NBER WORKING PAPER SERIES

# FIRMS' INVESTMENT AND THE REAL TRANSMISSION OF THE GLOBAL FINANCIAL CYCLE

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Working Paper 35918
http://www.nber.org/papers/w35918

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 2026

We thank Javier Bianchi, Laura Castillo-Martinez, Julian di Giovanni, Moritz Lenel, Matteo Maggiori, Andy Neumeyer, Felipe Saffie, Jesse Schreger, and seminar participants at various institutions for useful comments and suggestions. Alejandro Castillo and Zhe Ying Shen provided excellent research assistance. Hegarty acknowledges NSF funding through the Graduate Research Fellowship Program under grant number 1256260. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 35918
October 2026
JEL No. E22, F00, F30


## ABSTRACT

We study how global financial conditions transmit to firms' investment. We document that increases in risk premia are followed by large investment contractions, particularly among firms with higher default risk. We develop a quantitative heterogeneous-firm open-economy model where firms finance investment with defaultable debt priced by risk-averse global investors. We identify a strong risk channel linking changes in the global price of risk to financing costs through firms' quantity of risk—the sensitivity of debt repayment to global shocks. This introduces a risk dimension to stabilization policy: smoothing cash flows reduces firms' quantity of risk and dampens international financial transmission.



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# 1. Introduction

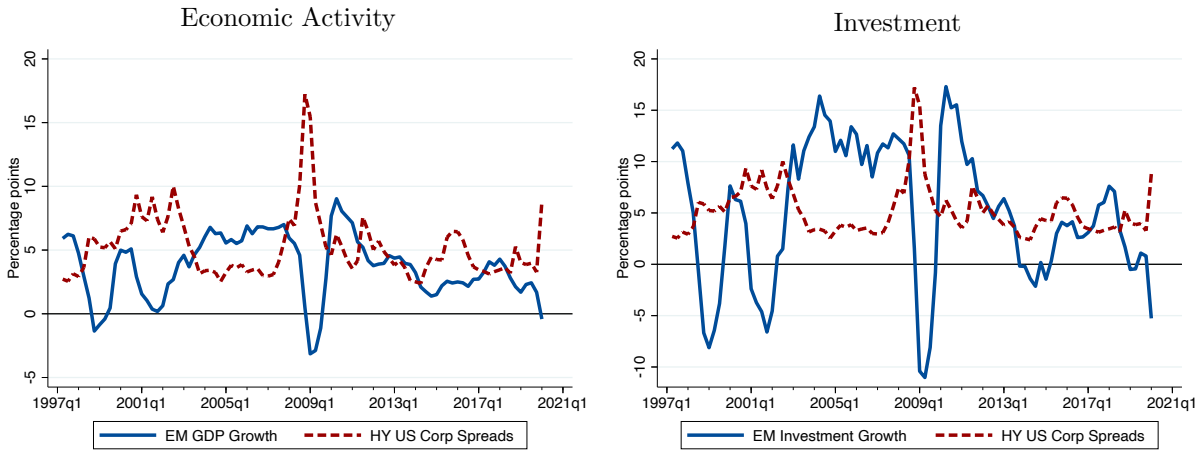
Risky asset prices and capital flows in the global economy tend to be highly synchronized, reflecting the presence of a "global financial cycle," often linked to lenders' risk-bearing capacity and global risk appetite (Rey, 2013; Kalemli-Özcan, 2019; Maggiori, 2022). In open economies, real economic activity is often exposed to these forces. For example, Figure 1 shows that emerging economies experience large swings in output and investment following changes in global borrowing costs. Motivated by these patterns, a central question is what drives the transmission of the global financial cycle to firms' investment decisions and, in turn, what role macroeconomic policy plays in stabilizing this transmission.

In this paper, we address these questions using a micro-to-macro approach that combines a heterogeneous-firm open-economy model with new evidence on firms' responses to fluctuations in global borrowing costs. We show that firms' risk plays a key role in the transmission of the global financial cycle. First, we identify a quantitatively strong risk channel through which changes in the global price of risk affect firms' investment. Second, we show that this mechanism gives rise to a risk dimension through which macroeconomic policies can stabilize fluctuations originating in international capital markets. For instance, exchange rate and macroprudential policies can mitigate the aggregate effects of these shocks by reducing firms' quantity of risk and, in turn, limiting their pass-through to borrowing costs.

Our analysis proceeds in three steps. First, we analyze empirically how fluctuations in the global financial cycle transmit to firms' investment in a sample of open economies. To do so, we combine firm-level balance sheet information with data on risky external borrowing costs, measured by the excess bond premium (Gilchrist and Zakrajšek, 2012). The excess bond premium is the component of credit spreads that is orthogonal to firms' default risk, and its aggregate component reflects fluctuations in the risk-bearing capacity of the financial sector. We document that increases in the excess bond premium are followed by heterogeneous investment dynamics across firms, with sharper contractions among riskier firms.

Motivated by the empirical patterns, we construct a heterogeneous-firm open-economy

**Figure 1:** U.S. Borrowing Costs and Economic Activity in Emerging Markets




*Note: The figure shows average year-over-year growth rates of real GDP (Panel a) and real investment (Panel b) relative to Barclays U.S. Corporate High Yield Spreads. The emerging markets included are Argentina, Brazil, Chile, Colombia, India, Korea, Mexico, Peru, the Philippines, Thailand, Turkey, and Ukraine. See Appendix Figure A.1 for similar patterns in advanced European economies, and Appendix A.1 for data sources.*

model to study the macroeconomic transmission of fluctuations in the global price of risk. We consider a canonical open-economy framework in which households consume goods produced by the home economy and the rest of the world. In this environment, we introduce heterogeneous domestic firms that face idiosyncratic and aggregate productivity shocks and finance investment with defaultable debt provided by foreign investors (as in Khan, Senga and Thomas, 2024; Ottonello and Winberry, 2020). These investors are subject to shocks that affect their valuation of systemic risk and induce variations in the excess bond premium akin to those observed in the data.

A quantitative version of our model is consistent with the evidence from our empirical analysis. A distinguishing feature of our analysis is the focus on the macroeconomic effects of changes in the price of risk in an economy with heterogeneous agents. To connect the model to the data, we use global methods and a set of co-state variables that preserve the model's aggregate nonlinearities and allow us to quantify these forces under a realistic distribution of risk across firms. We calibrate the model to a sample of Latin American economies and show that its responses to changes in the global price of risk are consistent with both micro- and macro-level empirical patterns of investment dynamics following changes in the excess bond premium. At the micro level, we estimate the same empirical regressions on model-simulated

data and show that the model replicates the observed heterogeneity in investment responses across firms by risk. At the macro level, the model accounts for the observed declines in output and investment, as well as the exchange rate depreciation.

We then use the model to quantify the channels through which changes in the global price of risk affect firms. First, we isolate a risk channel, defined as the partial-equilibrium effect of a shock to the global price of risk on investment through its effect on the debt-price schedule. We find that this is the main driver of aggregate investment contractions, and its effect is determined by firms' quantity of risk, measured as the covariance between debt payoff and global productivity innovations. Second, we measure a competitiveness channel as the effect of changes in the global price of risk on investment stemming from changes in output and input prices induced by the shock. This channel plays an important role in mitigating the contraction: in a counterfactual economy in which capital prices and real wages do not respond to increases in the global price of risk, the contraction in aggregate investment would be about 70 percent larger than in the baseline economy. Third, in economies with foreign-currency debt (e.g., emerging markets), we measure a debt-revaluation channel, defined as the effect on investment stemming from the revaluation of foreign-currency debt because of the movement in the real exchange rate caused by the global price of risk shock. We find this channel to be quantitatively small vis-à-vis the other two channels. We also study how the strength of these channels depends on features of the economic environment, such as the currency composition of debt and the input structure of production.

Finally, we use our model as a laboratory to analyze how macroeconomic policies can stabilize fluctuations in the global price of risk originating in international capital markets. Our analysis identifies a novel "risk dimension" of policies: how policies influence the transmission of external shocks through their effect on firms' quantity of risk. Policies that stabilize cash-flow fluctuations reduce firms' exposure to aggregate risk and dampen the pass-through of external shocks to borrowing costs and investment. We first apply this to exchange rate regimes in the presence of nominal rigidities, and find that the risk dimension is sizable and depends on the economic environment. In our baseline specification with foreign-currency debt, the risk dimension implies that fixed exchange rate regimes feature a higher quantity of risk because of a weaker adjustment of input prices. In contrast, in economies with local-

currency debt, the risk dimension implies that fixed regimes feature a lower quantity of risk because they mitigate the currency risk premia associated with local-currency borrowing.

We also apply our analysis to macroprudential policies by considering the effects of taxing firms' debt. As is standard in this literature, this type of policy reduces leverage and mitigates the response of firms' investment to external shocks. In addition, our analysis shows that the risk dimension accounts for more than half of the attenuation of investment responses to global price of risk shocks induced by macroprudential policies.

**Related literature.** Our paper contributes to various strands of the literature. First, it relates to the literature on the global financial cycle and imperfect international capital markets (see, e.g., Rey, 2013; Maggiori, 2022, and references therein). This literature has studied how global shocks propagate to international asset prices and domestic credit markets (see, for example, di Giovanni, Kalemli-Özcan, Ulu and Baskaya, 2022; Hassan, Schreger, Schwedeler and Tahoun, 2024; Akinci, Kalemli-Özcan and Queralto, 2026; Morelli, Ottonello and Perez, 2022; Bai, Kehoe, Lopez and Perri, 2025; Kekre and Lenel, 2025). We contribute to this literature by studying the transmission of the global financial cycle to real investment and economic activity. In this sense, our paper also relates to the closed-economy literature that emphasizes the role of risk premia in macroeconomic fluctuations (see, for example, He and Krishnamurthy, 2013; Kekre and Lenel, 2022).[1]

Second, our paper contributes to the literature on international business cycles (see, for example, Backus, Kehoe and Kydland, 1992; Aguiar and Gopinath, 2007). A strand of this literature, pioneered by Neumeyer and Perri (2005), identifies an important role for fluctuations in external borrowing costs in driving business cycles in open economies (see also Garcia-Cicco, Pancrazi and Uribe, 2010; Chang and Fernández, 2013; Fernández-Villaverde, Guerrón-Quintana, Rubio-Ramírez and Uribe, 2011). Building on this view, our paper shows that the pass-through of external borrowing costs to economic activity depends on economies' quantity of risk and is endogenous to macroeconomic policy.

Finally, our paper relates to the literature on the role of firm dynamics in open economies.

[1] A related literature in asset pricing studies the role of fluctuations in risk premia (see Cochrane, 2011, for a survey). In international asset pricing, fluctuations in risk premia have also been used to explain the cross section of currency and sovereign risk (see, for example, Lustig and Verdelhan, 2007; Longstaff, Pan, Pedersen and Singleton, 2011; Gilchrist, Wei, Yue and Zakrajšek, 2022).

This literature has shown that firm heterogeneity plays a central role in the transmission of sudden stops, sovereign risk, and monetary policy (e.g., Gopinath and Neiman, 2014; Ates and Saffie, 2021; Arellano, Bai and Bocola, 2026; Aruoba, Fernández, Lu and Saffie, 2022). Closest to our work, Castillo-Martinez (2025) studies the interaction between sudden stops and exchange rate regimes in a model with firm heterogeneity. We contribute to this literature by showing that the distribution of firms' risk plays a key role in the transmission of external shocks and the design of macroeconomic policy.

**Layout.** The rest of the paper is organized as follows. Section 2 reports our empirical evidence on firms' investment dynamics following changes in the excess bond premium. Section 3 develops our heterogeneous-firm open-economy model to interpret this evidence. Section 4 calibrates the model, verifies that it is consistent with the micro- and macro-level investment dynamics following changes in the excess bond premium, and uses the model to study the transmission of changes in the global price of risk. Section 5 studies the role of macroeconomic policies in stabilizing the transmission of the global price of risk. Section 6 analyzes how the transmission of the global price of risk and its policy implications depend on features of the economic environment, such as the currency denomination of debt and the input structure of production. Section 7 concludes.

# 2. Descriptive Empirical Evidence

This section studies the relationship between risky external borrowing costs and firms' investment at the micro level. Section 2.1 describes our data and the construction of the main variables of interest. Section 2.2 documents the heterogeneous investment dynamics following changes in the excess bond premium.

## 2.1. Data and Measurement

Our empirical analysis uses firm- and bond-level data for a sample of open economies. Our baseline analysis focuses on Latin America, the emerging market region with the most complete data coverage across all datasets. We use data from other emerging market countries

and advanced European economies for additional validation. The Latin American countries in our sample are Argentina, Brazil, Chile, Colombia, Mexico, and Peru. The non-Latin American countries in our emerging market sample are India, Korea, the Philippines, Thailand, Turkey, and Ukraine. The advanced European economies included in our sample are Austria, Belgium, Germany, Denmark, Spain, Finland, France, the U.K., Greece, Italy, the Netherlands, Poland, Portugal, and Sweden.

**Firm-level data.** Our empirical analysis uses balance-sheet data from Global Compustat. These data allow us to measure key firm-level variables at a high frequency for a consistent set of publicly traded firms over a broad set of countries. In addition, our model analysis uses ORBIS data, which include information on private firms. We provide further details on these datasets, our cleaning procedure, and the definition of variables in Appendix A.2.

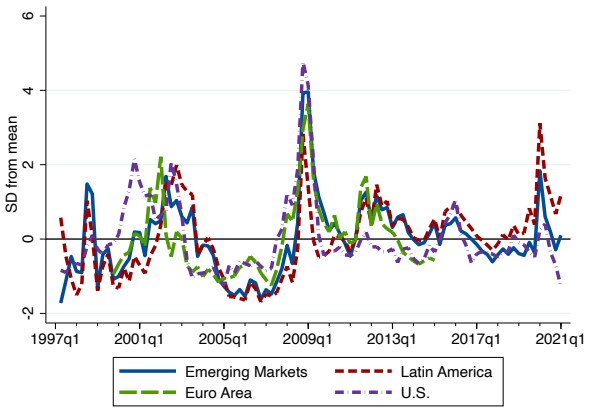
In the empirical analysis, our main variable of interest is firms' investment, which we measure as the log change in the book value of property, plant, and equipment. We also compute Merton (1974)'s "distance to default" as a measure of firms' default risk that is frequently used in the literature. As additional validation, we measure firms' risk based on their credit ratings. Appendix Tables A.1–A.4 and Figure A.2 report summary statistics for these variables, as well as other firm-level variables for the regional samples and by country.

**External borrowing costs measurement.** We measure risky external borrowing costs based on the excess bond premium (EBP), which the literature associates with fluctuations in the risk-bearing capacity of financial intermediaries. We follow the methodology in Gilchrist and Zakrajšek (2012) and compute the excess bond premium for the firms in our sample as the residuals of the projection of their bond spreads onto their distance to default and bond-specific characteristics. We then define the excess bond premium of a region (e.g., Latin America or emerging markets) as the quarterly average across bonds from firms in that region, after demeaning at the country level. Appendix A.3 provides details on the data used in this analysis and the estimation procedure, as well as results for alternative specifications for aggregating firm- and country-level data.

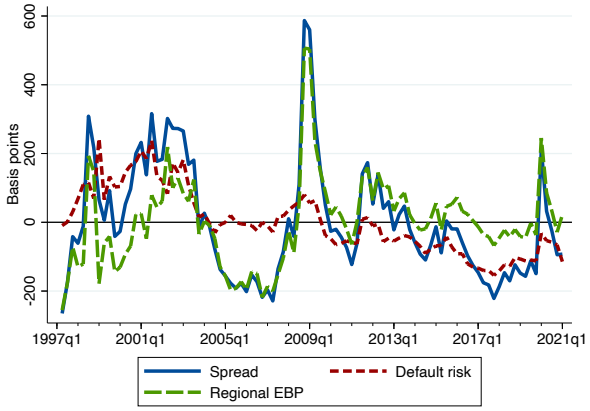
Panel (a) of Figure 2 shows the evolution of the excess bond premium for all emerging

**Figure 2:** Decomposition of Emerging Market Corporate Borrowing Costs

**(a)** Excess Bond Premium




**(b)** Bond Spread Decomposition




*Note: Panel (a) shows the regional excess bond premium for emerging markets, Latin America, the euro area, and the U.S. The units are standard deviations from the mean. The euro area excess bond premium is from De Santis (2018) and shared with us by the author. The U.S. excess bond premium is the updated measure from Gilchrist and Zakrajšek (2012), published by the Federal Reserve. Panel (b) shows the decomposition of average spreads in emerging markets into the portion predicted by default risk and the bond-specific excess bond premium, as described in Appendix A.3. Appendix Figure A.3 shows similar dynamics for the set of Latin American countries. All series are demeaned.*

markets, Latin America, and advanced European economies, together with that of the U.S. These series exhibit significant variation and a positive correlation, in line with the presence of the global financial cycle. Consistent with previous findings for the U.S., Panel (b) shows that the excess bond premium is also the main driver of average spread dynamics in emerging markets, accounting for most of their variation and for the bulk of their increase during crisis periods, such as the Global Financial Crisis and the COVID-19 pandemic. Appendix Figure A.4 shows similar dynamics of the excess bond premium across individual countries and Table A.10 shows correlations across regions.

### 2.2. External Borrowing Costs and Investment

In this section, we study the heterogeneous investment dynamics following changes in the excess bond premium for firms with different default risk. To do so, we estimate the following Jordà (2005) local projection model:

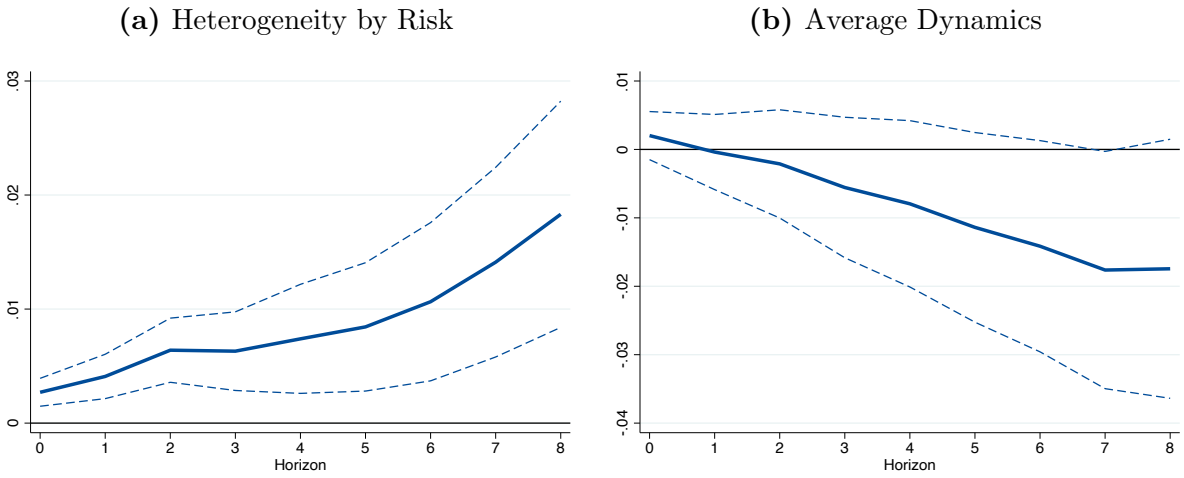
$$\Delta_h \log(k_{jt+h}) = \alpha_{hj} + \alpha_{hst} + \beta_h \times \rho_t \times \mathrm{dr}_{jt-1} + \gamma_h' X_t \times \mathrm{dr}_{jt-1} + \omega_h' Z_{jt-1} + \epsilon_{jth}, \quad (1)$$

where $\Delta_h \log(k_{jt+h}) \equiv \log(k_{jt+h}) - \log(k_{jt-1})$ denotes the period-$t$ cumulative log change in firm $j$'s capital over $h$ quarters; $\rho_t$ is a measure of the excess bond premium in period $t$; $\text{dr}_{jt}$ is a measure of firm $j$'s default risk; $X_t$ is a vector of controls for U.S. macroeconomic variables that may be correlated with the excess bond premium; $Z_{jt}$ is a vector of firm-level covariates; $\alpha_{hj}$ denotes firm fixed effects and $\alpha_{hst}$ industry-by-time fixed effects. Our baseline specification focuses on the Latin America sample, measures $\rho_t$ with the standardized regional excess bond premium, and $\text{dr}_{jt}$ with distance to default, standardized across all firms in our sample. For controls, the vector $X_t$ includes U.S. GDP growth and an indicator for the U.S. Great Recession period (2007.Q4 to 2009.Q2), and the vector $Z_{jt-1}$ includes firm size (measured as log total assets), capital growth, sales growth, fiscal quarter, current assets relative to total assets, and distance to default. We also consider alternative samples of countries, measures of risky external borrowing costs, measures of firms' risk, and vectors of aggregate and firm-level controls in Appendix A.4.

Panel (a) of Figure 3 reports our coefficient of interest, $\beta_h$, which measures the differential cumulative change in investment following an increase in the excess bond premium for firms with higher distance to default (lower default risk). The figure shows that the decline in the capital stock is more pronounced for firms with higher default risk. In particular, a one-standard-deviation increase in the excess bond premium is associated with a 1.8% larger cumulative decline in the capital stock for firms with a one-standard-deviation lower distance to default (higher default risk), relative to firms with the average distance to default.

To further interpret our cross-sectional estimates, Panel (b) reports the average investment dynamics following changes in the excess bond premium, which we obtain by estimating a version of Equation (1) without time fixed effects and adding $\rho_t$ and $X_t$ as additional covariates. On average, increases in the excess bond premium are followed by contractions in firms' investment that are large and persistent, consistent with the relationship between investment and risky borrowing costs illustrated with aggregate data in Figure 1. Quantitatively, the estimated coefficients on $\rho_t$ indicate that a one-standard-deviation increase in the excess bond premium is associated with a cumulative decline of 1.7% in the capital stock, peaking 7 quarters after the shock. The magnitude of the coefficients from the average dynamics is comparable to the cross-sectional estimates reported in Panel (a), which suggests

**Figure 3:** Investment Dynamics Following Changes in the Excess Bond Premium




*Note: Panel (a) shows the estimated $\beta_h$ coefficients of Equation (1), which correspond to the differential cumulative change in investment in response to the excess bond premium in period t for firms with a one-standard-deviation higher distance to default (lower default risk). Panel (b) reports the cumulative change in investment when the excess bond premium is one standard deviation higher for the average firm. We estimate Equation (1) without time fixed effects and with additional covariates $\rho_t$ and $X_t$ and report the coefficients on $\rho_t$. The x-axes show the horizon h (quarterly frequency). Both panels include controls for firms' sales growth, investment, fiscal quarter, size, share of current assets, distance to default, and firm fixed effects. The aggregate controls, $X_t$, are U.S. GDP growth and recession. Panel (a) includes industry-by-time fixed effects. All controls are standardized. Standard errors are clustered by firm and time with Driscoll and Kraay adjustment. Dashed lines represent 90% confidence intervals.*

a prominent role for firm heterogeneity.[2] For instance, this implies that the investment of firms with a distance to default one standard deviation above the mean does not contract following an increase in the excess bond premium.

Table 1 shows that the heterogeneity in investment dynamics following changes in the excess bond premium documented in our baseline analysis is robust across several alternative specifications. We summarize the main takeaways below and provide additional details in Appendix A.4.

1. *Alternative controls.* Panel (b) of Table 1 and Appendix Figures A.6 and A.7 show that the results are robust to alternative specifications of the controls. The first two lines report the results from removing the industry-by-time fixed effects in the baseline specification and adding alternative time-varying controls: we add aggregate controls, $\rho_t$ and $X_t$; and we add country-by-time fixed effects. The next two lines report the

[2]Appendix Figure A.6 Panel (a) reports the cross-sectional estimates from the average-dynamics specification (without time fixed effects), which closely match our baseline estimates.

**Table 1:** Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium Across Alternative Specifications

| | $h$=1 | | $h$=8 | | |
|---|---|---|---|---|---|
| | $\beta_1$ | SE | $\beta_8$ | SE | N |
| (a) *Baseline* | 0.004 | (0.001) | 0.018 | (0.006) | 13,087 |
| (b) *Alternative controls* | | | | | |
| Without time fixed effects | 0.004 | (0.001) | 0.018 | (0.007) | 13,124 |
| With alternative time fixed effects | 0.004 | (0.001) | 0.016 | (0.006) | 13,112 |
| Without aggregate controls | 0.004 | (0.001) | 0.016 | (0.008) | 13,087 |
| Without firms' characteristics | 0.004 | (0.001) | 0.016 | (0.006) | 13,087 |
| Interaction of firms' risk with other U.S. variables | 0.004 | (0.002) | 0.009 | (0.007) | 13,087 |
| Interaction of $\rho_t$ with firms' characteristics | 0.004 | (0.001) | 0.018 | (0.006) | 13,087 |
| Interaction of firms' risk with characteristics | 0.004 | (0.001) | 0.019 | (0.006) | 13,087 |
| (c) *Alternative measures of firms' default risk* | | | | | |
| Distance-to-default dummy | 0.011 | (0.003) | 0.044 | (0.015) | 13,087 |
| Investment-grade dummy | 0.006 | (0.003) | 0.017 | (0.013) | 21,995 |
| Credit rating | 0.006 | (0.002) | 0.018 | (0.011) | 21,995 |
| Leverage (sign flipped) | 0.003 | (0.001) | 0.016 | (0.008) | 18,902 |
| (d) *Alternative measures of* $\rho_t$ | | | | | |
| EBP with heterogeneity by country | 0.004 | (0.001) | 0.017 | (0.006) | 13,087 |
| EBP with heterogeneity by rating | 0.004 | (0.001) | 0.017 | (0.006) | 13,087 |
| Regional VIX | 0.002 | (0.001) | 0.004 | (0.004) | 8,141 |
| Emerging market EBP | 0.003 | (0.001) | 0.014 | (0.006) | 13,087 |
| U.S. EBP | 0.003 | (0.002) | 0.007 | (0.006) | 13,087 |
| U.S. financial shocks | -0.000 | (0.001) | 0.012 | (0.004) | 13,087 |
| (e) *Alternative samples* | | | | | |
| *by sector* | | | | | |
| Tradable | 0.005 | (0.001) | 0.019 | (0.006) | 12,090 |
| Nontradable | 0.004 | (0.003) | 0.034 | (0.018) | 12,090 |
| *by exchange rate regime* | | | | | |
| Flexible | 0.004 | (0.001) | 0.022 | (0.006) | 12,867 |
| Fixed | 0.004 | (0.003) | 0.014 | (0.018) | 12,867 |
| *by region* | | | | | |
| All emerging markets | 0.001 | (0.001) | 0.006 | (0.003) | 66,651 |
| Advanced European economies | 0.002 | (0.001) | 0.007 | (0.004) | 74,423 |

*Note: The first line of the table reports the coefficient and standard error estimates of Equation (1) for the cumulative change in capital stock between periods $t-1$ and $t+1$ or $t+8$. The number of observations is measured at the $h=8$ horizon. The remaining rows report the results from various robustness exercises. Appendix A.4 provides complete details about each exercise and reports the full path of coefficient estimates.*

results from dropping controls included in the baseline specification: the aggregate controls interacted with distance to default, $X_t \times \text{dr}_{jt-1}$; and the firm-level controls,

$Z_{jt-1}$. The final three lines report the results from adding controls to the baseline specification: an interaction of distance to default with the Fed funds rate and inflation, which are additional U.S. variables that could be correlated with the excess bond premium; an interaction between the excess bond premium and firm size, sales growth, and capital growth, which are firm characteristics that could also be correlated with risk; and an interaction of distance to default with these same firm characteristics, which may load differently depending on firms' risk.

2. *Alternative measures of firms' default risk.* Panel (c) of Table 1 and Appendix Figure A.8 show that the results are also robust to alternative measures of firms' default risk. In particular, we consider binary classifications of risk based on distance to default or investment-grade status, a measure based on credit ratings, and leverage.
3. *Alternative measures of the excess bond premium.* Panel (d) of Table 1 and Appendix Figures A.9 and A.10 show that the results are robust to alternative measures of the $\rho_t$ variable in Equation (1). First, we consider alternative ways of estimating the regional excess bond premium by allowing the loading of spreads on distance to default to vary by country and by firms' risk category. Second, we consider the Brazilian VIX as an alternative measure of $\rho_t$. Third, we expand the measure of the excess bond premium to include firms from all emerging markets, rather than only Latin America. Fourth, we consider the U.S. excess bond premium estimated in Gilchrist and Zakrajšek (2012). Finally, we consider the high-frequency U.S. financial shocks from Ottonello and Song (2025) as an identified measure of fluctuations in global intermediaries' risk-bearing capacity. We find that investment by riskier firms is more sensitive to fluctuations in each of these measures.
4. *Alternative samples.* Panel (e) of Table 1 and Appendix Figures A.11–A.13 study alternative subsamples of firms and countries. First, given that our model in the next section focuses on tradable firms, we verify that our results are also observed among firms in this sector. Second, connecting with the model analysis of exchange rate regimes, we estimate a higher sensitivity of risky firms' investment within country-periods featuring flexible and fixed exchange rate regimes. Finally, the last two rows of Table 1 show the results of estimating Equation (1) on the full sample of emerging

markets and the sample of advanced European economies.

