes fall. Overall, the ratio of income between entrepreneurs and depositor has increased.

Figure 4 illustrates the choice of occupations in the economy along with their income. The x-axis represents households with different productivity profiles, while the y-axis represents their income levels. The dark line corresponds to the autarky scenario, where the equilibrium deposit rate is at its highest, and there is no capital flow. In contrast, the dashed line represents the open economy scenario, where the deposit rate is determined by the international financial market and the income of entrepreneurs is high.

[Figure 4 about here]

Next, we focus on the interaction between macroprudential policies and capital controls on inequality. To investigate the effect of varying leverage ratios at different levels of capital controls, we allow the LTV cap to increase from 0.93 to 1. Our results show that the income inequality increases further as the leverage ratio rises in the fully open economy, because entrepreneurs can borrow more to receive higher income while the deposit rate remains constant. This result is illustrated by Figure 5.

[Figure 5 about here]

In a closed economy, however, the situation can differ significantly. As shown in Figure 6, an increase in the leverage ratio generates demand for loans from high productivity entrepreneurs, causing domestic interest rates to increase. As a result, the profits are shared by all households in the economy, the income inequality might decrease as leverage ratio rises in an autarky economy.

[Figure 6 about here]

In the case with $\tau = 1$, a higher LTV ratio causes the profit of entrepreneurs and the equilibrium deposit rate to increase simultaneously, where these two opposite effects might neutralize each other, leaving the calibrated income ratio unchanged.

Given the above simple calibrations, we summarize three important theoretical hypotheses that could be tested empirically.

Hypothesis 1: Macroprudential policies can effectively reduce income inequality in an open economy.

Hypothesis 2: The distribution of income in an open economy is more unequal than in a closed economy. Capital controls can alleviate such inequalities.

Hypothesis 3: The negative impact of macroprudential policies on income inequality diminishes as the economy becomes more closed.

IV. Data and estimation method

4.1 Data

We measure income inequality using a set of variables, including the Gini index of income, pre-tax income of the top 10% population, and pre-tax income of the bottom 50% population. The GINI index can measure the entire income distribution, while the measures for the top 10% and bottom 50% focus on specific income groups. The data on income inequality comes from the World Inequality Database (WID), and the Standardized World Income Inequality Database (SWIID).

Our main explanatory variables are macroprudential policies and capital controls. As discussed in our model, both policies can affect income inequality. In addition, policymakers often use both policies together. Therefore, it is desirable to consolidate both policies within a unified framework. The data on macroprudential policy is obtained from Alam et al. (2019). It tracks changes of various macroprudential indicators within 17 subcategories. If a country increases the intensity of a specific type of macroprudential policy in a particular month, it is recorded as "+1"; if the policy intensity is reduced, it is recorded as "-1". The annual policy intensity of the country is

then the sum of all "+1" and "-1" values. The aggregate index can be further divided into domestic and foreign policies according to its targeted underline assets' currency denomination. It can also be classified into lenders and borrowers according to the demand and supply sides of the market. Furthermore, based on the regulation type, the aggregate index can also be categorized into capital-based, asset-based and liquidity-based indexes (Aizenman et al., 2020). Capital-based policies require banks to provide countercyclical buffers and demand larger capital buffers from systemically important banks. Asset-based policies focus on the leverage of market participants and the concentration of financial assets. Liquidity-based policies regulate maturity mismatch, currency mismatch, credit growth, and other related issues.

Data on capital controls is sourced from the 2021 update of Fernandez et al. (2016). In addition to an overall capital controls index, we also examine subcategories of capital controls by direction and asset type.

Our control variables are selected following the literature on income inequality. There is a competition between human capital and technology, as highlighted by Piketty and Saez (2014). Higher human capital has led to an increase in the supply of skills, while technological innovation has raised their demand. Therefore, our study includes human capital and technology (Florida and Mellander, 2016; Frost and van Stralen, 2018). Human capital data is from Penn World Table 10.01. Technology is measured by the number of scientific and technical articles per 10,000 people. Government expenditure plays an important role in addressing income inequality (Frost and van Stralen, 2018). We use the government expenditure to GDP ratio as a control variable for government redistribution policy. The Stolper-Samuelson theorem, derived from the Heckscher-Ohlin model, suggests that trade liberalization hurts low-skilled workers in developed countries and thus reduces equality. Thus, we include trade openness as a control variable for international trade. Financial development is also an essential factor contributing to inequality (Gennaioli et al., 2014). We use the private credit to GDP ratio to control financial development. Additionally, we include employment rate, real GDP growth rate, and real interest rate as control variables to account for local macroeconomic conditions (Bumann and Lensink, 2016; Hailemariam et al.,2021).

Data for these control variables are taken from the World Bank database, CEIC database, Penn World Table 10.01 and Wind database.

To identify the channels through which macroprudential policy and capital controls affect income inequality, we examine a set of mediating variables, including the leverage ratio, gross capital flow and net capital flow. The leverage ratio, as measured by the ratio of assets to liabilities, and gross capital flows are sourced from the IMF's International Financial Statistics. Gross capital flow is defined as the sum of capital inflows and capital outflows relative to GDP, and net capital flow is defined as the difference of capital inflows and capital outflows relative to GDP. Control variables include economic volatility index (Bazillier et al., 2021), real GDP growth rate (Bumann and Lensink, 2016), banking crisis (Kumhof et al., 2015), external sovereign debt (Apeti, 2023), real interest rate (Hailemariam et al., 2021), U.S. dollar exchange rate (Min et al., 2015) and loan rate (Christen and Morgan, 2005). Economic volatility index is obtained from the Fed's FRED database. The real GDP growth rate, exchange rate and sovereign external debt come from CEIC database, and real interest rate and loan rate are from Wind database. Banking crisis is from Systemic Banking Crises Database II (Laeven and Valencia, 2020).

The whole sample covers 60 countries from 2000 to 2019. Table 3 summarizes the descriptive statistics for all variables used in this study. Appendix B1 provides the definitions of the data and their sources, Appendix B2 provides subcategories and definitions of macro-prudential, Appendix B3 provides the names of the countries in the sample.

[Table 3 about here]

4.2 Estimation method

To examine the relationship between income inequality and macroprudential and capital control policies, we consider a panel regression framework with the following specifications.

$$Gini_{i,t} = \beta_0 Gini_{i,t-1} + \beta_1 Map_{i,t} + \beta_2 Ka_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t},$$

$$Gini_{i,t} = \beta_0 Gini_{i,t-1} + \beta_1 Map_{i,t} + \beta_2 Ka_{i,t} + \beta_3 Map_{i,t} \times Ka_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t},$$

where $Gini_{i,t}$ is a measure of income inequality, $Map_{i,t}$ represents macroprudential policy index, $Ka_{i,t}$ represents capital control index, and $X_{i,t}$ is a set of control variables.

To estimate these equations, we adopt the dynamic panel data system generalized method of moments (system GMM) estimation, pioneered by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). This approach is widely used in the economic growth literature and offers several advantages over other estimation techniques, such as OLS or fixed-effect models. First, system GMM estimation accounts for omitted variable bias by allowing for fixed effect.

Second, system GMM accounts for simultaneity bias, which is particularly relevant in our study where inequality may have a two-way causal relationship with capital controls and macroprudential policies. Macroprudential measures can impact inequality, but income and wealth distributions also influence the design of optimal macroprudential policies. For example, macroprudential policies targeting debt-to-income ratio may affect poorer individuals' ability to purchase homes, as they may only afford lower down payment. System GMM can handle this endogeneity issue by using lagged values as instrumental variables of their own to conduct a two-stage GMM estimation.

Third, system GMM considers the dynamics of a dependent variable. As inequality is a highly persistent variable, the initial level of inequality can influence its current level. System GMM corrects such biases and provides consistent estimations. Moreover, it avoids Hurwicz bias which could bias the estimator downward when the time dimension of the panel is short in a dynamic model. Windmeijer (2005) has developed a small-sample correction to enhance the accuracy of standard errors obtained through the estimation, making the estimation more practical.

4.3 Alternative method

The baseline regression in our study employs system GMM estimation, which effectively addresses most endogeneity issues. However, we acknowledge three

potential problems that could bias the estimates from system GMM. First, system GMM is capable of handling large N and small T panels, while the T dimension of our panel is 20, which may face potential non-stationary problem. Second, our sample covers 60 countries, ranging from emerging to developed economies, which may exhibit large heterogeneity in the coefficient of income inequality across countries. Neglecting this heterogeneity could lead to biased and inconsistent estimates of the long-run effect on inequality. Third, recent development in panel data models emphasizes cross-sectional dependence (Juodis and Reese, 2022), which may also bias system GMM's results.

To address these issues, we employ the pooled mean group (PMG) estimator proposed by Pesaran and Smith (1995) and Pesaran et al. (1999). The PMG approach enables us to simultaneously investigate of short-run dynamic adjustments and long-run equilibrium heterogeneous relationships between income inequality and policies. The PMG method constrains the long-term coefficients to be homogeneous across the cross-section while allowing for heterogeneity in short-term coefficients and error variances. The regression framework of this method is as follows:

$$Gini_{i,t} = \alpha + \beta X_{i,t} + \gamma \Delta X_{i,t} + \sum_{i=1}^{N} \lambda_i Gini_{i,t-1} + \sum_{i=1}^{N} \delta_i \Delta Gini_{i,t} + \epsilon_{i,t}$$

where $Gini_{i,t}$ is the dependent variable for country *I* in year *t*, $X_{i,t}$is the independent variable for country *i* in year *t*, $\Delta X_{i,t}$ represents the first difference of $X_{i,t}$, λ_i and δ_i are individual country-specific coefficients for the lagged dependent variable and the first-differenced lagged dependent variable, respectively. $\epsilon_{i,t}$ is the error term for country *i* in year *t.* α, β and γ are the parameters to be estimated.

