International Portfolio

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Abstract

In this paper, we develop a heterogeneous-country model of international portfolio choice with global financial shocks. Without assuming imperfect international risk-sharing, our model endogenizes which countries enjoy the 'rich world privilege.' We predict that in global crises, lower-wealth countries experience a stronger capital flight, while wealthier countries face a more moderate retrenchment.

JEL Codes: F30, F40, F60, G15

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The wealthiest countries enjoy a privilege: they experience a positive difference between return on foreign assets and return on foreign liabilities. As a result, they can consistently run current account deficits without harming their international investment positions. In contrast, poorer countries are compelled either to maintain current account surpluses or to seek additional financing to cover interest payments on rising foreign debts. Figure 1 illustrates this disparity, showing that net foreign capital income is positive for wealthy economies but constitutes a burden of approximately 1–5% of GDP for the BRICS countries.

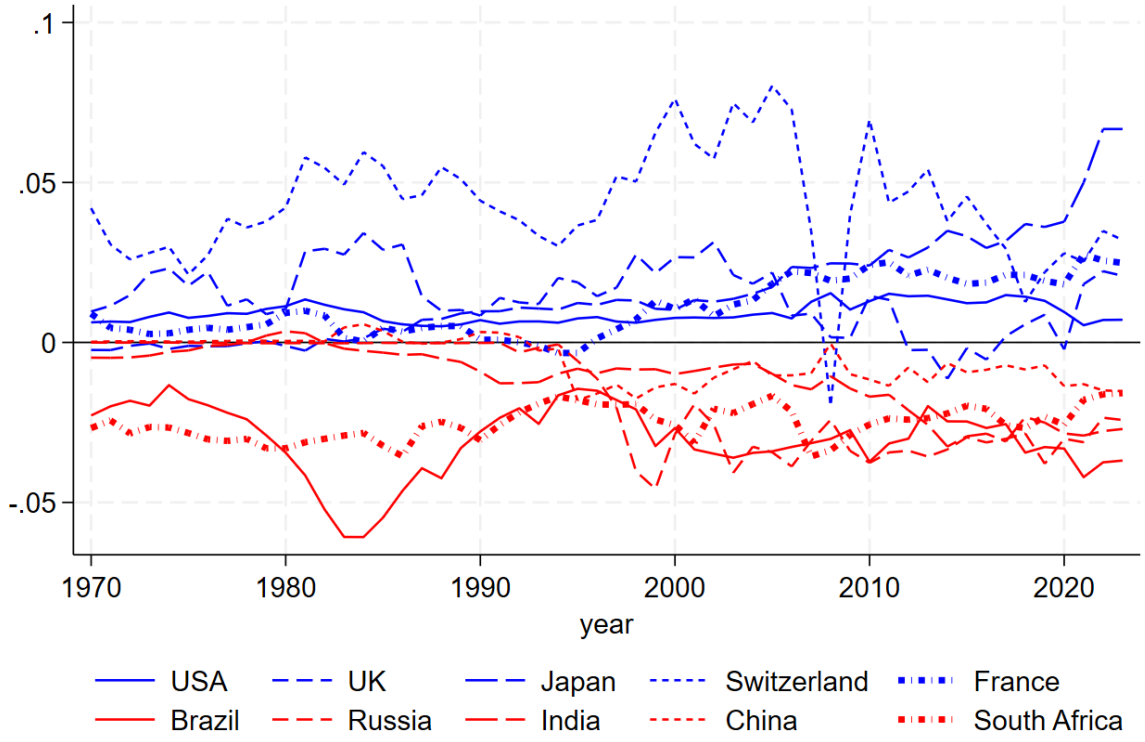


Figure 1. *Net foreign capital income received (paid) as a share of the country's GDP.*

Nievas and Sodano (2024) show that this privilege of rich countries comes from lower rates of return on their financial liabilities rather than from higher returns on financial assets. Therefore, a successful model of country-specific responses to global financial shocks must incorporate these countries' international portfolio choices.

The inequality of external wealth distribution results in countries' differential exposure to the global financial cycle. In global crises, emerging markets suffer from stronger capital flight, while wealthier countries experience a more moderate retrenchment. This results in a slower recovery for poorer countries that face limited access to foreign capital. In contrast, wealthy countries recover more rapidly and sometimes even experience above-average consumption growth after a crisis.