# 3. Model

We construct a theoretical framework to study the transmission of the global financial cycle to firms' real investment decisions and economic activity. The model is designed to connect with the cross-sectional evidence presented in the previous section and to study its macroeconomic implications. At the micro level, it features heterogeneous firms, generating a realistic distribution of risk. At the macro level, the driving forces of the global financial cycle are shocks to the global price of risk, which induce variations in the excess bond premium in the model. The model also features nominal rigidities that create scope for stabilization policies.

Section 3.1 details the heterogeneous firms' problem, which constitutes the main building block of our model. Section 3.2 describes the problem of global investors and characterizes their stochastic discount factor, which features shocks to the global price of risk. Section 3.3 describes the remainder of the model, including domestic households, nominal rigidities, and the rest of the world.

## 3.1. Heterogeneous Firms

There is a unit mass of heterogeneous firms, owned by domestic households. Firms produce a home good with a decreasing-returns-to-scale technology using capital and labor, $(k_{i,t}, l_{i,t})$, as inputs:

$$y_{i,t} = (A_t z_{i,t})^{\varsigma} \left(k_{i,t}^{\alpha} l_{i,t}^{1-\alpha}\right)^{\chi}, \tag{2}$$

where $z_{i,t}$ and $A_t$ denote idiosyncratic and global productivity, respectively; $\chi \in (0,1)$ governs the degree of decreasing returns; $\alpha \in (0,1)$ is the value-added share of capital; and $\varsigma \equiv 1-(1-\alpha)\chi$ is a normalization constant that makes firms' earnings linear in productivity. We assume that both $z_{i,t}$ and $A_t$ follow first-order autoregressive processes given by $\ln(z_{i,t+1}) = (1-\rho_z)\ln(z^{\star}) + \rho_z \ln(z_{i,t}) + \sigma_z \epsilon_{i,t+1}^{z}$ and $\ln(A_{t+1}) = (1-\rho_A)\ln(A^{\star}) + \rho_A \ln(A_t) + \sigma_A \epsilon_{t+1}^{A}$, where $\epsilon_{i,t+1}^{z}$ and $\epsilon_{t+1}^{A}$ are standard normal shocks.

Firms have access to a technology to accumulate capital subject to adjustment costs:

$$k_{i,t+1} = (1-\delta)\, k_{i,t} + I_{i,t} - \Psi_k\left(k_{i,t+1}, k_{i,t}\right), \tag{3}$$

where $I_{i,t}$ denotes investment expenditure in terms of capital goods; $\delta \in (0,1)$ is the depreciation rate; and $\Psi_k(k_{i,t+1}, k_{i,t}) \equiv \frac{\psi_k}{2}\left(\frac{k_{i,t+1}-(1-\delta)k_{i,t}}{k_{i,t}}\right)^2 k_{i,t}$ denotes convex adjustment costs.

Firms sell their output and hire labor in competitive markets. For a given choice of labor, their earnings in the domestic unit of account are given by $\Pi_{i,t} = (P_{H,t}\, y_{i,t} - W_t\, l_{i,t})$, where $P_{H,t}$ is the price of the home good and $W_t$ is the nominal wage. The demand for labor is given by

$$l^d_{i,t} = A_t\, z_{i,t}\, \left(k_{i,t}\right)^{\frac{\alpha\chi}{\varsigma}} \left(\frac{1-\varsigma}{W_t/P_{H,t}}\right)^{\frac{1}{\varsigma}}. \tag{4}$$

Given the optimal choice of labor, firm earnings (expressed in terms of the households' consumption bundle) are given by

$$\pi_{i,t} = \varsigma\, A_t\, z_{i,t}\, \left(k_{i,t}\right)^{\frac{\alpha\chi}{\varsigma}} \left(\frac{1-\varsigma}{w_t}\right)^{\frac{1-\varsigma}{\varsigma}} \left(p_{H,t}\right)^{\frac{1}{\varsigma}}, \tag{5}$$

where $p_{H,t} = \frac{P_{H,t}}{P_t}$ denotes the relative price of the home good; $w_t = \frac{W_t}{P_t}$ is the real wage; and $P_t$ denotes the price of the households' consumption bundle. Since $\varsigma \in (0,1)$, earnings are increasing in the capital input $k_{i,t}$ and in the relative price of the home good, and decreasing in the real wage.

Firms face frictions in financing their investment. On the debt side, these frictions arise from default risk (as in Khan *et al.*, 2024; Ottonello and Winberry, 2020). We consider long-term debt contracts denominated in foreign currency. We follow the quantitative literature (e.g., Chatterjee and Eyigungor, 2012) and assume that each bond matures in the next period with probability $m$ and, if it does not mature, the firm pays a constant coupon $\upsilon$. Given this bond structure, the proceeds from issuing new debt, net of debt repayment, are given by

$$\Delta\mathcal{B}^\star_{i,t} = q^\star_t\left(k_{i,t+1}, b_{i,t+1}, z_{i,t}\right)\left[b_{i,t+1} - (1-m)b_{i,t}\right] - \left[(1-m)\upsilon + m\right] b_{i,t} - \Psi_b\left(b_{i,t+1}, b_{i,t}\right), \tag{6}$$

where $q^\star_t\left(k_{i,t+1}, b_{i,t+1}, z_{i,t}\right)$ denotes the foreign-currency bond-price schedule for firm $i$, which, as explained below, depends on the firm's choices of capital and debt, as well as its productivity; the term $q^\star_t\left(k_{i,t+1}, b_{i,t+1}, z_{i,t}\right)\left[b_{i,t+1} - (1-m)b_{i,t}\right]$ denotes the proceeds from issuing new bonds; $\left[(1-m)\,\upsilon + m\right] b_{i,t}$ denotes current debt service; and $\Psi_b\left(b_{i,t+1}, b_{i,t}\right) \equiv \frac{\psi_b}{2}\left(\frac{b_{i,t+1}-(1-m)b_{i,t}}{b_{i,t}}\right)^2 b_{i,t}$ denotes debt adjustment costs, which help the quantitative model

match micro-level patterns of leverage. On the equity side, we assume that firms face costs when raising equity, $\mathcal{C}(d_{i,t}) = -\mathbb{I}_{\{d_{i,t}<0\}}\varphi d_{i,t}$ (as in Cooley and Quadrini, 2001; Gilchrist, Sim and Zakrajšek, 2014). Here, $d_{i,t}$ denotes firm $i$'s dividends expressed in terms of the consumption bundle:

$$d_{i,t} = \pi_{i,t} - p_{k,t}\, I_{i,t} + \varepsilon_t\, \Delta \mathcal{B}^{\star}_{i,t}, \tag{7}$$

where $p_{k,t} = \frac{P_{K,t}}{P_t}$ denotes the relative price of the capital good, and $\varepsilon_t = \frac{\xi_t}{P_t}$ is the real exchange rate (RER), with $\xi_t$ denoting the nominal exchange rate (i.e., the price of one unit of foreign currency in terms of the local currency). The equity-issuance cost is borne by the firm's owners: when the firm raises equity ($d_{i,t} < 0$), households inject $-d_{i,t}$ and pay the additional cost $\mathcal{C}(d_{i,t})$. The owners' period payoff is therefore $d_{i,t} - \mathcal{C}(d_{i,t})$, which enters the firm's problem below.

In addition to their production and financing choices, each firm has the option to exit the economy after production. The value of continuing operations after production takes place solves the Bellman equation

$$V_t^{\text{cont}}(k,b,z) = \max_{k',b'}\; d - \mathcal{C}(d) + \mathbb{E}_t\left[\Lambda_{t,t+1}\, V_{t+1}(k',b',z')\right], \tag{8}$$

$$\text{subject to (5), (6), and (7)},$$

where a firm's idiosyncratic states after repayment are given by $(k,b,z)$, the $t$ subscript encapsulates the aggregate state, and primes denote next-period idiosyncratic variables; $\Lambda_{t,t+1}$ denotes households' stochastic discount factor; and $V_t(k,b,z)$ is the value of a firm with the option to exit. Exiting firms receive no continuation value. We introduce noise in the exit decision so that the firm exits whenever $V_t^{\text{cont}}(k,b,z) < \epsilon_{\text{exit}}$, where $\epsilon_{\text{exit}} \sim_{iid} N(0,\sigma^2_{\text{exit}})$. As discussed below, firms that exit may default on their debt. Firms that exit the economy are replaced by new entrants with no initial debt and idiosyncratic capital and productivity $k_0$ and $z_0$. Appendix B.1 provides additional details on the recursive representation of firms' problem and the bond-price schedule they face.

### 3.2. Global Investors

The global economy features a set of international investors who provide a perfectly elastic supply of international credit to domestic firms and price firms' debt. Given a firm's choice

of $k'$ and $b'$, its debt-price schedule is given by

$$q_t^\star\left(k', b', z\right) = \mathbb{E}_t\left[\Lambda_{t,t+1}^\star \mathcal{R}_{t+1}\left(k', b', z', \epsilon'_{\text{exit}}\right)\right], \tag{9}$$

where $\Lambda_{t,t+1}^\star$ is the investors' stochastic discount factor, and $\mathcal{R}_t\left(k, b, z, \epsilon_{\text{exit}}\right)$ denotes the value of the debt claim, given by

$$\mathcal{R}_t\left(k, b, z, \epsilon_{\text{exit}}\right) \equiv \left(1 - \iota_t\left(k, b, z, \epsilon_{\text{exit}}\right)\right)\mathcal{R}_t^{\text{cont}}\left(k, b, z\right) + \iota_t\left(k, b, z, \epsilon_{\text{exit}}\right)\, \mathcal{R}_t^{\text{exit}}\left(k, b, z\right), \tag{10}$$

with $\iota_t\left(k, b, z, \epsilon_{\text{exit}}\right)$ denoting an indicator variable for exit. The term $\mathcal{R}_t^{\text{cont}}$ denotes repayment if the firm continues operations, and is given by

$$\mathcal{R}_t^{\text{cont}}(k, b, z) \equiv (1 - m)\left(\upsilon + q_t^\star\left(k', b', z\right)\right) + m,$$

where $(k', b')$ denote the firm's current-period choices. Lastly, $\mathcal{R}_t^{\text{exit}}\left(k, b, z\right)$ is the value of the debt claim in the event of exit, given by

$$\mathcal{R}_t^{\text{exit}}\left(k, b, z\right) = \lambda\, \frac{\pi_t\left(k, z\right) + (1 - \delta)\, k\, p_{k,t}}{b}\, \frac{1}{\varepsilon_t}, \tag{11}$$

where $\lambda \in (0, 1)$ is the share of resources recovered upon exit.[3]

We parameterize the global investors' stochastic discount factor as

$$\Lambda_{t,t+1}^\star = \beta^\star \times \exp\left(-\kappa_t\, \sigma_A\, \epsilon_{t+1}^A - \frac{1}{2}\kappa_t^2\, \sigma_A^2\right), \tag{12}$$

where $\beta^\star$ is the rest of the world's discount factor; $\kappa_t$ is a stochastic exogenous variable that captures the *global price of risk*; and $\epsilon_{t+1}^A$ denotes the standardized innovations to the global productivity process. This formulation of the foreign investors' stochastic discount factor has been used in the sovereign debt literature (e.g., Bianchi, Hatchondo and Martinez, 2018) to provide a tractable representation of changes in the global price of risk.

To understand how these shocks affect bond valuations, it is useful to consider the bond-pricing Equation (9) using a first-order approximation of the investors' stochastic discount

[3] Under this formulation, whether a firm's exit implies a debt default depends on whether $\mathcal{R}_t^{\text{exit}}\left(k, b, z\right)$ is less than the value of the debt repayments promised from $t$ onward, $\tilde{q}_t^{\text{face}} = \mathbb{E}_t\left[\sum_{s=0}^{\infty} \Lambda_{t,t+s}^\star (1 - m)^s\left(m + (1 - m)\upsilon\right)\right]$, which includes the payment due in the current period. As we further discuss in Section 4, in our quantitative analysis, most exits occur with default.

factor:[4]

$$q^{\star}_{i,t} \approx \beta^{\star}\, \mathbb{E}_t \left[ \mathcal{R}_{i,t+1} \right] - \beta^{\star}\, \kappa_t\, \mathbb{C}ov_t \left[ \sigma_A \epsilon^A_{t+1}, \mathcal{R}_{i,t+1} \right]. \tag{13}$$

This equation decomposes the bond price into two components: a risk-neutral expected repayment, $\beta^{\star}\mathbb{E}_t[\mathcal{R}_{i,t+1}]$, and a risk-premium term, $\beta^{\star}\kappa_t\, \mathbb{C}ov_t[\sigma_A \epsilon^A_{t+1}, \mathcal{R}_{i,t+1}]$. The risk-premium term is the product of the global price of risk, $\kappa_t$, and the quantity of risk, the covariance between the firm's next-period repayment and global productivity innovations. As we further explain in the next sections, this covariance is non-negative because firms are more likely to default in bad aggregate states, in which $\epsilon^A_{t+1}$ is low, so repayment $\mathcal{R}_{i,t+1}$ co-moves positively with $\epsilon^A_{t+1}$. An increase in $\kappa_t$ lowers bond prices and increases the marginal cost of investment, with a pass-through determined by each firm's quantity of risk.

### 3.3. Rest of the Model

**Households.** We assume a representative household with preferences over consumption ($c$) and labor ($l$) described by the lifetime utility function:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u\left(c_t, l_t\right), \tag{14}$$

where $\beta \in (0,1)$ denotes the subjective discount factor, and the period utility is given by $u(c_t, l_t) = c_t - \psi_l \frac{l_t^{1+\theta}}{1+\theta}$, where $\theta$ is the inverse of the Frisch elasticity. Given these preferences, labor supply is given by

$$l^s_t = \left( \frac{1}{\psi_l}\, w_t \right)^{\frac{1}{\theta}}. \tag{15}$$

The assumption of households' risk neutrality is intended to provide a baseline model that focuses on debt financing. As discussed below, we consider alternative stochastic discount factors for pricing firms' equity in additional analysis.

The consumption good is a bundle of home and foreign goods, with a constant-elasticity-of-substitution (CES) aggregation technology:

$$c_t = \mathcal{C}\left(c_{H,t}, c_{F,t}\right) = \left[ \omega_H^{1/\eta} \left(c_{H,t}\right)^{1-1/\eta} + \left(1-\omega_H\right)^{1/\eta} \left(c_{F,t}\right)^{1-1/\eta} \right]^{\frac{\eta}{\eta-1}}, \tag{16}$$

[4] This approximation is used only to illustrate the forces at work. We solve the model with global methods using the pricing Equation (9), without approximating the stochastic discount factor. The risk premia we report are the difference between each firm's equilibrium spread and the spread that a risk-neutral lender would charge given the same exit and debt policies (see Appendix C.2), so our quantitative results do not rely on this approximation.

where $c_{H,t}$ and $c_{F,t}$ denote consumption of home and foreign goods; $\eta > 0$ is the elasticity of substitution; and $\omega_H$ captures the degree of home bias. Their budget constraint, expressed in local currency, is given by

$$P_t\, c_t = W_t\, l_t + P_t\, D_t + P_t\, \Pi_{K,t}, \tag{17}$$

where $P_t \equiv \left[\omega_H P_{H,t}^{1-\eta} + (1-\omega_H)\, P_{F,t}^{1-\eta}\right]^{\frac{1}{1-\eta}}$ is the price aggregator and $P_{F,t}$ is the price of the foreign good. The term $W_t\, l_t$ denotes labor income; $D_t$ denotes aggregate net cash flows between production firms and households, including dividends, equity injections and their issuance costs, liquidation proceeds from exiting firms, and transfers used to finance new entrants; and $\Pi_{K,t}$ denotes the profits of capital producers, described below.

**Capital producers.** There is a representative capital producer that produces capital goods from home goods subject to adjustment costs. Producing $I_t$ units of capital requires $\Phi(I_t, K_t) = I_t + \frac{\phi}{2} K_t \left(\frac{I_t}{K_t} - \delta\right)^2$ units of the home good, where $I_t \equiv \int I_{i,t}\, \mathrm{d}i$ and $K_t \equiv \int k_{i,t}\, \mathrm{d}i$ denote aggregate investment and aggregate capital. Profit maximization yields the following expression for the relative price of capital:

$$p_{k,t} = p_{H,t} \left(1 + \phi \left(\frac{I_t}{K_t} - \delta\right)\right). \tag{18}$$

As is standard in the literature, this formulation gives rise to responses in the relative price of capital to aggregate shocks. The capital producer is owned by domestic households, to whom its profits are rebated.

**Nominal rigidities.** We assume that the labor market is characterized by nominal wage rigidities, which give rise to involuntary unemployment and a Mundellian role for exchange rate stabilization. We follow the formulation in Schmitt-Grohé and Uribe (2016) and assume that the nominal wage faces downward rigidity, i.e., $W_t \geq \bar{W}$, where $\bar{W}$ captures the degree of nominal rigidities.[5] A higher $\bar{W}$ implies that nominal wages have a smaller margin to adjust in the event of a negative shock, which may lead to involuntary unemployment.

[5] In Schmitt-Grohé and Uribe (2016), the downward rigidity is given by $W_t \geq \gamma W_{t-1}$, where $W_{t-1}$ denotes the previous-period nominal wage. In this paper, in order to reduce the dimensionality of our problem, we set a constant wage floor $\bar{W}$. This specification is similar to that in Bianchi, Ottonello and Presno (2023) and Bianchi and Sosa-Padilla (2024).

From Equation (4), we can integrate across firms to compute aggregate labor demand, which is given by

$$l_t^d \equiv \int l_{i,t}^d \mathrm{d}i = A_t \, \tilde{K}_t \left[ \frac{1-\varsigma}{w_t} p_{H,t} \right]^{\frac{1}{\varsigma}}, \tag{19}$$

where $\tilde{K}_t \equiv \int z_{i,t} \left(k_{i,t}\right)^{\frac{\alpha\chi}{\varsigma}} \mathrm{d}i$ captures the production capacity of the economy. In any equilibrium, it must be the case that $l_t^d \leq l_t^s$. Because of the presence of nominal wage rigidities, the labor market may not clear. At any point in time, wages and employment must therefore satisfy the following slackness condition:

$$\left(l_t^s - l_t^d\right)\left(W_t - \bar{W}\right) = 0. \tag{20}$$

That is, in periods of unemployment, the wage constraint binds. If the constraint does not bind, the economy is in full employment. Combining Equations (15) and (19), the full-employment (FE) real wage can be expressed as

$$w_t^{FE} = \left[(1-\varsigma)\, p_{H,t}\right]^{\frac{\theta}{\varsigma+\theta}} \times \left(\psi_l\right)^{\frac{\varsigma}{\varsigma+\theta}} \times \left(A_t \tilde{K}_t\right)^{\frac{\theta\varsigma}{\varsigma+\theta}}. \tag{21}$$

Given the nominal wage rigidities, the full-employment real wage may not be attained. The observed real wage in the economy is given by $w_t = \max\left\{w_t^{FE}, \frac{\bar{W}}{P_t}\right\}$, and unemployment is positive whenever $w_t > w_t^{FE}$. It is useful to rewrite this expression as a function of the nominal exchange rate, $\xi_t$:

$$w_t = \max\left\{w_t^{FE}, \frac{\bar{W}}{\xi_t} \times \varepsilon_t\right\}, \tag{22}$$

where $\varepsilon_t \equiv \xi_t / P_t$ is the real exchange rate.

**Government.** The government sets the path of the nominal exchange rate, $\{\xi_t\}$. We consider a policy rule in which the government can set any convex combination of a fixed exchange rate regime and the "flexible" regime that guarantees full employment: $\xi_t = (1 - \varrho)\xi_t^{Flex} + \varrho\xi^{Peg}$, where $\varrho \in [0,1]$ parameterizes the degree of exchange rate rigidity, with $\varrho = 0$ corresponding to the case of a flexible regime; $\xi_t^{Flex}$ denotes the flexible exchange rate that achieves full employment in period $t$, given by $\xi_t^{Flex} = \frac{1}{w_t^{FE}} \bar{W} \varepsilon_t$;[6] and $\xi^{Peg}$ is the level of the exchange rate under the fixed regime, which we normalize to one.

[6] Using (22), we focus on the minimum $\xi_t$ that leads to full employment.

**Rest of the world.** The rest of the world has a perfectly elastic supply of the foreign good at a fixed price in terms of foreign currency, $P_F^\star$. It has a downward-sloping demand for the home good given by

$$c_{H,t}^\star = \left(\frac{P_{H,t}^\star}{P_F^\star}\right)^{-\eta} c_t^\star, \tag{23}$$

where $c_t^\star$ denotes total consumption by the rest of the world, and $P_{H,t}^\star$ is the foreign-currency price of the $H$-good. These conditions can be micro-founded from the problem of a representative foreign household that has CES preferences over home and foreign tradable goods and is infinitely large relative to the small open economy, while the share of the home tradable good in its consumption basket is infinitesimally small (see, for example, Galí and Monacelli, 2005). Both the home and foreign goods satisfy the law of one price, i.e., $P_{F,t} = P_F^\star \xi_t$ and $P_{H,t}^\star = P_{H,t}/\xi_t$. Under these assumptions, with $P_F^\star$ normalized to one, foreign demand is $c_{H,t}^\star = \left(\frac{P_{H,t}}{\xi_t}\right)^{-\eta} c_t^\star$.

**Equilibrium.** Equilibrium is defined in a standard way: firms and households optimize given prices and government policies, and prices adjust to clear all markets, with the exception of the labor market, which is demand-determined given the wage rigidity. We provide a formal definition of the recursive equilibrium in Appendix B.2, as well as the optimality conditions that characterize it.

### 3.4. Discussion of Baseline Assumptions

This subsection discusses the model's baseline assumptions and their macroeconomic implications. First, for our baseline analysis, we consider a benchmark in which firms' debt is denominated in foreign currency. This choice is motivated by the large predominance of dollar-denominated debt in the external corporate debt of emerging economies (Du and Schreger, 2022), and allows us to analyze the debt-revaluation channel, which has been emphasized in the original-sin literature (Eichengreen, Hausmann and Panizza, 2002; Eichengreen and Hausmann, 2010). In Appendix C.7.1, we consider an alternative benchmark in which firms' debt is denominated in local currency, and show that the currency denomination of corporate debt plays an important role in the risk dimension of exchange rate policy by shifting the bearing of currency risk to foreign investors.

Second, for tractability, our baseline analysis assumes that firms issue debt directly to foreign investors. This assumption is aimed at capturing both external debt and loans from domestic financial institutions, and is motivated by the high pass-through of foreign shocks to domestic credit conditions through financial institutions documented in di Giovanni *et al.* (2022). In Appendix C.7.2, we analyze an extension in which firms' debt is financed by domestic banks that are funded with a mix of international and domestic funds.

Finally, for our baseline model, we consider the benchmark in which firms discount dividends using the domestic investors' stochastic discount factor. We choose this assumption to keep our model close to canonical business-cycle open-economy models (see, e.g., Uribe and Schmitt-Grohé, 2017, for a review), including those that study the effects of shocks to the global price of risk (Bai *et al.*, 2025). In Appendix C.7.2, we consider a specification in which firms discount dividends using the foreign investors' stochastic discount factor. In addition, we analyze alternative specifications of the domestic investors' stochastic discount factor for valuing firms' dividends.

# 4. The Transmission of the Global Financial Cycle

In this section, we connect the model to the data and study its economic forces. Section 4.1 discusses the model's solution and parameterization and compares its micro- and macro-level predictions with their empirical counterparts. Section 4.2 uses the calibrated model to analyze the channels through which changes in the global price of risk transmit to the real economy.

## 4.1. Solution, Parameterization, and Model Fit

A distinguishing feature of our analysis is its emphasis on the macroeconomic effects of changes in the price of risk in an economy with heterogeneous firms. Our solution method aims to quantify these forces under a realistic distribution of risk across firms. To do so, we use global methods and introduce a set of co-state variables that summarize the prices faced by individual firms while preserving the aggregate nonlinearities in the model's equilibrium. Appendix B.3 summarizes the computational algorithm.

**Table 2:** Model Parameterization: Calibrated Parameters

**(a)** Parameters for Cross-Sectional Moments

| Parameter | Description | Value |
|---|---|---|
| $\beta$ | Firms discount factor | 0.968 |
| $\sigma_z$ | TFP, volatility | 0.140 |
| $\psi_k$ | Capital adjustment costs | 0.150 |
| $\psi_b$ | Debt adjustment costs | 2.000 |
| $\lambda$ | Recovery rate | 0.150 |
| $\sigma_{\text{exit}}$ | Exit-shock volatility | 3.100 |
| $\varphi$ | Equity issuance cost | 0.300 |
| $k_0$ | New entrant capital | 2.500 |
| $z_0$ | New entrant TFP | 0.764 |

**(b)** Parameters for Aggregate Moments

| Parameter | Description | Value |
|---|---|---|
| $\omega_H$ | Home bias | 0.800 |
| $\sigma_A$ | Aggregate TFP, volatility | 0.026 |
| $\phi$ | Tobin's q | 0.750 |
| $\bar{W}$ | Wage rigidity | 1.015 |
| $\varrho$ | Nominal exchange rate | 0.250 |
| $\kappa_H$ | Price of risk | 50.00 |
| $\Pi_\kappa(\kappa_L, \kappa_H)$ | Probability of global crisis | 0.050 |
| $\Pi_\kappa(\kappa_H, \kappa_L)$ | Duration of global crisis | 0.150 |

*Note:* The table reports the calibrated parameters chosen to match the targeted moments. Panel (a) lists parameters governing cross-sectional moments. Panel (b) lists parameters governing aggregate moments and the stochastic process for the global price of risk.

Our quantitative analysis targets a prototypical Latin American economy, using the same sample of countries as in the empirical analysis of Section 2.2. The calibration is conducted at a quarterly frequency and targets both cross-sectional and aggregate moments. We proceed in three steps. First, we fix a subset of parameters to standard values commonly used in the literature, listed in Appendix Table C.2. For technology, we set the capital share to $\alpha = 0.3$ and the degree of decreasing returns to scale to $\chi = 0.85$, values commonly used in the heterogeneous-firm literature. For the capital depreciation rate, we set $\delta = 0.045$, in line with the business cycle literature in emerging markets (Neumeyer and Perri, 2005; Aguiar and Gopinath, 2007). For the autocorrelation of the productivity processes, we set $\rho_A = 0.98$ (King and Rebelo, 1999) and $\rho_z = 0.95$ (Bloom, Floetotto, Jaimovich, Saporta-Eksten and Terry, 2018). For preferences, we set the inverse Frisch elasticity to $\theta = 0.5$ and the elasticity of substitution between home and foreign goods to $\eta = 1.5$ (as in Itskhoki and Mukhin, 2021). For foreign lenders, we set the discount factor $\beta^\star$ to target an annual risk-free rate of 3%. Regarding firms' bond characteristics, we set $m$ to match the average duration of nonfinancial firms' debt in our sample and $\upsilon$ to target the observed annualized coupon yield (reported in Table A.7).

In the second step, we calibrate the parameters governing a set of firms' cross-sectional moments, reported in Panel (a) of Table 2. To compute these data moments, we use our

ORBIS dataset (unless stated otherwise) and average across all countries in our sample (see Appendix C.1 for details). Although all calibrated parameters influence all moments in the model, we describe the calibration in terms of the moments most directly affected by each parameter. The volatility of the idiosyncratic productivity process, $\sigma_z$, is calibrated to match the cross-sectional standard deviation of firms' investment rates. We calibrate the discount factor $\beta$ and the volatility of the exit shock, $\sigma_{\text{exit}}$, to match an average leverage ratio of 0.29 (see Appendix Table A.5) and an annual exit rate of 5.5% (based on Fernández-Villaverde, Mandelman, Yu and Zanetti, 2021).[7] The debt adjustment cost parameter, $\psi_b$, is calibrated to match the cross-sectional standard deviation of leverage, and the capital adjustment cost parameter, $\psi_k$, is calibrated to match the correlation between firm size and age. The recovery value parameter, $\lambda$, is calibrated to match an average recovery rate of 25%, as in Arellano, Bai and Zhang (2012).[8] We calibrate the equity issuance cost parameter, $\varphi$, to match an annual equity issuance rate of 8%.[9] Finally, we calibrate the initial capital and initial productivity of entrants, $k_0$ and $z_0$, to match the employment shares of young firms (Ottonello and Winberry, 2020).

