Inequality and Capital Flows in Advanced Economies*

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December 5, 2024

Abstract

Capital flowed out of equal countries and into unequal ones following global financial integration in the 1980-90s. Differences in private savings between countries with low and high-income inequality drive the flows. These findings are at odds with the predictions of standard heterogeneous-agent incomplete-market models. To rationalize the data, we develop a simple framework to analyze the direction of capital flows following international integration. When trading assets is subject to endogenous constraints arising from limited contract enforcement, capital will flow from equal to unequal countries following integration. A calibrated two-country heterogeneous-agent general-equilibrium model with limited enforcement frictions can quantitatively account for the data.

Keywords: Inequality, Current Account, Capital Flows

JEL codes: F32, F41, E21

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*We thank our discussants Christina Arellano, Edouard Challe, and Giancarlo Corsetti, as well as Pierpaolo Benigno, Tobias Broer, V.V. Chari, David Domeij, Tarek Hassan, Oleg Itskhoki, Dirk Krueger, Enrique Mendoza, Dmitry Mukhin, Ugo Panizza, Fabrizio Perri, Morten Ravn, Jesse Shreger, Ludwig Straub, Ivan Werning, and Christian Wolf for valuable discussions. We benefited from valuable feedback from seminar and conference participants at Autonoma Barcelona, Barcelona Summer Forum, BI-Oslo, Bocconi, BoE-BdF-IMF-OECD-BdI Workshop on International Capital Flows and Financial Policies, Bonn-UCL, Bristol, CEMFI, CEPR ESSIM, Columbia, CREI, EIEF, Glasgow, Helsinki GSE, Houston, IIES, Konstanz Seminar on Monetary Theory, LMU, LSE, LUISS, NBER EF&G, MIT, New York Fed, Nottingham, QMUL, Osaka, St. Louis Fed, Stony Brook, Michigan, Oxford, and the 3M's reading group. Support from John Fell Fund, the Ragnar Söderbergs stiftelse, Swedish Research Council Research Project Grant 2023-01635, UKRI Research Frontier Guarantee Funding, and the European Research Council grant No. 759482 under the European Union's Horizon 2020 research and innovation programme is gratefully acknowledged. We thank Lukas Boehnert, Merve Demirel, Maria Eskelinen, and Zhiheng Xu for outstanding research assistance. An earlier version of this paper was circulated under the title "Why Does Capital Flow from Equal to Unequal Countries?"

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1 Introduction

The external positions of advanced economies diverged in the decades following increased financial integration in the 1980s and 1990s, as shown in Figure 1. Caballero et al. (2008) and Mendoza et al. (2009) have shown that differences across countries in their ability to generate financial assets and in their financial market development can explain this divergence. We provide a micro-founded theory that can explain countries' differences in their capacity to generate financial assets and the ensuing divergence in external positions following international financial integration. Our model is motivated by a new stylized fact that we document—that this divergence in advanced economies' external positions is systematically related to income inequality across countries.[1] Figure 2 illustrates our empirical finding: countries with low inequality ran current account surpluses, whereas high-inequality countries ran deficits. For example, from 1990 to 2010, Sweden's cumulated current account to GDP ratio grew by 65 percentage points. By contrast, it fell by 40 percentage points for the U.S. These two countries exemplify the disparity in disposable income inequality across advanced economies. Sweden is among the most equal, and the U.S. is among the least.

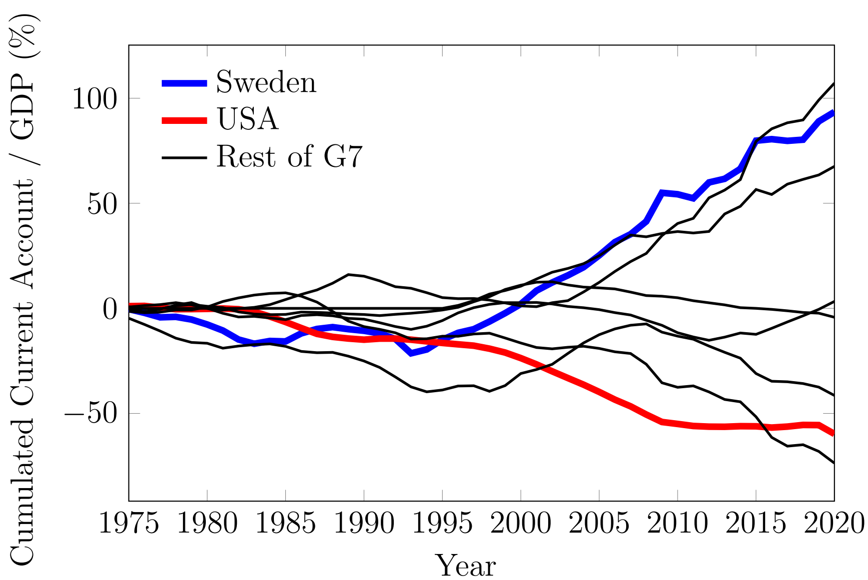

Figure 1: External positions

In this paper, we empirically, theoretically, and quantitatively investigate the relationship

[1]The relationship is weaker for emerging economies. In a previous version of this paper (De Ferra et al., 2021), we perform the same baseline analysis as in this paper for emerging economies. For the rest of this paper we focus solely on advanced countries.

between capital flows and inequality. On the empirical side, we establish new stylized facts related to capital flows and income inequality after taxes and transfers. Our main finding is that following financial liberalization in the 1980s and 1990s, capital has systematically flowed out of equal and into unequal countries. We show that the current account and the trade balance negatively correlate with income inequality. The driving force behind this negative relationship is aggregate saving—which is also negatively correlated with inequality—and not investment. Furthermore, private saving rather than government borrowing explains the negative relationship between aggregate saving and inequality. While our analysis contributes to the growing literature studying the determinants of capital flows across countries, we should emphasize that inequality is only one of many drivers of global imbalances. The relationship between inequality and the current account remains even after adding prominent determinants of savings and the current account. Income inequality can explain about 75% of the residual variation in capital flows.

Next, we establish that the negative relationship between capital flows (and private savings) and inequality also holds for measures of *residual income inequality*. We follow the literature on income process estimation and interpret residual income inequality as a measure of income risk across countries. Higher income risk, therefore, lowers the saving rate in a country, *ceteris paribus*. Finally, we use new measures of income risk from the Global Repository of Income Dynamics (GRID) to show that higher variance and more negative skewness of 1-year and 5-year log income growth lower the current account both in the time series and cross-section of countries. For the theoretical and quantitative analysis, we focus on income risk as the sole driver of income inequality.

To better understand the mechanism underlying the time-series of the aggregate flows, we turn to micro-level data on household savings. Using harmonized household-level data from Europe in the Household Finance and Consumption Survey (HFCS), we show that in more unequal countries, households, on average, have more credit cards and higher unsecured credit balances. Furthermore, we show that borrowing is more concentrated among low-income households in high-inequality countries on both extensive and intensive margins. By contrast, saving rates at the top of the distribution appear identical across countries. Thus, differences in aggregate savings rates appear to be driven by the bottom part of the income distribution.

These micro and macro findings are at odds with the workhorse macro framework for

Figure 2: Income inequality and the current account balance in advanced economies.

inequality—the Bewley-Huggett-Aiyagari-İmrohoroğlu model. When inequality is driven by idiosyncratic income risk, we show that that model predicts capital to flow from unequal to equal countries after opening up.[2] The reason is that higher risk leads to higher precautionary savings and a lower risk-free interest rate. After integration, real interest rates equilibrate across countries, leading the unequal country to lend to the equal one. Furthermore, at the micro level, the workhorse model predicts less debt among low-income households in the unequal country, the opposite of the data. The failure of the model to explain the data arises from the combination of uncontingent assets and an exogenous borrowing limit. To explain the data, we next show theoretically and quantitatively that a model with state-contingent assets and endogenous borrowing constraints can match the micro and macro data.[3]

Using a simple two-country framework, we explain why capital flows from a more equal to a equal country following international financial integration. When markets are integrated,

[2] If all of inequality is due to permanent income differences and preferences are homothetic, there are no capital flows across countries after liberalization.

[3] This result is reminiscent of the findings in Kehoe and Perri (2002), which show that introducing imperfectly enforceable loans can help explain empirical correlations that are at odds with the standard predictions of international business cycle models. Here, the context is different—capital flows along transitional dynamics instead of business cycle correlations.

savers in equal countries can lend to borrowers in unequal ones. Asset supply is endogenously more abundant in unequal countries because the harsher penalty of default leads to more risk-sharing opportunities. In the model, capital flows are necessarily bilateral between the two economies. The theoretical mechanism we described above is robust to the introduction of a third country (or "rest of the world") with a high current account surplus. In that setting, the more unequal advanced economy would still have a lower current account than its more equal peer. We develop a model with endogenous debt constraints, building on earlier work (Kehoe and Levine, 1993, 2001; Kocherlakota, 1996; Alvarez and Jermann, 2000; Krueger and Perri, 2006; Ligon et al., 2002), where we can analytically characterize capital flows after financial integration. The model features two countries, each inhabited by households that face idiosyncratic income risk. Countries differ in the extent of income inequality due to differences in the severity of income risk—one high-inequality country and one low-inequality country. Households have access to a complete set of state-contingent assets. We assume households can default on their obligations at the expense of being excluded from financial markets. Following Alvarez and Jermann (2000), we show that the option to default leads to endogenous borrowing limits on the securities households can trade.

We begin by solving for the closed economy equilibrium of the two countries. As in Krueger and Perri (2006), higher inequality leads to a looser borrowing constraint.[4] As a result, the gross asset supply and the risk-free rate are higher in the high-inequality country than in the low-inequality one. Thus, higher inequality leads to more risk-sharing opportunities. Next, we study the implications of financial integration by allowing households to trade securities across borders. We analytically characterize the transition from closed-economy steady states to the new open-economy steady state. The transition takes place in two periods. When international financial markets integrate, no arbitrage implies that interest rates across countries must equalize. At the new prices, savers in the low-inequality country face a higher interest rate and increase their savings by lending to borrowers in the high-inequality country, who face a lower interest rate and increase their borrowing. The equal country thus runs a current account surplus, and the unequal one a deficit. Hence, international financial integration generates a negative relationship between the current account and income inequality *along the transition.*

[4] We also show in the appendix that, holding inequality constant, more negative skewness of log-income changes leads to a looser borrowing constraint, consistent with our empirical findings from the GRID data.

In the stationary allocation of the open economy, the equal country holds external assets vis-à-vis the unequal country.

Finally, we show that a quantitative extension of the simple model is consistent with the stylized empirical facts established in the paper. We extend the simple two-country model to have a continuum of agents that face a rich, country-specific, stochastic labor income process. We calibrate these income processes to match inequality measures across equal and unequal countries. In particular, we calibrate the unequal country to the United States and the equal country to an average of European countries with low income inequality in our sample. As in the simple model, we assume that households have access to a full set of Arrow securities and that the borrowing constraints are determined such that no households default in equilibrium, as in Alvarez and Jermann (2000). In the closed economy steady states, the unequal country has looser borrowing constraints and, as a result, a higher risk-free interest rate than the equal country. We then perform the same experiment as the simple model, solving for the transition path from two closed economies to the two-country open economy steady state. Along the transition of the quantitative model, households in the unequal country accumulate debt vis-à-vis the equal country, resulting in persistent current account deficits in the unequal country and surpluses in the equal country. Two forces drive the result. First, as in the theoretical model, the equalization of interest rates across countries leads to savers in the equal country saving more and borrowers in the unequal one borrowing more. Second, that mechanism is amplified as borrowing constraints endogenously relax in the unequal country since households can sustain more debt at the new, lower steady-state real interest rate. Quantitatively, the model can explain about 40% of the capital flows documented in the empirical section.

Literature Our paper contributes to a vast literature investigating the causes and directions of international capital flows beginning with the seminal contribution of Lucas (1990). One prominent explanation proposed by Mendoza et al. (2009) and Caballero et al. (2008) show how differences in financial market development and in the ability to generate financial assets across countries may lead to current account imbalances. Our work builds on those important contributions, showing that heterogeneity in income inequality across countries contributes to differences in the extent of risk-sharing and their asset supply, and thus to the observed pattern of current account deficits and surpluses. Broner and Ventura (2011) and Broner and

Ventura (2016) study the effects of financial liberalization on capital flows, risk sharing, and welfare, when countries are heterogeneous and differ, in particular, in terms of the degree of enforcement of debt contracts. Broner et al. (2010) study the interaction between default penalties, international capital flows and the depth of financial markets. Our work builds on the strand of the literature, as we study how income, consumption risk, and the depth of financial markets are jointly determined, thereby influencing the direction and magnitude of international capital flows.

Our model with heterogeneous households builds on the contribution by Krueger and Perri (2006) and previous work by Alvarez and Jermann (2000) and Kehoe and Levine (2001). Our two-country, general-equilibrium theoretical framework includes analyzing steady states and the transition path following international financial integration. It characterizes consumption inequality in each country, international asset positions, and capital flows before, during, and after integration. We focus on how cross-country differences in income inequality lead to differences in their external borrowing. Our findings complement those of Krueger and Perri (2006), who instead focus on the response of consumption inequality to the increase in income inequality in a closed economy (the United States) over time. [5] We also complement the work of Broer (2014), who studies an open-economy version of Krueger and Perri (2006) and performs comparative statics on the world interest rate and the degree of income risk for the U.S. current account. We share the theoretical mechanism linking asset supply and inequality as the previous two papers, but our focus is on the impact of international financial integration for capital flows across countries in general equilibrium. Mian et al. (2020a) propose a theory linking wealth inequality to aggregate demand and aggregate savings. They also provide evidence in Mian et al. (2020b) showing that, within the United States, States with higher wealth inequality display a higher ratio of wealth to income. Our evidence, instead, shows that across countries, economies with higher income inequality have lower private savings. We view our paper as complementary to theirs for two reasons. First, we provide a micro-foundation for their exogenously assumed relaxation of borrowing constraints over time. Second, whereas we focus on cross-sectional differences in the response to a global shock (international financial integration), their results focus on changes over time within a country. Our paper is also

[5] See Aguiar and Bils (2015) for an alternative interpretation of the link between consumption and income inequality in the United States.

complementary to Auclert et al. (2021a), who study demographics as a driver of differential savings across countries leading to global imbalances, whereas we focus on the variation in capital flows that is not explained by demographics.

From an empirical point of view, Lane and Milesi-Ferretti (2007) is a seminal contribution, providing a comprehensive dataset on countries' external asset and liability positions. Alfaro et al. (2014) document that the direction of international capital flows strongly depends on whether the flows involve transactions within the sovereign and the private sector. We build on that important insight and we show that inequality has significant implications for saving by the private sector, but not for government saving. Ranciere et al. (2012) also analyzes the relationship between trends in income inequality and in countries' external balance. The empirical analysis in our paper differs in that we are able to identify a systematic relationship between the long-run average current account balance of a country and its average degree of income inequality in the sample period. Instead, that paper focuses on short-run changes over time in the two variables within each country, by considering data at a yearly frequency. Moreover, we are able to shed light on the forces driving the relationship of inequality with the current account, decomposing the latter in its components, highlighting the strong relationship of inequality with private savings and the lack of an effect on investment or on public saving.