After the pooled mean group (PMG) estimator, the corresponding error correction model (ECM) is given by:

$$\Delta Gini_{i,t} = \alpha + \beta \Delta X_{i,t} + \sum_{i=1}^{N} \gamma_i \Delta Gini_{i,t-1} + \sum_{i=1}^{N} \delta_i \Delta \epsilon_{i,t} + \theta \epsilon_{i,t-1} + \varepsilon_{i,t}$$

where $\Delta Gini_{i,t}$ represents the first difference of the dependent variable for country *i* in year *t*. $\Delta X_{i,t}$ stands for the first difference of the independent variable for country *i* at time *t*, $\Delta \epsilon_{i,t}$ denotes the first difference of the error term for country *i*. α and β are coefficients of the model. γ_i and δ_i are coefficients related to lagged dependent

variables and error terms specific to each country. θ is the error correction coefficient, indicating the speed of adjustment from short-term fluctuations to long-term equilibrium. $\varepsilon_{i,t}$ represents the new error term for country *i* in year *t*.

V. Empirical analysis

5.1 Impact of macroprudential policies and capital controls on income inequality

In this section, we empirically test the assumptions proposed in the theoretical analysis using system GMM estimation.[4] We are interested not only in the whole distribution of income, but also in which specific group is affected. Therefore, we select three representative measures of inequality, the Gini coefficient of income (Gini), the pre-tax income share of top 10% population (top 10%), and the pre-tax income share of bottom 50% population (bottom 50%).

Table 4 reports the impacts of overall index of macroprudential policies and capital controls on income inequality. Regression (1) tests the effect of macroprudential policy on income inequality under different inequality indicators; regression (2) estimates the effect of capital controls on income inequality; and regression (3) includes both macro prudential and capital control policies.

In the columns of regression (1), the macroprudential policy index has a significant negative effect on the Gini coefficient and the top 10% share, and a significant positive effect on the bottom 50% share. The implementation of macroprudential policies, for each additional unit added, results in a decrease of 0.14% (-0.065/47.47=-0.14%) in the Gini coefficient and a 0.24% decrease in the top 10%, while causing a 0.3% increase in the bottom 50%. These results are consistent with our calibration in Figure 2. Higher quantiles (the rich) share less income, while lower quantiles (the poor) share slightly more income. Hypothesis 1 is verified.

In the columns of regression (2), the capital control index has a significant negative effect on the Gini coefficient and the top 10% share, and a significant positive effect on

[4] This paper employs a two-step GMM estimation, and the standard errors are corrected following Windmeijer (2005). We use first and second lags of explanatory variables as instrument variables. Country and year fixed effects are controlled for, and the *"collapsed"* option is not used in the regression.

the bottom 50% share. The implementation of capital control policies, for each additional unit added, has a negative impact of 1.24% on the Gini coefficient, a negative impact of 3.14% on the top 10%, and a positive impact of 4.33% on the bottom 50%. These results are identical to our calibration in Figure 1. As the economy becomes more closed, the income share of the rich declines, while the income share of the poor increases. Overall, the economy has a more even distribution of income. Hypothesis 2 is verified.

In the columns of regression (3), after controlling for both policies, the estimated coefficient of macroprudential policy appears to be smaller on Gini and the bottom 50% income share. This result is in line with our model prediction that macroprudential policy and capital controls tend to offset each other. Therefore, we should further consider their interactions.

In summary, our benchmark results suggest that the implementation of macroprudential policy and capital controls can reduce income inequality by reducing the income share of high-income earners and increasing the income share of low-income earners.

The reliability of our estimation results is supported by a set of validity tests for GMM estimation developed by Hansen (1982) and Arellano and Bond (1991). Ar1 and Ar2 are the Arellano-Bond test for first and second lag autocorrelation among idiosyncratic disturbance terms. The Hansen test of over-identification is used to examine for validity of moment conditions. P value is reported in each cell. A rejection of Ar1 without rejecting Ar2 is required by GMM estimation. It suggests that the model should be dynamic and the constructed instruments satisfy moments conditions. In addition, the Hansen test is not rejected, suggesting the validity of our instruments.

[table 4 about here]

In order to better fit the macroprudential policy studied in our theoretical model, we replace the overall macroprudential policy with the actual regulatory LTV limits in each country in Table 4 for further analysis. Table 5 reports the impacts of LTV policy and capital controls on income inequality, and the overall regression results align with Table 4.

[table 5 about here]

5.2 Alternative estimation method

The PMG estimator, which constrains the long-term coefficients to be the same but allows the short-term coefficients and error variances to differ across different groups, effectively addresses the non-stationarity, heterogeneous coefficient, and cross-dependence issues in system GMM estimation. In this section, we replace system GMM with the PMG model.[5]

Table 6 presents the PMG estimation results. The regression outcomes are consistent with the baseline regression results. The conditions for the dynamic stable long-term relationship between macroprudential policies, capital control policies, and income inequality require that the coefficient on the ECM term be negative (within a unit circle) and statistically significant. The results in Table 6 demonstrate that the estimated ECM coefficients fall within the range of dynamic stability. Regarding the test for cross-sectional correlation, we employed the Cross-sectional Dependence (CD) weighted test proposed by Juodis and Reese (2022). Upon testing the model, we find that the p-value exceeds 0.1, thereby not rejecting the null hypothesis of no cross-sectional correlation. This supports the applicability of the PMG model to this sample and the reliability of our main results.[6]

[table 6 about here]

5.3 Decomposing macroprudential policies

One advantage of our dataset on macroprudential policies and capital controls is that detailed subcategories for both policies are available. Following the literature, there are three approaches to decompose macroprudential policies: capital-based, liquidity-

[5] Due to first-differencing of our data, 11 countries are absent from the regression sample. These 11 countries are: Austria, Ireland, Argentina, Brazil, Ecuador, Mexico, Bangladesh, Sri Lanka, Morocco, Côte d'Ivoire, and Colombia.

[6] At the same time, we also conducted pooled OLS regression. The regression results indicate the presence of heterogeneity issues and highlight cross-sectional correlation problems in pooled OLS regression, further emphasizing the reliability of the PMG estimates. To save space, the results of POLS regression are not presented in the main text, but they can be requested from the author if needed.

based and asset-based, borrower sectors and financial sectors, foreign and domestic policies.

Table 7 reports the results using the decomposed macroprudential policy. It shows that all types of macroprudential policies can significantly reduce the Gini coefficient and the income share of the top 10% and increase the income share of the bottom 50%, confirming our main result using the overall index. Hypothesis 1 is supported. Among the different macroprudential policies, policies that target the leverage of market participants, market borrowers, and foreign currencies appear to be more effective than others in reducing the Gini index, based on the magnitude of the coefficients.

[table 7 about here]

5.4 Decomposing capital controls

Capital controls can be classified by the direction of their flows and the type of assets. By direction of flows, capital controls are divided into controls on capital inflow (kai) and controls on capital outflow (kao). By asset types, capital controls can be categorized as equity restrictions (eq), debt restrictions (bo), and direct investment restrictions (fdi). Table 8 reports the effectiveness of various types of capital controls on inequality. These results are very consistent. All capital controls can significantly reduce the Gini coefficient of income and the share of pre-tax income in the top 10% and increase the share of pre-tax income in the bottom 50%. Similar to macroprudential policies, capital controls can significantly reduce income inequality. This is achieved by reducing the share of income earned by high-income earners and increasing the share of income earned by low-income earners. Hypothesis 2 is verified. Among the different capital control policies, policies that target capital inflow are more effective than capital outflow, based on the magnitude of the coefficients.

[table 8 about here]

5.5 Joint effect of capital controls and macroprudential policies

A key contribution of this paper is that we investigate how capital controls and macroprudential policies interact to affect inequality accordingly. Hypothesis 1 and 3

argue that macroprudential policies can be effective in reducing inequality in fully open economies, but this mitigating effect diminishes as economies become more closed. Whether macroprudential policies affect inequality in countries with some capital controls is ambiguous and depends on the tightness of the capital controls.

We test our theoretical predictions using two different empirical approaches. First, we consider an interaction term between capital controls and macroprudential policies. The results in Table 9 find significant coefficients for the interaction term between capital controls and macroprudential policies, suggesting that the inequality reduction effect of macroprudential policies depends on the level of capital controls. The positive sign of this coefficient suggests that the mitigating effect of macroprudential policies on inequality tends to disappear as the level of capital controls increases. This is precisely what our Hypothesis 3 predicts.

[table 9 about here]

Second, we split the sample into two different groups, one with low capital controls and the other with high capital controls. In particular, we consider two different ways of splitting our data. In the first classification method, we classify observations with capital control levels higher than the sample mean into the high-control group (ka>mean), and vice versa, they are classified as the low-control group (ka<mean). However, a small number of countries can be placed in different categories in different years as they fluctuate around the sample mean. To overcome this issue, in the second classification method, we start by computing the average capital control index for each country, and place countries above the sample mean as high control countries and countries below the sample mean as low control countries.

The results for these two approaches are reported in panel A and B in Table 10 respectively. In both panels, macroprudential policies in the low capital control group can significantly reduce the Gini index. This is achieved primarily by decreasing the income share of the top 10% of the population and increasing the income share of the bottom 50% of the population, which is highly consistent with our model predictions.

In contrast, macroprudential policies in the high capital control group have a positive but insignificant effect on the Gini index, which is consistent with the Hypothesis 3.

[table 10 about here]

To study the robustness of joint effect of macroprudential policy and capital control, we also replace the macroprudential policy with LTV, as well as employ PMG estimator. The regression results remain consistent with those in Table 9. For specific details, see Appendix Table B4 and B5.