In the third step, we calibrate the parameters governing aggregate responses, reported in Panel (b) of Table 2, to target time-series moments in our sample of countries. The data sources for these moments are described in Appendix C.1. We calibrate the home-bias parameter, $\omega_H$, to match the average ratio of exports to GDP. For the global productivity process, we calibrate $\sigma_A$ to match the observed volatility of GDP. We calibrate $\phi$ to match the observed volatility of aggregate investment relative to output. We jointly calibrate the nominal wage rigidity parameter, $\bar{W}$, and the exchange rate policy parameter, $\varrho$, to match

[7]This target lies within the range used in the literature. For the United States, annual exit rates range from 5.1–5.8% for manufacturing plants (Bilbiie, Ghironi and Melitz, 2012; Lee and Mukoyama, 2015) to approximately 7.5–9.5% for the broader population of employer firms (Hopenhayn, Neira and Singhania, 2022). Comparable values are used in studies of emerging markets (Andreasen, Bauducco, Dardati and Mendoza, 2026; Majerovitz, 2023). Since 62% of exiting firms default, our target implies an annual default rate of approximately 3.4%.

[8]This value is also broadly consistent with estimates of liquidation recovery rates documented by Kermani and Ma (2023) for U.S. nonfinancial firms.

[9]Because we do not observe actual equity issuances in our dataset, we compute this value by identifying firms with large increases in their reported book equity. In particular, we classify a firm as issuing equity if its equity value increases by more than 50% within one year. Our target implies a value for $\varphi$ of 0.30, which is in line with other studies. For instance, Gomes (2001) set the cost of seasoned equity issuance to 0.08; Gilchrist *et al.* (2014) to 0.12; and Cooley and Quadrini (2001) to 0.30.

**Table 3:** Targeted Moments

**(a)** Cross-sectional Moments

| Moment | Data | Model |
|---|---|---|
| Leverage | 0.29 | 0.32 |
| Exit rate | 5.5% | 5.6% |
| Investment/k (cs std) | 0.25 | 0.23 |
| Leverage (cs std) | 0.22 | 0.27 |
| Correlation size and age | 0.27 | 0.25 |
| Recovery rate | 25% | 28% |
| Share firms issuing equity | 8% | 10% |
| Age median public firm | 30 | 30 |
| Empl. share, age $\leq 1$ | 0.03 | 0.04 |
| Empl. share, $1 <$ age $\leq 10$ | 0.21 | 0.26 |

**(b)** Aggregate Moments

| Moment | Data | Model |
|---|---|---|
| Exports/GDP | 19.7% | 18.7% |
| $\sigma(GDP)$ | 2.3% | 2.6% |
| $\sigma(I)/\sigma(GDP)$ | 2.91 | 3.22 |
| $\rho(Unemprate, GDP)$ | $-0.61$ | $-0.58$ |
| $\Delta$ log RER | 1.7% | 1.7% |
| $\Delta$ EBP(*) | 1.2% | 1.3% |

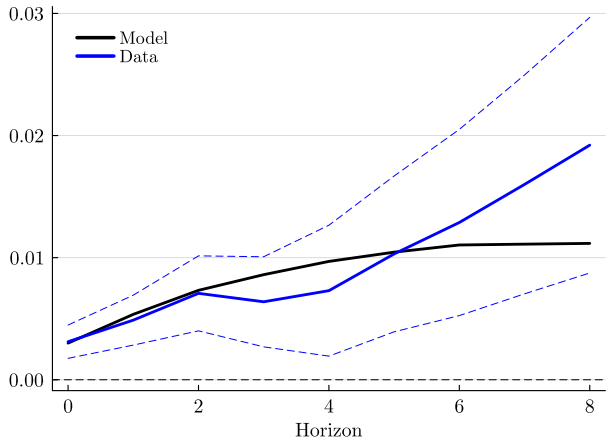
*Note:* The table reports model-implied moments and their data counterparts. Panel (a) shows targeted cross-sectional moments, and Panel (b) shows aggregate moments. Asterisks denote moments computed for the pool of Compustat firms used in our empirical analysis.

the correlation between the unemployment rate and output and the depreciation of the real exchange rate following an increase in the global price of risk (as shown in Figure 5).

We calibrate $\kappa_H$ so that, when the economy transitions from $\kappa_{t-1} = 0$ to $\kappa_t = \kappa_H$, the on-impact increase in the model-implied EBP equals a one-standard-deviation change in the Latin American EBP estimated in Section 2. We construct the model-implied EBP by applying an analogous procedure to model-simulated data: we regress firms' log spreads on their distance to default and average the residual component of spreads across firms at each date. Appendix C.2 provides further details on the construction of the EBP in the model, and shows how shocks to the global price of risk directly affect the EBP measure. We also choose the two parameters of the transition probability matrix so that the quarterly probability of entering the $\kappa_H$ state is 5% and the average duration of a $\kappa_H$ spell is about seven quarters ($\Pi_\kappa(\kappa_H, \kappa_L) = 0.15$).[10] Finally, in the baseline analysis, we consider a constant path

[10]We identify five high-risk episodes, defined as periods in which the standardized EBP rises above one standard deviation: the Russian/LTCM crisis (1998), the Argentine and Brazilian crises (2002–03), the Global Financial Crisis (2008–09), the euro-area debt crisis (2011–12), and the COVID-19 pandemic (2020). Five episodes in about 100 quarters of data motivate a low-to-high quarterly transition probability of $\Pi_\kappa(\kappa_L, \kappa_H) = 0.05$. For a stationary two-state Markov chain, the first-order autocorrelation of the high-risk indicator is $1 - \Pi_\kappa(\kappa_L, \kappa_H) - \Pi_\kappa(\kappa_H, \kappa_L)$. We set $\Pi_\kappa(\kappa_H, \kappa_L) = 0.15$, which implies an autocorrelation of 0.80. Because movements in the model EBP are driven by $\kappa$, the simulated EBP inherits this persistence: its autocorrelation is about 0.85, somewhat above the 0.75 autocorrelation of the EBP (see Appendix Table C.3).

**Figure 4:** Heterogeneous Firm Responses to Changes in the Excess Bond Premium



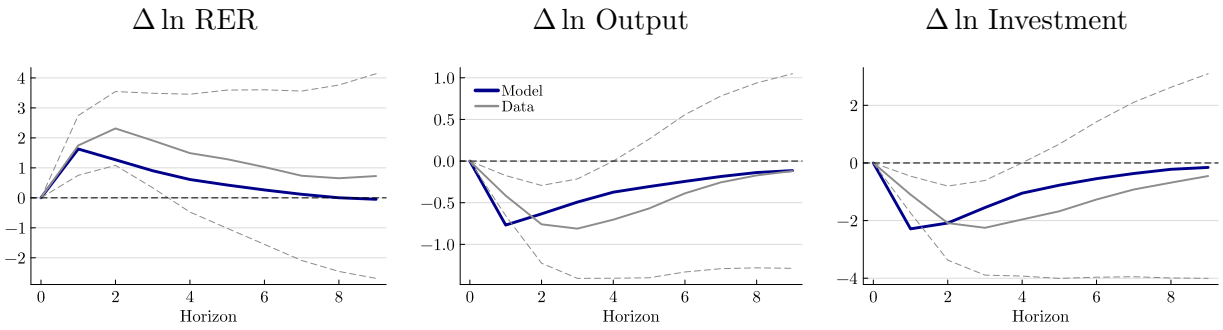

*Note:* The figure compares the model-implied local projection estimates with those from the empirical analysis (Equation (1)). Blue lines show the empirical estimates with 90% confidence intervals, and black lines show the model-implied estimates. For the model, $\rho_t$ is the model-implied excess bond premium defined in Appendix C.2. In both the model and the data, $\rho_t$ is standardized, so the coefficients measure the response to a one-standard-deviation increase in the EBP. For the model-generated data, we retain only "Compustat" firms, defined as those with $age > a\bar{g}e$, and drop observations with a lagged annualized default probability of at least 25 percent. The x-axis shows the horizon $h$.

for foreign consumption, $c_t^\star = 1$, and analyze in Appendix C.5.1 the case in which foreign demand falls when the global price of risk is high.

Table 3 shows that our calibrated model matches the targeted cross-sectional and aggregate moments fairly well. In addition, the model matches other important dimensions of the data that are not targeted. First, it generates cross-sectional and aggregate investment responses to an increase in the global price of risk that are aligned with the empirical patterns documented in Section 2. At the micro level, we estimate the same regressions as in our empirical analysis using a subsample of firms in the model that accounts for the selection of Compustat firms.[11] Figure 4 shows that the heterogeneous investment responses in the model by firms' risk are comparable to those observed in the data following changes in the excess bond premium. As we further explain in the next section, the investment of riskier firms contracts more in response to an increase in the global price of risk because their higher quantity of risk induces a larger pass-through to borrowing costs. At the aggregate level,

[11] Following the literature on firm heterogeneity in the U.S. (Ottonello and Winberry, 2020), we model selection into the model-Compustat sample with an age-based threshold after which firms enter this subsample. We calibrate this threshold to match the median age of publicly traded firms in our ORBIS sample, 30 years.

**Figure 5:** Aggregate Responses to Changes in the Excess Bond Premium




*Note:* Impulse responses to a one-standard-deviation increase in the EBP. The panels display the dynamics of the real exchange rate, aggregate output, and aggregate investment. Blue lines depict model-implied dynamics, in which the increase in the EBP is generated by the $\kappa$ shock; gray lines show the responses estimated in the data. The data responses are estimated from the regression $\Delta_h \log(x_{kt+h}) = \alpha_{hk} + \beta_h \rho_t + \epsilon_{hkt}$, where $\Delta_h \log(x_{kt+h})$ is the cumulative log change in the corresponding variable in country $k$ between quarters $t-1$ and $t+h$, $\alpha_{hk}$ denotes country fixed effects, and $\rho_t$ is the EBP for Latin America in period $t$, measured in standard deviations. Sample period 1997–2019.

Figure 5 shows that the model responses of output and investment to an increase in the global price of risk are also consistent with those estimated in the aggregate data following changes in the excess bond premium.[12]

Finally, the model also reproduces several unconditional data moments. At the cross-sectional level, Appendix Figure C.1 shows that the model's distribution of firm leverage is broadly consistent with that observed in the data, an important feature that quantitatively disciplines the distribution of risk across firms in the economy. At the aggregate level, Appendix Table C.3 shows that the model reproduces additional business-cycle moments, including the cyclicality of investment and consumption, the relative volatility of employment, and the persistence of output and of the EBP.

### 4.2. Channels of Transmission

We use the calibrated model to analyze the transmission channels of changes in the global price of risk. We decompose the effects of these shocks on firms' investment into three channels: a risk channel, which operates through its effect on the price of debt; and two

[12]To put these estimates into perspective, Appendix Figure C.5 shows that, in response to an increase in the global price of risk similar to that observed during the 2008 Global Financial Crisis (a shock of about three standard deviations), the model accounts for more than two-thirds of the observed contraction in investment and about a third of that in output.

indirect channels, a debt-revaluation channel and a competitiveness channel, which operate through the general equilibrium effects on other prices in the economy.

**Risk channel.** We define the risk channel as the partial-equilibrium effect of a shock to the global price of risk on investment through its effect on the debt-price schedule. We isolate this channel by solving a counterfactual in which the economy receives the $\kappa$ shock but all aggregate prices remain at their paths in the absence of the shock (for details on the definition of the channels, see Appendix C.3). In the risk channel, a higher $\kappa$ raises the compensation lenders require per unit of risk, and borrowing costs increase in proportion to each firm's quantity of risk. Firms respond to the higher cost of financing by cutting investment, with larger adjustments among firms with a larger quantity of risk.

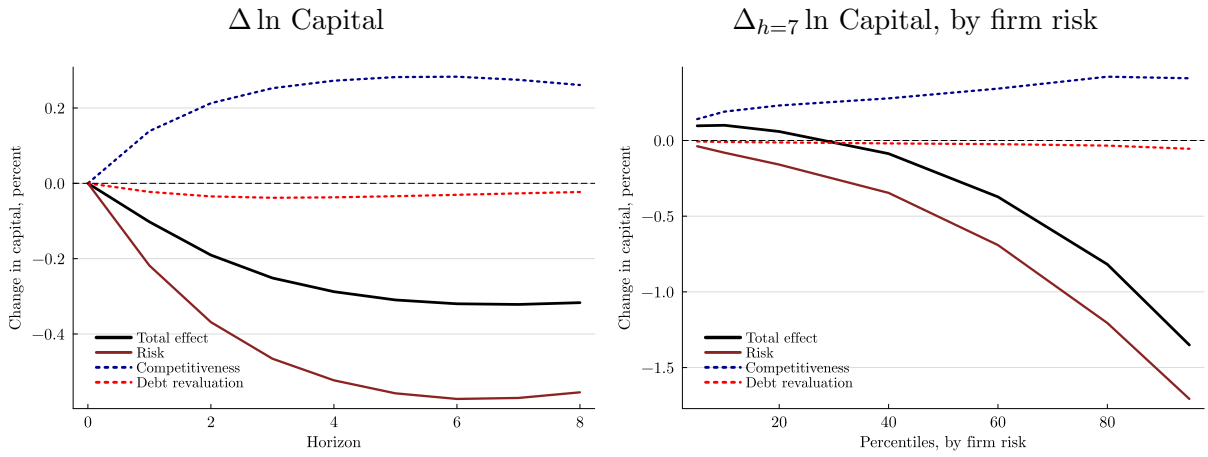
Figure 6 quantifies the risk channel by analyzing the aggregate and cross-sectional effects of a $\kappa$ shock on capital. Panel (a) of Figure 6 shows that the aggregate effect of the risk channel is almost twice as large as the full general equilibrium effect at the peak of the response, suggesting that the indirect channels are, overall, attenuating. Panel (b) shows that the effects of the risk channel are larger for riskier firms, which have a larger quantity of risk.[13] The differential investment responses to the risk channel are similar to the full general equilibrium effects, highlighting the predominant role of the quantity of risk in explaining the cross-sectional variation in investment sensitivities documented in the data.

The differential effects are also nonlinear, suggesting that the degree of firm heterogeneity matters for the aggregate transmission. Appendix C.5.3 further illustrates this, showing that a representative firm with average characteristics features a larger contraction in capital than the aggregate response in the baseline economy with heterogeneity.

**Debt-revaluation channel.** We define this channel as the effect of changes in the global price of risk on investment stemming from the revaluation of foreign-currency debt because of the movement in the real exchange rate caused by the global price of risk shock. As we further explain in Appendix C.3, we isolate this channel by comparing the full general-equilibrium effects of the shock to those of an economy in which firms are compensated

[13] At the extreme, firms at the bottom of the risk distribution feature a close-to-zero quantity of risk and pass-through of the price-of-risk shock.

**Figure 6:** Transmission Channels of Global Price of Risk Increases




*Note:* The figure shows the transmission channels of a shock to the global price of risk ($\Delta\kappa > 0$). The left panel reports the impulse response of aggregate capital. The right panel reports the change in capital at horizon $h = 7$ across firms sorted by pre-shock default probability. In both panels, the solid black line shows the total effect and the solid brown line shows the risk channel. The dotted blue and red lines show the competitiveness and debt-revaluation channels, respectively.

for the revaluation of their debt service measured in consumption units with a lump-sum transfer from households.

Panel (a) of Figure 6 shows that the debt-revaluation channel is contractionary in the aggregate. As shown in Figure 5, in response to an increase in the global price of risk, the decline in firms' investment induced by the risk channel leads to a real exchange rate depreciation, which implies a revaluation of debt that reduces the cash flows available to finance investment. Panel (b) shows that its effects are larger among riskier firms, which tend to be more indebted. In the baseline calibration, which targets the observed real exchange rate response to an increase in the excess bond premium, this channel is an order of magnitude smaller than the risk channel (see also Table 4). This is because, both in the data and in the model, the real exchange rate exhibits a mild depreciation of just under 2 percent in response to a one-standard-deviation increase in the excess bond premium, so the revaluation effects are small.

To further understand the magnitude of the debt-revaluation channel, we consider an additional exercise in which the real exchange rate depreciates by more than in the baseline calibration. In the baseline, the response of the real exchange rate to a global price of risk shock is disciplined by the average depreciation that follows an increase in the excess bond

premium (Figure 5). In this exercise, we instead discipline it with the larger depreciations observed during the "currency crisis" episodes in our sample of countries.[14] To do so, we scale up the real exchange rate response to an increase in the excess bond premium, while all other prices and aggregate dynamics remain those of the baseline economy (see Appendix C.5.4 for details). Appendix Figure C.7 shows that the larger depreciation makes the debt-revaluation channel about six times stronger than in the baseline economy. Nevertheless, even under this larger depreciation, the debt-revaluation channel remains one-third as large as the risk channel.

**Competitiveness channel.** We define this channel as the effects of changes in the global price of risk on investment stemming from changes in output and input prices (i.e., $p_{H,t}, w_t, p_{k,t}$) induced by the shock. As we describe further in Appendix C.3, to quantify this channel we compute a counterfactual exercise in which firms face a $\kappa_t$ shock but prices do not respond to it, and compare it with one in which prices respond. Appendix Figure C.3 shows that, in response to an increase in the global price of risk, the contraction in firms' investment induced by the risk channel puts downward pressure on the relative price of capital and on the price of the home good. Real wages remain relatively stable because, given the exchange rate policy response to the increase in the global price of risk, downward nominal wage rigidity binds, preventing downward adjustments in the real wage.

Panel (a) of Figure 6 shows that the net effect of these price dynamics is expansionary at the aggregate level, reflecting an increase in firms' competitiveness in response to an increase in the global price of risk. Panel (b) shows that these effects are widespread across firms. For low-risk firms, this reflects the effect of persistent price dynamics on the marginal revenue product of capital; for risky firms, there is an additional effect of competitiveness on the cash flows available to finance investment.

[14]The list of episodes is from the Global Crises Data by Country database (Reinhart and Rogoff, 2009). The episodes are Argentina (2008.Q4, 2014.Q1), Brazil (1999.Q1, 2001.Q2, 2008.Q4, 2013.Q3), Chile (2008.Q4, 2014.Q1), Colombia (1997.Q4, 2002.Q3, 2014.Q4), Mexico (1998.Q3, 2008.Q4), and Peru (1998.Q3). Across these episodes, the real exchange rate depreciates by about 14 log points on impact, while the excess bond premium increases by about 1.5 standard deviations.

# 5. The Risk Dimension of Macroeconomic Policies

In this section, we study the role of macroeconomic policies in stabilizing the transmission of the global financial cycle. Our analysis identifies a "risk dimension" by which policies can reduce the pass-through of changes in the global price of risk to borrowing costs by affecting the quantity of risk in the economy. Section 5.1 applies this analysis to exchange rate regimes and Section 5.2 to macroprudential policies.

## 5.1. Exchange Rate Regimes

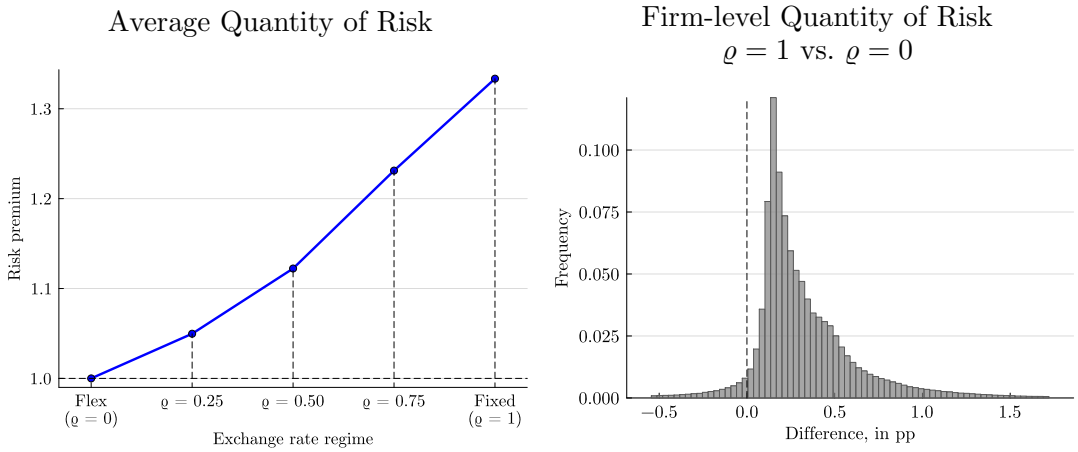
We begin by analyzing how exchange rate regimes, parameterized by $\varrho$, affect firms' quantity of risk. Panel (a) of Figure 7 shows that a higher degree of exchange rate rigidity is associated with a larger quantity of risk, measured by $\mathbb{C}ov_t\left[\sigma_A \epsilon^A_{t+1}, \mathcal{R}_{i,t+1}\right]$. Panel (b) compares the firm-level quantity of risk under the fixed regime, $\varrho = 1$, with that under the flexible regime, $\varrho = 0$. The distribution lies mostly above zero, showing that most firms have a higher quantity of risk under the fixed regime. Appendix Figure C.8 analyzes the forces behind this pattern and shows that firms' repayment values are more sensitive to global productivity shocks when the exchange rate is more rigid. This happens because higher rigidity limits the adjustment of real wages after contractionary shocks, leading to larger declines in firms' earnings.[15]

Figure 8 shows that the macroeconomic effects of an increase in the global price of risk are larger under a fixed exchange rate regime than under a flexible regime. The differential effects on firms' cumulative investment, reported in Panel (b), can be decomposed into two components. First, classic "Mundellian" forces stemming from nominal rigidities: for a given increase in borrowing costs, the fixed exchange rate regime prevents downward adjustments in real wages, leading to larger decreases in the marginal product of capital and investment in response to the shock.

Second, the higher quantity of risk in the fixed regime, described above, implies that the same increase in the global price of risk generates a larger aggregate risk-premium response,

[15] Appendix Figure C.8 also shows that higher exchange rate rigidity leads to a smaller debt revaluation, which increases repayment values. Quantitatively, however, this force is dominated by the effect on firms' earnings for most firms in the economy.

**Figure 7:** Exchange Rate Policy and the Quantity of Risk



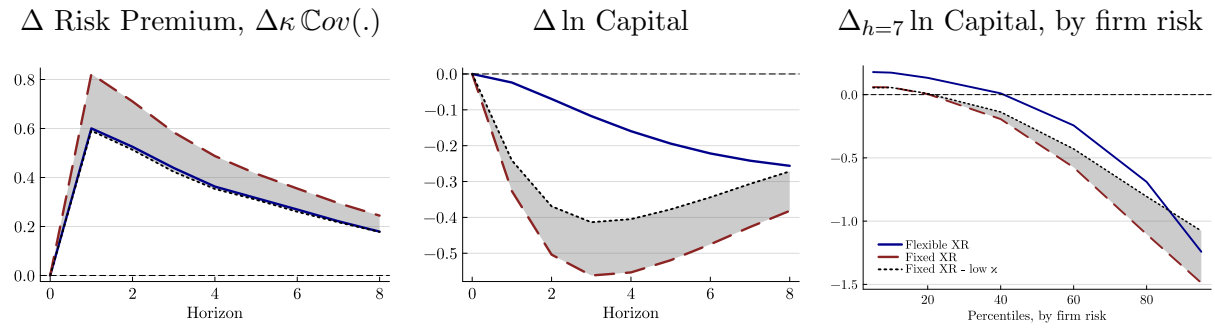

*Note:* The figure reports how exchange rate policy affects firms' quantity of risk. The left panel shows the average quantity of risk across exchange rate regimes, normalized by its value under a flexible exchange rate. The right panel shows the firm-level difference in the quantity of risk between the fixed $\varrho = 1$ and flexible $\varrho = 0$ regimes.

and hence a larger increase in borrowing costs (see Panel (a)); we refer to this margin as the "risk dimension" of exchange rate regimes. To assess its quantitative importance, we consider a counterfactual increase in $\kappa$ under the fixed exchange rate regime that leads to the same increase in the risk premium as that observed in the flexible regime. The gray area in Panel (b) shows that the risk dimension of exchange rate regimes accounts for a third of the differential effect on investment in response to an increase in the global price of risk.

Panel (c) of Figure 8 reports the effects of an increase in the global price of risk on the cross-section of firms' investment, indicating two main takeaways. First, the risk dimension, illustrated by the gray area, is widespread across firms, with the investment of all firms responding more under the fixed regime because of a higher quantity of risk. Second, a global price of risk shock has a larger impact under fixed regimes for most firms in the economy.

The comparison of exchange rate regimes depends on the currency denomination of firms' debt. As we further study in Section 6, when debt is denominated in local currency, the risk premium rises slightly more under the flexible regime, because foreign lenders bear the exchange rate risk and require compensation for it.

**Figure 8:** The Risk Dimension of Exchange Rate Regimes:
Responses to Global Price of Risk Increases




*Note:* Impulse responses to a shock to the global price of risk ($\Delta\kappa > 0$) across exchange rate regimes. Blue (red) lines show the dynamics under a flexible (fixed) exchange rate regime. The black dotted lines report the results for a fixed exchange rate regime in which we adjust the $\kappa$ shock so that the dynamics of the risk premium match those under the flexible regime. The gray area captures the additional contraction attributable to the larger risk dimension under the fixed regime.

### 5.2. Macroprudential Policies

Our second application consists of macroprudential policy, which has been considered as a tool to mitigate the effects of financial crises (e.g., Bianchi, 2011; Bianchi and Mendoza, 2018; Rebucci and Ma, 2019). Our focus is on the risk dimension of these policies, i.e., how they mitigate the effect of shocks to the price of risk by affecting firms' quantity of risk.

To illustrate the effects of these policies, we consider a constant tax on firms' debt issuance, denoted by $\tau$, rebated lump-sum to households. With the tax, the debt-related cash flows to the firm are given by

$$\Delta\mathcal{B}^{\star}_{i,t} = (1-\tau)q^{\star}_t\left(k_{i,t+1}, b_{i,t+1}, z_{i,t}\right)\left[b_{i,t+1} - (1-m)b_{i,t}\right] - \left[(1-m)\upsilon + m\right]b_{i,t} - \Psi_b\left(b_{i,t+1}, b_{i,t}\right).$$

Appendix Figure C.9 shows that the tax on debt induces a generalized reduction in firms' quantity of risk by discouraging borrowing. Appendix Figure C.10 reports the effects of an increase in the global price of risk in an economy with $\tau = 5\%$ and compares it to the baseline economy without debt taxes. Panel (a) shows that the increase in firms' borrowing costs is lower in the economy with debt taxes, reflecting the lower quantity of risk and lower debt. This implies that the negative effect on investment is attenuated in the aggregate, as shown in Panel (b). We further assess the quantitative relevance of the risk dimension by considering a counterfactual $\kappa$ shock in the baseline economy that reproduces the risk

premia of the taxed economy. In this case, the risk dimension accounts for more than half of the attenuation. Panel (c) shows that the policy has heterogeneous effects across firms. The investment of firms in the upper part of the risk distribution contracts less in response to an increase in the global price of risk in the economy with debt taxes. As a result, the price of capital and real wages fall less in this economy, which induces an investment response of firms in the lower part of the risk distribution that is less expansionary.

It is worth mentioning that our analysis does not imply the desirability of this policy from a welfare perspective. A normative analysis of the constrained-efficient policy is important but outside the scope of this paper.

# 6. Alternative Economic Environments

In this section, we extend our baseline model along several key dimensions. Section 6.1 analyzes an economy with local-currency debt and its implications for policy. Section 6.2 further studies the role of firm ownership, domestic financial intermediation, and imported inputs. We summarize our main findings below and provide further details on each extension in Appendix C.7.