This paper also contributes to the burgeoning literature studying monetary and exchange rate policy with heterogeneous households in open economies begun by de Ferra et al. (2020), who combined the incomplete markets framework of Bewley-Huggett-Aiyagari-Imrohoroglu with the small open economy framework of Gali-Monacelli to study how changes in the distribution of foreign-currency debt holdings determined the magnitude of the effects of a contraction in capital inflows. That literature (inter alia, Guo et al., 2023; Ferrante and Gornemann, 2022; Auclert et al., 2021b; Hong, 2020; Oskolkov, 2023; Guntin et al., 2023) details how inequality across households in terms of income, wealth and access to financial markets shapes the aggregate response of open economies to external shocks, and the different implications of alternative monetary policy regimes. Relative to those papers studying flows at business-cycle frequencies, our focus is on the relationship between income inequality and capital flows across countries when measured over a long period of time and in response to financial liberalization.

The rest of the paper is organized as follows. We outline our empirical analysis in Section 2. Section 3 presents our theoretical framework and analytical results. In Section 4 we lay out the quantitative model, its calibration, and the results of the quantitative experiments. Finally, Section 5 concludes.

2 Empirical Analysis

How does capital flow when equal and unequal countries become more integrated in global financial markets? In this section, we answer this question for advanced economies. We document a negative relationship between income inequality and the current account balance and decompose its determinants. The decomposition shows that private saving is the main driver of the relationship between the current account and income inequality. Finally, we show that international differences in income risk, which contribute to differences in income inequality, are an important determinant of private saving.

Inequality and current account balance. To carry out our empirical analysis, we compile a panel data set for advanced economies that combines information from national accounts with data on income inequality.[6] Our focus is on the period of buoyant capital flows between 1995 and 2010. Our primary measure of inequality is the Gini index for income net of taxes and transfers, but we show that our results are robust to other common inequality measures.

We estimate a linear regression model to document the relationship between inequality and capital flows. We do not interpret the regression coefficients as causal, merely as a way to account for the systematic relationship between the variables. The dependent variable is the current account balance-to-GDP ratio of individual countries. The Gini index for income net of taxation is the independent variable of interest. To study the impact of income inequality at the time of financial integration on the ensuing pattern of capital flows, we consider the average value of Gini from 1990 to 2000.[7] For capital flows, we consider the fifteen-year average in our period of interest, from 1995 to 2010. Our focus is thus the direction of capital flows across countries with differing levels of inequality after financial integration, as opposed to studying how changes in inequality within countries over time affect capital flows.[8] We also include a

[6]We draw data on inequality from the World Income Inequality Database released by UNU-WIDER—the only dataset that provides a long time-series measure of income inequality comparable across countries.

[7]Our choice of time period is driven by limited data availability for the Gini index before 1990 for a broad panel of countries.

[8]Broer (2014) shows that increases in income inequality in the US in the 1980s are correlated with more neg-

vector of controls for other determinants of the current account: measures of the demographic structure, the size of the government sector, GDP growth, dummies for the reliance of exports on mineral resources or fossil fuels, and continent fixed effects.[9] Formally, we estimate the following regression for country i:

$$Y_i = \alpha + \beta Gini_i + \gamma' X_i + \epsilon_i, \tag{1}$$

where X_i is the vector of controls. We weight countries by their GDP to give a proportionally larger weight to major economies and ensure that results are invariant to grouping countries.[10]

The first column of Table I displays the results of this analysis: Unequal countries run larger current account deficits, on average. The coefficient on the Gini index is -0.741: going from Swedish to US levels of inequality implies a roughly ten percentage point reduction in the current account (relative to GDP), approximately the difference in the current accounts between the two countries. Income inequality explains more than 52% of the residual variation in the current account, as measured by the adjusted R^2 (after controlling for the other determinants), and roughly 27% of the total variation. What lies behind this negative correlation between income inequality and the current account? We investigate this question next, by looking at the relationship between inequality and individual components of the current account.

From current account to private saving. The negative correlation between private saving and inequality is the key driver of the relationship between inequality and capital flows. We establish this using a series of accounting identities to unpack the relationship between current account and inequality. First, we recognize that the current account is equivalent to the trade balance plus the change in return on foreign assets. Next, we decompose the trade balance into saving and investment. Finally, we decompose saving into public and private saving:

$$TB = \underbrace{GDP - C - G}_{S} - I = S^{Private} + S^{Public} - I.$$

ative current account deficits. Our results are complementary to his, since we focus on all advanced economies in the cross-section, as opposed to one country in the time-series.

[9] Where relevant, we also average these controls over the period 1995-2010.

[10] Our results are robust to weighing all countries equally.

Table I: Main Regression

	Current Account	Trade Balance	Saving	Investment	Private Sav.	Public Sav.
Gini (Net income)	-0.741	-0.982	-1.314	-0.332	-0.933	-0.435
	(0.126)	(0.150)	(0.258)	(0.238)	(0.207)	(0.092)
GDP Growth	-0.293	0.429	1.880	1.450	0.5841	.539
	(0.510)	(0.656)	(0.750)	(0.580)	0.843)	((0.618)
Dependency ratio	-0.143	0.0136	0.201	0.188	0.127	0.151
	(0.231)	(0.303)	(0.368)	(0.205)	(0.372)	(0.267)
Gov. exp. (% GDP)	0.078	-0.148	-0.814	-0.666	-0.589	-0.240
	(0.230)	(0.299)	(0.377)	(0.255)	(0.414)	(0.182)
Fuel exporter	3.850	0.0365	-1.933	-1.969	-2.635	0.163
	(7.102)	(8.745)	(7.420)	(2.409)	(4.703)	(3.679)
Resource exporter	0.520	-3.037	-1.928	1.109	4.091	-6.417
	(0.972)	(1.255)	(1.482)	(1.069)	(1.580)	(1.048)
Intercept	26.99	33.07	63.78	30.70	55.49	7.031
	(6.216)	(7.656)	(11.97)	(11.22)	(11.72)	(8.506)
N	21	21	21	21	21	21
adj. R-sq	0.755	0.634	0.815	0.749	0.858	0.749

Estimates of the parameters in regression (1). Standard errors in parentheses. The column header indicates the dependent variable Y_i in the individual regressions. Section A.1 describes the data sources and additional details.

We estimate the same linear regression from (1) changing the dependent variable to the trade balance, aggregate saving, investment, public saving and private saving (all relative to GDP). The results of the regressions are in Table I, columns two through six, respectively.

The trade balance is also negatively correlated with inequality. The strength of the relationship is similar to that from the current account regression, indicating our results are driven by the trade balance, as opposed to returns on foreign assets. A negative correlation between the trade balance and income inequality can be driven either by a negative relationship between savings and inequality or a positive relationship between investment and inequality. The coefficients in columns three and four of Table I indicate a strong negative relationship between inequality and aggregate saving, while the correlation between inequality and investment is negative but insignificant. Interestingly, the correlation between saving and inequality is higher than that between trade balance and inequality. Also, when the dependent variable is saving, Gini explains almost 40% of total variation (and 67% of the residual variation).

Finally, we decompose the relationship between inequality and aggregate saving into public and private saving to determine the extent to which differences in fiscal policy may be driving the results. We present these results in the last two columns of Table I. Private savings drive the majority of the relationship between inequality and aggregate savings. While it's true that public savings is negatively correlated with inequality in our baseline sample, we show next that this result is not robust to alternative samples of countries nor measures of inequality. Let us go back to the regression of private savings on inequality.

Our baseline results are robust to the sample of countries considered and the measure of inequality used. We present the results of robustness exercises in Tables II and III. In particular, we verify that the United States is not the sole driver of our results. To do so, we run our suite of regressions without the United States. All the coefficients, except the one for public savings, are larger in magnitude than the baseline. The relationship also holds when restricting to the set of tightly integrated countries in the European Economic Area (EEA). We perform our analysis on the subset of advanced economies in the EEA, as well as on all countries in the EEA (which adds). Finally, as there are multiple ways to measure the extent of income inequality within a country, we consider other commonly used measures, namely the 90/50, 90/10, and 50/10 income ratios. Results are robust to these specifications.

Table II: Alternative Country Samples

	Baseline	Excluding USA	EEA (Advanced)	EEA (All)
Current Account	-0.741	-0.825	-0.810	-0.656
	(0.126)	(0.254)	(0.256)	(0.133)
R^2	0.755	0.518	0.461	0.536
Trade Balance	-0.982	-1.080	-1.072	-0.810
	(0.150)	(0.303)	(0.316)	(0.154)
R^2	0.634	0.258	0.349	0.412
Aggregate Saving	-1.314	-1.500	-1.532	-0.975
	(0.258)	(0.403)	(0.408)	(0.344)
R^2	0.815	0.567	0.494	0.240
Investment	-0.332	-0.420	-0.461	-0.165
	(0.238)	(0.391)	(0.388)	(0.270)
R^2	0.749	0.656	0.299	0.216
Private Saving	-0.933	-1.025	-1.153	-0.792
	(0.207)	(0.301)	(0.310)	(0.249)
R^2	0.858	0.740	0.665	0.409
Public Saving	-0.453	-0.184	-0.379	-0.205
	(0.092)	(0.167)	(0.164)	(0.141)
R^2	0.749	0.672	0.225	0.176
N	21	20	14	

[a] Estimates of the parameter β in regression (1). The first column replicates the baseline estimates for advanced countries presented in Table I. The second column presents estimates from an alternative specification where the United States is excluded from the sample. The third column presents estimates for the advanced sample comprising only countries belonging to the European Economic Area. The fourth column includes all countries in the EEA (this includes countries classified as Emerging Economies, which explains the increase in the number of observations). Standard errors in parentheses. The row header indicates the dependent variable Y_i in the individual regressions. Section A.1 describes the data sources and additional details.

Table III: Alternative Inequality Measures

	Baseline	50/10 income ratio	90/10 income ratio	90/50 income ratio
Current Account	-0.741	-11.98	-3.961	-17.42
	(0.126)	(3.561)	(0.866)	(3.769)
R^2	0.755	0.712	0.797	0.810
Trade Balance	-0.982	-15.55	-5.259	-23.67
	(0.150)	(4.621)	(1.074)	(4.297)
R^2	0.634	0.629	0.768	0.820
Aggregate Savings	-19.26	-1.500	-6.680	-30.96
	(0.258)	(5.935)	(1.465)	(4.977)
R^2	0.815	0.631	0.801	0.898
Investment	-0.332	-3.718	-1.421	-7.285
	(0.238)	(3.256)	(1.245)	(6.547)
R^2	0.749	0.327	0.382	0.440
Private Savings	-14.74	-1.025	-4.857	-21.34
	(0.207)	(3.724)	(1.035)	(4.872)
R^2	0.858	0.679	0.801	0.820
Public Savings	-5.749	-2.161	-0.205	-10.57
	(0.092)	(0.167)	(0.554)	(1.682)
R^2	0.749	0.683	0.779	0.851
N	21	17	17	17

[a] Estimates of the parameters in regression (1). The first column replicates the baseline estimates for advanced countries presented in Table I. The second, third and fourth columns present estimates from alternative specifications where we use the 50/10, 90/10 and 90/50 income ratios, respectively, as proxy for inequality. Standard errors in parentheses. The row header indicates the dependent variable Y_i in the individual regressions. Section A.1 describes the data sources and additional details.

Countries with higher income inequality have lower private saving on average and also run current account deficits. But why? Aggregate data alone cannot speak to the underlying determinants of these empirical regularities. To make progress, we first turn to micro data on income and saving across countries to help complete the picture of what drives differences in saving and capital flows.

2.1 From Inequality to Risk

So far, we have focused on the relationship between inequality measures and capital flows. Both permanent differences and income risk across households drive inequality in income. We perform two additional exercises to better understand whether permanent differences or risk drive our correlations between inequality and saving. First, we construct a proxy for income risk across countries and study its correlation with capital flows. Second, we use measures of income risk from the Global Repository of Income Dynamics (GRID) database and study their correlation with capital flows in the cross section and time series.

Measuring income risk across countries presents several challenges, which motivated the baseline analysis using raw inequality measures. First, we have access only to cross-sectional data.[11] Hence, we cannot use changes in income to estimate income processes across countries. Second, only a subset of countries provide data at the household level.

Income risk in LIS data Despite these challenges, we create a proxy for income risk for seventeen countries. We run Mincer-style regressions with standard covariates[12] using harmonized microdata from Luxembourg Income Study Database (LIS).[13] One of the strengths of the LIS data is that it provides measures of disposable income after taxes and transfers, which is directly comparable to our baseline inequality measure (and the relevant unit of analysis for household consumption and savings). We then treat the residuals from the Mincer regressions as our proxy of income risk, as is standard in the income-process estimation literature. Then, for each year and each country, we compute the Gini coefficient of the residual income as our measure of income risk in each country. We then perform the same empirical analysis with this measure of inequality. Table IV reports the results.

[11] For some countries, we can access panel data. However, the group of countries is not big enough to run a cross-country regression.

[12] We regress the income of each individual against a dummy for their age, gender, and immigrant status (if present in the dataset), a dummy for marital status, a dummy for the maximum education level achieved and an interaction between the education level achieved and age.

[13] The full documentation of the data is available here `https://www.lisdatacenter.org/our-data/lis-database/`.

Table IV: From Income Inequality to Risk in LIS Data[a]

	Gini on Household Income Net of Taxation		
	Baseline	Baseline (subset)	Residual
Trade Balance	−0.982	−0.923	−0.986
	(0.150)	(0.152)	(0.393)
R^2	0.634	0.590	0.548
Aggregate Savings	−1.314	−1.287	−1.556
	(0.258)	(0.314)	(0.214)
R^2	0.815	0.718	0.822
Private Savings	−0.933	−0.982	−1.183
	(0.207)	(0.228)	(0.130)
R^2	0.858	0.778	0.893
N	21	17	17

[a] Estimates of the parameter β_j in regression (1) for advanced economies, with income inequality or income risk as dependent variable. The first column replicates the baseline estimates for advanced countries presented in Table I. The second columns presents the estimate of the regression (1) for a subset of advanced economies for which LIS microdata are available. The third column presents the estimates of the regression (1) where we use our measure of income risk, the Gini index on the residual of the Mincer regression, instead of Gini on income net of taxation. Standard errors in parentheses. The row header indicates the dependent variable Y_i in the individual regressions. Section A.1 describes the data sources and additional details.

The first column reports the baseline regression and the second column reports the regression results on the subset of countries for which we have income risk measures. Finally, the last column reports the regression on our constructed measure of income risk. Our measure of income risk correlates negatively with all the dependent variables. Further, the aggregate and private savings coefficients are slightly larger in magnitude, which is consistent with the theory that we propose in the following section. If the causal mechanism for why higher inequality leads to lower saving is via a risk channel, the baseline coefficient should be attenuated toward zero, which is consistent with the coefficient on our residual measure increasing in magnitude.