In this paper, we reconcile these empirical facts with a micro-founded framework of

international portfolio choice that fully endogenizes which countries enjoy the privilege. In our model, countries are ex-ante homogeneous and issue risky bonds with the same level of risk. They optimize their portfolios by investing in three types of assets: (1) local capital, which can be used for production but carries a risk; (2) risk-free international bonds that can be used for both borrowing and saving; (3) country-specific bonds issued by other countries that offer a higher return than the risk-free bond but carry a higher risk. In this setup, countries with lower wealth exhibit higher country-specific interest rates than wealthier countries because they rely more heavily on risky international borrowing.

The model categorizes countries into three groups based on their international portfolio choice. The first group consists of countries that rely heavily on risky international borrowing and have minimal internal capital at risk. This reliance on risky borrowing can be expensive, especially when it is their sole source of production financing. The second group of countries mitigates these costs by opting for risk-free borrowing, thereby assuming a greater share of their internal risk. The third group exhibits the 'privilege': these countries maintain a negative international investment position while earning positive returns on their international portfolios. The final group comprises "ultimate savers" who invest in both risky and riskless bonds.

We use this international portfolio model to analyze the effects of a global financial crisis on country-specific international portfolio reallocation.

In response to a financial crisis, aggregate borrowing rates and aggregate risk premia increase. Lower-wealth countries have to increase interest rates significantly to attract international capital, which leads to substantial declines in domestic capital and consumption. Medium and high-wealth countries recover more quickly. The richest countries temporarily increase consumption and wealth as they benefit from rising interest rates.

Portfolio reallocation is also heterogeneous across wealth groups. Lower-wealth countries that heavily rely on risky international borrowing experience a dramatic decrease in domestic capital. Wealthier countries initially reduce their holdings of risk-free assets but then quickly shift to safer investments ('flight to safety') and increase their holdings of domestic capital.

1 Model

1.1 Model Outline

We consider a continuous time model with a unit measure of countries indexed by $i \in [0, 1]$. These countries optimize their portfolios by investing in three types of assets: (1) local capital, which can be used for production but carries a risk; (2) risk-free international

bonds that can be used for both borrowing and saving; (3) country-specific bonds issued by other countries that offer a higher return than the risk-free bond but carry a higher risk. Each country accepts investment from other countries around the world and faces an upward-sloping demand for its bonds, so it can choose the return on the bond to modify how much foreign investment it attracts. Each country also chooses the level of consumption and is averse to risk, assuming that there is a representative consumer making decisions within each country.

For simplicity, we first consider a very simple framework with country-level wealth as the only state variable. Countries face a borrowing constraint so that their wealth is bounded from below. In the simplest version of our model, we abstract completely from the exchange rate dynamics and assume that everything is expressed in terms of a global numeraire.

The following formula describes the wealth dynamics:

$$dw_{it} = \underbrace{r(w_{it} - \int b_{ijt}dj - k_{it} + b_{it})dt}_{\text{risk-free return}} + \underbrace{ak_{it}^{\alpha}dt + \sigma k_{it}dZ_{it}}_{\text{return on capital}} - \underbrace{c_{it}dt}_{\text{consumpiton}} - \underbrace{(r_{it}b_{it}dt + \sigma b_{it}dZ_{it})}_{\text{international debt repayment}}$$
$$+ \underbrace{\int r_{jt}b_{ijt}dtdj + \int \sigma b_{ijt}dZ_{jt}dj}_{\text{return on international bonds}}$$

where w_{it} is the wealth of country i at time t, k_{it} is the investment in capital of the country i at time t, c_{it} is the consumption of the country i, b_{ij} is the purchases of bonds of country j by the country i, b_{it} is the foreign risky debt of the country i.

Capital in our model is assumed to have decreasing returns to scale, so rich countries face lower returns on capital than developing countries. This effect will motivate developing countries to actively seek borrowing in the international financial markets, as their wealth will be insufficient to finance production.

Capital is assumed to be risky, so there is a local technological shock dZ_{it} for each country. This risk can be shared through the risky international bond b_{it}, so the larger the proportion of capital financed with international debt, the better the country is hedged against the local productivity shock. In this simple version, there is no 'skin-in-the-game' constraint, so, in principle, if all the capital is financed with international debt, the country will be able to trade away all the exposure to its productivity shock. As we will see, in equilibrium, the poorest countries will utilize this opportunity.

