Wealth Inequality and Sudden Stops*

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Abstract

Countries with greater wealth inequality experience deeper recessions during sudden stops. Household-level data show that more unequal countries have a higher share of indebted households, whose debt and assets decrease more during sudden stops. Using a tractable model with heterogeneous households subject to borrowing constraints, I analytically characterize a mechanism that links the cross-country and household-level evidence. Greater inequality increases the fraction of constrained households, amplifying declines in asset prices and consumption following an adverse aggregate shock. Quantitatively, a 0.01 increase in the wealth Gini amplifies the declines in GDP and consumption by 0.07 and 0.11 percentage points, respectively, per percentage point of capital outflow during a sudden stop. Wealth taxation, when optimally combined with capital control on external debt, limits the increase in constrained households during sudden stops by reducing households' borrowing needs through transfers, whereas the increase remains substantial under optimal capital control alone.

Keywords: Capital flows, Fisherian debt deflation, Optimal taxation, Sudden stops, Wealth inequality

JEL Classification Codes: E21, E44, E63, F38, F41, F44

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1 Introduction

Abrupt halts in capital flows have coincided with deep recessions in open economies. These episodes, known as *sudden stops*, are accompanied by current account reversals, contractions in domestic absorption, and drops in asset prices. (Calvo, 1998) When large capital outflows force domestic agents to deleverage, their ability to reduce debt and adjust spending depends on the asset buffers they can draw upon. The distribution of wealth, therefore, shapes how these individual adjustments translate into an aggregate contraction. I document that capital outflows during sudden stops are associated with larger declines in output, aggregate demand, and asset prices when wealth is distributed more unequally. This paper uncovers the mechanism underlying this relationship and establishes wealth inequality as a key determinant of macroeconomic vulnerability to sudden stops.

Two household-level facts point to household indebtedness as the link between wealth inequality and the severity of sudden stops. More unequal countries have a larger share of households with high debt relative to their assets. During sudden stops, the debt and assets of indebted households sharply decrease, while households with little debt show no comparable adjustments. I bring these facts together in a tractable model in which households with different levels of wealth are subject to borrowing constraints that depend on the market value of their assets. Greater wealth dispersion increases the fraction of constrained households when there is a negative aggregate shock, amplifying the contraction in asset demand due to the shock. Asset prices fall more under greater wealth inequality, which decreases households' collateral values and tightens their borrowing limits. This feedback effect through borrowing constraints further magnifies the drop in aggregate demand.

I document three empirical facts about wealth inequality, sudden stops, and household indebtedness using both cross-country and household-level data. First, large capital outflows during sudden stops are associated with deeper contractions when wealth is more unequally distributed. Using data from 54 countries between 1979 and 2016, I compare drops in GDP, consumption, investment, and stock prices at different levels of wealth inequality before sudden stops. Moving from the median to the 75th percentile of wealth inequality approximately triples the estimated GDP contraction associated with a one-percentage-point larger outflow. It approximately doubles the corresponding contractions in consumption, investment, and stock prices. This result is specific to wealth inequality. Income inequality does not have significant differential effects on the contractions in sudden stops.

Second, households in more unequal countries are more indebted relative to their assets. Using the ECB Household Finance and Consumption Survey (HFCS) data, I find that more unequal countries have higher aggregate household debt relative to assets and a larger fraction of households with high leverage. Greater inequality is associated not only with the concentration of assets at the top, but also with more households carrying substantial leverage. Greater inequality is also associated with larger external debt in the cross-country data.

Third, balance sheet adjustments during sudden stops were concentrated among indebted households. Using the European household survey data, I compare households in Greece, Italy, Portugal, and Spain, which experienced sudden stops in 2012, with households in other countries. In countries with sudden stops, indebted households experienced larger declines in debt and assets, along with sharp reductions in new borrowing and asset purchases compared to corresponding households in other countries. Households with less debt showed no comparable adjustment.

I then build a tractable model to connect these stylized facts and explain how wealth inequality amplifies contractions in sudden stops. I consider a three-period small open economy in which households differ in initial wealth. Households trade domestic capital and foreign bonds and face borrowing constraints that limit debt to a fraction of the market value of capital. There is an endogenous threshold of net wealth below which households borrow up to the limit and are constrained. A negative productivity shock lowers household income, asset prices, and aggregate consumption. Falling collateral values incur Fisherian debt deflation that leads to deleveraging and further declines in consumption. This can force aggregate consumption to decline more than output, generating a capital outflow when many households are already at their borrowing limits.

I characterize how wealth inequality amplifies the contractionary effects of a negative TFP shock on asset prices and aggregate consumption by exacerbating Fisherian debt deflation. To obtain an analytical result, I study a tractable family of mean-preserving spreads of the initial wealth distribution. I analytically show that a mean-preserving spread of the initial wealth distribution raises the fraction of households below the endogenous borrowing threshold, lowers capital demand following a shock of the same size, and amplifies the decline in asset prices and aggregate consumption. A numerical example demonstrates that the same amplification mechanism arises under a conventional mean-preserving spread without imposing the assumptions used for the analytical result.

To assess the quantitative importance of the mechanism, I extend the tractable model to an infinite-horizon setting and estimate how differences in wealth inequality affect macroeconomic dynamics around sudden stops. The extension allows wealth distribution and household leverage to evolve endogenously over time. Ex ante heterogeneous households have permanently different levels of productivity. The economy is subject to shocks to aggregate productivity, the world interest rate, and the tightness of the borrowing constraint. I simulate economies with different degrees of productivity dispersion under the same aggregate shocks to quantify the effects of wealth inequality on macroeconomic dynamics around sudden stops. In the model, a 0.01 increase in the wealth Gini adds 0.074 and 0.105 percentage points to the GDP and consumption contractions generated by a one-percentage-point increase in capital outflow, which is consistent with the data. Greater inequality also increases aggregate external debt before a sudden stop and raises the probability of a crisis when I compare different economies simulated from the model.

Household heterogeneity also allows the model to reproduce the countercyclicality of external debt relative to GDP. A representative agent version of the model produces the opposite relationship. In the baseline economy with heterogeneous households, productive and capital-rich households hold most external debt and finance investment partly from current income and accumulated capital. Hence, aggregate debt changes less than output over the business cycle. In the representative agent economy, a larger portion of investment is financed with debt, so aggregate debt fluctuates more than output. This generates the procyclicality of external debt relative to GDP, which is at odds with the data.

Households' asset choices collectively affect the price of capital and borrowing limits. Price changes also redistribute resources between buyers and sellers. In light of these pecuniary externalities, I study the optimal joint taxation of wealth and external debt with commitment. The government raises the debt tax and lowers the wealth tax during sudden stops. Committing to a lower wealth tax in states with low TFP and high borrowing costs preserves incentives to carry capital into those states. Hence, the government relies more heavily on the debt tax in sudden stops to finance redistribution toward households with a higher social marginal value of wealth. Transfers generated by both taxes directly provide resources that households can consume without taking on debt. These transfers mitigate the consumption decline and limit the increase in the fraction of constrained households when borrowing capacity shrinks. Redistribution through transfers, therefore, weakens the government's motive to boost borrowing limits in sudden stops.

I also compare the sudden stop dynamics under joint taxation to those under optimal capital control taxes on external debt alone. Joint taxation provides substantially larger transfers, both on average and during sudden stops. The two taxation schemes differ in how transfers change during these episodes. Under capital control, transfers temporarily increase as the government increases redistribution, which supports aggregate consumption and investment demand. Under joint taxation, however, transfers temporarily decrease and add pressure to reduce investment. This contributes to larger declines in the price of capital under joint taxation than under laissez faire, whereas capital control provides greater stabilization of consumption and the price of capital. Still, the fraction of constrained households rises only slightly in sudden stops under joint taxation due to larger transfers. Smaller transfers under capital control make households' spending more dependent on borrowing limits, so more households become constrained during sudden stops. In terms of social welfare, joint taxation raises social welfare by 11.24% in consumption-equivalent terms relative to laissez faire, compared with 5.75% under optimal capital control. The taxes generate welfare gains for poorer households at the expense of losses for wealthier households.

Literature Review This paper contributes to four strands of literature. I first extend the literature on sudden stops by documenting that the recessionary association of capital outflows is stronger when wealth inequality is greater. Calvo (1998) studies how an abrupt withdrawal of international credit can produce financial and balance-of-payments crises. Mendoza (2010) develops a model in which collateral constraints generate Fisherian debt deflation, and Bianchi (2011) shows that market-determined collateral values create an overborrowing externality. These papers abstract from the distribution of wealth across domestic households. Recent work emphasizes firm dynamics and exchange rate adjustment (Castillo-Martinez, 2025) or the role of production networks in propagating financial crises (Miranda-Pinto, Rojas, Saffie, and Silva, 2025). Among studies of household heterogeneity, Villalvazo (2026) is closest to this paper. Villalvazo (2026) identifies two opposing effects of household heterogeneity during sudden stops in a model with idiosyncratic risks. Leveraged households sell risky assets in sudden stops, while wealthy, unconstrained households purchase them as lower prices compensate for the additional risk, which mitigates the price decline. This paper provides cross-country evidence that greater wealth inequality is associated with larger declines in asset prices and aggregate demand during sudden stops. My model isolates the effects of wealth inequality by abstracting from idiosyncratic dividend risk. Greater wealth dispersion increases the fraction of constrained households during sudden stops, amplifying the contraction in asset demand. Unconstrained households buy the assets as prices fall, but the effect is smaller in the absence of idiosyncratic risk. Hence, greater wealth dispersion magnifies the declines in asset prices and aggregate demand.

Second, the normative analysis of this paper builds on the literature regarding macroprudential regulation of capital flows. Bianchi (2011), Bianchi and Mendoza (2018), and Korinek (2018) show that private agents fail to internalize the effect of their borrowing on asset prices and collateral values, providing a rationale for the prudential regulation of external debt. Biljanovska and Vardoulakis (2024) introduce redistribution between workers and entrepreneurs into a model of sudden stops and study how this motive shapes optimal policy. I contribute to this literature by incorporating a continuous distribution of heterogeneous households and characterizing jointly optimal taxes on wealth and external debt.

Third, this paper relates to a broad literature on the macroeconomic consequences of inequality. Galor and Zeira (1993) show that the initial distribution of wealth affects long-run growth when credit markets are imperfect, while Persson and Tabellini (1994) link inequality to growth through the political economy of redistribution. More recently, Mian, Straub, and Sufi (2021) show how rising income inequality increases household indebtedness and depresses aggregate demand. I contribute to this literature by studying wealth inequality as a source of macroeconomic vulnerability to capital outflows. In this sense, the paper is closely related to studies on inequality and the propagation of aggregate shocks. Beginning with Krusell and Smith (1998), quantitative heterogeneous-agent models have examined how household heterogeneity matters for aggregate dynamics. Kaplan, Moll, and Violante (2018) and Auclert (2019) show that heterogeneity in liquidity, balance-sheet exposures, and marginal propensities to consume changes the transmission of monetary policy, while Bayer, Born, and Luetticke (2024) quantify the interaction between inequality and the business cycle. At the intersection of inequality and financial crises, Kumhof, Rancière, and Winant (2015) show how rising income inequality can generate household leverage and crisis risk, and Paul (2023) finds that rising top-income inequality predicts financial crises and deeper subsequent recessions. These two papers primarily study how inequality contributes to the incidence of crises. This paper instead studies their severity and rationalizes that contractions in sudden stops are larger when wealth is more unequally distributed.

Finally, the paper relates to the literature on household heterogeneity in open economies. de Ferra, Mitman, and Romei (2020) show that household leverage, portfolio composition, and foreign-currency debt determine the consumption effects of a current-account reversal. Auclert, Rognlie, Souchier, and Straub (2021) study how household heterogeneity amplifies the real-income channel of exchange-rate movements, while Oskolkov (2023) examines how wealth and sectoral exposure shape the distributional effects of exchange-rate policy. Ferrante and Gornemann (2025) study how deposit dollarization exposes heterogeneous households to devaluations through bank balance sheets. On the empirical side, Guntin, Ottonello, and Perez (2023) document consumption adjustment across the income distribution during aggregate crises, and Verner and Gyöngyösi (2020) show that the revaluation of household foreign-currency debt depresses spending and local economic activity. I contribute to this strand of studies by demonstrating household-level evidence of the adjustment of debt and assets during sudden stops and connecting the evidence to the amplification of sudden stops under greater wealth inequality.

Outline This paper is organized as follows. I present the empirical relationship between wealth inequality and sudden stops in Section 2 and rationalize the facts using the tractable model in Section 3. I illustrate the quantitative model in Section 4 and conduct the quantitative analysis of the role of wealth inequality in sudden stops in Section 5. I proceed to study the government's optimal taxation in Section 6 and conclude in Section 7.

2 Empirical Analysis

I document three facts associated with wealth inequality and the vulnerability of an economy when a sudden stop occurs. First, recessions in sudden stops are deeper in more unequal countries. Second, households in more unequal countries carry more debt relative to their wealth. Third, the decline in asset demand during sudden stops is concentrated among indebted households. These findings suggest that greater wealth inequality increases the fraction of indebted households and amplifies contractions in asset demand and domestic absorption in sudden stops.

2.1 Data

I use two different sources of data for the empirical analysis. First, I use an annual panel of 54 countries from 1979 to 2016 to analyze how wealth inequality changes sudden-stop dynamics.[1] The macroeconomic variables include GDP, consumption, investment, the current account, stock market indices, and real exchange rates. I combine these variables with household net wealth Gini coefficients from the World Inequality Database (WID). The country-level controls include trade relative to GDP from the World Development Indicators, the IMF financial development index, debt-to-GDP and reserves-to-GDP ratios calculated by Lane and Milesi-Ferretti (2018), and the financial account openness index constructed by Chinn and Ito (2006).

I follow the convention in the literature (Korinek and Mendoza, 2014; Bianchi and Mendoza, 2020) to define a sudden stop episode. A sudden stop episode is a country-year observation in which (i) the year-on-year change of the current account to GDP ratio is higher by two standard deviations than the country-specific mean and (ii) VIX and JP Morgan EMBI aggregate spreads are higher by one standard deviation than the means for advanced economies and emerging market economies, respectively. I classify 47 countries as having experienced sudden stops in the sample period and provide a full list of sudden stop episodes in Table A1 of Appendix A.1.

Second, I use the Household Finance and Consumption Survey (HFCS) conducted by the European Central Bank (ECB) to study household-level asset and debt holdings. The HFCS provides disaggregated information on household income, assets, and liabilities. It is a repeated cross-sectional survey covering 15 countries in 2011 and 2014.[2] Among the 15 countries in the sample, Greece, Italy, Portugal, and Spain experienced sudden stops in 2012. Thus, the sample provides snapshots of household balance sheets before and after the sudden stops.

2.2 Fact 1: Wealth Inequality Amplifies Contractions in Sudden Stops

I first document that sudden stops are associated with larger drops in aggregate demand when wealth is more unequally distributed. To provide a motivating example, I compare the cyclical movements of GDP and consumption per capita around a sudden stop in countries

[1] I expand the sample of Bianchi and Mendoza (2020) collected from the IMF International Financial Statistics.

[2] I excluded data from countries that were only collected in 2014. The nominal values of household wealth and income are adjusted to constant 2014 values, taking into account the differences in the cost of living across countries and inflation. I describe the adjustment procedure in detail in Appendix A.2.

(A) GDP per capita (B) Consumption per capita

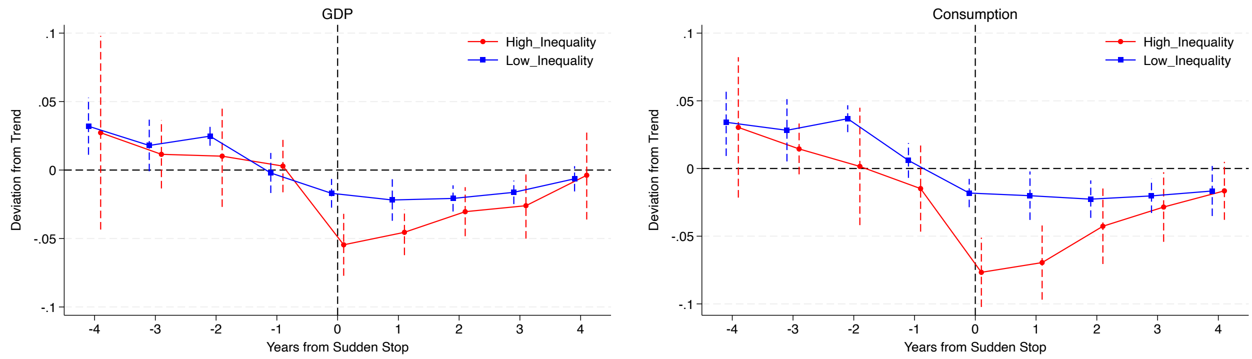

FIGURE 1. Dynamics around Sudden Stops

Notes: Cyclical components of GDP and consumption per capita are estimated using HP filter by each country. Dotted lines are 90% confidence intervals computed using Cameron et al. (2011) two-way clustered standard errors.

with high and low degrees of wealth inequality by running a distributed lag regression specified as

$$y_{it} = \sum_{h=-4}^{4} \beta^h \mathrm{SS}_{i,t+h} + \alpha_i + \eta_t + \varepsilon_{it}, \tag{1}$$

separately for countries with high and low degrees of inequality. High inequality corresponds to the case when a country i's wealth Gini is higher by one standard deviation than the cross-country average in year t, while low inequality refers to when a country i's wealth Gini is lower by one standard deviation compared to the cross-country average in that year. The dummy variable $\mathrm{SS}_{i,t+h}$ is 1 if a country i experienced a sudden stop in the year $t+h$. Estimates of β^h are plotted in Figure 1.

Countries with higher wealth Gini coefficients experience larger drops in GDP and consumption per capita during sudden stops, as shown in Figure 1. The drops are more persistent than those in countries with a lower wealth Gini coefficient. GDP per capita falls by roughly 2% in a low-inequality country during sudden stops, whereas it falls by 5% in a high-inequality country. Differences in consumption per capita are more pronounced, with consumption falling by 2% in a low-inequality country, while it drops by 7% in a high-inequality country.

I next analyze how wealth inequality affects the relationship between capital outflows and macroeconomic variables when sudden stops occur within a country. While regression (1) treats all sudden stops identically as a dummy variable, I allow the size of the capital outflow to vary across crises by multiplying the ratio of capital net outflow to GDP by the sudden stop dummy. Capital net outflow is measured as the difference between capital inflow and outflow data of Forbes and Warnock (2021). I denote this variable as Net Flow^{SS}. The regressions below estimate how a one-percentage-point larger outflow-to-GDP ratio

Table 1: Aggregate Demand and Stock Prices in Sudden Stops

	GDP	Consumption	Investment	Stock Price
Net Flow$_t^{SS}$	-0.154***	-0.314***	-1.084***	-1.877***
	(0.047)	(0.031)	(0.170)	(0.511)
Net Flow$_t^{SS}$ $\times$ ν_{t-1}	-0.309***	-0.252***	-1.414***	-1.821**
	(0.064)	(0.045)	(0.175)	(0.816)
Controls	Yes	Yes	Yes	Yes
Observations	864	864	847	782
Within R^2	0.531	0.432	0.357	0.085

Notes: GDP, consumption, and investment are HP-filtered cyclical components of log real per capita quantities. The stock-price outcome is the annual change in the log stock-price index. *** and ** denote significance at 1% and 5% levels using the Cameron et al. (2011) two-way clustered standard errors. A full table with regression coefficients of all other control variables is presented in Table A6 of Appendix B.1.

during a sudden stop is associated with the cyclical components of real GDP, consumption, and investment per capita, and the annual growth in stock prices.

My main focus is on the differential effects of wealth inequality on recessions in sudden stops. I first construct a measure of wealth inequality to make the results interpretable. To be specific, I follow a similar approach to Auerbach and Gorodnichenko (2017) and Lakdawala, Moreland, and Schaffer (2021). I first standardize all countries' wealth Gini coefficients by subtracting the mean and dividing by the standard deviation. Then, I apply the logistic transformation to the standardized Gini coefficients, which I denote as $\ell_{i,t-1}$. I normalize the transformed values by the difference between the median and the 75th percentile, denoting the resulting measure as $\nu_{i,t-1} = \frac{\ell_{i,t-1}-\ell_{50\%}}{\ell_{75\%}-\ell_{50\%}}$. Using this measure, I estimate regressions in which y_{it} denotes the HP-filtered cyclical component of the log of real GDP, consumption, or investment per capita. For stock prices, the dependent variable is the annual growth $\Delta \log q_{it}$. The regressions are specified as

$$y_{it} = \alpha + \beta \text{Net Flow}_{it}^{SS} + \gamma \text{Net Flow}_{it}^{SS} \times \nu_{i,t-1} + \Gamma X_{it} + \mu_i + \eta_t + \varepsilon_{it}, \tag{2}$$

$$\Delta \log q_{it} = \alpha + \beta \text{Net Flow}_{it}^{SS} + \gamma \text{Net Flow}_{it}^{SS} \times \nu_{i,t-1} + \Gamma X_{it} + \mu_i + \varepsilon_{it}, \tag{3}$$

where Net Flow$_{it}^{SS}$ is the capital outflow in sudden stops defined above, and X_{it} denotes a vector of lagged values of the following variables of country i in year t: the cyclical component of GDP per capita, the lagged value of ν, the real exchange rate, trade openness, the financial development index, financial openness, the debt-to-GDP ratio, and the foreign reserves-to-GDP ratio.

In regressions (2) and (3), the coefficient β represents the changes in aggregate demand and stock market growth rates associated with a one-percentage-point increase in the outflow-to-GDP ratio when a sudden stop occurs in a country with the median degree of wealth inequality. The interaction coefficient γ measures how the change differs between a country at the 75th percentile of wealth inequality and one at the median. It is the main coefficient of interest in the regressions.

Table 1 shows that larger capital outflows during sudden stops are associated with deeper contractions when wealth inequality is higher. A one-percentage-point increase in capital outflows during a sudden stop is associated with a 0.15% decline in GDP per capita relative to the trend in a country with the median degree of wealth inequality. There is an additional decline of 0.31 percentage points when the country's inequality measure is at the 75th percentile. The corresponding estimated contraction in consumption rises from 0.31% to 0.57%, and the estimated contraction in investment rises from 1.08% to approximately 2.5%. Stock prices fall by 1.88% in the median-inequality country and by 3.7% in the 75th-percentile country. Thus, moving from the median to the 75th percentile approximately doubles the effects of capital outflows on consumption, investment, and stock prices, while it triples for GDP. Consistent with the results in Table 1, greater wealth inequality is also associated with persistently larger recessions and asset-price drops after sudden stops, as shown in the local projection results in Appendix B.2.[3]

Robustness Checks I run a battery of robustness checks for stylized fact 1. I obtain consistent results when I use the log wealth Gini instead of $\nu_{i,t-1}$ in Appendix B.3. The negative inequality interaction also remains when inequality is measured by the lagged ratio of the top-10% to bottom-50% net-wealth shares in Appendix B.4. Because wealth inequality is persistent, I split the sample by countries' average wealth Gini and estimate the crisis response separately in Appendix B.5. The contractions remain larger in the high-inequality group. The result holds in emerging economies with lower financial development in Appendix B.6, survives interactions with other country characteristics in Appendix B.7, and is concentrated in indirect-investment outflows in Appendix B.8. It is also robust to controlling for private rather than total debt before the crisis. The differential effects of wealth inequality are pronounced in sudden stops but not in normal times, as shown in Appendix B.9. I also show that bank runs and systemic banking crises do not exhibit such macroeconomic contraction, as those episodes do not involve capital outflows in Appendix B.10.

Comparison to Income Inequality Income inequality does not have any significant differential effects on the recessions that occur during sudden stop episodes. To be specific, I construct the income inequality measure as in regression (2) using the previous year's income Gini coefficients collected by the World Bank. Table 2 shows that the additional decreases in GDP and consumption attributable to income inequality are insignificant. Investment and stock prices fall during crises, but there is no additional effect due to income inequality. This

[3] I estimate local projections in Appendix B.2 using cumulative changes in the logs of the dependent variables.

TABLE 2: Sudden Stops and Income Inequality

	GDP	Consumption	Investment	Stock Price
Net Flow_t^{SS}	-0.205**	-0.276**	-1.323***	-2.351***
	(0.093)	(0.112)	(0.364)	(0.725)
Net $\text{Flow}_t^{SS} \times \nu_{t-1}^{\text{Income}}$	-0.034	0.068	-0.186	-0.323
	(0.045)	(0.089)	(0.115)	(0.308)
Controls	Yes	Yes	Yes	Yes
Observations	1229	1229	1207	981
Within R^2	0.501	0.400	0.298	0.064

Notes: *** and ** denote significance at 1% and 5% levels using the Cameron et al. (2011) two-way clustered standard errors. A full table with regression coefficients of all other control variables is presented in Table A7 of Appendix B.1.

implies that the distribution of assets that can be used as capital buffers in a financial crisis matters for the magnitude of the recession, while the income distribution does not have a significant effect on recessionary dynamics.

These findings distinguish the role of wealth inequality from that of income inequality in sudden stop dynamics. Liu, Spiegel, and Zhang (2023) study how capital flows reshape the distribution of income. Villalvazo (2026) instead examines how heterogeneity in wealth and leverage shapes asset sales, asset purchases, and crisis severity. This paper complements Villalvazo (2026) by providing cross-country evidence on the relationship between wealth inequality and the severity of sudden stops, along with European household evidence on the balance-sheet adjustments underlying this relationship. Taken together, these findings suggest that the distribution of asset buffers and debt positions is central to how households absorb simultaneous declines in income and borrowing capacity.

2.3 Fact 2: More Unequal Economies Are More Leveraged

I find that greater wealth inequality is associated with higher leverage among households. Using the ECB HFCS data, I observe that more unequal countries have a higher ratio of aggregate household debt to aggregate household assets and a larger fraction of households with leverage ratios above 30% as shown in Figure 2. Greater wealth inequality does not only imply the concentration of assets at the top, but also that households in the lower parts of the distribution are more indebted and therefore have smaller net worth.[4]

Table 3 further shows the relationship between wealth inequality and external debt in

[4]This is consistent with the Shapley value decomposition in Appendix A.3 of the cumulative change in the Gini, constructed from decile mean wealth. The top 10%, the middle 40%, and the bottom 50% contribute 32%, 40.3%, and 25%, respectively, to the change in the wealth Gini over time.

(A) Aggregate Leverage Ratio (B) Fraction of Indebted Households

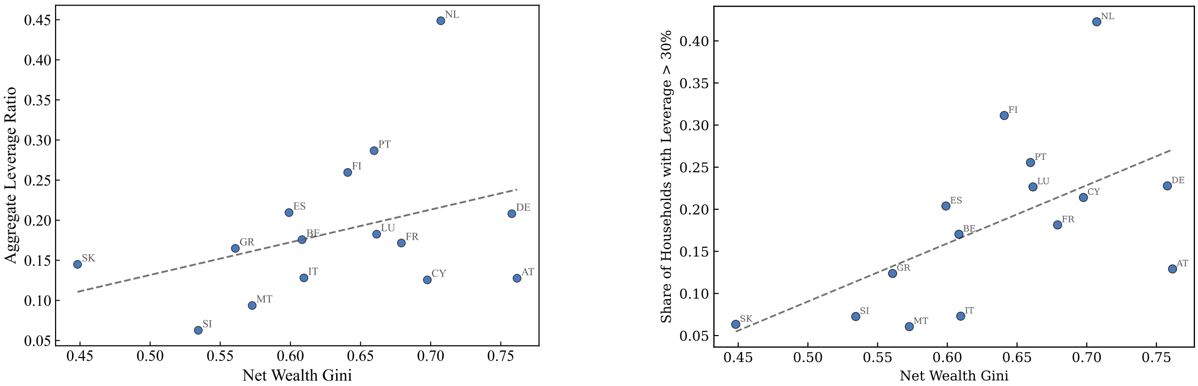

FIGURE 2. Household Leverage Ratio

Notes: Leverage ratio is defined as the ratio of total debt (DL1000) to total assets (DA3001). Panel (A) plots ratios of sum of debt to sum of assets of all households in each country in 2011. Panel (B) plots the fraction of households with leverage ratio higher than 30% in each country in 2011.