## 6.1. Local-Currency Debt

In this model variant, we assume that firms' debt is denominated in local currency. In this case, the currency risk is borne by foreign investors and the price of debt is given by:

$$q_{i,t}^{LC} \approx \beta^{\star}\, \mathbb{E}_t \left[ \frac{\xi_t}{\xi_{t+1}}\, \mathcal{R}_{i,t+1} \right] - \beta^{\star}\, \kappa_t\, \mathbb{C}ov_t \left[ \sigma_A \epsilon_{t+1}^{A}, \frac{\xi_t}{\xi_{t+1}}\, \mathcal{R}_{i,t+1} \right]. \tag{24}$$

This expression illustrates that the relevant notion of quantity of risk includes currency risk in addition to default risk. This has implications for how shocks to the price of risk transmit to the economy and for the role of exchange rate policy in stabilizing them. On the positive side, Table 4 shows that the capital contraction in response to an increase in the global price of risk is about 30 percent larger than in the baseline economy. This difference is driven by a higher quantity of risk and a stronger risk channel in the economy with local-currency debt, even though the debt-revaluation channel is absent in this economy.

**Table 4:** Cumulative Investment Responses, Channel Decomposition

| Model | Total effect | Risk channel | Comp. channel | Reval. channel | Peak $h$ | Heterogeneous responses: Safest firms | Heterogeneous responses: High-risk firms |
|---|---|---|---|---|---|---|---|
| Baseline | -0.32 | -0.57 | 0.27 | -0.03 | 7 | 0.10 | -1.35 |
| Local currency debt | -0.42 | -0.77 | 0.34 | 0.00 | 8 | 0.09 | -1.41 |
| Firm discount factor: | | | | | | | |
| Risk-averse domestic investors | -0.17 | -0.27 | 0.12 | -0.02 | 4 | 0.01 | -0.67 |
| Risk-averse foreign investors | -1.04 | -2.22 | 1.21 | -0.02 | 7 | -1.48 | 0.22 |
| Domestic debt and banks | -0.42 | -0.57 | 0.16 | -0.00 | 8 | 0.13 | -1.47 |
| Imported goods: | | | | | | | |
| Investment goods | -0.55 | -0.49 | -0.03 | -0.03 | 4 | -0.23 | -1.57 |
| Intermediate inputs | -0.36 | -0.49 | 0.14 | -0.02 | 5 | -0.01 | -1.38 |

*Note:* The table decomposes the response of aggregate capital to a shock to the global price of risk, for the baseline economy and the model variants listed in the first column. The total effect is $100 \times \left(\ln K_{t+h} - \ln K^{\text{ns}}_{t+h}\right)$, where $t$ is the period of the shock and $\{K^{\text{ns}}\}$ is the path of capital without the shock. The total effect is evaluated at the horizon at which the capital contraction is largest in each economy (column "Peak $h$"). The channels follow the decomposition described in Appendix C.3. The risk channel is the partial-equilibrium effect of the shock, with aggregate prices at their no-shock paths; the competitiveness channel then lets prices respond, compensating firms for the depreciation-induced increase in their debt service; and the debt-revaluation channel removes this compensation. The last two columns report the total response at the peak horizon for firms at the 5th and 95th percentiles of the pre-shock default-risk distribution.

On the policy side, Panel (a) of Figure C.12 shows that, in response to an increase in the global price of risk, the risk premium rises slightly more under the flexible exchange rate regime than under the fixed regime. This is because a flexible exchange rate contributes to a higher quantity of risk when debt is denominated in local currency. As illustrated by the gray area in Panels (b) and (c), the risk dimension of exchange rate regimes, defined in the previous section, now works slightly against the flexible regime, although the fixed regime remains more contractionary because of its muted price responses. This analysis highlights the role of the currency denomination of debt as a key determinant of the comparison of the risk dimension of different exchange rate regimes.

Appendix C.7.1 provides further details on this extension and reports the aggregate and firm-level responses of this economy to a global price of risk shock (Figure C.11).

### 6.2. Other Model Variants

**Firm ownership.** In these variants, we analyze alternative specifications of the stochastic discount factor that values firms' dividends. First, we consider a flexible expression for the stochastic discount factor of the domestic investor, given by

$$\Lambda_{t,t+1} = \beta \times \exp\left(-\kappa_D \, \sigma_A \, \epsilon^A_{t+1} - \frac{1}{2}\kappa_D^2 \, \sigma_A^2\right). \tag{25}$$

This formulation is symmetric to the foreign discount factor in Equation (12), with a time-invariant domestic valuation of risk, $\kappa_D$. It also nests the baseline model, which corresponds to $\kappa_D = 0$. We set $\kappa_D$ at the unconditional average of $\kappa$ for the foreign investors, so that both domestic and foreign investors have the same average risk aversion. Table 4 shows that the peak capital contraction in response to a global price of risk shock in the economy with risk-averse domestic investors is about half as large as in the baseline economy. This is because risk-averse owners find defaultable debt less attractive, and firms' leverage falls by about 10 percentage points (Appendix Table C.9). Appendix C.7.2 provides further details on this variant, including the corresponding impulse responses (Figure C.13).

Second, we analyze the case in which the stochastic discount factor that values firms' dividends coincides with the foreign discount factor (see Appendix C.7.2 for further details). In this extension, shocks to the global price of risk jointly affect the pricing of debt and equity. Table 4 shows that the risk channel is four times larger than in the baseline model because here it also includes the repricing of equity: firms discount risky payoffs more, which induces a stronger contraction in investment. However, this model variant predicts counterfactual responses of investment at the micro level. As shown in Table 4 and Appendix Figure C.14, the response of investment is stronger in safer firms than in risky firms. This is because safer firms are less financially constrained and their dividends are more sensitive to global price of risk shocks. This result further illustrates the relevance of the cross-sectional evidence to inform the channels of transmission of shocks to the global price of risk.

**Domestic debt and financial intermediaries.** This extension addresses the fact that, in the data, part of corporate debt is held by domestic financial intermediaries. The empirical literature has documented that these domestic intermediaries feature a high pass-through of

their lending rates to changes in the global price of risk (e.g., di Giovanni *et al.*, 2022). In Appendix C.7.2, we provide a simple extension to our baseline model that captures these two empirical regularities. In this extension, firms' debt is held by domestic intermediaries that finance themselves primarily with deposits but whose marginal source of finance responds to changes in the global price of risk. This setup retains the pricing of firms' debt and disconnects firms' borrowing from the economy's balance of payments. Table 4 and Appendix Figure C.15 show that the macroeconomic effects of increases in the global price of risk are similar to those in the baseline economy.

**Imported inputs.** We consider two extensions that introduce imported goods into production. In the first, we assume that capital is produced using a CES technology that combines home and foreign goods. In the second, firms use an imported intermediate input in production. The first extension therefore captures the direct use of imported investment goods, while the second captures the exposure of firms' earnings to the cost of imported inputs. As shown in Table 4 and Appendix Figure C.16, the risk channel is similar in magnitude to that in the baseline economy. In contrast, both extensions curtail the stabilizing role of the competitiveness channel because the real exchange rate depreciation makes capital more expensive in the first extension and the imported input more expensive in the second. This shows that changes in the global price of risk are transmitted more strongly in economies with stronger international linkages in their production structure.

# 7. Conclusions

In this paper, we study how fluctuations in global financial conditions transmit to firms' investment and economic activity in open economies. We combine new evidence on firms' responses to changes in the global risk premium with a quantitative heterogeneous-firm open-economy model in which firms finance investment with defaultable debt provided by risk-averse global investors. Our analysis highlights the central role of firms' risk in shaping the transmission of global financial shocks. Increases in the global price of risk raise firms' cost of financing investment, with pass-through determined by each firm's quantity of risk.

This risk channel generates heterogeneous investment responses across firms and is the main driver of the aggregate contraction following global financial shocks.

A key implication of our framework is that macroeconomic policies influence the transmission of external shocks through their effect on firms' quantity of risk. Policies that facilitate input cost adjustments reduce firms' exposure to aggregate risk and dampen the pass-through of external shocks to borrowing costs and investment. While our analysis focuses on exchange rate regimes, an important avenue for future research is to examine how other policies, such as fiscal policy or institutional changes in credit markets, shape firms' risk exposure and thereby influence how fluctuations in international financial markets transmit to real economic activity in open economies.

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# Supplemental Appendix for Firms' Investment and the Real Transmission of the Global Financial Cycle

# A. Empirical Appendix

## A.1. Aggregate Data

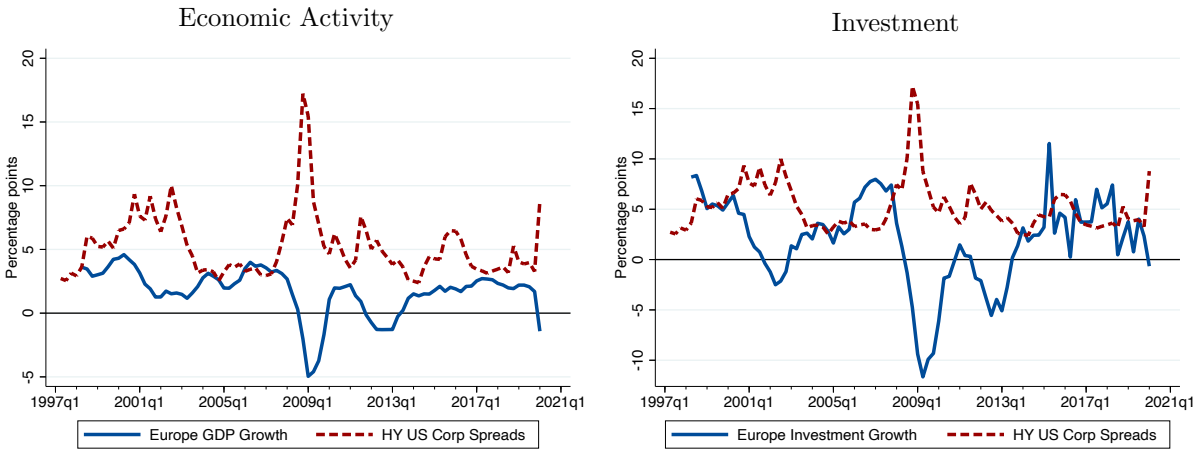
We use country-level data for the motivating patterns presented in Figure 1 and for the quantitative model. This section describes the sources of these data and the cleaning procedures. We collect quarterly real national accounts, consumer price indices, and employment data for Argentina, Brazil, Chile, Colombia, Mexico, and Peru from the IMF's International Financial Statistics (IFS) database or OECD's Main Economic Indicators (MEI), as available via FRED. For Argentina, Colombia, and Peru, we supplement national accounts with data directly from the central bank websites, which have older historical versions. For Argentina and Peru, we seasonally adjust the historical series. Then, we overlay the main data with the historical data. We seasonally adjust the unemployment rate data. For Argentina, we further supplement these data with private employment from the Ministerio de Economía and a consumer price index from Blanco, Diaz de Astarloa, Drenik, Moser and Trupkin (2022). We collect spot exchange rate data from Bloomberg.

We define a broader set of emerging market countries that includes Latin America plus India, Korea, the Philippines, Thailand, Turkey, and Ukraine. The sample of countries is chosen to be consistent with the countries used in our external borrowing cost measurement, presented in Appendix A.3. We download real quarterly national accounts data and GDP deflators from either the IMF's IFS or the OECD's MEI database. For the Philippines, Turkey, and Ukraine, we download GDP deflator data from the World Bank's World Development Indicators at an annual level. We collect spot exchange rates from Bloomberg.

For the set of advanced European economies, we collect data for Austria, Belgium, Germany, Denmark, Spain, Finland, France, the U.K., Greece, Italy, the Netherlands, Poland, Portugal, and Sweden. We download the following data through FRED: real national accounts data from Eurostat; GDP deflators and spot exchange rates from the OECD's MEI.

Figure A.1 uses these data to show large movements in output and investment following changes in global borrowing costs in advanced European economies, similar to the patterns shown for emerging markets in Figure 1.

**Figure A.1:** U.S. Borrowing Costs and Economic Activity in Advanced European Economies




*Note: The figure shows average year-over-year growth rates of real GDP (Panel a) and real investment (Panel b) relative to Barclays U.S. Corporate High Yield Spreads. The European economies included are Austria, Belgium, Germany, Denmark, Spain, Finland, France, the U.K., Greece, Italy, the Netherlands, Poland, Portugal, and Sweden.*

## A.2. Firm-Level Data

For our empirical analysis, we use firm-level data from Global Compustat, which gives us rich quarterly balance-sheet data for the sample of publicly traded firms across a wide set of countries. We use data from Latin America for our baseline analysis, but we supplement this with analysis for a broader set of emerging market economies and advanced European economies. For our quantitative model analysis, we use ORBIS data for the sample of Latin American countries. This section describes the process for cleaning each dataset and defining variables.

### A.2.1. Global Compustat

We obtain quarterly data on firms' balance sheets from Global Compustat and construct variables using standard methodology in the literature, with some additional adjustments

for currency. We only keep observations in which the reporting currency is either local currency or USD (99.8% of sample). For observations denominated in USD (8% of sample), we convert variables to local currency using average quarterly spot exchange rates. When considering changes in variables—e.g., sales growth or changes in the capital stock—we only compare observations reported in the same currency. For real variables, we deflate nominal variables with GDP deflators from each country.

**Variable Definitions**

1. *Investment:* We define investment as $\Delta \log(k_{jt+1})$, where $k_{jt+1}$ is the stock of capital at firm $j$ at the end of period $t$. We set the initial value $k_{jt+1}$ to the level of gross plant, property, and equipment (ppegtq) in the first period in which this is available. We then compute the evolution of the capital stock using changes in net plant, property, and equipment (ppentq). This variable measures investment net of depreciation with more observations than ppegtq. We linearly interpolate ppentq if there is one missing observation between two non-missing observations. We only interpolate between observations reported in the same currency. We deflate the capital stock series at the end of this procedure.
2. *Leverage:* We define leverage as the ratio of total debt (dlcq + dlttq) to total assets (atq).
3. *Real sales growth:* We define real sales growth as the percent change in sales (saleq), deflated by the local GDP deflator. We exclude observations if a firm changes reporting currency between consecutive quarters ($< 0.1\%$ of observations).
4. *Size:* We define size as the log of total real assets, converted to USD for comparability across countries. We deflate total assets by the price deflator for the U.S.
5. *Liquidity:* We define liquidity as the ratio of cash and short-term investments (cheq) to total assets.
6. *Cash flow:* We define operating cash flow as the ratio of operating income before depreciation (oibdp) minus interest (xint) minus taxes (txt) to lagged total assets.
7. *Industry:* We define industries using standard NAICS supersector definitions based on 2-digit NAICS codes: Natural resources and mining (11–21), Construction (23),

Manufacturing (31–33), Trade, transportation, and utilities (42, 49, 22), Information (51), Professional and business services (54–56), Education and health services (61–62), Leisure and hospitality (71–72), Other services (81). Financial activities (52–53) and Public administration (92) are dropped from our final sample based on restrictions below. We also include a category for a small number of firms with unclassified industries.

8. *Sector:* We identify firms in tradable and nontradable sectors using 2-digit NAICS codes. Tradable industries are agriculture (11), mining (21), manufacturing (31–33), wholesale trade (42), retail trade (44–45), and transportation and warehousing (48–49). Nontradable industries are information (51), professional, scientific, and technical services (54), administrative services (56), education (61), health and social services (62), arts (71), hospitality (72), and other services (81). We exclude the construction industry (23) and a small number of firms with unclassified industries from our sector definitions.
9. *Distance to default:* We measure firms' time-varying default risk using distance to default, described in detail below.

**Distance to default** We measure firms' time-varying default risk using the measure of distance to default proposed by Merton (1974), defined as $\text{dd}_{jt} = \frac{\log\left(\frac{V_{jt}}{D_{jt}}\right)+(\mu_{jt}-0.5\sigma_{jt}^2)}{\sigma_{jt}}$, where $V_{jt}$ is the value of firm $j$ in quarter $t$, $D_{jt}$ is the firm's debt, $\mu_{jt}$ is the firm's annual expected return, and $\sigma_{jt}$ is the annual volatility of the firm's value. We measure debt, $D_{jt}$, as the sum of short-term debt (dlcq) and one-half of long-term debt (dlttq). We follow an iterative procedure based on Gilchrist and Zakrajšek (2012) to impute the firm's value, $V_{jt}$. The procedure is as follows:

1. We set an initial value of the firm equal to the sum of debt and equity, $V = D + E$. We measure equity as the firm's stock price times the number of shares, using Global Compustat Security Daily.
2. We estimate the mean ($\mu$) and volatility ($\sigma$) of the return on the firm's value over a 250-day moving window.
3. We estimate a new value of $V$ using the Black-Scholes-Merton option-pricing framework

$E = V\Phi(\delta_1) - e^{-rT}D\Phi(\delta_2)$, where $\delta_1 \equiv \frac{\log(V/D)+(r+0.5\sigma^2)T}{\sigma\sqrt{T}}$ and $\delta_2 \equiv \delta_1 - \sigma\sqrt{T}$. Here, $r$ is the daily 1-year constant maturity Treasury yield and $T$ is equal to 1, corresponding to a one-year horizon.

4. We repeat steps 2 and 3 until $V$ converges.

Our methodology requires that firms have positive values for both debt and equity. To exclude extreme outliers, we trim distance to default at 1% and 99% of the global sample ($-1.1$ and 32.1).

**Sample Construction** We restrict our final sample to exclude extreme outliers. We make the following sample restrictions, in this order.

1. We only include firms with balance sheets reported in local currency or USD.
2. We drop firms in the financial (SIC 6000–6799 or NAICS 52–53) and utilities (SIC 4900–4999 or NAICS 22) industries.
3. We exclude firm-quarter observations with negative capital or assets.
4. We exclude firm-quarter observations for which acquisitions are larger than 5% of assets.
5. We exclude firm-quarter observations if net current assets as a share of total assets is higher than 10 or below $-10$.
6. We exclude firm-quarter observations if leverage is higher than 10 or negative.
7. We exclude firm-quarter observations with negative real sales or liquidity.
8. We trim investment at the 1st and 99th percentiles.

Table A.1 reports summary statistics for our main sample of Latin American countries and Table A.2 reports additional summary statistics by country for the subsample of observations with non-missing distance to default, which will be the basis of most of our empirical analysis. We have about 30,000 observations across Argentina, Brazil, Chile, Colombia, Mexico, and Peru over the time period 1997.Q3 to 2019.Q4. We observe distance to default for roughly 19,000 of these observations, starting in 1998.Q2 but increasing substantially around 2004. Our sample features considerable variation in investment, sales growth, size, and financial position.

We use the same cleaning procedure for additional samples of countries. Tables A.3

**Table A.1:** Global Compustat Data: Summary Statistics, Latin America

| | Mean | SD | p10 | Med | p90 | N |
|---|---|---|---|---|---|---|
| Investment | -0.15 | 5.91 | -4.73 | -0.91 | 4.80 | 30,735 |
| Real sales growth | 1.30 | 21.50 | -20.62 | 0.80 | 24.06 | 30,463 |
| Tradable sector | 0.78 | 0.41 | 0.00 | 1.00 | 1.00 | 30,735 |
| Book leverage | 0.31 | 0.34 | 0.08 | 0.27 | 0.52 | 26,296 |
| Distance to Default | 6.81 | 5.75 | 0.87 | 5.43 | 14.48 | 18,958 |

*Note: The table reports summary statistics for firm investment and default risk data. The sample includes Argentina, Brazil, Chile, Colombia, Mexico, and Peru over the time period 1997.Q3 to 2019.Q4. Investment is defined as the log change in capital stock multiplied by 100. Real sales growth is measured in percentage points. Tradable and nontradable sectors are defined above in Appendix A.*

**Table A.2:** Global Compustat Data: Summary Statistics by Country, Latin America

| | Observations | Firms | DD | Investment | Leverage | Tradable | First year |
|---|---|---|---|---|---|---|---|
| Argentina | 1,803 | 56 | 6.90 | -3.12 | 0.25 | 0.75 | 2004 |
| Brazil | 7,859 | 263 | 5.21 | -0.21 | 0.35 | 0.81 | 2002 |
| Chile | 3,202 | 106 | 9.01 | 0.24 | 0.28 | 0.74 | 1998 |
| Colombia | 524 | 25 | 8.47 | 1.07 | 0.20 | 0.83 | 2005 |
| Mexico | 3,651 | 106 | 8.55 | 0.24 | 0.28 | 0.68 | 2003 |
| Peru | 1,919 | 66 | 5.88 | 0.67 | 0.24 | 0.86 | 2002 |

*Note: The table reports the sample coverage and mean statistics by country for the sample of Latin American firms with non-missing distance to default (DD) and other controls included in the main regressions. Observations is the number of firm-quarter observations. Firms is the number of unique firms. DD is distance to default. Investment is defined as the log change in capital stock multiplied by 100. Leverage is book leverage. Tradable sectors are defined above in Appendix A. First year is the first observation in the sample and data extend through 2019.*

and A.4 report summary statistics for emerging market and advanced European economies. The emerging market sample includes the Latin American countries above as well as India, Korea, the Philippines, Thailand, Turkey, and Ukraine. These countries are chosen to be consistent with the bond-level data presented in the next section. The advanced European economies include Austria, Belgium, Germany, Denmark, Spain, Finland, France, the U.K., Greece, Italy, the Netherlands, Poland, Portugal, and Sweden.

**Credit Ratings** We collect firm-level credit ratings from S&P and/or Moody's for the Latin American firms in our Global Compustat sample. We use crosswalks between Compustat ID (gvkey) and ticker symbols to find the firm on Bloomberg and extract long-term foreign issuer ratings and the date on which they took effect. We obtain historical ratings

**Table A.3:** Global Compustat Data: Summary Statistics, Emerging Markets

| | Mean | SD | p10 | Med | p90 | N |
|---|---|---|---|---|---|---|
| Investment | -0.09 | 5.62 | -3.85 | -0.85 | 4.71 | 152,039 |
| Real sales growth | 1.10 | 24.17 | -24.19 | 0.29 | 27.43 | 150,053 |
| Tradable sector | 0.79 | 0.41 | 0.00 | 1.00 | 1.00 | 152,039 |
| Book leverage | 0.31 | 0.30 | 0.05 | 0.28 | 0.54 | 96,240 |
| Distance to Default | 5.88 | 5.15 | 1.07 | 4.49 | 12.51 | 114,656 |

*Note: The table reports summary statistics for firm investment and default risk data. The sample includes Argentina, Brazil, Chile, Colombia, India, Korea, Mexico, Peru, the Philippines, Thailand, Turkey, and Ukraine over the time period 1997.Q3 to 2019.Q4. Investment is defined as the log change in capital stock multiplied by 100. Real sales growth is measured in percentage points. Tradable and nontradable sectors are defined above in Appendix A.*

**Table A.4:** Global Compustat Data: Summary Statistics, Advanced European Economies

| | Mean | SD | p10 | Med | p90 | N |
|---|---|---|---|---|---|---|
| Investment | 0.46 | 7.60 | -4.07 | -0.39 | 5.29 | 185,955 |
| Real sales growth | 1.42 | 21.56 | -19.58 | -0.23 | 24.00 | 181,101 |
| Tradable sector | 0.61 | 0.49 | 0.00 | 1.00 | 1.00 | 185,955 |
| Book leverage | 0.26 | 0.24 | 0.04 | 0.23 | 0.48 | 132,073 |
| Distance to Default | 6.86 | 5.37 | 1.21 | 5.74 | 13.85 | 143,819 |

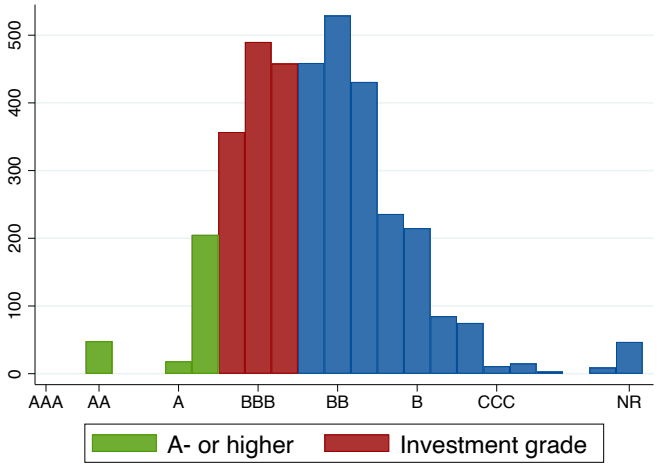
*Note: The table reports summary statistics for firm investment and default risk data. The sample includes Austria, Belgium, Germany, Denmark, Spain, Finland, France, the U.K., Greece, Italy, the Netherlands, Poland, Portugal, and Sweden over the time period 1997.Q3 to 2019.Q4. Investment is defined as the log change in capital stock multiplied by 100. Real sales growth is measured in percentage points. Tradable and nontradable sectors are defined above in Appendix A.*

for 74% of firms in our bond sample, which cover 85% of bonds. We use a crosswalk from the BIS to place the ratings on the same scale and construct an aggregate rating using the worse rating of the two when both are available. S&P and Moody's ratings coincide for 91% of observations and are within two notches for 80% of the remaining observations. Figure A.2 shows the distribution of ratings. Mapping to the Compustat sample summarized in Table A.1, 1% of firm-quarter observations are matched to ratings of A- or higher and 5% are matched to investment-grade or better ratings.

### A.2.2. ORBIS

Our quantitative analysis of the model relies on data representative of both publicly traded and private firms. We use annual balance-sheet data from ORBIS to cover a broad sample of

**Figure A.2:** Distribution of Firms' Credit Ratings




*Note: The figure reports the distribution of credit ratings from S&P and/or Moody's. When both ratings are available, the lower rating is used. The y-axis reports the number of firm-by-quarter observations.*

firms from Argentina, Brazil, Chile, Colombia, Mexico, and Peru. We process the historical vintages of ORBIS data using the guide provided by Kalemli-Özcan, Sørensen, Villegas-Sanchez, Volosovych and Yeşiltaş (2024).

We define the following variables to use in the construction of moments.

- *Real capital:* We define capital stock ($k_{jt}$) as tangible fixed assets (TFAS) and deflate using the GDP deflator as described above.
- *Investment:* We define investment as $(k_{jt+1} - (1-\delta)k_{jt})$, assuming an annual depreciation rate of 11%.
- *Leverage:* We define leverage as the ratio of total debt (LTDB+LOAN+CRED) to total assets (TOAS).
- *Real sales growth:* We define real sales growth as the percent change in sales (TURN) deflated by the GDP deflator.
- *Size:* We define size as the log of capital stock.
- *Liquidity:* We define liquidity as current assets (CUAS) over total assets (TOAS).
- *Age:* We define firm age as the number of years since the incorporation date.
- *Public/Private:* We define public and private firms based on firms' listed status. We define public firms as listed firms and private firms as unlisted firms.
- *Equity issuance:* We proxy equity issuance by a percent change in shareholders' funds

(SHFD) greater than 50%. To limit the influence of temporary fluctuations, we omit observations that have missing or trimmed change in shareholders' funds in the previous year (see discussion of trimming below).

We follow our sample restrictions for Compustat data as closely as possible when constructing our ORBIS dataset. We make the following sample restrictions, in this order.

1. We drop delisted firms.
2. We drop firms in the financial (SIC 6000–6799 or NAICS 52–53) and utilities (SIC 4900–4999 or NAICS 22) industries.
3. We exclude firm-year observations with negative or zero capital or assets.
4. We exclude firm-year observations if net current assets as a share of total assets is higher than 10 or below −10.
5. We exclude firm-year observations if leverage is higher than 1 or negative.
6. We exclude firm-year observations with absolute value of real sales growth greater than 100%.
7. We exclude firm-year observations with negative sales or liquidity.
8. We calculate all cross-sectional moments in the year 2012, for which we have the best coverage across all six countries. We report alternative moment calculations averaged over 2005–2017, which is the widest set of years for which we can compute all moments across all six countries.
9. We trim leverage and change in shareholders' funds at the top and bottom 5% by country and year. We trim size at the bottom 5% (to retain the largest firms).

Table A.5 presents summary statistics by country for our main sample, which uses cross-sectional data from 2012 as well as the broader sample, which averages cross-sectional moments from 2005–2017. The 2012 sample has better coverage of private firms for Brazil and Peru, with similar coverage for the other countries.