Income risk in GRID data Recently, the GRID database has provided harmonized measures of income risk across countries. The key advantages of GRID are that the data are panels and based on high-quality administrative tax data, mitigating concerns of measurement error. The downsides of GRID are that it only provides individual measures of pre-tax labor earnings, as opposed to household measures of income after taxes and transfers, and it is only available for nine advanced economies over a shorter time horizon than LIS (starting between 1983 and 2005, depending on the country). The income risk measures provided from the GRID data are 1-year and 5-year variance and skewness of log-income changes. On the smaller set of GRID countries, we find a very similar relationship between inequality and the current account: running our baseline regression on the restricted sample, we get a coefficient of -0.779 (s.e. 0.145). If, instead, we control for measures of income risk from GRID, we find that the variances of income changes are associated with lower current accounts. We obtain coefficients of -39.57 (s.e. 17.62) and -19.16 (s.e. 22.81) on the variance of 1-year and 5-year income changes, respectively. The sign is consistent with the higher risk leading to lower savings. The skewness of income changes is positively associated with the current account, we obtain coefficients of 2.73 (s.e. 7.57) and 5.28 (s.e. 2.38) on the skewness of 1-year and 5-year income changes, respectively. The sign is again consistent with higher risk leading to lower savings: a positive coefficient means that more negative skewness—or income growth that's more skewed to declines instead of rises—leads to less savings. We show in Appendix D that in models with endogenous borrowing constraints, more negative skewness is associated with more risk-sharing, consistent with these empirical findings.

Panel Analysis in GRID data Finally, our empirical analysis has focused on comparing long-run averages of inequality measures and capital flows across countries. A concern is that the results could be confounded by constant unobserved differences across countries (e.g., culture, etc.). We performed a panel analysis using the GRID data to alleviate such concerns. We run a panel version of our baseline regression, which includes country fixed effects.[14]. Repeating the same analysis as in the cross-section, we again find that variances of income changes are associated with lower current accounts: we obtain coefficients of -34.03 (s.e. 16.01) and -30.20 (s.e. 7.99) on the variance of 1-year and 5-year income changes, respectively. Standard

[14]As such, we omit any constant control variables over the panel

errors are clustered at the country level. Similarly, we find that the skewness of income changes is positively associated with the current account: we obtain coefficients of 1.45 (s.e. 0.59) and 5.78 (s.e. 1.20) on the skewness of 1-year and 5-year income changes, respectively. The income risk measures also explain around 30% of the current account variation, as explained by the R^2. Thus, income risk and capital flows are tightly linked in the cross-section and time series.

2.2 Inequality and Financial Markets

Finally, we explore in the microdata from the Household Finance and Consumption Survey (HFCS) how saving and borrowing across the distribution depends on the level of income risk within a country. The HFCS are harmonized microdata across 18 eurozone countries plus Hungary and Poland. The survey contains detailed data on household consumption, income, and, wealth. We use the 2016 wave of the survey, which contains the greatest coverage in terms of variables and countries.

First, we compute ratios of savings to income for households across the income distribution. We sort countries into two groups based on whether they are above- or below-median income risk. We plot the distributions for the two groups in Figure 3. Unsurprisingly, the saving rate is increasing in income, in the distribution of both groups of countries. However, the saving rate is significantly lower in the bottom two quintiles of the income distribution in unequal countries. The saving rate is even negative for the lowest quintile in unequal countries, while it's positive for the equal countries. These findings are consistent with low-income households borrowing more in unequal countries than their counterparts in equal countries.

Second, we try to understand what drives the greater indebtedness of low-income households in unequal countries. We estimate the relationship between measures of household indebtedness in the HFCS data and income inequality. Table V presents the results. The more unequal a country, households are likely to have: 1) more credit cards, 2) higher credit card balances, 3) greater debt, 4) greater unsecured debt, and 5) higher leverage. We interpret these findings as evidence that households in unequal countries face looser borrowing limits, have greater access to unsecured borrowing, and borrow more, motivating the theoretical mechanism proposed below.

Motivated by these findings in the aggregate and microdata, we write down a theory that is

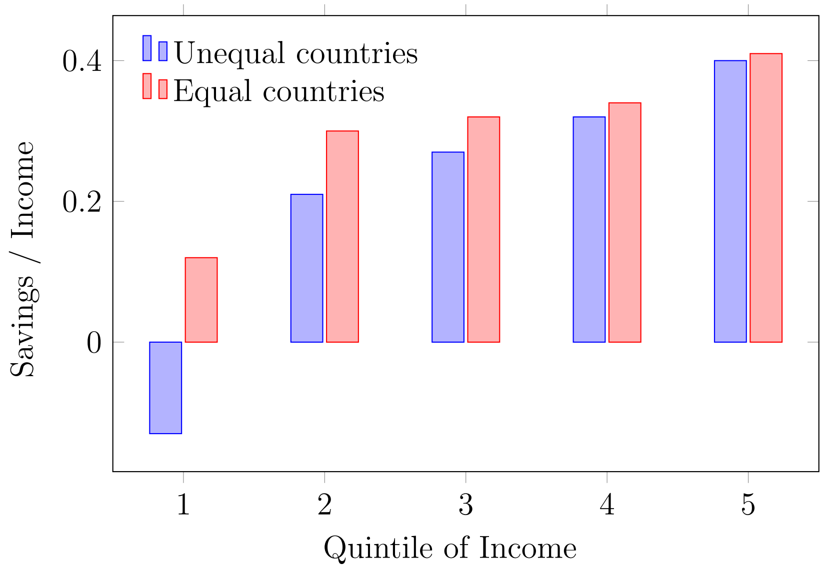

Figure 3: Evidence from HFCS data. Ratios of savings to income for households in the five quintiles of the income distribution. The red and blue bars represent the data for household in countries with above- and below-median income inequality, respectively.

consistent with the evidence and can rationalize the relationship between the observed capital flows and income inequality.

Table V: Income inequality and measures of household indebtedness.[a]

	Gini After-tax HH Income
Numer of credit cards	1.89
	(0.03)
Credi card balances / income ratio	0.13
	(0.01)
Debt / income ratio	1.33
	(0.02)
Non-mortgage loans / income ratio	0.32
	(0.01)
Debt / asset ratio	0.35
	(0.01)

[a] Parameter estimates from a linear regression of measures of household indebtedness on countries' Gini indices for income net of taxation. The row header indicates the dependent variable Y_i in the individual regressions. Standard errors in parentheses. Standard errors in parentheses. Data are from the HFCS 2016 wave.

3 Theory

We now propose a simple theory that can rationalize our empirical evidence on capital flows and income inequality. The model is an extension of the textbook treatment of the pure-exchange limited-commitment model in Chapter 22 of (Ljungqvist and Sargent, 2018), based on the contributions of Kehoe and Levine (2001) and Krueger and Perri (2006).[15] We extend that closed economy setting to feature heterogeneous countries that differ in the severity of income risk, thus giving rise to international differences in income inequality. Heterogeneous households that differ in their income and wealth levels inhabit each country. Households can trade goods and financial assets either domestically or, when markets are internationally integrated, with foreign residents. In this section, we lay out the environment of the model economy, the market structure and the optimization problem that households face. Next, we characterize two stationary equilibria of the model economy: first, when countries are closed to international trade; and, second with international integration of goods and financial markets. In the closed economy, greater income risk in the unequal country makes borrowing constraints looser and results in greater asset supply than in the equal country. Under international integration, the equal country holds positive external assets vis-à-vis residents of the unequal country. Finally, we characterize the transition from the stationary allocation under closed economy to the one under international integration. Along the transition, when international integration occurs, the unequal country runs a current account deficit, accumulating external liabilities vis-à-vis the equal country. This result in the model economy closely mirrors our empirical findings.

3.1 The Model

The world economy comprises two countries, $i = 1, 2$. Time is discrete and indexed by $t = 0, 1, \ldots, \infty$. Each country is inhabited by two ex-ante identical households, indexed by j. There is a single, homogeneous perishable consumption good that can be traded across households in every country. We examine two contrasting scenarios regarding international trade in goods and assets. First, in the closed economy scenario, no international trade takes place. Second,

[15]Our modeling choice of unsecured contracts is motivated by the advanced economy setting, where unsecured debt contracts are prevalent. In the context of emerging markets, secured borrowing contracts are the predominant form of credit access, as in Mendoza et al. (2009); Buera et al. (2011); Moll et al. (2017).

in the international integration scenario, households can freely trade goods and assets with residents of any country without any frictions.

Resources. Household j in country i receives a stochastic endowment $y_{j,i,t}$ of consumption good in period t. The endowment realizations follow a symmetric two-point Markov process with persistence π. We denote the two endowment realizations as $y_{H,i}$ and $y_{L,i}$ for high (H) and low (L). Formally, $y_{j,i,t} \in \{y_{H,i}, y_{L,i}\}$, with $y_{H,i} > y_{L,i}$.

Endowment realizations are perfectly negatively correlated across households. In each country, when one household receives a high endowment, the other receives a low endowment: $y_{j,i,t} = y_{H,i} \leftrightarrow y_{\hat{j},i,t} = y_{L,i}$, with $j \neq \hat{j}$. Hence, with probability π all households will retain in the next period their current endowment realization, and with probability $1 - \pi$ they will all switch. This process for the endowment defines the aggregate state variable x, which can take two possible values: N and S. $x = N$ when no household switches endowment realization, and $x = S$ when they all switch. Endowment switches are perfectly synchronized across countries: if households in country 1 switch endowment values ($x = S$), households in country 2 also switch. [16]

We define the two endowment levels as $y_{H,i} = y(1 + \epsilon_i)$ and $y_{L,i} = y(1 - \epsilon_i)$. The two possible values for the endowment typically differ across countries: $\epsilon_1 \neq \epsilon_2$. Thus, ϵ_i captures the degree of income risk and income inequality in country i.[17] Without loss of generality, we define country 1 as the one with low income inequality, so that $\epsilon_1 < \epsilon_2$. In each country, the total endowment equals $y_{H,i} + y_{L,i} = 2y$.

We restrict attention to economies where the degree of income inequality is sufficiently high. Specifically, we impose that $\epsilon_1 > \epsilon^*$. The threshold ϵ^* is defined as the degree of income risk beyond which welfare is decreasing in income risk, for a household that consumes her endowment in every period and who has a high endowment realization in the current period.

[16] We make the assumption of perfect correlation across countries to analytically characterize the transition dynamics. We have verified numerically that the qualitative properties of capital flows along the transition are not sensitive to this assumption.

[17] The variable y is simply a scaling factor.

Preferences. The following lifetime utility function represents household preferences:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u\left(c_{j,i,t}\right) \tag{2}$$

where β is the subjective discount factor, $c_{j,i,t}$ is consumption of household j in country i at time t and $u\left(\cdot\right)$ is the period utility function which takes the standard CRRA form.

Asset Markets and Autarky. Households can trade state-contingent securities with each other. In each period, the budget constraint of household j, i is given by:

$$c_{j,i,t} = y_{j,i,t} - b_{j,i,t}\left(x_t\right) + \sum_{x_{t+1} \in \{N,S\}} q_{i,t}\left(x_{t+1}\right) b_{j,i,t+1}\left(x_{t+1}\right), \tag{3}$$

where $b_{j,i,t}$ denotes debt that the household owes at the beginning of period t. This debt is contingent on whether in the current period endowment realizations switch or not, as summarized by the state variable x_t. $b_{j,i,t+1}\left(x_{t+1}\right)$ is the amount of securities that the household issues in period t contingent on whether in the next period endowment realizations will switch or not– i.e. the next-period realization of the aggregate state x. Households can thus transfer different amounts of resources to the next period, depending on whether their endowment realization will be high or low. The vector of unit prices of the state-contingent securities is $q_{i,t}\left(x_{t+1}\right)$.

An asset-issuance constraint $\bar{b}_{i,t+1}\left(y_{j,i,t}, x_{t+1}\right)$ bounds the amounts of state-contingent debt that the households can issue in each period:

$$b_{j,i,t+1}\left(x_{t+1}\right) \leq \bar{b}_{i,t+1}\left(y_{j,i,t}, x_{t+1}\right). \tag{4}$$

The constraint depends on the next-period state on which the security is contingent, and on the current endowment realization. Furthermore, this constraint can vary across countries and over time, and it is therefore indexed by i and t. The constraint emerges because households have the option to renege on their liabilities, as we detail below in (7) and (8). When a household reneges on her liabilities, she is permanently excluded from financial markets and enters financial autarky. In autarky, a household's consumption is equal to her endowment in all periods and states of the world: $c_{j,i,t} = y_{j,i,t} \forall t$.

Household Problem. In each period, households maximize their welfare subject to their budget and asset-issuance constraints. Adopting recursive notation, the maximization problem defines the following value function:

$$
\begin{aligned}
V_i\left(y_{j,i}, b_{j,i}, \Omega\right) = \max_{c_{j,i}, b'_{j,i}(x')_{x' \in \{N,S\}}} & \left\{u\left(c_{j,i}\right) + \beta\left[\pi V_i\left(y_{j,i}, b'_{j,i}\left(N\right), \Omega'\left(N\right)\right)\right.\right. \\
& \left.\left. + \left(1-\pi\right) V_i\left(y_{i,\hat{j}}, b'_{j,i}\left(S\right), \Omega'\left(S\right)\right)\right]\right\} \\
\text{s.t. } & c_{j,i} = y_{j,i} - b_{j,i}\left(x\right) + \sum_{x' \in \{N,S\}} q_i\left(x'\right) b'_{j,i}\left(x'\right), \\
& b'_{j,i}\left(x'\right) \leq \bar{b}_i\left(y_{j,i}, x', \Omega\right), \\
& \Omega'\left(x'\right) = \Xi\left(x', \Omega\right).
\end{aligned} \tag{5}
$$

The state variables in the household problem are the current endowment realization $y_{j,i}$, the level of debt $b_{j,i}$ and the distribution of assets across households Ω_i, which is an aggregate state variable. The continuation value incorporates an expectation over the next-period realizations of the state variable x, which can take values N or S. In the former case, the next-period endowment realization equals the current-period one, in the latter case it switches value. The severity of the asset-issuance constraint $\bar{b}_i$ also depends on the aggregate state variable Ω_i, as do asset prices, in equilibrium. Ξ is a function that characterizes the transition of the distribution Ω_i, whose next-period value depends on the current distribution and on the next-period realization of the state x. The solution to the above problem defines the household policy functions for consumption $c_{i,PF}\left(y_{j,i}, b_{j,i}, \Omega\right)$ and for issuance of the state-contingent securities $b'_{i,PF}\left(x', y_{j,i}, b_{j,i}, \Omega\right)$.

For a household in autarky, the value function depends solely on the current endowment realization:

$$
V_{i,AUT}\left(y_{j,i}\right) = u\left(y_{j,i}\right) + \beta\left[\pi V_{i,AUT}\left(y_{j,i}\right) + \left(1-\pi\right) V_{i,AUT}\left(y_{i,\hat{j}}\right)\right]. \tag{6}
$$

Incentive Compatibility. The asset-issuance constraint limits the amount of securities that households can issue. This amount is most debt that the household could take on and still weakly prefer to repay the debt than default and be excluded from financial markets.[18]

[18]As in Alvarez and Jermann (2000), these constraints are just tight enough to prevent households from defaulting, but otherwise allow for the greatest possible degree of risk-sharing.

Thus, the constraints insure that in equilibrium no household chooses to default.