TABLE 3: Wealth Inequality and External Debt

	Within	Within	Between	Within	Within	Between
Wealth Gini$_{t-1}$	1.503*	1.672**	2.431*	1.863***	1.722**	2.732**
	(0.820)	(0.764)	(1.257)	(0.585)	(0.678)	(1.251)
Controls	No	No	No	Yes	Yes	Yes
Country FE	Yes	Yes	–	Yes	Yes	–
Year FE	No	Yes	–	No	Yes	–
Observations	1,093	1,093	52	1,093	1,093	52

Notes: Within regressions are regressions with fixed effects and between regressions are regressions with country-means of the variables. ***, **, and * denote significance at 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors for the within regressions and heteroskedasticity-robust standard errors for the between regressions. A full table with regression coefficients of all other control variables is presented in Table A8 of Appendix B.1.

the country panel data. The dependent variable of the regressions in Table 3 is the log of external debt liabilities relative to external debt assets, obtained from the data of Lane and Milesi-Ferretti (2018), and the coefficients represent the changes in the external debt measure associated with a 0.01 increase in the wealth Gini. Greater wealth inequality is associated with larger external debt relative to external assets, both within a country and across countries. For example, A 0.01 increase in the wealth Gini is associated with a 1.86% increase in the ratio of external debt liabilities to external debt assets in the following year for regression (4) in Table 3, which controls for country fixed effects and lagged values of country characteristics. The cross-country patterns of the between effect regressions in Table 3 are consistent with a recent finding by de Ferra, Mitman, and Romei (2025) that documents capital flows from more equal countries to more unequal countries.

2.4 Fact 3: Indebted Households Reduce Debt and Assets in Sudden Stops

I analyze how assets and debt change across household groups with different debt exposure when a sudden stop occurs. I compare the indebted group in countries with sudden stops to the corresponding group in countries without a sudden stop in the ECB HFCS data.[5] Mortgage debt constitutes the main component of household debt in the HFCS. I therefore use mortgage status to identify the principal indebted group in the household analysis.[6] In a sudden stop, income falls during the recession, while aggregate deleveraging makes external financing harder to obtain. An indebted homeowner must continue servicing debt from lower income and may be unable to roll over the loan. An outright owner holds the same type of real asset without this payment or refinancing need.

I classify households by housing tenure.[7] Renters and non-owners do not hold real estate. They hold 3% of total household assets and are concentrated in the bottom two deciles of the wealth distribution, as shown in Tables A3 and A4. Outright owners own real estate without mortgage debt. They represent 46% of households and hold 59% of gross assets. The indebted group consists of homeowners with mortgage debt. They make up 26% of households and hold 38% of gross assets. Because renters hold only a small fraction of total assets, I focus on the indebted and outright-owner groups.

I compare how the subcategories of assets and debts of households changed for these groups of households in countries with sudden stops. For each asset and debt subcategory X, country c, and group g, I compute the mean of each balance-sheet component. I take its log change between 2011 and 2014, denoted D^X_{cg}, and form

$$\mathrm{DD}^X_g = \frac{1}{|\mathcal{S}|}\sum_{c\in\mathcal{S}} D^X_{cg} - \frac{1}{|\mathcal{N}|}\sum_{c\in\mathcal{N}} D^X_{cg}, \tag{4}$$

where $\mathcal{S}$ denotes the set of four sudden stop countries and $\mathcal{N}$ denotes the set of control countries. Equation (4) compares the change over time in the sudden stop countries with the change over time in the control countries, separately for each group.[8]

Panel (A) of Figure 3 shows that the mean outstanding debt in the indebted group fell by more than 20% in the sudden stop countries relative to the control countries, driven by the decline in outstanding mortgage debt. In contrast, the debt growth of outright owners does not show a statistically significant difference compared to the control countries. Non-mortgage financial debt and non-collateralized loans, which include auto, consumer, and

[5] The repeated cross-sectional structure of the HFCS allows me to compare the adjustments of these groups before and after the 2012 sudden stop rather than tracking an individual household.

[6] Liabilities and assets of firms owned by households are excluded from the data, so the leverage ratio in the data should be considered a lower bound.

[7] I restrict the sample to reference persons aged 25–59 as of 2011.

[8] With only four treated countries, I conduct exact permutation inference. I reassign the sudden stop label to all possible subsets of four countries, recompute the statistic, and locate the actual estimate in the resulting placebo distribution. Because the direction of the adjustment is predicted, I report p-values for a predicted contraction $p = \frac{1}{1365}\sum_{\tilde{\mathcal{S}}} \mathbf{1}\{\mathrm{DD}(\tilde{\mathcal{S}}) \leq \mathrm{DD}(\mathcal{S})\}$, where $\tilde{\mathcal{S}}$ runs over all placebo assignments.

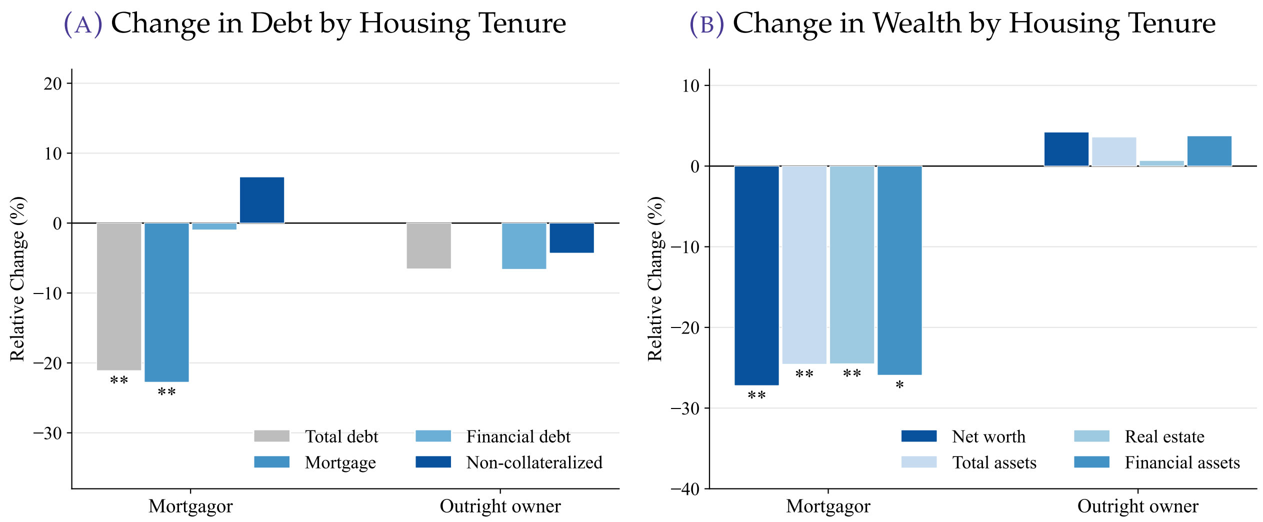

FIGURE 3. Balance Sheet Change by Housing Tenure in Sudden Stop Countries

Notes: Each panel plots the difference-in-differences estimate in (4) for the subcategories as follows. Panel (A) plots total debt (DL1000), mortgage debt (DL1100), financial debt (DL1200), and non-collateralized loans (DL1230). Panel (B) plots net assets (DN3001), gross assets (DA3001), real estate (DA1400), and financial assets (DA2100). ** and * denote significance at the 5% and 10% levels.

personal loans, show no significant changes in either group.

A fall in mortgage debt can be interpreted as a combination of two effects. First, amortization occurs on a fixed schedule through debt repayments. Second, existing debt is replaced less frequently as new borrowing declines. Panel (A) of Figure 4 shows that, relative to the corresponding group in the control countries, the share of indebted households whose debt was originated within the previous three years falls by more than 10 percentage points. The share that purchased a main residence within the previous three years falls by more than 5 percentage points. Outright owners show no comparable decline in recent purchases.

The changes in real estate ownership status are consistent with lower debt originations concentrated among indebted households. Figure 4 shows that the share of indebted individuals owning real estate other than their main residence fell by 7.5 percentage points more in sudden stop countries than in control countries. The average value of other real estate and associated debt also declined more in the sudden stop countries, as shown in Figure A2.

Panel (B) of Figure 3 shows the corresponding changes on the asset side. In the indebted group, average real estate values and financial assets fell by 24.5% and 25.9% more, respectively, in the sudden stop countries than in the control countries. Mean total assets fell by 24.6% more, while mean net worth fell by 27.2% more. For outright owners, the estimated changes in the wealth components are small relative to those of the indebted group.

The three empirical facts jointly motivate the mechanism developed below. Fact 1 shows that capital outflows are associated with larger contractions in more unequal countries. Fact 2 shows that greater wealth inequality is associated with higher aggregate indebtedness

(A) New Purchases and Mortgage Origination (B) Ownership of Real Estate and Mortgages

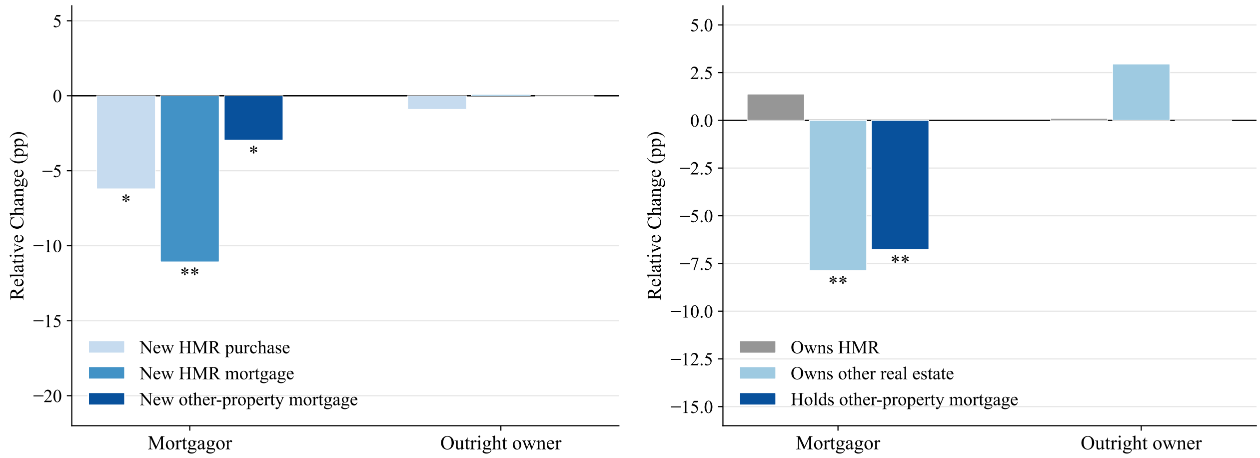

FIGURE 4. Real Estate Ownership Change in Sudden Stop Countries

Notes: Panel (A) shows the percentage-point change in the share of households that purchased their main residence (HB0700) or originated a mortgage on the main residence (HB1301–HB1303) or on other property (HB3301–HB3303) within the three years preceding the survey. HMR stands for household main residence. ** and * denote significance at the 5% and 10% levels.

and a larger share of highly leveraged households. Fact 3 shows that the household balance sheet adjustments during the sudden stop episode were concentrated among indebted households. The empirical facts suggest that wealth inequality can make aggregate demand and asset prices more sensitive to capital outflows by increasing the indebtedness of an economy. The model formalizes how this channel connects the three empirical facts.

3 Tractable Model

I now build a tractable model that connects the empirical facts. The empirical analysis establishes that contractions in sudden stops are larger in more unequal countries, that these countries are more leveraged, and that the balance sheet adjustments are concentrated among leveraged households. Using the tractable model, I analytically characterize the mechanism through which greater wealth inequality amplifies adverse aggregate shocks and connect the household-level evidence to the cross-country findings. I extend the tractable framework to a quantitative model in Section 4 to assess the quantitative importance of the mechanism and its implications for optimal policy.

I consider a unit measure of households that live for three periods $t \in \{0, 1, 2\}$ and enter period 0 with heterogeneous initial endowments of domestic capital k_{i0}. Households hold domestic productive capital and foreign assets and face collateral constraints when borrowing. Aggregate productivity in period 1 is the only source of uncertainty. In this simple model, I focus on the effects of a negative productivity shock on asset prices and aggregate consumption, and how wealth inequality propagates the effects of the shock. A negative productivity shock decreases domestic income and asset prices, which tightens borrowing constraints. As I show later, the shock can incur capital outflows if the TFP has already been low. Wealth inequality raises the fraction of households that become constrained when the shock hits. Their joint reduction in capital demand produces a larger price decline that feeds back into a larger drop in aggregate consumption.

3.1 Environment

3.1.1 Household

An individual household i is endowed with an initial stock of domestic capital k_{i0} and enters period 0 with no foreign bonds $b_{i0} = 0$. The household maximizes lifetime utility by choosing consumption c_{it}, domestic assets $k_{i,t+1}$, and foreign bonds $b_{i,t+1}$ while being subject to budget and borrowing constraints. The household's problem can be written as

$$\max_{\{c_{it}, b_{i,t+1}, k_{i,t+1}\}_{t=0,1}, c_{i2}} \mathbb{E}_0 \left[u(c_{i0}) + \beta u(c_{i1}) + \beta^2 c_{i2} \right], \tag{5}$$

$$\text{s.t.} \quad c_{i0} + q_0 k_{i1} + \frac{b_{i1}}{R} = f(k_{i0}) + q_0 k_{i0}, \tag{6}$$

$$c_{i1} + q_1 k_{i2} + \frac{b_{i2}}{R} = z_1 f(k_{i1}) + q_1 k_{i1} + b_{i1}, \tag{7}$$

$$c_{i2} = f(k_{i2}) + k_{i2} + b_{i2}, \tag{8}$$

$$\frac{b_{i,t+1}}{R} \geq -\theta q_t k_{i,t+1}; \quad \forall t < 2, \tag{9}$$

where $u(\cdot)$ is a strictly increasing and concave function. I impose the linear utility function at period 2 because there is no uncertainty once z_1 is realized at the beginning of period 1.[9] q_t and R denote the prices of domestic assets and the international interest rate. I assume that the world interest rate is constant over time. Domestic assets bought today can be used for production in the future, and I impose the production function as $f(k) = k^\alpha$ with $\alpha < 1$ for simplicity. Production in period 1 is scaled by aggregate productivity z_1, so that period 1 output is $z_1 f(k_{i1})$, while I normalize productivity to $z_0 = z_2 = 1$ in periods 0 and 2. For simplicity, I abstract from capital depreciation over time, and households can trade their assets after production at price q_t in periods 0 and 1. In the final period, they simply consume their assets after production.

A household can pledge a fraction θ of the current market value of its domestic assets as collateral, as in Jermann and Quadrini (2012) and Bianchi and Mendoza (2018).[10] The collat-

[9]This can be considered as taking the certainty equivalence value of CARA utility as the utility function at period 2.

[10]Previous studies, such as Bianchi (2011), Seoane and Yurdagul (2019), and Rojas and Saffie (2022), address the real exchange rate depreciation during sudden stops. I abstain from including the real exchange rate in the model because I do not observe differential effects of wealth inequality on the real exchange rate depreciation

eral is evaluated at the current market price q_t, which creates a pecuniary externality, as in Ottonello, Perez, and Varraso (2022), because households do not internalize how their asset choices jointly affect the asset price and the borrowing limit. For tractability, aggregate productivity z_1 in period 1 is the only source of uncertainty from the perspective of households in period 0.

The first-order conditions of the household's problem are

$$k_{i1} :: q_0 u'(c_{i0}) = \beta \mathbb{E}_0 \left[u'(c_{i1})(z_1 f'(k_{i1}) + q_1) \right] + \mu_{i0} \theta q_0, \tag{10}$$

$$k_{i2} :: q_1 u'(c_{i1}) = \beta (f'(k_{i2}) + 1) + \mu_{i1} \theta q_1, \tag{11}$$

$$b_{i1} :: u'(c_{i0}) = \beta R \mathbb{E}_0 u'(c_{i1}) + \mu_{i0}, \tag{12}$$

$$b_{i2} :: u'(c_{i1}) = \beta R + \mu_{i1}, \tag{13}$$

and the complementary slackness conditions hold as

$$\mu_{it} \left(\frac{b_{i,t+1}}{R} + \theta q_t k_{i,t+1} \right) = 0; \quad \mu_{it} \geq 0, \quad \forall t. \tag{14}$$

3.1.2 Market Clearing

The balance of payments in this economy is represented as

$$\int \left(c_{it} + \frac{b_{i,t+1}}{R} \right) \, di = \int \left(z_t f(k_{it}) + b_{it} \right) \, di. \tag{15}$$

I assume that domestic capital is in fixed physical supply and that the asset price q_t clears the capital market in each period. The market clearing condition is

$$\int k_{i,t+1} \, di = \int k_{i0} \, di = \overline{K}, \quad \forall t, \tag{16}$$

where $\overline{K}$ denotes the aggregate physical capital endowment.

3.1.3 Competitive Equilibrium

The competitive equilibrium of this economy is defined as follows.

Definition 1. *Given the distribution of initial capital $\{k_{i0}\}_i$, the competitive equilibrium is defined as allocations $\{c_{it}, k_{i,t+1}, b_{i,t+1}\}_{i,t}$ and prices $\{q_t\}_t$ such that*

1. *Given $\{q_t\}$ and k_{i0}, $\{c_{it}, k_{i,t+1}, b_{i,t+1}\}_t$ maximizes household i's utility in (5).*
2. *The domestic asset market is cleared in each period.*

in a sudden stop in my sample.

3.2 Effect of a Negative TFP Shock

I analyze the effects of a negative shock to aggregate productivity z_1 in period 1. A negative productivity shock can trigger a sudden stop through the balance sheets of financially constrained households. I first characterize an endogenous threshold level of wealth in period 1 that distinguishes between constrained and unconstrained households. I then examine how a negative shock to z_1 moves the threshold and the asset price q_1. I finally examine how the responses of the asset price and aggregate consumption change along a tractable family of mean-preserving spreads of the initial wealth distribution.

3.2.1 Wealth Inequality and Productivity Shock in Period 1

I denote an individual household's wealth at the beginning of period 1 as $\tilde{w}_i = z_1 f(k_{i1}) + b_{i1} + q_1 k_{i1}$, and let G be the joint distribution of (k_{i1}, b_{i1}) determined in period 0. While G itself is independent of the price q_1 and the realization of z_1, each household's period-1 wealth depends on both. In the absence of idiosyncratic shocks throughout the periods, $\tilde{w}_i$ is increasing in the household's initial wealth at the beginning of period 0. Throughout this section, I assume $u(c) = \log c$ and $\beta R = 1$.

A household is either constrained or unconstrained in equilibrium at period 1. I assume that the distribution G is such that not all households are unconstrained under a given realization of z_1, which generally holds when wealth is continuously distributed across households or when a non-zero measure of households is near the borrowing limit. Across the wealth distribution G, there is a cutoff level of net wealth that separates constrained from unconstrained households.

Lemma 1. *The unconstrained households demand an identical amount of capital $\bar{k}_2$ where*

$$\bar{k}_2 = (f')^{-1}(q_1 R - 1) \quad \text{and} \quad \frac{\partial \bar{k}_2}{\partial q_1} < 0. \tag{17}$$

Households with wealth $\tilde{w}_i < \overline{w}$ are constrained, where $\overline{w}$ satisfies

$$\overline{w} = 1 + (1-\theta) q_1 \bar{k}_2, \tag{18}$$

and I have

$$\left.\frac{\partial \overline{w}}{\partial z_1}\right|_{q_1} = 0 \qquad \text{and} \qquad \frac{\partial \overline{w}}{\partial q_1} < 0. \tag{19}$$

Proof. See Appendix C.1. □

Lemma 1 characterizes how the productivity shock reaches households in period 1. Because the shock does not alter the tightness of the borrowing constraint, it leaves the threshold $\overline{w}$ unaffected at a given price. Instead, a lower z_1 moves the wealth distribution itself downward and also changes the equilibrium price of assets. I characterize how households' demand for assets changes under the productivity shock to study what determines the change in price.

For unconstrained households, the productivity shock has indirect effects through the asset price but no direct effects. For the constrained households with $\tilde{w}_i < \overline{w}$, the binding collateral constraint implies $b_{i2} = -R\theta q_1 k_{i2}$. Combining the first-order conditions with respect to k_{i2} and b_{i2} yields the consolidated Euler equation

$$(1-\theta)q_1 u'(\tilde{w}_i - (1-\theta)q_1 k_{i2}) = \beta\left(f'(k_{i2}) + 1 - \theta q_1 R\right), \tag{20}$$

where the asset demand k_{i2} increases with wealth $\tilde{w}_i$.Totally differentiating (20) with respect to z_1, q_1, and k_{i2}, the total response of the constrained household's asset demand to a productivity shock can be written as

$$\frac{dk_{i2}}{dz_1} = \underbrace{\frac{(1-\theta)q_1 u''(c_{i1})f(k_{i1})}{\beta f''(k_{i2}) + (1-\theta)^2 q_1^2 u''(c_{i1})}}_{\text{Direct effect} \equiv \frac{\partial k_{i2}}{\partial z_1} > 0} + \underbrace{\frac{\theta + (1-\theta)(q_1 k_{i1} - \tilde{w}_i)u''(c_{i1})}{\beta f''(k_{i2}) + (1-\theta)^2 q_1^2 u''(c_{i1})}}_{\text{Price effect} \equiv \frac{\partial k_{i2}}{\partial q_1} < 0} \frac{dq_1}{dz_1}, \tag{21}$$

which is obtained from the total differentiation of (20) with respect to z_1, q_1, and k_{i2}.

When the asset price falls as z_1 declines, constrained households buy more assets at the cheaper price, but they cannot buy as much as unconstrained households because they are up against their borrowing limit and must finance any additional purchases from their own scarce resources.[11] This makes constrained households' asset demand less elastic to price changes than that of unconstrained households, which gives us Lemma 2.

Lemma 2. *The price elasticity of asset demand is smaller for constrained households, i.e.,*

$$\left|\frac{\partial k_{i2}}{\partial q_1}\frac{q_1}{k_{i2}}\right| < \left|\frac{\partial \overline{k}_2}{\partial q_1}\frac{q_1}{\overline{k}_2}\right|, \tag{22}$$

where household i is a constrained household.

Proof. See Appendix C.2. □

In equilibrium, the asset price q_1 clears the domestic asset market and satisfies

$$\int_{i\in\mathcal{C}} k_{i2}\, di + \int_{i\in\mathcal{U}} \overline{k}_2\, di = \overline{K}, \tag{23}$$

where $\mathcal{C}$ and $\mathcal{U}$ denote the sets of constrained and unconstrained households, respectively. When z_1 falls, constrained households reduce their asset demand while the shift in the wealth distribution enlarges the mass of constrained households. Both forces put downward pressure on the asset price. Totally differentiating the market clearing condition with

[11] The term associated with k_{i1} in the numerator of the price effect captures the valuation effect of a higher asset price on period-1 wealth $\tilde{w}_i$. I maintain throughout that this valuation effect does not dominate, so $\partial k_{i2}/\partial q_1 < 0$ holds for every constrained household at every price.

respect to z_1 and q_1 gives

$$\frac{dq_1}{dz_1} = \frac{\overbrace{\int_{i\in\mathcal{C}} \left|\frac{\partial k_{i2}}{\partial z_1}\right| di}^{\text{Average direct effect}}}{\underbrace{\int_{i\in\mathcal{C}} \left|\frac{\partial k_{i2}}{\partial q_1}\right| di + \int_{i\in\mathcal{U}} \left|\frac{\partial \bar{k}_2}{\partial q_1}\right| di}_{\text{Average elasticity of asset demand}}} > 0. \tag{24}$$

Hence, a negative productivity shock lowers the asset price, and the size of the price drop depends on the average direct effect in the numerator and the average price elasticity of asset demand in the denominator. The price falls less when there are more unconstrained households with more elastic asset demand.

The productivity shock also raises the fraction of constrained households. Whether a household is constrained is determined by its wealth relative to the threshold $\tilde{w}_i - \overline{w}$, and the shock affects both terms: every household's distance to the threshold changes as

$$\frac{d(\tilde{w}_i - \overline{w})}{dz_1} = f(k_{i1}) + \left[k_{i1} - \frac{\partial \overline{w}}{\partial q_1}\right] \frac{dq_1}{dz_1}, \tag{25}$$

which is strictly positive. Two forces reinforce each other. First, the distribution of $\tilde{w}_i$ shifts to the left as output falls, which is the partial equilibrium channel. Second, Fisherian deflation increases the threshold $\overline{w}$ in general equilibrium as the price drop feeds into the borrowing limit. Since (25) is positive for every household, wealth falls relative to the threshold as z_1 falls. Households can only cross from the unconstrained region into the constrained region when z_1 falls, so the fraction of constrained households rises.

Now, turning to the change in aggregate consumption due to a productivity shock, only constrained households change their consumption because the consumption of unconstrained households in period 1 is constant at 1. The bond Euler equation of an unconstrained household implies $u'(c_{i1}) = 1$, so unconstrained households simply reduce their bond holdings to buy more capital without changing their consumption. The partial equilibrium effect of the shock on a constrained household's consumption is

$$\left.\frac{\partial c_{i1}}{\partial z_1}\right|_{q_1} = f(k_{i1}) \frac{\beta f''(k_{i2})}{\beta f''(k_{i2}) + (1-\theta)^2 q_1^2 u''(c_{i1})} > 0, \tag{26}$$

In partial equilibrium with a fixed asset price, a lower z_1 directly reduces the household's output and consumption. Combining this with the general equilibrium effect from the price drop, aggregate consumption changes as

$$\frac{dC_1}{dz_1} = \underbrace{\int_{i\in\mathcal{C}} \left.\frac{\partial c_{i1}}{\partial z_1}\right|_{q_1} di}_{\text{Partial equilibrium effect}} + \underbrace{\int_{i\in\mathcal{C}} \frac{\partial c_{i1}}{\partial q_1} \frac{dq_1}{dz_1} di}_{\text{General equilibrium effect}}. \tag{27}$$

A negative shock to z_1 lowers aggregate consumption in partial equilibrium. Moreover, combining the budget constraint with the consolidated Euler equation shows that $\partial c_{i1}/\partial q_1 >$

0 applies to every constrained household. Hence, the general equilibrium term in (27) reinforces the partial equilibrium effect rather than offsetting it, and aggregate consumption decreases when productivity falls. I establish the effects of a negative TFP shock as follows.

Proposition 1. *Suppose that the period-1 net wealth distribution is continuous and has bounded support. Let $\overline{F} \equiv \int f(k_{i1})\, di$. A negative shock to z_1*

1. *lowers the asset price q_1;*
2. *lowers aggregate consumption C_1;*
3. *generates a capital outflow if $z_1 < z^*$ such that z^* satisfies $dC_1/dz_1|_{z^*} = \overline{F}$.*

Proof. See Appendix C.3. □

Note that any negative TFP shock decreases asset prices and aggregate consumption, but productivity must already be low for capital outflows to occur. When productivity is high, few households are constrained, and the consumption-smoothing motive against a temporary output loss dominates. In that case, households borrow, and capital flows in. When $z_1 < z^*$, a large fraction of households is constrained. A further negative shock forces them to deleverage as the falling asset price erodes the value of their collateral. Their consumption then falls by more than output, and capital flows out.[12] The threshold z^* is the productivity level at which these two forces balance. Appendix D.1 shows that a negative shock to the borrowing limit θ has similar effects on asset prices and aggregate consumption and always generates a capital outflow.

The empirical analysis in Section 2 showed that contractions during sudden stops are larger when wealth is distributed more unequally. I now examine how wealth inequality changes the responses of the asset price and aggregate consumption to a productivity shock. A mean-preserving spread alone does not determine which part of the distribution becomes more dispersed. To obtain an analytical result, I consider a family of mean-preserving spreads that expands the lower tail proportionally while preserving mean wealth.

Let $\{\Phi_\lambda\}_{\lambda \in [1,\lambda_F]}$ be a family of initial wealth distributions with $\Phi_1 = G$ and $\Phi_{\lambda_F} = F$. The notation $\Phi(x; q_1, \Phi_\lambda)$ denotes the cumulative distribution of period-1 wealth induced by Φ_λ at price q_1. Aggregate capital and mean period-1 wealth are the same for every λ at each price between q_1^F and q_1^G. For any such price and every x below the common mean,

$$\Phi(x; q_1, \Phi_\lambda) = \lambda \Phi(x; q_1, G), \tag{28}$$

$\lambda > 1$ corresponds to spreading out $\Phi(x; q_1, G)$ and hence greater wealth inequality.[13]

[12] Endogenous tightening of the borrowing limit is crucial in generating the capital outflow. Under a constant borrowing limit, as in Aiyagari (1994), more households become constrained and borrow up to the limit when z_1 falls, which always increases aggregate debt and capital inflow.

