The Role of Inequality in the Optimal Design of Capital Controls*

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Abstract

Sudden stops in capital inflows are disruptive and costly events that can cause severe redistributive effects. In this paper, I investigate the role of inequality in the design of optimal capital controls that seek to mitigate the negative effects of these phenomena. To do so, I set up a small open production economy model with collateral constraints and two types of agents that are heterogeneous in income and borrowing capacities. I calibrate the model and use the model to study the response of the economy to exogenous shocks that produce a tightening of the collateral constraint and a reversal of the current account as observed during sudden stops. I then solve the constrained solution for a Social Planner´s problem that cares about both the standard pecuniary externality in these models and also redistribution. I use the model to disentangle the role of these two channels and find that inequality implies differentiated capital controls between high income and low income agents. While in normal times taxes are higher for high income households to prevent overborrowing, the planner allows low income households to borrow more to enable some redistribution. When the economy faces a sudden stop, taxes for all agents are reduced to nearly zero. Finally, I investigate the welfare effects of implementing a simple, constant, and uniform rule for capital controls.

Keywords: Sudden stops, Optimal Capital Controls, Inequality.
JEL codes: F41, G01, H23

1 Introduction

Most Small Open Economy models with collateral constraints rely on a Representative Agent (RA) framework, in which the external borrowing capacity of the RA depends on its income level (Bianchi (2011), Benigno et al. (2013, 2016), Seoane and Yurdagul (2019)). These models feature a pecuniary externality because the RA fails to internalize how his own borrowing and consumption affect prices and therefore the value of his income. As a result, the economy tends to overborrow, increasing the risk and severity of sudden stops, crises characterized by an abrupt cut-off of external credit, and a sharp decline in output. In this setting, capital controls become desirable to limit overborrowing, although they can follow an un-

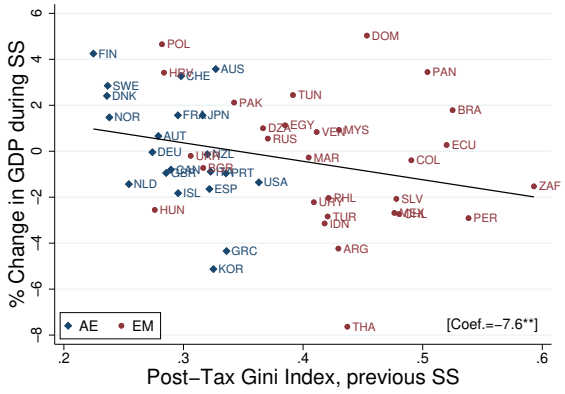
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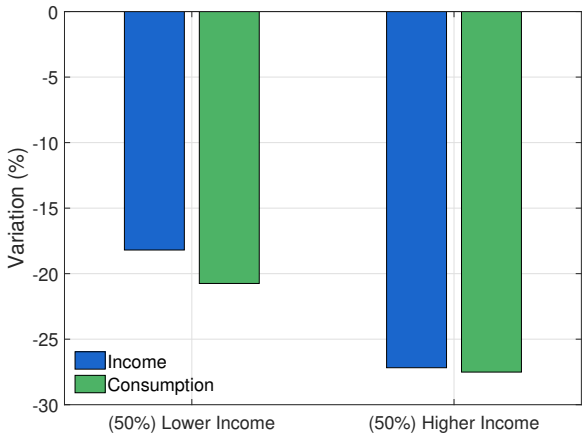
conventional optimal pattern, easing during booms and tightening during crises (Schmitt-Grohé and Uribe (2017); Flemming et al. (2019)). Despite the valuable insights provided by the RA framework, recent work has highlighted the role of inequality in influencing the risk of financial crises (Paul (2023), Arce and Tran-Xuan (2022)) and the severity of sudden stops (Villalvazo (2023)), an aspect that RA models overlook. Based on these findings, this paper proposes a simple model with limited heterogeneity to explore the role of inequality in optimal capital control policy.

Figure 1: Sudden Stops and Inequality

(a) Severity of Sudden Stops*



(b) Income and Consumption by Household Group during the 1995 Mexican Crisis



*Villalvazo (2023) presents a similar fact. Dates of Sudden stops (SS) episodes come from Bianchi and Mendoza (2020). $*p < 0.10, **p < 0.05, ***p < 0.01$. Sources: The World Bank and SWII (Solt (2020)) for inequality data. "AE": Advanced Economies, "EM": Emerging Economies. The graph on the right shows the real variation in consumption and income for the bottom 50% and top 50% of Mexican households, based on income. Income includes only wages and business income, while consumption includes both durable and non-durable goods. These data were estimated using the 1994 and 1996 ENIGH survey data from INEGI. Only household heads aged 25 to 64 were included. Nominal values were deflated using the Consumer Price Index (CPI)

The motivation behind this paper comes from some empirical observations mentioned below. On the one hand, as shown in Figure 1(a) (also presented in Villalvazo (2023)), economies with higher levels of income inequality tend to experience more severe sudden stop episodes[1]. This suggests that inequality can amplify the economic impact of these episodes. On the other hand, these crises can also have important distributional consequences. Figure 1(b) examines the case of Mexico during the 1995 sudden stop[2], a major event that deeply affected this emerging economy, which is characterized by high levels of inequality. The figure shows that high-income households experienced a more pronounced decline in both consumption and income compared to low-income households. This pattern reinforces the idea that inequality not only affects the severity of sudden stops but may also condition their redistributive implications, disproportionately

[1]This relationship is robust when conditioning by economy; see Figure 8 in the appendix.

[2]Figure 9 in the appendix presents the behavior of macroeconomic variables in Mexico during the sudden stop, known as the Tequila effect.

impacting certain groups within the population. The design of an appropriate policy becomes particularly relevant in a context where the International Monetary Fund has shown increased receptiveness to the use of capital controls (IMF (2022)). In this regard, the role of inequality and the potential distributive dimension of the crisis should not be overlooked.

I examine the optimal use of capital controls before and during sudden stop crises. To this end, I develop a small open production economy model with collateral constraints and two types of agents (TAs): high-income households and low-income households, which differ in their income levels and borrowing capacities. The model is an extension of Bianchi (2011) and is used to study how the economy responds to exogenous shocks that tighten collateral constraints and trigger sudden stops. Although the model features TAs, it still presents a pecuniary externality because both agents fail to internalize how their borrowing and consumption decisions affect prices. However, this externality differs between agents as they face different borrowing capacities. In designing an optimal capital control policy, the government, whose objective is to maximize social welfare, must therefore account for income heterogeneity and its implications for the pecuniary externality. To this end, I solve for the optimal policy using a social planner problem, in which the planner maximizes aggregate welfare subject to the constraints of the agents while internalizing the effects of the externality.

Solving the TAs model quantitatively, I find that inequality implies differentiated capital controls between high-income households and low-income households. In normal times, capital controls are positive and higher for high-income households to prevent overborrowing, while the planner allows low-income households to borrow more to facilitate some redistribution. When the economy faces a sudden stop (characterized by tighter financial conditions for both agents and a decline in external capital flows), capital controls for all agents are reduced to nearly zero. This result contrasts with the RA approach in the existing literature, where capital controls increase during crises.

Having differentiated capital controls for high-income households and low-income households, positive in normal times to correct the pecuniary externality but differing across agents to address redistribution, is the main contribution of my paper to the literature on inequality and sudden stops. Moreover, because crises affect agents differently in an economy with inequality, these controls tend to behave in a more countercyclical manner, tightening during booms and easing during crises.

This work recognizes that implementing two different capital controls is challenging. To address this, I explore a uniform constant capital control applied to both types of agents that can approximate the optimal outcome. Such a uniform policy can move the economy closer to the social optimum by reducing the risk of sudden stops and improving overall household welfare. Therefore, the capital control designed by the government should take into account the role of inequality in achieving this optimal outcome.

Related literature. This paper aligns with the literature on macroprudential policies, sudden stops, and

heterogeneity. Recent papers have explored the inclusion of heterogeneous agents in models with collateral constraints and have analyzed the implications for optimal taxation. Biljanovska and Vardoulakis (2024) present a model with two types of agents, workers and entrepreneurs, where only the latter have access to financial markets. Consequently, capital controls regulate only the entrepreneurs, and the optimal capital control equation they derive ends up being equivalent to the RA model of Bianchi and Mendoza (2018). In contrast, my paper allows both types of agents to access financial markets, meaning that both are directly involved in borrowing decisions, with some being more vulnerable than others. Furthermore, since these agents may have different income levels, they are likely to borrow to varying extents, necessitating differentiated macroprudential regulations tailored to their income levels and the specific vulnerabilities of each agent type. My paper is much more aligned with the work of Arce and Tran-Xuan (2022). Arce and Tran-Xuan present a model incorporating two types of agents with financial frictions and nonhomothetic preferences. Their findings indicate that both income inequality and non-homotheticity amplify the effects of sudden stops, underscoring the importance of considering distributional effects when implementing macroprudential policies. However, they do not explore the characteristics of taxes and their dependence on inequality, nor do they examine their properties before and during a sudden stop. A paper that explores the adoption of different regulations by applying differentiated taxes is the work of Korinek and Sandri (2016). They adopt a two-agent model, one debtor and one saver. In their model, they primarily conduct a qualitative theoretical analysis in a three-period framework, exploring the role of inequality through bond holding in the use of macroprudential policies and capital controls. My work differs in that it considers all agents as debtors but with different income levels, in addition to conducting a quantitative analysis of these regulations.

Layout. The paper is structured as follows: Section 2 presents the model with two types of agents, section 3 characterizes the Social Planner problem and the optimal capital controls. Section 4 shows the quantitative analyses and main results. Finally, section 5 discusses the implementation, and section 6 concludes.