Formally, the asset-issuance constraints are characterized as the levels of debt for which the value to the household of repaying and participating in financial markets equals the value of autarky. Consider a household with current endowment realization y. The constraints that apply to this household when issuing securities contingent on the next-period endowment realizations switching or not switching are given by $\bar{b}_i(y, S, \Omega_i)$ and $\bar{b}_i(y, N, \Omega_i)$, respectively. The former is determined implicitly by:

$$V\left(\hat{y}, \bar{b}_i(y, S, \Omega_i), \Xi(S, \Omega_i)\right) = V_{AUT}(\hat{y}), \tag{7}$$

where $\hat{y} \neq y$ is the next-period endowment of this household and $\Xi(x', \Omega_i)$ is the next-period distribution, given endowments switching realizations in the next period, $x' = S$. The condition above implies that the value to the household of repaying debt equals that of moving to autarky. Similarly, for securities contingent on endowment realizations not switching:

$$V\left(y, \bar{b}_i(y, N, \Omega_i), \Xi(N, \Omega_i)\right) = V_{AUT}(y). \tag{8}$$

The incentive compatibility constraints that the households face, from which the above constraints on securities issuance derive, are as follows:

$$V_i\left(y_{j,i}, b'_{j,i}(N), \Xi(N, \Omega_i)\right) \geq V_{i,AUT}(y_{j,i}),$$
$$V_i\left(y_{j,i}, b'_{j,i}(S), \Xi(S, \Omega_i)\right) \geq V_{i,AUT}\left(y_{i,\hat{j}} \neq y_{j,i}\right)$$

Market Clearing. The markets for state-contingent securities must clear. In the closed economy scenario, there is one market in each country for each of the two state-contingent securities. The market clearing conditions are thus given by

$$\sum_{j=1,2} b'_{j,i}(x') = 0 \;\forall i, x'. \tag{9}$$

and the prices for the two individual securities may differ across countries: $q_1(x') \neq q_2(x')$. In the international integration scenario, one single market for each of the two state-contingent securities exists in the world economy. Hence, the market clearing condition for each security holds at the world level:

$$\sum_{i=1,2} \sum_{j=1,2} b'_{j,i}\left(x'\right) = 0 \; \forall x'. \tag{10}$$

and there is only one price for each of the two individual securities in the world economy: $q_i\left(x'\right) = q\left(x'\right) \forall i, x'$.

Equilibrium We can now define the equilibrium in the world economy.

Definition An equilibrium in the world economy is a system of value functions $V_{i,AUT}\left(y\right)$ and $V_i\left(y, b, \Omega\right)$, policy functions for state-contingent securities' issuance $b'_{i,PF}\left(x', y_{j,i}, b_{j,i}, \Omega\right)$ and consumption $c_{i,PF}\left(y_{j,i}, b_{j,i}, \Omega\right)$, securities prices $q_i\left(x'\right)$, and asset-issuance constraints $\bar{b}_i\left(y_{j,i}, x', \Omega\right)$ such that:

- The value and policy functions solve the households' maximization problem (5),
- Welfare upon default is consistent with relegation to autarky (6)
- The asset-issuance constraints ensure that households do not default on their liabilities, according to (7) and (8),
- Securities markets clear, (9) or (10).

3.2 Stationary Allocations

We study the properties of the model economy by focusing on stationary allocations where aggregate variables are constant. First, we define a stationary allocation and we show it is an equilibrium for the model economy. Second, we analyze the properties of the closed-economy stationary allocation, depending on the level of income inequality. We thus characterize differences across countries that differ in terms of their income inequality, when they cannot trade in goods and assets with each other. Third, we study the properties of the open-economy stationary allocation, when the two countries differ in terms of their inequality, focusing in particular on the two countries' external asset positions. Finally, we analyze the implications of international financial integration, by studying the transition from the closed-economy stationary allocation towards the open-economy one.

Definition A stationary allocation is an equilibrium allocation where aggregate variables are constant over time. In particular:

- The distribution Ω is constant and it does not depend on whether endowment realizations switch or not. Hence, the distribution satisfies:

$$\Omega = \Xi\left(x, \Omega\right) \forall \Omega, x \tag{11}$$

- Securities' prices are constant and given by $q_{N,i}, q_{S,i}$ for $i = 1, 2$ when economies are closed and by q_N, q_S when financial markets are integrated.

- Asset-issuance constraints are constant and given by $\bar{b}_{N,i}, \bar{b}_{S,i}$.

In the equilibrium of the stationary allocation, households choose the same next-period asset positions, conditional on the realization of their individual endowments. Specifically, the next-period asset position that the high-endowment households choose conditional on next-period realizations not switching equals the asset position that the low-endowment households choose conditional on next-period realizations switching, and vice-versa:

$$b'_{i,1}\left(N\right) = b'_{i,2}\left(S\right) \text{ and } b'_{i,1}\left(S\right) = b'_{i,2}\left(N\right) \forall i. \tag{12}$$

These choices imply that the distribution Ω over assets and endowment realizations is constant, independently of whether household endowments switch realizations or not.

Properties of Closed-Economy Stationary Allocation. We characterize the properties of the closed-economy stationary allocation, as function of the degree of income inequality.

Consumption risk is symmetric in the equilibrium of the closed-economy stationary allocation. We denote by $\tilde{\epsilon}_i$ the degree of consumption risk in country i. High-endowment households enjoy high consumption, and low-endowment ones have low consumption. Formally:

$$c_{j,i} = \begin{cases} c_{H,i} \equiv y\left(1 + \tilde{\epsilon}_i\right) \text{ if } y_{j,i} = y_{H,i} \equiv y\left(1 + \epsilon_i\right) \\ c_{L,i} \equiv y\left(1 - \tilde{\epsilon}_i\right) \text{ if } y_{j,i} = y_{L,i} \equiv y\left(1 - \epsilon_i\right). \end{cases} \tag{13}$$

Households' choices for next-period asset positions satisfy:[19]

$$b'_{i,PF}\left(N, y_{H,i}, b_{H,i}\right) = b'_{i,PF}\left(S, y_{L,i}, b_{L,i}\right) = b_{H,i},$$
$$b'_{i,PF}\left(S, y_{H,i}, b_{H,i}\right) = b'_{i,PF}\left(N, y_{L,i}, b_{L,i}\right) = b_{L,i}. \tag{14}$$

These choices imply that the distribution Ω of households over endowment and asset levels is a two-point one, satisfying:

$$b_{j,i} = \begin{cases} b_{H,i} \text{ if } y_{j,i} = y_{H,i} \\ b_{L,i} \text{ if } y_{j,i} = y_{L,i}. \end{cases} \tag{15}$$

The asset-issuance constraints that households face are:

$$\bar{b}_i\left(y_{j,i}, x' = N\right) = \begin{cases} \bar{b}_{H,i,N} \text{ if } y_{j,i} = y_{H,i}, \\ \bar{b}_{L,i,N} \text{ if } y_{j,i} = y_{L,i}, \end{cases} \quad \text{and } \bar{b}_i\left(y_{j,i}, x' = S\right) = \begin{cases} \bar{b}_{H,i,S} \text{ if } y_{j,i} = y_{H,i}, \\ \bar{b}_{L,i,S} \text{ if } y_{j,i} = y_{L,i}. \end{cases} \tag{16}$$

Moreover, the constraints contingent on the individual endowment realization being high are equal across the two households:

$$\bar{b}_{H,i,N} = \bar{b}_{L,i,S} = b_{H,i}. \tag{17}$$

Finally, for the household with currently high endowment realization, the incentive-compatibility constraint binds, and welfare is equal across autarky and participation in financial markets:

$$V_i\left(y_{H,i}, b_{H,i}\right) = V_{i,AUT}\left(y_{H,i}\right). \tag{18}$$

Appendix B.1 details the full set of conditions that characterize the stationary allocation equilibrium, as well as the vector of equilibrium quantities and prices that characterizes the solution.

Consumption risk is the key variable that shapes the equilibrium of the closed-economy stationary allocation. The severity of the incentive-compatibility constraint that the high-endowment household faces is key to determine of the equilibrium degree of consumption

[19] In what follows, we omit the distribution Ω as an arguments of a function, being constant in the stationary allocation.

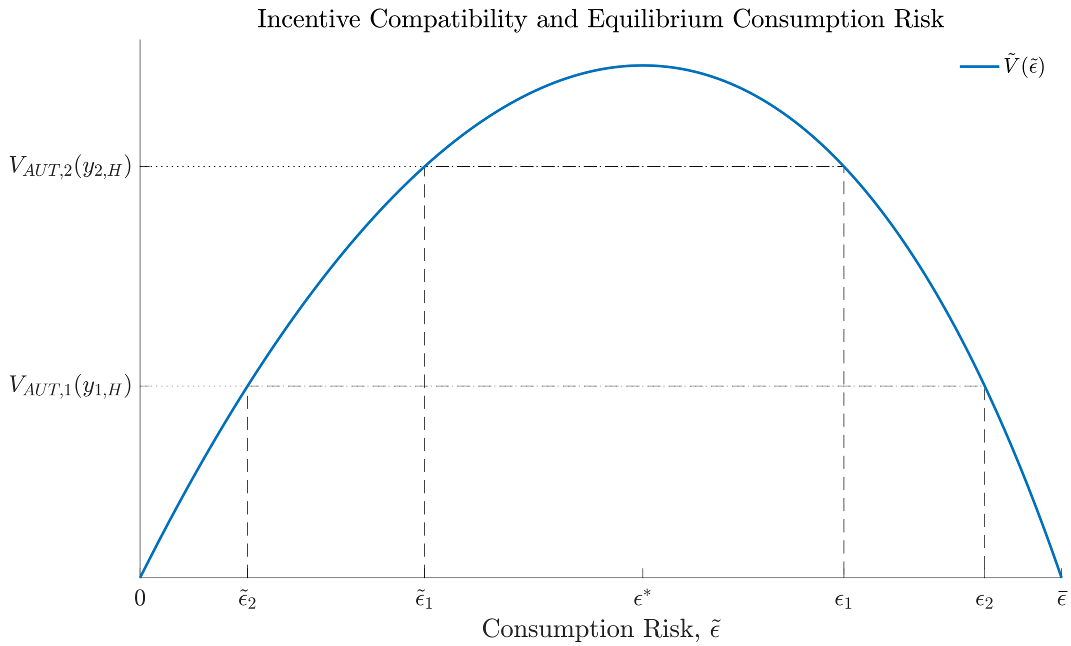

Figure 4: Determination of equilibrium consumption risk as function of income risk. The binding incentive-compatibility constraint of the high-endowment household (18) implies that welfare for this household equals her welfare in autarky.

risk. Specifically, when income risk is sufficiently high, $\epsilon_i > \epsilon^*$ the greater is income risk, the weaker is the incentive for the high-endowment household to default on her liabilities, because the value of autarky is declining in income risk. Hence, households can share risks to a greater degree, and equilibrium consumption risk is lower. Formally, the value function of the high-endowment household can be expressed as function of the degree of consumption risk that the household faces, when imposing that consumption follows the process in (13): $V_i\left(y_{H,i}, b_{H,i}, \Omega\right) = \tilde{V}\left(\tilde{\epsilon}_i\right)$. The function $\tilde{V}\left(\tilde{\epsilon}_i\right)$ has a maximum at $\tilde{\epsilon}^\star$, it is increasing for $\tilde{\epsilon}_i \in [0, \tilde{\epsilon}^\star)$, and it is decreasing for $\tilde{\epsilon}_i > \tilde{\epsilon}^\star$, tending to $-\infty$ in the limit for $\tilde{\epsilon} \to 1$. We denote by $\bar{\epsilon}$ the positive degree of consumption risk for which welfare is as high as it would be in the absence of consumption fluctuations: $\tilde{V}\left(\bar{\epsilon}\right) = \tilde{V}\left(0\right)$ with $\bar{\epsilon} > 0$. When the asset-issuance constraint (16) binds for the high-endowment household, her value function satisfies: $V_i\left(y_{H,i}, b_{H,i}, \Omega\right) = V_{i,AUT}\left(y_{H,i}\right)$, which amounts to $\tilde{V}\left(\tilde{\epsilon}_i\right) = \tilde{V}\left(\epsilon_i\right)$. Two positive values for $\tilde{\epsilon}$ solve this condition. One of these values is trivially given by $\tilde{\epsilon}_i = \epsilon_i$. The other value satisfies $\tilde{\epsilon}_i < \epsilon_i$, implying that while welfare of the high-endowment household is as high as in autarky, the equilibrium degree of consumption risk is lower than the degree of income risk.

The equilibrium degree of consumption risk is decreasing in the country's degree of in-

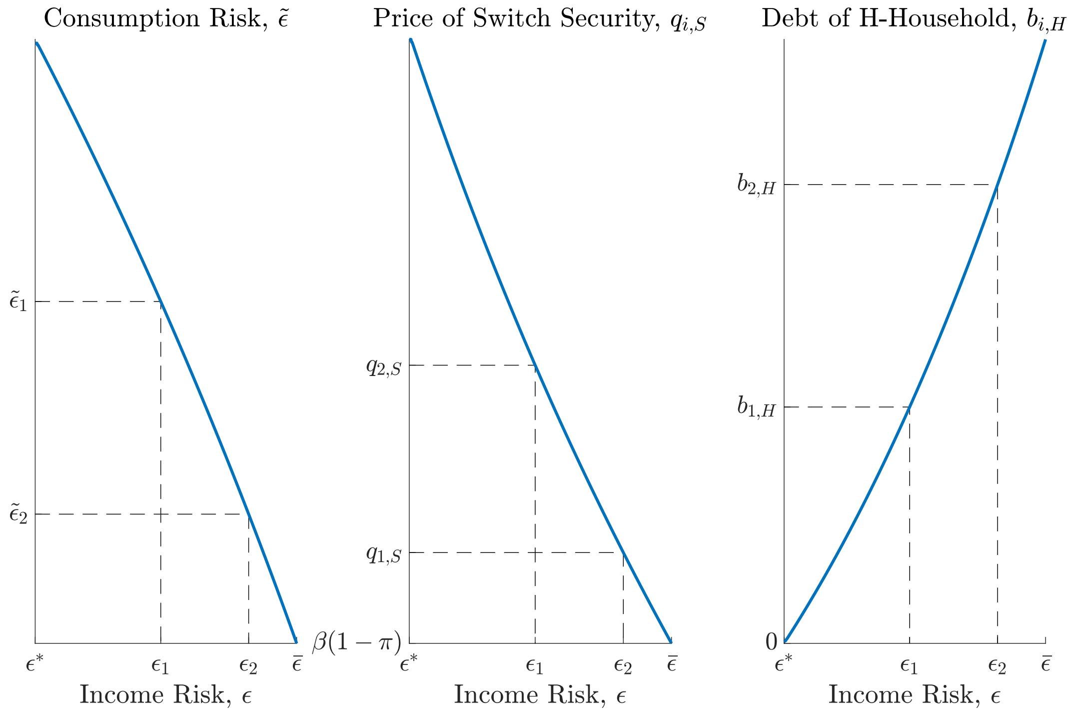

Figure 5: Equilibrium variables as function of income risk. Consumption risk, price of switch-security, debt of high-endowment household.

come risk. A higher degree of income risk implies that the incentive compatibility constraint becomes more slack, as $\tilde{V}(\epsilon_i)$ is decreasing in ϵ_i for $\epsilon_i > \tilde{\epsilon}^\star$. Hence, a lower value of $\tilde{\epsilon}_i$ satisfies the incentive compatibility constraint, given that $\tilde{V}(\tilde{\epsilon}_i)$ is increasing in $\tilde{\epsilon}_i$ for $\tilde{\epsilon}_i \in (0, \tilde{\epsilon}^\star)$. Hence, in the equilibrium of the closed-economy stationary allocation, the country with higher income risk features lower consumption risk and a greater degree of risk sharing. The higher degree of risk-sharing is sustained by looser asset-issuance constraints faced by households in equilibrium, as well as by lower asset prices, given the greater asset supply.