VI. Testing the theoretical channels

Our main results are consistent with our theoretical arguments that macroprudential policies and capital controls can reduce income inequality. In addition, our model proposes several key influencing channels. We argue that the regulations in macroprudential policies can affect the leverage ratio which is crucial in the financial market, while the capital control policies can adjust the gross and net capital flow to affect income inequality. In this section, we empirically test these channels.

6.1 Leverage

According to our model, lower leverage, such as caps on LTV ratios or Debt-to-income ratio can decrease income inequality in an open economy.

In Table 11, the first column shows the impact of macroprudential policies and capital controls on leverage ratios. The results show that macroprudential policies can reduce leverage ratios. While capital control policies are negligible. Column 2 reports that high leverage can significantly increase the Gini coefficient. That is, macroprudential policies can reduce income inequality by reducing leverage ratios. Column 3 and 4 suggest that reducing inequality is achieved by lowering the income share of the top 10% high-income people and boosting the income share of the bottom 50% population.

[table 11 about here]

6.2 Gross and net capital flows

According to our model, when foreign credit flows into the financial sector, domestic entrepreneurs benefit from borrowing at lower rental rates, causing income inequality to rise. In this type of scenarios, capital controls can help mitigate this rising inequality by regulating capital flows. To verify this channel, we consider two types of capital flows, gross capital flows and net capital flows.

Table 12 presents that capital controls are sufficient to reduce gross capital flows, and gross capital flows further reduce income inequality. Interestingly, macroprudential policies can also reduce gross capital flows, because they regulate gross credit, regardless of the source of the flows.

Table 13 presents that capital controls can reduce net capital flows, and net capital flows further reduce income inequality. Similarly, macroprudential policy can also reduce net capital flows. Results in table 12 and 13 are consistent with the literature on capital account liberalization and inequality (Furceri and Loungani, 2018; Furceri et al., 2019; and Erauskin and Turnovsky, 2019), And net capital flows have a greater impact on inequality than total capital flows on inequality.

[table 12 about here]

[table 13 about here]

VII. Conclusion

In this paper, we investigate the impact of macroprudential policies and capital controls on income inequality. We have developed a theoretical model and provided qualitative insights into how these policies, both individually and when used together, influence income inequality. Through a series of empirical tests and robustness checks, we validate the three hypotheses proposed by our theoretical model. Our results confirm that macroprudential policies and capital controls can indeed mitigate income inequality, while the effectiveness of macroprudential policies diminishes as more capital controls are imposed on the economy.

Our empirical analysis also explores the key channels through which macroprudential policies and capital controls affect income inequality. We discover that

both macroprudential policies and capital controls can affect gross and net capital flows, which further affect income inequality. Moreover, macroprudential policies can affect income inequality through leverage ratios. These results suggest that tighter regulation of financial markets can help mitigate income inequality, though perhaps at the expense of efficiency.

Our research carries important policy implications. Policymakers should be aware that the implementation of macroeconomic policies can have spillover effects on the income distribution in our society, even if these policies are not designed to address income. Capital account openness can facilitate the movement of factors across borders, but it can also exacerbate inequality. Macroprudential policies, in this context, could serve as 'two birds, one stone' policy tool in the sense that, on the one hand, its primary objective is to maintain financial stability; On the other hand, it could inadvertently help promote income equality at a time when policymakers are dealing with the challenges of financial globalization.

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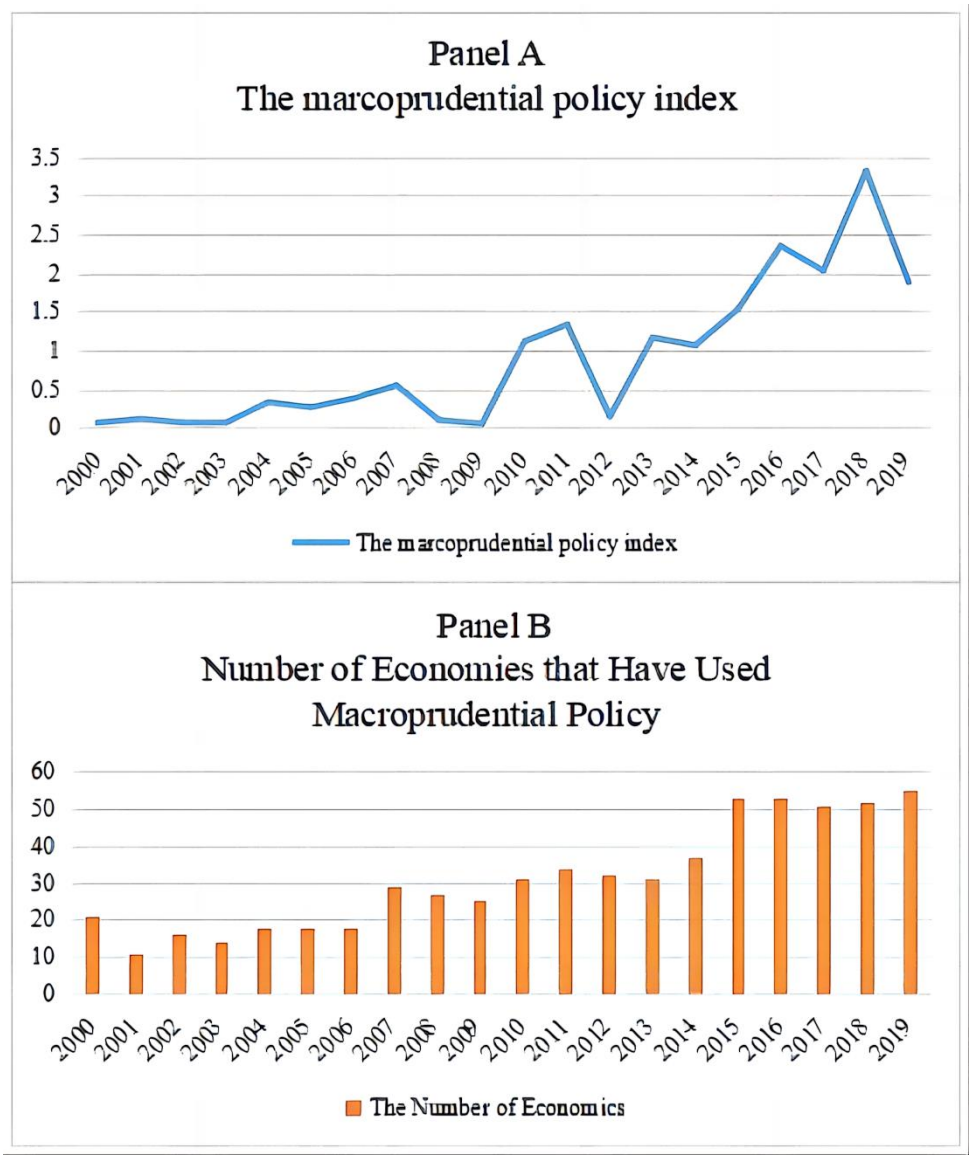

Figure1 The change of macroprudential policy and Number of Economies that Have Used Macroprudential Policy