### A.3. External Borrowing Costs Measurement

We measure risky external borrowing costs using the regional excess bond premium. For the countries in our main Latin America sample and the broader emerging market sample, we construct the measure ourselves using the data and procedures described below. For the

**Table A.5:** ORBIS Data: Summary Statistics

**(a)** Main sample (2012)

| | Argentina | Brazil | Chile | Colombia | Mexico | Peru |
|---|---|---|---|---|---|---|
| Leverage | 0.36 | 0.25 | 0.38 | 0.14 | 0.35 | 0.25 |
| Leverage (cs std) | 0.21 | 0.25 | 0.23 | 0.22 | 0.23 | 0.20 |
| Investment/k (cs std) | 0.26 | 0.26 | 0.16 | 0.28 | 0.29 | 0.25 |
| Correlation size and age | 0.22 | 0.15 | 0.22 | 0.35 | 0.36 | 0.30 |
| Share firms issuing equity | 0.09 | 0.02 | 0.07 | 0.12 | 0.14 | 0.06 |
| Age median public firm | 35 | 39 | 25 | 38 | 23 | 20 |
| Observations | 158 | 3,431 | 205 | 55,886 | 1,424 | 900 |
| Public share, observations | 33% | 5% | 49% | 0.1% | 6% | 9% |
| Public share, sales | 61% | 58% | 62% | 13% | 46% | 14% |

**(b)** Alternative sample (2005–2017)

| | Argentina | Brazil | Chile | Colombia | Mexico | Peru |
|---|---|---|---|---|---|---|
| Leverage | 0.34 | 0.31 | 0.33 | 0.15 | 0.34 | 0.27 |
| Leverage (cs std) | 0.22 | 0.22 | 0.23 | 0.21 | 0.23 | 0.19 |
| Investment/k (cs std) | 0.21 | 0.22 | 0.17 | 0.43 | 0.32 | 0.18 |
| Correlation size and age | 0.14 | 0.05 | 0.19 | 0.36 | 0.35 | 0.18 |
| Share firms issuing equity | 0.04 | 0.10 | 0.02 | 0.07 | 0.06 | 0.05 |
| Age median public firm | 37 | 37 | 25 | 36 | 24 | 24 |
| Observations | 2,118 | 28,073 | 3,444 | 695,977 | 20,236 | 3,133 |
| Public share, observations | 30% | 8% | 36% | 0.1% | 6% | 29% |
| Public share, sales | 62% | 65% | 62% | 16% | 34% | 45% |

*Note: The table reports summary statistics for our ORBIS sample. Panel (a) reports statistics for 2012, which we use as our main sample for the model calibration. Panel (b) reports average statistics for each country across 2005–2017.*

U.S., we use the excess bond premium from Gilchrist and Zakrajšek (2012), which is updated and published by the Federal Reserve using the methodology described in Favara, Gilchrist, Lewis and Zakrajšek (2016). For the advanced European economies, we use a measure of the euro area excess bond premium from De Santis (2018).[16] The euro area EBP is available from 1999.Q4 to 2015.Q1.

**Corporate Bond Data** We collect corporate bond data from Bloomberg and match it to firm-level data using crosswalks to connect identifiers across the datasets. Firms in Compustat are uniquely identified by the gvkey variable. Bonds in Bloomberg are uniquely identified by a Bloomberg ID (bbgid) but are attached to firm identifiers—ISIN, CUSIP, and ticker.

[16] We are grateful to Roberto De Santis for kindly sharing the data with us.

We use WRDS Capital IQ to create crosswalks between the Compustat gvkey and the other identifiers available from Bloomberg. We collect data in stages to minimize unnecessary data collection.

1. For each country except the United States, we download a list of corporate bonds that meet the following criteria: denominated in USD, fixed or zero coupon, and have some firm identifier data. We exclude local-currency bonds because we do not want to capture currency risk in our spreads relative to U.S. Treasury yields.
2. For each bond on the list, we match to Compustat gvkey first using ISIN, then CUSIP, then ticker, so we have one firm attached to each bond.
3. For bonds that are successfully matched to firms, we return to the Bloomberg terminal and download end-of-quarter price data (px_last).
4. For bonds that have non-missing price data, we download additional descriptive variables—coupon rate, coupon frequency, call options, etc.

In addition to the criteria listed in step 1, we only keep emerging market economies for which we have at least 100 observations. We limit our sample to bonds with a term to maturity of at least 1 year and no more than 30 years (744 observations). We drop firms in the financial (SIC 6000–6799) and utilities (SIC 4900–4999) industries (1,534 observations). We drop observations that are missing any data on duration, market value of issue, coupon, date of issue, maturity type (i.e., callable), or industry (1,037 observations). We start our sample in 1997.Q2 (11 observations). Table A.6 describes the coverage of our dataset. We have data from 12 countries in total, covering 562 bonds issued by 172 firms. Almost half of our sample is from Latin America.

We observe end-of-quarter prices and the date of the first coupon payment. We assume that prices are observed after coupon payments are made for each quarter and that coupons are paid relative to the quarter in which the first coupon payment was made—i.e., if a bond had a semi-annual coupon and the first coupon was paid in the first quarter, we assume it will be paid in the first and third quarters going forward. All of our results are robust to excluding bonds that report either "Long first" or "Short first" for the first-period coupon type (17.5% of observations).

Using price data and bond characteristics, we construct a spread for each corporate bond

**Table A.6:** Corporate Bond Data: Sample Composition

| | Observations | Bonds | Firms | Min year |
|---|---|---|---|---|
| Argentina* | 733 | 49 | 11 | 1997 |
| Brazil* | 590 | 38 | 15 | 1997 |
| Chile* | 547 | 33 | 7 | 1998 |
| Colombia* | 180 | 11 | 2 | 2005 |
| India | 1,311 | 101 | 42 | 2002 |
| Korea | 1,450 | 111 | 29 | 1997 |
| Mexico* | 1,347 | 95 | 23 | 1997 |
| Peru* | 301 | 15 | 7 | 2012 |
| Philippines | 494 | 29 | 7 | 1997 |
| Thailand | 467 | 34 | 16 | 1997 |
| Turkey | 563 | 38 | 12 | 2002 |
| Ukraine | 115 | 8 | 1 | 2009 |
| Total | 8,098 | 562 | 172 | . |

* Indicates countries in the Latin America subsample.

*Note: The table reports the number of bond-quarter observations, number of unique bonds, number of unique firms, and first year observed for the corporate bond data in our sample.*

relative to a risk-free security that accounts for the coupon structure of the bond and its maturity. We follow the methodology of Gilchrist and Zakrajšek (2012) to price a synthetic risk-free security with the same coupon structure and maturity as the corporate bond using the continuously compounded zero-coupon Treasury yields estimated by Gürkaynak, Sack and Wright (2007). Finally, we construct the spread, $S_{ijt} = y_{ijt} - y^f_{it}$, where $y_{ijt}$ is the yield of corporate bond $i$ issued by firm $j$ in quarter $t$ and $y^f_{it}$ is the yield of the corresponding synthetic risk-free bond with the same cash flow structure.

We drop observations with spreads less than 5 basis points or more than 3,500 basis points (42 observations). Tables A.7 and A.8 provide descriptive statistics for the bonds in the Latin American and broader emerging market samples. Characteristics are relatively similar across the samples.

**Baseline excess bond premium measurement** We residualize bond spreads by estimating the following regression:

$$\log S_{it} = \beta \mathrm{dd}_{jt} + \gamma' \boldsymbol{Z}_{it} + \epsilon_{it}, \tag{A.1}$$

**Table A.7:** Corporate Bond Data: Summary Statistics, Latin America

| | Mean | SD | Min | p50 | Max |
|---|---|---|---|---|---|
| Number of bonds per firm/quarter | 2.34 | 1.98 | 1.00 | 2.00 | 13.00 |
| Market value of issue (usd mil., 2000) | 455 | 326 | 7 | 359 | 1779 |
| Maturity at issue (years) | 10.12 | 5.17 | 1.00 | 10.00 | 40.00 |
| Term to maturity (years) | 6.36 | 4.95 | 1.00 | 5.50 | 30.00 |
| Duration (years) | 5.07 | 2.95 | 0.97 | 4.72 | 19.85 |
| Callable (pct.) | 0.43 | 0.50 | | | |
| Credit rating (Bloomberg) | | | CCC- | BB+ | A- |
| Coupon rate (pct.) | 7.04 | 2.23 | 1.48 | 6.88 | 12.75 |
| Nominal effective yield (pct.) | 6.80 | 3.69 | 0.81 | 5.96 | 36.83 |
| Credit spread (basis points) | 457 | 366 | 6 | 356 | 3406 |

*Note: The table reports summary statistics for 241 bonds issued by 65 firms across 6 countries over 1997.Q2 to 2021.Q1. Callable includes bonds with a maturity type of "CALLABLE," "CALL/PUT," or "CALL/SINK." The Bloomberg composite credit rating is measured at time of data download and is only available for 74 bonds. The countries are Argentina, Brazil, Chile, Colombia, Mexico, and Peru.*

**Table A.8:** Corporate Bond Data: Summary Statistics, Emerging Markets

| | Mean | SD | Min | p50 | Max |
|---|---|---|---|---|---|
| Number of bonds per firm/quarter | 2.31 | 2.27 | 1.00 | 2.00 | 23.00 |
| Market value of issue (usd mil., 2000) | 395 | 268 | 5 | 365 | 1779 |
| Maturity at issue (years) | 10.56 | 6.96 | 1.00 | 10.00 | 50.00 |
| Term to maturity (years) | 6.26 | 5.09 | 1.00 | 5.00 | 30.00 |
| Duration (years) | 5.02 | 3.10 | 0.97 | 4.49 | 20.36 |
| Callable (pct.) | 0.26 | 0.44 | | | |
| Credit rating (Bloomberg) | | | CCC- | BBB- | AA |
| Coupon rate (pct.) | 6.18 | 2.40 | 0.25 | 5.75 | 13.00 |
| Nominal effective yield (pct.) | 5.92 | 3.69 | 0.49 | 5.06 | 37.18 |
| Credit spread (basis points) | 384 | 354 | 5 | 282 | 3406 |

*Note: The table reports summary statistics for 562 bonds issued by 172 firms across 12 countries over 1997.Q2 to 2021.Q1. Callable includes bonds with a maturity type of "CALLABLE," "CALL/PUT," or "CALL/SINK." The Bloomberg composite credit rating is measured at time of data download and is only available for 186 bonds. The countries are Argentina, Brazil, Chile, Colombia, India, Korea, Mexico, Peru, the Philippines, Thailand, Turkey, and Ukraine.*

where $S_{it}$ is the spread of bond $i$ in period $t$; $\text{dd}_{jt}$ measures the distance to default of firm $j$ (issuer of bond $i$) in period $t$, $\boldsymbol{Z}_{it}$ is the vector of bond-level characteristics; and $\epsilon_{it}$ denotes a normally distributed error term. The bond-level characteristics included in the vector $\boldsymbol{Z}_{it}$ are duration, amount issued, coupon rate, and age of issue, all measured in logs; an indicator for whether the bond is callable; and fixed effects by industry.

Table A.9 reports the results from estimating (A.1) for the Latin America sample as

**Table A.9:** Credit Spreads and Distance to Default

| | (1) Latin America | (2) All Emerging Markets |
|---|---|---|
| Distance to default | -0.054*** | -0.075*** |
| | (0.012) | (0.011) |
| log(Duration) | 0.062 | -0.020 |
| | (0.057) | (0.041) |
| log(Amount issued) | -0.019 | -0.053 |
| | (0.057) | (0.044) |
| log(Coupon rate) | 1.019*** | 0.761*** |
| | (0.139) | (0.100) |
| log(Age of issue) | -0.039 | -0.062*** |
| | (0.030) | (0.022) |
| Callable | 0.294*** | 0.342*** |
| | (0.070) | (0.060) |
| Observations | 3698 | 8098 |
| $R^2$ | 0.508 | 0.433 |
| Root MSE | 0.482 | 0.550 |
| Number of firms | 65 | 172 |
| Number of bonds | 241 | 562 |

Standard errors in parentheses
* $p < .1$, ** $p < .05$, *** $p < .01$

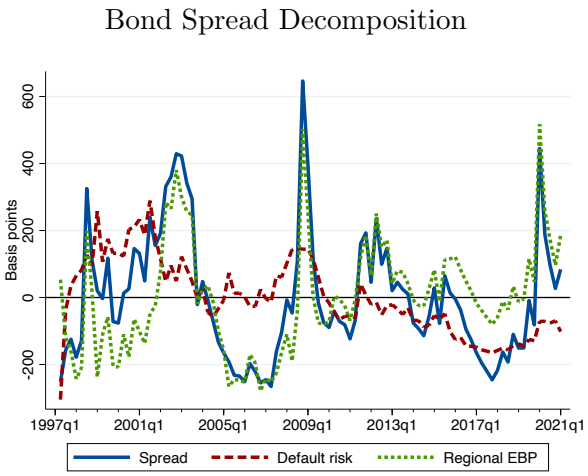
*Note: Sample period: 1997.Q2–2021.Q1. The table shows the estimated coefficients of Equation (A.1) for different samples of countries. The dependent variable is* $\log S_{ijkt}$*, the log of the corporate bond spread for bond* $i$ *issued by firm* $j$ *in country* $k$ *and quarter* $t$*. The model includes fixed effects by industry and controls for duration, amount issued, coupon rate, and age of issue, all measured in logs. Standard errors are clustered by firm and quarter. Latin America includes Argentina, Brazil, Chile, Colombia, Mexico, and Peru. The full emerging market sample includes the Latin American countries plus India, Korea, the Philippines, Thailand, Turkey, and Ukraine.*

well as the full emerging market sample. The estimates indicate that firms with higher distance to default (lower default risk) have lower bond spreads, and that roughly 50% of the variation in spreads can be accounted for by distance to default and the other covariates included in $\boldsymbol{Z}_{it}$.

Using the estimates from (A.1), we estimate the excess bond premium of each bond as follows:

$$E\hat{B}P_{it} \equiv S_{it} - \exp\left(\hat{\beta} dd_{jt} + \hat{\gamma}' Z_{it} + \frac{\hat{\sigma}^2}{2}\right), \tag{A.2}$$

**Figure A.3:** Decomposition of Latin American Corporate Borrowing Costs




*Note: The figure shows the decomposition of average spreads in Latin America into the portion predicted by default risk and the bond-specific excess bond premium, as defined in Equation (A.2). All series are demeaned and computed using the sample of Latin American countries.*

where $\hat{\sigma}^2$ is the estimated variance of the $\epsilon_{it}$ shocks. The excess bond premium is the difference between the bond spread and the predicted bond spread based on default risk and other bond characteristics. Figure 2 Panel (b) shows the average dynamics of each of these components for the sample of emerging markets. Figure A.3 shows the same for Latin America. Predicted bond spreads account for 36% of the variance in spreads in emerging markets and 28% of the variance in Latin America.

Finally, we construct a measure of the regional excess bond premium by estimating:

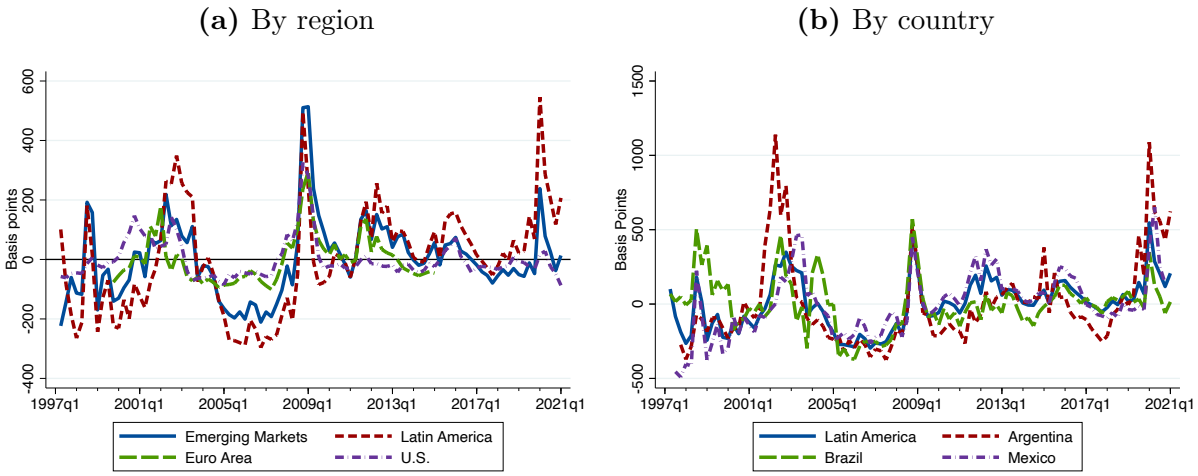
$$E\hat{B}P_{it} = \rho_k + \rho_t + v_{it}, \tag{A.3}$$

where $\rho_k$ and $\rho_t$ denote country and time fixed effects.[17] The $R^2$ of this regression is 0.31 for the Latin American subsample and 0.20 for the full emerging-market sample.

Figure A.4 Panel (a) shows our estimates of the regional excess bond premium in basis points for emerging markets and Latin America, along with the euro area and U.S. excess bond premia. (Figure 2 in the main text shows the same series expressed in standard deviations from the mean.) The excess bond premia across regions are positively correlated, as reported in Table A.10, consistent with the presence of a global financial cycle. Though

[17] We include country fixed effects to allow for persistent heterogeneity across countries that may confound our estimates of common variation over time. Our results are robust to alternative choices of fixed effects, such as firm-level or bond-level fixed effects.

**Figure A.4:** Excess Bond Premium: Regional Measures




*Note: Panel (a) shows the regional excess bond premium for the full set of emerging markets, Latin America, the euro area, and the U.S. Panel (b) shows country-level estimates of the excess bond premium for the three largest countries in the Latin America sample, alongside the Latin American excess bond premium. All series are demeaned and the frequency is quarterly.*

**Table A.10:** Excess Bond Premium and Global Risk Measures: Correlations

| | Latin America EBP | EM EBP | U.S. EBP | EA EBP |
|---|---|---|---|---|
| Latin America EBP | 1.000 | . | . | . |
| Emerging Market EBP | 0.782 | 1.000 | . | . |
| U.S. EBP | 0.333 | 0.647 | 1.000 | . |
| Euro area EBP | 0.518 | 0.803 | 0.728 | 1.000 |

*Note: The table reports correlations among the excess bond premia by region. The Latin American and emerging market EBPs are estimated using the procedure outlined above. The U.S. EBP is the updated measure from Gilchrist and Zakrajšek (2012) and the euro area EBP from De Santis (2018).*

correlated, the series differ in magnitude. The standard deviation for the Latin American excess bond premium is about 2.5 times higher than that of the U.S. during this time period. Figure A.4 Panel (b) shows estimates by country for the three largest countries in our Latin America sample, where we use country-by-time fixed effects in Equation (A.3).

**Alternative excess bond premium measurement** We consider robustness to our measurement of the excess bond premium by altering the first-stage relationship between risk and spreads in Equation (A.1) or adjusting the second-stage fixed effects in Equation (A.3). First, we estimate three additional versions of the excess bond premium, in which we allow for the possibility that distance to default affects bond spreads nonlinearly or heterogeneously

by country or firm rating. For the nonlinear specification, we modify Equation (A.1) to include distance to default squared,

$$\log S_{ijkt} = \beta \text{dd}_{jkt} + \omega \text{dd}_{jkt}^2 + \gamma' \boldsymbol{Z}_{it} + \epsilon_{ijkt}. \tag{A.4}$$

Next, we allow heterogeneous effects by firm credit ratings,

$$\log S_{ijkt} = \alpha_l + \beta_l \text{dd}_{jkt} + \gamma' \boldsymbol{Z}_{it} + \epsilon_{ijkt}, \tag{A.5}$$

where $l$ are indices for the following rating groups: no rating, rating below investment grade, and rating investment grade or higher. Finally, we allow heterogeneous effects by country, $k$,

$$\log S_{ijkt} = \alpha_k + \beta_k \text{dd}_{jkt} + \gamma' \boldsymbol{Z}_{it} + \epsilon_{ijkt}. \tag{A.6}$$

The results for Equations (A.4)–(A.6) are reported in Tables A.11 and A.12 for the Latin America sample. Allowing nonlinearity and heterogeneity by credit ratings both improve the fit of the model similarly, increasing the $R^2$ from 0.51 to 0.53 or 0.56. For the ratings heterogeneity specification, the addition of ratings is more important than the interaction with distance to default. Adding heterogeneous interaction terms and country fixed effects improves the fit of the model substantially, from an $R^2$ of 0.51 to 0.61.

Figure A.5 Panel (a) shows the estimates of the regional excess bond premium with alternative first-stage relationships between corporate bond spreads and risk, given by Equations (A.4)–(A.6). Panel (b) shows variations in which the country-level fixed effects in Equation (A.3) are replaced with either firm-level or bond-level fixed effects. Across the specifications, second-stage results look remarkably similar to the baseline.

### A.4. Additional Results

The heterogeneity in investment dynamics following changes in the excess bond premium documented in our main analysis is robust across several alternative specifications. Table 1 summarizes these exercises, and this section provides complete details. The numbering below follows the order of the main body of the empirical section and each line of the table is described within the relevant subsection.

**Table A.11:** Credit Spreads and Distance to Default: Alternative Specifications

| | (1) Baseline | (2) Non-linear | (3) Rating heterogeneity |
|---|---|---|---|
| DD | -0.054*** | -0.127*** | -0.053*** |
| | (0.012) | (0.027) | (0.012) |
| DD squared | | 0.004*** | |
| | | (0.001) | |
| Inv grade × DD | | | -0.009 |
| | | | (0.021) |
| Any rating × DD | | | 0.010 |
| | | | (0.018) |
| Inv grade | | | -0.418*** |
| | | | (0.150) |
| Any rating | | | -0.047 |
| | | | (0.128) |
| $N$ | 3698 | 3698 | 3698 |
| $R^2$ | 0.508 | 0.531 | 0.561 |
| Root MSE | 0.482 | 0.471 | 0.456 |
| Number of firms | 65 | 65 | 65 |
| Number of bonds | 241 | 241 | 241 |

Standard errors in parentheses
* $p < .1$, ** $p < .05$, *** $p < .01$

*Note: Sample period: 1997.Q2–2021.Q1. Countries include Argentina, Brazil, Chile, Colombia, Mexico, and Peru. The table reports the results for estimating Equations (A.4) and (A.5), which allow for nonlinearity and heterogeneity by credit ratings in the first stage of our excess bond premium estimation, relative to our baseline estimates of Equation (A.1). The dependent variable is* $\log S_{ijkt}$*, the log of the corporate bond spread for bond* $i$ *issued by firm* $j$ *in country* $k$ *and quarter* $t$*. The model includes fixed effects by industry and controls for duration, amount issued, coupon rate, and age of issue, all measured in logs. Standard errors are clustered by firm and quarter.*

### A.4.1. Alternative Controls

In this section, we provide additional details for robustness to alternative specifications of the control variables in Equation (1), summarized in Table 1 Panel (b). Figures A.6 and A.7 show the full path of estimated coefficients across alternative specifications for the control variables defined below.

**Table A.12:** Credit Spreads and Distance to Default: Heterogeneity by Country

| | (1) Baseline | (2) Country heterogeneity |
|---|---|---|
| Distance to default | -0.054*** | |
| | (0.012) | |
| Argentina × Distance to default | | -0.103*** |
| | | (0.020) |
| Brazil × Distance to default | | -0.022 |
| | | (0.014) |
| Chile × Distance to default | | -0.044*** |
| | | (0.013) |
| Colombia × Distance to default | | -0.050*** |
| | | (0.006) |
| Mexico × Distance to default | | -0.054** |
| | | (0.022) |
| Peru × Distance to default | | 0.009 |
| | | (0.019) |
| Observations | 3698 | 3698 |
| $R^2$ | 0.508 | 0.613 |
| Root MSE | 0.482 | 0.430 |
| Number of firms | 65 | 65 |
| Number of bonds | 241 | 241 |

Standard errors in parentheses
* $p < .1$, ** $p < .05$, *** $p < .01$

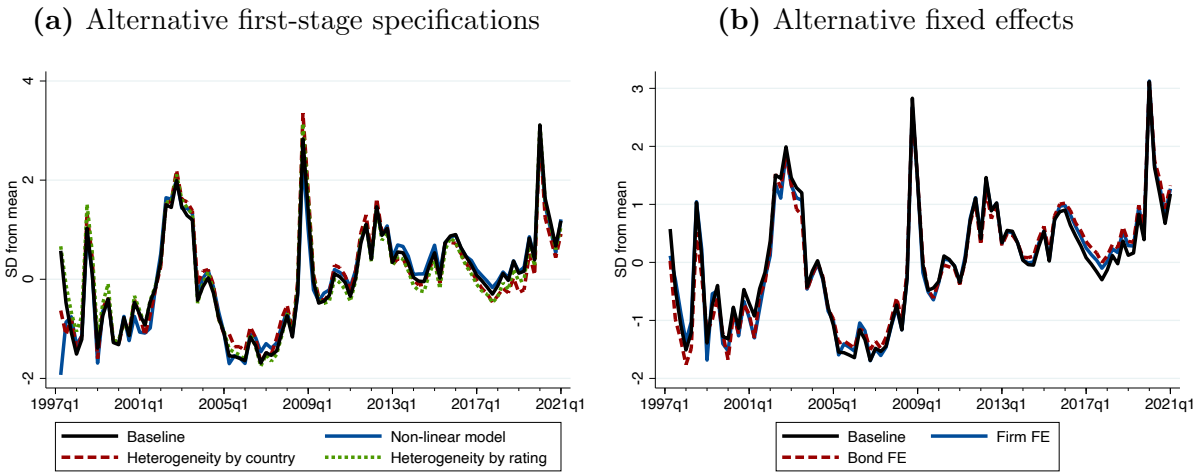
*Note: Sample period: 1997.Q2–2021.Q1. Countries include Argentina, Brazil, Chile, Colombia, Mexico, and Peru. The table shows the estimated coefficients of Equation (A.6), which allows for heterogeneity by country in the first stage of our excess bond premium estimation, relative to our baseline estimates. The dependent variable is* $\log S_{ijkt}$*, the log of the corporate bond spread for bond* $i$ *issued by firm* $j$ *in country* $k$ *and quarter* $t$*. The model includes fixed effects by industry and controls for duration, amount issued, coupon rate, and age of issue, all measured in logs. Standard errors are clustered by firm and quarter.*

**Without time fixed effects** We drop industry-by-time fixed effects and add aggregate controls, $\rho_t$ and $X_t$. The coefficients on $\rho_t$ are reported in Panel (b) of Figure 3. The coefficients on $\rho_t \times \mathrm{dr}_{jt-1}$ from the same regression are shown in Figure A.6 Panel (a).

**With alternative time fixed effects** We replace industry-by-time fixed effects with country-by-time fixed effects. Results are shown in Figure A.6 Panel (b).

**Without aggregate controls** We remove aggregate controls interacted with distance to default, $X_t \times \mathrm{dr}_{jt-1}$. Results are shown in Figure A.7 Panel (b).

**Figure A.5:** Excess Bond Premium: Alternative Specifications




*Note: Panel (a) shows our baseline estimate of the excess bond premium ($\rho_t$) for the Latin America sample and alternative estimates that vary the first-stage relationship between spreads and distance to default. Equations (A.4)–(A.6) show the first-stage specifications used to allow for nonlinearity, heterogeneity by rating, and heterogeneity by country in the relationship between distance to default and bond spreads. Panel (b) shows estimates of specifications that replace country-level fixed effects in the second-stage Equation (A.3) with either firm-level or bond-level fixed effects. The units are standard deviations from the mean and the frequency is quarterly.*

**Without firms' characteristics** We remove all lagged firm-level characteristics $Z_{jt-1}$ except for distance to default. Results are shown in Figure A.7 Panel (c).

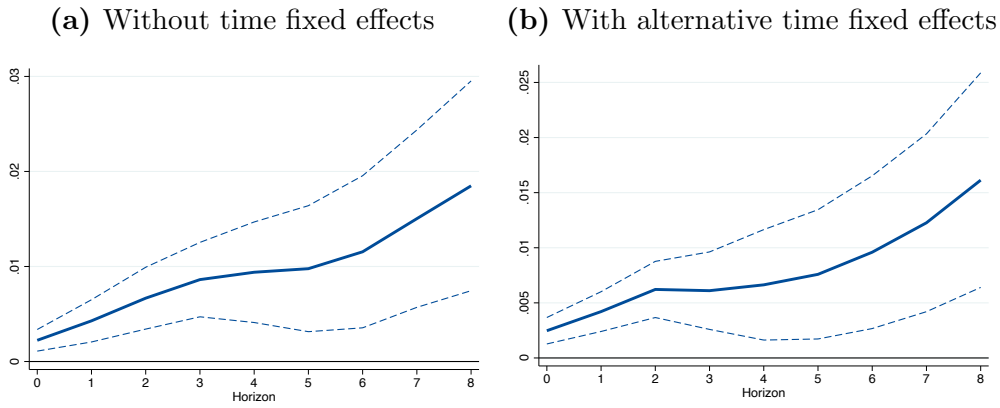
**Interaction of firms' risk with other U.S. variables** We expand the set of aggregate controls, $X_t$, to include the Fed funds rate and U.S. inflation, which are additional U.S. variables that could be correlated with the excess bond premium. Results are shown in Figure A.7 Panel (d).