Figures 4 and 5 represent $\tilde{V}(\tilde{\epsilon}_i)$, as a function of $\tilde{\epsilon}$ and the implicit solution for $\tilde{\epsilon}$ as function of the degree of income risk ϵ, respectively.

Properties of Open-Economy Stationary Allocation We describe here the properties of the equilibrium stationary allocation in the open economy.

First, we introduce the variable τ, which denotes the trade balance of the unequal country, 2, expressed as ratio to the country's total endowment:

$$\tau = \frac{y_{H,2} + y_{L,2} - c_{H,2} - c_{L,2}}{y_{H,2} + y_{L,2}}. \tag{19}$$

The resource constraints for the two individual countries, in the open economy, read as:

$$c_{H,1} + c_{L,1} = y(1 + \epsilon_1) + y(1 - \epsilon_1) + 2\tau y = 2y(1 + \tau), \tag{20}$$

$$c_{H,2} + c_{L,2} = y(1 + \epsilon_2) + y(1 - \epsilon_2) - 2\tau y = 2y(1 - \tau). \tag{21}$$

having imposed the market clearing condition for goods: $\sum_{i=1,2}\sum_{j=H,L}(y_{j,i} - c_{j,i}) = 0$.

International integration of financial markets implies the degree of consumption risk is identical in equilibrium across the two countries.[20] Equilibrium consumption levels for the two households in the two countries are thus given by:

$$\begin{aligned} c_{1,H} &= y(1 + \tilde{\epsilon})(1 + \tau), \; c_{2,H} = y(1 + \tilde{\epsilon})(1 - \tau), \\ c_{1,L} &= y(1 - \tilde{\epsilon})(1 + \tau), \; c_{2,L} = y(1 - \tilde{\epsilon})(1 - \tau), \end{aligned} \tag{22}$$

where $\tilde{\epsilon}$ denotes the common degree of consumption risk in both countries.

In the open-economy stationary allocation, the asset-issuance constraint binds with equality for both countries' high-endowment households. The degree of income risk in the two countries crucially determines the severity of the constraints and, in turn, the equilibrium degree of consumption risk. In the open-economy the relative severity of the constraints across the two countries determines the aggregate external asset positions of the two countries, and the trade imbalances across them.

The equilibrium trade balance in the stationary allocation of the closed economy is determined as follows:[21]

$$\left(\frac{1+\tau}{1-\tau}\right)^{1-\gamma} = \frac{V_{1,AUT}(y_{1,H})}{V_{2,AUT}(y_{2,H})}, \tag{23}$$

where γ denotes the degree of relative risk aversion in (2). As the value of autarky is higher in the equal than in the unequal country, the trade balance of the unequal country is positive in the stationary allocation of the open economy. The positive trade balance in the stationary allocation is consistent with the unequal country owing external liabilities to the equal country, and running a trade surplus to pay for the return on these constant liabilities.

The external asset positions of the two countries are given by the aggregate wealth of the two households in each country: $b_i = b_{H,i} + b_{L,i}$. In equilibrium, the unequal country holds

[20] Consumption risk is symmetric in the stationary allocation of the open-economy, as it is the case in the closed-economy setting. Households with high or low endowment enjoy high or low consumption, respectively.

[21] Appendix B.2 details in full how these equilibrium values are characterized.

positive external debt vis-à-vis the equal country:

$$b_2 = \frac{\tau}{1 - q_N + q_S} > 0. \tag{24}$$

The equilibrium degree of consumption risk in the open economy lies in the interval bounded by the equilibrium degrees of consumption risk that emerge in the two countries' closed-economy stationary allocations:

$$\tilde{\epsilon} \in (\tilde{\epsilon}_2, \tilde{\epsilon}_1). \tag{25}$$

3.3 Transition Dynamics

We consider the transition of the world economy from a scenario where countries do not trade with each other, to the stationary allocation with open financial markets. We analyze a version of the model with log preferences ($\gamma = 1$), where endowment realizations switch deterministically every period ($\pi = 0$), and where the two countries differ sharply in terms of income inequality. Under this parametrization, there is no risk and so there is only one possible state that realizes each period (S). Thus, S-securities are effectively risk-free bonds, and N-securities are not traded. We assume that international markets are unexpectedly integrated at $t = 0$, after households honor contracts from the previous period.[22]

It takes two periods for the economy to transition to the open economy steady state. The trade balance dynamics and net foreign asset position are plotted in Figure 6. The real interest rate equilibrates when international markets open, causing the equal country to save by running a positive trade balance vis-à-vis the unequal country. The interest rate in the first period of the transition is below that of the final open-economy stationary allocation, generating a slight overshooting of the NFA in the first period. The economy reaches steady state in period two. The unequal country makes interest payments in perpetuity on the debt accumulated during the transition.

To understand why the transition takes this form, we proceed in two steps to prove the characterization. First, we show that an economy where high-endowment households' asset positions are the open-economy stationary-allocation ones and where the sum of the low-endowment households' asset positions is also the open-economy stationary-allocation one

[22]We make this timing assumption to avoid any ex-post default that may occur as a result of the MIT shock.

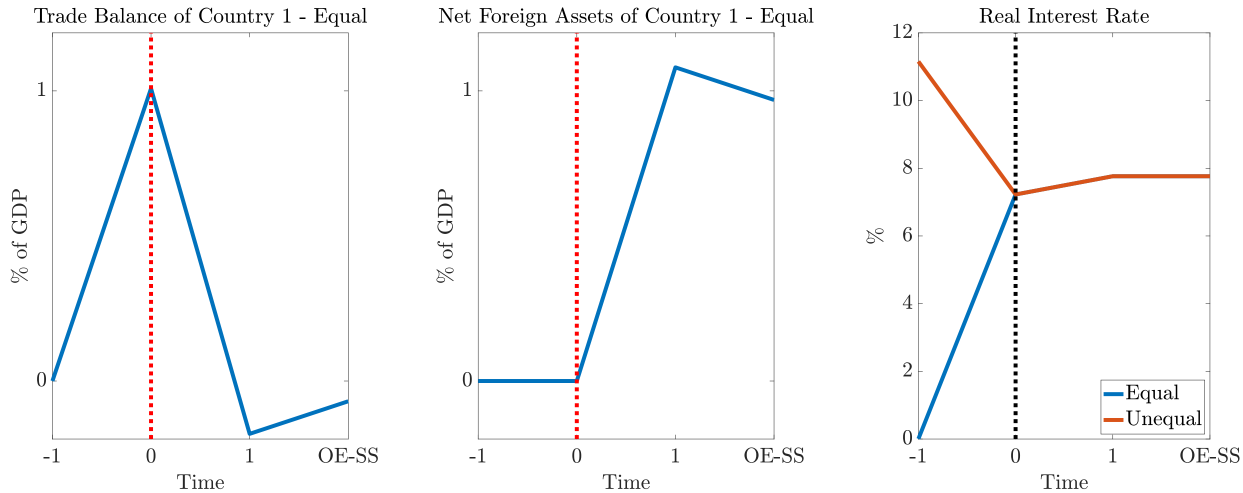

Figure 6: Transition dynamics following international financial integration - Theoretical model.

converges in one period to the steady state of the open economy. Second, in an open economy where households' initial asset positions are the closed-economy stationary-allocation ones, households choose asset positions that give rise to the aforementioned asset distribution, from which convergence to the steady state occurs in one period. Intuitively, in order for the economy to reach the new steady state, the asset positions of the households need to converge to the new open-economy steady-state values, but begin at the closed-economy values. The deterministic nature of the endowment switching implies that within two periods both households will have experienced the low-income state, and hence a binding borrowing constraint. Those effectively eliminate the history dependence from the initial asset positions, allowing the economy to reach the steady state in two periods.

Despite being a simple, stylized model, the framework can capture the dynamics of capital flows between equal and unequal countries following financial integration. The endogenous borrowing limits from the limited-commitment friction are key for delivering the correct direction of capital flows when financial markets integrate.

4 Quantitative Exercise

Thus far, we have illustrated the economic forces that can cause capital to flow from equal to unequal countries following international financial integration. In this section, we extend our theoretical framework into a richer model that can capture quantitative properties of inequality in income and consumption across countries.

Extending the model. *Households* — Instead of two types of households, we now assume that a continuum of households of unit measure, $j \in [0,1]$, populates each country i. Households continue to have preferences as in (2). Households' endowment process $y_{j,i,t}$ now follow a canonical persistent-transitory Markov process:

$$\begin{aligned}
\log\left(y_{j,i,t}\right) &= z_{j,i,t} + \nu_{j,i,t} \\
z_{j,i,t} &= \rho z_{j,i,t-1} + \eta_{j,i,t} \\
\nu_{j,i,t} &\sim \mathcal{N}\left(-\frac{\sigma_\nu^2}{2}, \sigma_\nu^2\right) \\
\eta_{j,i,t} &\sim \mathcal{N}\left(-\frac{\sigma_\eta^2}{2}, \sigma_\eta^2\right).
\end{aligned}$$

We assume that a weak law of large numbers holds and that $\eta_{j,i,t}$ and $\nu_{j,i,t}$ are independent across households. Thus, all risk in the richer model is idiosyncratic. We discretize the endowment process in each country i into a Markov chain with values $\mathbf{y}_i$ and transition matrix π_i, with invariant distribution Π_i.

Financial markets — We continue to assume a one-sided lack of commitment, that is households cannot commit to honoring contracts that they sign, and that the punishment for reneging on contracts is exclusion from financial markets. We also continue to assume that households can trade in assets that are contingent on the realization of their idiosyncratic state $b_{j,i,t+1}\left(y_{j,i,t}\right)$ with prices $q_{j,i,t+1}\left(y_{j,i,t}\right)$, as in Krueger and Perri (2006). In the closed economy, households can trade assets domestically, with other residents of their home country. When international markets open, households can trade bonds with households in all countries. The endogenous debt constraints are determined in equilibrium as in Alvarez and Jermann (2000), such that, households in every state of the world weakly prefer to repay their debt instead of being excluded from financial markets:

$$b_{j,i,t+1}\left(y_{j,i,t+1}\right) \geq -\bar{B}_i\left(y_{j,i,t+1}\right), \tag{26}$$

where $\bar{B}_i\left(y\right)$ is defined implicitly as:

$$V_i\left(-\bar{B}_i\left(y\right), y\right) = V_{i,AUT}(y). \tag{27}$$

The value of the portfolio of assets issued by each household is given by:

$$\sum_{y_{j,i,t+1}\in\mathcal{Y}} q_{j,i,t+1}\left(y_{j,i,t+1}\right)\cdot b_{j,i,t+1}\left(y_{j,i,t+1}\right). \tag{28}$$

As in the simple model, we allow the endowment processes to be different across countries. Thus, the borrowing constraints will endogenously differ across the two countries. Market clearing is as in the simple model, with bonds in zero net supply within each country $\int \sum_{y_{j,i,t+1}\in\mathcal{Y}} b_{j,i,t}\left(y_{j,i,t+1}\right) d\Phi_i(b_{j,i,t}, y_{j,i,t})) = 0$ when economies are closed and in zero net supply globally $\sum_{i=1,2}\int \sum_{y_{j,i,t+1}\in\mathcal{Y}} b_{j,i,t}\left(y_{j,i,t+1}\right) d\Phi_i(b_{j,i,t}, y_{j,i,t})) = 0$ when international financial markets are integrated, where $\Phi_i(b_{j,i,t}, y_{j,i,t})$ is the invariant distribution over households in country i. The full definition of equilibrium in the extended model is presented in Appendix C.

Calibration — We calibrate the two economies in the model to broadly reflect "equal" (E) and "unequal" (U) countries in the data. We calibrate the unequal country to the United States, and the equal country to an average of five European countries.[23] The time period is set as two years. The calibration of the U.S. economy broadly follows Krueger et al. (2016), who assume ex-ante discount factor heterogeneity across households and estimate a process for disposable household income using the PSID. We use their annual estimates, $\rho^U = 0.9695$, $\left(\sigma_\nu^U\right)^2 = 0.0522$, and $\left(\sigma_\eta^U\right)^2 = 0.0384$, converted to two-year equivalents. We discretize the income process into a 15-point Markov chain using Gauss-Hermite quadrature on the transitory shock and the Rouwenhorst method (Kopecky and Suen, 2010) for the persistent shock. In order to calibrate the income process for the equal country we take the unequal country process and make it more re-distributive via an affine tax that taxes the endowment proportionally and then rebates the receipts lump-sum to households.[24] Thus, $Y_E = (1-\tau)\times Y_U + \tau$, since $\Pi_U' Y_U = 1$. We set $\tau = 0.1$ to capture the differences in cross-sectional inequality between the U.S. and an average of the European countries. Specifically, we match the variance of log disposable income of 0.48 computed in the LIS data for the European countries.[25] Additionally, this choice of τ matches well other inequality moments, e.g. 50/10 ratio of disposable income is 1.8 in the data vs 2.0 in the model (compared to 2.6 in model and data for the U.S.). We

[23]We pick equal countries in northern Europe: Germany, Sweden, Denmark, Finland, and the Netherlands.

[24]We take this calibration strategy because our advanced sample lacks panel data on disposable household income for equal countries.

[25]Our estimates are also consistent with the cross-country comparisons reported in Krueger et al. (2010).

assume that preference parameters are common across countries. We assume two values for the discount factor in each country to generate wealth concentration at the top of the distribution and to match the relative amount of credit between equal and unequal countries. We set the annual discount factor for the patient households to $\beta = 0.96$ and for the impatient households, $\beta = 0.954$, with one-fifth of households having the higher discount factor. We target a 99 / 90 wealth ratio in the unequal country of 6.6, corresponding to the empirical value from the 1995 U.S. Survey of Consumer Finances. We target that credit in the unequal country is 40% higher than the equal country, corresponding to the ratio of non-mortgage consumer credit between the U.S. and European countries in the 1990s (Guardia, 2002). Finally, we set the elasticity of intertemporal substitution $1/\sigma = 1/2$, a standard value.