Lastly, each country can invest in the bond of any other country so that b_{ij} is the investment of the country i into the risky bond of country j. We impose the market clearing condition so that the international debt of each country i is equal to the investment of all the other countries into its bond so that $b_i = \int b_{ji}dj$.[1]

[1]Note that $\int b_{ji}dj \neq \int b_{ij}dj$, the right-hand side is the total investment from the rest of the world

Investments in each country-specific bond b_{ij} are subject to a country-specific risk dZ_{jt}. This risk is fully diversified so that the resulting aggregate risk does not depend on the risk coming from each specific country. Note that even though the country-specific risk is fully diversified, it will still determine portfolio weights b_{ij}, as the exposure to the aggregate risk will depend on them. As we will see, optimal portfolio weights minimize exposure to the aggregate risk while maximizing the return. Note additionally that the variance of the return on this aggregate portfolio is, in general, not zero but equal to $\int \sigma^2 b_{ij}^2 dj$, and can be calculated by swapping the order of integration.

Taking the time evolution of wealth, we consider the Hamilton-Jacobi-Bellman equation:

$$\rho V(w) = \max_{c_i, k_i, b_{ij}, r_i} \left[u(c_i) + \frac{\partial V(w)}{\partial w} \left(r(w_i - \int b_{ij} dj - k_i + b_i) + a k_i^\alpha - c_i - r_i b_i + \int r_j b_{ij} dj \right) + \frac{1}{2} \frac{\partial^2 V(w)}{\partial w^2} \left(\sigma^2 (k_i - b_i)^2 + \int \sigma^2 b_{ij}^2 dj \right) \right]$$

The value function V depends only on w, consumer chooses $c_i,\ k_i,\ b_{ij}$ and r_i to maximize the increase in value.

The important parameter of the value function that determines the optimal portfolio choice is the relative risk aversion, which we denote as:

$$\gamma(w) = -\frac{\frac{\partial^2}{\partial w^2} V(w) w}{\frac{\partial}{\partial w} V(w)}$$

The optimal portfolio choice is given by the Sharpe ratio:

$$b_{ij} = \frac{w_i}{\gamma_i} \frac{r_j - r}{\sigma^2}$$

Investments in risky international bonds will depend on their risk and the premium they pay over the risk-free rate. Due to risk, the deviation between r_j and the risk-free rate r is present, so the average premium will be determined by the aggregate risk aversion.

The optimal portfolio choice determines the aggregate demand for the country's risky bond:

$$b_i = \frac{w}{\gamma} \frac{r_i - r}{\sigma^2}$$

where aggregate wealth w is given by: $w = \int w_j dj$ and aggregate relative risk aversion $\gamma = w \left(\int \frac{w_j}{\gamma_j} dj \right)^{-1}$. Note that countries face a positively sloped supply of funds, so a higher interest rate of r_i allows them to attract more investment.

into the country i. In contrast, the left-hand side is the total investment from the country i into the rest of the world.

The optimal exposure to the country-specific risk determines the optimal capital choice:

$$k_i - b_i = \frac{w_i}{\gamma_i} \frac{m_i - r}{\sigma^2}$$

where m_i is the marginal return to capital given by: $m_i = a\alpha k_i^{\alpha-1}$. This exposure will be higher for the wealthier countries.

Given the choice of capital and the supply of foreign funds, we can find that the simple average between the marginal return on capital and the risk-free rate gives the optimal interest rate.

$$r_i = \frac{m_i + r}{2}$$

Note that the higher marginal return on capital creates an additional difference between country-level interest rates. Developing countries need international borrowing more due to their low internal wealth and, therefore, have to pay higher rates to attract more foreign investment.

Lastly, we have a market-clearing condition to ensure that risk-free bonds are in zero net supply. This condition determines the risk-free rate.

$$\int w_j dj = \int k_j dj$$
$$r = \frac{2}{3}\frac{\gamma}{w}\text{cov}\left(\frac{w_i}{\gamma_i}, m_i\right) + \int m_j dj - \frac{2}{3}\gamma\sigma^2$$

1.2 Equilibrium

In this subsection, we characterize our model's equilibrium and provide intuition behind the relationship between interest rates and optimal portfolios with a numerical example.

The left panel of Figure 2 shows the relationship between wealth and country-specific risky bond rates. In our setting, all the bonds have the same level of volatility, so the difference in the levels of risk does not drive the differences in the interest rates. The driving force behind this result is the differential demand for external funds. Countries with low levels of wealth cannot finance internal capital for production, so they are forced to rely on international borrowing. Due to the decreasing returns to scale, it pays more for developing countries to invest an additional unit of capital into production, so the returns on capital are higher.