**Interaction of $\rho_t$ with firms' characteristics** We expand the interactions of aggregate covariates, $\rho_t$ and $X_t$, to include additional firm-level characteristics besides distance to default. We include lagged size, sales growth, and capital growth as the set of interacted covariates. Results are shown in Figure A.7 Panel (e).

**Interaction of firms' risk with characteristics** We modify Equation (1) to include interactions between firm-level covariates and distance to default, $\text{dr}_{jt-1}$. For consistency, we use the same firm-level characteristics as the previous line: size, sales growth, and capital

growth. Results are shown in Figure A.7 Panel (f).

**Figure A.6:** Heterogeneous Investment Dynamics Following Changes in the EBP: Alternative Time Controls




*Note: The figure shows coefficient estimates from Equation (1) without industry-by-time fixed effects. Panel (a) introduces controls for aggregate variables, $\rho_t$ and $X_t$. Panel (b) introduces country-by-time fixed effects. All other controls are the same as the main specification shown in Figure 3. Coefficients can be interpreted as the effect of a one-standard-deviation lower risk on the cumulative log change in capital stock in response to the excess bond premium in period t. The x-axes show the horizon h (quarterly frequency).*

### A.4.2. Alternative Measures of Firms' Default Risk

We evaluate robustness to our measure of firms' default risk in Equation (1) using four alternative measures. Table 1 Panel (c) summarizes the results. All variables are defined in such a way that a positive coefficient on the interaction term, $\rho_t \times \mathrm{dr}_{jt-1}$, can be interpreted as the differential cumulative change in investment for firms with *lower* default risk. Definitions of each measure of firms' default risk are provided below. Figure A.8 shows the full path of estimated coefficients across measures.

**Distance-to-default dummy** We construct a binary measure of low-risk firms defined as firm-quarter observations with distance to default above the 90th percentile. Results are shown in Figure A.8 Panel (a).

**Investment-grade dummy** We construct a binary indicator for firms with investment-grade or higher credit ratings (BBB-). These constitute 5% of firm-quarter observations in our sample. Firms with ratings below investment grade and firms for which we do not have

credit-ratings data are coded as zero. See Appendix A for details about the credit ratings data and merging process. Results are shown in Figure A.8 Panel (b).

**Credit rating** We construct a continuous indicator for firms' credit ratings, where each step is assigned an integer and we standardize the units such that a one-standard-deviation increase in continuous credit rating is associated with a more favorable rating. We include observations for which we do not have ratings data with a dummy variable for whether we observe the rating or not. Results are shown in Figure A.8 Panel (c).

**Leverage (sign flipped)** We measure default risk using leverage, measured in standard deviations, where the sign is flipped such that it aligns with the direction of distance to default. Results are shown in Figure A.8 Panel (d).

### A.4.3. Alternative Measures of the Excess Bond Premium

We explore robustness to the measure of $\rho_t$ in Equation (1).

**EBP with heterogeneity by country** We modify the procedure for estimating the excess bond premium to allow for firms' default risk to load heterogeneously onto credit spreads by country. Appendix A.3 provides the details of the specification and results. Table A.12 reports the coefficients on distance to default from this first-stage regression given by Equation (A.6). Figure A.5 reports the resulting excess bond premium measure, which is highly correlated with the baseline. Figure A.9 Panel (a) shows the effects on investment using this measure of $\rho_t$ in Equation (1).

**EBP with heterogeneity by rating** We modify the procedure for estimating the excess bond premium to incorporate data on credit ratings in addition to distance to default. Equation (A.5) adds controls for firms' credit ratings and interacts them with distance to default to provide a richer measure of firms' default risk. Table A.11 reports the regression coefficients and Figure A.5 reports the resulting excess bond premium measure, which is also highly correlated with the baseline. Figure A.9 Panel (b) shows the effects on investment using this measure of $\rho_t$ in Equation (1).

**Regional VIX** We consider the Brazilian VIX as an alternative measure of $\rho_t$. This measure is available starting in 2011.Q1, so these regressions reflect a smaller sample than our baseline. Figure A.9 Panel (c) shows the effects on investment using this measure of $\rho_t$ in Equation (1).

**Emerging market EBP** We estimate the excess bond premium using the full sample of emerging markets. Figure 2 Panel (a) compares the excess bond premium measures across regions and Table A.10 reports correlations. Figure A.9 Panel (d) shows the effects on investment using this measure of $\rho_t$ in Equation (1).

**U.S. EBP** We replace the regional excess bond premium with the U.S. excess bond premium, also shown in Figure 2 Panel (a) and Table A.10. Figure A.10 Panel (a) shows the effects on investment using this measure of $\rho_t$ in Equation (1).

**U.S. financial shocks** Finally, we use the high-frequency U.S. financial shocks from Ottonello and Song (2025) as an identified measure of fluctuations in global intermediaries' risk-bearing capacity. These shocks capture unexpected changes in the net worth of U.S. financial intermediaries, measured by high-frequency changes in their market value. We first aggregate daily shocks into a quarterly measure by summing all shocks within the quarter. We then multiply them by $-1$, so that positive values correspond to tighter financial conditions, and standardize the resulting quarterly series. Since these shocks are identified at high frequency, we omit the controls for U.S. conditions. Results are shown in Figure A.10 Panel (b).

### A.4.4. Alternative Samples

This section reports results using different subsamples of our data or using different sets of countries.

**By sector** We fully interact the controls in Equation (1) with dummy variables for tradable or nontradable sectors (interacted controls are firms' characteristics, $Z_{jt-1}$, firms' default risk, $\text{dr}_{jt-1}$, and interactions of $\text{dr}_{jt-1}$ with $\rho_t$ and $X_t$). Sectors are defined in Appendix A.2 and

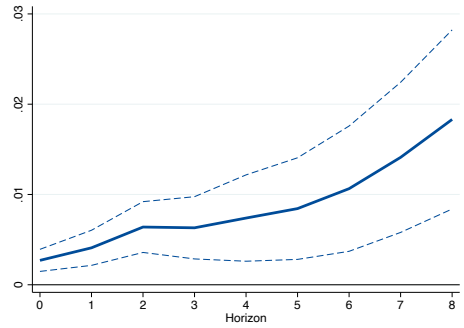
exclude the construction industry and a small set of firms with unclassified industries. Figure A.11 reports the coefficients on distance to default interacted with the excess bond premium by sector.

**By exchange rate regime** We fully interact the controls in Equation (1) with dummy variables for flexible or fixed exchange rate regimes (interacted controls are firms' characteristics, $Z_{jt-1}$, firms' default risk, $\text{dr}_{jt-1}$, and interactions of $\text{dr}_{jt-1}$ with $\rho_t$ and $X_t$). Exchange rate regimes are defined as in Ilzetzki, Reinhart and Rogoff (2019, 2022). Fixed regimes are defined using coarse classifications 1 (peg) or 2 (crawling peg or narrow band), while flexible regimes are defined using coarse classifications 3 (managed floating) or 4 (freely floating). Freely falling regimes (coarse classification 5) are omitted. The fixed regimes in our sample are Argentina 2004.Q3–2015.Q3 and Peru 2000.Q2–2002.Q4 and 2012.Q3–2019.Q4. Figure A.12 reports the coefficients on distance to default interacted with the excess bond premium by exchange rate regime.

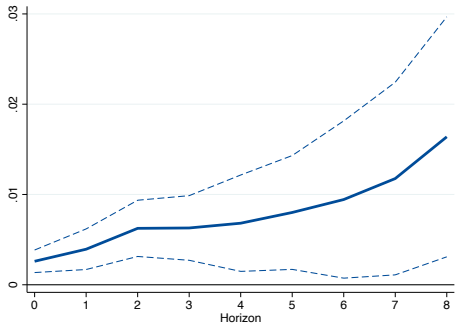
**By region** Finally, we estimate Equation (1) on the full sample of emerging markets and the set of advanced European economies. Figure A.13 shows the results. For the emerging market sample, we address regional heterogeneity across the full sample of countries by including region-by-industry-by-time fixed effects and interacting the aggregate control variables separately by region (Latin America, Asia, and other). Emerging market countries are Argentina, Brazil, Chile, Colombia, India, Korea, Mexico, Peru, the Philippines, Thailand, Turkey, and Ukraine. Advanced European economies are Austria, Belgium, Germany, Denmark, Spain, Finland, France, the U.K., Greece, Italy, the Netherlands, Poland, Portugal, and Sweden. Summary statistics for each sample are shown in Appendix Tables A.3 and A.4. Regional excess bond premia are defined in Appendix A.3.

**Figure A.7:** Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium: Alternative Controls

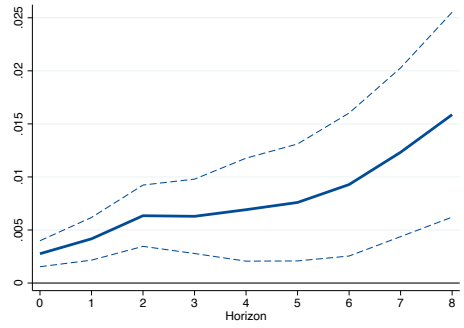
**(a)** Baseline



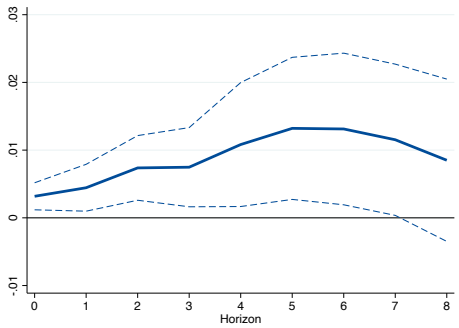

**(b)** Without aggregate controls



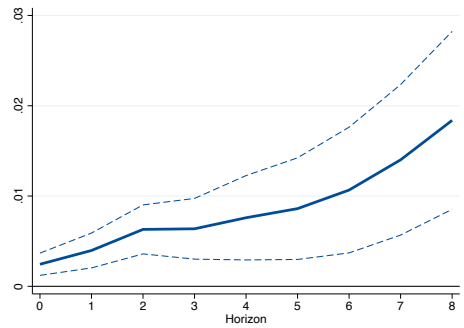

**(c)** Without firms' characteristics



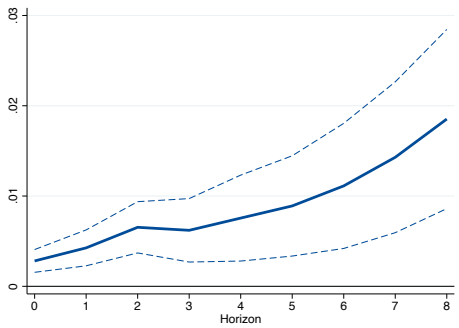

**(d)** Interaction of firms' risk with other U.S. variables




**(e)** Interaction of $\rho_t$ with firms' characteristics




**(f)** Interaction of firms' risk with characteristics

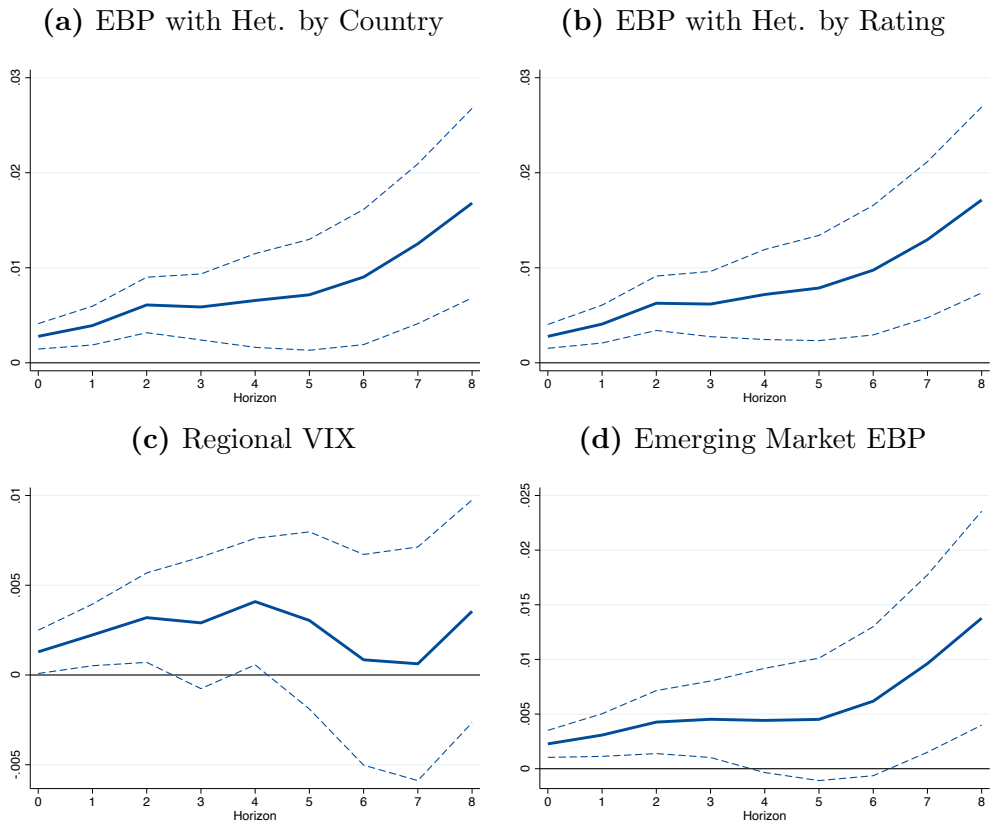



*Note: The figure shows the $\beta_h$ coefficient estimates from Equation (1), which correspond to the relative cumulative log change in capital stock in response to the excess bond premium in period t for firms with one-standard-deviation lower risk. Panel (a) includes controls for firms' characteristics, $Z_{jt}$, and aggregate conditions, $X_t$, interacted with firms' risk, as defined in the main text; Panel (b) removes aggregate controls, $X_t$; Panel (c) removes firms' characteristics, $Z_{jt}$; Panel (d) expands the set of aggregate conditions, $X_t$, to include U.S. inflation and the federal funds rate; Panel (e) interacts $\rho_t$ and $X_t$ with controls for lagged size, sales growth, and capital growth; Panel (f) interacts these same controls with firms' risk, $dr_{jt}$. The x-axes show the horizon h (quarterly frequency).*

**Figure A.8:** Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium: Alternative Measures of Firms' Risk

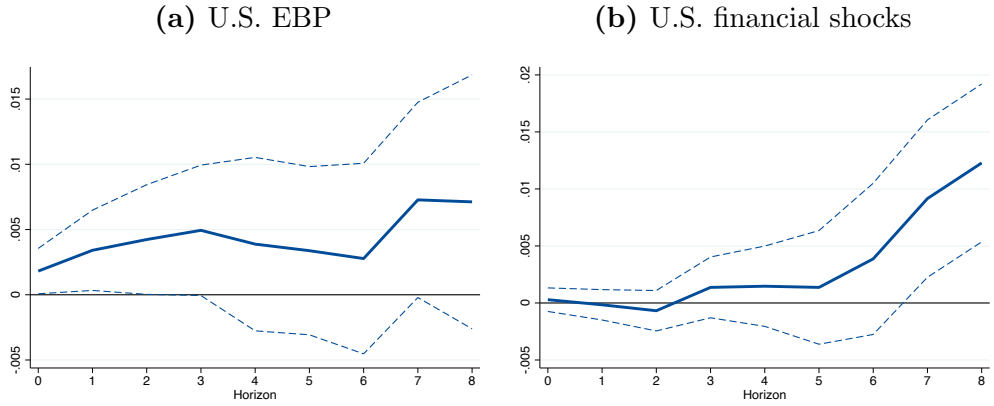
*Note: The figure shows coefficient estimates from Equation (1) with alternative definitions of firm risk. Coefficients can be interpreted as the relative cumulative log change in capital stock in response to the excess bond premium shock for: Panel (a), firms with distance to default above the 90th percentile; Panel (b), firms with investment-grade credit ratings or higher; Panel (c), firms with one-standard-deviation higher continuous credit ratings; Panel (d), firms with one-standard-deviation lower leverage. The x-axes show the horizon h (quarterly frequency). Controls are the same as the main specification shown in Figure 3 with controls for distance to default replaced with the risk measure labeled.*

**Figure A.9:** Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium: Alternative EBP Measures



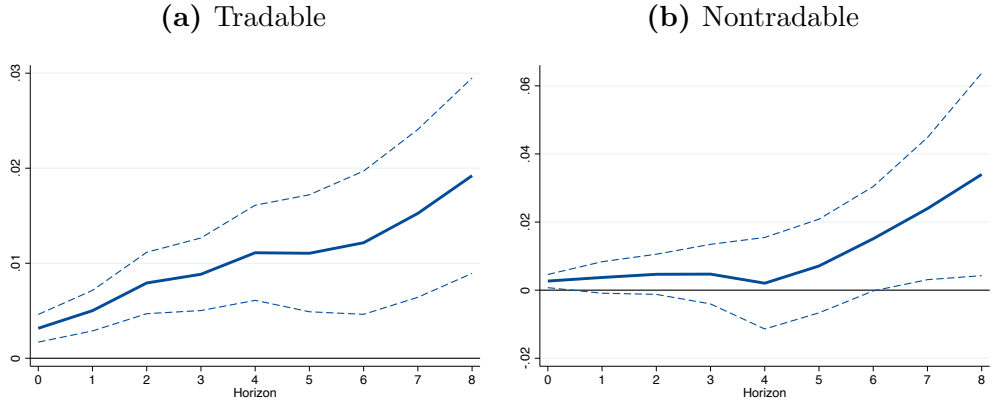

*Note: The figure shows coefficient estimates from Equation (1) with alternative measures of $\rho_t$. Coefficients can be interpreted as the effect of a one-standard-deviation lower risk on the cumulative log change in capital stock in response to the variable labeled: Panels (a) and (b) are the excess bond premium calculated by allowing heterogeneous loadings of distance to default on spreads by country or credit rating. Panel (c) is the regional VIX for Brazil. Panel (d) is the excess bond premium estimated on the full sample of emerging markets. The x-axes show the horizon h (quarterly frequency). Controls are the same as the main specification shown in Figure 3.*

**Figure A.10:** Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium: U.S. Data



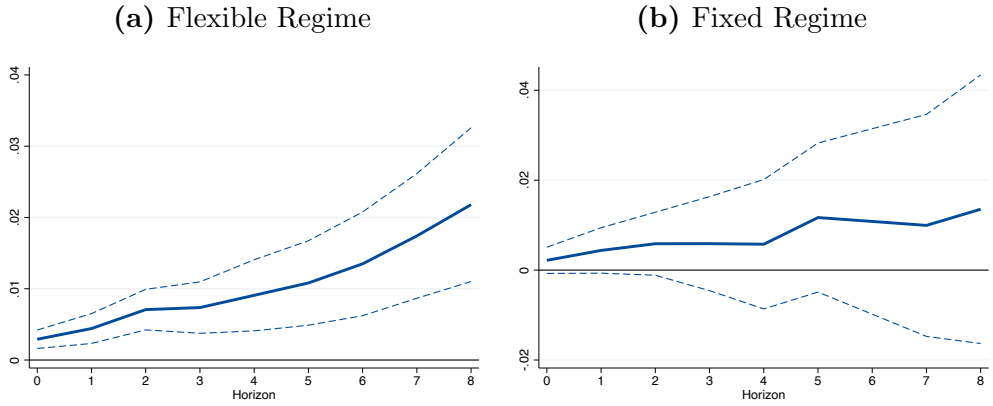

*Note: The figure shows coefficient estimates from Equation (1) with $\rho_t$ measured using U.S. data. Coefficients can be interpreted as the effect of a one-standard-deviation lower risk on the cumulative log change in capital stock in response to the variable labeled: Panel (a) is the U.S. excess bond premium; Panel (b) is U.S. financial shocks from Ottonello and Song (2025). The x-axes show the horizon h (quarterly frequency). Firm-level controls are the same as the main specification shown in Figure 3. Panel (b) omits controls for aggregate conditions interacted with firms' risk.*

**Figure A.11:** Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium across Sectors



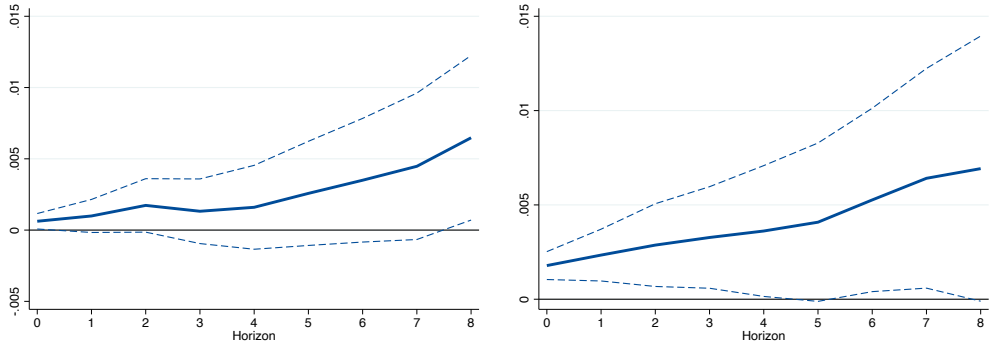

*Note: The figure shows the estimated $\beta_h$ coefficients from Equation (1) with additional interactions between the excess bond premium and firms' risk and sector. Coefficients correspond to the relative cumulative log change in capital stock in response to the excess bond premium in period t for firms with one-standard-deviation lower risk, within each sector. The x-axes show the horizon h (quarterly frequency). Controls are the same as the main specification shown in Figure 3 with firms' characteristics and distance to default fully interacted with sector.*

**Figure A.12:** Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium across Exchange Rate Regimes




*Note: The figure shows the estimated $\beta_h$ coefficients from Equation (1) with additional interactions between the excess bond premium and firms' risk and exchange rate regime. Coefficients correspond to the relative cumulative log change in capital stock in response to the excess bond premium in period t for firms with one-standard-deviation lower risk, conditional on exchange rate regime in period t. The x-axes show the horizon h (quarterly frequency). Controls are the same as the main specification shown in Figure 3 with firms' characteristics and distance to default fully interacted with exchange rate regime.*

**Figure A.13:** Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium: Alternative Regions




*Note: The figure shows the estimated $\beta_h$ coefficients from Equation (1), estimated using the full sample of emerging markets or the advanced European economies. Coefficients correspond to the relative cumulative log change in capital stock in response to the regional excess bond premium in period t for firms with one-standard-deviation lower risk, measured with distance to default. The x-axes show the horizon h (quarterly frequency). Controls are the same as the main specification shown in Figure 3. Panel (a) includes additional region-by-industry-by-time fixed effects and interactions between region and aggregate controls, $X_t$. Regions are defined as Latin America, Asia, and other.*

# B. Model Appendix

## B.1. Firms' Recursive Problem

A firm's state vector is $(k, b, z, \boldsymbol{S})$, where $\boldsymbol{S}$ denotes the aggregate state. This state includes the firm distribution, $\Omega$, aggregate productivity, and the global price of risk. Conditional on continuing operations, the equity value of a firm, expressed in units of the consumption bundle, solves

$$V^{\text{cont}}(k, b, z, \boldsymbol{S}) = \max_{k', b'} \; d - \mathcal{C}(d) + \mathbb{E}_{\left(z', \boldsymbol{S}', \epsilon'_{\text{exit}}\right)|(z, \boldsymbol{S})} \left[\Lambda(\boldsymbol{S}, \boldsymbol{S'}) \; V(k', b', z', \boldsymbol{S'}, \epsilon'_{\text{exit}})\right] \quad \text{(B.1)}$$

$$\text{s.t. } d = \pi(k, z, \boldsymbol{S}) - p_k(\boldsymbol{S}) I(k', k) + \varepsilon(\boldsymbol{S}) \Delta\mathcal{B}^{\star}(b', b, \boldsymbol{S})$$

$$\boldsymbol{S'} = \Upsilon(\boldsymbol{S}),$$

where $\Lambda(\boldsymbol{S}, \boldsymbol{S'})$ denotes households' stochastic discount factor and $\Upsilon(\boldsymbol{S})$ denotes the conjectured law of motion for aggregate states and for the firm distribution, $\Omega$. The equity-issuance cost $\mathcal{C}(d)$, investment expenditure $I(k', k)$, and net debt proceeds $\Delta\mathcal{B}^{\star}(b', b, \boldsymbol{S})$ are defined in Section 3.1.[18]

After production, the firm observes the exit shock $\epsilon_{\text{exit}}$ and chooses whether to exit or continue operations. We assume $\epsilon_{\text{exit}} \sim_{iid} N(0, \sigma^2_{\text{exit}})$. The firm continues whenever $V^{\text{cont}}(k, b, z, \boldsymbol{S}) \geq \epsilon_{\text{exit}}$ and exits otherwise. Its value is $V^{\text{cont}}(k, b, z, \boldsymbol{S})$ if it continues and zero if it exits. Before the shock is realized, the firm's value is therefore $V(k, b, z, \boldsymbol{S}) = \mathbb{E}_{\epsilon_{\text{exit}}}\left[V(k, b, z, \boldsymbol{S}, \epsilon_{\text{exit}})\right] = \left[1 - h(k, b, z, \boldsymbol{S})\right] V^{\text{cont}}(k, b, z, \boldsymbol{S})$, where the exit probability is

$$h(k, b, z, \boldsymbol{S}) = \int_{V^{\text{cont}}(k, b, z, \boldsymbol{S})}^{\infty} \mathrm{d}\Phi_{\epsilon}(\epsilon_{\text{exit}}) = 1 - \Phi_{\epsilon}\left(V^{\text{cont}}(k, b, z, \boldsymbol{S})\right), \quad \text{(B.2)}$$

where $\Phi_{\epsilon}(\epsilon_{\text{exit}})$ is the cumulative distribution function of a normal distribution with zero mean and standard deviation $\sigma_{\text{exit}}$. If the firm exits, it liquidates its assets after production and permanently leaves the economy. Exiting firms are replaced by an equal mass of entrants. Entrants begin with a common initial state $(k_0, b_0, z_0)$, where $k_0$ is calibrated as described in Section 4.1, $b_0 \approx 0$, and $z_0$ is set below average productivity to capture the low measured productivity of young firms.

[18] Both investment and debt are subject to adjustment costs, as specified in Section 3.1. For firms with little debt, we normalize the debt adjustment cost in $\Delta\mathcal{B}^{\star}$ by $\max\{b, 0.05\,k\}$ rather than $b$, so that it remains well defined.

Given a firm's current choices of $k'$ and $b'$, its debt-price schedule is

$$q^{\star}\left(k', b', z, \boldsymbol{S}\right) = \mathbb{E}_{(z', \boldsymbol{S}')|(z, \boldsymbol{S})}\left[\Lambda^{\star}(\boldsymbol{S}, \boldsymbol{S}')\mathcal{R}\left(k', b', z', \boldsymbol{S}'\right)\right], \tag{B.3}$$

where $\Lambda^{\star}(\boldsymbol{S}, \boldsymbol{S}')$ is the global investors' stochastic discount factor, and $\mathcal{R}\left(k', b', z', \boldsymbol{S}'\right)$ is the value of the debt claim next period. This value depends on whether the firm continues operations or exits:

$$\mathcal{R}\left(k', b', z', \boldsymbol{S}'\right) \equiv \left[1 - h\left(k', b', z', \boldsymbol{S}'\right)\right] \mathcal{R}^{\text{cont}}\left(k', b', z', \boldsymbol{S}'\right) + h\left(k', b', z', \boldsymbol{S}'\right) \mathcal{R}^{\text{exit}}\left(k', b', z', \boldsymbol{S}'\right), \tag{B.4}$$

where $\mathcal{R}^{\text{cont}}(k', b', z', \boldsymbol{S}') \equiv (1 - m)\left(\upsilon + q^{\star}\left(k'', b'', z', \boldsymbol{S}'\right)\right) + m$ denotes the value of the debt claim if the firm continues operations. This value depends on the next-period bond price, which is a function of the firm's next-period choices $k'' \equiv k'(k', b', z', \boldsymbol{S}')$ and $b'' \equiv b'(k', b', z', \boldsymbol{S}')$. In the event of exit, lenders' recovery value, expressed in foreign-currency units, is

$$\mathcal{R}^{\text{exit}}\left(k, b, z, \boldsymbol{S}\right) = \lambda \frac{\pi\left(k, z, \boldsymbol{S}\right) + (1 - \delta)\, k\, p_k\left(\boldsymbol{S}\right)}{b} \frac{1}{\varepsilon(\boldsymbol{S})}, \tag{B.5}$$

where $\lambda$ captures the share of resources recovered by the lender. In our numerical solution, we cap this recovery at $\overline{\mathcal{R}} = \tilde{q}^{\text{face}}$, defined in Section 3.2, so that lenders recover at most the value of their claim.