4.1 Closed-Economy Steady State

We solve for the closed-economy steady state in both equal and unequal countries. The lower risk in the equal country results on average in borrowing constraints that are only 52% of the borrowing constraints across assets in the unequal country. The endogenously looser borrowing constraints in the unequal country lead to more borrowing, and thus to a higher real interest rate of 4.1%, compared to the equal country with a real interest rate of 3.6%. The looser borrowing constraint also results in a greater absolute difference between consumption inequality and income inequality in the unequal country: the variance of log consumption is 0.10 in the unequal country, compared to a variance of log income of 0.68. In the equal country, the variance of log consumption is 0.13, compared to a variance of log income of 0.48. The fact that more unequal countries have great "gaps" between income inequality and consumption inequality is consistent with the evidence in Krueger et al. (2010), which we take as an independent validation of the model. We should note that the model only speaks to residual (or within-group) consumption inequality driven by income risk (since the risk is estimated off of residual income). Given that across-group income inequality is larger in the unequal countries

4.2 International Financial Integration

We revisit the experiment of opening international financial markets between the two countries in the quantitative model. Starting with both countries in steady state, at time $t = 0$, financial markets permanently open across countries, and we compute the perfect foresight transition to the new open-economy steady state.

Figure 7 shows the evolution of the current account, consumption, trade balance, and the real interest rate for the two countries along the transition path. The blue line shows the equal country and the red line the unequal country. On impact, the current account rises in the equal country and falls in the unequal country. Starting from a zero net foreign asset position, this current account imbalance corresponds to a large trade imbalance and finances a consumption boom in the unequal country.

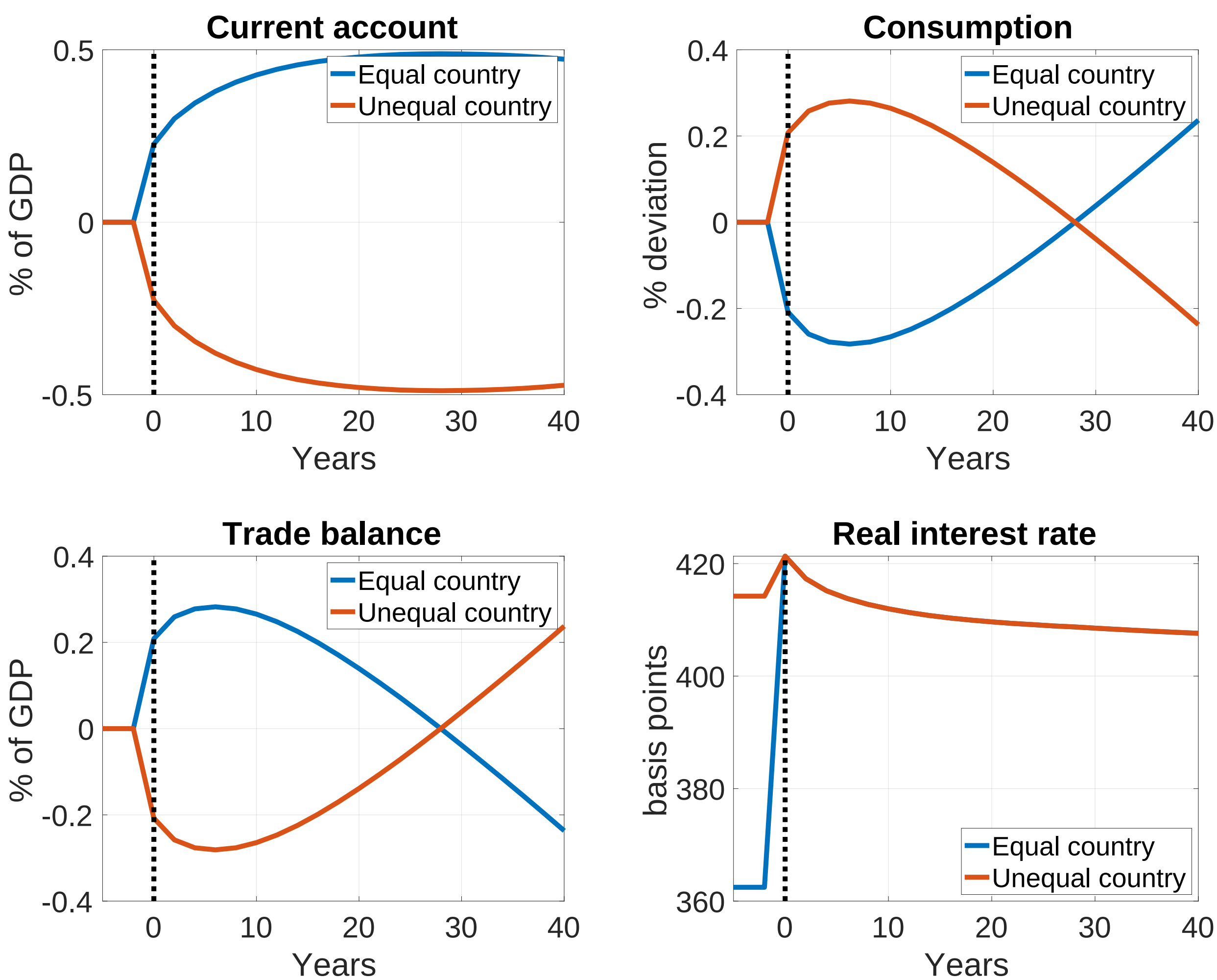

Figure 7: Transition dynamics following international financial integration.

Over time, however, as the unequal country accumulates a negative net foreign asset position with respect to the equal country, consumption and the trade balance begin to fall. The unequal country continues to accumulate debt vis-a-vis the equal country and eventually the current account deficit begins to decline until reaching a new steady state (beyond the horizon shown in the figures). After about thirty years, however, the trade balance reverses—interest payments on accumulated debt now exceed new borrowing made by the unequal country, and so the unequal country now has a positive trade balance and consumption lower than before the opening of international financial markets. In the new steady state, as in the simple model, the unequal country on net makes payments to the equal country. The opening of international financial markets generates a short-run consumption boom in the unequal country at the expense of permanently making debt service payments in the long run.

Next, we ask how well the quantitative model aligns with the empirical facts on inequality and the current account documented in Section 2. The difference in Gini of disposable income between the equal and unequal countries in the quantitative model is 0.04. Multiplying that by the coefficient of -0.741 from the estimated empirical model in Table I, we get an implied difference in the current account of -0.03, or -3% of GDP. Over the first fifteen years of transition (which correspond to the 15-year window in our empirical analysis), the average difference in the current account between the equal and unequal countries was -0.8% of GDP. Our quantitative model is able to explain 27% of the relationship between the current account and inequality in the data, despite still being relatively stylized.

4.3 Evidence supporting the mechanism from macrodata

A key economic force driving the predictions of the model is that when international financial markets open, capital flows toward countries where rates of return are highest. In the model, the return on assets is highest in unequal countries just before financial liberalization. In this subsection, we present evidence supporting the model mechanism, namely that more unequal countries had higher real rates before financial liberalization. In the data, however, cross-country comparisons of rates of return are less straightforward than in the model because of differences across assets issued in different countries in terms of their denomination, risk, and liquidity. We take two complementary approaches to overcome these concerns. First, we use measures of the natural rate of interest derived in Holston et al. (2017). Second, we use returns on short-term safe assets collected by Jordà et al. (2019).

We take the estimates of the natural rate of interest for the three major economies from

Holston et al. (2017): the US, the UK, and the Euro Area. The US had the highest levels of inequality, the Euro Area the lowest and the UK in between. Focusing on the period from before financial liberalization (1971-1980) we find that the average real rate in the US was 3.4%, compared to 3.1% in the UK and 2.6% in the Euro Area, consistent with the mechanism in the model. Further, after financial liberalization (1995-2010) the differences in real rates between the countries all fall by more than half, suggesting the same convergence in rates across countries as in the model.

The data from Jordà et al. (2019) cover a larger set of countries[26]. We use their measure of real returns on short-term safe assets (bills) as that is the comparable asset to the model. We then regress the real return from 1970-1980 on the income Gini net of taxation. We find a significant positive coefficient of 0.0843 (s.e. 0.0342), again providing supportive evidence that more unequal countries had higher real rates before financial integration. If we run the same regression using returns from 1995-2010 (the post-integration period) the coefficient is smaller in magnitude and insignificant. Thus, two separate and complementary measures of the real rate support the model mechanism that drives capital flows from equal to unequal countries following financial integration.

4.4 Exogenously incomplete markets counterfactual

In this subsection, we show why our empirical findings motivate the choice of the limited commitment model, as opposed to the workhorse macro framework for inequality—the Bewley-Huggett-Aiyagari-İmrohoroğlu model. We perform one final experiment: we solve our two-country quantitative model replacing the full set of contingent claims with a risk-free bond, and impose an exogenous borrowing constraint as opposed to one that arises endogenously from the limited-commitment friction. We set the same borrowing constraint in both countries to ease comparability. We calibrate the borrowing constraint to match the debt-to-income and wealt statistics in the unequal country.[27] We set the borrowing limit to 73% (66%) of average disposable income for the patient (impatient) type. The closed-economy steady state of the

[26] Australia, Belgium, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK and US

[27] Qualitatively, this is without loss of generality as long as the exogenous borrowing constraint is tighter than the natural borrowing limit in each country. We have also solved the model imposing tighter and looser borrowing constraints, and found similar quantitative results.

unequal country has an annual real rate of 47 basis points. In the equal country, the lower level of income risk results in a much higher equilibrium interest rate to clear the domestic asset market: 114 basis points. In this version of the model where the two countries have identical borrowing constraints, the closed-economy real interest rate is higher in the equal country (in contrast to the macro evidence in the foregoing section), as the precautionary saving motive is weaker there.

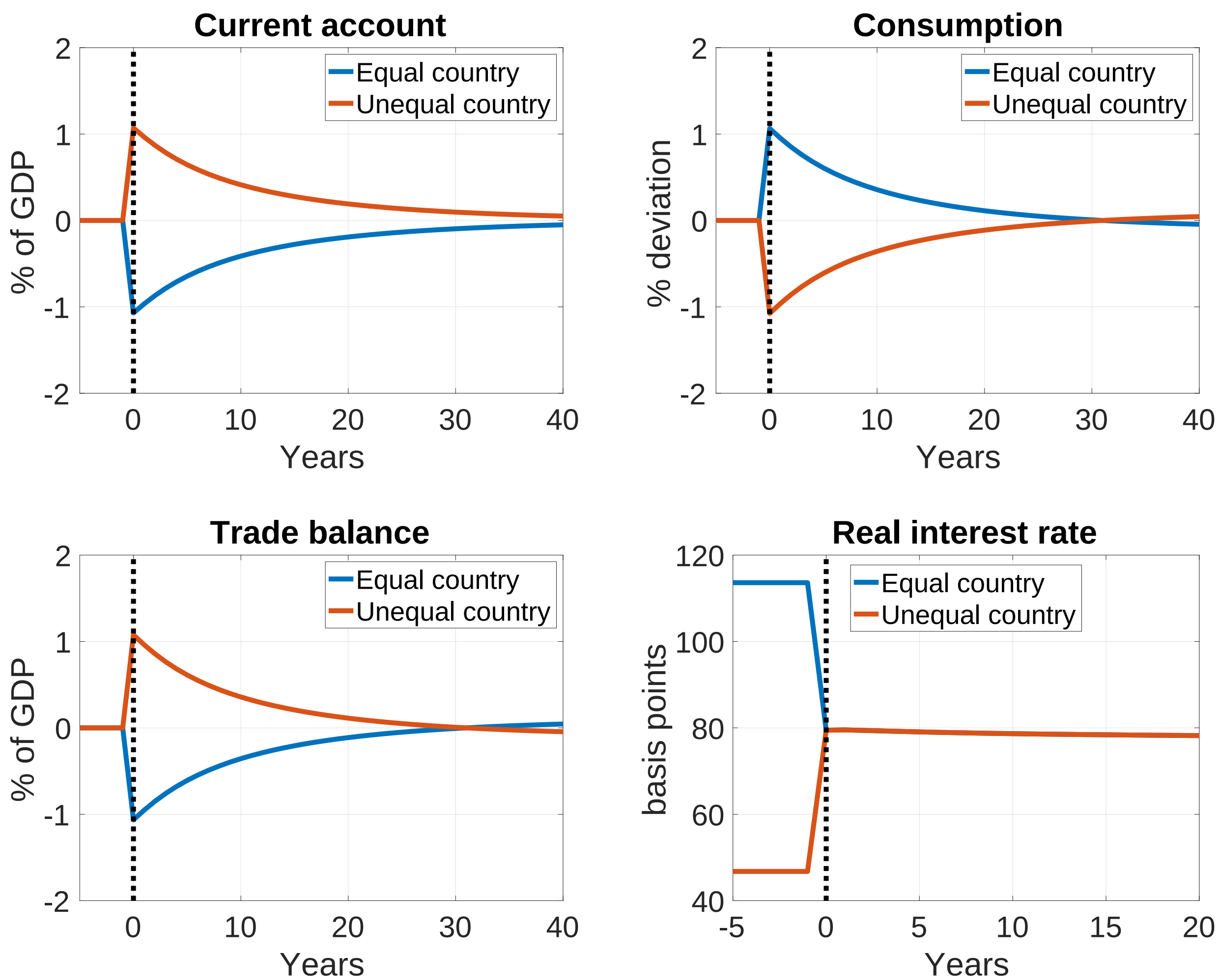

Figure 8: Transition dynamics with exogenous borrowing constraints.

Next, we open international financial markets and compute the transition path to the new open-economy steady state, keeping the exogenous borrowing constraints fixed (and the same across countries). The transition dynamics are displayed in Figure 8. When financial markets open, capital flows from unequal to equal countries—the opposite of the benchmark model and the findings in the data. As the real rate equilibrates between the two countries, the equal country faces a lower real rate, inducing it to borrow vis-a-vis the unequal country. The borrowing generates a consumption boom and negative trade balance in the equal country, which eventually reserves. The dynamics in the exogenous incomplete markets model look similar to the limited commitment model, but with capital flowing in the *opposite* direction. Non-homothetic preferences—an increasingly popular model feature to match cross-sectional savings data (e.g., De Nardi et al., 2010; Straub, 2019)— would only exacerbate the problem. The higher desired savings of high-income households in the unequal country would result in an even lower real rate relative to the equal country, generating even larger current account deficits in the equal country along the transition. While we cannot rule out that there exist calibrations of the exogenous incomplete markets model that would generate the observed capital flows, our findings here suggest that the model with limited enforcement frictions is a parsimonious theory that can explain both cross-sectional household data, the observed relationship between inequality and capital flows, and real interest rates across countries.

5 Conclusions

In this paper, we documented a novel empirical finding: the current account balance and inequality are negatively correlated in a cross-section of advanced economies. The negative relationship between private saving and inequality is the main driver of this correlation. We propose a theory that provides a simple explanation for this new stylized fact. If most of the inequality is driven by income risk, opening international financial markets leads to new risk-sharing opportunities across countries. Borrowing constraints relax in the more unequal country as interest rates fall, leading to more borrowing, driven by capital inflows from the equal country. If private financial markets do not endogenously respond to financial liberalization, then the magnitude of capital flows is much smaller or even in the opposite direction.

The models that we have written down are not without limitations. In particular, we have taken the after-tax and transfer measures of income inequality as primitives. Private and public risk sharing can be complements or substitutes, in theory, (e.g., Attanasio and Rıos-Rull, 2000; Krueger and Perri, 2011; Rajan, 2011). In reality, governments simultaneously determine the size and generosity of the welfare state and regulations concerning financial markets. Governments may provide more generous social insurance due to failures in financial markets. We view exploring how these forces balance in a political-economy equilibrium as a promising avenue for future research.