2 Model

In this section, I extend the framework established by Bianchi (2011). The extension consists of incorporating two types of agents and a production economy into a small open-economy model. Specifically, there is a unit mass of agents i who consume tradable and nontradable goods and have access to an international credit market, where they can borrow according to the collateral value. The agents produce nontradable goods in a competitive market, taking prices and wages as given. In nontradable production, the agents rely on a specific technology and utilize only labor. The source of heterogeneity arises because one type of agent has a more productive technology than the other. Thus, we can define $i \in \{H, L\}$, where H represents all households-firms with high technology, and L represents all households-firms with low technology. The fraction of household-firms with a given technology is $\pi_i \in (0, 1)$ for $i \in H, L$, with $\sum_{i \in \{H,L\}} \pi_i = 1$.

2.1 Households

In the small open economy, there are two types of agents, $i \in \{H, L\}$, who have preferences of the form:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u^i(c_{i,t}) \tag{1}$$

with $c_{i,t}$ denoting the consumption basket of agent i and β representing the discount factor ($\beta \in (0,1)$). $\mathbb{E}_t$ is the time t expectation operator. $u^i(c_{i,t})$ denotes the utility function and their functional form is given by $(c_{i,t}^{1-\sigma} - 1)/(1-\sigma)$, where $\sigma > 0$ is the coefficient of relative risk aversion.

The consumption basket of agent i is a composite of tradables ($c_{i,t}^T$) and non-tradables ($c_{i,t}^N$):

$$c_{i,t} = \left[\omega (c_{i,t}^T)^{-\eta} + (1-\omega)(c_{i,t}^N)^{-\eta}\right]^{-1/\eta}, \qquad \eta > -1 \tag{2}$$

where $1/(1+\eta)$ is the elasticity of substitution between tradable and non-tradable goods and $\omega \in (0,1)$ is the relative weight of tradable goods in the consumption basket.

Each household i maximize utility subject to their budget constraint, which is expressed in units of tradables goods:

$$c_{i,t}^T + p_t^N c_{i,t}^N + b_{i,t+1} = (1+r) b_{i,t} + y_t^T + w_t h_{i,t} + \Phi_{i,t}^N \tag{3}$$

where p_t^N is the relative price of the non-tradable goods, $b_{i,t+1}$ denotes the net foreign asset position of the agent i at the end of period t with net real return r, $h_{i,t}$ is the supply labor of the agent i, w_t is the real wage and finally $\Phi_{i,t}^N$ is the profit of household i from their own firm. The wage and profit of agent i come from the non-tradable sector. Finally, y_t^T denotes the endowments of tradables, which are assumed to be common for all agents and treated as exogenous and stochastic.

Each agent i has the ability to borrow internationally; however, their borrowing capacity is constrained by a fraction κ of their income. The collateral constraint of agent i is:

$$b_{i,t+1} \geq -\kappa (y_t^T + w_t h_{i,t} + \Phi_{i,t}^N) \tag{4}$$

κ can be interpreted as the fraction of income that creditors impose as a restriction on loans. This constraint is what causes the agents to be financially constrained and is the reason why regulation can be implemented in the economy.

In the recursive form, the problem of each $i \in \{H, L\}$ household can be written:

$$V^i(b_i, B_i, B_{-i}, y^T) = \max_{\{b_i', c_i^T, c_i^N\}} u_i(c_i) + \beta \mathbb{E} V^i(b_i', B_i', B_{-i}', y^{T\prime})$$

subject to

$$
\begin{aligned}
c_i^T + p^N c_i^N + b_i' &= (1+r)b_i + y^T + wh_i + \Phi_i^N && \{\lambda_i\} \\
b_i' &\geq -\kappa(y_i^T + wh_i + \Phi_i^N) && \{\mu_i\} \\
B_i' &= \Gamma(B_i, B_{-i}, y^T)
\end{aligned}
$$

The optimization problem of agent i includes, as endogenous state variables, the individual bond holding (b_i), the aggregate bond holding of agents of the same type (B_i), and the aggregate bond holding of agents of the other type or sector (B_{-i}). Additionally, it includes as an exogenous state variable the tradable goods process (y^T). Households need to forecast the aggregate bond holding of their type and the aggregate bond holding of the other type to form expectations over the relative price. Therefore, Γ denotes the forecast of aggregate bond holding of type i for every aggregate endogenous state and exogenous state. Here, λ_i and μ_i represent the multiplier of the budget constraints and the multiplier of the collateral constraint, respectively, for agent $i \in \{H, L\}$.

We can obtain the Euler equation and the intratemporal allocation of consumption for each agent i, respectively. For details, please refer to the appendix A.1, where we combine (A.1) and (A.3) and (A.1) with (A.2).

$$
u_T^i(t) = \beta(1+r)\mathbb{E}_t u_T^i(t+1) + \mu_{i,t} \qquad \forall i \in \{H, L\} \tag{5}
$$

$$
p_t^N = \frac{1-\omega}{\omega}\left(\frac{c_{i,t}^T}{c_{i,t}^N}\right)^{1+\eta} \qquad \forall i \in \{H, L\} \tag{6}
$$

where $u_T^i(t) = \partial u^i(c_{i,t})/\partial c_{i,t}^T$, is the marginal utility of tradable consumption.

2.2 Firms

Each household i is the owner of their own firm. Firm $i \in \{H, L\}$ produces non-tradable goods. Each firm i operates with a specific technology with decreasing return to scale characterized by a productivity level denoted as θ_i and employing a certain amount of labor in their production process.

$$
y_{i,t}^N = \theta_i F(n_{i,t}) = \theta_i n_{i,t}^\alpha \tag{7}
$$

Where $y_{i,t}^N$ denotes non-tradable output of the type i and labor demand is expressed by $n_{i,t}$, with $\alpha \in (0, 1)$, the labor share in non-tradable firm. We assume that $0 < \theta_L \leq \theta_H$. Each firm i chooses the amount of labor

to maximize profits, given by:

$$\Phi_{i,t}^N = p_t^N y_{i,t}^N - w_t n_{i,t} \tag{8}$$

$$\text{subject to} \qquad y_{i,t}^N = \theta_i n_{i,t}^\alpha \tag{9}$$

The optimality condition associated with this problem is:

$$p_t^N \theta_i \alpha n_{i,t}^{\alpha-1} = w_t \qquad \forall i \in \{H, L\} \tag{10}$$

2.3 Competitive Equilibrium

An competitive equilibrium in this economy consists of a set of allocations $\{c_{i,t}^T, c_{i,t}^N, n_{i,t}, b_{i,t+1}\}_{t=0}^\infty$ for each $i \in \{H, L\}$ and a sequence of prices $\{p_t, w_t\}_{t=0}^\infty$ such that:

1. Each households $i \in \{H, L\}$ maximizes her utility (1) subject to (2), (3) and (4).
2. Each firm $i \in \{H, L\}$, maximizes its benefits (8) subject to the technological constraint (9).
3. Aggregated market clearing:

$$\sum_{i \in \{H,L\}} \pi_i N_i = 1 \tag{11}$$

$$\sum_{i \in \{H,L\}} \pi_i C_i^N = \sum_{i \in \{H,L\}} \pi_i Y_i^N \tag{12}$$

$$\sum_{i \in \{H,L\}} \pi_i C_i^T + \sum_{i \in \{H,L\}} \pi_i B_i' = (1+r) \sum_{i \in \{H,L\}} \pi_i B_i + \sum_{i \in \{H,L\}} \pi_i Y^T \tag{13}$$

We follow the convention of denoting individual variables with lowercase letters and aggregate variables with uppercase letters. For example, while n_i represents the individual labor demand of a firm of type i, N_i denotes the total aggregate demand for labor in sector i, and so forth. In equilibrium, $n_i = N_i$, and similarly for other variables.

Equation (11) represents the labor market equilibrium, where the total demand for labor by firms is equal to the total labor supply (which is equal to 1). Equation (12) represents the equilibrium in the non-tradable market, meaning that all non-tradable goods are consumed domestically, and equation (13) represents the aggregate allocation of the resource constraints.

2.4 The source of (in)equality in the model

Considering that households-firms i can have different levels of technological productivity, θ, we can demonstrate that this implies differences in the allocations. To do this, if we combine the expression (10) for the

types $i \in \{H, L\}$ and do the same with the profit equations (8), we can obtain:

$$\frac{n_{H,t}}{n_{L,t}} = \frac{\phi^N_{H,t}}{\phi^N_{L,t}} = \left(\frac{\theta_H}{\theta_L}\right)^{1/(1-\alpha)}$$

It is easy to see that if all agents had the same technological efficiency, i.e., if $\theta_H = \theta_L > 0$, there would be no inequality, as all firms would hire the same number of workers and receive similar profits. However, if $\theta_H > \theta_L > 0$, in this case, agents of type H would demand more workers and have greater profits than the firms of agents of type L.

2.5 Relative price of non-tradable goods and salary

Unlike models with a representative agent, where the relative price only depends on the individual agent's tradable consumption (as shown by Bianchi (2011)), in this model, the price now depends on the consumption of tradable goods of both types of agents.

Thus, by combining equation (6) with (12), and taking into account that in equilibrium $c^T_i = C^T_i$ and $c^N_i = C^N_i$ for $i \in \{H, L\}$, we can derive the relative price of non-tradable goods in the economy:

$$p^N_t = \frac{1-\omega}{\omega}\left(\frac{\sum_{i\in H,L}\pi_i C^T_{i,t}}{\sum_{i\in H,L}\pi_i Y^N_{i,t}}\right)^{1+\eta} \tag{14}$$

where we express aggregate non-tradable production in the numerator given the market-clearing conditions, as shown in equation (12). Now, with the existence of heterogeneity, this price is an increasing function of the aggregate consumption of tradable goods by each type of agent in the economy.

Additionally, by combining equations (10), (11) and the equilibrium $n_i = N_i$, we can determine the salary:

$$w_t = \alpha\Theta p^N_t \tag{15}$$

where $\Theta = \left(\pi_H\theta_H^{1/(1-\alpha)} + \pi_L\theta_L^{1/(1-\alpha)}\right)^{1-\alpha}$.