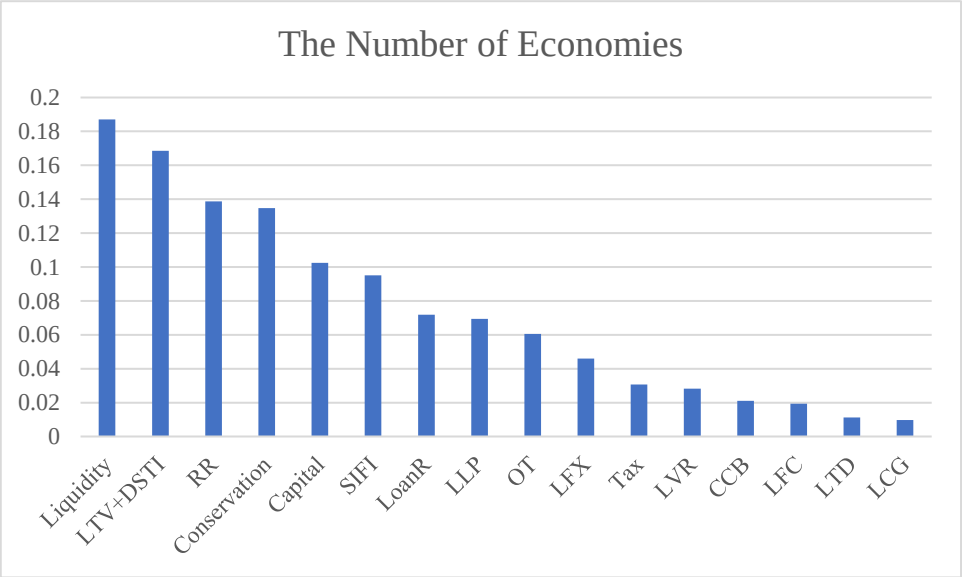

Figure2 Frequency of Policy Actions by Instrument

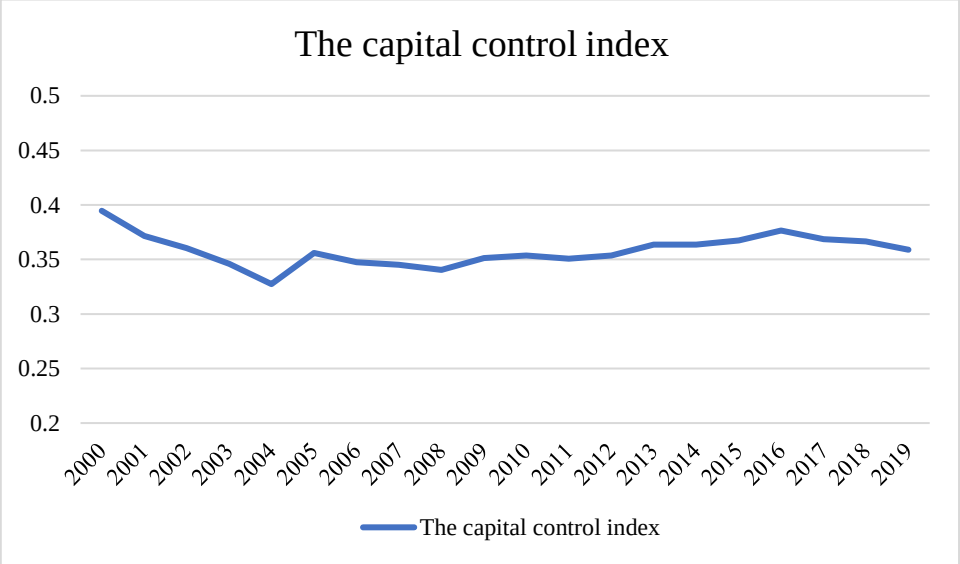

Figure3 The change of capital control index

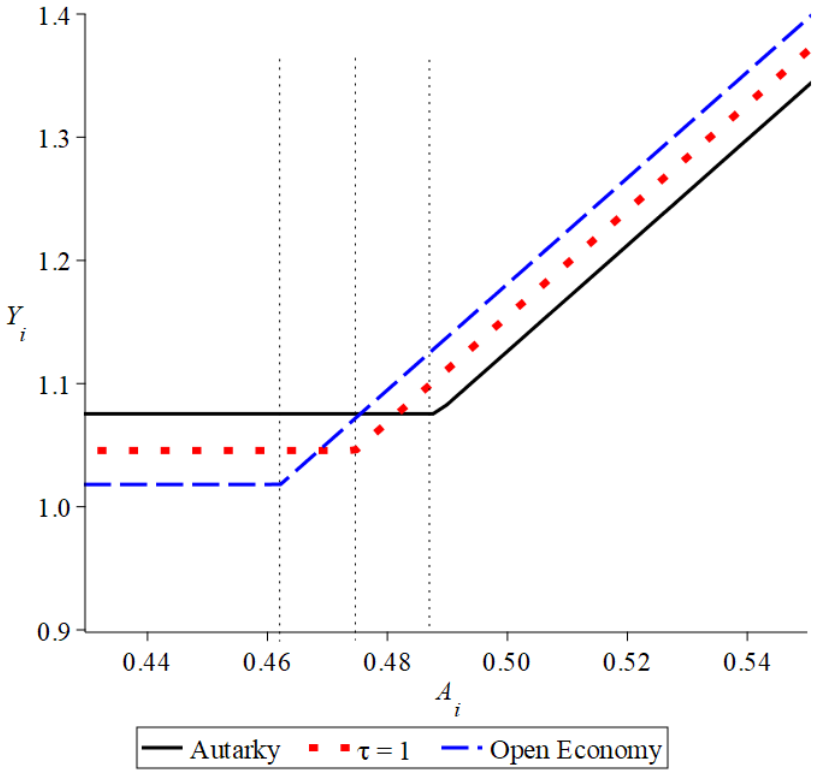

Figure 4: Capital Control Policy

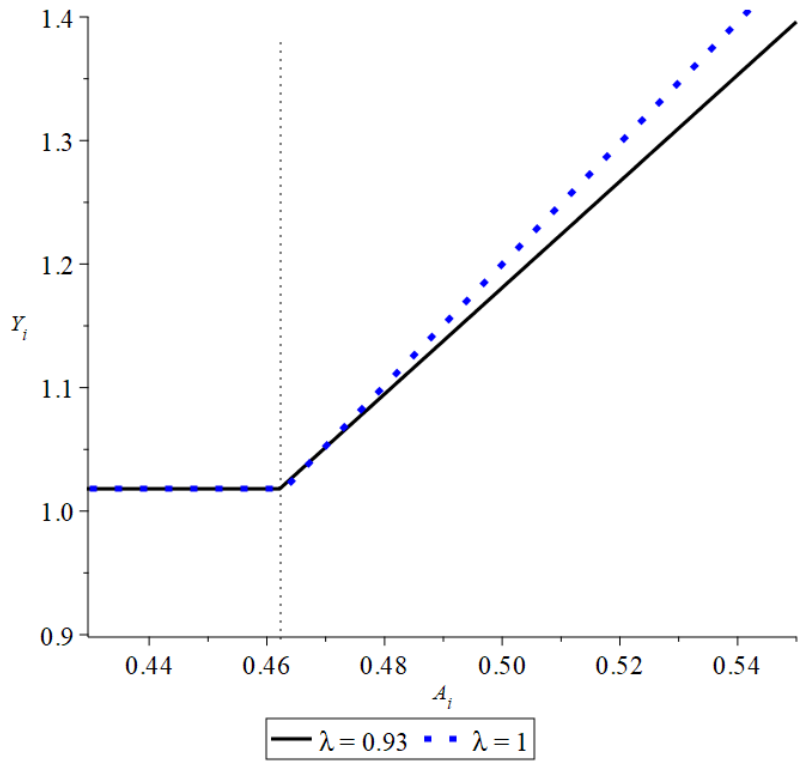

Figure 5: Leverage ratio increase in a Fully Open Economy

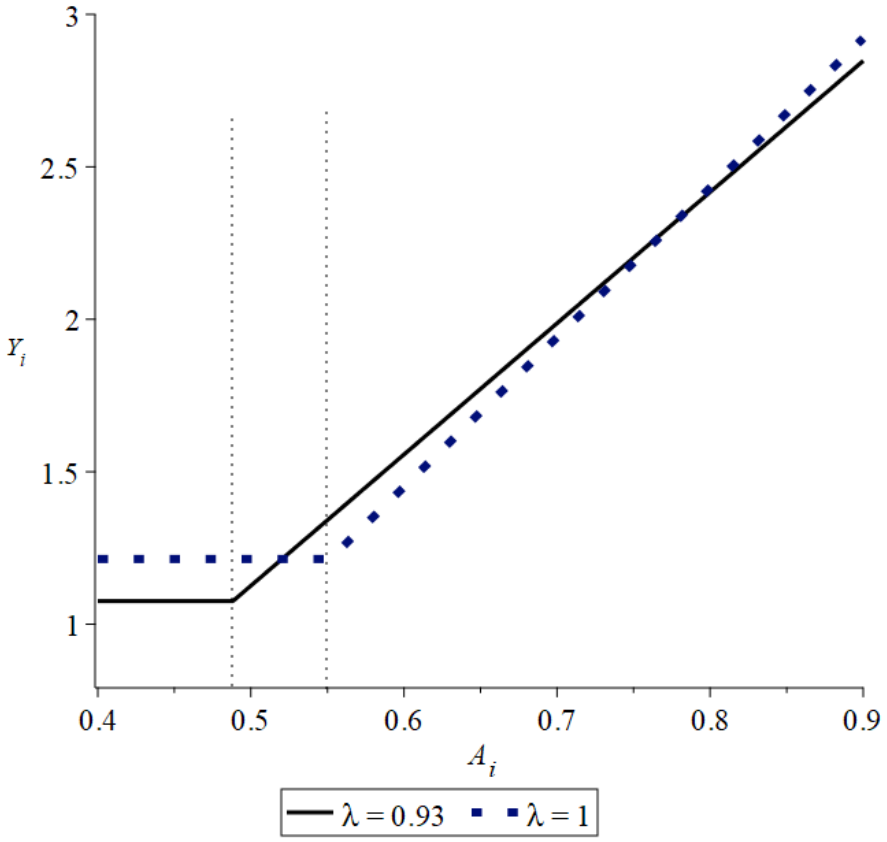

Figure 6: Leverage ratio increase in an Autarky Economy

Table 1: Benchmark Parameter values

Parameter	Value	Target
Endowment W	1	Normalization
Productivity parameter A_{max}	2.23	R_D^*=1.046
Foreign deposit rate R_F	1.018	Data
Capital requirement ρ	0.025	Data

Table 2: Calibration Results of Policy Instruments

Policy Instruments		Deposit rate R_D^*		Income ratio (top 10% over bottom 50%)	
LTV cap		λ = 0.93	λ = 1	λ = 0.93	λ = 1
Capital Controls	fully open	1.018	1.018	3.04	3.12
	$\tau = 1$	1.046	1.066	2.95	2.95
	Autarky	1.075	1.115	2.85	2.77

Table 3 Descriptive statistics

Variable	Observations	Mean	S.D.	Min	Max
Gini	1,031	47.47	5.736	32.30	72.30
Top 10%	1,053	41.17	9.712	26.83	67.83
Bottom 50%	1,053	17.08	5.000	5.300	26.14
Macro-prudential policy	1,053	0.968	1.921	-7	13
Capital controls	1,053	0.330	0.325	0	1
Human capital	1,053	2.975	0.520	1.437	4.352
High-technology	1,053	0.0310	0.0705	2.22e-05	0.610
Employment	1,053	0.448	0.0706	0.264	0.656
Goods trade	1,053	0.901	0.594	0.196	4.373
Financial development	1,053	0.819	0.509	0.002	3.046
Government expenditure	1,053	0.294	0.122	0.0749	0.977
Sovereign external debt	1,048	1.557	2.413	0.0360	20.59
Economic volatility index	1,048	19.06	6.220	11.09	32.70
Real interest rate	1,053	4.863	5.505	-13.64	41.71
Banking crisis	1,043	0.0978	0.297	0	1
Loan rate	1,043	9.391	8.534	0	67.25
Exchange rate	1,043	343.5	1454	0.500	13389
Real GDP growth rate	1,053	3.107	3.356	-24.67	24.37
LTV	975	0.926	0.129	0.379	1.1
Capital	1,053	0.514	1.053	-3	6
Liquidity	1,053	0.253	1.023	-7	11
Asset	1,053	0.201	0.661	-2	5
Borrower	1,053	0.234	0.822	-3	6
Financial	1,053	0.734	1.543	-7	11
Foreign	1,053	0.344	0.740	-2	4
Domestic	1,053	0.624	1.598	-7	13
Kai	1,053	0.296	0.299	0	1
Kao	1,053	0.365	0.377	0	1
Bo	1,022	0.340	0.383	0	1
Eq	1,053	0.340	0.374	0	1
Di	1,053	0.377	0.409	0	1
Leverage	1,048	1.600	1.057	-4.880	6.964
Gross capital flow(%)	1,043	5.907	10.79	0.336	88.21
Net capital flow(%)	1,043	0.515	1.203	-19.22	10.12