### B.2. Definition of Equilibrium

***Definition* 1.** *Let $\boldsymbol{S} = (A, \kappa, \Omega)$ denote the aggregate state, where $A$ is global productivity, $\kappa$ is the global price of risk, and $\Omega$ is the distribution of firms across the idiosyncratic states $(k, b, z)$. Let $\Omega^{cont}$ and $\Omega^{exit}$ denote the distributions of continuing and exiting firms, respectively. Given a nominal exchange rate policy, a recursive competitive equilibrium is a set of*

1. *Value functions for firms $\{V(k, b, z, \boldsymbol{S}), V^{cont}(k, b, z, \boldsymbol{S})\}$,*
2. *Policy functions $\{k'(k, b, z, \boldsymbol{S}), b'(k, b, z, \boldsymbol{S}), h(k, b, z, \boldsymbol{S}), l^d(k, b, z, \boldsymbol{S}), l^s(\boldsymbol{S}), c(\boldsymbol{S})\}$,*
3. *A bond-pricing kernel $q^{\star}\left(., \boldsymbol{S}\right)$,*
4. *A real wage $w\left(\boldsymbol{S}\right) = W\left(\boldsymbol{S}\right)/P\left(\boldsymbol{S}\right)$ and a real exchange rate $\varepsilon\left(\boldsymbol{S}\right) = \xi\left(\boldsymbol{S}\right)/P\left(\boldsymbol{S}\right)$,*
5. *A conjectured law of motion for the aggregates $\Upsilon\left(\boldsymbol{S}\right)$,*

*such that:*

*i Given prices and the perceived $\Upsilon\left(\boldsymbol{S}\right)$, $l^d\left(., \boldsymbol{S}\right)$ is given by Equation (4); the policies $\{k'\left(., \boldsymbol{S}\right), b'\left(., \boldsymbol{S}\right), h\left(., \boldsymbol{S}\right)\}$ solve the maximization problem in Equation (B.1); and $V\left(., \boldsymbol{S}\right)$ and $V^{cont}\left(., \boldsymbol{S}\right)$ are the associated value functions.*

*ii* *Given firms' optimal policies, the bond-pricing kernel* $q^{\star}(.,\boldsymbol{S})$ *satisfies Equation* (B.3).

*iii* *Given prices and* $\Upsilon(\boldsymbol{S})$, $\{c(\boldsymbol{S}), l^{s}(\boldsymbol{S})\}$ *solve the households' problem, as defined in Equations* (14)–(15).

*iv* *The conjectured law of motion* $\Upsilon(\boldsymbol{S})$ *is consistent with agents' policies.*

*v* *The H-good market clears:*

$$Y(\boldsymbol{S}) = I_H(\boldsymbol{S}) + c_H(\boldsymbol{S}) + c_H^{\star}(\boldsymbol{S}) + Q(\boldsymbol{S}),$$

*where* $Y(\boldsymbol{S})$ *denotes aggregate output,* $Y(\boldsymbol{S}) = \int y(.,\boldsymbol{S})\, \mathrm{d}\Omega(.,\boldsymbol{S})$, *and* $y(.,\boldsymbol{S})$ *is defined in Equation* (2).[19] *The terms* $I_H(\boldsymbol{S})$ *and* $Q(\boldsymbol{S})$ *denote, respectively, the home-good component of investment and the additional resource costs associated with capital adjustment and external equity issuance. The terms* $c_H(\boldsymbol{S})$ *and* $c_H^{\star}(\boldsymbol{S})$ *denote domestic and foreign demand for the home good. Appendix B.4 defines each of these objects.*

*vi* *The balance of payments is satisfied:*

$$Y(\boldsymbol{S}) - I_H(\boldsymbol{S}) - Q(\boldsymbol{S}) - \frac{P(\boldsymbol{S})}{P_H(\boldsymbol{S})} c(\boldsymbol{S}) = -\frac{\xi(\boldsymbol{S})}{P_H(\boldsymbol{S})} \left[ \int \Delta\mathcal{B}^{\star}(.,\boldsymbol{S})\, \mathrm{d}\Omega^{\mathrm{cont}} - \int \mathcal{R}^{\mathrm{exit}}(.,\boldsymbol{S})\, b(.)\, \mathrm{d}\Omega^{\mathrm{exit}} \right],$$

*where* $\Delta\mathcal{B}^{\star}(.,\boldsymbol{S})$ *denotes net debt proceeds from the rest of the world for continuing firms, as defined in Equation* (6), *and* $\int \mathcal{R}^{exit}(.,\boldsymbol{S})\, b(.)\, d\Omega^{exit}$ *denotes the payments of exiting firms, where* $\mathcal{R}^{exit}(.,\boldsymbol{S})$ *is defined in Equation* (B.5).

*vii* *The condition* $l^{d}(\boldsymbol{S}) \leq l^{s}(\boldsymbol{S})$ *and the slackness condition of Equation* (20) *are both satisfied.*

### B.3. Computational Algorithm

In our model, firms' quantity of risk is endogenous and depends on general-equilibrium prices. Changes in wages, in the relative price of capital, and in the real exchange rate affect firms' default decisions and the value of their repayments in each aggregate state.

To preserve these nonlinearities, we solve the model with global methods and approximate the distribution of firms with a small set of aggregate state variables. Given these aggregate states, we solve for firms' policies, default decisions, and bond-price schedules over the entire state space. The only linear element of the solution is the law of motion that

[19] The timing assumption is such that firms that exit at time $t$ produce in that period and then leave the economy.

firms use to forecast future prices. The dependence of repayment risk on firms' states and on current prices is fully nonlinear.

The aggregate state can be written as $\boldsymbol{S} \equiv (A, \kappa, \Omega)$, where $\boldsymbol{s} = (A, \kappa)$ denotes the exogenous aggregate state and $\Omega$ denotes the distribution of firms across the idiosyncratic states $(k, b, z)$. Following Krusell and Smith (1998), we replace the distribution of firms with a small set of statistics that summarize it. The distribution matters for firms' decisions because it determines aggregate quantities and prices. First, let

$$\tilde{K}_t \equiv \int z_{i,t} \left(k_{i,t}\right)^{\frac{\alpha\chi}{\varsigma}} \, \mathrm{d}i$$

denote the economy's production capacity. This statistic is the productivity-weighted capital stock that determines aggregate output and labor demand, and therefore wages. Second, we use the economy's exports,

$$Z_t = \left(\frac{\xi_t}{P_{H,t}}\right)^{\eta} c^{\star},$$

as an additional aggregate state. $Z_t$ is an equilibrium object that is determined within the period. We nonetheless include it as a co-state in firms' problem, and in the simulation we solve for the value of $Z_t$ that clears the $H$-good market. Given $(A_t, \kappa_t, \tilde{K}_t, Z_t)$ and the conjectured law of motion for future aggregates, we can compute wages, the real exchange rate, the relative price of capital, and the other prices that enter firms' choices. Appendix B.4 describes this aggregate block in detail.

The co-states $(\tilde{K}_t, Z_t)$ contain the information about the firm distribution that firms use when forecasting aggregate prices and quantities. Other moments of the distribution, such as average leverage or the cross-sectional dispersion of capital, could in principle improve the forecast of $(\tilde{K}_{t+1}, Z_{t+1})$. To keep the solution tractable, however, we assume that firms forecast $(\tilde{K}_{t+1}, Z_{t+1})$ using only $(A_t, \kappa_t, \tilde{K}_t, Z_t)$ and the realization of next-period aggregate shocks. Let $\tilde{\boldsymbol{S}}_t = \left(A_t, \kappa_t, \tilde{K}_t, Z_t\right)$ denote the reduced aggregate state.

The perceived laws of motion are log-linear. The coefficients of the law of motion for $\tilde{K}_{t+1}$ depend on the current value of $\kappa_t$, and those of the law of motion for $Z_{t+1}$ depend on the transition of $\kappa$ between $t$ and $t+1$. Appendix B.4 states both laws of motion. When estimating the law of motion for $Z_{t+1}$, we use a ridge penalty on the coefficient of $\log A_t$, since $\log A_t$ and $\log Z_t$ are highly collinear in the simulated samples.

The algorithm consists of three main steps. First, we guess the coefficients of the conjectured laws of motion. Given these conjectures, we solve for firms' optimal choices following these sub-steps:

1. Guess the continuation value $V^{\text{cont}}\left(k, b, z, \tilde{\boldsymbol{S}}\right)$ and the bond-price schedule $q\left(k', b', z, \tilde{\boldsymbol{S}}\right)$ for each point of the state space and for each possible choice of $(k', b')$.
2. Taking the bond-price schedule as given, solve the firms' problem and update the value function and policy rules.
3. Using the optimal policies computed in the previous step, update the bond-price schedule implied by lenders' stochastic discount factor and firms' default decisions.
4. Iterate until convergence of both $V^{\text{cont}}(.)$ and $q(.)$.

Since the firms' problem has several non-convexities, we solve it using a global search over firms' choices, implemented on graphics processing units. We evaluate policies on the state grids described below, and compute bond prices and continuation values on finer grids for the choice variables $k'$ and $b'$. For each value of $k'$ on the finer grid, we first find the best value of $b'$ on its finer grid and then refine it off the grid with a local golden-section search, interpolating bond prices and continuation values linearly between grid points. This gives the firm's value associated with each capital choice. Given these values, we then add a small extreme-value (Gumbel) taste shock, with scale $5 \times 10^{-3}$ in units of firm value, to the choice of capital, which smooths the capital policy across neighboring grid points and attenuates the jumps induced by the grid. Capital and debt policies, dividends, and bond prices are then computed as probability-weighted averages across capital choices, and the firm distribution is updated using the resulting average choice $(k', b')$. The continuation value that enters the exit decision is the expected maximum over capital choices implied by the taste shock, which exceeds the maximum only negligibly.

The firm's idiosyncratic productivity process $z$ is discretized using Tauchen's method. Aggregate productivity is represented on a grid for $A$, while its innovations are integrated using a discrete quadrature rule. The global price-of-risk process $\kappa$ is represented by two states. The capital grid is evenly spaced in logs and the leverage grid in levels. The grids for $\tilde{K}$ and $Z$ are centered around their steady-state values, and the interior points of the $Z$ grid are concentrated near the steady state. In the general-equilibrium computations, we

use 30 points for $k$, 20 points for $b$, 11 points for $z$, 9 points for $A$, 7 points for aggregate productivity innovations, 2 points for $\kappa$, 5 points for $\tilde{K}$, and 5 points for $Z$. In total, firms' policies, values, and bond-price schedules are solved over a state space of close to three million grid points.

The last step of the algorithm consists of simulating the economy in order to update the aggregate conjectures. The simulation follows the non-stochastic approach in Young (2010). By updating the distribution of firms directly, this approach avoids the sampling error associated with individual firm simulation. This is important in our model because of the exit decision. With a finite number of simulated firms, small sampling errors in the mass of firms near the exit threshold translate into large swings in the aggregate exit rate and, therefore, in $Z$ and $\tilde{K}$. In each period of the simulation, we update the distribution over $(k, b, z)$ using the firms' policy rules and default decisions. We then solve for the value of $Z_t$ that clears the $H$-good market, which reduces to a one-dimensional problem.

Given the simulated paths for $A_t$, $\kappa_t$, $\tilde{K}_t$, and $Z_t$, we re-estimate the coefficients of the perceived laws of motion for $\tilde{K}_{t+1}$ and $Z_{t+1}$. The updated coefficients are dampened before being used in the next iteration. We repeat the procedure, alternating between solving firms' problem and simulating the economy, until the coefficients of the aggregate laws of motion converge. The final policy functions, bond-price schedules, and laws of motion are then used to construct the impulse responses and counterfactual exercises of Section 4.

### B.4. Aggregate Block

This appendix collects the aggregate equations used in the numerical solution. Let the reduced aggregate state be

$$\tilde{\boldsymbol{S}}_t = (A_t, \kappa_t, \tilde{K}_t, Z_t),$$

where $A_t$ is aggregate productivity, $\kappa_t$ is the global price-of-risk state, $\tilde{K}_t$ is aggregate production capacity, and $Z_t$ denotes exports of the home good. Aggregate production capacity is defined as

$$\tilde{K}_t \equiv \int z_{i,t} k_{i,t}^{\frac{\alpha\chi}{\varsigma}} \, \mathrm{d}i.$$

**Heterogeneous production firms and prices.** Aggregate output of the home good is

$$Y_t = A_t \left( \frac{1-\varsigma}{W_t/P_{H,t}} \right)^{\frac{1-\varsigma}{\varsigma}} \tilde{K}_t.$$

Aggregate labor demand is

$$L_t^d = \left( \frac{1-\varsigma}{W_t/P_{H,t}} \right)^{\frac{1}{\varsigma}} A_t \tilde{K}_t.$$

The relative price of foreign goods in units of the home good is pinned down by foreign demand for the home good, $Z_t = \left(\frac{\xi_t}{P_{H,t}}\right)^{\eta} c^{\star}$. That is,

$$\frac{\xi_t}{P_{H,t}} = \left( \frac{Z_t}{c^{\star}} \right)^{1/\eta}.$$

The CES price index implies

$$\frac{P_t}{P_{H,t}} = \left[ \omega_H + (1-\omega_H) \left( \frac{\xi_t}{P_{H,t}} \right)^{1-\eta} \right]^{\frac{1}{1-\eta}},$$

so that

$$p_{H,t} \equiv \frac{P_{H,t}}{P_t} = \left( \frac{P_t}{P_{H,t}} \right)^{-1}, \qquad \varepsilon_t \equiv \frac{\xi_t}{P_t} = \frac{\xi_t / P_{H,t}}{P_t / P_{H,t}}.$$

The full-employment real wage, expressed in units of the consumption bundle, is

$$w_t^{FE} = \left[ (1-\varsigma)\, p_{H,t} \right]^{\frac{\theta}{\varsigma+\theta}} (\psi_l)^{\frac{\varsigma}{\varsigma+\theta}} \left( A_t \tilde{K}_t \right)^{\frac{\theta\varsigma}{\varsigma+\theta}}.$$

The nominal exchange rate rule interpolates between the full-employment exchange rate and the fixed exchange rate:

$$\xi_t = (1-\varrho) \frac{\bar{W} \varepsilon_t}{w_t^{FE}} + \varrho \xi^{Peg},$$

where $\varrho = 0$ corresponds to the flexible exchange rate case and $\varrho = 1$ to the fixed exchange rate case. The observed real wage is

$$w_t = \max \left\{ w_t^{FE}, \frac{\bar{W}}{\xi_t} \varepsilon_t \right\} \quad \text{so that} \quad \frac{W_t}{P_{H,t}} = \frac{w_t}{p_{H,t}}.$$

Given wages and prices, operating profits of the heterogeneous production firms, in units of the consumption bundle, are

$$\Pi_t = \varsigma p_{H,t} Y_t.$$

**Market clearing.** The home-good market-clearing condition is

$$Y_t = C_{H,t} + I_{H,t} + Z_t + Q_t,$$

where $C_{H,t}$ and $I_{H,t}$ denote domestic consumption and investment, respectively, and $Z_t$ denotes exports of the $H$-good. The additional term $Q_t$ captures the resource costs of external equity issuance and the capital producers' costs. We characterize these objects below.

**Investment and capital producers.** Let $I_t \equiv \int I_{i,t}\,\mathrm{d}i$ denote aggregate demand for capital goods from the heterogeneous production firms. Investment demand for the home good depends on the specification of the investment good. In the baseline economy, investment is produced using the home good, so $I_{H,t} = I_t$. In the CES-investment-good economy, investment goods use the same home-foreign CES bundle as consumption, so the home-good component is $I_{H,t} = \omega_H \left(p_{H,t}\right)^{-\eta} I_t$. The relative price of capital is

$$p_{k,t} = \frac{P_{I,t}}{P_t}\left[1 + \phi\left(\frac{I_t}{K_t} - \delta\right)\right],$$

where $P_{I,t} = P_{H,t}$ in the baseline economy and $P_{I,t} = P_t$ in the CES-investment-good economy, and $K_t \equiv \int k_{i,t}\,\mathrm{d}i$ is the aggregate capital stock.

In the numerical solution, to limit the number of state variables, the investment rate entering the capital producer's first-order condition is evaluated using the growth rate of aggregate production capacity, $g_{K,t} \equiv \frac{\tilde{K}_{t+1}}{\tilde{K}_t} - 1$.[20] The relative price of capital is computed as

$$p_{k,t} = \frac{P_{I,t}}{P_t}\left(1 + \phi g_{K,t}\right).$$

Capital-producer profits, expressed in units of the consumption bundle, are therefore

$$\Pi_{K,t} = p_{k,t} I_t - \frac{P_{I,t}}{P_t}\Phi_t \quad \text{where} \quad \Phi_t = I_t + \frac{\phi}{2}\tilde{K}_t g_{K,t}^2.$$

The capital producer is owned by domestic households, to whom these profits are rebated.

**Household income and consumption.** Let $D_t$ denote aggregate net cash flows between firms and households. For a continuing firm, $d_{i,t} > 0$ is a dividend paid to households and $d_{i,t} < 0$ is an equity injection of $-d_{i,t}$ by households. Since equity issuance entails the proportional cost $\varphi$, the net payoff to households is $d_{i,t} - \varphi \max\{-d_{i,t}, 0\}$. The term $D_t$ aggregates these payoffs across continuing firms, adds the resources returned by exiting firms, and subtracts the transfers used to finance new entrants.

[20] This approximation is quantitatively innocuous: in the unconditional simulation, the correlation between $\tilde{K}_{t+1}/\tilde{K}_t - 1$ and the growth rate of the aggregate capital stock, $K_{t+1}/K_t - 1 \approx I_t/K_t - \delta$, is 0.999.

Household income is therefore

$$\mathcal{I}_t = w_t L_t^d + D_t + \Pi_{K,t}.$$

Given this income, household demand for the home and foreign goods is

$$C_{H,t} = \omega_H \, p_{H,t}^{-\eta} \, \mathcal{I}_t, \qquad C_{F,t} = (1 - \omega_H) \, \varepsilon_t^{-\eta} \, \mathcal{I}_t.$$

**The $Q_t$ term.** Lastly, we characterize the resource costs of external equity issuance and the capital producers' costs. The capital producer's input requirement $\Phi_t$ exceeds $I_t$ by the adjustment cost $\frac{\phi}{2}\tilde{K}_t g_{K,t}^2$. In the baseline economy, this cost is paid in home goods. In the CES investment-good economy, it is paid in the same home-foreign bundle as consumption, so its home-good component is $\omega_H p_{H,t}^{-\eta} \frac{\phi}{2}\tilde{K}_t g_{K,t}^2$. External equity issuance also absorbs real resources. A firm with negative dividends incurs the issuance cost

$$\mathcal{C}(d_{i,t}) = -\mathbb{I}_{\{d_{i,t}<0\}} \varphi d_{i,t},$$

expressed in units of the consumption bundle. Aggregating across firms and converting into units of the home good gives

$$\mathcal{C}_t = \frac{\varphi}{p_{H,t}} \int \max\{-d_{i,t}, 0\} \, \mathrm{d}i.$$

The additional resource term is therefore

$$Q_t = \begin{cases} \frac{\phi}{2}\tilde{K}_t g_{K,t}^2 + \mathcal{C}_t, & \text{baseline economy,} \\ \omega_H p_{H,t}^{-\eta} \frac{\phi}{2}\tilde{K}_t g_{K,t}^2 + \mathcal{C}_t, & \text{CES investment-good economy.} \end{cases}$$

**Aggregate shocks.** The aggregate shocks evolve as follows. Aggregate productivity satisfies

$$\log A_{t+1} = \rho_A \log A_t + \sigma_A \epsilon_{t+1}^A,$$

where $\epsilon_{t+1}^A \sim N(0,1)$, and $\kappa_t$ follows a two-state Markov chain with transition matrix $\Pi_\kappa$. Lenders' stochastic discount factor is

$$\Lambda_{t,t+1}^\star = \beta^\star \exp\left(-\kappa_t \sigma_A \epsilon_{t+1}^A - \frac{1}{2}\kappa_t^2 \sigma_A^2\right).$$

**Table B.1:** Fit of the Perceived Aggregate Laws of Motion

| Sample | $\widetilde{K}$ | $Z$ |
|---|---|---|
| *Panel A: $R^2$* | | |
| All observations | 0.999859 | 0.994220 |
| $\kappa_t = \kappa_L$ / no increase in $\kappa$ | 0.999851 | 0.994145 |
| $\kappa_t = \kappa_H$ / $\kappa_L \to \kappa_H$ | 0.999879 | 0.995661 |
| *Panel B: Normalized RMSE* | | |
| All observations | 0.0119 | 0.0760 |

*Note:* The table evaluates one-step forecasts from Equations (B.6)–(B.7) on a separate 10,000-period simulation, excluding the first 3,000 periods. Panel A reports the $R^2$ of the log forecasts. The second and third rows restrict the sample to the states ($\tilde{K}$) or transitions ($Z$) on which each law of motion is estimated. Panel B reports the root-mean-squared error (RMSE) divided by the standard deviation of the realized log variable.

**Perceived aggregate laws of motion.** The aggregate laws of motion used by firms are

$$\log \tilde{K}_{t+1} = \Lambda_0^{\kappa_t} + \Lambda_A^{\kappa_t} \log A_t + \Lambda_K^{\kappa_t} \log \tilde{K}_t, \tag{B.6}$$

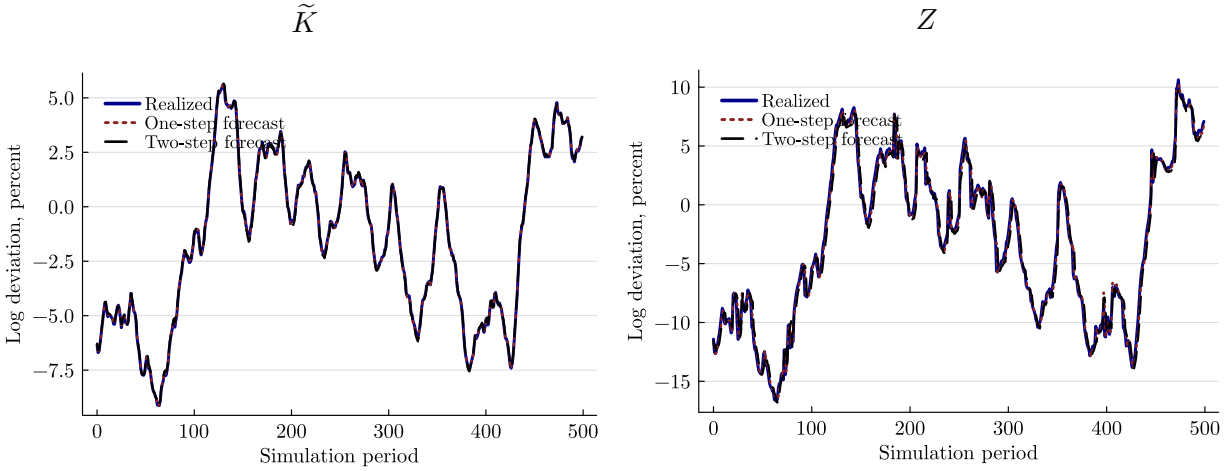
$$\log Z_{t+1} = \Theta_0^{\Delta\kappa_{t+1}} + \Theta_A^{\Delta\kappa_{t+1}} (\log A_{t+1} - \log A_t) + \Theta_Z^{\Delta\kappa_{t+1}} \log Z_t + \gamma^{\Delta\kappa_{t+1}} \log A_t. \tag{B.7}$$

These coefficients are updated in the algorithm of Appendix B.3 using simulated paths for $\tilde{K}_t$ and $Z_t$. We also considered specifications in which $\tilde{K}_{t+1}$ depends on $Z_t$ and $Z_{t+1}$ depends on $\tilde{K}_t$. These additional terms did not improve the forecasting fit, so we use the more parsimonious specifications above.

**Numerical accuracy.** Table B.1 evaluates one-step forecasts from the perceived aggregate laws of motion, using the realized aggregate states at $t$ and, for $Z_{t+1}$, the realized values of $A_{t+1}$ and $\kappa_{t+1}$. Despite their log-linear form, the conjectured laws of motion forecast the aggregate states with high accuracy. The full-sample $R^2$ is 0.9999 for $\tilde{K}$ and 0.9942 for $Z$, and the normalized RMSE is 0.012 and 0.076, respectively.[21] The second and third rows of Panel A report the $R^2$ separately for the subsamples on which each law of motion is estimated: for $\tilde{K}$, periods with $\kappa_t = \kappa_L$ and with $\kappa_t = \kappa_H$; for $Z$, periods with no increase in $\kappa$ and transitions from $\kappa_L$ to $\kappa_H$. The fit remains high in each case, indicating that the specifications in Equations (B.6) and (B.7) accurately capture the dynamics of the aggregate states both within each price-of-risk state and during transitions into the high-risk state.

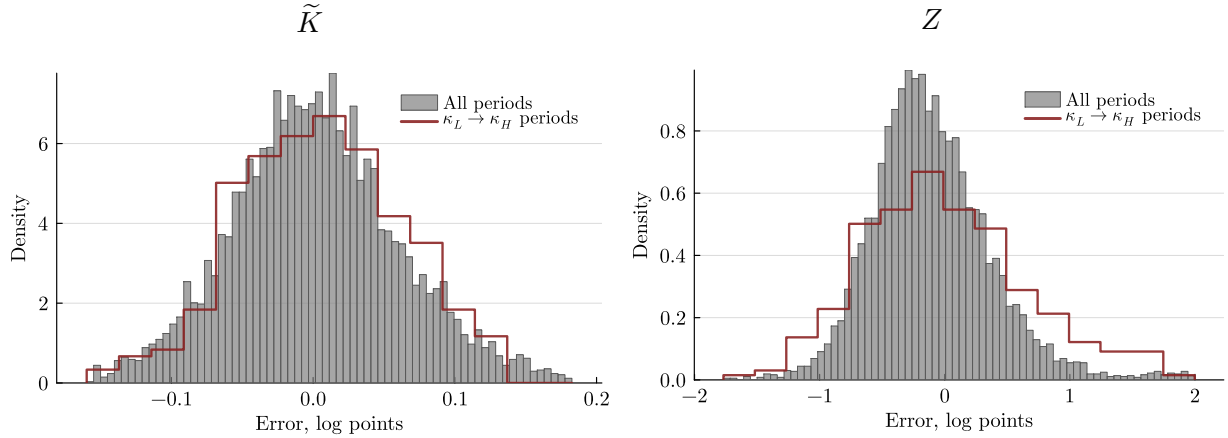
[21] For comparison, the nonlinear approximation of Fernández-Villaverde, Hurtado and Nuño (2023) based on neural networks has an $R^2$ of 0.9922.

**Figure B.1:** Realized and Forecast Aggregate States




*Note:* The figure compares the realized aggregate states with one- and two-step forecasts over a 500-period window of the simulation. Forecasts use the realized paths of the exogenous aggregate states and recursively forecast the endogenous states over the indicated horizon.

**Figure B.2:** One-Step Forecast Errors for the Aggregate States




*Note:* The gray bars report the distribution of one-step forecast errors; the brown lines report the distribution conditional on transitions from $\kappa_L$ to $\kappa_H$. Forecast errors are measured as the log forecast minus the log realized value, in log points.

Figure B.1 compares the realized paths with one- and two-step forecasts, while Figure B.2 reports the distributions of one-step errors. The forecasts closely track both variables and the errors are concentrated around zero, including around transitions from $\kappa_L$ to $\kappa_H$.