The degree of reliance on international investment also depends on the levels of wealth, as can be seen in the right panel of Figure 2. Countries at the borrowing limit rely exclusively on international borrowing to finance their capital and are not exposed at all to the risk associated with production. Countries with higher wealth start to rely more

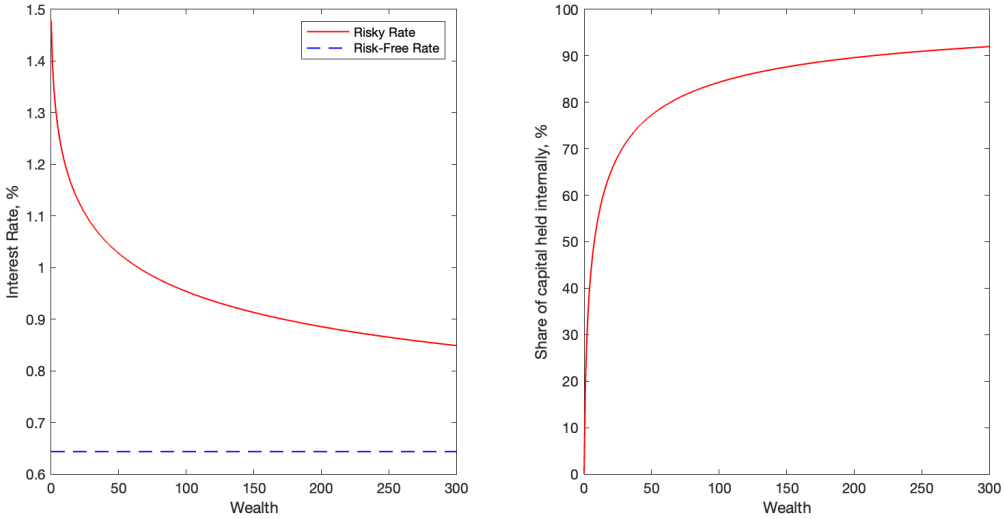


Figure 2. ***Left:*** *country-specific risky bond interest rate,* ***Right:*** *share of country-specific capital held internally*

on their wealth to finance capital, with the richest countries holding almost all the capital internally.

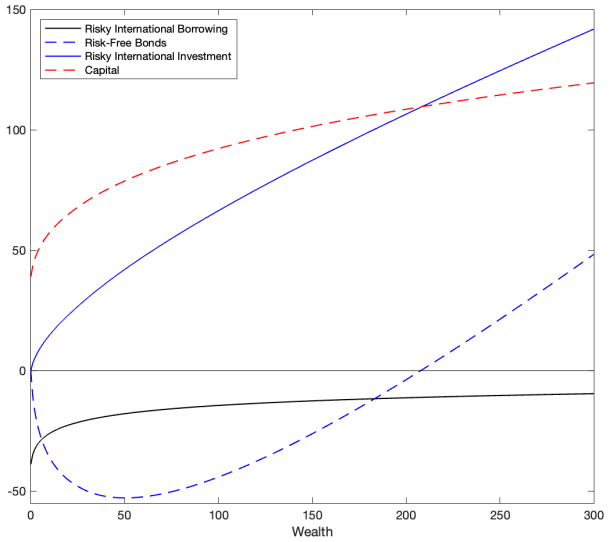


Figure 3. ***Left:*** *country-specific risky bond interest rate,* ***Right:*** *share of country-specific capital held internally*

Figure 3 examines portfolio structure for the different levels of wealth. Countries with low levels of wealth rely on risky international borrowing and hold little international assets. In other words, they rely on foreign investors to finance their productive capital. Countries with medium levels of wealth substitute costly, risky borrowing for cheaper, risk-free borrowing, leaving them more exposed to both their own country-level risk and international shocks – these are the countries that are going to be most severely hit during

the global financial crises. Finally, rich countries act as insurance providers to the rest of the world, with the main part of their portfolio being risky international bonds and internal capital.

Figure 4 illustrates that our model generates a region where countries can have a positive aggregate return on international position while being net debtors. This effect arises due to a difference between risk-free and risky rates, which countries can exploit if they are rich enough not to need risky debt to finance internal capital and not too concerned about risk exposure. The prevalence of this effect depends on the variance of risky rates across the world (variance of wealth across the world) and the variance of the productivity shock. Depending on the calibration, it is possible to have a perpetually positive drift of country-level wealth and no ergodic wealth distribution.