Table 4 Impact of macroprudential policies and capital controls on income inequality

	Gini			Top 10%			Bottom 50%		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Macroprudential policy	-0.065***		-0.060***	-0.105***		-0.065*	0.052*		0.032*
	(0.021)		(0.014)	(0.038)		(0.038)	(0.031)		(0.017)
Capital controls		-0.591**	-0.293*		-1.292*	-1.092***		0.740**	0.540*
		(0.269)	(0.164)		(0.782)	(0.648)		(0.361)	(0.306)
Human capital	-0.343	-0.384**	-0.142	0.056	-0.285	0.304	-0.424	0.109	-0.060
	(0.220)	(0.190)	(0.132)	(0.343)	(0.354)	(0.280)	(0.348)	(0.130)	(0.168)
High-technology	-1.026*	0.679	0.550	1.635	1.303	4.316***	-0.985	-1.198*	-1.373*
	(0.584)	(0.826)	(0.610)	(1.307)	(1.321)	(1.426)	(1.322)	(0.652)	(0.737)
Employment	2.598**	0.091	-0.181	2.751	-0.047	-3.059	2.777	-0.124	-0.175
	(1.288)	(1.520)	(1.143)	(2.810)	(2.472)	(3.094)	(2.441)	(1.368)	(1.378)
Goods trade	-0.267**	-0.369***	-0.095	-0.101	-0.064	0.035	-0.094	0.025	0.016
	(0.113)	(0.120)	(0.079)	(0.162)	(0.285)	(0.147)	(0.414)	(0.079)	(0.067)
Real interest rate	0.015	0.004	-0.007	0.083*	0.028	0.005	0.060*	-0.006	-0.003
	(0.013)	(0.011)	(0.011)	(0.045)	(0.053)	(0.036)	(0.035)	(0.017)	(0.015)
Financial development	1.060	-0.298	0.544	-2.540*	-1.025	-2.254	0.234	0.421	0.674
	(0.839)	(0.501)	(0.750)	(1.511)	(1.853)	(1.733)	(1.627)	(0.932)	(0.883)
Government expenditure	1.101	1.331**	-0.085	-1.007	-1.389	-2.166	2.503	0.865	0.770
	(0.823)	(0.572)	(0.500)	(1.223)	(1.879)	(1.415)	(2.122)	(0.605)	(0.639)
Real GDP growth rate	0.032	0.022	0.019	0.016	0.069**	0.007	-0.004	0.022	0.015
	(0.027)	(0.029)	(0.015)	(0.029)	(0.033)	(0.032)	(0.020)	(0.015)	(0.015)
L.Gini	0.995***	0.986***	0.993***						
	(0.010)	(0.010)	(0.008)						
L.Top 10%				0.955***	0.969***	0.979***			
				(0.015)	(0.018)	(0.013)			
L.Bottom50%							0.968***	0.984***	0.985***
							(0.041)	(0.019)	(0.015)
Constant	-0.628	1.988**	0.787	1.818	3.258**	3.699***	-0.509	-0.787*	-0.324
	(0.953)	(0.869)	(0.670)	(1.203)	(1.549)	(1.163)	(0.714)	(0.443)	(0.454)
Observations	1,031	1,031	1,031	1,053	1,053	1,053	1,053	1,053	1,053
Countries	60	60	60	60	60	60	60	60	60
Hansen p	0.745	0.318	0.229	0.518	0.609	0.576	0.329	0.315	0.473
Ar1 p	0.00294	0.00935	0.00256	2.01e-05	1.60e-05	1.52e-05	0.0237	0.0367	0.0345
Ar2 p	0.137	0.1232	0.1831	0.248	0.104	0.140	0.237	0.333	0.326

Table 5 Impact of LTV and capital controls on income inequality

	Gini			Top 10%			Bottom 50%		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
LTV	-0.004*		-0.008***	-0.011***		-0.007*	0.013**		0.014**
	(0.002)		(0.002)	(0.004)		(0.004)	(0.007)		(0.007)
Capital controls		-0.591**	-0.863***		-1.292*	0.040		0.740**	0.381
		(0.269)	(0.195)		(0.782)	(0.419)		(0.361)	(0.462)
L.Gini	0.996***	0.986**	0.977***						
	(0.003)	*	(0.006)						
		(0.010)							
L.Top 10%				0.930***	0.969***	0.941***			
				(0.011)	(0.018)	(0.013)			
L.Bottom50%							0.966***	0.984***	0.969***
							(0.025)	(0.019)	(0.030)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	4.572***	1.988**	5.819***	10.186***	3.258**	6.492***	-3.173*	-0.787*	-3.397
	(0.578)	(0.869)	(0.880)	(1.569)	(1.549)	(1.668)	(1.891)	(0.443)	(2.132)
Observations	886	1,031	886	891	1,053	891	891	1,053	891
Countries	49	60	49	49	60	49	49	60	49
Hansen p	0.418	0.318	0.986	0.801	0.609	0.951	0.986	0.315	0.944
Ar1 p	0.00254	0.00935	0.00752	2.01e-05	1.60e-05	1.77e-05	0.0326	0.0367	0.0343
Ar2 p	0.234	0.232	0.242	0.106	0.104	0.127	0.229	0.333	0.239

Table 6 The PMG estimator of impact of macroprudential policies and capital controls on income inequality

Variables	Gini			Top 10%			Bottom 50%		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Macroprudential policy	-0.032**		-0.029*	-0.130**		-0.185***	0.058**		0.051*
	(0.014)		(0.015)	(0.051)		(0.049)	(0.027)		(0.029)
Capital controls		-1.447**	-3.875*		-7.087*	-0.673		3.154*	1.296
		(0.657)	(2.125)		(3.724)	(2.781)		(1.853)	(1.232)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
ECM	-0.039***	-0.042***	-0.041***	-	-0.229***	-0.297***	-	-0.230***	-0.265***
	(0.008)	(0.008)	(0.008)	0.264***	(0.021)	(0.025)	0.261***	(0.021)	(0.024)
				(0.022)			(0.024)		
CD-P value	0.6012	0.3395	0.1985	0.3931	0.9173	0.1068	0.3604	0.4724	0.1581
Observations	840	840	840	867	867	867	867	867	867
R-squared	0.219	0.227	0.148	0.235	0.198	0.190	0.237	0.116	0.200
Number of groups	49	49	49	49	49	49	49	49	49

Table 7 Decomposing macroprudential policies

Gini	(1) Capital	(2) Liquidity	(3) Asset	(4) Borrower	(5) Financial	(6) Foreign	(7) Domestic
Macro-prudential policy	-0.096**	-0.018**	-0.037**	-0.107*	-0.096***	-0.065**	-0.056**
	(0.040)	(0.014)	(0.221)	(0.062)	(0.035)	(0.026)	(0.026)
L.Gini	0.991***	0.993***	0.987***	0.995***	1.001***	0.993***	0.991***
	(0.019)	(0.009)	(0.019)	(0.012)	(0.011)	(0.009)	(0.015)
Control variables	YES	YES	YES	YES	YES	YES	YES
Constant	0.117	0.815	1.684	0.558	-1.076	0.611	-0.841
	(1.480)	(0.850)	(1.677)	(1.587)	(0.992)	(0.820)	(1.032)
Observations	1,031	1,031	1,031	1,031	1,031	1,031	1,031
Countries	60	60	60	60	60	60	60
Hansen p	0.332	0.217	0.144	0.337	0.455	0.674	0.955
Ar1 p	0.00287	0.0109	0.0104	0.0108	0.00127	0.00687	0.00274
Ar2 p	0.2464	0.3383	0.2577	0.135	0.2676	0.3402	0.4425
Top 10%							
Macro-prudential policy	-0.159*	-0.144**	-0.338**	-0.140*	-0.083**	-0.356*	-0.102*
	(0.093)	(0.141)	(0.396)	(0.071)	(0.039)	(0.180)	(0.060)
L.top10%	0.941***	0.947***	0.954***	0.962***	0.945***	0.955***	0.927***
	(0.055)	(0.021)	(0.051)	(0.008)	(0.011)	(0.027)	(0.017)
Control variables	YES	YES	YES	YES	YES	YES	YES
Constant	5.727	4.134*	2.309	2.099***	3.752***	3.153	6.991***
	(4.760)	(2.465)	(4.417)	(0.788)	(1.191)	(3.273)	(2.017)
Observations	1,053	1,053	1,053	1,053	1,053	1,053	1,053
Countries	60	60	60	60	60	60	60
Hansen p	0.242	0.717	0.301	0.347	0.505	0.526	0.627
Ar1 p	2.12e-05	1.90e-05	3.60e-05	1.52e-05	1.80e-05	1.31e-05	1.72e-05
Ar2 p	0.109	0.180	0.262	0.277	0.180	0.246	0.210
Bottom 50%							
Macro-prudential policy	0.053*	0.042**	0.001**	0.180***	0.061*	0.097*	0.033***
	(0.030)	(0.061)	(0.038)	(0.058)	(0.035)	(0.055)	(0.009)
L.Bottom 50%	0.959***	0.935***	0.959***	0.983***	0.948***	0.986***	0.965***
	(0.035)	(0.029)	(0.022)	(0.014)	(0.026)	(0.016)	(0.006)
Control variables	YES	YES	YES	YES	YES	YES	YES
Constant	-0.471	0.218	-0.778*	0.266	1.297	0.063	-0.068
	(0.494)	(0.768)	(0.465)	(0.435)	(0.794)	(0.525)	(0.173)
Observations	1,053	1,053	1,053	1,053	1,053	1,053	1,053
Countries	60	60	60	60	60	60	60
Hansen p	0.146	0.386	0.290	0.477	0.218	0.381	0.483
Ar1 p	0.0333	0.0361	0.0338	0.0289	0.0324	0.0360	0.0346
Ar2 p	0.314	0.354	0.264	0.388	0.309	0.369	0.301