This model integrates both a standard pecuniary externality and a distributive channel. The pecuniary externality arises from the fact that the relative prices (p^N_t and w_t) are exogenous for individuals but endogenous for the economy. Households-firms fail to internalize the impact of their individual debt decisions on these prices, thereby exacerbating the effects of shocks on the business cycle. The distributive channel arises from the differences in how each agent values their consumption of tradable goods. In the context of inequality, this is reflected in the differences in marginal utilities across agents, which indirectly affects the welfare of the economy. It is worth noting that this distributive channel is also highlighted in Biljanovska and Vardoulakis (2024).

3 Optimal Capital Controls

Taking into account that the decisions of the agents are suboptimal in the presence of this externalities, in this section, we address the Social Planner's problem, where he must determine the set of efficient allocations. Subsequently, we derive the optimal state-contingent taxes on debt, which are rebated to households as a lump-sum transfer. The idea is to implement the efficient allocation chosen by the Planner in a decentralized equilibrium with regulation. We assume that when the Social Planner chooses the allocations, he has the ability to commit to policy promises.

3.1 Social Planner

The Social Planner chooses allocations to maximize the social welfare function, subject to agents' budget constraints and collateral constraints. The Social Planner maximizes:

$$\sum_{i=\{H,L\}} \varpi_i \pi_i \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t u^i(C_{i,t}) \right] \tag{16}$$

where $\varpi_i \geq 0$ is the social welfare weight, which is an exogenous parameter. Additionally, $\sum_{i \in I} \pi_i \varpi_i = 1$. The Social Planner chooses the optimal path of $C^T_{i,t}$, $C^N_{i,t}$, $B_{i,t+1}$, and $N_{i,t}$ for $i \in \{H, L\}$, maximizing equation (16) subject to the budget constraint and collateral constraint for each $i \in \{H, L\}$, the pricing rule (6), and equation (10) also for each $i \in \{H, L\}$, as well as equations (11)-(13). Formally, the Social Planner's optimization problem in recursive form can be expressed as follows:

$$V(B_i, B_{-i}, y^T) = \max_{C^T_i, B'_i} \left\{ \sum_{i \in \{H,L\}} \varpi_i \pi_i u^i(C_i(C^T_i, C^N_i)) + \beta \mathbb{E} V(B'_i, B'_{-i}, y^{T\prime}) \right\}$$

subject to

$$C^T_i + \mathcal{P}^N C^N_i + B'_i = (1+r)B_i + Y^T + \mathcal{W} + \Phi^N_i \qquad \{\pi_i \lambda^{SP}_i\} \qquad \forall i \in \{H, L\} \tag{17}$$

$$B'_i \geq -\kappa \left(Y^T + \mathcal{W} + \Phi^N_i \right) \qquad \{\pi_i \mu^{SP}_i\} \qquad \forall i \in \{H, L\} \tag{18}$$

$$\Phi^N_i \equiv \mathcal{P}^N Y^N_i - \mathcal{W} N_i \qquad \forall i \in \{H, L\} \tag{19}$$

$$\mathcal{P}^N \equiv \frac{1-\omega}{\omega} \left(\frac{\sum_{i \in \{H,L\}} \pi_i C^T_i}{\sum_{i \in \{H,L\}} \pi_i Y^N_i} \right)^{1+\eta} \tag{20}$$

$$\mathcal{W} \equiv \alpha \Theta \mathcal{P}^N \tag{21}$$

We use the notation "SP" to distinguish the Social Planner's multipliers. By notation, we define and explicitly present $\Phi^N_i, \mathcal{P}^N$ and $\mathcal{W}$ which can be directly substituted into equations (17) and (18). An important characteristic is that the Social Planner chooses aggregate variables because he internalizes the pecuniary ex-

ternality, recognizing that agents' consumption of tradables affects the relative price and, consequently, the collateral value. However, he also acknowledges that the incidence on prices, given the consumption valuation of each agent, differs across agents. Therefore, in contrast to models with Representative Agent, where the Social Planner neglects the redistribution effect, in this framework, the Social Planner must consider the implications of the distribution.

The first-order conditions of the social planner for $i \in \{H, L\}$ are:

$$\{C^T_{i,t}\} : \lambda^{SP}_{i,t} = \underbrace{\varpi_i u^i_T(t)}_{\substack{\text{Private} \\ \text{benefit}}} + v_t \Bigg[\underbrace{(\pi_i \lambda^{SP}_{i,t} - \pi_{-i} \lambda^{SP}_{-i,t})(\Omega_{i,t} - C^N_{i,t})}_{\substack{\text{Distributive} \\ \text{channel}}} + \underbrace{\kappa \Big(\sum_{i \in \{H,L\}} \pi_i \mu^{SP}_{i,t} \Omega_{i,t} \Big)}_{\substack{\text{Pecuniary} \\ \text{externality}}} \Bigg] \tag{22}$$

$$\{B_{i,t+1}\} : \lambda^{SP}_{i,t} = \beta(1+r)\mathbb{E}_t \lambda^{SP}_{i,t+1} + \mu^{SP}_{i,t} \tag{23}$$

$$B_{i,t+1} + \kappa \Big(Y^T_t + \mathcal{P}^N_t \Omega_{i,t} \Big) \geq 0 \qquad \text{with equality if } \mu^{SP}_{i,t} > 0 \tag{24}$$

where $\Omega_{i,t} = Y^N_{i,t} + \alpha\Theta(1 - N_{i,t})$ for $i \in \{H, L\}$ and $v_t = (1+\eta)\mathcal{P}^N_t / \big(\sum_{i \in \{H,L\}} \pi_i C^T_{i,t} \big)$. Note that we did not have to maximize with respect to $C^N_{i,t}$ and $N_{i,t}$ since these variables are derived from the decomposition of prices themselves, which are given by equations (6) and (10).

As can be seen in equation (22), the Social Planner's shadow price not only considers the private benefit of the agent but also takes into account the social benefit by internalizing the pecuniary externality and accounting for the redistributive effects. The social planner seeks to internalize the effects of debt decisions on prices, which is accomplished by reducing the aggregate level of indebtedness. Concurrently, the planner aims to allocate greater access to debt to the agent who places a higher value on consumption, while restricting access for the agent with a lower marginal utility of consumption, in order to enhance overall economic welfare.

As formulated, the Social Planner's problem involves a limited redistribution of resources among agents. This is because, by explicitly imposing two individual budget constraints instead of a single aggregate resource condition, the Planner lacks the freedom to equalize marginal utilities between the two types of agents. This inability to equalize reflects that the individual budget constraints restrict the Planner's capacity to reallocate resources, as each agent remains bound by their own income and borrowing capacity, determined by the model's conditions.

The approach of using individual budget constraints implies that optimization is conditioned not only by the total resources available in the economy but also by the initial distribution of these resources among agents. This introduces rigidity into the solution, contrasting with the approach of an aggregate resource constraint, where the Planner could redistribute resources more flexibly, allowing for the equalization of

marginal utilities between agents.

While the individual budget constraints in our model could implicitly result in an aggregate resource condition, the reverse is not true. Imposing an aggregate condition would fail to capture the specific limitations faced by each agent, such as their collateral constraints or the initial inequality in resource distribution. This detail is critical, as the model, as formulated, explicitly reflects the individual limitations agents face. This allows for a more precise study of how these limitations influence the Social Planner's decisions and, ultimately, social welfare and the dynamics of the economy.

In our model, it is easy to show that if inequality did not exist—that is, if $\theta_H = \theta_L > 0$—then it would hold that $\lambda^{SP}_{i,t} = \lambda^{SP}_{-i,t} = \lambda^{SP}_t$; $\mu^{SP}_{i,t} = \mu^{SP}_{-i,t} = \mu^{SP}_t$; $N_{i,t} = 1$; $Y^N_{i,t} = C^N_{i,t}$; $C^T_{i,t} = C^T_{-i,t} = C^T_t$, and thus equation (22) without inequality would be equivalent to Bianchi (2011).:

$$\lambda^{SP}_t = u_T(t) + \Psi_t \mu_t$$

where $\Psi_t \equiv \kappa(1+\eta)\tilde{p}^N_t C^N_t / C^T_t$ with $\tilde{p}^N_t = (1-\omega)/\omega (C^T_t / Y^N_t)^{1+\eta}$.

The efficient allocations of the Social Planner can be achieved in a decentralized regulated economy through debt taxes (capital controls). The regulating government aims to manage the economy's borrowing to prevent crises while addressing limited redistribution in the context of inequality. Given that agents hold varying debt positions, this framework allows for the exploration of differentiated capital controls tailored to the specific characteristics of each type of agent.

3.2 Decentralization

The presence of externality means that agents are not affected to the same extent under tighter financial conditions. This opens up the possibility of improving welfare by considering this issue with different policies for each type of agent. In this section, we explore the possibility of a benevolent government applying a differentiated proportional tax on borrowing ($\tau_{i,t}$) for agents $i \in \{H, L\}$. This implies that the tax imposed on agents will vary depending on their debt levels.

The household's budget constraint, as specified in equation (3), is now expressed as follows:

$$c^T_{i,t} + p^N_t c^N_{i,t} + b_{i,t+1} = (1+r)(1+\tau_{i,t-1}) b_{i,t} + y^T_t + w_t h_{i,t} + \Phi^N_{i,t} + T_{i,t} \qquad \forall i \in \{H, L\} \tag{25}$$

If $\tau_{i,t} > 0$, it represents a capital control tax for agent i, which would increase the cost of borrowing for the agent. Similarly, if $\tau_{i,t} \leq 0$, it would represent a subsidy. The revenue of the Government from capital control taxes is given by $-(1+r)\sum_{i\in\{H,L\}} \pi_i \tau_{i,t-1} b_{i,t} = \sum_{i\in\{H,L\}} \pi_i T_{i,t}$. We assume that the government consumes no goods and rebates equally to the public in the form of lump-sum transfers, i.e., $T_{i,t} = -(1+r)\tau_{i,t-1} b_{i,t}$. This framework aligns with the earlier assertion that the Social Planner faces limitations in achieving more

flexible redistribution. In this regulated scenario, transfers to each type of agent are financed by the taxes they pay. These taxes then become the enforced mechanism through which the Social Planner attempts to equalize the marginal utilities of the agents.