[13] Appendix C.4 shows that (28) corresponds to a type of mean-preserving spread defined by Rothschild and

I impose two conditions on the equilibrium under the baseline distribution G. First,

$$R\theta q_1^G \leq 1. \tag{29}$$

Purchasing one additional unit of capital relaxes the borrowing limit by θq_1^G, which requires repayment of $R\theta q_1^G$ in period 2. Condition (29) states that this repayment does not exceed the undepreciated resale value of the unit of capital. Second, the baseline wealth threshold lies below mean wealth, and constrained households are a minority, i.e.,

$$\overline{w}^G < \mathbb{E}_G[\widetilde{w}_i], \qquad |\mathcal{C}^G| = \Phi(\overline{w}^G; q_1^G, G) < \frac{1}{2}. \tag{30}$$

Under the two assumptions, I analytically show that greater wealth inequality amplifies the effects of a productivity shock on asset prices and consumption.

Proposition 2. *Consider the mean-preserving spread in* (28), *and suppose that (29–30) hold. Greater wealth inequality amplifies the fraction of constrained households and response of the asset price to the productivity shock. That is,*

$$\frac{\partial |\mathcal{C}|}{\partial \lambda} > 0 \quad \text{and} \quad \frac{\partial^2 q_1}{\partial \lambda \, \partial z_1} > 0. \tag{31}$$

In addition, if $\alpha \geq 1/2$, greater wealth inequality amplifies response of consumption. That is,

$$\frac{\partial^2 C_1}{\partial \lambda \, \partial z_1} > 0. \tag{32}$$

Proof. See Appendix C.4. □

At a fixed price, a higher λ increases the mass of households in the lower tail without changing its composition. Hence, more households reduce capital demand when productivity falls. At the same time, the economy has fewer unconstrained households whose demand responds strongly to a lower price. Both changes make the asset price respond more to the productivity shock.[14]

The proposition connects the three empirical facts. Greater inequality increases the fraction of constrained households with high leverage ratio whose capital demand and consumption are tied to collateral values. When productivity falls, balance sheet adjustments are consequently concentrated among these households, while fewer unconstrained households respond to the lower asset price. The resulting fall in the asset price further tightens borrowing limits and produces a larger aggregate contraction. Appendices D.1 and D.2 provide results indicating that greater wealth inequality amplifies the effects of shocks to borrowing capacity θ and the world interest rate R on asset price and consumption.

Stiglitz (1970). The distributions have bounded but not necessarily common support.

[14]For the response of aggregate consumption to the productivity shock, the condition $\alpha \geq 1/2$ ensures that the increase in households forced to cut spending outweighs any reduction in individual spending cuts caused by the lower asset price by limiting how sharply the marginal product of capital declines.

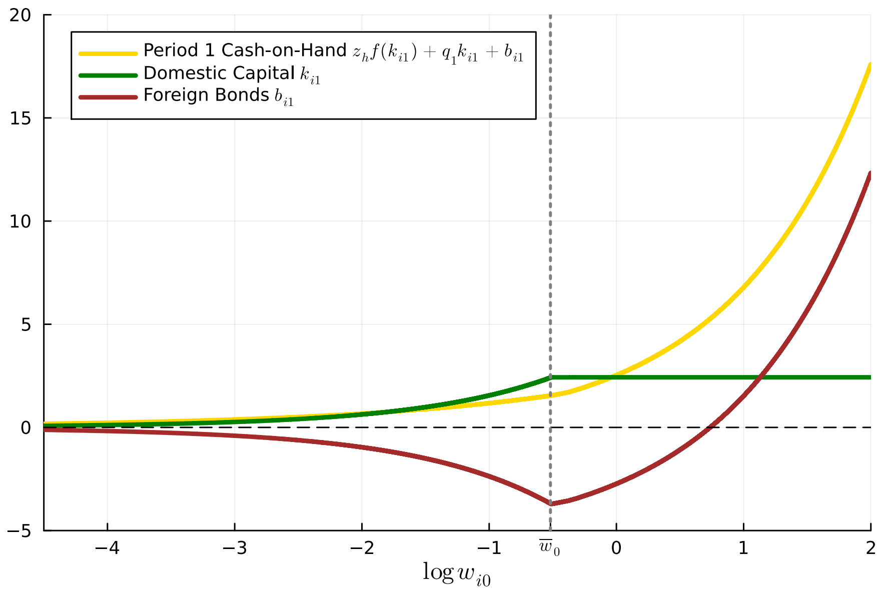

FIGURE 5. Policy Functions of k_{i1} and b_{i1} at Period 0

3.2.2 Numerical Example

I provide a numerical example of the productivity shock. I impose $u(c) = \log c$, $\beta R = 1$ with the world interest rate of 4%, and $\alpha = 0.66$. The tightness of the borrowing constraint is imposed as $\theta = 0.8$ and aggregate productivity z_1 equals 0.95 with a probability of 0.1 and 1.0 with a probability of 0.9, corresponding to a 5% negative productivity shock. I compare the equilibria under two initial wealth distributions, $G = \text{LogNormal}(0, 1.2^2)$ and $F = \text{LogNormal}(-0.33125, 1.45^2)$, with wealth Gini coefficients of 0.604 and 0.695, respectively, where F is a mean-preserving spread of G.

The household's first-order conditions in period 1 imply that a household always consumes $1/\beta R$ if it is unconstrained under all possible realizations of z_1. For these unconstrained households, their first-order conditions in period 0 can be written as

$$q_0 R - \mathbb{E}_0[z_1] f'(k_{i1}) = \mathbb{E}_0 q_1 + \frac{\mathbb{C}ov_i(u'(c_1), z_1 f'(k_{i1}) + q_1)}{\mathbb{E}_0 u'(c_{i1})} = \mathbb{E}_0 q_1, \tag{33}$$

as the covariance term in (33) becomes zero as all unconstrained households consume the same amount. Hence, they buy the same amount of k_{i1} in period 0. Denote that level of k_{i1} as $\bar{k}_1$. Since the capital demand k_{i1} is weakly increasing in k_{i0}, this implies the existence of a threshold value of k_{i0} such that a household with an initial capital stock below that level buys strictly less than $\bar{k}_1$. Correspondingly, there is a wealth threshold $\overline{w}_0$ for the initial wealth such that households below the threshold borrow up to the limit in period 0, as shown in Figure 5. For bonds, constrained households' debt increases with initial wealth because a larger capital stock raises the borrowing limit, whereas debt decreases with wealth for unconstrained households. As a result, households' wealth at the beginning of period 1 increases with their initial wealth.

TABLE 4: Numerical Results under a Productivity Shock

	Baseline Distribution (G)	Alternative Distribution (F)	Counterfactual
Wealth Gini at Period 0	0.605	0.696	0.605
Mean Wealth at Period 1 ($z_1 = z_H$)	5.084	5.016	5.084
Wealth Gini at Period 1 ($z_1 = z_H$)	0.570	0.644	0.644
Constrained Fraction at Period 1 ($z_1 = z_H$)	37.69%	49.43%	37.69%
Constrained Fraction at Period 1 ($z_1 = z_L$)	39.54%	51.56%	49.90%
Change in Consumption C_1 (%)	-1.62%	-2.13%	-2.48%
Change in Asset Price q_1 (%)	-0.30%	-0.40%	-0.42%

Table 4 summarizes the effects of a negative productivity shock on aggregate consumption and the price of capital. Period-1 wealth is $\tilde{w}_i = z_1 f(k_{i1}) + q_1 k_{i1} + b_{i1}$, the same object that determines whether a household lies below the wealth threshold. When aggregate productivity falls by 5%, aggregate consumption decreases by 1.62% and the price of capital falls by 0.30% in the baseline economy as the fraction of constrained households rises from 37.69% to 39.54%. The contraction is amplified in the alternative economy with a more unequal distribution of k_0 at period 0. Aggregate consumption falls by 2.13% and the price of capital drops by 0.40%, while the constrained fraction rises from 49.43% to 51.56%. This numerical comparison shows that the amplification mechanism can arise under a conventional lognormal mean-preserving spread without imposing the assumptions (29) and (30) in Proposition 2.

I also analyze the effect of greater inequality on the changes in aggregate consumption and asset prices while keeping the fraction of constrained households before the negative productivity shock fixed. To be specific, I construct a counterfactual distribution of wealth at period 1 by keeping the average wealth and the fraction of constrained households at period 1 fixed at the baseline level under the initial distribution G and increasing the wealth Gini coefficient to the level under the initial distribution F.[15] The counterfactual distribution matches the Gini coefficient at period 1 under the initial distribution F, while also matching the average wealth and the fraction of constrained households under the distribution G.

Greater inequality amplifies the effects of a negative productivity shock by making the fraction of constrained households respond more to the shock. Under the counterfactual distribution, the fraction of constrained households rises to 49.90%. Aggregate consumption falls by 2.48%, and the capital price falls by 0.42% when TFP z_1 decreases by 5% from z_H to z_L. The drops in consumption and the price of capital are larger than under G because more households become constrained after the shock. This highlights that greater inequality can amplify the responses of aggregate variables to a shock, even when we control for the fraction of constrained households before the shock.

[15] Starting from the baseline distribution of $\tilde{w}_{i1}$ in the high-productivity state, I apply a mean-preserving global spread of the form $\tilde{w}_{i1}^{\text{raw}} = A\tilde{w}_{i1}^{\gamma}$, where A preserves mean wealth and $\gamma > 1$. I then make a zero-sum adjustment among households near the wealth threshold to restore the baseline constrained fraction and choose γ to match the period 1 wealth Gini under F.

In sum, the tractable model shows that greater wealth inequality amplifies the contractionary effects of a negative productivity shock on asset prices and aggregate consumption by increasing the fraction of constrained households directly hit by the shock. In Appendices D.1 and D.2, I show that greater inequality amplifies the effects of shocks on the borrowing constraint tightness θ and world interest rate R through a similar mechanism.

4 Quantitative Model

I now extend the three-period model to an infinite horizon environment with aggregate uncertainty. This allows me to analyze the dynamic behavior of aggregate output and debt prior to a sudden stop, particularly depending on the degree of wealth inequality that is endogenously generated in the model. There are three sources of aggregate uncertainty: aggregate TFP z, world interest rate R, and financial friction θ. In addition, I assume that individual households are heterogeneous *ex ante*. They are born with permanently different levels of productivity that follow an exogenous distribution. This allows me to generate wealth inequality dynamically because all households' choices of capital would converge to a single point had there been no such individual heterogeneity.[16] I abstract from idiosyncratic income shocks to distinguish the role of idiosyncratic risk from that of inequality. Lastly, I assume that labor and capital are used for production and introduce homogeneous capital producers to allow for capital accumulation.

4.1 Households

I consider a unit measure of heterogeneous households with permanently different levels of productivity ω, so that every aggregate defined as an integral over households coincides with the corresponding cross-sectional mean. A household maximizes its lifetime utility by choosing consumption c, capital k', bonds b', and labor supply n, and I assume the GHH utility function. The household's recursive problem is written as

$$V(S,k,b;\omega) = \max_{c,n,k',b'} u(c - v(n)) + \beta \mathbb{E} V(S',k',b';\omega), \tag{34}$$

$$\text{s.t. } c + qk' + \frac{\zeta}{2}(k'-k)^2 + \frac{b'}{R} = z\omega f(k,n) + q(1-\delta)k + b + \pi, \tag{35}$$

$$\frac{b'}{R} \geq -\theta q k', \tag{36}$$

where $S \equiv (z, R, \theta, \Gamma)$ denotes the aggregate state, with Γ representing the joint distribution of (k, b, ω) across households. The price of capital q is taken as given by each household, and ω is the individual's productivity, which follows an exogenous distribution with a unit

[16]Without individual heterogeneity, the capital distribution becomes degenerate as individual asset choices converge to a single point in the long-run. A similar argument was made by Caselli and Ventura (2000).

mean. I also assume that each household owns an equal share of the capital-producing firms and receives the lump-sum profit π rebated from the capital producers.

The household's first-order conditions are obtained as

$$
\begin{aligned}
b' &:: \quad u'(c - \nu(n)) = \beta R \mathbb{E} u'(c' - \nu(n')) + \mu, && (37)\\
k' &:: \quad (q + \zeta(k' - k))u'(c - \nu(n)) \\
&\qquad = \beta \mathbb{E} u'(c' - \nu(n'))(z'\omega f_k(k', n') + q'(1 - \delta) + \zeta(k'' - k')) + \theta q \mu, && (38)\\
n &:: \quad \nu'(n) = z\omega f_n(k, n), && (39)
\end{aligned}
$$

where μ is the Lagrangian multiplier for the borrowing constraint (36). The first-order conditions with respect to b' and k' imply that households equate the marginal costs of saving or investing to the expected marginal benefits plus the shadow value of savings or investment that relaxes the borrowing constraint. Note that there is no wealth effect on labor supply, as shown in the first-order condition with respect to n.

4.2 Capital Producers

I introduce a unit mass of homogeneous capital producers who supply new capital in this economy. The capital producers buy consumption goods from the households to use as production inputs. They maximize static profits defined as

$$\max_i \pi = qi - i - \frac{\phi}{2}\frac{i^2}{K}, \tag{40}$$

where K denotes the aggregate capital stock at the beginning of the period. Capital producers face a quadratic cost for current investment. The capital producers rebate the profits to the households. The first-order condition of the representative capital producer yields

$$q = 1 + \frac{\phi i}{K}, \tag{41}$$

since the capital producer takes the aggregate stock of capital as given. In equilibrium, the price of capital satisfies

$$q = 1 + \frac{\phi I}{K}, \tag{42}$$

since the capital producers are homogeneous.

4.3 Market Clearing

There are two markets in this economy. First, the domestic capital market is cleared each period. Hence, the asset market clearing condition satisfies

$$\underbrace{\int (1 - \delta)k_s \, ds}_{\equiv(1-\delta)K} + \underbrace{\int i_j \, dj}_{\equiv I} = \underbrace{\int k'_s \, ds}_{\equiv K'}, \tag{43}$$

where s denotes each entrepreneur-household and j denotes each capital producer. Combining this with individual households' budget constraints, I obtain the market clearing condition in the goods market as

$$C + I + \frac{\zeta}{2} \int (k_s' - k_s)^2 ds + \frac{\phi}{2} \frac{I^2}{K} + \frac{B'}{R} = z \int \omega_s f(k_s, n_s) ds + B, \tag{44}$$

which is the resource constraint of the economy. i_s denotes each individual household's investment and is therefore heterogeneous across households.

4.4 Exogenous Processes

I assume three exogenous processes for the exogenous components of the aggregate state. For the international interest rate R and aggregate productivity, I assume that the two variables follow AR(1) processes specified as

$$\log z_t = \rho_z \log z_{t-1} + \epsilon_z, \qquad \epsilon_z \sim N(0, \sigma_z^2), \tag{45}$$

$$\log \frac{R_t}{R} = \rho_R \log \frac{R_{t-1}}{R} + \epsilon_R, \qquad \epsilon_R \sim N(0, \sigma_R^2). \tag{46}$$

Finally, the tightness of the households' borrowing constraints is a binary random variable with two possible values $\{\theta_H, \theta_L\}$ and follows a stationary Markov process.

4.5 Competitive Equilibrium

The recursive competitive equilibrium of this economy is defined as follows. Let Γ be the joint distribution of (k, b, ω) and $K(\Gamma) \equiv \int k \, d\Gamma(k, b, \omega)$.

Definition 2. *Let $S \equiv (z, R, \theta, \Gamma)$ denote the aggregate state. Given the productivity distribution $F(\omega)$, a recursive competitive equilibrium is a set of policy functions $\{c(S,k,b;\omega), n(S,k,b;\omega), k'(S,k,b;\omega), b'(S,k,b;\omega)\}$, a value function $V(S,k,b;\omega)$, a price function $q(S)$, and a law of motion for Γ such that*

1. *Given S, ω, and $q(S)$, the policy functions $\{c, n, k', b'\}$ solve the household problem (34), and $V(S,k,b;\omega)$ is the associated value function.*

2. *Given S, $q(S)$ clears the domestic capital market and satisfies*

$$q(S) = 1 + \frac{\phi \left(\int k'(S,k,b;\omega) \, d\Gamma(k,b,\omega) - (1-\delta) K(\Gamma) \right)}{K(\Gamma)}. \tag{47}$$

3. *Γ' next period is consistent with the policy functions and transition of aggregate shocks.*

In the numerical solution, I follow Krusell and Smith (1998) and approximate the information contained in Γ by aggregate capital K, together with a perceived law of motion for K'. Appendix E.1 describes this approximation.

5 Quantitative Analysis

5.1 Calibration

TABLE 5: Calibration of Parameters

Parameter	Value	Source
σ	2	Standard
β	0.91	Standard
δ	0.08	Standard
ψ	2	Standard
α	0.34	Labor income share of 66%
ϕ	2.42	Penn World Tables 11.0
ρ_z	0.84	Penn World Tables 11.0
σ_z	0.029	Penn World Tables 11.0
R	1.011	Bianchi and Mendoza (2018)
ρ_R	0.68	Bianchi and Mendoza (2018)
σ_R	0.0186	Bianchi and Mendoza (2018)
ζ	0.8363	Estimated
θ_H	0.291	Estimated
θ_L	0.095	Estimated
p_{HH}	0.899	Estimated
σ_ω	0.8636	Estimated

I assume that households' preferences follow the GHH utility function specified as

$$u(c - v(n)) = \frac{\left(c - \frac{n^{1+\frac{1}{\psi}}}{1+\frac{1}{\psi}}\right)^{1-\sigma}}{1-\sigma}, \tag{48}$$

where ψ is the Frisch elasticity of labor supply. The relative risk aversion coefficient is set to $\sigma = 2$ as in many small open economy models, and the Frisch elasticity is set to $\psi = 2$, which is close to the range of macro-elasticities measured by Rogerson and Wallenius (2009). Households' time discount factor is set to 0.91, and the annual capital depreciation rate is $\delta = 0.08$ as each period corresponds to a year. The Cobb-Douglas parameter for capital input is set to $\alpha = 0.34$, which implies a labor income share of 66%. The capital production cost parameter ϕ is set to 2.42, which I estimate by regressing the price of capital on the investment-capital ratio using data from the Penn World Tables.[17] The TFP process is estimated using the annual TFP of countries from the Penn World Tables. I estimate the AR(1) process of the linear-detrended components of the 54 countries in my sample while controlling for country fixed effects. This gives me estimates of $\rho_z = 0.84$ and $\sigma_z = 0.029$.

[17] I define the price of capital as the relative price of new capital to the price of investment goods, following the definition of Tobin's q. I regress this relative price on the investment-capital ratio with country and year fixed effects and obtain an estimate of 2.42.

TABLE 6: Moments from the Model and Data

Moment	Model	Data	Source
Average debt/GDP	27.62%	27.67%	Lane and Milesi-Ferretti (2018)
Sudden stop occurrence rate	3.65%	3.57%	Regression sample in Table 1
Average wealth Gini	0.67	0.77	World Inequality Database
$\sigma_C / \sigma_{\text{GDP}}$	1.073	1.13	IMF International Financial Statistics
$\sigma_I / \sigma_{\text{GDP}}$	1.589	3.95	IMF International Financial Statistics
$\sigma_{\text{CA/GDP}}$	5.22%	3.85%	IMF International Financial Statistics

I impose the same exogenous process for the world interest rate R in Bianchi and Mendoza (2018), which is estimated using the annualized return of 90-day U.S. T-bills.

I assume that the exogenous process of θ follows a two-state stationary Markov chain. Hence, $\theta \in \{\theta_H, \theta_L\}$ and its transition probability matrix is

$$\Pi_{\theta'|\theta} = \begin{pmatrix} p_{HH} & 1 - p_{HH} \\ 0.999 & 0.001 \end{pmatrix}, \tag{49}$$

where I set the probability of θ staying at θ_L as 0.1% to ensure that a sudden stop lasts for a maximum of one year in the data. I estimate the individual capital adjustment cost parameter ζ, the parameters $\{\theta_H, \theta_L, p_{HH}\}$ in the exogenous process of θ, and the standard deviation of the LogNormal distribution of ω, denoted as σ_ω, to jointly match six moments in the data using the method of simulated moments.[18] All parameters used in the model are listed in Table 5, and the target moments with their sources are summarized in Table 6.

I solve the model using the method of Krusell and Smith (1998) to update the law of motion of aggregate capital K. I generate 5,000 households and simulate the economy for 20,000 periods to solve the model. The evolution of aggregate capital follows

$$\log K' = 0.041 + 0.939 \log K + 0.114 \log z - 0.092 \log R - 0.052\, \mathbb{I}(\theta = \theta_L), \tag{50}$$

with R^2 of 0.979. The estimated law of motion implies that investment increases with aggregate TFP and decreases with borrowing costs. The details of the computation algorithm are in Appendix E.1.

I further compare the wealth distribution obtained from the dynamic model to the HFCS data. In the model, I define each household's net wealth as the market value of the capital and bonds it holds at the end of each period. After classifying all households into decile groups based on net wealth, I calculate the average wealth share of each group in the total net wealth of the economy throughout the simulation. In the data, net wealth is defined as a household's gross assets net of gross liabilities. I also calculate the average wealth shares of net wealth decile groups in each country in 2011 and compare them to the distribution

[18] When estimating σ_ω, I fix the mean of individual productivity at 1.

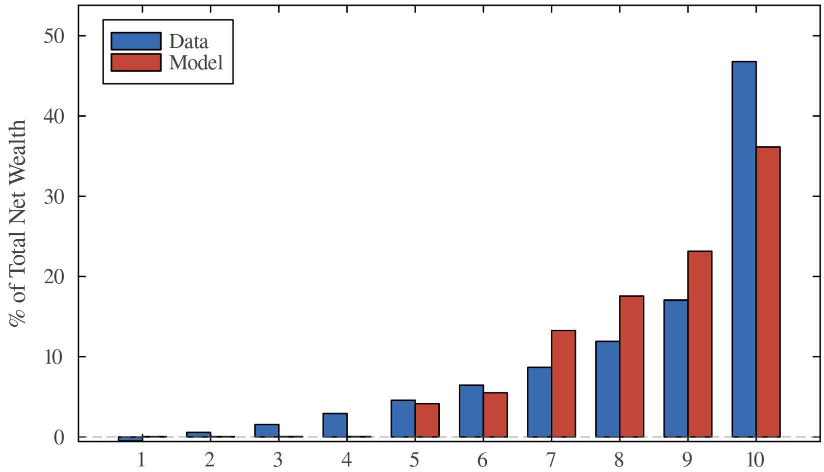

FIGURE 6. Net Wealth Share by Deciles (Untargeted)

generated by the model. As shown in Figure 6, the model generates a distribution that reasonably resembles the data. The model produces a lower concentration of wealth at the top than the data, but the discrepancy is small. Figure 7 compares the leverage ratio of households in the model and the data. The model shows that households with the lowest levels of TFP borrow up to the limit because their income and assets are too low to finance consumption and investment. The leverage ratio decreases for households in the middle deciles 5 and 6 but then increases in net wealth as these households are productive enough to borrow to finance investment.

5.2 Sudden Stop Dynamics and Wealth Inequality

I now conduct an event-study analysis of sudden stop episodes to study the aggregate dynamics around the crises by simulating the economy for 80,000 periods with 5,000 households. I calculate the current account as $(B_{t+1} - B_t)$ and define a sudden stop as an episode in which the increase in the current account-to-GDP ratio is more than two standard deviations above its simulated mean.

Figure 8 illustrates the dynamics of aggregate TFP, the world interest rate, the current account, and aggregate debt. In a sudden stop in the model, TFP remains low for consecutive periods in panel (A), leading to low capital accumulation before the sudden stop. External borrowing conditions become tighter as the world interest rate rises in panel (B). The borrowing constraint also tightens as θ decreases in a typical sudden stop episode. The current account shows a steep reversal during a sudden stop episode, moving from a persistently negative level before the crisis. Panel (D) of Figure 8 shows that the economy has been accumulating a positive level of debt until the crisis under lower interest rates.

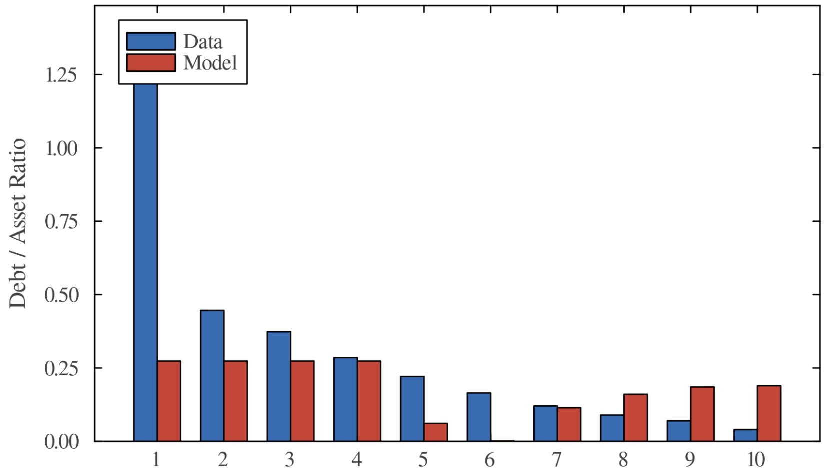

FIGURE 7. Leverage Ratio by Deciles (Untargeted)

Notes: The leverage ratio is the ratio of total debt to total assets within each net wealth decile. In the data it is the ratio of total debt (DL1000) to total assets (DA3001), averaged across the 15 European countries in 2011, with deciles taken from the ECB HFCS series DNTOP10. In the model it is the ratio of debt to the market value of assets within each net wealth decile, averaged over the simulation of 80,000 periods.

Macroeconomic variables follow crisis dynamics similar to those studied by Mendoza (2010) and Bianchi and Mendoza (2018), as shown in Figure 9. Aggregate consumption, investment, and asset prices all fall sharply in a sudden stop. Consumption falls by more than 15%, and investment declines by more than 50% of the long-run mean. The model generates larger current account reversals in sudden stops, implying deeper contractions in consumption and investment than the data indicate. Relative to the size of the current account reversal, the contractions are comparable to the data.[19] The drop in investment is consistent with a 10% decline in the price of capital. Output, however, does not fall as much on impact because aggregate capital was chosen in the previous period. The fall in TFP and labor supply has a limited contemporaneous effect on output, while the contraction in domestic absorption is accompanied by substantial deleveraging, as shown by the debt-to-GDP ratio. As current investment falls, output declines one period after the sudden stop and then gradually recovers.

Incorporating household heterogeneity allows the model to reproduce the countercyclicality of the ratio of external debt to GDP observed in the data, which the representative agent model fails to match. After removing country-specific linear trends, the correlation between net foreign debt relative to GDP and output is -0.141. The correlation is -0.281 in the baseline model with heterogeneous households, whereas the same model with homogeneous households generates the opposite sign of 0.125. The difference reflects how

[19]During sudden stops, consumption falls by 0.493% in the model and 0.349% in the data per percentage-point increase in the current account balance. The corresponding investment declines are 2.246% and 1.586%, respectively. Both consumption and investment are measured by their cyclical components.