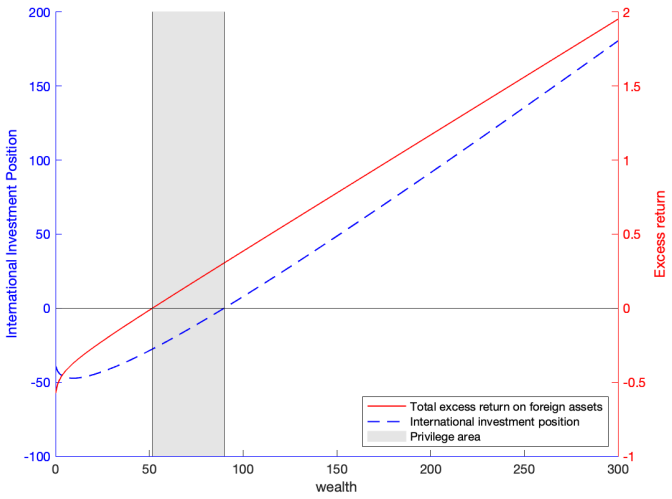


Figure 4. *Net international investment position and total excess return on foreign assets. In the shaded area, the total return on international investments is positive, while the aggregate position is negative – there is an exorbitant privilege.*

1.3 Effects of global wealth destruction

The scenario for the global financial crisis involves the destruction of wealth in proportion to the destruction of wealth in all countries. To consider the pure effect of the changing global financial market conditions, we will assume that the country itself does not face any additional shocks apart from those coming from reduced global supply of funds and changing global rates.

First, consider the response of aggregate variables during the crisis transition. Figure 5 shows the impulse responses of aggregate wealth, aggregate risk premium, risk-free rate, and average risk rate. The direct effects of wealth destruction on aggregate wealth are shown in the first panel. Due to the decrease in the supply of funds, both risk-free and

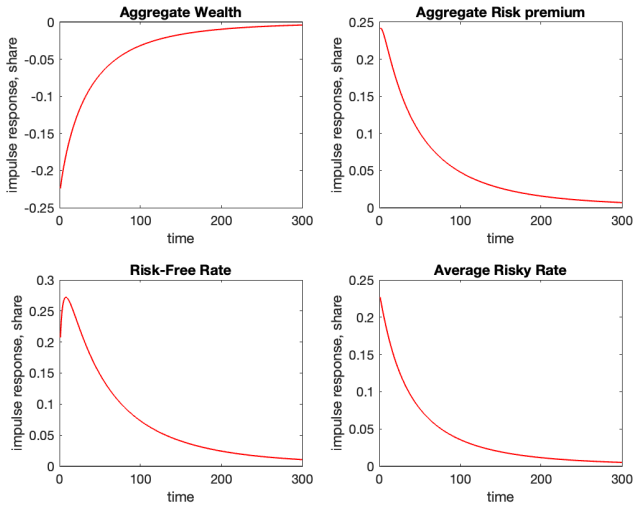


Figure 5. *Effects of proportional wealth destruction on aggregates*

risky rates increase. The peak of the risk-free rate is not coming immediately, generating a hump-shaped response. The reason for this is the preferred portfolio composition of countries with different levels of wealth: while medium-wealth countries rely on international risk-free borrowing, low-wealth countries prefer risky borrowing – so initially, the effect of declining supply of funds is balanced by a decline of demand for risk-free borrowing as many medium-wealth countries become low-wealth. The last panel shows that aggregate risk premium increases, reflecting both the desire of constrained countries to compete for limited funding and the increase in aggregate absolute risk aversion.

The effects of the financial crisis on country-specific borrowing rates, capital investment, consumption, and wealth can be seen in Figure 6. When choosing the interest rate, countries face a dilemma – on the one hand, higher interest rates allow for attracting more scarce international funds; on the other hand, higher interest rates increase the costs if capital investment depends on international funding. In this model, all the countries increase their interest rates, with lower-wealth countries increasing the rates by significantly more. This strategy, however, does not allow low countries to preserve their capital holdings fully, so they face a sharper initial decline in capital than middle and high-wealth countries. Consumption in all countries declines, with lower-wealth countries facing a more severe decline than medium and high-wealth countries, with the latter even countries enjoying a period of increased consumption after an initial drop. After the crisis, all countries faced the need to save more, and perhaps surprisingly, low-wealth countries experienced an initial rise in wealth caused by severe consumption reduction. For medium- and high-wealth countries, there is a different effect of later increases in wealth, which is caused by increasing global interest rates. This later increase is so significant for high-wealth countries that their consumption even has a temporary increase before converging