Then, in a regulated economy with differentiated taxes, Euler's equation can be modified to account for the impact of the differential tax rates. The modified Euler's equation can be expressed as follows:

$$u_T^i(t) = \beta(1+r)(1+\tau_{i,t})\mathbb{E}_t u_T^i(t+1) + \mu_{i,t} \qquad \forall i \in \{H, L\} \tag{26}$$

The remaining equilibrium conditions: (A.4),(6), (10) $\forall i \in \{H, L\}$, and (11), (12), and (13) stay unchanged.

3.3 Optimal tax on debt

This section derives the optimal taxes on debts. The optimal value of $\tau_{i,t}$ $\forall i \in \{H, L\}$ can be derived by combining equations the first-order condition of the Social Planner, equation (22) and (23) for $i \in \{H, L\}$, and subsequently integrating them with equation (26) for $i \in \{H, L\}$. Although the details can be found in the appendix A.2, it is possible to express the tax τ_i for $i \in \{H, L\}$:

$$\tau_{i,t} = \mathbb{E}_t v_{t+1} \frac{\left[\pi\left(\Delta_{t+1}^u \zeta_{t+1} + \kappa \Pi_{t+1}\right)\right]}{\mathbb{E}_t \omega_i u_T^i(t+1)} - v_t \frac{\left[\pi\left(\Delta_t^u \zeta_t + \kappa \Pi_t\right)\right]}{\beta(1+r)\mathbb{E}_t \omega_i u_T^i(t+1)} \qquad \forall i \in \{H, L\} \tag{27}$$

where

$$\Delta_t^u = \omega_H u_T^H(t) - \omega_L u_T^L(t) \leq 0 \tag{28}$$

$$\zeta_t = \Omega_{H,t} - C_{H,t}^N \geq 0 \tag{29}$$

$$\Pi_t = \sum_{i \in \{H,L\}} \mu_{i,t}^{SP} \Omega_{i,t} \geq 0 \tag{30}$$

The expression (27) for $i \in \{H, L\}$ assumes that the share of agents in the economy is identical, $\pi_H = \pi_L = \pi$, and that $\mu_{i,t}^{SP} = \varpi_i \mu_{i,t}$. The latter indicates that the regulator always seeks to apply a capital control for agent type i such that this agent's collateral constraint mimics that of the Social Planner's world.

Equation (28) highlights the differences in the marginal valuations of tradable consumption, being negative in the case of inequality and zero in the absence of inequality. Equation (29) complements this by capturing the redistribution component. If positive, it implies that the high income agent (H) is consuming less than their net income, which corresponds to the low income agent (L) consuming more, under conditions of inequality. Without inequality, this equation becomes null. Finally, equation (30) represents the multipliers of the collateral constraints, which are always non-negative by definition.

The equation (27) suggests that inequality can play a role in determining the optimal capital controls. Note that if $\Pi_t = 0$ and $\mathbb{E}_t[\Pi_{t+1}] = 0$, i.e., if the economy is not binding at time t and at $t+1$, the taxes persist,

implying that the regulator would only focus on limited redistribution. If $\Pi_t = 0$ and $\mathbb{E}_t[\Pi_{t+1}] > 0$, this indicates that if the probability of a future crisis is positive, the regulator would act prudentially by increasing taxes today. On the other hand, if $\Pi_t > 0$, meaning the economy is in crisis today, the regulator would aim to lower taxes or even apply a subsidy (if the value becomes negative). In this context, the regulator's objective would be to relax the regulation so that agents can achieve their maximum desirable level of debt.

Note that $\Pi_t > 0$ could arise either because type-H agents are binding ($\mu^{SP}_{H,t} > 0$) or because type-L agents are binding ($\mu^{SP}_{L,t} > 0$), in which case taxes would be determined. However, if both $\mu^{SP}_{H,t} > 0$ and $\mu^{SP}_{L,t} > 0$, taxes will be indeterminate. Therefore, we set taxes to be undefined (NaN) when the collateral constraints of both types of agents are binding simultaneously for the planner. This follows Schmitt-Grohé and Uribe (2017) for the Representative Agent case.

If we combine equation (27) for the agent types $i \in \{H, L\}$, it is possible to obtain:

$$\frac{\tau_{H,t}}{\tau_{L,t}} = \frac{\mathbb{E}_t[\omega_L u^L_T(t+1)]}{\mathbb{E}_t[\omega_H u^H_T(t+1)]}. \tag{31}$$

From this expression, it follows that the regulator will impose a higher fiscal burden on type-H agents because, in a context of inequality, $\mathbb{E}_t[\omega_L u^L_T(t+1)] > \mathbb{E}_t[\omega_H u^H_T(t+1)]$. However, it is easy to see that the taxes will be equivalent in a context without inequality, where $\mathbb{E}_t[\omega_L u^L_T(t+1)] = \mathbb{E}_t[\omega_H u^H_T(t+1)]$.

4 Quantitative results

In this section, we quantify the role of pecuniary externalities in this economy and its relationship with income inequality. We solved the model using the fixed-point iteration algorithm (FiPIt) proposed by Mendoza and Villalvazo (2020), which allows us to obtain the global non-linear solution in models with two endogenous state variables and occasionally binding constraints.

4.1 Calibration

In our model, the units are measured in years. The proportion of agents with high technological productivity (θ_H) is $\pi_H = 50\%$, which is the same for agents with low technological productivity (θ_L). To ensure that high-productivity agents have higher income compared to low-productivity ones, we set the ratio of $\theta_H/\theta_L = 1.5$. However, let us explore the case when inequality plays no role, that is, $\theta_H/\theta_L = 1.0$. The technological productivity is normalized such that $\sum_{i\in\{H,L\}} \pi_i\theta_i = 1$.

The labor share of non-tradable goods, denoted by α, is set to $\alpha = 0.75$, following the study by Schmitt-Grohé and Uribe (2016). We assume a social welfare weight (ϖ_i) equal to one for the group of type-i agents, reflecting a utilitarian welfare function where the social planner values each type of agent equally.

The remaining model parameters follow Bianchi (2011). These parameters capture various aspects of the

model, such as the borrowing constraint, interest rate, discount factor, and other relevant factors (see Table 1).

The endowment process of tradable goods is of the standard form:

$$\log y_t^T = \rho \log y_{t-1}^T + \sigma_{y^T} \epsilon_t^{y^T} \qquad \epsilon_t^{y^T} \sim N(0,1) \tag{32}$$

where we set $\rho = 0.53$ and $\sigma_{y^T} = 0.047$, following Arce and Tran-Xuan (2022). We discretize the above process by dividing it into 15 distinct values evenly spaced for $\log y_t^T$. We discretize the tradable endowment process using Tauchen's method (Tauchen (1986)). Meanwhile, the endogenous state variable for each agent i ($b_{i,t}$) was discretized using 40 evenly spaced points ranging from -1.05 to -0.2.

Table 1: Calibration

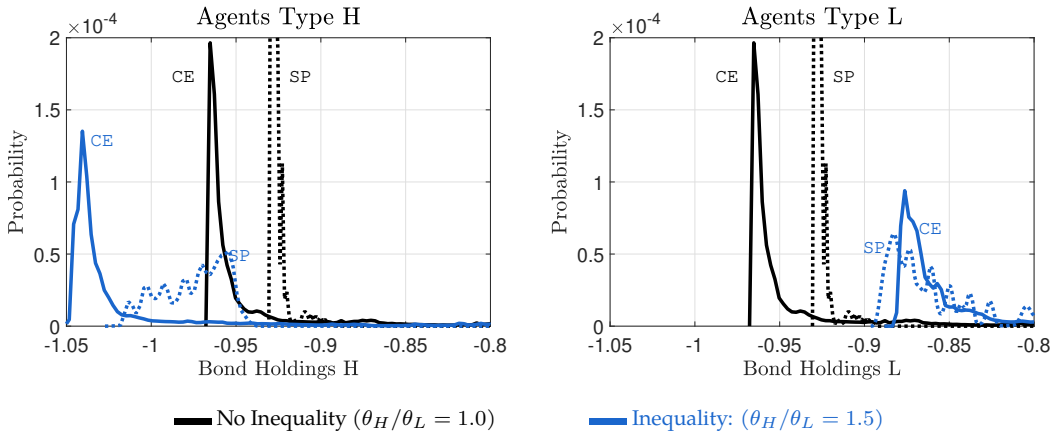
Parameter	Description	Value
r	Interest rate	0.04
σ	Risk aversion	2.0
$1/(1+\eta)$	Elasticity of subsitution	0.83
κ	Credit coefficient	0.32
ω	Weight on tradables in CES	0.31
β	Discount factor	0.91
α	Labor share in nontraded sector	0.75
θ^H/θ^L	Relative productivity	{1.0;1.5}
$\pi^H = \pi^L$	Fraction of households with θ_i	0.50
ϖ^H/ϖ^L	Social welfare weight ratio	1.0
ρ	Tradable output persistence	0.53
σ_{y^T}	Std. dev. of tradable shock	0.047

4.2 Borrowing decisions and optimal capital control

In this section, we explore the bond accumulation decisions for households-firms H and L in a competitive economy and in the Social Planner's economy. To illustrate the results, particularly the debt allocations of the two types of agents in contexts with and without inequality, I simulated the model for 500,000 periods, discarding the initial 5,000 periods. The figure 2 plots the ergodic distribution of bond decision rule. The graph on the left represents type H agents, while the graph on the right corresponds to type L agents. The black line represents the case without inequality, and the blue line represents the case with inequality. Solid lines depict the competitive case, whereas dashed lines illustrate the constrained-efficient case.