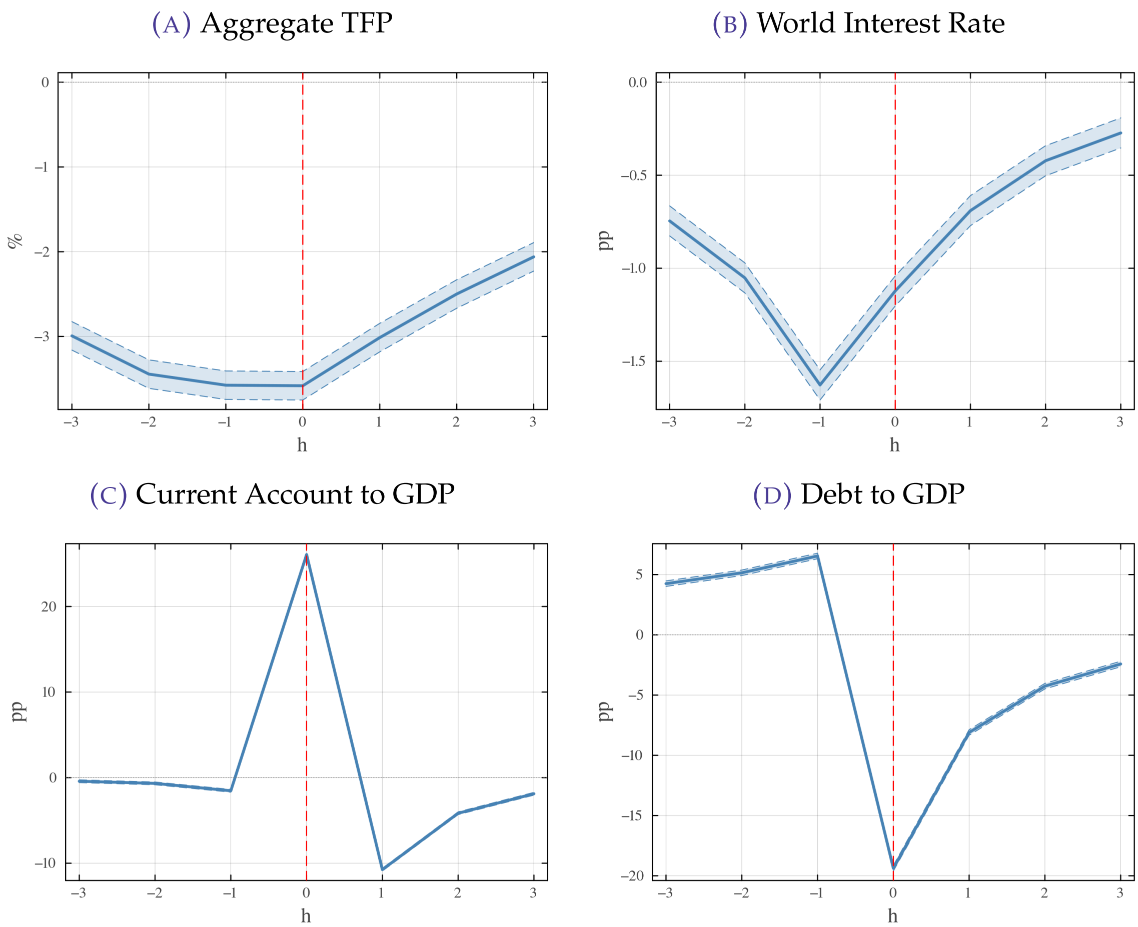

FIGURE 8. Current Account and Aggregate Shocks during Sudden Stops

Notes: The debt-to-GDP ratio in panel (D) is calculated as the end-of-period value $-B_{t+1}/GDP_t$. Current account to GDP ratio, debt to GDP, and the world interest rate are plotted as percentage-point deviations from the unconditional mean. Aggregate TFP is plotted as the percentage deviation from the unconditional mean. Dotted lines are 90% confidence intervals.

investment is financed in the two models. In the representative agent economy, a higher TFP raises both current income and the expected return to capital due to persistence. The household responds by increasing investment while smoothing consumption and financing the part of the investment boom that exceeds current resources through foreign borrowing. Higher investment relative to the capital stock at the beginning of the period raises the price and collateral value of capital. Hence, both capital and leverage rise during an expansion, allowing external debt to grow faster than current output.[20] Household heterogeneity weakens this link. The productive, capital-rich households that hold the majority of external debt can finance investment from their higher current income and accumulated net worth in times of expansion. Less productive, capital-poor households have weaker incentives to

[20]The cyclicality of the external debt to GDP ratio in a representative agent model depends on allowing for capital accumulation. I obtain a countercyclical external debt to GDP with a correlation coefficient of -0.121 with GDP in a model with homogeneous households and a fixed supply of capital without capital producers, while keeping all other model ingredients the same as in the baseline model.

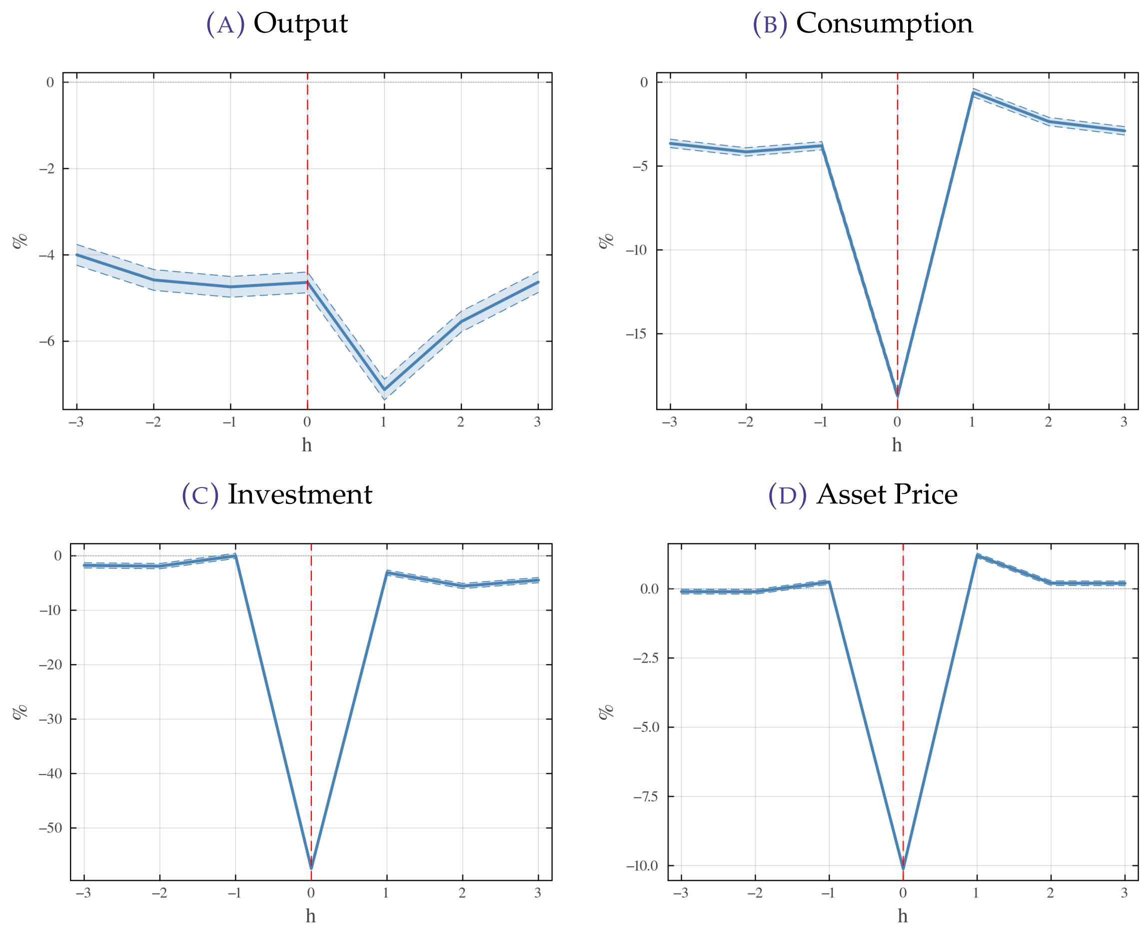

FIGURE 9. Macroeconomic Dynamics during Sudden Stops

Notes: All variables are plotted as the percentage deviations from the unconditional mean. Dotted lines are 90% confidence intervals.

expand capital holdings and are credit-constrained, so they account for little of the change in aggregate debt. Hence, aggregate external debt adjusts more slowly than output, causing the debt-to-GDP ratio to be countercyclical, as it does in the data.

I now study how inequality changes sudden stop dynamics. I construct nine economies that differ in permanent productivity dispersion σ_ω and simulate each economy for 80,000 periods under the same aggregate shocks. To be specific, I analyze the differential effects of a 0.01 increase in wealth Gini relative to the median of each economy in the simulated panel data and the actual data of each country. Table 7 summarizes the estimation results of the two sets of regressions. The coefficients of the interaction term are negative for all three dependent variables in both panels. Comparing the coefficients of the interaction terms, the model generates similar amplification effects of wealth inequality on the contractions of all three real quantities in a sudden stop. Greater inequality amplifies the output loss due to a negative TFP shock in sudden stops because it implies that capital is concentrated among productive households, which causes labor input to decline more in response to a produc-

TABLE 7: Regressions with Simulated and Actual Data

	Simulated Panel			Data		
	GDP	Consumption	Investment	GDP	Consumption	Investment
Net Flow$_t^{SS}$	-0.106***	-0.638***	-2.308***	-0.084	-0.256***	-0.796**
	(0.001)	(0.010)	(0.010)	(0.095)	(0.064)	(0.354)
Net Flow$_t^{SS}$ $\times$ Inequality$_{t-1}$	-0.074***	-0.105***	-0.449***	-0.086*	-0.070**	-0.365**
	(0.006)	(0.010)	(0.037)	(0.051)	(0.026)	(0.155)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.492	0.583	0.408	0.518	0.426	0.339

Notes: The dependent variables in the simulated data are percentage deviations from each economy's ergodic mean. I control for the capital stock at the beginning of period and the lagged value of debt-to-gdp ratio in the regressions with simulated data. For the regressions with real data, I use the same dependent variables and the same set of control variables used in regressions (2) and (3). I control for economy fixed effect for the simulated data and country and year fixed effects for the real data. Inequality$_{t-1}$ is deviation of the lagged wealth Gini from the median of each economy and country, divided by 0.01. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

tivity shock of the same size. Wealth inequality amplifies contractions in consumption and investment demand as more households become constrained in sudden stops, similar to the tractable model. Investment and the capital price are linked through the capital producer's optimal condition, so a larger contraction in investment relative to the capital stock at the beginning of the period is associated with a larger decline in the capital price.

Wealth inequality increases the probability of a sudden stop in the simulated data. When I compare the probability across the nine economies, it rises from 3.54% in the least unequal economy to 3.91% in the most unequal economy, as shown in Table 8. External debt carried into a sudden stop rises from 39.28% to 41.83% of GDP. A larger productivity dispersion increases the mass of households at both ends of the productivity distribution. Those households exhibit a high leverage ratio because the bottom households behave like hand-to-mouth households while the productive households at the top raise debt to finance investment, as shown in Figure 7. Larger debt accumulation before a sudden stop makes an economy more vulnerable, resulting in a higher probability of a crisis and amplified deleveraging when a crisis occurs. The average reversal in the current account increases with the level of wealth inequality, implying larger capital outflows in a typical sudden stop. Aggregate demand for consumption and investment also drops more on average when inequality is greater. However, the contraction in output does not exhibit a monotonic relationship with wealth inequality because a larger productivity dispersion implies that there is a greater mass of productive households. The composition effect on the distribution of individual productivity may dampen the effect on GDP. In summary, greater wealth inequality leads to more debt accumulation before a sudden stop and a higher likelihood of a crisis, which is similar to what Kumhof et al. (2015) find in the U.S. data before the global financial crisis.

TABLE 8: Sudden Stops across Economies with Different Inequality Levels

	Extensive Margin		Intensive Margin				
Wealth Gini	Pr(SS) (%)	Debt/GDP (%)	ΔCA/GDP (pp)	ΔGDP (%)	ΔC (%)	ΔI (%)	Δq (%)
0.586	3.54	39.28	26.73	-4.74	-16.95	-54.16	-9.70
0.606	3.69	39.83	27.17	-4.57	-17.58	-54.90	-9.78
0.621	3.79	40.27	27.42	-4.42	-18.07	-55.45	-9.82
0.631	3.82	40.63	27.68	-4.42	-18.52	-56.05	-9.85
0.639	3.86	40.94	27.89	-4.32	-18.83	-56.64	-9.92
0.647	3.84	41.23	28.08	-4.41	-19.22	-57.46	-10.01
0.652	3.86	41.51	28.25	-4.39	-19.50	-57.96	-10.07
0.656	3.88	41.71	28.39	-4.34	-19.66	-58.29	-10.09
0.659	3.91	41.83	28.48	-4.30	-19.79	-58.58	-10.12

Notes: Probability of sudden stops are calculated as the fraction of sudden stop episodes during 80,000 periods in each economy. The debt-to-gdp ratio is measured at the beginning of a sudden stop episode. The intensive margin effects on GDP, consumption, investment, and asset price are average percentage deviations from the ergodic mean of each economy.

5.3 Distributional Effects of Sudden Stop

Sudden stops change households' asset and consumption choices unevenly across the wealth distribution. To measure the heterogeneity in the data, I sort households into four groups by net wealth: the bottom 50%, the 51–80%, the 81–95%, and the top 5%, and estimate the change in each asset category between 2011 and 2014 with

$$y_{i,c,t} = \sum_{q=1}^{4} \left(\beta^q + \gamma^q SS_c + \delta^q t + \kappa^q SS_c t\right) D^q_{i,c,t} + \Gamma X_{i,t} + \varepsilon_{i,c,t}, \tag{51}$$

where $D^q_{i,c,t}$ is the dummy variable for household i in net wealth group q in country c at year t, and SS_c is the dummy variable for the four countries that experienced sudden stops.[21] $X_{i,t}$ is a vector of control variables at the household-year level.[22] The coefficient of interest, κ^q, is the change between 2011 and 2014 for wealth group q in the sudden stop countries relative to the corresponding change in the control countries.

I define a household's net asset as its end-of-period net wealth $qk' + b'/R$ and sort households into the same four groups separately in each period. For net wealth, I compute the log change in each contemporaneous group's mean. For consumption, I average household-level percentage changes within groups defined by contemporaneous net wealth. The model counterpart of κ^q is the average response during sudden stop periods minus its average dur-

[21] Household Finance and Consumption Network (2013, 2016) provides sampling weights for each household-year observation. I rescale the sampling weights to equalize the relative size of each country in the pooled sample and estimate a weighted least squares regression.

[22] I control for the education level of the primary earner, the household's total income from labor and self-employment, the size of the household, and the age of the primary earner, along with its squared value.

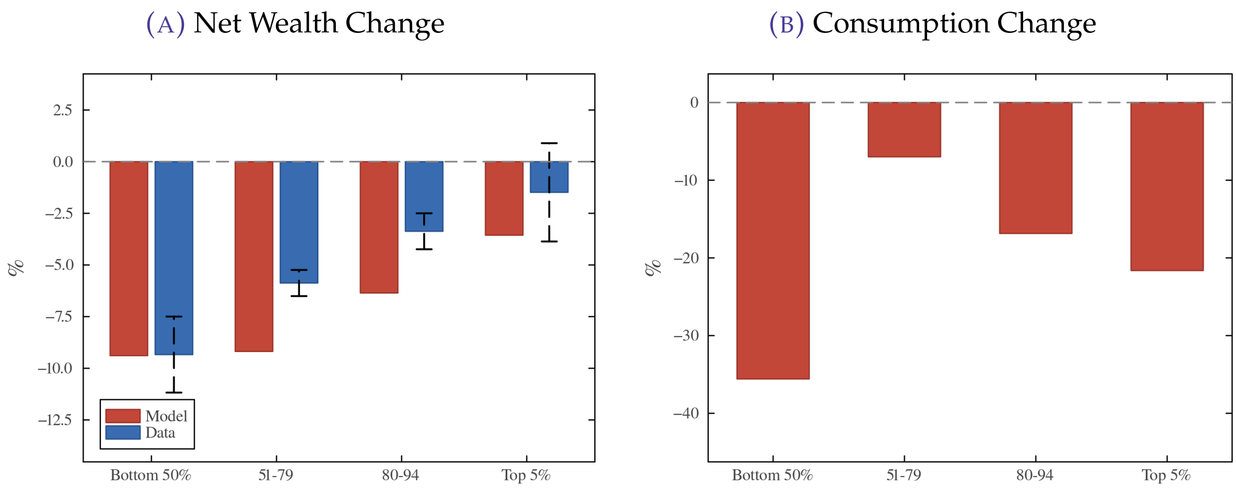

FIGURE 10. Distributional Effects of Sudden Stops

Notes: The data bars report the estimated coefficients $\widehat{\kappa}^q$ from equation (51). Error bars show plus or minus one heteroskedasticity-robust standard error from the multiply imputed, survey-weighted regression. Model bars report the corresponding sudden stop response relative to normal periods.

ing normal periods. These statistics summarize the distributional response of net wealth and consumption across the wealth distribution.

Panel (A) of Figure 10 shows that the relative change in net wealth is more negative for poorer households in the wealth distribution. In the data, the wealth change in sudden stops is statistically insignificant for the top 5%, while it becomes monotonically more negative for households with lower wealth. In the model, capital investment falls across the wealth distribution in a typical sudden stop because aggregate productivity decreases and the interest rate rises. The larger decline in households with low wealth is due to their smaller asset buffers when their income drops in a typical sudden stop. The smaller decline in net wealth of richer households is attributed to two complementary forces. These households hold debt before a sudden stop, so debt repayment offsets part of the decline in gross asset positions. Moreover, they do not cut investments in capital as much because they are permanently more productive than poorer households.

Panel (B) shows the corresponding consumption response across the wealth distribution. Households observed in the bottom 50% exhibit a large average consumption decline, as lower income and tighter borrowing limits restrict their ability to smooth consumption. Consumption also falls significantly in the top 5% because of debt repayment during the sudden stop. The consumption of households in the middle exhibits smaller declines because they are less indebted before a sudden stop. Their consumption response is driven mainly by lower income and asset values.

6 Normative Analysis

Individual households take the price of capital as given, but they do not internalize that their capital demand collectively determines that price in equilibrium and affects the collateral capacity of every household in the economy. The pecuniary externality creates an opportunity for the government to raise welfare by taxing the positions that households carry into the next period. I consider a utilitarian government that recognizes this effect and chooses taxes on capital holdings and debt issuance under commitment. The wealth tax τ_t^w is levied on the market value of the capital stock at the beginning of each period.[23] The debt tax τ_t^b is levied on debt issuance. All tax revenues are returned through the lump-sum transfer T_t.

The government's problem is

$$\max_{\substack{\{\tau_t^w,\tau_t^b,T_t,q_t\}_{t\geq 0}\\ \{c_{j,t},n_{j,t},k_{j,t+1},b_{j,t+1}\}_{j,t\geq 0}}} \mathbb{E}_0 \sum_{t\geq 0} \beta^t \int u(\tilde{c}_{j,t})\, dj \tag{52}$$

$$\begin{aligned}
\text{s.t.}\quad & c_{j,t} + q_t k_{j,t+1} + \frac{\zeta}{2}(k_{j,t+1}-k_{j,t})^2 + (1-\tau_t^b)\frac{b_{j,t+1}}{R_t} \\
&\qquad = z_t\omega_j f(k_{j,t},n_{j,t}) + q_t(1-\tau_t^w)(1-\delta)k_{j,t} + b_{j,t} \\
&\qquad\quad + \frac{\phi}{2}\frac{\left(\int [k_{i,t+1}-(1-\delta)k_{i,t}]\, di\right)^2}{\int k_{i,t}\, di} + T_t, \qquad (53)\\
& g_{j,t} \equiv \frac{b_{j,t+1}}{R_t} + \theta_t q_t k_{j,t+1} \geq 0, \qquad (54)\\
& q_t = 1 + \phi\frac{\int [k_{j,t+1}-(1-\delta)k_{j,t}]\, dj}{\int k_{j,t}\, dj}, \qquad (55)\\
& T_t = \tau_t^w q_t(1-\delta)\int k_{j,t}\, dj - \tau_t^b \int \frac{b_{j,t+1}}{R_t}\, dj, \qquad (56)\\
& z_t\omega_j f_n(k_{j,t},n_{j,t}) = v'(n_{j,t}), \qquad (57)\\
& \left[q_t(1-\theta_t(1-\tau_t^b)) + \zeta(k_{j,t+1}-k_{j,t})\right] u'(\tilde{c}_{j,t}) + \theta_t q_t \Omega_{j,t} - \Psi_{j,t} = 0, \qquad (58)\\
& M_{j,t} \equiv (1-\tau_t^b)u'(\tilde{c}_{j,t}) - \Omega_{j,t} \geq 0, \qquad M_{j,t}g_{j,t} = 0. \qquad (59)
\end{aligned}$$

Here $\tilde{c}_{j,t} \equiv c_{j,t} - v(n_{j,t})$ and

$$\Omega_{j,t} \equiv \beta R_t \mathbb{E}_t u'(\tilde{c}_{j,t+1}), \tag{60}$$

$$\Psi_{j,t} \equiv \beta \mathbb{E}_t \left[u'(\tilde{c}_{j,t+1}) X_{j,t+1}^{\zeta}\right], \tag{61}$$

$$X_{j,t}^{\zeta} \equiv z_t\omega_j f_k(k_{j,t},n_{j,t}) + q_t(1-\tau_t^w)(1-\delta) + \zeta(k_{j,t+1}-k_{j,t}). \tag{62}$$

Constraints (58) and (59) require the government to respect the investment and saving decisions induced by its policy. The debt tax changes the current financing cost, while the future wealth tax changes the return to capital in $\Psi_{j,t}$. The multipliers $\beta^t\gamma_{j,t}$ and $\beta^t\eta_{j,t}$ on these

[23] Without commitment, the government would impose a confiscatory wealth tax.

two conditions measure the cost of changing household investment and saving decisions. Policy commitments made before the initial date remain binding, so the government cannot unexpectedly tax the return on capital chosen in the previous period. Accordingly, I solve for the optimal taxes from a timeless perspective. The initial multipliers $\gamma_{j,-1}$ and $\eta_{j,-1}$ are set to the values implied by the converged state-contingent ergodic solution rather than to zero. The Lagrangian and the full set of first-order conditions are reported in Appendix C.5.

Although the government does not set the capital price q_t directly, it internalizes that taxes affect q_t. The effect of taxation on q_t enters the government's optimal condition for capital as

$$\mathcal{E}_t^q = q_{K',t}(\mathcal{D}_t + \mathcal{K}_t), \tag{63}$$

where $\mathcal{D}_t$ and $\mathcal{K}_t$ denote distributive and collateral externalities associated with the price changes. The collateral externality $\mathcal{K}_t$ implies that a higher price relaxes borrowing limits by raising the value of pledgeable capital. The distributive externality $\mathcal{D}_t$ arises because a higher price benefits households selling capital at the expense of those purchasing it when there are heterogeneous households, as studied by Dávila and Korinek (2018). The government takes both effects into account when choosing the allocation to be implemented by the two taxes. The signs of the two externalities are theoretically ambiguous as in Dávila and Korinek (2018).

The two tax instruments operate on different household decisions. Let $\lambda_{j,t}$ denote the social marginal value of wealth that the government assigns to an additional unit of household j's wealth. The government's optimal condition for the wealth tax is

$$\underbrace{-\mathbb{C}ov_j(\lambda_t, k_t)}_{\text{redistributive motive}} + \underbrace{\int \gamma_{j,t-1} u'(\tilde{c}_{j,t})\, dj}_{\text{return on capital chosen in } t-1} = 0. \tag{64}$$

The first term signifies the redistribution motive. Capital is concentrated among wealthy households whose marginal value of wealth is relatively low, and taxation on wealth transfers resources toward households for whom additional consumption is more valuable. This motive gives the government a reason to impose a positive wealth tax. The second term acts in the opposite direction, as a higher wealth tax discourages investment by lowering the return on investment. The optimal wealth tax balances two motives.

The government's first-order condition with respect to the debt tax is

$$\underbrace{\frac{1}{R_t}\mathbb{C}ov_j(\lambda_t, b_{t+1})}_{\text{redistributive motive}} + \underbrace{\theta_t q_t \int \gamma_{j,t} u'(\tilde{c}_{j,t})\, dj}_{\text{higher investment costs}} - \underbrace{\int \eta_{j,t} u'(\tilde{c}_{j,t})\, dj}_{\text{higher saving returns}} = 0. \tag{65}$$

A positive debt tax reduces the proceeds received by debt issuers and returns the revenue through the government budget. This creates a redistribution motive for taxing debt when aggregate debt is concentrated among capital-rich households, as shown in the first term of (65). At the same time, a higher debt tax makes capital purchases today more expensive for those whose borrowing is constrained and increases the return on saving in bonds. The optimal debt tax balances the redistributive motive with its effects on the returns on investment and savings.

Since the signs of the optimal taxes are theoretically ambiguous, I numerically solve for the optimal taxes under commitment and examine how the taxes shape macroeconomic dynamics during sudden stop episodes. I follow the approach of Le Grand and Ragot (2025) to solve for the government's optimal taxes with commitment.[24] I approximate the policy functions to the first order around the ergodic state associated with each value of θ, as described in Appendix E.2.

I compare three allocations to separate the roles of the two tax instruments. The first allocation is the laissez faire allocation without any tax. The second allocation is under the government's optimal taxation on both wealth and external debt, which I refer to as joint taxation henceforth. The third allocation is under the government's optimal debt tax with commitment but without the wealth tax, which is a common policy instrument studied in the literature on sudden stops. I refer to this allocation as capital control. I simulate all three allocations under the same sequence of aggregate shocks. I identify sudden stop dates from the laissez faire allocation using the definition in Section 5 and compare macroeconomic dynamics in the three economies around the sudden stops.[25]

Optimal tax rates on wealth and external debt around sudden stop episodes are illustrated in Figure 11. The government's optimal wealth tax rate is 16.6% one period before a sudden stop. It falls to 11.5% in the sudden stop and rises to 20% in the following period. The positive wealth tax reflects the redistributive motive in equation (64), which transfers resources from capital-rich households to poorer households that have a higher social marginal value of wealth. However, TFP and the borrowing limit are low, and interest rates are high in a typical sudden stop. If the government commits to high wealth tax rates in such a state, households would significantly reduce the amount of capital stocks carried into the sudden stop episodes. Hence, the government commits to a lower wealth tax during sudden stops and raises it after TFP and the borrowing limit recover.

The optimal debt tax moves in the opposite direction. It rises from 5.1% before the sudden stop to 42.1% in the sudden stops, and then falls to 3.4% in the following period. Similarly, the debt tax rises during the sudden stop under optimal capital control without wealth taxes, from 6.5% to 26.3%, before falling to 0.5% in the following period. This increase contrasts with the decline in the macroprudential debt tax during crises studied by previous works such as Bianchi and Mendoza (2018). With heterogeneous agents, borrowing is con-

[24] I impose a simplifying assumption that the government takes the first moments of aggregate capital and bonds as state variables rather than the entire distribution.

[25] I solve the three economies following the same algorithm to make the dynamics comparable, which makes the sudden stop dynamics in the laissez faire equilibrium numerically different from those solved with the Krusell-Smith method, but the dynamics are qualitatively the same.

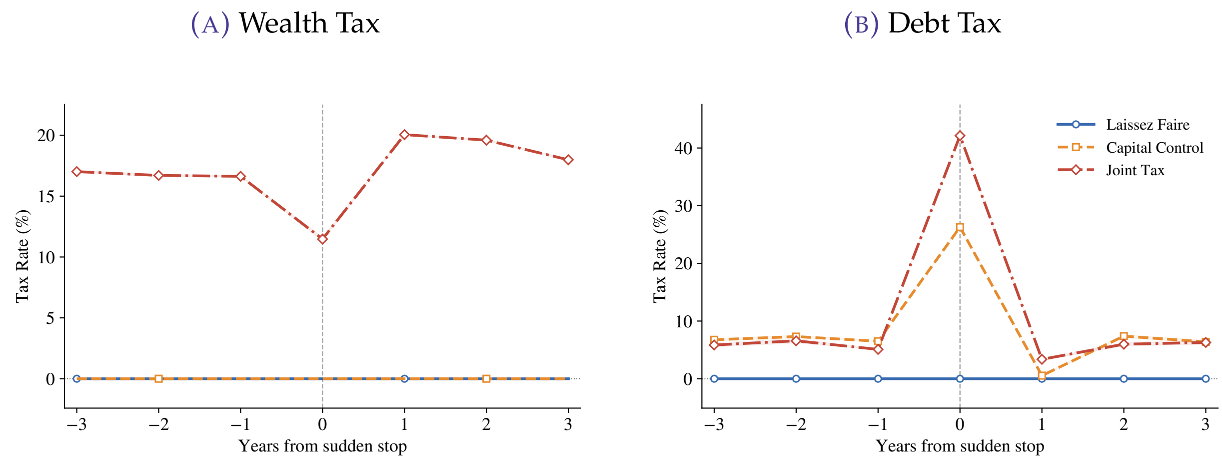

FIGURE 11. Optimal Tax Rates around Sudden Stops

Notes: The two panels plot the government's optimal tax rates around the same sudden stop dates generated from the laissez faire allocation. Capital Control denotes the allocation in which the wealth tax is fixed at zero, and Joint Tax denotes the allocation in which the government taxes both wealth and external debt.

centrated among capital-rich households, and the government optimally taxes borrowing to redistribute resources to poorer households with a high marginal value of wealth, to the level higher than in normal states. Without taxes, households at the bottom bear the largest proportional loss in consumption when sudden stops occur, so the redistributive motive for taxation becomes more prominent.[26] The government trades off the costs of lower borrowing and investment in sudden stops against the welfare gains from redistribution.