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Online Appendix

A Appendix to the Empirical Analysis

A.1 Data

We collect data on countries' external balance and income inequality from various sources. Data on income inequality are drawn from the World Income Inequality Database released by UNU-WIDER. The Gini index for net income is the measure of income inequality we use in our main specification. We exclude from the sample of countries tax havens, according to the definition in Hines Jr (2010), due to the difficulty in interpreting data involving these jurisdictions and to the large magnitude of the flows involved. We categorize countries as advanced or emerging economies. We use the classification of advanced economies from the IMF World Economic Outlook of 1999. We classify as emerging market economies all other countries for which we have data and that are not classified as least developed countries by UNCTAD. Data on income inequality from UNU-WIDER are largely unavailable for least developed countries.[28] We draw data for the current account balance and for national account variables from the dataset collected by Uribe and Schmitt-Grohé (2017). We use data on saving by the public sector from the World Economic Outlook.[29] We compute saving by the private sector residually, as the difference between aggregate saving and saving by the public sector. Moreover, we control for the old-age dependency ratio using data from the UN World Population Prospects 2019.[30] We construct dummies for countries' reliance of exports on mineral commodities and on fuel, using the classification in UNCTAD (2019). Finally, we collect data for countries' GDP in US dollars from the dataset of Lane and Milesi-Ferretti (2007), which we use to weight individual countries in the regressions described in the next section.

[28] We provide in Appendix A.2 below the full list of countries and their classification.

[29] We use the series on General Government Primary Net Borrowing and Lending.

[30] Following Eurostat, we define this variable as the ratio of the population aged 65 and above to the population between 15 and 64 years of age.

A.2 List of Countries

The advanced economies included in our sample are the following ones: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Israel, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, United Kingdom, United States.

B Appendix to the Theoretical Model

B.1 Closed-Economy Stationary Allocation

We detail here the full set of conditions that characterize the stationary allocation equilibrium. The above-introduced allocation satisfies the following system of equation, which characterizes the equilibrium:

$$q_{i,N} u'(c_{H,i}) = \beta \pi u'(c_{H,i}) + \mu_{H,i,N} \tag{H-N Euler}$$

$$q_{i,S} u'(c_{H,i}) = \beta (1-\pi) u'(c_{L,i}) + \mu_{H,i,S} \tag{H-S Euler}$$

$$q_{i,N} u'(c_{L,i}) = \beta \pi u'(c_{L,i}) + \mu_{L,i,N} \tag{L-N Euler}$$

$$q_{i,S} u'(c_{L,i}) = \beta (1-\pi) u'(c_{H,i}) + \mu_{L,i,S} \tag{L-S Euler}$$

$$c_{H,i} = y_{H,i} - b_{H,i} + q_{i,N} b_{H,i} + q_{i,S} b_{L,i} \tag{H Budget Constraint}$$

$$c_{L,i} = y_{L,i} - b_{L,i} + q_{i,N} b_{L,i} + q_{i,S} b_{H,i} \tag{L Budget Constraint}$$

$$0 = \left(b_{H,i} - \bar{b}_{H,i,N}\right) \mu_{H,i,N} \tag{H-N C.S.C}$$

$$0 = \left(b_{L,i} - \bar{b}_{H,i,S}\right) \mu_{H,i,S} \tag{H-S C.S.C}$$

$$0 = \left(b_{L,i} - \bar{b}_{L,i,N}\right) \mu_{L,i,N} \tag{H-N C.S.C}$$

$$0 = \left(b_{H,i} - \bar{b}_{L,i,S}\right) \mu_{L,i,S} \tag{H-S C.S.C}$$

$$V_i(y_{H,i}, b_{H,i}, \Omega) = V_{i,AUT}(y_{H,i}) \tag{H I.C.}$$

$$V_i(y_{L,i}, b_{L,i}, \Omega) > V_{i,AUT}(y_{L,i}) \tag{L I.C.}$$

$$0 = b_{H,i} + b_{L,i} \tag{Asset Market Clearing}$$

$$c_{H,i} + c_{L,i} = y_{H,i} + y_{L,i} \tag{Goods Market Clearing}$$

We solve the above system of equations for the vector of variables $\left(c_{H,i}, c_{L,i}, b_{H,i}, b_{L,i}, q_{i,N}, q_{i,S}, \bar{b}_{H,i,N}, \bar{b}_{H,i,S}, \bar{b}_{L,i,N}, \bar{b}_{L,i,S}, \mu_{H,i,N}, \mu_{H,i,S}, \mu_{L,i,N}, \mu_{L,i,S}\right)$.

The values of the individual variables in the closed-economy stationary equilibrium allocation are determined as follows. First, we determine the equilibrium degree of consumption risk $\tilde{\epsilon}_i$ as function of income risk ϵ, by imposing that (H I.C.) binds. Imposing the values in (13) for consumption, the value function of the high-endowment household can be written as function of the degree of consumption risk as follows:

$$
\begin{aligned}
V_i\left(y_{H,i}, b_{H,i}, \Omega\right) &= \frac{u\left(c_{H,i}\right)\left(1-\beta\pi\right)+u\left(c_{L,i}\right)\beta\left(1-\pi\right)}{\left(1-\beta\right)\left(1+\beta-2\pi\beta\right)} \\
&= \frac{u\left(y\left(1+\tilde{\epsilon}_i\right)\right)\left(1-\beta\pi\right)+u\left(y\left(1-\tilde{\epsilon}_i\right)\right)\beta\left(1-\pi\right)}{\left(1-\beta\right)\left(1+\beta-2\pi\beta\right)} \equiv \tilde{V}\left(\tilde{\epsilon}_i\right).
\end{aligned} \tag{29}
$$

When (H I.C.) binds, the value function of the household with currently high endowment satisfies: $V_i\left(y_{H,i}, b_{H,i}, \Omega\right) = V_{i,AUT}\left(y_{H,i}\right)$. This condition implicitly determines the degree of consumption risk $\tilde{\epsilon}$ as the solution to the following condition:

$$
\begin{aligned}
&u\left(y\left(1+\tilde{\epsilon}_i\right)\right)\left(1-\beta\pi\right)+u\left(y\left(1-\tilde{\epsilon}_i\right)\right)\beta\left(1-\pi\right) = \\
&\qquad\qquad u\left(y\left(1+\epsilon_i\right)\right)\left(1-\beta\pi\right)+u\left(y\left(1-\epsilon_i\right)\right)\beta\left(1-\pi\right),
\end{aligned} \tag{30}
$$

which corresponds to $\tilde{V}\left(\tilde{\epsilon}_i\right) = \tilde{V}\left(\epsilon_i\right)$. Two values for $\tilde{\epsilon}$ solve that condition. One of these values is trivially given by $\tilde{\epsilon}_i = \epsilon_i$. The other value satisfies $\tilde{\epsilon}_i < \epsilon_i$, implying that while welfare of the high-endowment household is as high as in autarky, the degree of consumption risk is lower than the degree of income risk. Hence, participation in financial markets allows households to partially insure against their income risk. We focus in what follows on this allocation where meaningful risk-sharing occurs. We denote by $\tilde{\epsilon}\left(\epsilon_i\right)$ the degree of consumption risk-sharing in country i associated with the closed-economy stationary equilibrium allocation.

The following values characterize the solution for the closed-economy stationary equilibrium allocation:

$$c_{H,i} = y(1+\tilde{\epsilon}_i) \tag{31}$$

$$c_{L,i} = y(1-\tilde{\epsilon}_i) \tag{32}$$

$$b_{H,i} = -b_{L,i} \tag{33}$$

$$b_{L,i} = \frac{\tilde{\epsilon}_i - \epsilon_i}{1+q_S-q_N} < 0 \tag{34}$$

$$q_{i,N} = \beta\pi \tag{35}$$

$$q_{i,S} = \beta(1-\pi)\frac{u'(y(1-\tilde{\epsilon}_i))}{u'(y(1+\tilde{\epsilon}_i))} \tag{36}$$

$$\bar{b}_{H,i,N} = \bar{b}_{L,i,S} = b_{H,i} \tag{37}$$

$$\bar{b}_{H,i,S} = \bar{b}_{L,i,N} = 0 \;\; \text{(not binding)} \tag{38}$$

$$\mu_{H,i,S} = 0 \tag{39}$$

$$\mu_{H,i,N} = 0 \tag{40}$$

$$\mu_{L,i,S} = \beta(1-\pi)u'(y(1+\epsilon_i))\left[\left(\frac{u'(y(1-\tilde{\epsilon}_i))}{u'(y(1+\tilde{\epsilon}_i))}\right)^2 - 1\right] \tag{41}$$

$$\mu_{L,i,N} = 0 \tag{42}$$

B.2 Open-Economy Stationary Allocation

The system of equations that characterizes the open economy stationary allocation is the same as the one in closed economy, except for the two market clearing equations, which are now given by:

$$0 = \sum_{i=1,2}(b_{H,i}+b_{L,i}) \tag{Asset Market Clearing}$$

$$\sum_{i=1,2}(c_{H,i}+c_{L,i}) = \sum_{i=1,2}(y_{H,i}+y_{L,i}) \tag{Goods Market Clearing}$$

The equilibrium values of variables in the open-economy stationary allocation are determined as follows.

First, impose that the incentive-compatibility constraints bind for the high-endowment households in both countries:

$$V_i\left(y_{H,i}, b_{H,i}, \Omega\right) = V_{i,AUT}\left(y_{H,i}\right) \forall i = 1, 2 \tag{43}$$

Define the function $\tilde{\tilde{V}}\left(\tilde{\epsilon}, \tau\right)$, which is the open-economy analogous object to $\tilde{V}$:

$$\tilde{\tilde{V}}\left(\tilde{\epsilon}, \tau\right) = \frac{u\left(y\left(1+\tilde{\epsilon}\right)\left(1+\tau\right)\right)\left(1-\beta\pi\right) + u\left(y\left(1-\tilde{\epsilon}\right)\left(1+\tau\right)\right)\beta\left(1-\pi\right)}{\left(1-\beta\right)\left(1+\beta-2\pi\beta\right)}. \tag{44}$$

Under CRRA, the above simplifies as $\tilde{\tilde{V}}\left(\tilde{\epsilon}, \tau\right) = \tilde{V}\left(\tilde{\epsilon}\right)\left(1+\tau\right)^{1-\gamma}$. The system of two incentive compatibility constraint (43) thus writes as:

$$\tilde{\tilde{V}}\left(\tilde{\epsilon}, \tau\right) = V_{1,AUT}\left(y_{1,H}\right) = \tilde{V}\left(\epsilon_1\right) \tag{45}$$

$$\tilde{\tilde{V}}\left(\tilde{\epsilon}, -\tau\right) = V_{2,AUT}\left(y_{2,H}\right) = \tilde{V}\left(\epsilon_2\right) \tag{46}$$

From the above relationships, we can determine the stationary-allocation trade imbalance as function of the relative severity of the incentive compatibility constraints across countries, which depends in turn on the across-country differences in their degrees of income inequality:

$$\left(\frac{1+\tau}{1-\tau}\right)^{1-\gamma} = \frac{V_{1,AUT}\left(y_{1,H}\right)}{V_{2,AUT}\left(y_{2,H}\right)}. \tag{47}$$

To determine the degree of consumption risk, we use the fact that, for low values of τ, $1+\tau \simeq 1/\left(1-\tau\right)$. Hence, we can the above equality implies that:

$$\left(1+\tau\right)^{1-\gamma} = \sqrt{\frac{V_{1,AUT}\left(y_{1,H}\right)}{V_{2,AUT}\left(y_{2,H}\right)}}, \tag{48}$$

thus implying that the equilibrium degree of consumption risk $\tilde{\epsilon}$ equates welfare in a hypothetical country with balanced trade to a geometric average of autarky welfare in the two countries:

$$\tilde{V}\left(\tilde{\epsilon}\right) = \sqrt{V_{1,AUT}\left(y_{1,H}\right) V_{2,AUT}\left(y_{2,H}\right)}, \tag{49}$$

implying in turn that the equilibrium degree of consumption risk in the open-economy stationary allocation lies in between the closed-economy , stationary-allocation values of consumption risk in the two countries:

$$\tilde{\epsilon} \in \left(\tilde{\epsilon}_2, \tilde{\epsilon}_1\right). \tag{50}$$

Finally, equilbrium values for all quantities and prices follow by imposing the obtained values for $\tilde{\epsilon}$ and τ in the system of equations above detailed.

B.3 Transition dynamics

Here, we present the proof of the characterization of the transition dynamics in the deterministically switching model. Consider the economy where high-endowment households' asset positions are the open-economy stationary-allocation ones. First, guess that the world economy is in steady state from the next period onward. Given the guess, all households face the stationary-allocation asset-issuance constraints. Second, guess that the asset-issuance constraints bind for the low-endowment households. Since the price q_S is the stationary-allocation one, the amount of assets that high-endowment households buy is the stationary-allocation one. Borrowing and saving choices by high- and low-endowment households thus satisfy market clearing. For these choices to be an equilibrium, we need to confirm the guess that the borrowing constraints that low-endowment households face bind. This is indeed the case in the economy with large international differences in income risk we consider.[31]

Consider now the economy in the initial period of the transition, where international financial markets are open, but households' asset positions are the ones from the stationary allocation of the closed-economy allocation. We show that households' choices in this setting give rise to the aforementioned economy from which convergence to the open-economy stationary allocation occurs in one period. First, consider the low-income households. They face the stationary-allocation borrowing constraints, as they will become high-income in the next period, and we have established that high-income households enjoy stationary allocation consumption and face stationary-allocation prices from the penultimate period of the transition onward. If the borrowing constraints bind, the low-income households choose the stationary allocation asset positions for when they will become high-income in the following period.[32] High-income households do not face binding borrowing constraints, as they desire to transfer resources to the following period. However, for the market clearing condition to be satisfied, it must be the case that the total amount of assets they purchase is the same as in stationary

[31] Note that the constraints also bind if there are no differences across countries in income inequality, as convergence trivially occurs immediately in that case. We check numerically that the constraints also bind for intermediate ranges of international differences in inequality.

[32] Again, borrowing constraints do bind in this economy for the L agents.

allocation, since the low-income households issue a total amount of securities equal to the stationary allocation one. Hence, in the following period, this economy will become the one where high-income households have stationary-allocation asset positions, and the total asset position of low-income households equals the stationary-allocation one. We have established above that convergence to the stationary allocation occurs in one period from this economy, so in total the convergence from the stationary allocation of the closed economy to that of the open one occurs in two periods.