In the no-inequality case, the black lines on the left and right are identical. Here, when inequality is absent, the Social Planner (SP) assigns a higher probability to lower levels of debt (less negative bonds) compared to the competitive economy (CE). This reflects the Planner's intention to prevent agents from excessive borrowing, effectively internalizing the pecuniary externality. However, with inequality introduced, we observe that while the SP allocates a lower probability mass for type H agents to overborrow, it does the

Figure 2: Ergodic Distribution of Bond Holdings by Type of Agent



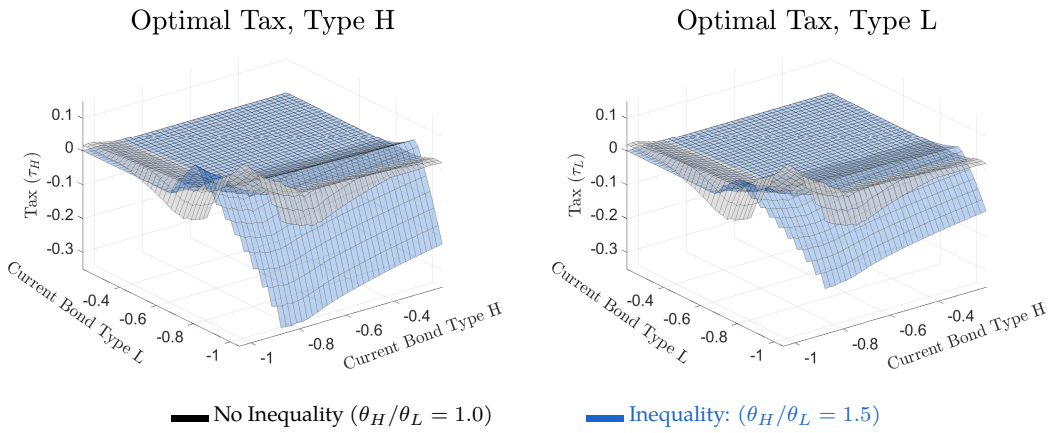
Note: CE: Competitive Equilibrium, SP: Social Planner.

opposite for type L agents, encouraging them to take on more debt (more negative) relative to the CE. Notably, in the inequality case, the differences between the CE and SP are pronounced. The SP strongly discourages overborrowing, or significantly distorts the borrowing behavior of type H agents, reflecting the internalization of the pecuniary externality. Simultaneously, the SP enables type L agents to access more debt, addressing the distributive problem.

Figure 3 shows the two types of taxes, for agent H (left panel) and agent L (right panel), that achieve the constrained-efficient allocations when tradable shocks are one standard deviation below trend, across different levels of current bond holdings for types H and L. The graphs display both the no-inequality case (grey shading) and the inequality case (light blue shading). These results stem from the nonlinear solution to the problem. These figures reveal that, in the face of a negative shock and for sufficiently low levels of debt (less negative bonds for both types of agents), taxes are very low—zero in the no-inequality case and slightly above zero in the inequality case. This can be observed where the light blue shading lies above the grey shading for bond levels higher than -0.6. This pattern suggests that even at lower debt levels, where there is less incentive to impose taxes, inequality prompts the government to levy taxes for redistributive purposes.

Taxes increase up to a certain point, depending on the agents' initial debt. In the context of inequality, we observe that when type L agents seek higher levels of debt, both taxes become positive, but they are higher for type H agents. This suggests that, in the event of a negative shock to tradable income, and if agents already have high debt, the government will prefer to regulate the situation by increasing taxes to prevent agents from taking on even more debt and facing future constraints. However, if the agents already had very high debt when the negative shock occurred, the government will opt to apply a subsidy (a negative tax) to assist them. This subsidy will be higher for type H agents than for type L agents. It is important to note that the light blue shading extends to uncharted areas because, in those spaces, both agents are subject

Figure 3: Capital Controls for Negative One–Standard Deviation Shocks



Note: The graph presents the optimal capital controls for type H agents and type L agents across the full state space of endogenous states, $B_L \otimes B_H$, evaluated with a negative shock of one standard deviation to tradable endowment. The gray layer corresponds to the case without income inequality, and the light blue layer to the case with income inequality.

to constraints. This can be corroborated in Figure 10 in the appendix. It shows that the multipliers increase for sufficiently high levels of initial debt. An additional aspect revealed by this figure is that introducing inequality into the model causes the Social Planner, in their attempt to encourage type L agents to take on more debt, to face the cost of potentially having them remain constrained for a longer period. (See the graph on the right, where the light blue shading extends above the gray shading).

4.3 Optimal capital control during a sudden stops crisis

In this section, we draw inspiration from the work of Schmitt-Grohé and Uribe (2017) to analyze the behavior of capital controls during sudden stop events. We define a sudden stop crisis an event in which the credit constraint is binding for both agent H and agent L, and there is an increase in the current account that exceeds one standard deviation from their mean[3].

To achieve this, from the simulation of 500,000 periods, we extract a window spanning 5 years before and after a sudden stop. In total, we construct 11 event windows centered at zero as the crisis years in a CE, computing averages for each variable across the cross-section of crisis events. We employ the procedure to analyze the results for both an CE and a SP. We characterize the behavior of the CE and the SP economy around this crisis when the sudden stop occurs in the CE. The variables of interest are defined in Table 2.

Figure 4 illustrates the dynamics of key macroeconomic variables—GDP, relative prices, current account (CA), and consumption inequality —during a sudden stop crisis in a CE. The solid blue line displays the CE dynamics, while the dotted line represents the SP allocations. The black line corresponds to the scenario without inequality, and the light blue line to the scenario with inequality.

[3]Bianchi (2011) defines Sudden Stops in the representative agent case as instances when the credit constraint binds, leading to an increase in the current account that exceeds one standard deviation.

Table 2: Variable definitions

Variables	Model
GDP	$Y = p^N Y^N + Y^T$
Current Account (CA)	$CA = \mathcal{B}' - \mathcal{B}$
Relative prices	$p^N = (1-\omega)/\omega \ (C^T/Y^N)^{1+\eta}$
Income, agents type $i \in \{H, L\}$	$M_i = Y^T + w + \Phi_i^N$
Consumption, agents type $i \in \{H, L\}$	$C_i = [\omega(C_i^T)^{-\eta} + (1-\omega)(C_i^N)^{-\eta}]^{-1/\eta}$
Consumption Inequality	C_H/C_L
Where	
Aggregate tradable goods	$Y^T = y^T$
Aggregate non-tradable goods	$Y^N = \sum_{i\in\{H,L\}} \pi_i Y_i^N$
Aggregate non-tradable Consumption	$C^N = \sum_{i\in\{H,L\}} \pi_i C_i^N$
Aggregate bonds	$\mathcal{B}' = \sum_{i\in\{H,L\}} \pi_i B_i'$

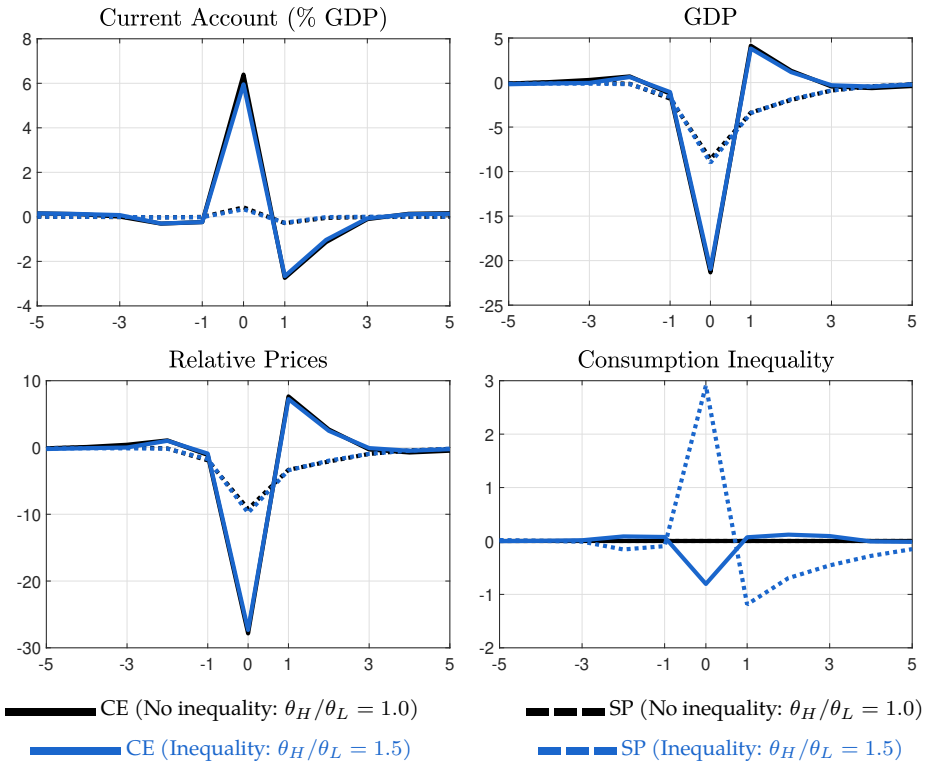
Notably, imposing inequality in the model does not significantly alter the severity of the sudden stop, as seen in the degree of current account reversal and the percentage decline in GDP relative to its long-term level. However, differences emerge in consumption inequality. In the scenario without inequality, consumption inequality is naturally zero. With inequality, during a sudden stop, consumption inequality decreases in the CE, indicating that high income households (type H) experience a greater drop in consumption compared to low income households (type L), aligning with empirical evidence (see Figure 1 (b)). The larger drop in consumption for the former is due to their profits falling more than those of the latter, which explains the differences in consumption during the crisis. In contrast, the SP aims to increase inequality during this episode.