Note that the optimal tax on external debt is higher under joint taxation than under optimal capital control during sudden stops. As discussed above, the government commits to lower wealth taxes in these episodes to maintain the amount of capital stock carried into the crises. However, lower wealth taxes redistribute fewer resources in sudden stops, so the government relies more heavily on the debt tax to compensate for the reduction. Under optimal capital control, the debt tax also rises during sudden stops because of welfare gains from redistribution. However, the debt tax does not have to offset the lower redistribution by the wealth tax. Hence, the debt tax rises more in sudden stops under joint taxation than under optimal capital control, as shown in panel (B) of Figure 11.

In terms of lump-sum transfers rebated to households, joint taxation provides substantially larger transfers than capital control, both on average and during sudden stops, as shown in Figure 12. However, the two taxation schemes differ in how transfers respond

[26] I confirm that the optimal capital control tax decreases during sudden stops in the representative agent version of the economy, which is similar to the time-consistent optimal macroprudential tax studied by Bianchi and Mendoza (2018) and Biljanovska and Vardoulakis (2024). Basu, Boz, Gopinath, Roch, and Unsal (2025) also find that the optimal capital control tax is countercyclical in an economy with full FX mismatch and frictionless cross-border financial flows, which is similar to the representative agent version of the economy in this paper. With a redistributive motive, the government subsidizes borrowing to support investment and the price of capital in sudden stops.

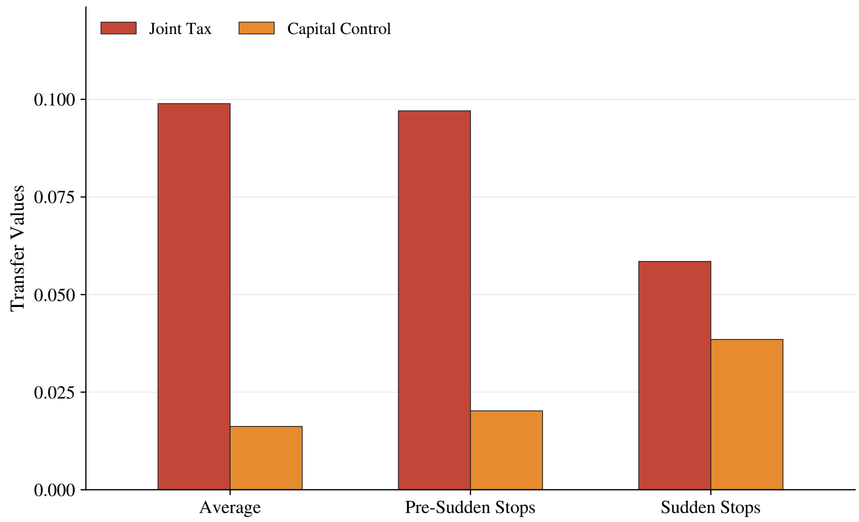

FIGURE 12. Lump-sum Transfers under Optimal Taxes

during these episodes. Average transfers fall by 39.7% during sudden stops under joint taxation but remain about 50% higher than under capital control. Transfers rise under optimal capital control by 90.4% during sudden stops as the government imposes higher tax rates for redistributive purposes. As a result, poorer households likewise receive smaller net transfers under joint taxation and larger net transfers under capital control than they did before the sudden stop. Net tax payments by wealthier households move in the opposite direction.

I then compare the macroeconomic dynamics around sudden stops. The degree of current account reversal dramatically decreases from 35.8 percentage points relative to GDP under laissez faire to 22.5 percentage points under joint taxation and 17.9 percentage points under capital control. The consumption decline follows the same order, falling from 24.2% relative to its mean under laissez faire to 18.2% under joint taxation and 13.5% under capital control. Both taxation schemes mitigate current account reversals and aggregate consumption drops around sudden stops due to lower deleveraging pressure, as less external debt is carried into the sudden stops under the two taxation schemes than under laissez faire. The taxes reduce incentives to borrow for both top and bottom households by making borrowing costly. Wealth tax further disincentivizes wealthy households by reducing the return on investment compared to laissez faire. Among the two taxation schemes, capital control provides better stabilization of the current account and consumption due to the temporary increase in transfers.

The two taxation schemes have different effects on the price of capital in sudden stops. Poor households' asset purchases rely more on transfers from the government than those of wealthy, capital-rich households. Under optimal capital control, it turns out that a temporary increase in transfers supports these households' investment demand while inducing wealthy households to reduce investment only slightly. Under joint taxation, on the

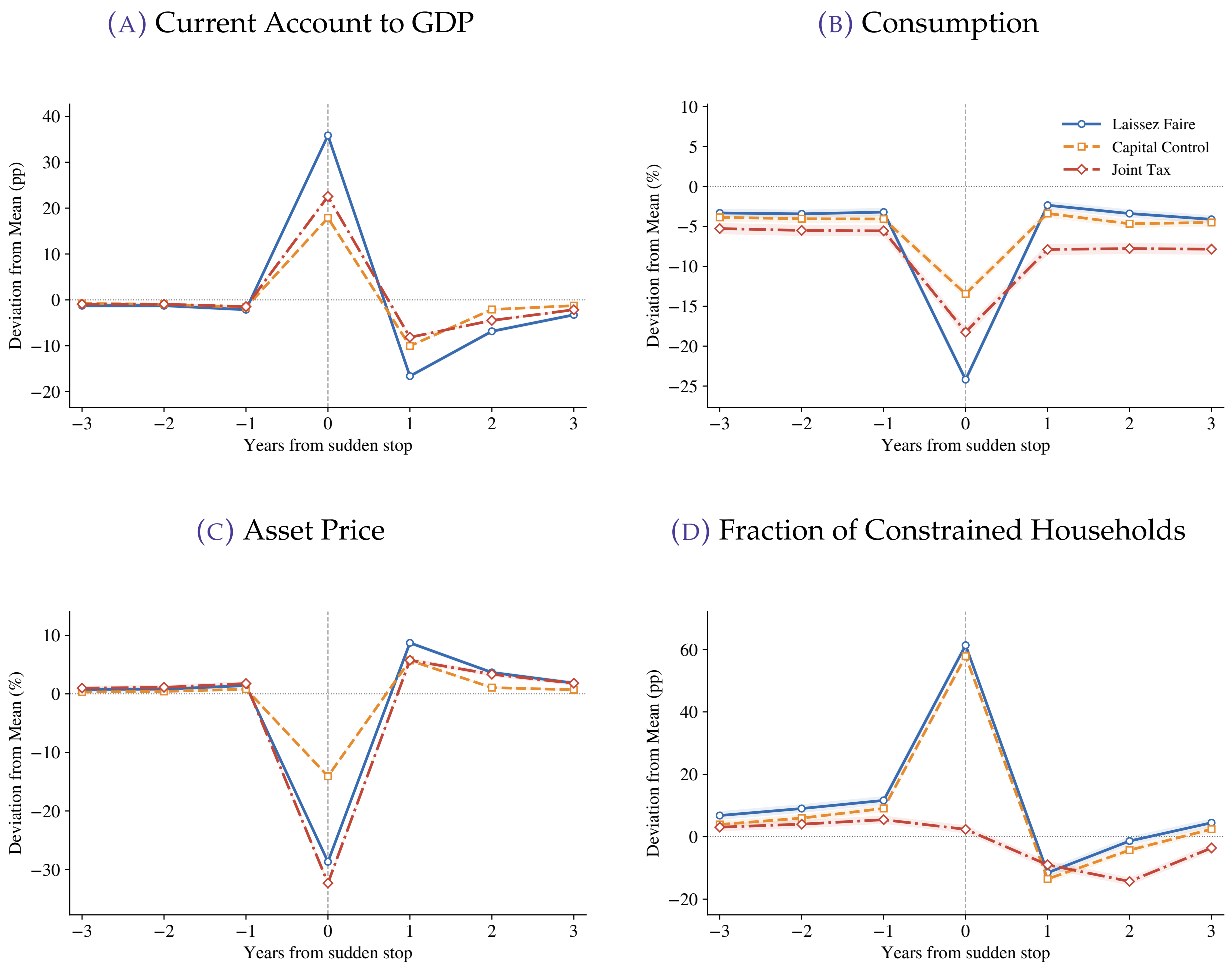

FIGURE 13. Macroeconomic Dynamics around Sudden Stops with Taxes

Notes: The plots illustrate percentage and percentage-point deviations from respective means of the three economies around the sudden stop dates identified from the laissez faire allocation. All three allocations are simulated under the same aggregate shocks.

other hand, temporarily lower transfers in sudden stops decrease investment demand, as poor households significantly reduce their investment while a lower tax burden on wealthy households minimally supports their investment. Hence, the capital price falls by 32.3% relative to its mean under joint taxation, compared with 28.7% under laissez faire and 14.1% under capital control.

Despite the larger price decline, the fraction of constrained households rises by only 2.4 percentage points relative to its mean under joint taxation, compared with 61.4 under laissez faire and 57.9 under capital control. A temporary loss of transfers does not necessarily lead households to exhaust their borrowing capacity. The substantial transfers that remain under joint taxation help households finance consumption without relying entirely on borrowing, despite the decline in collateral values. Under capital control, smaller transfers leave households more dependent on borrowing than under joint taxation, even though the government

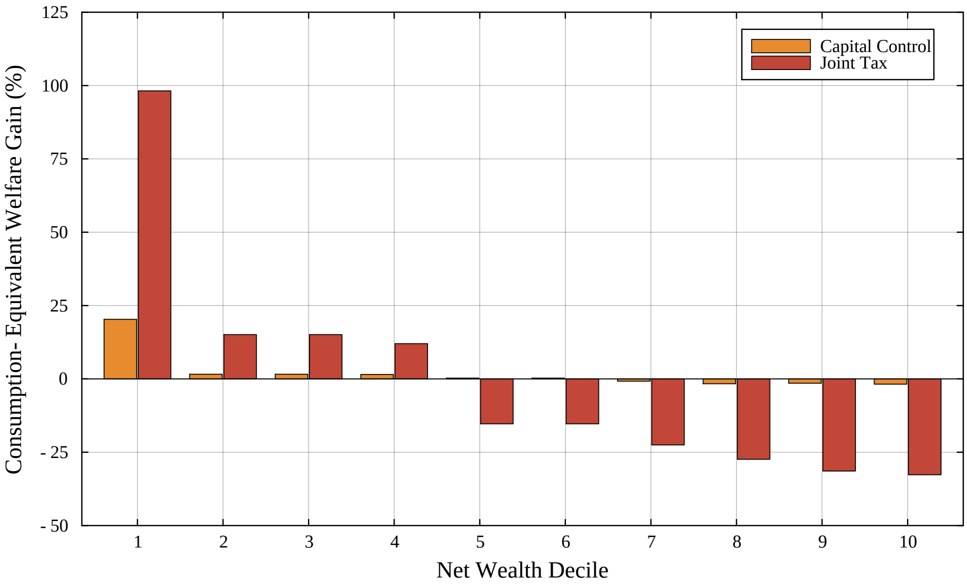

FIGURE 14. Welfare Gains from Capital Control and Joint Taxation by Net Wealth Decile

Notes: The figure reports consumption-equivalent welfare gains relative to the laissez faire allocation. Households are assigned to net wealth deciles using their rank in the laissez faire allocation.

increases the transfers. Hence, joint taxation directly insulates households from becoming constrained in sudden stops by providing them with sufficient resources to maintain consumption.

I conclude the normative analysis by evaluating welfare gains and losses under the two optimal policies across the wealth distribution. To be specific, I measure the consumption-equivalent social welfare gain under a taxation policy as the uniform permanent increase in all households' laissez faire consumption that makes social welfare under laissez faire equal to that under the policy. Relative to the laissez faire allocation, optimal joint taxation generates a welfare gain of 11.24% in consumption-equivalent terms. The optimal capital control raises social welfare by 5.75% in consumption-equivalent terms.[27] Moving from optimal capital control to jointly optimal taxation on wealth and debt raises social welfare by 5.49 percentage points in consumption-equivalent terms, even though capital control alone provides greater stabilization of consumption and the capital price.

Neither policy is a Pareto improvement, as shown in Figure 14. I first compare joint taxation with the laissez faire allocation. Households in the bottom four wealth deciles gain between 12.0% and 98.2%, whereas households in the upper six deciles lose between 15.3% and 32.7%. The distributional consequences are more muted under capital control. Relative to the laissez faire allocation, households in the bottom six deciles gain between 0.3% and 20.3%, while those in the upper four deciles lose between 0.8% and 1.8%. Joint taxation on

[27]The size of the welfare gains is comparable to those of the optimal wealth tax studied in the literature, including Guvenen, Kambourov, Kuruscu, Ocampo, and Chen (2023). Optimal capital control in the economy with homogeneous agents increases welfare by 2.85% in consumption-equivalent terms.

wealth and debt produces much larger gains at the bottom of the wealth distribution and larger losses at the top. Higher social welfare under joint taxation coincides with substantially stronger redistribution across wealth levels.

7 Concluding Remarks

This paper shows that wealth inequality amplifies sudden stops. Cross-country data show that capital outflows of the same size are associated with larger contractions in more unequal economies. European household data show that reductions in average debt and asset values during sudden stops were concentrated among indebted household groups, consistent with the balance-sheet adjustment underlying the model mechanism. In the tractable model, borrowing limits are tied to the market value of domestic capital, while household net wealth determines whether a household falls below the endogenous borrowing threshold. Greater inequality places more households below that threshold and amplifies declines in asset prices and aggregate consumption. The quantitative model reproduces this amplification and shows that optimal taxes on wealth and external debt improve social welfare by reducing external debt before sudden stops and redistributing resources toward lower-wealth households. Wealth inequality is central to the propagation of sudden stops.

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A Data Appendix

A.1 List of Sudden Stop Crises

I construct the episodes in Table A1 using the criteria described in Section 2 following Bianchi and Mendoza (2020). The underlying filters are implemented at a quarterly frequency. For Spain in 2012, the current account reversal episode began in 2012 Q3, one quarter after the surge in VIX in 2012 Q2. Therefore, I classify Spain's 2012 reversal as a sudden stop associated with the European sovereign debt crisis. Table A1 summarizes the years in which sudden stops occurred in 47 of the 54 countries in the sample. The broader current-account-reversal indicator used in regression A10 records the country-year observations satisfying the capital-flow filter, regardless of whether they also satisfy the systemic filter.

A.2 List of Countries in ECB HFCS and Data Adjustments

I analyze 15 countries in the first and second waves of the ECB HFCS. Table A2 summarizes the reference years for each country in the two waves of the survey and the adjustment factors provided by Household Finance and Consumption Network (2013, 2016) to make the raw data values comparable across countries and time.

Since price levels differ across countries, the HFCS provides adjustment factors to make the nominal values in the data comparable across countries. Using this information, I convert the raw data values of all countries to comparable 2014 euro values as

$$x_{i,1}^{\text{Comp. 2014 Eur.}} = x_{i,1} \times IAF_i \times PPP_{i,2}, \tag{A1}$$

$$x_{i,2}^{\text{Comp. 2014 Eur.}} = x_{i,2} \times PPP_{i,2}, \tag{A2}$$

where $x_{i,t}$ is the raw data value of an observation in country i in wave t, PPP_i is the purchasing power parity adjustment factor in Table A2, and IAF_i is the inflation adjustment factor of country i. I perform this adjustment for all countries except Spain. Spain is handled separately because the revised Wave 1 file provides a direct conversion factor of 0.945, while the Wave 2 conversion factor is 0.908. Accordingly, I multiply Spanish nominal values by 0.945 in Wave 1 and by 0.908 in Wave 2. I do not apply the generic inflation-adjustment formula to Spain.

TABLE A1: List of Sudden Stop Episodes

Country	Year			Country	Year		
Algeria	1991	1999		Malaysia	1994		
Argentina	1990	2002		Mexico	1983	1995	
Australia	2008			Morocco	1983	2003	
Bulgaria	1994	2009		Netherlands	2003	2009	
Brazil	1984	2003		Nigeria	1992	1995	2000
Canada	1982			Norway	1990	1999	2008
Chile	1982			Pakistan	2002	2009	
Colombia	1989	1999		Panama	1995	1998	
Croatia	1998			Peru	1985		
Denmark	1999	2010		Philippines	1984	1998	2009
Dominican Republic	1981	1994		Poland	1999		
Ecuador	1999			Portugal	1982	2012	
Egypt	1991			Russia	1999		
El Salvador	1999			South Africa	1983	1985	
Finland	2000			Spain	2009	2012	
France	1997			Sweden	2001		
Germany	2009			Switzerland	2010		
Greece	2012			Thailand	1998		
Hungary	1995	2009		Türkiye	1994	2001	
Iceland	2001	2009		Ukraine	1999		
Indonesia	1984	1998		United Kingdom	1991		
Italy	1983	2012		Uruguay	1982	2009	
Japan	2015			Venezuela	1983		
Korea	1998						

Notes: Sudden Stop episodes without the household wealth Gini coefficients are excluded from the sample.

TABLE A2: Reference Year by Countries in ECB HFCS

Country	Wave 1 Reference Year	Wave 1 PPP	Wave 2 Reference Year	Wave 2 PPP	Inflation Adjustment Factor between Waves 1 and 2
Belgium	2010	0.850	2014	0.802	1.079
Germany	2010	0.907	2014	0.859	1.072
Greece	2009	1.041	2014	1.021	1.066
Spain	2011	0.945	2014	0.908	1.049
France	2009	0.842	2014	0.810	1.081
Italy	2010	0.914	2014	0.848	1.079
Cyprus	2010	1.072	2014	0.968	1.068
Luxembourg	2010	0.796	2014	0.724	1.093
Malta	2010	1.305	2013	1.078	1.069
Netherlands	2009	0.875	2013	0.794	1.091
Austria	2010	0.862	2014	0.824	1.101
Portugal	2010	1.150	2013	1.066	1.079
Slovenia	2010	1.145	2014	1.068	1.074
Slovakia	2010	1.413	2014	1.286	1.094
Finland	2009	0.801	2013	0.713	1.108

Notes: I discarded Estonia, Hungary, Ireland, Latvia, and Poland from the sample because they did not conduct the first wave of the survey. PPP denotes the purchasing power parity adjustment factor provided by Household Finance and Consumption Network (2013, 2016) and is calculated based on the Harmonized Index of Consumer Prices (HICP). For Spain, the factors 0.945 and 0.908 are applied directly to Waves 1 and 2, respectively. The inflation adjustment factor reported in the final column is not separately applied to the Spanish observations.

TABLE A3: Population Share by Net Wealth Decile and Housing Tenure (%)

Group	Net wealth decile 1	2	3	4	5	6	7	8	9	10	Total
2011											
Renter / non-owner	8.89	7.63	4.72	2.69	1.52	0.75	0.34	0.17	0.13	0.12	27.0
Outright owner	0.18	1.48	3.20	4.33	5.27	5.97	6.44	6.49	6.73	6.60	46.7
Mortgagor	1.05	0.89	2.04	2.98	3.23	3.29	3.20	3.35	3.14	3.24	26.4
2014											
Renter / non-owner	8.57	8.52	4.94	2.76	1.60	0.72	0.30	0.22	0.12	0.12	27.9
Outright owner	0.16	0.64	2.85	4.15	5.34	6.06	6.62	6.92	6.88	6.69	46.3
Mortgagor	1.38	0.78	2.21	3.10	3.06	3.22	3.08	2.87	3.02	3.17	25.9

Notes: Each cell is the average share of households falling in a given net-wealth-decile × tenure cell. Net wealth deciles are from the ECB HFCS series DNTOP10. A household is a renter/non-owner if it holds no real estate (DA1110= 0 and DA1120= 0), an outright owner if it holds real estate with no mortgage (DL1100= 0), and a mortgagor if it holds real estate financed with a mortgage (DL1100> 0). Shares are computed within each country-year, weighted by the household weight HW0010, and then averaged across the 15 countries separately for each wave. Columns are net wealth deciles.

TABLE A4: Gross Asset Share by Net Wealth Decile and Housing Tenure (%)

Group	Net wealth decile 1	2	3	4	5	6	7	8	9	10	Total
2011											
Renter / non-owner	0.12	0.27	0.36	0.35	0.37	0.31	0.23	0.18	0.21	0.50	2.9
Outright owner	0.03	0.25	0.82	1.59	2.56	3.82	5.25	7.13	10.42	27.12	59.0
Mortgagor	0.73	0.42	0.99	1.74	2.31	2.80	3.33	4.33	5.69	15.85	38.2
2014											
Renter / non-owner	0.09	0.24	0.36	0.38	0.40	0.32	0.20	0.22	0.17	0.69	3.1
Outright owner	0.03	0.08	0.64	1.40	2.46	3.69	5.27	7.26	10.35	27.19	58.4
Mortgagor	1.00	0.42	1.18	1.92	2.28	2.87	3.33	3.87	5.52	16.22	38.6

Notes: Each cell is the average share of aggregate household gross assets (DA3001) held by a given net-wealth-decile × tenure cell. Net wealth deciles are from the ECB HFCS series DNTOP10. A household is a renter/non-owner if it holds no real estate (DA1110= 0 and DA1120= 0), an outright owner if it holds real estate with no mortgage (DL1100= 0), and a mortgagor if it holds real estate financed with a mortgage (DL1100> 0). Shares are computed within each country-year, weighted by the household weight HW0010, and then averaged across the 15 countries separately for each wave. Columns are net wealth deciles.

A.3 Decomposing Changes in the Gini

Wealth inequality can increase when mean wealth grows faster in upper deciles than in lower deciles. I examine which parts of the wealth distribution account for changes in inequality across decile mean wealth. For each country, I calculate a Gini coefficient using ten observations, each representing the mean net wealth of one wealth decile, and decompose its cumulative change into contributions from the wealth growth of each decile. Because the calculation uses decile means, it captures changes in inequality across deciles but not changes in wealth dispersion within each decile. I follow the Shapley value decomposition approach of Shorrocks (2013).

For each country c, I denote the average real net wealth of a household decile $d \in \{1, \ldots, 10\}$ in the years 1979 and 2016 as $w_d^{c,0}$ and $w_d^{c,T}$, respectively. Let γ^c be the gross cumulative growth rate of average wealth of country c throughout the sample periods, and $\gamma_c = \mu^{c,T}/\mu^{c,0}$ the gross growth rate of mean wealth. Let $G(\mathbf{w}^{c,0})$ be the Gini coefficient calculated from the ten decile mean wealth levels in country c at the beginning of the sample, assigning each decile its population share of 10%. If every decile's wealth grew at the common rate γ_c, the whole distribution would simply be rescaled and the Gini would remain unchanged with $G(\gamma_c \mathbf{w}^{c,0}) = G(\mathbf{w}^{c,0})$. The change in this Gini thus arises because the decile means grow at different rates. To attribute it to each individual decile, consider the case when a decile's wealth is the value realized in 2016 while the others are held at the no-change benchmark $\gamma_c w_d^{c,0}$.

The contribution of decile d's wealth growth to the change in the Gini coefficient is calculated as the weighted average of the difference in Gini by switching decile from the no-change benchmark to its realized value for all possible combinations of the other deciles' wealth values. Following the standard formula of Shapley value, a decile d's contribution ϕ_d^c is calculated as

$$\phi_d^c = \sum_{S \subseteq \mathcal{N} \setminus \{d\}} \frac{|S|!\,(N - |S| - 1)!}{N!} \left[G\left(\mathbf{w}^{c,S \cup \{d\}}\right) - G\left(\mathbf{w}^{c,S}\right) \right], \tag{A3}$$

where $\mathcal{N} \equiv \{1, 2, \cdots, 10\}$. $G\left(\mathbf{w}^{c,S \cup \{d\}}\right)$ is the Gini when decile d and a group of other deciles S is switched to their realized wealth values, while $G\left(\mathbf{w}^{c,S}\right)$ is the Gini when that group S is switched to their realized wealth values, but decile d remains at its no-change benchmark. Shorrocks (2013) shows that the efficiency property of Shapley values also holds for Gini coefficients, and summing up ϕ_d^c across all deciles exactly yields the change in the Gini constructed from the ten decile means.

I express the contributions ϕ_d^c of a decile d in country c as a fraction of the total change in the Gini constructed from decile mean wealth, and take the median of the values across all countries for each decile. Table A5 summarizes the median contribution of each decile. A positive number means that the decile mean changed in a way that increased this Gini, i.e.,

Table A5: Contribution of Wealth Deciles to Changes in the Gini Constructed from Decile Mean Wealth

Decile	Contribution of Decile (%)
Bottom 10%	−0.0
10–20%	−0.6
20–30%	3.6
30–40%	8.9
40–50%	13.1
50–60%	15.2
60–70%	14.8
70–80%	10.1
80–90%	0.2
Top 10%	32.0
Bottom 50%	*25.0*
Middle 40%	*40.3*
Top 10%	*32.0*

Notes: The Gini is calculated from the ten decile mean wealth levels, assigning each decile a population share of 10%. The decomposition therefore captures changes across decile means but not changes in wealth dispersion within a decile. It does not decompose the WID wealth Gini used in the main regressions.

an upper decile pulled ahead or a lower decile slipped behind. A negative entry means that it lowered the Gini. The top decile mean contributes the most to the change over time. However, the upper-middle decile means also contribute significantly. Considering that these groups' wealth levels are typically below average, this implies that the middle of the distribution lagged behind in terms of mean wealth growth. Thus, changes across decile means reflect both the top decile pulling ahead and middle deciles falling behind; the exercise does not measure changes in concentration within any decile.

B Additional Results

B.1 Full Versions of Tables

I present the complete versions of Tables 1, 2, and 3 with a full list of regression coefficients for all the control variables used in the regressions.

TABLE A6: Aggregate Demand and Stock Prices in Sudden Stops

	GDP	Consumption	Investment	Stock Price
Net Flow_t^{SS}	-0.154***	-0.314***	-1.084***	-1.877***
	(0.047)	(0.031)	(0.170)	(0.511)
Net $\text{Flow}_t^{SS} \times \nu_{t-1}$	-0.309***	-0.252***	-1.414***	-1.821**
	(0.064)	(0.045)	(0.175)	(0.816)
ν_{t-1}	0.001	-0.002	-0.002	-0.035
	(0.002)	(0.003)	(0.009)	(0.025)
GDP_{t-1}	0.690***	0.636***	2.038***	-1.278
	(0.045)	(0.063)	(0.179)	(0.977)
Real Exchange Rate_{t-1}	0.002	0.044**	0.063	-0.182
	(0.012)	(0.018)	(0.063)	(0.130)
Trade Openness_{t-1}	0.000**	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)
Financial Development_{t-1}	0.022	0.050*	0.107	-0.786***
	(0.022)	(0.025)	(0.112)	(0.258)
Financial Openness_{t-1}	-0.001	-0.002	0.003	0.040
	(0.001)	(0.002)	(0.012)	(0.029)
Debt/GDP_{t-1}	-0.001	-0.000	-0.004	-0.009
	(0.001)	(0.002)	(0.005)	(0.015)
$\text{Reserves/GDP}_{t-1}$	0.011	0.016	0.040	0.489**
	(0.019)	(0.025)	(0.099)	(0.239)
Observations	864	864	847	782
Within R^2	0.531	0.432	0.357	0.085

Notes: This is a full version of Table 1 in Section 2. GDP, consumption, and investment are HP-filtered cyclical components of log real per capita quantities. The stock-price outcome is the annual change in the log stock-price index. ***, **, and * denote significance at 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors.