Table 8 Decomposing capital controls

Gini	(1) Kai	(2) Kao	(3) Bo	(4) Eq	(5) Di
Capital controls	-0.526**	-0.401*	-0.625*	-0.459**	-0.544**
	(0.202)	(0.212)	(0.340)	(0.215)	(0.232)
L.Gini	0.986***	0.988***	0.983***	0.990***	0.990***
	(0.006)	(0.010)	(0.012)	(0.010)	(0.010)
Control variables	YES	YES	YES	YES	YES
Constant	1.883***	1.581**	2.062**	1.534**	1.752*
	(0.648)	(0.716)	(0.965)	(0.760)	(1.045)
Observations	1,031	1,031	1,030	1,031	1,031
Countries	60	60	60	60	60
Hansen p	0.137	0.261	0.645	0.246	0.662
Ar1 p	0.0203	0.0194	0.00918	0.0208	0.0119
Ar2 p	0.2195	0.3301	0.1406	0.2316	0.2199
Top10%					
Capital controls	-1.472**	-0.925**	-0.910**	-0.922*	-0.470**
	(0.682)	(0.411)	(0.365)	(0.526)	(0.224)
L.top10%	0.964***	0.936***	0.940***	0.966***	0.951***
	(0.012)	(0.016)	(0.014)	(0.021)	(0.012)
Control variables	YES	YES	YES	YES	YES
Constant	3.843***	7.304***	7.094***	2.481	5.474***
	(1.198)	(1.490)	(1.348)	(1.721)	(1.237)
Observations	1,053	1,053	1,052	1,053	1,053
Countries	60	60	60	60	60
Hansen p	0.504	0.676	0.659	0.723	0.0456
Ar1 p	1.60e-05	1.27e-05	1.50e-05	1.55e-05	1.66e-05
Ar2 p	0.125	0.224	0.171	0.127	0.793
Bottom 50%					
Capital controls	0.361**	0.643**	0.332**	0.421*	0.263**
	(0.149)	(0.273)	(0.137)	(0.217)	(0.106)
L.bottom 50%	0.969***	0.988***	0.980***	0.984***	0.991***
	(0.016)	(0.019)	(0.015)	(0.018)	(0.016)
Control variables	YES	YES	YES	YES	YES
Constant	-0.827***	-0.655	-0.976***	0.515	-0.667**
	(0.277)	(0.444)	(0.309)	(0.386)	(0.292)
Observations	1,053	1,053	1,052	1,053	1,053
Countries	60	60	60	60	60
Hansen p	0.423	0.448	0.541	0.480	0.592
Ar1 p	0.0336	0.0384	0.0338	0.0338	0.0339
Ar2 p	0.261	0.365	0.262	0.268	0.259

Table 9 Interactive effect of capital controls and macroprudential policies

	(1)	(2)	(3)
	Gini	Top 10%	Bottom 50%
Macroprudential policy	-0.100***	-0.101***	0.065*
	(0.011)	(0.029)	(0.037)
Capital control	-0.227**	-0.603**	0.027
	(0.092)	(0.283)	(0.356)
Macroprudential *capital control	0.080***	-0.013	-0.131**
	(0.015)	(0.047)	(0.056)
Human capital	-0.186*	0.631**	0.124
	(0.097)	(0.265)	(0.200)
High-technology	0.260	4.347***	-1.035
	(0.294)	(0.789)	(0.664)
Employment	1.330**	-4.207**	-4.114**
	(0.578)	(1.584)	(1.854)
Goods trade	-0.102**	-0.160	0.209
	(0.047)	(0.133)	(0.132)
Real interest rate	-0.003	0.023	0.012
	(0.007)	(0.021)	(0.009)
Financial development	0.218	-2.406***	2.410**
	(0.268)	(0.570)	(1.103)
Government expenditure	0.484	-3.588***	-2.128**
	(0.476)	(0.767)	(1.044)
Real GDP growth rate	0.022**	0.009	-0.026
	(0.010)	(0.028)	(0.016)
L.Gini	0.998***		
	(0.004)		
L.Top 10%		0.946***	
		(0.010)	
L.Bottom 50%			0.974***
			(0.020)
Constant	-0.012	4.765***	1.045
	(0.493)	(1.318)	(0.728)
Observations	1,031	1,053	1,053
Countries	60	60	60
Hansen p	0.463	0.738	0.874
Ar1 p	0.00117	1.57e-05	0.0305
Ar2 p	0.276	0.153	0.258

Table 10 Joint effect of capital controls and macroprudential policies

Panel A		ka<mean			ka>mean	
	Gini	Top 10%	Bottom50%	Gini	Top 10%	Bottom50%
Macroprudential	-0.074**	-0.078*	0.060**	0.001	0.046	-0.010
policy	(0.029)	(0.047)	(0.028)	(0.031)	(0.034)	(0.013)
Human capital	-0.296	0.972*	-0.454	-0.461*	-1.398*	0.488*
	(0.293)	(0.576)	(0.270)	(0.269)	(0.754)	(0.246)
High-technology	0.417	1.897	-2.007	-0.091	-1.218	-0.124
	(1.869)	(2.440)	(1.898)	(0.708)	(1.797)	(0.899)
Employment	1.719	-7.068	3.574	2.550	-2.206	0.817
	(2.492)	(4.556)	(2.460)	(2.507)	(3.597)	(1.913)
Goods trade	-0.055	-0.291	0.072	0.235	-0.459	-0.112
	(0.087)	(0.271)	(0.197)	(0.275)	(0.724)	(0.167)
Real interest rate	0.012	0.013	0.014	0.003	0.031	-0.011
	(0.021)	(0.036)	(0.016)	(0.015)	(0.025)	(0.010)
Financial	0.623	-3.729**	1.967**	-0.978	2.149	-0.885
development	(1.365)	(1.477)	(0.730)	(1.059)	(2.580)	(0.739)
Government	-0.265	-4.152**	1.942*	0.120	-2.035	0.931*
expenditure	(0.357)	(1.718)	(0.971)	(0.521)	(1.606)	(0.531)
Real GDP growth	-0.007	-0.013	0.033	0.025	0.018	-0.005
rate	(0.020)	(0.054)	(0.024)	(0.032)	(0.035)	(0.013)
L.Gini	0.980***			1.013***		
	(0.017)			(0.017)		
L.top10%		0.909***			0.918***	
		(0.031)			(0.052)	
L.bottom 50%			0.920***			0.957***
			(0.030)			(0.030)
Constant	0.933	7.664**	-0.807	-0.498	8.003*	-0.642
	(1.397)	(3.422)	(0.940)	(1.732)	(4.667)	(0.870)
Observations	678	688	688	353	365	365
Countries	41	41	41	31	31	31
Hansen p	0.796	0.856	0.924	0.376	0.351	0.391
Ar1 p	0.00235	0.000133	0.0499	0.0585	0.00351	0.000908
Ar2 p	0.912	0.153	0.342	0.119	0.291	0.472
Panel B		low ka country			high ka country	
Macroprudential	-0.068***	-0.092*	0.028*	0.018	0.057	0.007
policy	(0.021)	(0.052)	(0.016)	(0.021)	(0.040)	(0.023)
Human capital	-0.102	0.672	-0.307	0.029	-0.299	-0.385
	(0.316)	(0.656)	(0.312)	(0.129)	(0.409)	(0.630)
High-technology	-0.284	2.149	-0.973	0.028	-0.472	-0.403
	(3.236)	(4.489)	(3.220)	(1.432)	(1.333)	(1.059)
Employment	-0.468	-4.966	4.208*	-0.543	-4.704	-0.179
	(1.456)	(5.423)	(2.362)	(5.806)	(7.300)	(3.206)
Goods trade	0.013	-0.231	-0.028	0.031	-0.588	-0.072
	(0.126)	(0.383)	(0.174)	(0.189)	(0.703)	(0.435)
Real interest rate	0.017	0.010	0.027***	0.008	0.027	-0.034**
	(0.018)	(0.044)	(0.009)	(0.006)	(0.017)	(0.015)
Financial	0.109	-2.741**	-0.113	-0.905	0.244	1.930
development	(0.591)	(1.336)	(0.754)	(0.701)	(1.743)	(1.965)
Government	-0.243	-4.428**	1.214*	-1.412*	-1.294	-1.014
expenditure	(0.684)	(1.851)	(0.638)	(0.816)	(2.566)	(1.557)
Real GDP growth	-0.004	-0.013	-0.021	0.011	0.048*	-0.054
rate	(0.019)	(0.073)	(0.012)	(0.011)	(0.027)	(0.050)
L.Gini	0.973***			1.005***		
	(0.019)			(0.026)		
L.top10%		0.921***			0.959***	
		(0.037)			(0.032)	
L.bottom 50%			0.965***			1.011***
			(0.020)			(0.034)
Constant	1.891	6.539	-0.718	0.342	4.820	0.876
	(1.730)	(4.067)	(0.483)	(3.073)	(5.017)	(0.817)
Observations	687	694	694	344	359	359
Countries	37	37	37	23	23	23
Hansen p	0.970	0.969	0.980	0.763	0.727	0.933
Ar1 p	0.00706	0.000243	0.0614	0.120	0.0203	0.0151
Ar2 p	0.975	0.273	0.258	0.479	0.404	0.760