To understand the decision-making of the private agent in an CE and the SP in a model with and without inequality, Figure 5 depicts the behavior of the micro variables. In this graph, income, consumption, debt and tax applied to each agent is presented before and during a sudden stop crisis.

Initially, the level of inequality in the economy across these variables for both agents is evident. Specifically, Agent H concentrates a higher number of these components. During a sudden stop, while the percentage decline in income for both agents is very similar, this is not the case for consumption. For Agent H, the SP prevents a greater decline in consumption compared to Agent L. To achieve this, the SP finances the consumption of Agent H by incurring more debt during the sudden stop, unlike Agent L. This lesser decline in the consumption of Agent H primarily mitigates the drop in relative prices.

The graphs in the third row show the dynamics of debt for each agent type. Prior to a sudden stop, for Agent H, the SP maintains a lower debt level compared to the CE. However, during the sudden stop, Agent H's debt increases significantly under the SP's guidance, which reduces the binding nature of their borrowing constraint. In contrast, the behavior for Agent L is reversed. Before the sudden stop, the SP allocates more debt to Agent L. However, as the sudden stop unfolds and collateral values drop, Agent L becomes more constrained. This illustrates the SP's contrasting approach to managing debt levels between the two agent

Figure 4: Macro variables during a Sudden Stops



Note: GDP, relative prices and consumption inequality are expressed as percentage deviations from averages in the corresponding ergodic distribution. Each line represents the mean across all 11-year windows centered on a sudden stop crisis, based on a 500K time series from the competitive equilibrium. A sudden stop crisis episode is defined as a period when the collateral constraints of agents H and L are binding and the current account exceeds its mean by one standard deviation. CE: Competitive Economy, SP: Social Planner.

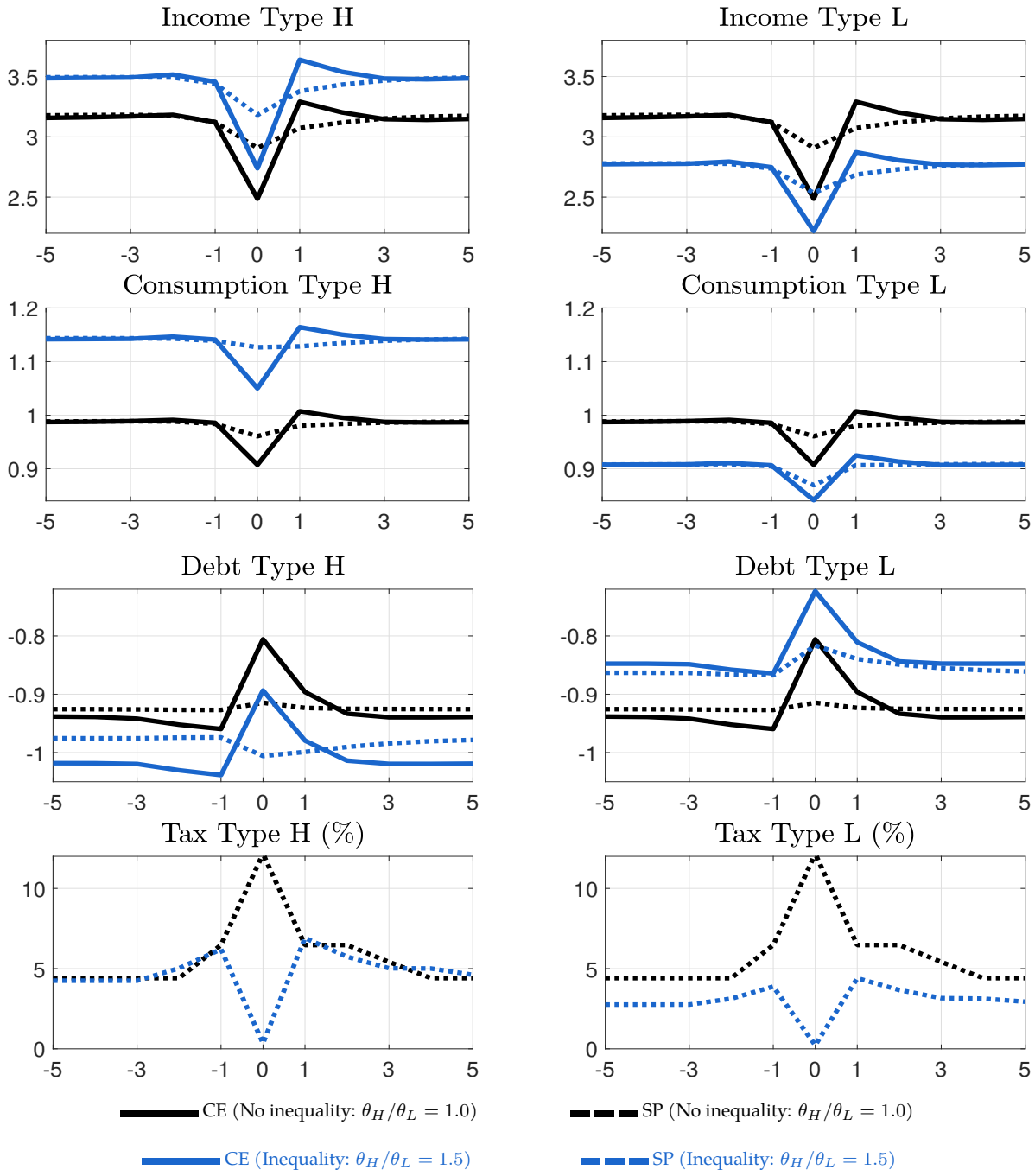
types in response to crisis conditions.

¿How should the benevolent government behave to achieve the allocations given by the SP? In this case, when inequality is an issue, the government will seek to redistribute resources during normal times, i.e., taking account the distributive channel while also avoiding the risk of the economy experiencing a sudden stop. This is accomplished by significantly reducing the debt of Agent H and slightly increasing the debt of Agent L. However, in difficult times, when sudden stops are highly likely, the government opts to offer more debt to high-income agents to prevent a sharper decline in prices, while also utilizing available fiscal space, something that is not accessible to low-income households, who cannot access additional debt. This can be clearly observed in the behavior of the probability of being binding (i.e., credit constraint multipliers being positive) before and during a sudden stop, as shown in Figure 11 of the appendix.

It is important to note that, in a scenario with inequality, redistribution increases the likelihood that the low-income agent will be credit-constrained under the social planner's intervention, compared to the competitive case. On the other hand, for the high-income agent, the opposite happens, and the probability of being constrained is practically zero under the social planner's intervention. As the economy approaches a sudden stop, the low-income agent is fully financially constrained (the probability of being biding is 1) in both

the competitive and efficient cases. This intuitively suggests that, despite the social planner's intention to redistribute resources, such redistribution will not be feasible during times of crisis. In this context, the optimal policy is to reduce taxes for both types of agents. On the one hand, this measure helps smooth the consumption of high-income agents and mitigates the fall in prices, which, in turn, benefits low-income agents by preventing their debt from being even more negatively affected.

Figure 5: Business cycle dynamics during a Sudden Stops



Note: Each line represents the mean across all 11-year windows centered on a sudden stop crisis, based on a 500K time series from the competitive equilibrium. A sudden stop crisis episode is defined as a period when the collateral constraints of agents H and L are binding and the current account exceeds its mean by one standard deviation. CE: Competitive Economy, SP: Social Planner.

To summarize the results, Table 3 presents the long-term statistics for both the competitive equilibrium and the social planner scenarios. The table is divided into cases with and without inequality, and also includes the welfare gains. These gains are calculated as the consumption compensation for each state (B_H, B_L, y^H)

that equalizes the expected utility between the CE and the SP economies. We denote $\gamma(B_H, B_L, y^H)$ as the welfare gain for all agents satisfying:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[(1+\gamma) \sum_{i \in \{H,L\}} \pi_i u^i(C_{i,t}^{CE}) \right] = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\sum_{i \in \{H,L\}} \varpi_i \pi_i u^i(C_{i,t}^{SP}) \right] \tag{33}$$

In the case without inequality, it is evident that both agents have the same level of debt, and that agents tend to overborrow in the competitive equilibrium. In the SP scenario, debt holdings are lower, as the planner aims to avoid sudden stops. In the simulation, the probability of a sudden stop is 8.6% in the CE, while in the SP case, it is 0%. To achieve these results in a regulated economy, the average taxes are set at 4.4% for both agents.

In the case with inequality, while high income households tend to overborrow, low income households are underborrowed. It is important to note that the SP would prefer the low income households to have more debt, even if this implies a higher probability of being financially constrained (32.8% compared to 23.8%). In the simulation, while the probability of a sudden stop is 8.3% in the CE, in the SP case it is 0.6%. This suggests that the SP helps avoid a sudden stop, but distorts the high income agent's debt levels significantly in order to allow greater debt access for the low-income agents. To achieve these results in a regulated economy, the average taxes are 4.3% for the high-income agents and 3.9% for the low-income agents.

Table 3: Long-term Statistics, Capital Controls and Sudden-Stop Moments

	No Inequality ($\theta_H/\theta_L = 1.0$)		Inequality ($\theta_H/\theta_L = 1.5$)	
	CE	SP	CE	SP
Long-Term Statistics				
Debt % GDP	29.8	29.4	29.9	29.4
Type H	14.9	14.7	16.3	15.6
Type L	14.9	14.7	13.6	13.8
Prob. of crisis (%)	8.6	0.0	8.3	0.6
Prob. $\mu_H > 0$ (%)	9.8	0.0	11.2	0.6
Prob. $\mu_L > 0$ (%)	9.8	0.0	23.8	32.8
Severity of crisis ($\Delta C\%$)				
Type H	-8.1	-2.8	-8.1	-1.5
Type L	-8.1	-2.8	-7.4	-4.4
Welfare Gains (%)	–	0.108	–	0.089
Tax Statistics				
Median τ_H (%)	–	4.4	–	4.3
Median τ_L (%)	–	4.4	–	3.9

Note: Crisis episodes are defined when the collateral constraints of agents H and L are binding, and the current account exceeds its mean by 1 sd.