TABLE A7: Sudden Stops and Income Inequality

	GDP	Consumption	Investment	Stock Price
Net Flow_t^{SS}	-0.205**	-0.276**	-1.323***	-2.351***
	(0.093)	(0.112)	(0.364)	(0.725)
Net $\text{Flow}_t^{SS} \times \nu_{t-1}^{\text{Income}}$	-0.034	0.068	-0.186	-0.323
	(0.045)	(0.089)	(0.115)	(0.308)
$\nu_{t-1}^{\text{Income}}$	0.001	-0.001	0.002	0.033*
	(0.001)	(0.001)	(0.005)	(0.017)
GDP_{t-1}	0.690***	0.638***	1.924***	-1.189
	(0.037)	(0.056)	(0.175)	(0.776)
Real Exchange Rate_{t-1}	0.004	0.042***	0.060*	-0.270**
	(0.007)	(0.011)	(0.031)	(0.119)
Trade Openness_{t-1}	0.000***	0.000	0.001	-0.000
	(0.000)	(0.000)	(0.000)	(0.001)
Financial Development_{t-1}	0.015	0.028**	0.030	-0.512***
	(0.012)	(0.014)	(0.063)	(0.166)
Financial Openness_{t-1}	-0.000	-0.002	0.003	0.017
	(0.001)	(0.001)	(0.007)	(0.019)
Debt/GDP_{t-1}	-0.000	0.001	-0.003	-0.010
	(0.001)	(0.001)	(0.004)	(0.012)
$\text{Reserves/GDP}_{t-1}$	0.013	0.030	0.026	0.321
	(0.014)	(0.021)	(0.077)	(0.191)
Observations	1229	1229	1207	981
Within R^2	0.501	0.400	0.298	0.064

Notes: This is a full version of Table 2 in Section 2. ***, **, and * denote significance at 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors.

TABLE A8: Wealth Inequality and Net Foreign Debt

	Within (1)	Within (2)	Between (3)	Within (4)	Within (5)	Between (6)
Wealth Gini_{t-1}	1.503*	1.672**	2.431*	1.863***	1.722**	2.732**
	(0.820)	(0.764)	(1.257)	(0.585)	(0.678)	(1.251)
GDP_{t-1}				0.148	0.981*	-9.831
				(0.595)	(0.569)	(16.009)
Real exchange rate_{t-1}				-0.216	-0.135	0.836
				(0.265)	(0.221)	(1.179)
Trade openness_{t-1}				-0.002	0.003	-0.004
				(0.002)	(0.002)	(0.003)
$\text{Reserves/GDP}_{t-1}$				-1.138**	-0.907*	0.758
				(0.519)	(0.479)	(0.667)
Controls	No	No	No	Yes	Yes	Yes
Country FE	Yes	Yes	–	Yes	Yes	–
Year FE	No	Yes	–	No	Yes	–
R^2	0.012	0.018	0.056	0.096	0.073	0.119
Observations	1,093	1,093	52	1,093	1,093	52
Countries	52	52	52	52	52	52

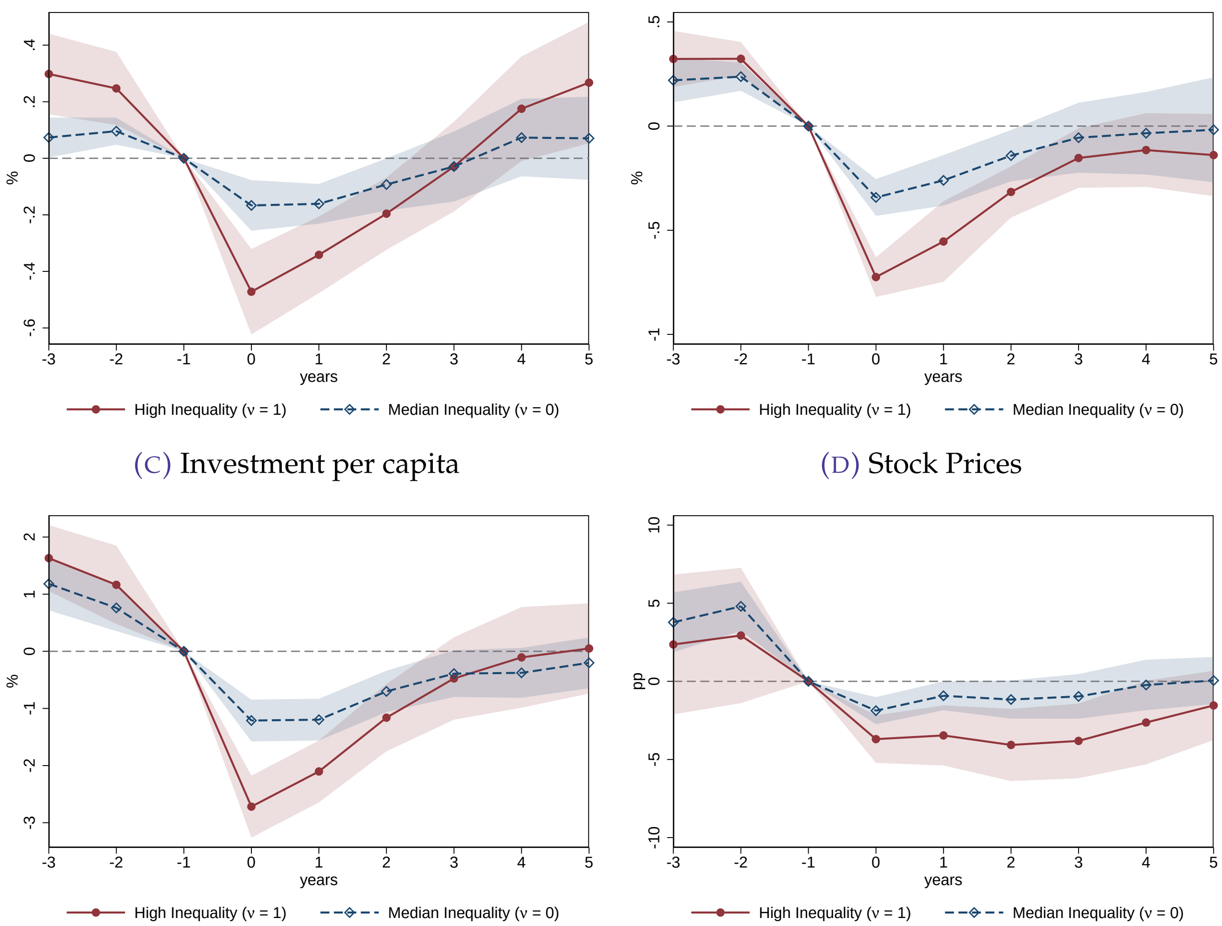
Notes: This is a full version of Table 3 in Section 2. R^2 reported in the table is the within R^2 for the within regressions and adjusted R^2 for the between regressions. ***, **, and * denote significance at 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors for the within regressions and heteroskedasticity-robust standard errors for the between regressions.

B.2 Local Projection of the Differential Effects of Wealth Inequality

Greater wealth inequality is associated with deeper declines in aggregate demand and asset prices for a prolonged period after a sudden stop. I estimate local projection versions of the baseline regressions (2) and (3) specified as

$$\Delta y_{i,t+h} = \alpha + \beta \text{Net Flow}_{it}^{SS} + \gamma \text{Net Flow}_{it}^{SS} \times \nu_{i,t-1} + \Gamma X_{it} + \mu_i + \eta_t + \varepsilon_{it}, \tag{A4}$$

where $\Delta y_{i,t+h}$ denotes the cumulative response of the natural log of each outcome relative to the year before the sudden stop. Figure A1 shows that the recovery of aggregate demand and asset prices takes up to 3 years, and that the declines are deeper under greater wealth inequality.



(A) GDP per capita

(B) Consumption per capita

(C) Investment per capita

(D) Stock Prices

FIGURE A1. Dynamic Effects of Capital Outflows in Sudden Stops

Notes: The panels report cumulative responses relative to the year before the sudden stop, normalized to zero at $h = -1$. Dashed lines report 90% confidence intervals.

B.3 Regression Controlling for Wealth Gini

I estimate regressions in which the dependent variables are the HP-filtered cyclical components of the logs of real GDP, consumption, and investment per capita, as well as the annual log change in stock prices. The regressions are specified as

$$y_{it} = \alpha + \beta \text{Net Flow}_{it}^{SS} + \gamma \text{Net Flow}_{it}^{SS} \times \log \text{Gini}_{i,t-1} + \Gamma X_{it} + \mu_i + \eta_t + \varepsilon_{it}, \quad \text{(A5)}$$

$$\Delta \log q_{it} = \alpha + \beta \text{Net Flow}_{it}^{SS} + \gamma \text{Net Flow}_{it}^{SS} \times \log \text{Gini}_{i,t-1} + \Gamma X_{it} + \mu_i + \varepsilon_{it}, \quad \text{(A6)}$$

where I replace the normalized inequality measure ν with the natural logarithm of the wealth Gini coefficient. The interaction terms retain the same sign as in the baseline specification and have similar statistical significance, which supports the qualitative robustness of the baseline results in Table 1.

TABLE A9: Controlling for Wealth Gini Coefficients

	GDP	Consumption	Investment	Stock Price
Net Flow$_t^{SS}$	-1.245***	-1.215***	-6.167***	-8.121**
	(0.208)	(0.135)	(0.591)	(3.166)
Net Flow$_t^{SS}$ × log Gini$_{t-1}$	-3.728***	-3.084***	-17.382***	-21.316*
	(0.678)	(0.507)	(2.098)	(10.747)
log Gini$_{t-1}$	0.017	-0.030	-0.008	-0.414
	(0.022)	(0.025)	(0.093)	(0.289)
GDP$_{t-1}$	0.690***	0.636***	2.037***	-1.275
	(0.046)	(0.063)	(0.174)	(0.972)
Real Exchange Rate$_{t-1}$	0.002	0.043**	0.063	-0.181
	(0.012)	(0.018)	(0.063)	(0.133)
Trade Openness$_{t-1}$	0.000**	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)
Financial Development$_{t-1}$	0.022	0.052**	0.107	-0.773***
	(0.022)	(0.024)	(0.112)	(0.264)
Financial Openness$_{t-1}$	-0.001	-0.002	0.003	0.039
	(0.001)	(0.002)	(0.012)	(0.029)
Debt/GDP$_{t-1}$	-0.001	-0.000	-0.004	-0.009
	(0.001)	(0.002)	(0.005)	(0.015)
Reserves/GDP$_{t-1}$	0.011	0.016	0.041	0.501**
	(0.019)	(0.025)	(0.100)	(0.245)
Observations	864	864	847	782
Within R^2	0.530	0.432	0.357	0.085

Notes: ***, **, and * denote significance at 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors.

B.4 Regression Using the Top-to-Bottom Wealth Ratio

As an alternative measure of wealth inequality, Table A10 replaces the wealth Gini with the lagged ratio of the net-wealth share of the top 10% to that of the bottom 50%, measured in its original units. The interaction coefficients are negative and statistically significant for GDP, consumption, investment, and stock-price growth. Economic magnitudes are therefore interpreted in the units of this ratio, while the common negative signs show that the direction of amplification is robust to the choice of inequality measure.

TABLE A10: Controlling for the Top 10% to Bottom 50% Wealth Ratio

	GDP	Consumption	Investment	Stock Price
Net Flow$_t^{SS}$	-0.083	-0.251***	-0.820***	-1.105*
	(0.094)	(0.056)	(0.301)	(0.580)
Net Flow$_t^{SS}$ × T10/B50$_{t-1}$	-0.001***	-0.001***	-0.004***	-0.008**
	(0.000)	(0.000)	(0.001)	(0.004)
T10/B50$_{t-1}$	-0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
GDP$_{t-1}$	0.699***	0.615***	2.035***	-1.333
	(0.046)	(0.065)	(0.208)	(0.966)
Real Exchange Rate$_{t-1}$	0.010	0.053***	0.108*	-0.194
	(0.012)	(0.016)	(0.056)	(0.154)
Trade Openness$_{t-1}$	0.000**	0.000	0.001	-0.001
	(0.000)	(0.000)	(0.001)	(0.001)
Financial Development$_{t-1}$	0.022	0.058**	0.115	-0.869***
	(0.021)	(0.023)	(0.099)	(0.288)
Financial Openness$_{t-1}$	-0.001	-0.001	-0.014**	0.044
	(0.002)	(0.002)	(0.006)	(0.028)
Debt/GDP$_{t-1}$	-0.001	0.000	-0.006	-0.011
	(0.001)	(0.002)	(0.006)	(0.016)
Reserves/GDP$_{t-1}$	0.006	0.011	-0.021	0.551**
	(0.017)	(0.026)	(0.082)	(0.258)
Observations	853	853	836	768
Within R^2	0.548	0.451	0.375	0.096

Notes: T10/B50$_{t-1}$ is the lagged ratio of the net-wealth share of the top 10% to that of the bottom 50%, obtained from the World Inequality Database and entered in levels. Its interaction coefficient reports the additional response associated with a one-unit increase in this ratio. ***, **, and * denote significance at the 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors.

B.5 Subsample Regressions

Regressions (2) and (3) exploit within-country variation in wealth inequality to identify its amplifying effect on recessions during sudden stops. However, wealth inequality is highly persistent within each country, which limits the scope of within-country identification. To examine whether the amplifying effect also operates through cross-country differences in wealth inequality levels, I split the sample into two groups based on the cross-country median of average wealth Gini coefficients: countries with above-median inequality and those with below-median inequality. I then estimate the following regressions separately for each group:

$$y_{it} = \alpha + \beta \text{Net Flow}_{it}^{SS} + \Gamma X_{it} + \mu_i + \eta_t + \varepsilon_{it}, \tag{A7}$$

$$\Delta \log q_{it} = \alpha + \beta \text{Net Flow}_{it}^{SS} + \Gamma X_{it} + \mu_i + \varepsilon_{it}, \tag{A8}$$

The vector X_{it} includes the same country characteristics as in (2) and (3). The results show that recessions in sudden stops are more pronounced in the high-inequality subsample than in the low-inequality subsample.

TABLE A11: Subsample Regressions

	GDP		Consumption		Investment		Stock Price	
	High	Low	High	Low	High	Low	High	Low
Net Flow_t^{SS}	-0.710***	-0.057***	-0.739***	-0.232***	-3.739***	-0.616**	-4.401***	-1.381**
	(0.166)	(0.016)	(0.125)	(0.048)	(0.438)	(0.253)	(1.614)	(0.525)
ν_{t-1}	0.002	-0.000	0.000	-0.007***	-0.012	-0.009	-0.055	-0.039
	(0.003)	(0.001)	(0.009)	(0.002)	(0.014)	(0.008)	(0.070)	(0.031)
GDP_{t-1}	0.706***	0.641***	0.672***	0.573***	2.307***	1.637***	-0.778	-2.306
	(0.044)	(0.073)	(0.072)	(0.082)	(0.206)	(0.229)	(0.788)	(1.457)
Real Exchange Rate_{t-1}	-0.017	0.013	0.022	0.056**	-0.088	0.167*	-0.225	-0.149
	(0.018)	(0.015)	(0.027)	(0.022)	(0.076)	(0.087)	(0.162)	(0.194)
Trade Openness_{t-1}	0.000*	0.000**	0.000	0.000	-0.000	0.001	0.000	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)
Financial Development_{t-1}	0.020	0.004	0.039	0.049*	-0.006	0.118	-0.845*	-0.806***
	(0.039)	(0.017)	(0.047)	(0.024)	(0.203)	(0.086)	(0.433)	(0.203)
Financial Openness_{t-1}	-0.001	0.002	-0.002	-0.001	0.009	-0.004	0.028	0.066
	(0.002)	(0.002)	(0.003)	(0.002)	(0.015)	(0.008)	(0.036)	(0.040)
Debt/GDP_{t-1}	-0.000	-0.001	0.002	-0.002*	0.002	-0.011	-0.003	-0.014
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.006)	(0.009)	(0.028)
$\text{Reserves/GDP}_{t-1}$	0.022	0.009	0.052	0.008	0.224	-0.038	0.530	0.545*
	(0.044)	(0.018)	(0.060)	(0.017)	(0.196)	(0.066)	(0.412)	(0.265)
Observations	391	471	391	471	374	471	375	407
Within R^2	0.555	0.467	0.456	0.387	0.415	0.287	0.060	0.137

Notes: ***, **, and * denote significance at 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors.

B.6 Sudden Stops in Emerging Markets

I show that the baseline results indicate that wealth inequality amplifies contractions and asset market corrections in sudden stops in emerging market economies where asset markets are less developed. I estimate the baseline regressions separately for the emerging market economies in Table A12, while discarding South Korea from the sample because it switched from an emerging market to an advanced economy. The results for emerging market economies are qualitatively consistent with the baseline results.

TABLE A12: Sudden Stops in Emerging Markets and Advanced Economies

	GDP	C	I	Δq
Net Flow$_t$	-0.514**	-0.524***	-2.677***	-2.229
	(0.109)	(0.109)	(0.665)	(1.757)
Net Flow$_t^{SS} \times \nu_{t-1}$	-0.148	-0.182**	-0.668*	-2.449
	(0.132)	(0.083)	(0.333)	(1.456)
ν_{t-1}	-0.001	-0.001	-0.014	-0.037
	(0.002)	(0.005)	(0.009)	(0.039)
GDP$_{t-1}$	0.666***	0.710***	2.167***	-0.803
	(0.052)	(0.090)	(0.195)	(1.004)
Real Exchange Rate$_{t-1}$	-0.011	0.026	-0.052	-0.237
	(0.017)	(0.026)	(0.077)	(0.160)
Trade Openness$_{t-1}$	0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)
Financial Development$_{t-1}$	0.024	0.017	0.066	-0.541
	(0.034)	(0.036)	(0.174)	(0.355)
Financial Openness$_{t-1}$	-0.000	-0.001	0.015	0.026
	(0.002)	(0.003)	(0.016)	(0.040)
Debt/GDP$_{t-1}$	-0.008	-0.006	-0.055**	-0.023
	(0.006)	(0.007)	(0.024)	(0.034)
Reserves/GDP$_{t-1}$	0.036	0.052	0.324	0.437
	(0.036)	(0.049)	(0.217)	(0.447)
Observations	366	366	349	332
Within R^2	0.537	0.441	0.377	0.061

Notes: ***, **, and * denote significance at 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors.

B.7 Controlling for Interaction Terms with Other Country Characteristics

The differential effects of wealth inequality on contractionary dynamics in sudden stops in Table 1 are robust to controlling for the interaction terms of the Net Flow^{SS} with the other country characteristics, including the lagged values of GDP per capita to account for differences in average income across countries before a sudden stop, as shown in Table A13.

TABLE A13: Including Interaction Terms with Other Control Variables

	GDP	C	I	Stock Price	GDP	C	I	Stock Price
Net Flow$_t^{SS}$	-1.166*	-0.959***	-4.392***	6.504	0.851	-0.321	2.376	21.610*
	(0.656)	(0.197)	(1.376)	(6.482)	(0.657)	(0.444)	(1.799)	(10.609)
Net Flow$_t^{SS}$ $\times$ ν_{t-1}	-0.512***	-0.329***	-1.587*	-5.063**	-0.546***	-0.340***	-1.701***	-5.674***
	(0.093)	(0.057)	(0.818)	(1.851)	(0.114)	(0.070)	(0.477)	(2.004)
Net Flow$_t^{SS}$ $\times$ Debt/GDP$_{t-1}$	-0.105	-0.054*	-0.092	-0.619	-0.014	-0.025	0.214	-0.082
	(0.065)	(0.030)	(0.342)	(1.037)	(0.068)	(0.048)	(0.190)	(0.993)
Net Flow$_t^{SS}$ $\times$ Reserves/GDP$_{t-1}$	2.349***	2.091***	13.631***	20.027	5.431***	3.066***	23.975***	42.809**
	(0.608)	(0.594)	(2.696)	(12.657)	(1.168)	(0.941)	(3.103)	(16.025)
Net Flow$_t^{SS}$ $\times$ Financial Development$_{t-1}$	0.609	0.483*	0.764	-16.323	-0.022	0.284	-1.353	-22.080**
	(0.770)	(0.279)	(1.769)	(11.112)	(0.435)	(0.353)	(1.361)	(9.270)
Net Flow$_t^{SS}$ $\times$ Financial Openness$_{t-1}$	-0.135	0.024	0.448	-0.045	-0.041	0.054	0.763**	0.586
	(0.125)	(0.048)	(0.511)	(1.774)	(0.095)	(0.070)	(0.278)	(1.347)
Net Flow$_t^{SS}$ $\times$ Trade Openness$_{t-1}$	0.010*	0.004	0.015	0.017	0.002	0.001	-0.012	-0.039
	(0.005)	(0.003)	(0.020)	(0.062)	(0.005)	(0.004)	(0.012)	(0.064)
Net Flow$_t^{SS}$ $\times$ log GDP per capita$_{t-1}$					-0.136***	-0.043*	-0.457***	-0.951*
					(0.037)	(0.025)	(0.072)	(0.475)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	864	864	847	782	864	864	847	782
Within R^2	0.543	0.437	0.371	0.094	0.551	0.438	0.377	0.097

Notes: ***, **, and * denote significance at 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors.

B.8 Effects of Different Types of Capital Outflows

The baseline results in Table 1 are primarily driven by capital flows other than direct investment, which typically represent long-term investments in physical capital. Table A14 summarizes the estimates from regressions in which I replace the Net Flow^{SS} variable with disaggregated types of capital flows. Debt-like flows are the sum of portfolio debt and other investment flows, which mainly consist of bank loans. Non-DI flows are the sum of portfolio debt, portfolio equity, and other investment flows.

TABLE A14: Effects of Different Types of Capital Outflows

	Total	Debt-like	Non-DI	DI	4-Way
Net Flow$_t^{SS}$	-0.154***				
	(0.047)				
Net Flow$_t^{SS}$ $\times$ ν_{t-1}	-0.309***				
	(0.064)				
Debt-like$_t^{SS}$		-0.171***			
		(0.054)			
Debt-like$_t^{SS}$ $\times$ ν_{t-1}		-0.212***			
		(0.075)			
Non-DI$_t^{SS}$			-0.210***		
			(0.066)		
Non-DI$_t^{SS}$ $\times$ ν_{t-1}			-0.215***		
			(0.074)		
Direct Investment$_t^{SS}$				0.011	-0.056
				(0.067)	(0.059)
Direct Investment$_t^{SS}$ $\times$ ν_{t-1}				0.251**	0.004
				(0.103)	(0.109)
Portfolio Equity$_t^{SS}$					-0.350**
					(0.140)
Portfolio Equity$_t^{SS}$ $\times$ ν_{t-1}					-2.071*
					(1.122)
Portfolio Debt$_t^{SS}$					-0.207***
					(0.070)
Portfolio Debt$_t^{SS}$ $\times$ ν_{t-1}					-0.412**
					(0.180)
Other$_t^{SS}$					-0.187***
					(0.055)
Other$_t^{SS}$ $\times$ ν_{t-1}					-0.215***
					(0.067)
ν_{t-1}	0.001	0.001	0.001	0.000	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
GDP$_{t-1}$	0.690***	0.689***	0.692***	0.678***	0.696***
	(0.045)	(0.044)	(0.043)	(0.047)	(0.043)
Real Exchange Rate$_{t-1}$	0.002	0.003	0.002	0.008	0.001
	(0.012)	(0.014)	(0.013)	(0.016)	(0.011)
Trade Openness$_{t-1}$	0.000**	0.000**	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Financial Development$_{t-1}$	0.022	0.021	0.024	0.026	0.029
	(0.022)	(0.022)	(0.021)	(0.021)	(0.020)
Financial Openness$_{t-1}$	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Debt/GDP$_{t-1}$	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Reserves/GDP$_{t-1}$	0.011	0.011	0.010	0.013	0.008
	(0.019)	(0.018)	(0.018)	(0.021)	(0.017)
Observations	864	864	864	864	864
Within R^2	0.531	0.527	0.533	0.500	0.551

Notes: ***, **, and * denote significance at 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors.

B.9 Capital Outflows in Normal Times

I compare the effects of capital outflows in normal times to sudden stops in Table A15. To be specific, I estimate regressions specified as

$$y_{it} = \alpha + \sum_{k \in \{\text{SS, Non-SS}\}} \left(\beta^k \text{Net Flow}_{it}^k + \gamma^k \text{Net Flow}_{it}^k \times \nu_{i,t-1} \right) + \Gamma X_{it} + FE + \varepsilon_{it}, \qquad \text{(A9)}$$

where $\text{Net Flow}_{it}^{\text{Non-SS}}$ is the capital net outflows to GDP ratio in normal times. There are contractions in GDP, consumption, and investment when capital flows out in normal times, but the effects are much smaller than in sudden stops. The differential effects of wealth inequality in normal times is much smaller and are almost a third of the differential effects in sudden stops. For stock prices, capital flows in normal times do not incur any drops, and the interaction term with wealth inequality is also statistically insignificant.

TABLE A15: Effects of Capital Net Outflows

	GDP	Consumption	Investment	Stock Price
$\text{Net Flow}_t^{\text{Non-SS}}$	-0.038***	-0.040*	-0.355***	1.062**
	(0.013)	(0.024)	(0.071)	(0.480)
$\text{Net Flow}_t^{\text{Non-SS}} \times \nu_{t-1}$	-0.095***	-0.073***	-0.377***	-0.399
	(0.017)	(0.023)	(0.098)	(0.329)
Net Flow_t^{SS}	-0.148***	-0.308***	-1.044***	-1.927***
	(0.051)	(0.037)	(0.177)	(0.443)
$\text{Net Flow}_t^{SS} \times \nu_{t-1}$	-0.319***	-0.259***	-1.455***	-1.810**
	(0.052)	(0.035)	(0.132)	(0.819)
ν_{t-1}	0.000	-0.003	-0.005	-0.043*
	(0.002)	(0.003)	(0.008)	(0.022)
GDP_{t-1}	0.672***	0.619***	1.916***	-1.065
	(0.045)	(0.062)	(0.170)	(0.892)
$\text{Real Exchange Rate}_{t-1}$	-0.002	0.040**	0.037	-0.107
	(0.013)	(0.018)	(0.059)	(0.109)
$\text{Trade Openness}_{t-1}$	0.000**	0.000	0.001	-0.001
	(0.000)	(0.000)	(0.001)	(0.001)
$\text{Financial Development}_{t-1}$	0.018	0.046*	0.074	-0.705***
	(0.020)	(0.025)	(0.108)	(0.220)
$\text{Financial Openness}_{t-1}$	-0.001	-0.002	0.003	0.042
	(0.001)	(0.002)	(0.011)	(0.028)
Debt/GDP_{t-1}	-0.002**	-0.001	-0.010**	-0.007
	(0.001)	(0.001)	(0.005)	(0.013)
$\text{Reserves/GDP}_{t-1}$	0.016	0.019	0.057	0.458*
	(0.018)	(0.024)	(0.105)	(0.247)
Observations	864	864	847	782
Within R^2	0.560	0.447	0.407	0.117

Notes: ***, **, and * denote significance at 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors.

B.10 Comparison across Crisis Classifications

Table A16 compares the conditional associations between macroeconomic outcomes and three crisis classifications. For each classification, I estimate

$$y_{it} = \alpha + \beta \mathrm{D}_{it} + \gamma \mathrm{D}_{it} \times \nu_{i,t-1} + \Gamma \mathrm{X}_{it} + \mu_i + \eta_t + \varepsilon_{it}, \tag{A10}$$

where X_{it} contains the controls used in regression (2). The indicator D_{it} denotes either a sudden stop, a bank-run episode identified in the narrative chronology of Jamilov, König, Müller, and Saidi (2025), or a systemic banking crisis classified by Laeven and Valencia (2020). The two alternative crisis classifications were not selected based on their capital flows, and the two types of crises were associated with capital inflows of 3.34% of GDP rather than capital outflows on average. The GDP decline and its interaction with wealth inequality are statistically significant only for sudden stops. Bank-run and systemic banking-crisis episodes are associated with stock price declines, but their interactions with wealth inequality are not statistically significant.