Table 11 Leverage channel of macroprudential policies

	(1) Leverage	(2) Gini	(3) Top 10%	(4) Bottom 50%
Capital control	0.031			
	(0.210)			
Macroprudential policy	-0.017*			
	(0.009)			
Leverage		0.028**	0.001***	-0.001***
		(0.011)	(0.000)	(0.000)
Sovereign external debt	0.000			
	(0.000)			
Economic volatility index	0.002			
	(0.001)			
Real interest rate	-0.012	0.021***	0.012	0.012***
	(0.008)	(0.007)	(0.013)	(0.004)
Human capital		-0.354***	-0.177	-0.000
		(0.106)	(0.197)	(0.053)
High-technology		0.157	1.802***	-1.228
		(0.391)	(0.569)	(0.870)
Employment		1.636*	-3.871**	2.933***
		(0.961)	(1.730)	(0.849)
Goods trade		-0.265***	0.002	-0.049
		(0.058)	(0.095)	(0.065)
Financial development		-0.119	0.160	-0.099
		(0.339)	(0.805)	(0.275)
Government expenditure		2.093***	-2.997***	0.802
		(0.434)	(0.855)	(0.498)
Real GDP growth rate		-0.000	-0.026*	-0.020***
		(0.006)	(0.015)	(0.005)
L.Leverage	0.955***			
	(0.047)			
L.Gini		0.987***		
		(0.007)		
L.Top 10%			0.953***	
			(0.007)	
L.Bottom 50%				0.962***
				(0.017)
Constant	0.013	0.458	4.758***	-0.548**
	(0.050)	(0.607)	(0.897)	(0.257)
Observations	1,048	1,023	1,041	1,041
Countries	60	60	60	60
Hansen p	0.509	0.496	0.634	0.982
Ar1 p	0.00711	0.00543	1.37e-05	0.0371
Ar2 p	0.249	0.291	0.121	0.249

Table 12 Gross capital flow channel of both macroprudential policies and capital controls

	(1) Gross flow	(2) Gini	(3) Top 10%	(4) Bottom 50%
Capital control	-3.849*			
	(2.013)			
Macroprudential policy	-0.385***			
	(0.131)			
Gross capital flow		0.006**	0.034**	-0.003**
		(0.003)	(0.017)	(0.001)
Sovereign external debt	0.002			
	(0.003)			
Economic volatility index	0.039			
	(0.025)			
Real interest rate	0.015	0.006	0.051	0.054***
	(0.053)	(0.008)	(0.036)	(0.008)
Banking crisis	-0.010			
	(0.662)			
Loan	-0.007			
	(0.056)			
Exchange rate	0.000			
	(0.000)			
Human capital		-0.351***	-0.544	-0.058
		(0.091)	(0.460)	(0.090)
High-technology		-0.947***	-7.476**	2.127***
		(0.327)	(3.583)	(0.601)
Employment		-0.590	9.164**	-0.350
		(0.918)	(4.504)	(0.735)
Goods trade		-0.500***	-1.490***	0.112**
		(0.081)	(0.399)	(0.051)
Financial development		0.303	4.378	-1.757**
		(0.519)	(3.616)	(0.732)
Government expenditure		-0.326	-0.611	1.159
		(0.373)	(3.474)	(0.762)
Real GDP growth rate	-0.002***	0.013	0.053	0.001
	(0.000)	(0.009)	(0.039)	(0.005)
L.Gross capital flow	0.875***			
	(0.062)			
L.Gini		0.986***		
		(0.006)		
L.Top 10%			1.022***	
			(0.041)	
L. Bottom 50%				1.014***
				(0.018)
Constant	1.547	2.295***	-4.441	0.299
	(1.195)	(0.507)	(3.949)	(0.318)
Observations	1,043	1,011	1,027	1,027
Countries	60	60	60	60
Hansen p	0.134	0.268	0.313	0.486
Ar1 p	0.0410	0.0130	1.52e-05	0.0297
Ar2 p	0.130	0.176	0.376	0.207

Table 13 Net capital flow channel of both macroprudential policies and capital controls

	(1) Net flow	(2) Gini	(3) Top 10%	(5) Bottom 50%
Capital control	-0.675*** (0.203)			
Macroprudential policy	-0.028*** (0.008)			
Net capital flow		0.059** (0.026)	0.723** (0.323)	-0.149*** (0.036)
Sovereign external debt	-0.000 (0.000)			
Economic volatility index	0.004** (0.001)			
Real interest rate	-0.013** (0.005)	-0.008 (0.006)	0.197* (0.101)	0.029*** (0.009)
Banking crisis	-0.002 (0.062)			
Loan	0.010** (0.004)			
Exchange rate	0.000*** (0.000)			
Human capital		-0.601*** (0.143)	-0.256 (0.840)	-0.098 (0.109)
High-technology		-0.912 (0.650)	-11.373 (7.239)	2.541*** (0.921)
Employment		1.553** (0.729)	8.356 (6.951)	-1.482** (0.714)
Goods trade		-0.050 (0.087)	-0.556 (0.706)	0.050 (0.102)
Financial development		1.939*** (0.709)	11.069* (6.604)	-2.161*** (0.797)
Government expenditure		0.691 (0.819)	-12.600* (7.137)	0.755 (0.739)
L.Net capital flow	0.875*** (0.011)			
L.Gini		0.977*** (0.007)		
L. Top 10%			1.001*** (0.070)	
L.Bottom 50%				1.034*** (0.018)
Constant	0.127 (0.125)	1.085** (0.496)	-5.749 (7.582)	1.189*** (0.410)
Observations	1,043	1,011	1,027	1,027
Countries	60	60	60	60
Hansen p	0.501	0.383	0.922	0.277
Ar1 p	0.0782	0.0243	3.51e-05	0.0340
Ar2 p	0.234	0.446	0.560	0.215

Appendix A, Proofs of Propositions

Proposition 1. The condition of household to become an entrepreneur is given by

$$A_i \geq A_E = \frac{1-\rho+\lambda}{(1+\lambda)(1-\rho)} R_D$$

Proof: From equation (4), the household decides to become an entrepreneur if and only if

$$Y_i^E = A_i(W_i + L_i) - R_L L_i \geq Y_i^W = R_D W_i$$

Considering the macroprudential policies only allow the entrepreneur to borrow up to $L_i = \lambda W_i$, and plug equation (8), we have $A_i(1+\lambda)W_i - R_L L_i \geq (1-\rho)R_L W_i$, thus

$$A_i \geq A_E = \frac{1-\rho+\lambda}{(1+\lambda)(1-\rho)} R_D. \qquad \square$$

Proposition 2. The bank's deposit rate R_D at equilibrium is given by the following equation

$$\tau(1+\lambda-\rho)^2 R_D^2 + (1+\lambda)(1-\rho)(1-\rho-\tau\lambda)A_{max}R_D - (1+\lambda)(1-\rho)^2 A_{max}R_F = 0$$

which yields the following loan rate R_D at steady state

$$R_D^* = \frac{-(1+\lambda)(1-\rho)(1-\rho-\tau\lambda)A_{max} + (1-\rho)\sqrt{((1+\lambda)(1-\rho-\tau\lambda)A_{max})^2 + 4\tau(1+\lambda-\rho)^2(1+\lambda)A_{max}R_F}}{2\tau(1+\lambda-\rho)^2}$$

Proof: At equilibrium, the financial market has to be clear, $L = (1-\rho)(D+B)$. Thus,

$$\int_{A_E}^{A_{max}} \lambda W_i f(x)dx = (1-\rho)\left[\int_0^{A_E} W_i f(x)dx + \left(1 - \frac{R_F}{R_D}\right)\frac{W}{\tau}\right].$$

Since the productivities are drawn from a uniform distribution where $f(x) = \frac{1}{A_{max}}$, and randomly assign to household which is unrelated to their initial wealth, thus

$$\lambda\tau\frac{A_{max} - A_E}{A_{max}} W = (1-\rho)\left(\tau\frac{A_E}{A_{max}} + 1 - \frac{R_F}{R_D}\right) W$$

Using $A_E = \frac{1-\rho+\lambda}{(1+\lambda)(1-\rho)} R_D$, we have

$$\tau(1+\lambda-\rho)^2 R_D^2 + (1+\lambda)(1-\rho)(1-\rho-\tau\lambda)A_{max}R_D - (1+\lambda)(1-\rho)^2 A_{max}R_F = 0,$$

where the positive root is

$$R_D^* = \frac{-(1+\lambda)(1-\rho)(1-\rho-\tau\lambda)A_{max} + (1-\rho)\sqrt{((1+\lambda)(1-\rho-\tau\lambda)A_{max})^2 + 4\tau(1+\lambda-\rho)^2(1+\lambda)A_{max}R_F}}{2\tau(1+\lambda-\rho)^2}$$

Let $\mathrm{a} = (1+\lambda)(1-\rho)(1-\rho-\tau\lambda)$, $\mathrm{b} = 4\tau(1+\rho)^2(1+\lambda-\rho)^2(1+\lambda)R_F$, $\mathrm{c} = 2\tau(1+\lambda-\rho)^2$, we can simplify the solution to

$$R_D^* = \frac{-aA_{max} + \sqrt{(aA_{max})^2 + bA_{max}}}{c}$$

Therefore,

$$R_D^* = \frac{\left[\sqrt{(aA_{max})^2 + bA_{max}} - aA_{max}\right]\left[\sqrt{(aA_{max})^2 + bA_{max}} + aA_{max}\right]}{c\left[\sqrt{(aA_{max})^2 + bA_{max}} + aA_{max}\right]}$$

$$= \frac{(aA_{max})^2 + bA_{max} - (aA_{max})^2}{c\left[\sqrt{(aA_{max})^2 + bA_{max}} + aA_{max}\right]}$$

$$= \frac{bA_{max}}{c\left[\sqrt{(aA_{max})^2 + bA_{max}} + aA_{max}\right]}$$

$$= \frac{b}{c\left[\sqrt{a^2 + b/A_{max}} + a\right]}$$

As A_{max} increases, R_D^* increases.