4.4 Capital Control and Inequality

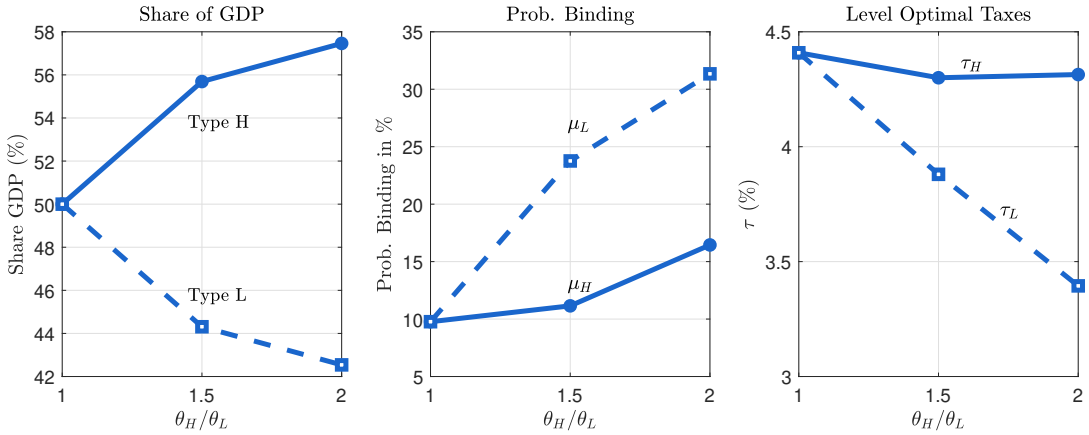
In this section, we explore the relationship between capital controls and inequality. To do so, we conducted simulations of the model using various ratio values (θ_H/θ_L). Figure 6 illustrates the share of GDP, the probability of having a collateral constraint binding, and the average level of optimal capital control with different ratios. The continuous line corresponds to agent H, and the discontinuous line corresponds to

agent L.

In an economy without inequality, i.e., with $\theta_H/\theta_L = 1$, it is trivial that each agent gets the same proportion of GDP. In this case, both agents have the same probability of facing a binding collateral constraint in an CE. Therefore, they face the same average level of capital control, which is 4.4%. However, as there are more differences in technological productivity $\theta_H/\theta_L > 1$, Agent H gets a major proportion of income in the economy. Consequently, Agent L is more vulnerable to facing a binding constraint, given that their lower income results in a lower value of their collateral.

Finally, the optimal levels of capital controls decrease as the gap in technological productivity widens. This suggests that, as inequality increases, optimal taxes become less stringent for low-income agents. This adjustment reflects the higher likelihood that these agents remain financially constrained for extended periods.

Figure 6: Inequality and Capital Controls



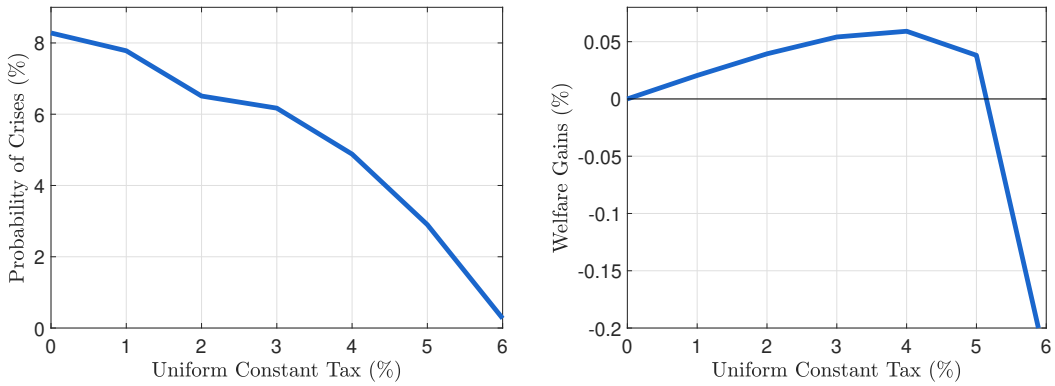
Note: The share of GDP by agent is calculated as the income of agents of type $i \in H, L$ relative to the total income of all types. The probability of being binding is estimated in the competitive economy.

5 Implementation

In practice, it is challenging for policymakers to adopt time-varying capital controls based on the state of nature or differentiated by income or debt levels of agents. In this section, we explore a simple rule for capital controls that is uniform for both agents and fixed over time. For this exercise, we use a straightforward tax rule ranging between 0% and 6%. This approach is not entirely unreasonable, as empirical evidence shows that capital controls in both emerging and advanced economies are acyclical (Fernández et al. (2015)). The idea of this exercise is to numerically search for a uniform constant tax that approximates the optimal equilibrium of the social planner in terms of the probability of a crisis and welfare gains.

In Figure 7, the impact of the uniform constant tax on the probability of a crisis and welfare gains is illustrated. It is observed that as the uniform constant tax increases, the probability of default decreases, and welfare gains increase, up to a certain point, after which they turn negative. Increasing capital controls raise

Figure 7: Impact of Uniform Constant Tax on Probability of crises and Welfare Gains



Note: The graph illustrates the impact of a uniform constant tax applied to agents' debt. The results were estimated under the assumption of inequality, with $\theta_H/\theta_L = 1.5$.

the costs of borrowing, making agents take fewer risks and be less vulnerable to shocks. However, excessively high capital controls can lead to significant consumption losses. This is because facing negative shocks that result in sudden stops, high and invariant taxes make the crisis much worse.

In our analysis, applying a uniform constant tax of 4% maximizes welfare while reducing the probability of sudden stops to 5%. This constant rate of 4% is close to the optimal tax rates observed under inequality between the two types of agents (4.3% and 3.9%, as shown in Table 3). Additionally, implementing a uniform tax of 4% results in a welfare gain of 0.059%, which is slightly lower than the 0.089% achieved under the optimal policy. Consequently, the decision to implement uniform or differentiated taxes ultimately becomes a matter for policymakers to carefully evaluate, as certain approaches may leave agents with lower welfare levels.

6 Conclusions

Sudden stop crises are costly and have significant redistributive effects. This paper investigates the role of inequality in the design of optimal capital controls when redistribution becomes a central concern. To explore this, we develop a model with two types of heterogeneous agents, each with access to external debt but differing in how they are affected by sudden stops.

Unlike a standard Representative Agent model, where the pecuniary externality stems solely from agents failing to internalize the effects of their borrowing on relative prices, a model with two types of heterogeneous agents introduces an additional channel: the distributive channel. This arises because agents value their consumption differently, which has significant implications for the overall welfare of the economy.

I solve the competitive equilibrium, the constrained efficient planner's problem, and derive the optimal taxes on borrowing (i.e., capital controls) in a decentralized economy with regulation. When the two types

of agents differ in income (i.e., inequality), the Social Planner addresses both the pecuniary externality and the distributive implications. A benevolent government in a decentralized economy with taxes aims to avoid sudden stops while also ensuring redistribution. To achieve this, it adopts different tax policies to achieve the efficient allocation of the Social Planner. The government accomplishes this by reducing the indebtedness of high income households through high taxes and improving the indebtedness of low income households through lower taxes during normal times. However, in times of crisis, all taxes are reduced to levels close to zero. These results contrast with the model where inequality is omitted, finding that taxes are higher for all agents during times of crisis.

Additionally, this paper finds that as inequality increases in the economy, capital controls become less stringent for low income households. Finally, this paper acknowledges the challenges involved in implementing differentiated and time-varying capital controls. Consequently, it is possible to use a uniform constant tax on the debt of any agent, which can approximate the optimal case of the Social Planner.

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Appendix

A Notes

A.1 First Order Condition of the Model

Each households i maximize Eq. (1) subject to Eqs. (2), (3) and (4) by choosing $c^T_{i,t}$, $c^N_{i,t}$ and $b_{i,t+1}$. The first order conditions are:

$$[c^T_{i,t}] \quad :u^i_T(t) = \lambda_{i,t} \qquad \forall i \in \{H, L\} \tag{A.1}$$

$$[c^N_{i,t}] \quad :u^i_N(t) = p^N_t \lambda_{i,t} \qquad \forall i \in \{H, L\} \tag{A.2}$$

$$[b_{i,t+1}] \quad :\lambda_{i,t} = \beta(1+r)\mathbb{E}_t \lambda_{i,t+1} + \mu_{i,t} \qquad \forall i \in \{H, L\} \tag{A.3}$$

$$b_{i,t+1} + \kappa(y^T_t + w_t h_{i,t} + \Phi^N_{i,t}) \geq 0 \qquad \text{with equality if } \mu_{i,t} > 0 \qquad \forall i \in \{H, L\} \tag{A.4}$$

where $u^i_T(t) = \partial u^i / \partial c_{i,t} \cdot \partial c_{i,t} / \partial c^T_{i,t} = c^{1+\eta-\sigma}_{i,t} \omega (c^T_{i,t})^{-\eta-1}$ for $i \in \{H, L\}$; $u^i_N(t) = \partial u^i / \partial c_{i,t} \cdot \partial c_{i,t} / \partial c^N_{i,t} = c^{1+\eta-\sigma}_{i,t}(1-\omega)(c^N_{i,t})^{-\eta-1}$ for $i \in \{H, L\}$.