TABLE A16: Different Types of Crisis

	Sudden Stop		Bank Run (JKMS)		Banking Crisis (LV)	
	GDP	Stock Price	GDP	Stock Price	GDP	Stock Price
Crisis_t	-0.013**	-0.081	-0.010	-0.489*	-0.005	-0.590***
	(0.006)	(0.056)	(0.007)	(0.254)	(0.006)	(0.117)
$\text{Crisis}_t \times \nu_{t-1}$	-0.011*	-0.133*	-0.001	0.052	-0.002	0.065
	(0.006)	(0.078)	(0.006)	(0.126)	(0.006)	(0.148)
ν_{t-1}	-0.000	-0.062**	-0.001	-0.059*	-0.001	-0.068**
	(0.002)	(0.030)	(0.002)	(0.029)	(0.002)	(0.025)
GDP_{t-1}	0.696***	-0.885	0.695***	-0.656	0.693***	-0.553
	(0.038)	(1.087)	(0.044)	(0.963)	(0.046)	(0.872)
Real Exchange Rate_{t-1}	0.004	0.033	0.007	0.037	0.007	0.086
	(0.006)	(0.186)	(0.006)	(0.170)	(0.005)	(0.149)
Trade Openness_{t-1}	0.000**	0.000	0.000***	-0.000	0.000***	-0.000
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Financial Development_{t-1}	0.022	-0.875***	0.024	-0.889***	0.025	-0.735***
	(0.016)	(0.301)	(0.015)	(0.294)	(0.016)	(0.181)
Financial Openness_{t-1}	-0.001	0.026	-0.001	0.028	-0.001	0.023
	(0.002)	(0.028)	(0.002)	(0.025)	(0.002)	(0.029)
Debt/GDP_{t-1}	-0.001	-0.012	-0.001	-0.006	-0.001	-0.004
	(0.001)	(0.016)	(0.001)	(0.012)	(0.001)	(0.010)
$\text{Reserves/GDP}_{t-1}$	0.013	0.446*	0.015	0.433	0.015	0.274
	(0.013)	(0.260)	(0.014)	(0.275)	(0.014)	(0.310)
Constant	-0.036***	0.432	-0.039***	0.470	-0.040***	0.354*
	(0.011)	(0.272)	(0.011)	(0.277)	(0.011)	(0.206)
Observations	1128	941	1128	941	1128	941
Within R^2	0.527	0.064	0.518	0.112	0.515	0.154

Notes: ***, **, and * denote significance at 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors.

B.11 Regressions with Both Wealth and Income Inequality Measures

I estimate the baseline regressions while controlling for the interaction terms and the inequality measures for both the wealth and income Gini coefficients. Table A17 shows that wealth inequality has significant differential effects on sudden stops, even when I control for the income inequality measure and the associated interaction term. As indicated in Table 2, income inequality does not amplify the recessions in sudden stops.

TABLE A17: Regressions with Both Inequality Measures

	GDP	Consumption	Investment	Stock Price
Net Flow_t^{SS}	-0.125***	-0.277***	-0.888***	-1.775**
	(0.043)	(0.038)	(0.261)	(0.720)
Net $\text{Flow}_t^{SS} \times \nu_{t-1}$	-0.332***	-0.281***	-1.571***	-1.925*
	(0.086)	(0.055)	(0.233)	(1.050)
ν_{t-1}	0.001	-0.002	-0.003	-0.051*
	(0.002)	(0.003)	(0.009)	(0.029)
Net $\text{Flow}_t^{SS} \times \nu_{t-1}^{\text{Income}}$	0.049	0.060*	0.323	0.137
	(0.095)	(0.034)	(0.209)	(0.673)
$\nu_{t-1}^{\text{Income}}$	-0.000	0.001	0.003	0.043*
	(0.002)	(0.002)	(0.005)	(0.021)
GDP_{t-1}	0.692***	0.639***	2.056***	-1.238
	(0.044)	(0.062)	(0.169)	(0.981)
Real Exchange Rate_{t-1}	0.002	0.043**	0.063	-0.182
	(0.012)	(0.019)	(0.063)	(0.130)
Trade Openness_{t-1}	0.000**	0.000	0.000	-0.001
	(0.000)	(0.000)	(0.001)	(0.001)
Financial Development_{t-1}	0.024	0.052**	0.119	-0.789***
	(0.021)	(0.025)	(0.108)	(0.255)
Financial Openness_{t-1}	-0.001	-0.002	0.002	0.039
	(0.001)	(0.002)	(0.012)	(0.030)
Debt/GDP_{t-1}	-0.001	-0.000	-0.004	-0.011
	(0.001)	(0.002)	(0.005)	(0.013)
$\text{Reserves/GDP}_{t-1}$	0.012	0.016	0.044	0.511**
	(0.019)	(0.024)	(0.103)	(0.239)
Observations	864	864	847	782
Within R^2	0.531	0.433	0.360	0.088

Notes: ***, **, and * denote significance at 1%, 5%, and 10% levels using the Cameron et al. (2011) two-way clustered standard errors.

B.12 Change in Real Estate Subcategories in Sudden Stops

Figure A2 plots the change in real estate subcategories in sudden stop countries relative to other countries, estimated as (4). Real estate values of mortgagors dropped more in the sudden stop countries than in the control countries, whereas the growth of outright owners' real estate values does not differ significantly between the two groups of countries. Among the subcategories of real estate, holdings of real estate other than household main residences and the associated mortgages dropped the most, consistent with the finding in Panel (A) of Figure 4.

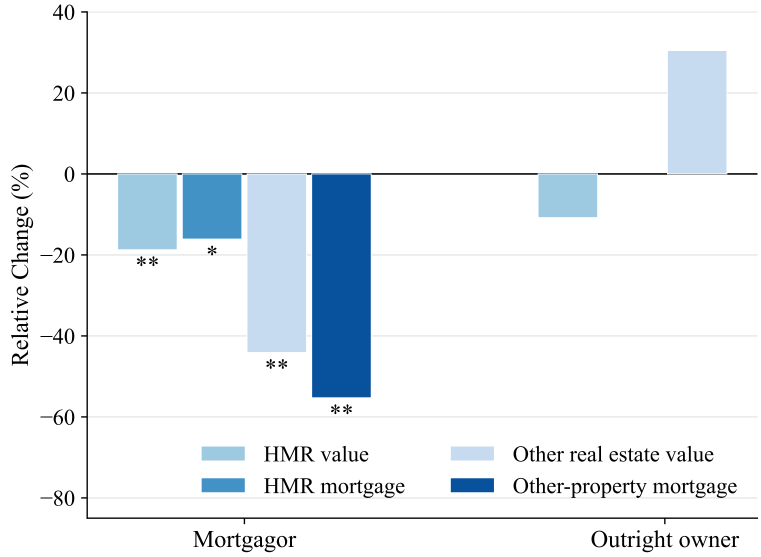


FIGURE A2. Values of Real Estate and Mortgages

Notes: The plot shows changes of the value of the main residence (DA1110), the mortgage on the main residence (DL1110), the value of other real estate (DA1120), and the mortgage secured by other property (DL1100−DL1110). Stars denote one-sided permutation p-values for the predicted direction, with ** and * indicating significance at the 5% and 10% levels.

C Derivations and Proofs

C.1 Proof of Lemma 1

The first-order conditions of an unconstrained household i in period 1 satisfy

$$q_1 u'(c_{i1}) = \beta(f'(k_{i2}) + 1), \tag{A11}$$

$$u'(c_{i1}) = 1, \tag{A12}$$

which yields $q_1 R - 1 = f'(k_{i2}) < f'(0)$. Since $f'(0) \to \infty$, k_{i2} must be positive. Let $(f')^{-1}(q_1 R - 1) = \bar{k}_2$. The unconstrained household's period-1 wealth is $\tilde{w}_i = z_1 f(k_{i1}) + q_1 k_{i1} + b_{i1}$, and under log utility and $\beta R = 1$, its consumption is $c_{i1} = 1$. Hence, its debt choice b_{i2} satisfies

$$u'\left(\tilde{w}_i - q_1 \bar{k}_2 - \frac{b_{i2}}{R}\right) = 1,$$

$$\iff b_{i2} = R(\tilde{w}_i - q_1 \bar{k}_2 - 1). \tag{A13}$$

Hence, b_{i2} is increasing in $\tilde{w}_i$. Therefore, there exists a lower bound for $\tilde{w}_i$ such that $b_{i2} = -\theta q_1 R \bar{k}_2$. The lower bound of $\tilde{w}_i$ for the unconstrained households satisfies

$$\overline{w} = 1 + (1 - \theta) q_1 \bar{k}_2. \tag{A14}$$

Now denote $\bar{k}_1$ as the level of k_{i1} that corresponds to $\tilde{w}_i = 1 + (1 - \theta) q_1 \bar{k}_2$, which exists because both k_{i1} and $\tilde{w}_i$ are monotonic in the initial capital endowment k_{i0}. To see how productivity z_1 and the asset price q_1 affect $\bar{k}_2$ and $\overline{w}$, I differentiate $\bar{k}_2$ and $\overline{w}$.

1. Unconstrained households' asset holdings $\bar{k}_2$

   Recall that $\bar{k}_2 = (f')^{-1}(q_1 R - 1)$, which does not depend on z_1. I have

$$\frac{\partial \bar{k}_2}{\partial q_1} = \frac{R}{f''(\bar{k}_2)} = \frac{R\bar{k}_2}{(\alpha - 1) f'(\bar{k}_2)} = -\frac{R\bar{k}_2}{(1 - \alpha)(q_1 R - 1)} < 0, \tag{A15}$$

   and unconstrained households reduce (increase) asset holdings when the price goes up (down).

2. Threshold level of wealth $\overline{w}$

   Since z_1 does not enter the threshold $\overline{w} = 1 + (1 - \theta) q_1 \bar{k}_2$, the productivity shock does not move the threshold directly, and

$$\frac{\partial \overline{w}}{\partial z_1} = 0. \tag{A16}$$

   The productivity shock instead shifts the wealth distribution through each household's output, as $\partial \tilde{w}_i / \partial z_1 = f(k_{i1}) > 0$. For completeness, the direct effect of the borrowing tightness θ on $\overline{w}$ is

$$\frac{\partial \overline{w}}{\partial \theta} = -q_1 \bar{k}_2 < 0, \tag{A17}$$

and differentiating $\overline{w}$ with respect to q_1 gives

$$\frac{\partial \overline{w}}{\partial q_1} = -\frac{\alpha q_1 R + 1 - \alpha}{(1-\alpha)(q_1 R - 1)}(1-\theta)\bar{k}_2 < 0, \tag{A18}$$

which implies that fewer (more) households are constrained as the wealth threshold goes down (up) when the asset price goes up (down).

C.2 Proof of Lemma 2

Totally differentiating the constrained household's consolidated Euler equation (20) with respect to q_1 and k_{i2}, the price effect of a constrained household's asset demand is[28]

$$\frac{\partial k_{i2}}{\partial q_1} = \frac{\theta + (1-\theta)(q_1 k_{i1} - (1-\theta) q_1 k_{i2} - c_{i1}) u''(c_{i1})}{\beta f''(k_{i2}) + (1-\theta)^2 q_1^2 u''(c_{i1})} < 0. \tag{A19}$$

The elasticity of asset demand for constrained households can be expressed as

$$\begin{aligned}\left|\frac{dk_{i2}}{dq_1}\frac{q_1}{k_{i2}}\right| &= \left|\frac{\theta + (1-\theta)(q_1 k_{i1} - (1-\theta) q_1 k_{i2} - c_{i1}) u''(c_{i1})}{\beta f''(k_{i2}) + (1-\theta)^2 q_1^2 u''(c_{i1})} \cdot \frac{q_1}{k_{i2}}\right| \\ &= \frac{\theta c_{i1} + 1 - \theta - (1-\theta)(q_1 k_{i1} - (1-\theta) q_1 k_{i2}) u'(c_{i1})}{(1-\alpha)((1-\theta) - \frac{1}{q_1 R} c_{i1} + \theta c_{i1}) + (1-\theta)^2 q_1 k_{i2} u'(c_{i1})},\end{aligned} \tag{A20}$$

where I substitute (20) into the price effect (A19) to obtain the second equality. Dropping the nonpositive term $-(1-\theta)q_1 k_{i1} u'(c_{i1})$ from the numerator and rewriting the denominator using the identity $(1-\theta) - \frac{c_{i1}}{q_1 R} + \theta c_{i1} = (1-\theta)(1-c_{i1}) + \left(1 - \frac{1}{q_1 R}\right) c_{i1}$, I have

$$\left|\frac{dk_{i2}}{dq_1}\frac{q_1}{k_{i2}}\right| \le \frac{\theta c_{i1} + 1 - \theta + (1-\theta)^2 q_1 k_{i2} u'(c_{i1})}{(1-\alpha)\left[(1-\theta)(1-c_{i1}) + \left(1 - \frac{1}{q_1 R}\right) c_{i1}\right] + (1-\theta)^2 q_1 k_{i2} u'(c_{i1})}. \tag{A21}$$

The denominator strictly exceeds $(1-\alpha)\left(1 - \frac{1}{q_1 R}\right)$ times the numerator, term by term:

$$\begin{aligned}&(1-\alpha)\left[(1-\theta)(1-c_{i1}) + \left(1 - \frac{1}{q_1 R}\right) c_{i1}\right] - (1-\alpha)\left(1 - \frac{1}{q_1 R}\right)(\theta c_{i1} + 1 - \theta) \\ =&\frac{(1-\alpha)(1-\theta)(1-c_{i1})}{q_1 R} \ \ge\ 0, \\ &(1-\theta)^2 q_1 k_{i2} u'(c_{i1})\left[1 - (1-\alpha)\left(1 - \frac{1}{q_1 R}\right)\right] > 0,\end{aligned} \tag{A22}$$

where the first line uses $c_{i1} \le 1$ for the constrained households and the second uses $(1-\alpha)\left(1 - \frac{1}{q_1 R}\right) < 1$. Therefore

$$\left|\frac{dk_{i2}}{dq_1}\frac{q_1}{k_{i2}}\right| < \frac{q_1 R}{(1-\alpha)(q_1 R - 1)} = \left|\frac{\partial \bar{k}_2}{\partial q_1}\frac{q_1}{\bar{k}_2}\right|, \tag{A23}$$

[28] Throughout, I maintain that every constrained household satisfies $\theta c_{i1}^2 + (1-\theta)\left(z_1 f(k_{i1}) + b_{i1}\right) > 0$, which, by the budget constraint, equals c_{i1}^2 times the numerator of (A19) and therefore delivers its sign. Equivalently, $q_1 k_{i1} < \tilde{w}_i + \frac{\theta c_{i1}^2}{1-\theta}$: no constrained household's capital valuation exceeds its net worth by more than $\frac{\theta c_{i1}^2}{1-\theta}$. Since $c_{i1} \le 1$, the condition implies $z_1 f(k_{i1}) + b_{i1} > -\frac{\theta}{1-\theta}$.

where the price elasticity of asset demand for the unconstrained households is obtained from Appendix C.1. Since $k_{i2} < \bar{k}_2$ for the constrained households, (A23) implies

$$\left|\frac{\partial k_{i2}}{\partial q_1}\right| < \left|\frac{\partial \bar{k}_2}{\partial q_1}\right|. \tag{A24}$$

C.3 Proof of Proposition 1

I first show the effects on the asset price and aggregate consumption, and then examine capital outflows.

Effect on asset price: This is immediate from (24), and any negative shock to z_1 lowers q_1.

Effect on aggregate consumption: The partial effect of z_1 on a constrained household's consumption is positive by (26). For the general equilibrium term, differentiating $c_{i1} = \tilde{w}_i - (1-\theta)q_1 k_{i2}$ with respect to q_1 yields

$$\frac{\partial c_{i1}}{\partial q_1} = k_{i1} - (1-\theta)k_{i2} - (1-\theta)q_1\frac{\partial k_{i2}}{\partial q_1}. \tag{A25}$$

With the price effect (A19) and the consolidated Euler equation (20), I obtain

$$\left(\beta f''(k_{i2}) + (1-\theta)^2 q_1^2 u''(c_{i1})\right)\frac{\partial c_{i1}}{\partial q_1} = \beta f''(k_{i2})k_{i1} - \alpha(1-\theta)\beta f'(k_{i2}) - (1-\theta)\beta. \tag{A26}$$

Every term on the right-hand side is strictly negative, and the coefficient on the left-hand side is also negative. Therefore, I have

$$\frac{dC_1}{dz_1} = \int_{i\in\mathcal{C}} \left.\frac{\partial c_{i1}}{\partial z_1}\right|_{q_1} di + \int_{i\in\mathcal{C}} \frac{\partial c_{i1}}{\partial q_1}\frac{dq_1}{dz_1} di > 0, \tag{A27}$$

so a negative shock to z_1 decreases aggregate consumption.

Effect on capital outflows: Capital outflow is defined as $\frac{B_2}{R} - B_1$. The balance of payments $C_1 + B_2/R = z_1\bar{F} + B_1$ gives

$$\frac{d}{dz_1}\left(\frac{B_2 - B_1}{R}\right) = \bar{F} - \frac{dC_1}{dz_1}, \tag{A28}$$

so a negative shock generates a capital outflow, $\frac{d}{dz_1}(B_2/R) < 0$, if and only if the fall in aggregate consumption exceeds the fall in output and $dC_1/dz_1 > \bar{F}$.

Let $|\mathcal{C}|$ denote the mass of constrained households and define

$$g(z_1) \equiv \frac{dC_1}{dz_1} - \bar{F}. \tag{A29}$$

The constrained set expands as productivity falls because every household's wealth relative to the threshold is strictly increasing in z_1, as shown in (25). Because net wealth is continuously distributed and the constrained and unconstrained choices coincide at the threshold, a household crossing the threshold does not create a jump in aggregate consumption or in the derivatives entering (27) and (24). Hence, $g(z_1)$ is continuous.

When productivity is sufficiently high, all households are unconstrained. Each household then keeps period-1 consumption fixed at $c_{i1} = 1$ and uses foreign bonds to smooth the temporary change in output. Consequently, $dC_1/dz_1 = 0$ and

$$g(z_1) = -\overline{F} < 0. \tag{A30}$$

Following a negative shock, households borrow rather than reduce consumption by the full decline in output, generating a capital inflow.

At sufficiently low productivity, bounded support implies that the wealth threshold eventually passes the upper end of the net wealth distribution, so every household is constrained. Aggregating the binding borrowing constraints and using asset-market clearing gives

$$\frac{B_2}{R} = -\theta q_1 \overline{K}. \tag{A31}$$

Substituting this expression into the balance of payments yields

$$C_1 = z_1 \overline{F} + B_1 + \theta q_1 \overline{K}, \tag{A32}$$

and therefore

$$g(z_1) = \theta \overline{K} \frac{dq_1}{dz_1} > 0. \tag{A33}$$

In this low-productivity region, households cannot use additional borrowing to smooth consumption. The asset-price decline instead tightens every borrowing limit, leading to a larger fall in consumption than the direct decline in output and capital flows out.

Since $g(z_1)$ is positive at sufficiently low productivity and negative at sufficiently high productivity, continuity implies that it crosses zero between the two regions. Define the first crossing as

$$z^* \equiv \inf\{z_1 : g(z_1) \leq 0\}. \tag{A34}$$

Then $g(z^*) = 0$, or equivalently $dC_1/dz_1|_{z^*} = \overline{F}$, and $g(z_1) > 0$ for every $z_1 < z^*$. Hence, an economy whose productivity is already below z^* experiences a capital outflow in response to a further negative productivity shock.

C.4 Proof of Proposition 2

I first verify that the distributional change in (28) is a Rothschild–Stiglitz mean-preserving spread. I then derive the effects on the asset price, the constrained fraction, and aggregate consumption.

Lemma A1. *At every price $q_1 \in [q_1^F, q_1^G]$ and for every $1 \leq \lambda < \lambda' \leq \lambda_F$, the wealth distribution induced by $\Phi_{\lambda'}$ is a Rothschild–Stiglitz mean-preserving spread of the wealth distribution induced* *by* Φ_λ.

Proof. Let

$$H(x) \equiv \int_{-\infty}^{x} [\Phi(u; q_1, \Phi_{\lambda'}) - \Phi(u; q_1, \Phi_\lambda)]\, du. \tag{A35}$$

By (28), the difference inside the integral is positive below the common mean. By assumption, it remains positive until the two cumulative distributions cross above the mean and become negative afterward. Hence, $H(x)$ first increases and then decreases. The two distributions have the same mean, so $H(x)$ equals zero above both supports. It follows that $H(x) \geq 0$ for every x. This is the Rothschild–Stiglitz condition for a mean-preserving spread. □

I next collect the derivatives of the choices made by a constrained household. Differentiating its budget constraint and consolidated Euler equation gives

$$\frac{\partial k_{i2}}{\partial z_1} = \frac{(1-\theta)q_1 f(k_{i1})}{\beta|f''(k_{i2})|c_{i1}^2 + (1-\theta)^2 q_1^2} > 0, \tag{A36}$$

$$\left|\frac{\partial k_{i2}}{\partial q_1}\right| = \frac{\theta c_{i1}^2 + (1-\theta)\{z_1 f(k_{i1}) + b_{i1}\}}{\beta|f''(k_{i2})|c_{i1}^2 + (1-\theta)^2 q_1^2}, \tag{A37}$$

$$\left.\frac{\partial c_{i1}}{\partial z_1}\right|_{q_1} = f(k_{i1}) \frac{\beta|f''(k_{i2})|c_{i1}^2}{\beta|f''(k_{i2})|c_{i1}^2 + (1-\theta)^2 q_1^2} > 0, \tag{A38}$$

$$\begin{aligned}\frac{\partial c_{i1}}{\partial q_1} = {} & k_{i1} \frac{\beta|f''(k_{i2})|c_{i1}^2}{\beta|f''(k_{i2})|c_{i1}^2 + (1-\theta)^2 q_1^2} + \alpha(1-\theta) \frac{\beta f'(k_{i2}) c_{i1}^2}{\beta|f''(k_{i2})|c_{i1}^2 + (1-\theta)^2 q_1^2} \\ & + (1-\theta) \frac{\beta c_{i1}^2}{\beta|f''(k_{i2})|c_{i1}^2 + (1-\theta)^2 q_1^2} > 0.\end{aligned} \tag{A39}$$

Lemma 2 shows that constrained households change their capital demand less in response to the price than unconstrained households:

$$\frac{q_1}{k_{i2}} \left|\frac{\partial k_{i2}}{\partial q_1}\right| < \frac{1}{(1-\alpha)(1-1/(q_1 R))}. \tag{A40}$$

Substituting (A37) into the differentiated budget constraint also gives

$$\frac{q_1}{c_{i1}} \frac{\partial c_{i1}}{\partial q_1} = 1 + \frac{\theta c_{i1}}{1-\theta} - \frac{1-\alpha}{1-\theta} \left[(1-\theta)(1-c_{i1}) + \left(1 - \frac{1}{q_1 R}\right) c_{i1}\right] \frac{q_1}{k_{i2}} \left|\frac{\partial k_{i2}}{\partial q_1}\right|. \tag{A41}$$

This equation divides a price-induced change in wealth between capital demand and consumption. A larger change in capital demand results in a smaller change in consumption.

I use these equations to bound how a lower price changes the derivatives in (A36)–(A39). Differentiating their common denominator with respect to q_1, substituting (A41), and using (A40) gives

$$2 \leq \frac{d \log[\beta|f''(k_{i2})|c_{i1}^2 + (1-\theta)^2 q_1^2]}{d \log q_1} \leq \frac{2-\alpha}{(1-\alpha)(1-1/(q_1 R))}. \tag{A42}$$

The first inequality uses $\theta q_1 R \leq 1$, which is equivalent to $1 - 1/(q_1 R) \leq 1 - \theta$. Combining this result with the numerators of (A36) and (A37), I obtain

$$\frac{d\log(\partial k_{i2}/\partial z_1)}{d\log q_1} \leq -1, \tag{A43}$$

$$\frac{d\log|\partial k_{i2}/\partial q_1|}{d\log q_1} \geq -\frac{2-\alpha}{(1-\alpha)(1-1/(q_1 R))}. \tag{A44}$$

When $\alpha \geq 1/2$, applying the same calculation to (A38) and (A39) gives

$$(1-\alpha)\left(1-\frac{1}{q_1 R}\right)\frac{d\log\left(\partial c_{i1}/\partial z_1|_{q_1}\right)}{d\log q_1} < 1,$$

$$(1-\alpha)\left(1-\frac{1}{q_1 R}\right)\frac{d\log(\partial c_{i1}/\partial q_1)}{d\log q_1} < 1. \tag{A45}$$

The restriction $\alpha \geq 1/2$ is needed only here. It makes both coefficients α and $2(1-\alpha)$, which appear after substituting (A41), no larger than one.

I now examine the equilibrium price. At a common price, aggregate capital demand under Φ_λ is

$$\bar{k}_2(q_1) - \lambda \int_{\tilde{w}_i < \overline{w}} [\bar{k}_2(q_1) - k_{i2}(q_1)]\, dG. \tag{A46}$$

The expression inside the integral is positive. Thus, holding q_1 fixed, a higher λ lowers aggregate capital demand. Since capital demand decreases with q_1, market clearing requires the price to fall. Therefore,

$$\frac{\partial q_1}{\partial \lambda} < 0. \tag{A47}$$

At a fixed price, a higher λ also puts more households below the wealth threshold. The decline in q_1 raises the threshold relative to household wealth and moves additional households into the constrained group. Hence,

$$\frac{\partial |\mathcal{C}|}{\partial \lambda} > 0. \tag{A48}$$

I next compare the response of the price to productivity. From market clearing,

$$\frac{dq_1}{dz_1} = \frac{\displaystyle\int_{\mathcal{C}} \frac{\partial k_{i2}}{\partial z_1}\, di}{\displaystyle\int_{\mathcal{C}} \left|\frac{\partial k_{i2}}{\partial q_1}\right| di + (1-|\mathcal{C}|)\left|\frac{\partial \bar{k}_2}{\partial q_1}\right|}. \tag{A49}$$

At a fixed price, a higher λ raises the numerator because it increases the mass of constrained households with $\partial k_{i2}/\partial z_1 > 0$. It also lowers the denominator because it replaces the more price-responsive demand of an unconstrained household with the less price-responsive demand of a constrained household.

The decline in the equilibrium price works in the opposite direction because it changes the derivatives of households already in each group. To include this effect, differentiating

(A46) with respect to λ gives

$$\left|\frac{dq_1}{d\lambda}\right| = \frac{\bar{k}_2 - \overline{K}}{\lambda\left[\int_{\mathcal{C}}\left|\frac{\partial k_{i2}}{\partial q_1}\right|di + (1-|\mathcal{C}|)\left|\frac{\partial \bar{k}_2}{\partial q_1}\right|\right]}. \tag{A50}$$

For an unconstrained household,

$$\left|\frac{\partial \bar{k}_2}{\partial q_1}\right| = \frac{\bar{k}_2}{q_1(1-\alpha)(1-1/(q_1 R))}. \tag{A51}$$

Let

$$D_G = \int_{\mathcal{C}^G}\left|\frac{\partial k_{i2}}{\partial q_1}\right|di + (1-|\mathcal{C}^G|)\left|\frac{\partial \bar{k}_2^G}{\partial q_1}\right|.$$

Combining (A43)–(A51) with (A49)–(A50), I obtain

$$\frac{d}{d\lambda}\log\frac{dq_1}{dz_1} \geq \frac{\left|\partial \bar{k}_2^G/\partial q_1\right|}{D_G}\left[1-\left(1-\frac{\overline{K}}{\bar{k}_2^G}\right)\left\{2-\alpha-(1-\alpha)\left(1-\frac{1}{q_1^G R}\right)\right\}\right]. \tag{A52}$$

Market clearing implies

$$0 < 1 - \frac{\overline{K}}{\bar{k}_2^G} = \frac{1}{\bar{k}_2^G}\int_{\mathcal{C}^G}(\bar{k}_2^G - k_{i2})di < |\mathcal{C}^G| < \frac{1}{2}. \tag{A53}$$

The expression inside braces in (A52) is smaller than two. Therefore, the expression in square brackets is positive. This proves

$$\frac{\partial^2 q_1}{\partial\lambda\,\partial z_1} > 0. \tag{A54}$$

The two terms have a simple interpretation. At a fixed price, a higher λ increases the response of constrained demand and reduces the share of price-responsive unconstrained demand. The lower equilibrium price changes existing demand responses in the opposite direction. Conditions (29) and (30) ensure that this second effect is smaller than the first.