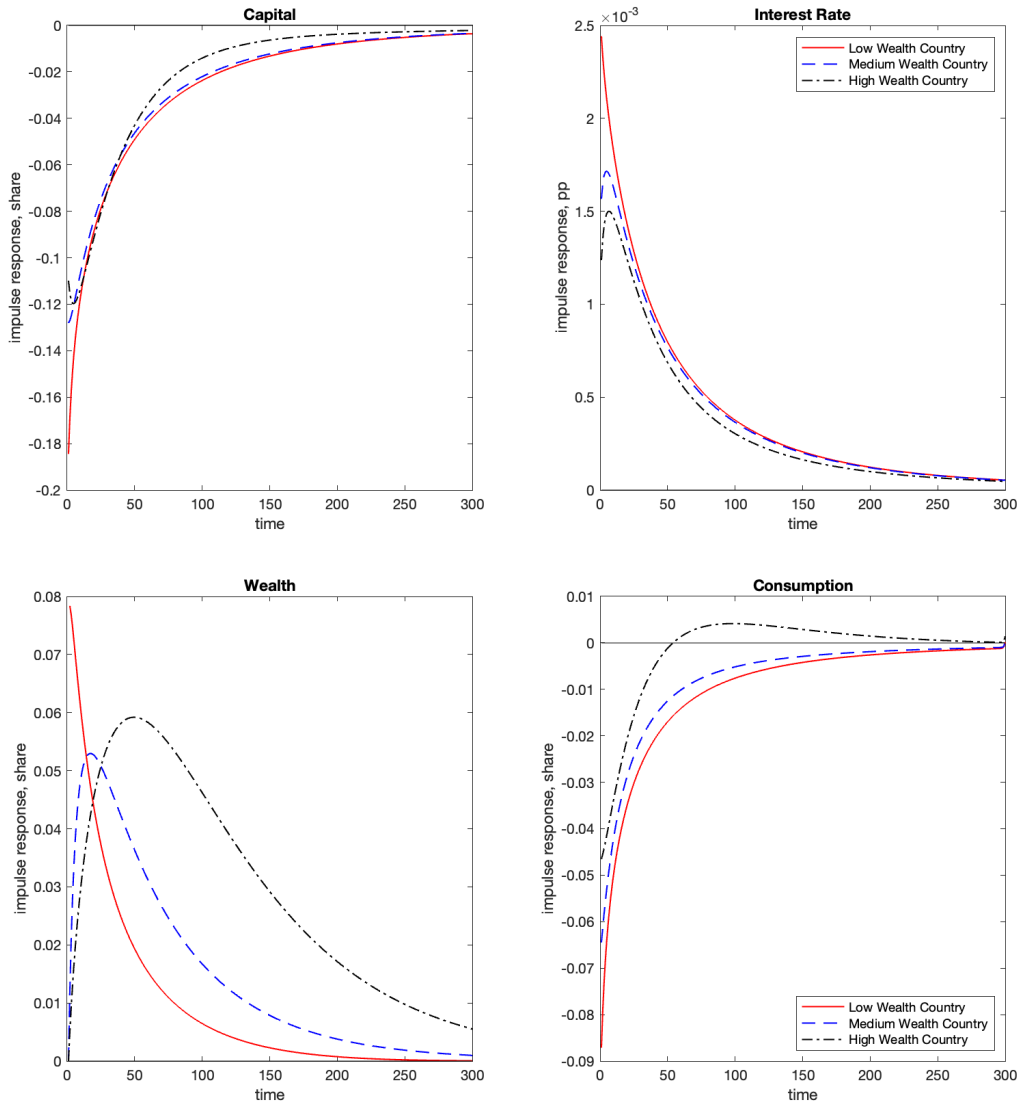


Figure 6. *Effects of proportional wealth destruction on low-wealth, medium wealth and high-wealth countries*

back to the equilibrium.