A.2 Optimal capital controls

For the equation (22) for $i \in \{H, L\}$, we have:

$$\lambda^{SP}_{H,t} = \varpi_H u^H_T(t) + v_t \left[(\pi_H \lambda^{SP}_{H,t} - \pi_L \lambda^{SP}_{L,t})(\Omega_{H,t} - C^N_{H,t}) + \kappa \Big(\sum_{i \in \{H,L\}} \pi_i \mu^{SP}_{i,t} \Omega_{i,t} \Big) \right] \tag{A.5}$$

$$\lambda^{SP}_{L,t} = \varpi_L u^L_T(t) + v_t \left[(\pi_L \lambda^{SP}_{L,t} - \pi_H \lambda^{SP}_{H,t})(\Omega_{L,t} - C^N_{L,t}) + \kappa \Big(\sum_{i \in \{H,L\}} \pi_i \mu^{SP}_{i,t} \Omega_{i,t} \Big) \right] \tag{A.6}$$

Where is it true that $\Omega_{H,t} - C^N_{H,t} = -(\Omega_{L,t} - C^N_{L,t})$, therefore, the equation (A.6) can be rewritten as:

$$\lambda^{SP}_{L,t} = \varpi_L u^L_T(t) + v_t \left[(\pi_H \lambda^{SP}_{H,t} - \pi_L \lambda^{SP}_{L,t})(\Omega_{H,t} - C^N_{H,t}) + \kappa \Big(\sum_{i \in \{H,L\}} \pi_i \mu^{SP}_{i,t} \Omega_{i,t} \Big) \right] \tag{A.7}$$

Differentiating (A.5) and (A.7), we have::

$$\lambda^{SP}_{H,t} - \lambda^{SP}_{L,t} = \varpi_H u^H_T(t) - \varpi_L u^L_T(t) \tag{A.8}$$

Replacing equation (A.8) into (A.5) and (A.7), and assuming that the share of agents is identical, $\pi_H = \pi_L = \pi$ (as calibrated in Table 1), we have:

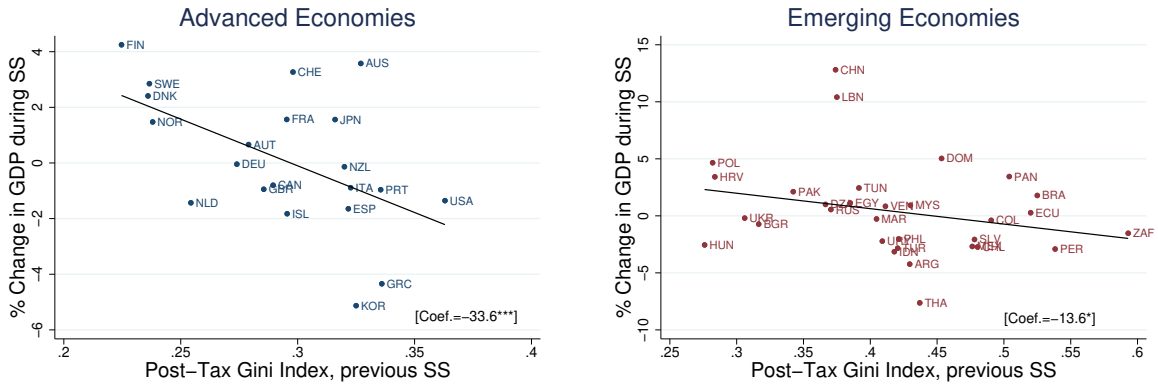
$$\lambda^{SP}_{H,t} = \varpi_H u^H_T(t) + \pi v_t \left[\left(\varpi_H u^H_T(t) - \varpi_L u^L_T(t) \right) (\Omega_{H,t} - C^N_{H,t}) + \kappa \Big(\sum_{i \in \{H,L\}} \mu^{SP}_{i,t} \Omega_{i,t} \Big) \right] \tag{A.9}$$

$$\lambda^{SP}_{L,t} = \varpi_L u^L_T(t) + \pi v_t \left[\left(\varpi_H u^H_T(t) - \varpi_L u^L_T(t) \right) (\Omega_{H,t} - C^N_{H,t}) + \kappa \Big(\sum_{i \in \{H,L\}} \mu^{SP}_{i,t} \Omega_{i,t} \Big) \right] \tag{A.10}$$

Each of these equations can be substituted into the Social Planner's Euler equations (23) and then combined with the Euler equation from the regulated economy (26). This process allows us to derive the tax equation, expressed in equation 26, for each $i \in \{H, L\}$.

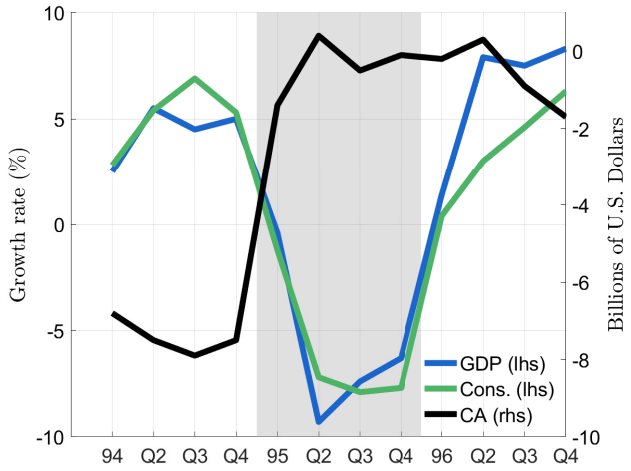
B Graphs

Figure 8: Income Inequality and Sudden Stops in Advanced and Emerging Economies



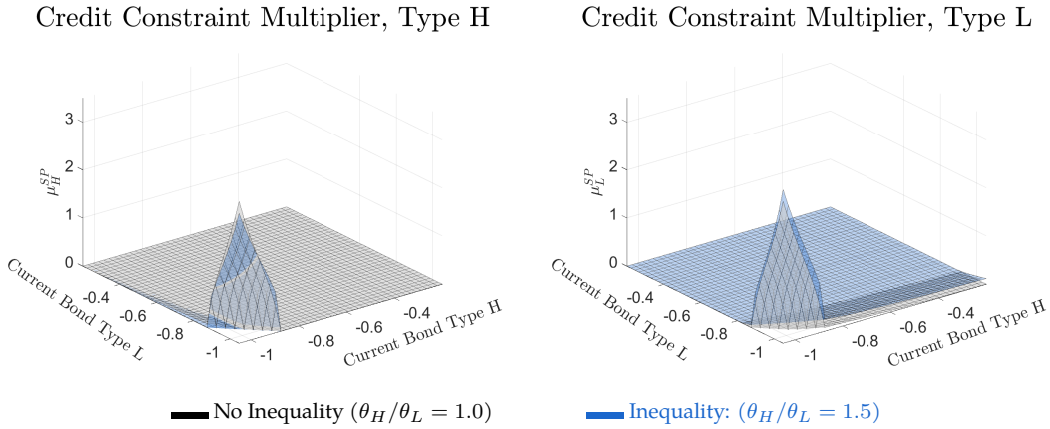
Note: Dates of Sudden stops (SS) episodes come from Bianchi and Mendoza (2020). $*p < 0.10, **p < 0.05, ***p < 0.01$. Sources: The World Bank and SWII (Solt (2020)) for inequality data

Figure 9: The 1995 Sudden Stop in Mexico



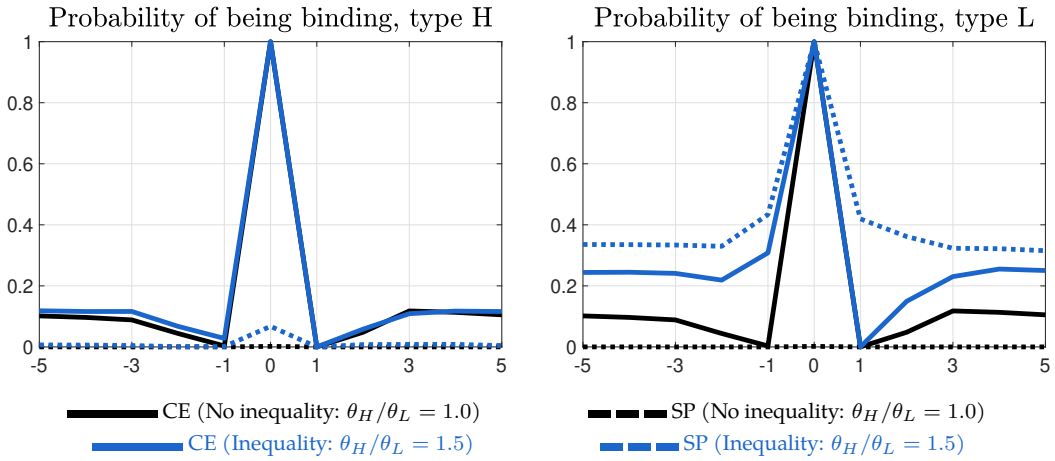
Note: The GDP and consumption (private) data represent the real variation of each quarter compared to the same quarter of the previous year. The current account is expressed in levels (right side) in billions of dollars. The macroeconomic data were obtained from INEGI and the Central Bank of Mexico.

Figure 10: Credit Constraint Multiplier for Negative One–Standard Deviation Shocks



Note: The graph presents the collateral constraint multiplier by the Social Planner for type H agents and type L agents across the full state space of endogenous states, $B_L \otimes B_H$, evaluated with a negative shock of one standard deviation to tradable endowment. The gray layer corresponds to the case without income inequality, and the light blue layer to the case with income inequality.

Figure 11: Probability of being constrained around sudden stops



Note: Each line represents the mean across all 11-year windows centered on a sudden stop crisis, based on a 500K time series from the competitive equilibrium. A sudden stop crisis episode is defined as a period when the collateral constraints of agents H and L are binding and the current account exceeds its mean by one standard deviation. CE: Competitive Economy, SP: Social Planner.