□

Appendix B1 Data sources

Variable	Definition	Data source
Gini	measure income inequality in a country	Standardized World Income Inequality Database
Top 10%	Pre-tax income of the top 10% population	World Inequality Database
Bottom 50%	Pre-tax income of the bottom 50% population	World Inequality Database
Macroprudential policy	In order to avoid the impact of the real economy, the policy of using prudential tools to prevent systematic financial risks	Alam et al. (2019)
LTV	Continuous loan-to-value policies, limited to loan-to-value ratios, are applied to both residential and commercial mortgages.	Alam et al. (2019)
Capital controls	A set of measures implemented by governments or central banks to regulate the flow of capital across national borders. It involves imposing restrictions or regulations on the movement of funds, investments, and assets in and out of a country	Fernández et al.(2016)
Human capital	Based on years of schooling and returns to education	Penn World Table 10.01
High-technology	Number of scientific and technical articles per 10,000 people	World Bank
Employment	The ratio of employed people to the total population	CEIC
Goods trade	The ratio of trade to GDP	CEIC
Financial development	The ratio of private credit to GDP	Gennaioli et al., 2014
Government expenditure	The ratio of government expenditure to GDP	CEIC
Sovereign external debt	The ratio of sovereign external debt to GDP	CEIC
Economic volatility index	The market expectation of near term volatility conveyed by stock index option prices	FRED
Real interest rate	Real interest rate	Wind
Banking crisis	0-1variable,the value is 1 if there is an economic crisis in the current	Systemic Banking Crises Database II,

	year, otherwise it is 0	Laeven & Valencia (2020)
Loan rate	Loan rate	Wind
Exchange rate	Exchange rate against the US dollar	CEIC
Real GDP growth rate	Real GDP growth rate,(real GDP-L.real GDP)/ real GDP	CEIC
Capital	Require banks to provide countercyclical buffers and systemic important banks to provide larger capital buffers	Financial Spillovers and Macroprudential Policies, Aizenman et al. (2020)
Liquidity	Regulate maturity mismatch, currency mismatch, credit growth, and other liquidity-related issues	Financial Spillovers and Macroprudential Policies, Aizenman et al. (2020)
Asset	Focus on the leverage of market participants and the concentration of financial assets	Financial Spillovers and Macroprudential Policies, Aizenman et al. (2020)
Borrower	Macroprudential policies for borrowers	Cerutti et al. (2017)
Financial	Macroprudential policies for financial institutions	Cerutti et al. (2017)
Foreign	Macroprudential policies for foreign countries	Cerutti et al. (2017)
Domestic	Macroprudential policies for the domestic market	Cerutti et al. (2017)
Kai	Overall inflow restrictions index	Fernández et al.(2016)
Kao	Overall outflow restrictions index	Fernández et al.(2016)
Bo	Average bond restrictions	Fernández et al.(2016)
Eq	Average equity restrictions	Fernández et al.(2016)
Di	Average direct investment restrictions	Fernández et al.(2016)
Leverage	The ratio of private credit to GDP	IMF
Gross capital flow	(Capital inflow + capital outflow)/GDP	EPFR
Net capital flow	(Capital inflow - capital outflow)/GDP	EPFR

Appendix B2 Definitions of macro-prudential policy

Variable	Definition	Capital/Liquidity/ Asset	Borrower /Financial	Foreign/ Domestic
CCB	A requirement for banks to maintain a counter cyclical capital buffer	Capital	Financial	Domestic
Conservation	Requirements for banks to maintain a capital conservation buffer	Capital	Financial	Domestic
Capital	Capital requirements for banks, which include risk weights, systemic risk buffers, and minimum capital requirements	Capital	Financial	Domestic
LLP	Loan loss provision requirements for macro-prudential purposes	Capital	Borrower	Domestic
LoanR	Loan restrictions, that are more tailored than those captured in "LCG"	Capital	Borrower	Domestic
LFX	Limits on net or gross open foreign exchange positions, limits on FX exposures and FX funding, and currency mismatch regulations	Capital	Financial	Foreign
SIFI	Measures taken to mitigate risks from global and domestic systemically important financial institutions , which includes capital and liquidity surcharges	Capital	Financial	Foreign
LCG	Limits on growth or the volume of aggregate credit, the household-sector credit, or the corporate-sector credit, and penalties for high credit growth	Liquidity	Borrower	Domestic
LFC	Limits on foreign currency lending, and rules or recommendations on FC loans	Liquidity	Financial	Foreign
TAX	Taxes and levies applied to specified transactions, assets, or liabilities, which include stamp duties, and capital gain taxes	Liquidity	Financial	Domestic
Liquidity	Measures taken to mitigate systemic liquidity and funding risks, including minimum requirements for liquidity coverage ratios, liquid asset ratios, net stable funding ratios, core funding ratios and external debt restrictions that do not distinguish currencies	Liquidity	Financial	Foreign
RR	Reserve requirements for macro-prudential purposes	Liquidity	Financial	Domestic
LTV	Limits to the loan-to-value ratios, applied to residential and commercial mortgages	Asset	Borrower	Domestic

	but also applicable to other secured loans, such as for automobiles			
DSTI	Limits to the debt-service-to-income ratio and the loan-to-income ratio, which restrict the size of debt service payments or the size of a loan relative to income	Asset	Borrower	Domestic
LTD	Limits to the loan-to-deposit ratio and penalties for high LTD ratios	Asset	Borrower	Domestic
LVR	A limit on leverage of banks	Asset	Financial	Domestic
Other	Macro-prudential measures not captured in the above categories—e.g., stress testing, restrictions on profit distribution, and structural measures	Asset	Financial	Domestic

Appendix B3 country list

Argentina	Greece	Philippines
Australia	Hungary	Poland
Austria	Iceland	Portugal
Bangladesh	India	Republic of Korea
Belgium	Indonesia	Republic of Moldova
Brazil	Ireland	Romania
Bulgaria	Israel	Russian Federation
Canada	Italy	Singapore
Chile	Japan	Slovenia
China	Latvia	South Africa
Colombia	Malaysia	Spain
Cyprus	Malta	Sri Lanka
Czech Republic	Mauritius	Sweden
Côte d'Ivoire	Mexico	Switzerland
Denmark	Morocco	Thailand
Ecuador	Netherlands	Tunisia
Finland	New Zealand	Ukraine
France	Norway	United Kingdom
Germany	Paraguay	United States
Ghana	Peru	Zambia

Appendix B4 Interactive effect of capital controls and LTV

	(1)	(2)	(3)
	Gini	Top 10%	Bottom 50%
LTV	-0.006**	-0.027*	0.009*
	(0.002)	(0.015)	(0.005)
Capital control	-0.173***	-0.709***	0.183**
	(0.038)	(0.192)	(0.090)
LTV *capital control	0.014***	0.077***	-0.022**
	(0.005)	(0.018)	(0.009)
Human capital	-0.620***	-0.504	0.214
	(0.126)	(0.620)	(0.215)
High-technology	0.510	3.845**	-1.973**
	(0.331)	(1.566)	(0.755)
Employment	0.795**	-9.227*	2.654
	(0.386)	(5.392)	(2.720)
Goods trade	-0.209***	0.064	-0.064
	(0.062)	(0.268)	(0.103)
Real interest rate	0.002	0.023	-0.006
	(0.004)	(0.036)	(0.019)
Financial development	0.121	0.548	0.642
	(0.380)	(1.636)	(1.015)
Government expenditure	0.662**	-2.927*	1.047**
	(0.309)	(1.623)	(0.517)
Real GDP growth rate	-0.004	-0.008	0.048
	(0.004)	(0.066)	(0.038)
L.Gini	0.985***		
	(0.007)		
L.Top 10%		0.953***	
		(0.014)	
L.Bottom 50%			0.947***
			(0.018)
Constant	2.832***	10.675**	-2.393*
	(0.670)	(5.189)	(1.191)
Observations	886	891	891
Countries	49	49	49
Hansen p	0.270	0.538	0.280
Ar1 p	0.0165	1.62e-05	0.0351
Ar2 p	0.224	0.112	0.352

Appendix B5 The PMG estimator of interactive effect of capital controls

	(1)	(2)	(3)
	Gini	Top 10%	Bottom 50%
LTV	-0.009*	-0.055	-0.005
	(0.005)	(0.043)	(0.011)
Capital control	-0.850	-3.775	3.585**
	(1.685)	(4.725)	(1.394)
LTV *capital control	0.020	0.099**	0.036
	(0.021)	(0.044)	(0.029)
Human capital	0.007	-0.055	-0.014
	(0.022)	(0.088)	(0.054)
High-technology	-0.084	-0.515	-0.422
	(0.089)	(0.517)	(0.327)
Employment	-0.157*	0.037	-0.212
	(0.080)	(0.255)	(0.133)
Goods trade	-0.457	-3.754	0.144
	(0.450)	(2.445)	(1.703)
Real interest rate	0.013	-0.003	-0.022
	(0.032)	(0.052)	(0.042)
Financial development	-0.692	2.810	1.647
	(1.046)	(3.618)	(1.499)
Government expenditure	0.380	-1.038**	-0.722
	(3.321)	(4.763)	(4.204)
Real GDP growth rate	0.007*	0.021	-0.064**
	(0.004)	(0.032)	(0.027)
ECM	-0.052***	-0.229***	-0.250***
	(0.010)	(0.023)	(0.023)
Observations	884	89	89
Countries	41	41	41
R-squared	0.066	0.096	0.079
CD P-value	0.263	0.888	0.251