Figure 7 provides portfolio composition changes for low-, medium-, and high-wealth countries. Low-wealth countries rely heavily on risky international investment in order to finance their internal capital, so there is an almost one-to-one pass-through of a decline in international risky debt to a decline in capital. If we consider medium and high-wealth countries, we notice a much less pronounced relationship between the two. Right after the shock, there is a decline in risk-free holdings in all countries that later turns into an increase. This effect is due to the shape of the risk-free rate response. After this initial period, all countries exhibit the 'flight to safety' effect by trying to increase their holdings of risk-less bonds, even though for low- and medium-wealth countries, this means a reduction of risk-free borrowing. Oppositely, the share of investments into risky assets, including internal capital and international risky bonds, declines for all the

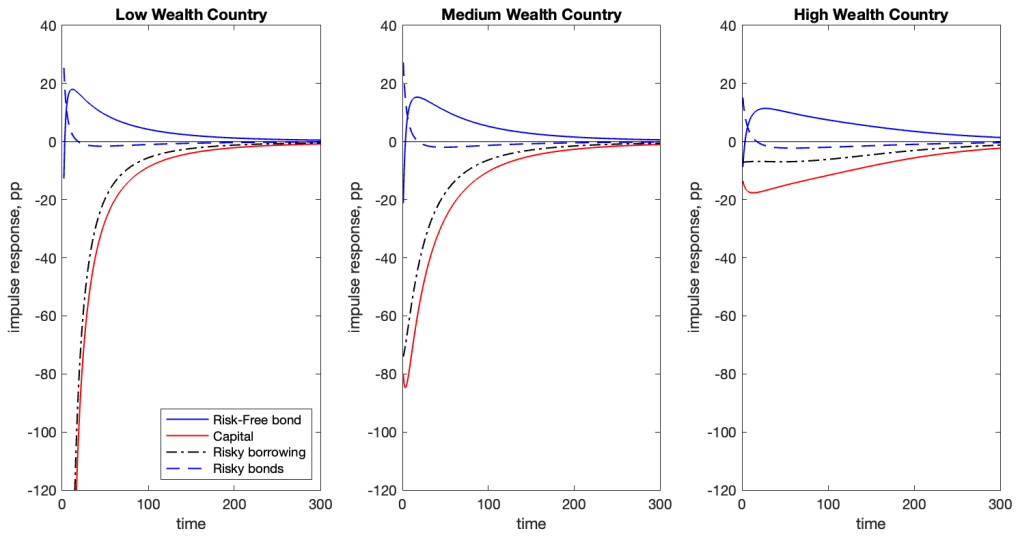


Figure 7. *Effects of top wealth destruction on portfolio composition*

countries. However, this decline is significantly more pronounced for low- and medium-wealth countries.

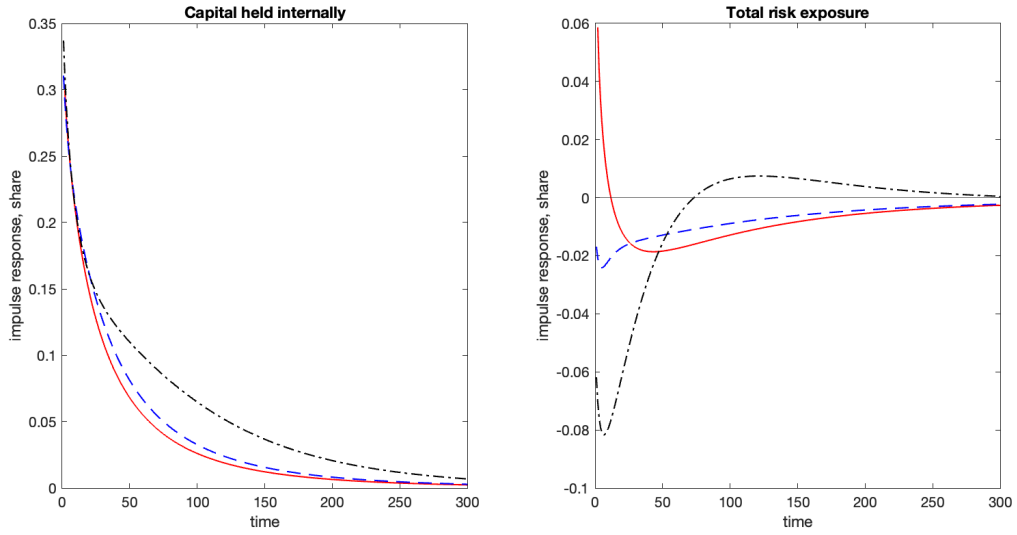


Figure 8. *Effects of top wealth destruction on share of capital held internally and total risk exposure*

Figure 8 considers the effect of the financial crisis on the share of capital held internally and exposure to aggregate risk. High-wealth countries increase their share of internally held capital by more. Total risk exposure declines for high- and medium-wealth countries, reflecting the decreasing appetite for risk. High wealth countries initially respond more actively, but then recover their ability to hold risk quickly and even having a temporary increase of risk exposure compared to equilibrium. For the low-wealth countries, the effect is the opposite. Due to more expensive international borrowing, low-wealth countries are forced to hold more risk, compared to the equilibrium where their exposure, especially to

their own risk, is almost nil.