C Appendix to the Quantitative Model

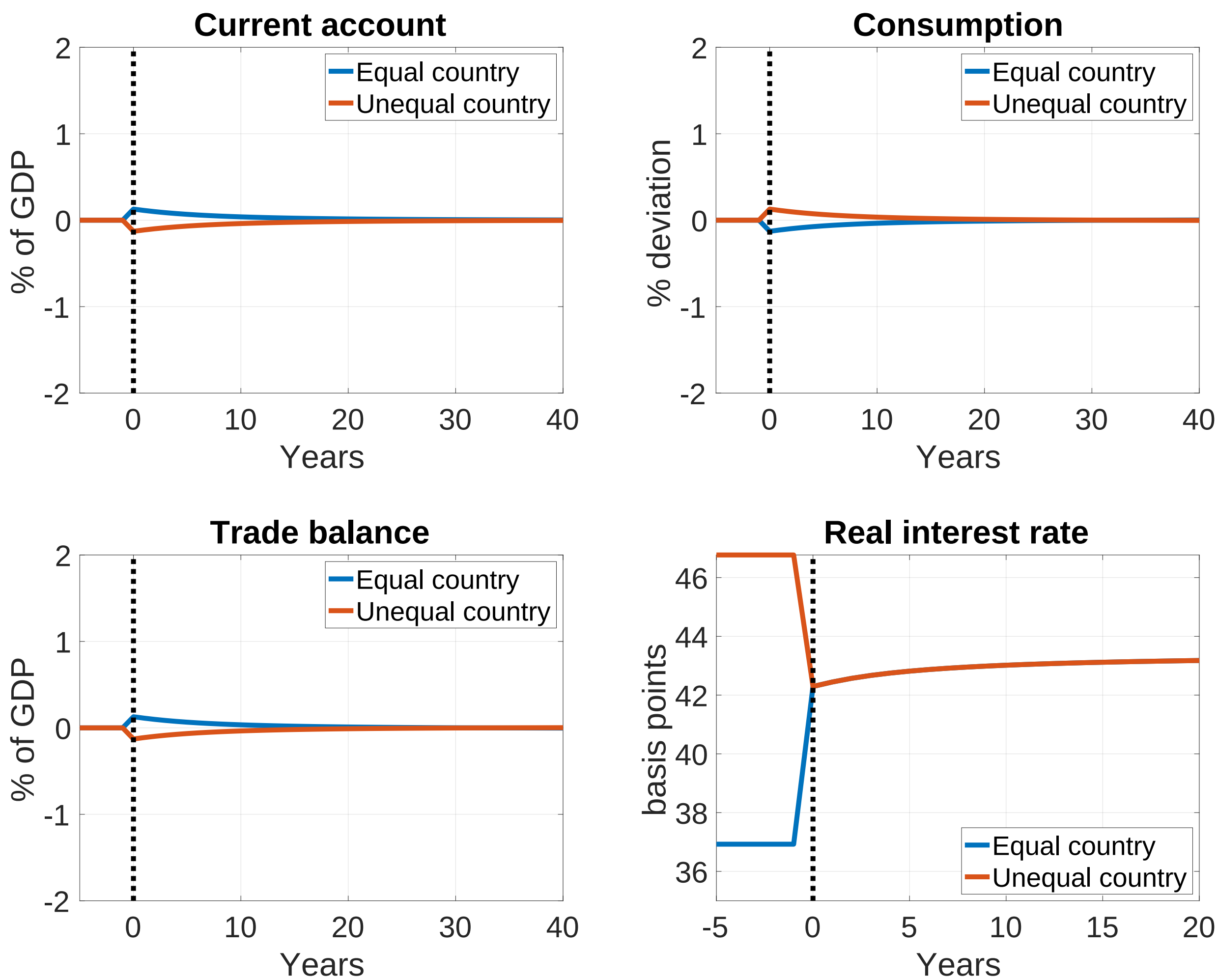

Figure 9: Transition dynamics with fixed borrowing constraints.

D Skewness

We consider a version of the analytical model with non-zero skewness of income changes. In this setting, a more negative degree of skewness of income changes for a given variance results in higher risk-sharing. More negative skewness of income growth for a fixed variance implies that higher income levels have more negatively skewed income changes. Intuitively, more negative skewness for high-income individuals makes the value of autarky lower (and thus more risk-sharing can be supported) since the low-income state realizes earlier. While we consider a stylized example here, more broadly, administrative data reveals that the skewness of income growth becomes more negative as the level of recent earnings increases (Guvenen et al., 2021).

We extend the simple two-income deterministic switching model as follows. There is still a unit-mass continuum of households with logarithmic preferences. Income fluctuations are still deterministic. Now, household income can take one of three possible values, which we denote as High, Medium, and Low (H, M, L). The H and L income realizations are given by $y(1+\epsilon)$ and $y(1-\epsilon)$, respectively, as in the simpler two-point version of Section 3. The M income realisation equals y. Without loss of generality, we set y to unity. We need three income states because a stationary two-state model necessarily has zero skewness of log income changes.

To allow for positive and negative skewness of income changes, we consider two alternative modes for income fluctuations. We denote these modes as "Upward carousel" and "Downward carousel." In the Upward carousel, each household's income follows the sequence $L, M, H, L, M, H, \ldots$. In the Downward carousel, the reverse happens so that each household's income follows the sequence $H, M, L, H, M, L \ldots$. The stationary distribution has an equal mass of households in each state: one-third have L, M, and H income, respectively. Income fluctuations in the Downward carousel display positive skewness, as households experience small income declines when transitioning from H to M and M to L, and one large income rise when transitioning from L to H. Conversely, the Upward carousel features negative skewness of income growth as households experience small, positive income changes, from L to M and M to H, and one large income decline, from H to L.

We now analyze the planning problem for this economy. The planner can redistribute resources across households, and her objective is to maximize total household welfare. We assume, as in the two-income model that there is limited commitment and that households are always free to live in autarky. The planner is subject to incentive compatibility constraints such that any allocation must deliver welfare to each household at least high as what could be obtained in autarky (where households consume their income in each period). Formally, the planner problem is as follows for the Upward carousel:

$$\max_{\tilde{\epsilon}_H,\tilde{\epsilon}_M,\tilde{\epsilon}_L} \quad \log(1+\tilde{\epsilon}_H)+\log(1+\tilde{\epsilon}_M)+\log(1+\tilde{\epsilon}_L)$$

$$\text{s.t.} \quad \tilde{\epsilon}_H+\tilde{\epsilon}_M+\tilde{\epsilon}_L=0$$

$$\log(1+\tilde{\epsilon}_H)+\beta\log(1+\tilde{\epsilon}_L)+\beta^2\log(1+\tilde{\epsilon}_M)\geq\log(1+\epsilon)+\beta\log(1-\epsilon)=V_{H,Up,AUT}$$

$$\log(1+\tilde{\epsilon}_M)+\beta\log(1+\tilde{\epsilon}_H)+\beta^2\log(1+\tilde{\epsilon}_L)\geq\beta\log(1+\epsilon)+\beta^2\log(1-\epsilon)=V_{M,Up,AUT}$$

The incentive compatibility for the M household binds under the Upward carousel.[33] In turn, a binding constraint for both the M and the H household implies that $\tilde{\epsilon}_M=0$. Hence, $\tilde{\epsilon}_L=-\tilde{\epsilon}_H$. The planner problem simplifies to the two-point income process setting, where the planner sets $\tilde{\epsilon}_H$ to the lowest possible value that satisfies the incentive compatibility constraint for the H household. For $\epsilon<\frac{1-\beta}{1+\beta}$, the only solution is $\tilde{\epsilon}_H=\epsilon$ and no risk-sharing occurs. For $\epsilon\geq\frac{1-\beta}{1+\beta}$ and $V_{H,Up,AUT}>0$, $\tilde{\epsilon}_H$ is the smallest of the two solutions to the incentive compatibility constraint. In this setting, there is thus meaningful risk-sharing between the H and L income states.

Consider the planner problem under the Downward carousel now. With this income process, the incentive compatibility constraint for the M household does not necessarily bind, and $\tilde{\epsilon}_M<0$ may be consistent with the solution. However, for exposition, let's consider the allocation where $\tilde{\epsilon}_M=0$, $\tilde{\epsilon}_L=\tilde{\epsilon}_H$, and $\tilde{\epsilon}_H$ is the lowest value that satisfies the H-household incentive compatibility. Figure 10 presents the value function of the H-household as a function of $\tilde{\epsilon}_H$, jointly with the same value function under the Upward carousel. The figure clearly shows that under the Downward carousel, the peak of the value function lies further to the right than under the Upward carousel. The Downward-carousel, H-household value function is increasing for a greater range of $\tilde{\epsilon}_H$. The range where the value function is increasing is larger because the low-consumption period is discounted more heavily by the H household, as it occurs two periods later instead of one. Hence, under the Downward carousel, there is a greater range of values of ϵ, for which the planner cannot deliver any risk-sharing, whereas it could under the Upward carousel. Hence, the allocation with negative skewness of income fluc-

[33] This can be shown by contradiction. If the incentive compatibility constraint binds for H, but not for M, then $\tilde{\epsilon}_M>0$. This can be shown by noting that $V_{M,Up,AUT}=\beta V_{H,Up,AUT}$. However, the solution to the planner problem without imposing the incentive compatibility for the M household implies that $\tilde{\epsilon}_M<0$. Hence, a contradiction is reached, and the incentive compatibility for the M household must bind under the upward carousel.

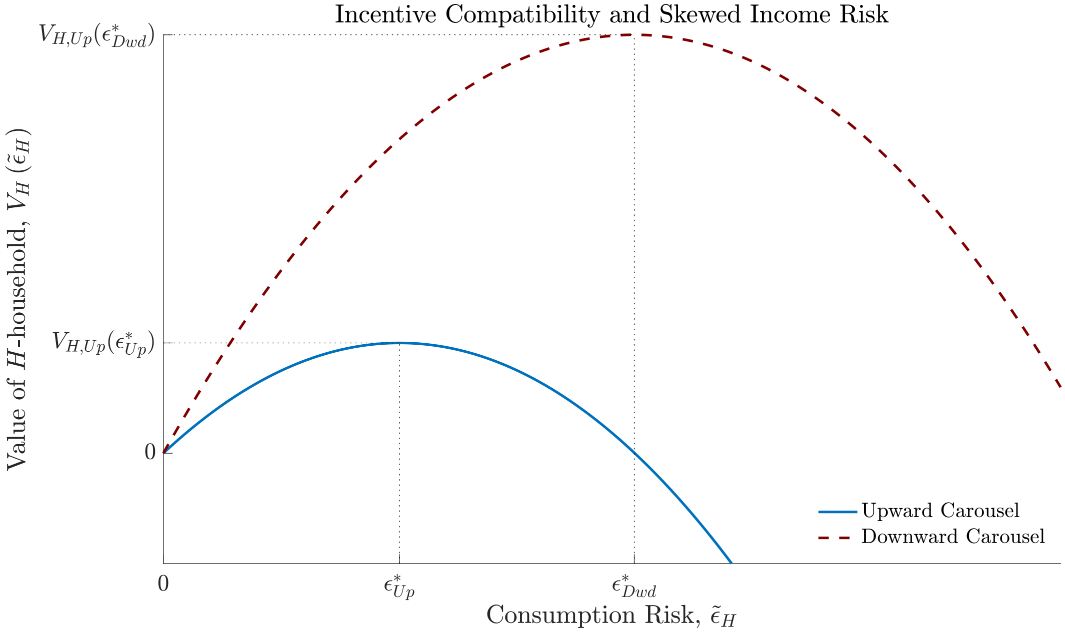

Figure 10: Determination of equilibrium consumption inequality as a function of income skewness.

tuations, the Upward carousel, is associated with more risk-sharing in the model, consistent with the empirical result that countries with a greater degree of skewness experience capital inflows upon integration with international financial markets.

For completeness, under the Downward carousel, the solution to the planner problem is given by $\tilde{\epsilon}_H = \min(\epsilon, \tilde{\epsilon}^*_H)$, where, in turn, $\tilde{\epsilon}^*_H$, is the smallest value that solves

$$\log(1+\tilde{\epsilon}^*_H)+\beta\log(1+\tilde{\epsilon}^*_M)+\beta^2\log(1+\tilde{\epsilon}^*_L) = V_{H,Down,AUT} = \log(1+\epsilon)+\beta^2\log(1-\epsilon) \quad (51)$$

imposing that $\tilde{\epsilon}^*_M = -\frac{1-\beta}{2+\beta}\tilde{\epsilon}^*_H$ and $\tilde{\epsilon}_L = -\frac{1+2\beta}{2+\beta}\tilde{\epsilon}^*_H$. For β close to unity, this solution is extremely similar to the simpler one previously considered with $\tilde{\epsilon}_M = 0$ and $\tilde{\epsilon}_L = -\tilde{\epsilon}_H$. When $\tilde{\epsilon}_H = \epsilon$, $\tilde{\epsilon}_M = 0$ and $\tilde{\epsilon}_L = -\tilde{\epsilon}_H$.

Figure 11 displays in full the solution for $\tilde{\epsilon}_H$ and $\tilde{\epsilon}_M$ as function of ϵ under the Downward and Upward carousel.

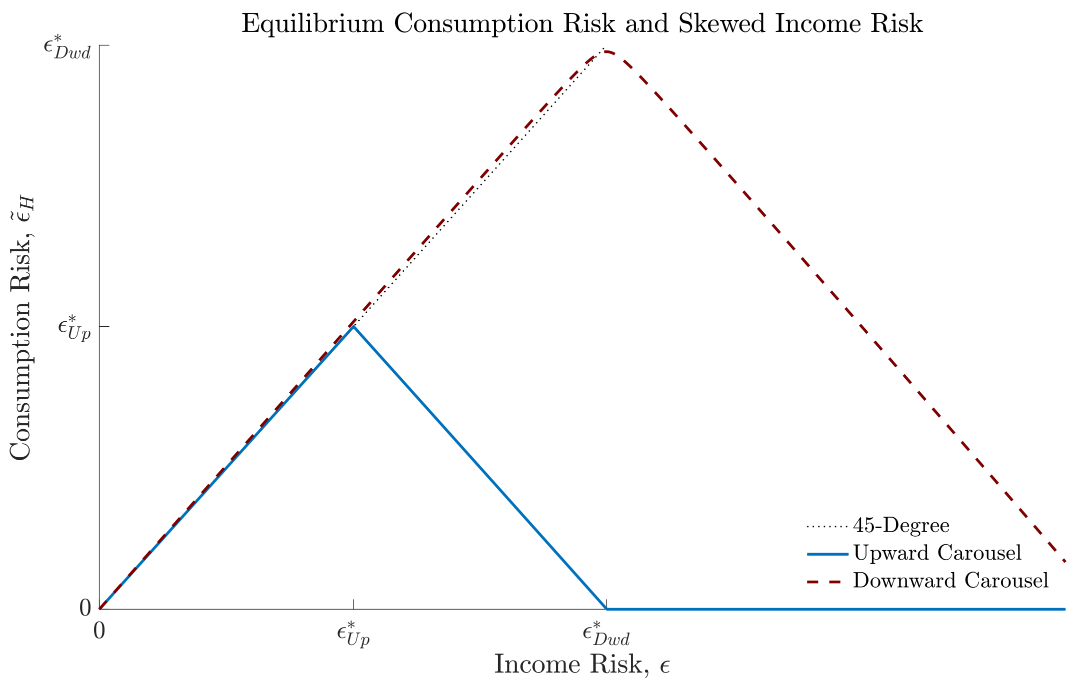

Figure 11: Equilibrium consumption allocations as a function of income risk.