Finally, aggregate consumption responds according to

$$\frac{dC_1}{dz_1} = \int_{\mathcal{C}}\left.\frac{\partial c_{i1}}{\partial z_1}\right|_{q_1}di + \frac{dq_1}{dz_1}\int_{\mathcal{C}}\frac{\partial c_{i1}}{\partial q_1}di. \tag{A55}$$

Both integrals are positive. At a fixed price, (28) increases each integral in proportion to λ. A household that crosses the threshold also adds the positive responses in (A38) and (A39).

The price decline can offset part of this increase. However, (A50), (A51), and (30) imply

$$\frac{1}{q_1^G}\left|\frac{dq_1}{d\lambda}\right| < \frac{|\mathcal{C}^G|}{1-|\mathcal{C}^G|}(1-\alpha)\left(1-\frac{1}{q_1^G R}\right) < (1-\alpha)\left(1-\frac{1}{q_1^G R}\right). \tag{A56}$$

When $\alpha \geq 1/2$, (A45) and (A56) show that the increase at a fixed price is larger than the offsetting price effect. Both integrals in (A55) therefore rise with λ. The response dq_1/dz_1 also rises by (31). Hence,

$$\frac{\partial^2 C_1}{\partial\lambda\,\partial z_1} > 0. \tag{A57}$$

A negative productivity shock has $dz_1 < 0$. The two positive cross-derivatives mean that the declines in asset price and aggregate consumption are larger when wealth inequality increases.

C.5 First-Order Conditions of the Commitment Taxation Problem

This appendix derives the first-order conditions used in Section 6. I retain the calibrated adjustment cost $\zeta > 0$ and define

$$K_t \equiv \int k_{j,t}\, dj, \tag{A58}$$

$$B_{t+1} \equiv \int b_{j,t+1}\, dj, \tag{A59}$$

$$I_t \equiv K_{t+1} - (1-\delta)K_t. \tag{A60}$$

The capital price and the rebated profit of the capital producers are

$$q_t = 1 + \phi \frac{I_t}{K_t}, \tag{A61}$$

$$\pi_t = \frac{\phi I_t^2}{2K_t} = \frac{(q_t - 1)I_t}{2}, \tag{A62}$$

and

$$q_{K',t} \equiv \frac{\partial q_t}{\partial K_{t+1}} = \frac{\phi}{K_t}. \tag{A63}$$

For brevity, define

$$g_{j,t} \equiv \frac{b_{j,t+1}}{R_t} + \theta_t q_t k_{j,t+1}, \tag{A64}$$

$$M_{j,t} \equiv (1-\tau_t^b)u'(\tilde{c}_{j,t}) - \Omega_{j,t}, \tag{A65}$$

$$A_t \equiv q_t\big[1 - \theta_t(1-\tau_t^b)\big], \tag{A66}$$

$$X_{j,t}^{\zeta} \equiv z_t \omega_j f_k(k_{j,t}, n_{j,t}) + q_t(1-\tau_t^w)(1-\delta) + \zeta(k_{j,t+1} - k_{j,t}), \tag{A67}$$

$$\Omega_{j,t} \equiv \beta R_t \mathbb{E}_t u'(\tilde{c}_{j,t+1}), \tag{A68}$$

$$\Psi_{j,t} \equiv \beta \mathbb{E}_t \left[u'(\tilde{c}_{j,t+1}) X_{j,t+1}^{\zeta}\right]. \tag{A69}$$

Let $\lambda_{j,t}$ be the multiplier on household j's budget constraint, $\gamma_{j,t}$ the multiplier on the investment Euler equation, and $\eta_{j,t}$ the multiplier on the saving Euler equation. Let $\varphi_{j,t}$ be the multiplier associated with a binding collateral constraint, $\kappa_{j,t}$ the multiplier on the intratemporal labor condition, ξ_t the multiplier on the capital-price equation, and $\kappa_{T,t}$ the multiplier on the government budget constraint.

The government's Lagrangian is

$$\mathcal{L} = \mathbb{E}_0 \sum_{t \geq 0} \beta^t \Big\{ \int u(\tilde{c}_{j,t})\, dj$$

$$+ \int \lambda_{j,t} \Big[z_t \omega_j f(k_{j,t}, n_{j,t}) + q_t(1-\tau_t^w)(1-\delta)k_{j,t} + b_{j,t} + \pi_t + T_t$$

$$
\begin{aligned}
&\qquad\qquad\qquad - c_{j,t} - q_t k_{j,t+1} - \frac{\zeta}{2}(k_{j,t+1} - k_{j,t})^2 - (1-\tau_t^b)\frac{b_{j,t+1}}{R_t}\Bigg] dj \\
&+ \int \varphi_{j,t} g_{j,t}\, dj \\
&+ \int \gamma_{j,t}\Big[\big(A_t + \zeta(k_{j,t+1} - k_{j,t})\big)u'(\tilde{c}_{j,t}) + \theta_t q_t \Omega_{j,t} - \Psi_{j,t}\Big] dj \\
&+ \int \eta_{j,t} M_{j,t}\, dj \\
&+ \int \kappa_{j,t}\left[z_t \omega_j f_n(k_{j,t}, n_{j,t}) - \nu'(n_{j,t})\right] dj \\
&+ \xi_t \left[q_t - 1 - \phi \frac{I_t}{K_t}\right] \\
&+ \kappa_{T,t}\left[\tau_t^w q_t (1-\delta) K_t - \tau_t^b \frac{B_{t+1}}{R_t} - T_t\right] \Bigg\}.
\end{aligned} \tag{A70}
$$

Let $\mathcal{C}_t$ and $\mathcal{U}_t$ denote the sets of constrained and unconstrained households. For $j \in \mathcal{C}_t$, the collateral constraint satisfies $g_{j,t} = 0$. For $j \in \mathcal{U}_t$, the saving Euler equation satisfies $M_{j,t} = 0$. Accordingly, $\varphi_{j,t} = 0$ applies to unconstrained households, and $\eta_{j,t} = 0$ applies to constrained households. The remaining inequalities:

$$
M_{j,t} \geq 0 \quad \text{for } j \in \mathcal{C}_t, \qquad g_{j,t} \geq 0 \quad \text{for } j \in \mathcal{U}_t, \tag{A71}
$$

hold at the solution.

The objects $\Omega_{j,t}$ and $\Psi_{j,t}$ contain date-$t+1$ marginal utilities. By the law of iterated expectations, the date-t terms involving these objects contribute to the date-$t+1$ Lagrangian as

$$
\int \left[\gamma_{j,t}\left(\theta_t q_t R_t - X^{\zeta}_{j,t+1}\right) - R_t \eta_{j,t}\right] u'(\tilde{c}_{j,t+1})\, dj. \tag{A72}
$$

The date-t first-order conditions include the realized effects of the previous period's multipliers.

The first-order condition with respect to consumption is

$$
\begin{aligned}
\lambda_{j,t} = u'(\tilde{c}_{j,t}) + \Bigg[&\big(A_t + \zeta(k_{j,t+1} - k_{j,t})\big)\gamma_{j,t} + (1-\tau_t^b)\eta_{j,t} \\
&+ \left(\theta_{t-1} q_{t-1} R_{t-1} - X^{\zeta}_{j,t}\right)\gamma_{j,t-1} - R_{t-1}\eta_{j,t-1}\Bigg] u''(\tilde{c}_{j,t}).
\end{aligned} \tag{A73}
$$

Thus, $\lambda_{j,t}$ incorporates both the current value of household wealth and its effects on investment and saving decisions made in adjacent periods.

The first-order condition with respect to labor is

$$
\begin{aligned}
0 = \;&\lambda_{j,t}\left[z_t \omega_j f_n(k_{j,t}, n_{j,t}) - \nu'(n_{j,t})\right] \\
&+ \kappa_{j,t}\left[z_t \omega_j f_{nn}(k_{j,t}, n_{j,t}) - \nu''(n_{j,t})\right] \\
&- \gamma_{j,t-1} u'(\tilde{c}_{j,t}) z_t \omega_j f_{kn}(k_{j,t}, n_{j,t}).
\end{aligned} \tag{A74}
$$

Because the intratemporal labor condition is imposed as a constraint, its first bracket is zero at the solution. Hence,

$$\kappa_{j,t} = \frac{\gamma_{j,t-1} u'(\tilde{c}_{j,t}) z_t \omega_j f_{kn}(k_{j,t}, n_{j,t})}{z_t \omega_j f_{nn}(k_{j,t}, n_{j,t}) - v''(n_{j,t})}. \tag{A75}$$

The first-order condition with respect to the lump-sum transfer is

$$\kappa_{T,t} = \int \lambda_{j,t}\, dj. \tag{A76}$$

The value of public funds is therefore the average value that the government assigns to additional household wealth.

The first-order condition for the wealth tax is

$$\int \lambda_{j,t}(K_t - k_{j,t})\, dj + \int \gamma_{j,t-1} u'(\tilde{c}_{j,t})\, dj = 0. \tag{A77}$$

Because the household measure is one, we have

$$\int \lambda_{j,t}(K_t - k_{j,t})\, dj = -\mathbb{C}ov_j(\lambda_t, k_t). \tag{A78}$$

The wealth-tax condition can therefore be written as

$$\underbrace{-\mathbb{C}ov_j(\lambda_t, k_t)}_{\text{redistribution from capital holders}} + \underbrace{\int \gamma_{j,t-1} u'(\tilde{c}_{j,t})\, dj}_{\text{return on capital chosen in } t-1} = 0, \tag{A79}$$

which is equation (64) in the main text.

The first-order condition for the debt tax is

$$\frac{1}{R_t} \int \lambda_{j,t}(b_{j,t+1} - B_{t+1})\, dj + \theta_t q_t \int \gamma_{j,t} u'(\tilde{c}_{j,t})\, dj - \int \eta_{j,t} u'(\tilde{c}_{j,t})\, dj = 0. \tag{A80}$$

The first integral is the covariance between the value of household wealth and the household bond position. Hence, we have

$$\underbrace{\frac{1}{R_t}\mathbb{C}ov_j(\lambda_t, b_{t+1})}_{\text{redistribution across bond positions}} + \underbrace{\theta_t q_t \int \gamma_{j,t} u'(\tilde{c}_{j,t})\, dj}_{\text{current investment}} - \underbrace{\int \eta_{j,t} u'(\tilde{c}_{j,t})\, dj}_{\text{current saving}} = 0, \tag{A81}$$

which gives equation (65) in the main text.

The first-order condition with respect to household bond holdings is

$$(1 - \tau_t^b)\lambda_{j,t} + \tau_t^b \int \lambda_{i,t}\, di = \varphi_{j,t} + \beta R_t \mathbb{E}_t \lambda_{j,t+1}. \tag{A82}$$

Changing one household's bond position affects its current resources, future wealth, collateral constraint, and the tax revenue returned to all households.

The first-order condition with respect to the capital price is

$$\xi_t = I_t \int \lambda_{i,t}\, di - (\mathcal{D}_t + \mathcal{K}_t), \tag{A83}$$

where

$$\begin{aligned} \mathcal{D}_t \equiv\ & (1 - \tau_t^w)(1 - \delta)\mathbb{C}ov_i(\lambda_t, k_t) - \mathbb{C}ov_i(\lambda_t, k_{t+1}) \\ & + \int \gamma_{i,t} u'(\tilde{c}_{i,t})\, di - (1 - \tau_t^w)(1 - \delta) \int \gamma_{i,t-1} u'(\tilde{c}_{i,t})\, di, \end{aligned} \tag{A84}$$

$$\mathcal{K}_t \equiv \theta_t \int \varphi_{i,t} k_{i,t+1}\, di - \theta_t \int \gamma_{i,t} M_{i,t}\, di. \tag{A85}$$

The first two terms of $\mathcal{D}_t$ capture the redistribution generated by revaluing current and future capital positions. The remaining terms account for the investment decisions that the government must implement. The component $\mathcal{K}_t$ captures how a change in the capital price affects collateral constraints and the implementation of household investment.

The first-order condition with respect to household capital is

$$\begin{aligned}
&(q_t + \zeta(k_{j,t+1} - k_{j,t}))\lambda_{j,t} \\
&= \theta_t q_t \varphi_{j,t} + \beta \mathbb{E}_t \left[\lambda_{j,t+1} X^{\zeta}_{j,t+1}\right] \\
&\quad + \zeta(\gamma_{j,t} - \gamma_{j,t-1}) u'(\tilde{c}_{j,t}) \\
&\quad + \beta \gamma_{j,t} \mathbb{E}_t \left[u'(\tilde{c}_{j,t+1}) \left(\zeta - z_{t+1}\omega_j f_{kk}(k_{j,t+1}, n_{j,t+1})\right)\right] \\
&\quad - \beta \zeta \mathbb{E}_t \left[\gamma_{j,t+1} u'(\tilde{c}_{j,t+1})\right] \\
&\quad + \beta \mathbb{E}_t \left[\kappa_{j,t+1} z_{t+1} \omega_j f_{nk}(k_{j,t+1}, n_{j,t+1})\right] \\
&\quad + q_{K',t} \left(\mathcal{D}_t + \mathcal{K}_t\right) \\
&\quad + \beta \mathbb{E}_t \left[\xi_{t+1} \frac{(q_{t+1} - 1) + (1-\delta)\phi}{K_{t+1}}\right] \\
&\quad - \beta \mathbb{E}_t \left[\kappa_{T,t+1} \left((1-\delta)\left[q_{t+1}(1-\tau^{w}_{t+1}) - 1\right] + \frac{(q_{t+1}-1)^2}{2\phi}\right)\right].
\end{aligned} \tag{A86}$$

The term

$$\mathcal{E}^q_t \equiv q_{K',t} \left[\mathcal{D}_t + \mathcal{K}_t\right] \tag{A87}$$

is the current price effect reported in equation (63) of the main text. It is absent from an individual household's capital condition because the household takes q_t as given. The last two expectation terms in (A86) collect the effects of current capital on the next period's price equation, capital-producer rebate, and wealth-tax base.

D Effects of Other Shocks in the Tractable Model

D.1 Effects of Financial Shocks

I consider a financial shock that lowers the tightness of the borrowing constraint θ in period 1. I set aggregate productivity to $z_1 = 1$ so that $f(k) = k^\alpha$ in every period and let the period-1 tightness θ be stochastic from the perspective of period 0. The environment is otherwise identical to the one in Section 3, and the existence of the wealth threshold that distinguishes constrained and unconstrained households holds the same as for the productivity shock. I show that a negative financial shock has effects analogous to those of a negative productivity shock, with the difference that its direct effect operates through the households' debt capacity rather than through their output.

The unconstrained first-order conditions imply that every unconstrained household demands

$$\bar{k}_2 = (f')^{-1}(q_1 R - 1), \qquad \frac{\partial \bar{k}_2}{\partial q_1} < 0. \tag{A88}$$

Under log utility and $\beta R = 1$, an unconstrained household consumes one unit. Matching its bond choice to the borrowing limit gives the wealth threshold

$$\overline{w} = 1 + (1-\theta) q_1 \bar{k}_2, \tag{A89}$$

so households with $\tilde{w}_i < \overline{w}$ are constrained. Differentiating the threshold gives

$$\frac{\partial \overline{w}}{\partial \theta} = -q_1 \bar{k}_2 < 0, \qquad \frac{\partial \overline{w}}{\partial q_1} = -\frac{\alpha q_1 R + 1 - \alpha}{(1-\alpha)(q_1 R - 1)}(1-\theta)\bar{k}_2 < 0. \tag{A90}$$

Unlike the productivity shock, the financial shock raises the wealth threshold directly through $\partial \overline{w}/\partial \theta < 0$, pushing marginal households into the constrained region without any change in output. Combining the first-order conditions with respect to k_{i2} and b_{i2} for a constrained household and totally differentiating with respect to θ, q_1, and k_{i2} gives the direct effect of the financial shock on asset demand:

$$\frac{\partial k_{i2}}{\partial \theta} = \frac{q_1(1 - u'(c_{i1})) + (1-\theta) q_1^2 k_{i2} u''(c_{i1})}{\beta f''(k_{i2}) + (1-\theta)^2 q_1^2 u''(c_{i1})} > 0. \tag{A91}$$

A negative financial shock lowers constrained households' capital demand because it reduces their debt capacity. The price elasticity of capital demand is again smaller for constrained households, exactly as in Lemma 2, since the price effect $\partial k_{i2}/\partial q_1$ does not depend on the source of the shock.

Totally differentiating the market clearing condition gives the effect of the financial shock on the asset price:

$$\frac{dq_1}{d\theta} = \frac{\int_{\mathcal{C}} \left|\frac{\partial k_{i2}}{\partial \theta}\right| di}{\int_{\mathcal{C}} \left|\frac{\partial k_{i2}}{\partial q_1}\right| di + \int_{\mathcal{U}} \left|\frac{\partial \bar{k}_2}{\partial q_1}\right| di} > 0, \tag{A92}$$

so a negative shock to θ lowers q_1. Combining (A90) with (A92) gives

$$\frac{d\overline{w}}{d\theta} = \frac{\partial \overline{w}}{\partial \theta} + \frac{\partial \overline{w}}{\partial q_1}\frac{dq_1}{d\theta} < 0, \tag{A93}$$

so the fraction of constrained households rises as θ falls, through both the direct effect of tighter borrowing limits and the decline in the asset price. Only constrained households change consumption, and differentiating their consumption gives

$$\frac{dC_1}{d\theta} = \underbrace{\int_C \frac{\alpha q_1 f'(k_{i2}) - q_1^2 R + q_1}{f''(k_{i2}) + (1-\theta)^2 q_1^2 R u''(c_{i1})} di}_{\text{Partial equilibrium effect}} + \underbrace{\int_C \frac{f''(k_{i2})k_{i1} - \alpha(1-\theta) f'(k_{i2}) - (1-\theta)}{f''(k_{i2}) + (1-\theta)^2 q_1^2 R u''(c_{i1})} \frac{dq_1}{d\theta} di}_{\text{General equilibrium effect} > 0} > 0. \tag{A94}$$

Thus, a lower θ reduces aggregate consumption. Because period-1 output does not depend on θ, the balance-of-payments identity gives

$$\frac{B_2 - B_1}{R} = -C_1 + Y_1 + \frac{R-1}{R} B_1 \quad \Longrightarrow \quad \frac{d}{d\theta}\left(\frac{B_2 - B_1}{R}\right) = -\frac{dC_1}{d\theta} < 0. \tag{A95}$$

Hence, a negative financial shock increases capital outflow. This sign is unambiguous because the shock changes consumption without changing current output.

Table A18 compares a decline in θ_1 from 0.8 to 0.7 across the two initial wealth distributions. In this numerical example, the constrained fraction rises in both economies while aggregate consumption and the asset price fall more in the economy with the more unequal initial wealth distribution.

TABLE A18: Numerical Results from the Model with Financial Shock

	Baseline	Alternative
Initial Wealth Gini	0.604	0.695
Period 1 Wealth Gini ($\theta_1 = \theta_H$)	0.570	0.644
Constrained Fraction at Period 1 ($\theta_1 = \theta_H$)	37.44%	49.36%
Constrained Fraction at Period 1 ($\theta_1 = \theta_L$)	45.52%	57.60%
$C_1^L - C_1^H$	-2.70%	-3.46%
$q_1^L - q_1^H$	-1.22%	-1.66%

D.2 Effects of Interest Rate Shocks

I consider an alternative version of the tractable model in Section 3. I set aggregate productivity to $z_1 = 1$ and hold the borrowing constraint tightness θ fixed over time, while the period-1 interest rate follows a binary distribution, $R_1 \in \{R_h, R_l\}$, with $R_h > R_l = 1/\beta$. The high interest rate R_h occurs with probability p. The rest of the model is unchanged. I analyze the period-1 crisis dynamics when the interest rate rises.

An individual household is either constrained or unconstrained in equilibrium. As in the main section, there exists a cutoff level of net wealth across the wealth distribution G that separates constrained and unconstrained households. I denote $\overline{w} \equiv \frac{1}{\beta R_1} + (1-\theta)q_1\overline{k}_2$ as the wealth threshold where $\overline{k}_2 = (f')^{-1}(q_1R_1 - 1)$. For constrained households with $\tilde{w}_i < \overline{w}$, the binding collateral constraint implies $b_{i2} = -R_1\theta q_1 k_{i2}$. Combining the first-order conditions with respect to k_{i2} and b_{i2} of the constrained households, I obtain

$$(1-\theta)q_1 u'(\tilde{w}_i - (1-\theta)q_1k_{i2}) = \beta(f'(k_{i2}) + 1 - \theta q_1 R_1), \tag{A96}$$

and capital demand k_{i2} increases with wealth $\tilde{w}_i$. I can decompose the effect of the interest rate shock on the constrained households' asset demand as

$$\frac{dk_{i2}}{dR_1} = \underbrace{\frac{\beta\theta q_1}{\beta f''(k_{i2}) + (1-\theta)^2 q_1^2 u''(c_{i1})}}_{\text{Direct effect} \equiv \frac{\partial k_{i2}}{\partial R_1} < 0} + \underbrace{\frac{\beta\theta R_1 + (1-\theta)(q_1k_{i1} - \tilde{w}_i)u''(c_{i1})}{\beta f''(k_{i2}) + (1-\theta)^2 q_1^2 u''(c_{i1})}}_{\text{Price effect} \equiv \frac{\partial k_{i2}}{\partial q_1} < 0} \frac{dq_1}{dR_1}, \tag{A97}$$

which is obtained from the total differentiation of (A96) with respect to R_1, q_1, and k_{i2}. The price-elasticity comparison can be established directly in the high-interest-rate state. An unconstrained household consumes $1/(\beta R_1)$, while a constrained household consumes less. Hence, when $R_1 = R_h > 1/\beta$, every constrained household satisfies $c_{i1} < 1/(\beta R_h) < 1$. Applying the same algebra as in the proof of Lemma 2, with R replaced by R_h, gives

$$\left|\frac{\partial k_{i2}}{\partial q_1}\frac{q_1}{k_{i2}}\right| < \frac{q_1 R_h}{(1-\alpha)(q_1R_h - 1)} = \left|\frac{\partial \overline{k}_2}{\partial q_1}\frac{q_1}{\overline{k}_2}\right|. \tag{A98}$$

Since $k_{i2} < \overline{k}_2$, this also implies

$$\left|\frac{\partial k_{i2}}{\partial q_1}\right| < \left|\frac{\partial \overline{k}_2}{\partial q_1}\right|. \tag{A99}$$

The direct interest-rate response is also smaller for a constrained household:

$$\begin{aligned}\left|\frac{\partial k_{i2}}{\partial R_1}\right| &= \left|\frac{\beta\theta q_1}{\beta f''(k_{i2}) + (1-\theta)^2 q_1^2 u''(c_{i1})}\right| \\ &< \left|\frac{q_1}{f''(k_{i2})}\right| < \left|\frac{q_1}{f''(\overline{k}_2)}\right| = \left|\frac{\partial \overline{k}_2}{\partial R_1}\right|. \end{aligned}\tag{A100}$$

Totally differentiating the asset-market clearing condition with respect to R_1 and q_1 gives the effect of the interest-rate shock on the asset price:

$$\frac{dq_1}{dR_1} = \frac{\int \frac{\partial k_{i2}}{\partial R_1} di}{\int \left| \frac{\partial k_{i2}}{\partial q_1} \right| di} < 0, \tag{A101}$$

Equation (A101) shows that a rise in the interest rate lowers the asset price. Its effect on the fraction of constrained households runs through two opposing channels. The lower q_1 raises the threshold $\overline{w}$ (Lemma 1, $\partial\overline{w}/\partial q_1 < 0$), while the direct effect $\partial\overline{w}/\partial R_1|_{q_1} = -\frac{1}{\beta R_1^2} + (1-\theta)q_1\frac{\partial\overline{k}_2}{\partial R_1} < 0$ lowers it, since a higher interest rate reduces both unconstrained consumption $1/(\beta R_1)$ and unconstrained capital $\overline{k}_2$. The net change in the constrained fraction is therefore ambiguous and is resolved numerically in Table A19, where it rises.

Under a high interest rate, constrained households' capital demand is less responsive to both asset prices and interest rates than that of unconstrained households. Hence, the absolute values of both the numerator and the denominator in (A101) decrease as the fraction of constrained households increases, and the analytical comparison across wealth distributions has no general sign. Table A19 provides a numerical example in which aggregate consumption and the asset price fall more when the initial wealth distribution is more unequal.

TABLE A19: Numerical Results from the Model with Interest Rate Shock

	Baseline	Alternative
Initial Wealth Gini	0.604	0.695
Period 1 Wealth Gini ($R_1 = R_l$)	0.570	0.644
Constrained Fraction at Period 1 ($R_1 = R_l$)	37.71%	58.35%
Constrained Fraction at Period 1 ($R_1 = R_h$)	38.93%	61.63%
$C_1^{R_h} - C_1^{R_l}$	-2.35%	-2.43%
$q_1^{R_h} - q_1^{R_l}$	-1.98%	-2.00%

E Computation Algorithms

E.1 Algorithm for the Competitive Equilibrium

For the numerical solution, I use the Krusell and Smith (1998) algorithm and approximate the distributional state Γ by aggregate capital K. The resulting approximate aggregate state is (z, R, θ, K), where z is TFP, R is the world interest rate, $\theta \in \{\theta_H, \theta_L\}$ is the tightness of the borrowing constraint, and K is aggregate capital. The individual state variables are the agent's permanent productivity ω, capital k, and bond holdings b passed on from the previous period. I specify the perceived law of motion for aggregate capital as

$$\log K' = a + b \log K + c \log z + d \log R + e\mathbb{I}(\theta = \theta_L), \tag{A102}$$

and solve for the policy functions that are consistent with the law of motion.

1. Generate discrete grids for the aggregate states and individual states.
2. Initialize the coefficients $\boldsymbol{\beta}^{(0)} = (a, b, c, d, e)$ in (A102).
3. Given $\boldsymbol{\beta}^{(j)}$, solve the household's Bellman equation using value function iteration over the full state space.
   (a) For each aggregate state, compute K' from (A102), aggregate investment using $I = K' - (1-\delta)K$, and the price of capital using $q = 1 + \phi I/K$.
   (b) For each individual state, solve for labor using the intratemporal condition.
   (c) For each individual state, maximize over (k', b') subject to the budget constraint and the borrowing constraint until convergence.
4. Using the converged policy functions, simulate a panel of N agents for T periods. In each period, compute aggregate capital as the cross-sectional mean, forecast K' from (A102), and update each agent's individual states using the interpolated policy functions. Aggregate states (z', R', θ') are drawn jointly.
5. Estimate (A102) using the simulated data. Update the coefficient to $\boldsymbol{\beta}^{(j+1)}$.
6. If $\|\boldsymbol{\beta}^{(j+1)} - \boldsymbol{\beta}^{(j)}\| < \varepsilon$, the algorithm has converged. Otherwise, return to step 3.

E.2 Algorithm for the Optimal Commitment Tax

Following an approach similar to Le Grand and Ragot (2025), I approximate the government's optimal policy functions to the first order around the ergodic state associated with each value of θ. The state variables include the household's capital and bond positions, as well as the multipliers carried over from the previous period, which encode the government's past commitments. Each state-contingent ergodic point includes the household allocations, policy variables, and lagged multipliers. The simulation is initialized from this converged ergodic solution, and the lagged multipliers subsequently evolve according to the approximated policy functions.

1. Discretize the permanent productivity distribution and the aggregate shocks z, R, and θ.

2. Solve for the competitive equilibrium and use its allocations and first-order policy functions to initialize the government's problem.

3. Given the current first-order policy functions, solve the government's first-order conditions in Appendix C.5 at the ergodic state associated with each current value of θ.

    (a) For each realization of future aggregate shocks, use the first-order policy function associated with the future value of θ to compute continuation allocations and multipliers and construct the corresponding conditional expectations.

    (b) Solve the full nonlinear system for the current allocation and multipliers, treating the debt tax, wealth tax, and transfers as policy choices.

4. Linearize the government's first-order conditions around the ergodic state associated with each value of θ. Use the resulting policy functions to update the two ergodic states using their implied conditional first moments.

5. Using the converged first-order policy functions, simulate the economy under the sequence of aggregate shocks.