We can see that in our model, the need to maintain risky foreign borrowing forces low-wealth countries to increase their interest rates by more. This reliance on risky foreign borrowing forces them to reduce their capital holdings and consumption by more than rich countries. On the other hand, rich countries are both less affected initially by these perturbations and recover more quickly, even enjoying paradoxical periods of increased consumption before converging back to equilibrium due to a faster recovery of appetite for risk.

It is important to note that in our setting, because of portfolio differences across countries, the effects of wealth destruction will differ depending on which countries are affected and how. For example, if we instead consider wealth destruction in only top-wealth countries, we will see a different pattern, both in aggregates and country-level responses.

In the aggregates (Figure 9), there will be no comparable hump-shaped response of risk-free rates since as the wealth of medium-wealth countries remains untouched, there is no decline in risk-free borrowing balancing the decline in risk-free saving. Because of this, portfolios of all countries exhibit the 'flight-to-safety' response without the initial period of the reversal of this effect, seen in the baseline example.

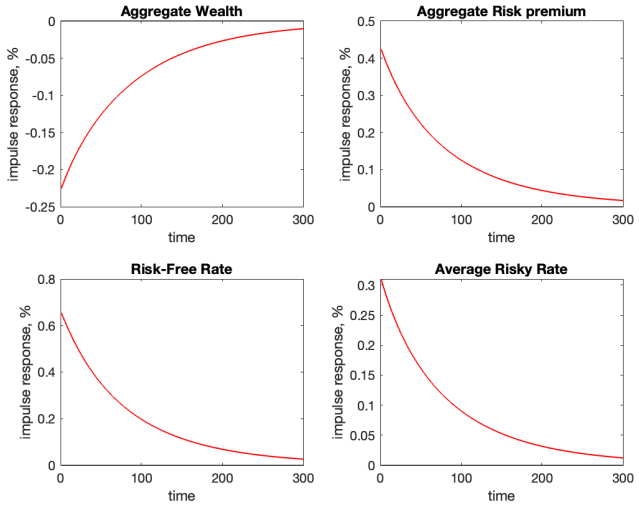


Figure 9. *Aggregate effects of top wealth destruction*

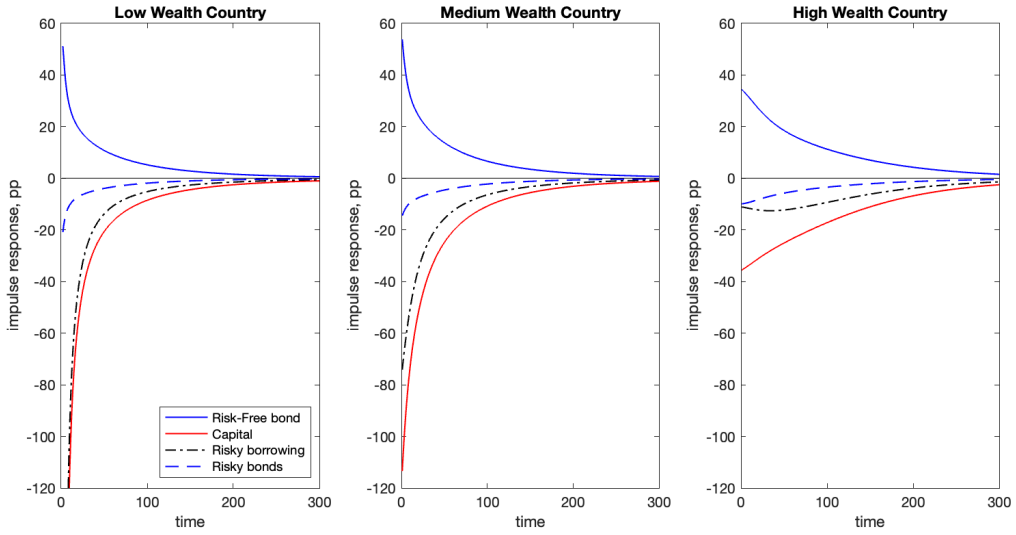


Figure 10. *Effects of top wealth destruction on portfolio composition*