# C. Quantitative Appendix

## C.1. Model Calibration

**Data counterparts.** Our calibration strategy relies on data representative of both publicly traded and private firms. We use annual balance-sheet data from ORBIS to cover a broad sample of firms from Argentina, Brazil, Chile, Colombia, Mexico, and Peru. The data are described in Appendix A. We construct the cross-sectional moment targets using the average of the country-specific moments calculated in 2012. Table C.1 reports the moments using alternative calculations, either pooling observations across countries, restricting the sample to Colombia, the country with the best coverage of private firms, or averaging moments across years.

**Table C.1:** ORBIS Data: Alternative Target Moment Calculations

| | Average | Pooled | Colombia | Average, 2005-2017 |
|---|---|---|---|---|
| Leverage | 0.29 | 0.15 | 0.14 | 0.29 |
| Investment/k (cs std) | 0.25 | 0.28 | 0.28 | 0.25 |
| Leverage (cs std) | 0.22 | 0.22 | 0.22 | 0.22 |
| Correlation size and age | 0.27 | 0.33 | 0.35 | 0.21 |
| Share firms issuing equity | 8% | 11% | 12% | 6% |
| Age median public firm | 30 | 30 | 38 | 31 |

*Note: The table reports the target moments used in the model calibration under alternative calculations. Average is the average of country-specific moments. Pooled calculates the moments using data pooled across countries, while Colombia reports the moments for Colombian firms only. Cross-sectional moments are calculated in 2012 for the first three columns. Average, 2005–2017 reports average moments across countries and years. Leverage is book leverage. Investment is defined as* $k_{jt+1} - (1-\delta)k_{jt}$*, where capital stock* $k_{jt}$ *for firm* $j$ *in year* $t$ *is tangible fixed assets deflated by the GDP deflator and* $\delta = 0.11$*. Size is log tangible fixed assets. Age is the number of years since incorporation. Equity issuance is proxied by an increase in shareholders' funds greater than 50%. Public firms are listed firms.*

For the empirical aggregate moments, we calculate standard deviations and correlations separately by country and then take the average across countries to generate the moments presented in Table 3.[22] The EBP target is a one-standard-deviation change in the Latin American excess bond premium described in Appendix A, expressed in percentage points.

[22]The exports-to-GDP ratio excludes Chile. The correlation of unemployment and GDP excludes Argentina.

**Model parameterization: fixed parameters.** Table C.2 reports the set of fixed parameters used in the calibration described in Section 4.1. These parameters are set outside the calibration procedure and govern technology, preferences, the structure of long-term debt, and the foreign lenders' discount factor.

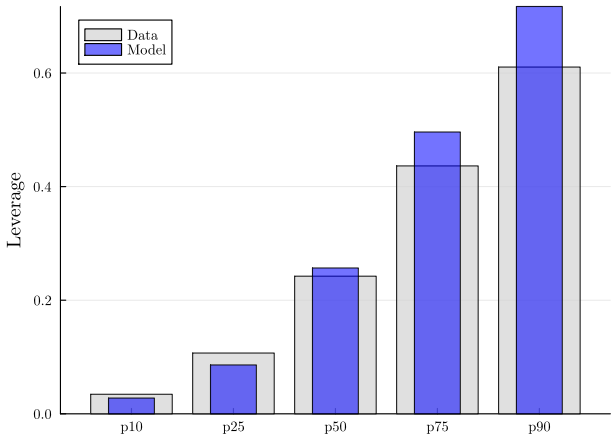
**Table C.2:** Fixed Parameters

| Parameter | Description | Value |
|---|---|---|
| $\alpha$ | Capital share | 0.300 |
| $\chi$ | Dec. returns to scale | 0.850 |
| $\delta$ | Depreciation rate | 0.045 |
| $\rho_A$ | Aggregate TFP, persistence | 0.980 |
| $\theta$ | Inverse Frisch elasticity | 0.500 |
| $\eta$ | Trade elasticity | 1.500 |
| $\beta^\star$ | Lenders discount factor | 0.992 |
| $m$ | Bond maturity | 0.052 |
| $\upsilon$ | Bond coupon | 0.018 |
| $\rho_z$ | Idiosyncratic TFP, persistence | 0.950 |

*Note:* The table reports parameters fixed outside the calibration procedure. These parameters govern domestic production, financial contracts, labor supply, trade, and the lenders' discount factor.

**Untargeted moments.** Table C.3 reports additional aggregate moments that we do not target directly in the calibration. The model reproduces the strong procyclicality of investment and consumption, with correlations with GDP close to their empirical counterparts. It also matches the relative volatility of employment and the persistence of output, while it somewhat understates the relative volatility of consumption. Finally, the two-state Markov process for the global price of risk reproduces the persistence of the EBP observed in the data.

**Figure C.1:** Distribution of Leverage: Model and Data




*Note:* The figure compares the distribution of firm leverage in the data and in the model. Bars report leverage at selected percentiles of the cross-sectional distribution: p10, p25, p50, p75, and p90. Gray bars show the data and blue bars show the model.

**Table C.3:** Untargeted Moments

| Moment | Data | Model |
|---|---|---|
| $(X+M)/GDP$ | 39.9% | 34.9% |
| $\rho(I, GDP)$ | 0.84 | 0.83 |
| $\rho(C, GDP)$ | 0.83 | 0.93 |
| GDP autocorrelation | 0.82 | 0.75 |
| $\sigma(C)/\sigma(GDP)$ | 0.99 | 0.89 |
| $\sigma(Emp)/\sigma(GDP)$ | 0.71 | 0.74 |
| EBP, autocorrelation(*) | 0.75 | 0.85 |

*Note:* The table reports untargeted aggregate moments in the data and in the model. The moments include correlations with GDP, relative volatilities, and properties of the EBP series. The asterisk denotes moments computed for the pool of Compustat firms used in our empirical analysis.

Figure C.1 compares the unconditional distribution of firm leverage in the model with its empirical counterpart. The model closely matches the median leverage ratio in the data and reproduces the dispersion of leverage across firms, which is important for our mechanism.

## C.2. Model-implied EBP and Risk Premia

This appendix describes how we construct the model-implied EBP and the model-implied risk premium, and compares the two measures. Both are based on firms' bond spreads. We

first define the internal rate of return of a bond as the rate $r(.)$ that satisfies

$$q\left(k', b', z, \boldsymbol{S}\right) = \frac{m + (1-m)\left(\upsilon + q\left(k', b', z, \boldsymbol{S}\right)\right)}{1 + r(k', b', z, \boldsymbol{S})}.$$

The annualized spread of the bond with respect to the risk-free rate, $r_f$, is $S(k', b', z, \boldsymbol{S}) = \left(\frac{1+r(k', b', z, \boldsymbol{S})}{1+r_f}\right)^4 - 1$. We denote by $S_{i,t}$ the spread of firm $i$ in period $t$ in the simulated panel.

**Model-implied EBP.** We construct the model-implied EBP from model-simulated data following the same procedure as in Section 2. We measure each firm's distance to default as $DD_{i,t} = -\Phi^{-1}\left(p^D_{i,t}\right)$, where $p^D_{i,t}$ is the firm's annualized default probability and $\Phi$ is the standard normal cumulative distribution function. Using the simulated firm panel, we estimate the pooled regression

$$\log S_{i,t} = \alpha + \beta\, DD_{i,t} + \epsilon_{i,t},$$

which captures the component of spreads explained by firms' default risk. The regression does not include time effects, since these would absorb the aggregate component that the EBP is intended to measure. The firm-level EBP is the difference between the observed spread and the spread predicted by default risk, $\widehat{EBP}_{i,t} = S_{i,t} - \exp\left(\hat{\alpha} + \hat{\beta}\, DD_{i,t} + \hat{\sigma}^2/2\right)$, where $\hat{\sigma}^2$ is the residual variance and the last term accounts for the retransformation from logs to levels. The model-implied EBP is the average of $\widehat{EBP}_{i,t}$ across firms in each period. This construction mirrors the empirical EBP. It isolates movements in spreads that are not explained by firms' default risk, which in the model are driven by the global price of risk $\kappa_t$.

**Model-implied risk premium.** To compute the model-implied risk premium, we solve for debt prices under a hypothetical risk-neutral lender. Taking firms' exit and debt policies as given, the risk-neutral price schedule is

$$\begin{aligned}\tilde{q}(k', b', z, \boldsymbol{S}) = \mathbb{E}_{(z', \boldsymbol{S}')|(z, \boldsymbol{S})}\Big[\beta^\star\big([1 - h(k', b', z', \boldsymbol{S}')]\mathcal{R}^{\text{cont}}(k', b', z', \boldsymbol{S}') \\ + h(k', b', z', \boldsymbol{S}')\mathcal{R}^{\text{exit}}(k', b', z', \boldsymbol{S}')\big)\Big],\end{aligned}$$

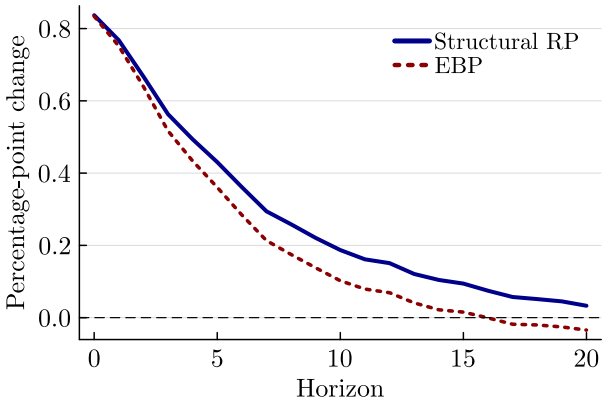
where $\mathcal{R}^{\text{cont}}(k', b', z', \boldsymbol{S}') \equiv (1-m)\left[\upsilon + \tilde{q}(k'', b'', z', \boldsymbol{S}')\right] + m$, and the next-period policies $k''$ and $b''$, as well as the exit probability $h$, are evaluated using the policies from the original economy with risk-averse lenders. Let $\tilde{S}(.)$ be the spread of the bond under risk-neutral

**Table C.4:** Model-Implied EBP and Risk Premium: Aggregate Moments

| Moment | Structural RP | EBP |
|---|---|---|
| Correlation between structural RP and EBP | 0.8602 | |
| Mean low-to-high $\kappa$ change | 1.2883 | 1.3293 |

*Note:* The table compares the model-implied risk premium and EBP in the baseline economy. Both series are averages across "Compustat" firms. The first row reports the correlation between the two aggregate series. The second row reports the average on-impact change of each measure, in percentage points, when the economy transitions from $\kappa = 0$ to $\kappa = \kappa_H$.

**Figure C.2:** Model-Implied EBP and Risk Premium: Response to a $\kappa$ Shock




*Note:* The figure compares the responses of the model-implied EBP and structural risk premium to an increase in the global price of risk ($\Delta\kappa > 0$). The solid blue line shows the structural risk premium and the dotted red line shows the EBP, both in percentage-point deviations from their no-shock paths. The horizontal axis shows the horizon. Both measures are computed on the subsample of "Compustat" firms.

pricing. The model-implied risk premium is

$$RP(k', b', z, \boldsymbol{S}) = S(k', b', z, \boldsymbol{S}) - \tilde{S}(k', b', z, \boldsymbol{S}). \tag{C.1}$$

The aggregate risk premium is the average of $RP(.)$ across firms in each period.

Table C.4 compares the two measures in the baseline economy. The correlation between the two aggregate series is 0.86, and they imply a very similar on-impact response to a shock to the global price of risk. A transition from $\kappa_{t-1} = 0$ to $\kappa_t = \kappa_H$ raises both measures by about 1.3 percentage points.

Figure C.2 shows the response of the two measures to an increase in the global price of risk. The dynamics of the EBP and of the risk premium are closely aligned on impact and over the initial horizons.[23]

[23]The on-impact responses in the figure are smaller than the changes reported in Table C.4. The two

### C.3. Channel Decomposition: Additional Details

This appendix describes the construction of the counterfactuals behind Figure 6 and Table 4 in the main text.

We index the counterfactuals by three binary indicators, $(\boldsymbol{r}, \boldsymbol{g}, \boldsymbol{o})$, and denote the associated capital response at horizon $h$ by $\Delta_h^{\boldsymbol{rgo}}$. The first indicator, $\boldsymbol{r}$, governs whether lenders' pricing of firms' debt responds to the $\kappa$ shock. The second indicator, $\boldsymbol{g}$, governs whether the aggregate co-states $(\tilde{K}, Z)$, and hence real wages, relative prices, and the real exchange rate, respond to the $\kappa$ shock. The third indicator, $\boldsymbol{o}$, governs whether firms bear the depreciation-induced increase in their debt service, which allows us to isolate the debt-revaluation channel. When $\boldsymbol{o} = 0$, firms receive a compensating transfer, described below, that offsets the effect of the larger real debt burden. Since there is no RER depreciation when aggregate prices do not respond, this indicator matters only when $\boldsymbol{g} = 1$. Given this notation, the total effect of a $\kappa$ shock is

$$\mathcal{T}_h \equiv \Delta_h^{111} - \Delta_h^{000},$$

where the counterfactual 111 turns on all three mechanisms and reproduces the baseline impulse response.

We solve the counterfactuals as finite-horizon transitions. Let $t$ denote the period of the $\kappa$ shock. Since shocks are temporary, we assume that the economy returns to the baseline environment at some large $T > t$. At that date, firms' continuation values and bond-price schedules are set to those of the baseline economy, so firms understand that the baseline environment resumes after the transition. For each economy, we recompute firms' policies and debt-price schedules backward from $T$, over the complete firm and aggregate state space. Firms and lenders continue to integrate over future idiosyncratic and aggregate shocks, so they do not have perfect foresight over the realized path of the economy. Given the counterfactual policies, we simulate each economy forward from the same baseline distribution

exercises compare the low and high price-of-risk states in different ways. The table reports the average one-period change in each measure around transitions from $\kappa_L$ to $\kappa_H$ in the unconditional simulations. This change also reflects the movements in productivity, in the aggregate states, and in the firm distribution that accompany these transitions. The impulse responses instead compare paired shock and no-shock paths that start from the same pre-shock state and share the same draws, with the price of risk remaining at $\kappa_L$ along the no-shock path. They therefore isolate the effect of the $\kappa$ transition.

of firms at the time of the shock and evaluate its response along the baseline shock and no-shock aggregate paths. This approach keeps the counterfactuals comparable. All of them start from the same distribution of firms, and hence the same distribution of the quantity of risk, so differences in their responses reflect only the mechanisms that each counterfactual turns on or off.

To isolate the risk channel, we construct counterfactuals in which aggregate prices do not respond to the $\kappa$ shock ($\boldsymbol{g} = 0$). Recall that the coefficients of the law of motion for $\tilde{K}'$ depend on the current value of $\kappa$, and those of the law of motion for $Z'$ differ between transitions from $\kappa_L$ to $\kappa_H$ and transitions with no increase in $\kappa$, so firms understand that changes in the global price of risk affect future aggregate prices and quantities. In these counterfactuals, we shut down this $\kappa$-dependence: the law of motion for $\tilde{K}'$ uses the $\kappa_L$ coefficients in both states, and the law of motion for $Z'$ uses the no-increase coefficients also for transitions from $\kappa_L$ to $\kappa_H$, and firms' policies are recomputed under these beliefs. Thus, firms still face the higher price of risk in their borrowing costs, but they do not forecast a change in aggregate prices or quantities induced by the $\kappa$ shock. When simulating forward, we additionally impose the no-shock paths of $(\tilde{K}, Z)$ on the economy that receives the shock, so all prices remain at their no-shock paths. The risk channel is

$$\mathcal{RP}_h \equiv \Delta_h^{100} - \Delta_h^{000}.$$

The remaining two channels are obtained by introducing the general-equilibrium forces sequentially, allowing prices to respond to changes in $\kappa$. The two channels are

$$\mathcal{C}_h \equiv \Delta_h^{110} - \Delta_h^{100}, \qquad \mathcal{D}_h \equiv \Delta_h^{111} - \Delta_h^{110}.$$

Notice that in the competitiveness channel we remove the effect of the RER depreciation on firms' debt burden, compensating firms for the depreciation-induced increase in their debt service ($\boldsymbol{o} = 0$).

The main advantage of this definition of channels is that, for each horizon $h$, the three channels sum exactly to the total response $\mathcal{T}_h = \mathcal{RP}_h + \mathcal{C}_h + \mathcal{D}_h$. By construction, the competitiveness and debt-revaluation channels include their interactions with the risk channel. Below, we show that measuring each channel in isolation yields similar results.

Next, we describe the transfer that firms receive in the counterfactuals with $\boldsymbol{o} = 0$.

When the currency depreciates, the value of firms' foreign-currency debt payments increases in units of the consumption bundle. The transfer compensates firms for this increase. To construct it, we run $J$ independent simulations of the baseline economy. Each simulation consists of two paths with the same initial conditions, one that receives the $\kappa$ shock and one that does not. We then take the average depreciation of the nominal exchange rate across simulations. Let $\xi^S_{h,j}$ denote the nominal exchange rate at horizon $h$ in the path with the $\kappa$ shock of simulation $j \in \{1, \ldots, J\}$, and let $\xi^{NS}_{0,j}$ denote the impact exchange rate in the corresponding no-shock path, which we use as the benchmark for the inherited debt. The average depreciation at horizon $h$, expressed in units of the consumption bundle, is

$$\bar{\Delta}_h = \frac{1}{J} \sum_{j=1}^{J} \frac{\xi^S_{h,j} - \xi^{NS}_{0,j}}{P^S_{h,j}}, \tag{C.2}$$

where $P^S_{h,j}$ is the price level in the path with the shock. In the counterfactuals with $\boldsymbol{g} = 0$, the exchange rate remains at its no-shock path, so there is no depreciation to compensate and the transfer is zero.

When $\boldsymbol{o} = 0$, the dividend at date $h$ of the transition becomes

$$d^{\boldsymbol{o}=0}(k, b, z, \boldsymbol{S}; h) = d(k, b, z, \boldsymbol{S}) + \mathbb{I}\{\kappa = \kappa_H\} \bar{\Delta}_h \, (1-m)^h \, [m + (1-m)\upsilon] \, b, \tag{C.3}$$

where $\boldsymbol{S} = (A, \kappa, \tilde{K}, Z)$ denotes the aggregate state and $[m + (1-m)\upsilon] \, b$ is the firm's scheduled debt service. The factor $(1-m)^h$ is the share of the firm's debt at date $h$ that was inherited at the time of the shock when firms roll over their maturing debt, so the transfer compensates only the revaluation of pre-shock debt, while debt issued after the shock is priced at post-shock exchange rates. This deterministic factor implicitly assumes that the inherited exposure amortizes at rate $m$ regardless of the debt the firm issues or retires after the shock. Notice that the transfer changes only firms' cash flows and leaves the debt contract and lenders' payoffs unchanged. We recompute firms' policies under these dividends. Since policies change, bond prices are also recomputed.

**Alternative decomposition.** As discussed above, the competitiveness and debt-revaluation channels of our decomposition include their interactions with the risk channel. To assess whether these interactions matter, we consider an alternative decomposition in which the

**Table C.5:** Alternative Channel Decomposition

| Model | Total effect | Risk channel | Comp. channel | Reval. channel | Peak $h$ | Heterogeneous responses: Safest firms | Heterogeneous responses: High-risk firms |
|---|---|---|---|---|---|---|---|
| Baseline | -0.32 | -0.57 | 0.28 | -0.03 | 7 | 0.10 | -1.35 |
| Local currency debt | -0.42 | -0.77 | 0.35 | 0.00 | 8 | 0.09 | -1.41 |
| Firm discount factor: | | | | | | | |
| Risk-averse domestic investors | -0.17 | -0.27 | 0.14 | -0.02 | 4 | 0.01 | -0.67 |
| Risk-averse foreign investors | -1.04 | -2.22 | 1.48 | -0.02 | 7 | -1.48 | 0.22 |
| Domestic debt and banks | -0.42 | -0.57 | 0.16 | -0.00 | 8 | 0.13 | -1.47 |
| Imported goods: | | | | | | | |
| Investment goods | -0.55 | -0.49 | -0.03 | -0.03 | 4 | -0.23 | -1.57 |
| Intermediate inputs | -0.36 | -0.49 | 0.15 | -0.02 | 5 | -0.01 | -1.38 |

*Note:* The table decomposes the response of aggregate capital to a shock to the global price of risk, for the baseline economy and the model variants listed in the first column. The total effect is evaluated at the horizon at which the capital contraction is largest in each economy (column "Peak $h$"). In contrast to Table 4, each channel is measured in isolation, as described in Appendix C.3. The risk channel coincides with that of Table 4, while the competitiveness and debt-revaluation channels are computed by re-solving the bond-pricing equation with $\kappa = 0$. The three channels exclude the interactions between mechanisms and do not add up to the total effect. The last two columns report the total response at the peak horizon for firms at the 5th and 95th percentiles of the pre-shock default-risk distribution.

two channels are measured in isolation, without the response of lenders' pricing:

$$\mathcal{RP}_h \equiv \Delta_h^{100} - \Delta_h^{000}, \qquad \mathcal{C}_h \equiv \Delta_h^{010} - \Delta_h^{000}, \qquad \mathcal{D}_h \equiv \Delta_h^{011} - \Delta_h^{010}.$$

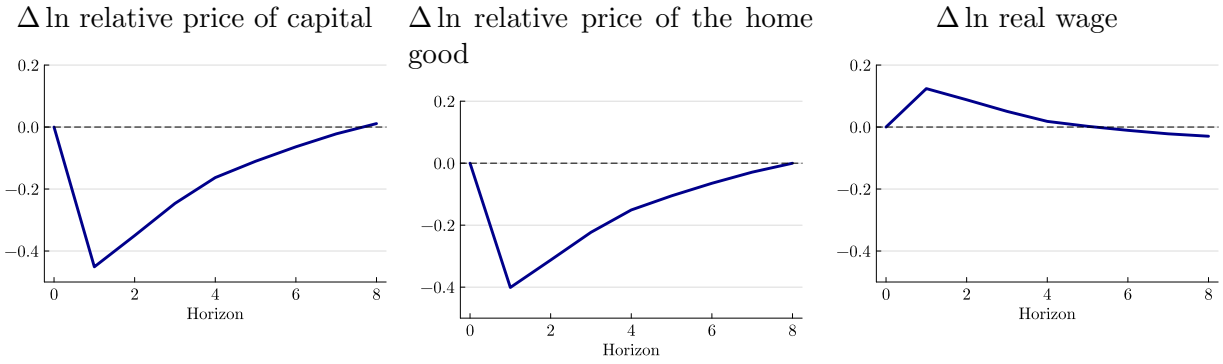
The risk channel is the same as in the main text. The other two channels are based on the counterfactuals 010 and 011, in which aggregate prices respond to the shock but lenders' pricing of risk does not ($\boldsymbol{r} = 0$). This requires re-solving the bond-pricing equation setting $\kappa = 0$, so the shock operates only through aggregate prices and the debt-service burden. Because each channel is measured in isolation, the three channels exclude the interactions between mechanisms and do not add up to the total effect. Table C.5 shows that the results are similar to those of Table 4. In particular, the debt-revaluation channel remains quantitatively small across all model variants.

## C.4. Additional Figures

Figure C.3 shows the responses of the relative price of capital, the relative price of the home good, and real wages. Despite the nominal depreciation of the exchange rate, the real wage

slightly increases after the shock. This is because the downward nominal wage constraint binds, so nominal wages do not adjust, while the fall in the price of the home good lowers the price level and raises the real wage.

**Figure C.3:** Aggregate Responses to Changes in the EBP: Additional Variables




*Note:* Impulse responses to a one-standard-deviation increase in the EBP, generated in the model by the $\kappa$ shock. The panels show the dynamics of the relative price of capital, the relative price of the home good, and real wages.

## C.5. Additional Quantitative Exercises

This appendix reports four exercises that complement our main quantitative results and shed light on the forces behind them. Appendix C.5.1 lets the increase in the global price of risk be accompanied by a decline in foreign demand for the home good, and shows that the risk channel is essentially unchanged. Appendix C.5.2 asks how much of the contraction in investment observed around the Global Financial Crisis the model can account for by increases in the global price of risk. Appendix C.5.3 quantifies the contribution of firm heterogeneity by comparing the baseline responses with those of a representative-firm counterfactual. To further assess the importance of the debt-revaluation channel, Appendix C.5.4 considers a counterfactual with a larger real exchange rate depreciation following an increase in the global price of risk, disciplined by the dynamics observed around currency crises.

### C.5.1. Lower Global Demand

In the main text, we assume that foreigners' consumption, $c^\star$, is fixed. This isolates the role of changes in the global price of risk from changes in the demand for the home good. In practice,

however, spikes in the global price of risk tend to occur in contractionary environments, and a tightening of global financial conditions may also weaken global demand and reduce the demand for the home economy's exports. This trade channel operates alongside the risk channel and could affect its measurement. We allow for this possibility by letting $c^\star$ move with the price of risk:

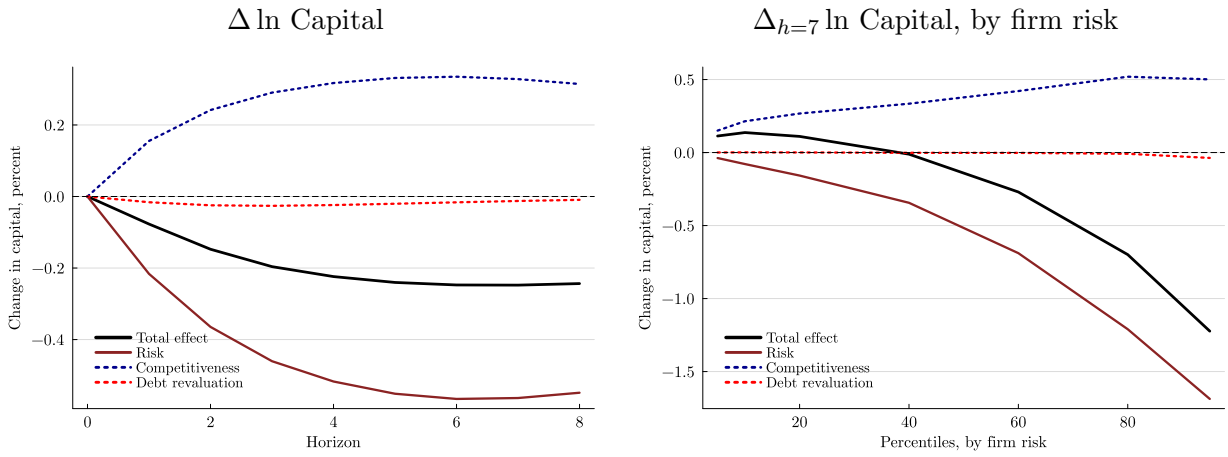
$$c_t^\star = \begin{cases} c^\star & \text{if } \kappa{=}\kappa_L \\ c^\star\,(1-\Delta c) & \text{if } \kappa{=}\kappa_H. \end{cases} \tag{C.4}$$

We calibrate $\Delta c$ to the decline in foreign demand observed during the Global Financial Crisis, scaled by the size of the shock. We measure foreign demand with U.S. consumption. During this episode, U.S. consumption fell by about 2.3 percent at its trough, while the excess bond premium rose by about 3.1 standard deviations (roughly 3.7 percentage points, given a standard deviation of 1.17 percentage points). A one-standard-deviation increase in the premium is then associated with a decline in foreign demand of 0.73 percent. We therefore set $\Delta c = 0.73\%$. As an alternative, we also considered targeting the average response of U.S. consumption to changes in the excess bond premium, as we do for output and investment in Figure 5. That calibration implies a smaller decline in $c^\star$ and results closer to those of the baseline economy.

Figure C.4 reports the channel decomposition for the baseline economy under this joint shock. Panel (a) shows the response of aggregate capital across horizons, and Panel (b) shows the response at the peak horizon across firms sorted by default risk. The risk channel is essentially the same as in the baseline economy. The competitiveness channel is somewhat stronger (prices adjust more given the additional decline in demand), and the debt-revaluation channel remains small.[24]

[24] We let the decline in foreign demand be part of the competitiveness channel. In the counterfactuals with $\boldsymbol{g} = 0$, we hold $c^\star$ at its low-$\kappa$ value together with the no-shock paths of the aggregate states, so the risk channel captures only the response of lenders' pricing, as in the baseline economy.

**Figure C.4:** Transmission Channels with Lower Global Demand




*Note:* The figure shows the transmission channels of an increase in the global price of risk ($\Delta\kappa > 0$) that is accompanied by a decline in foreign demand, $c_t^\star$, in the baseline economy. The left panel reports the impulse response of aggregate capital, $100 \times \left(\ln K_{t+h} - \ln K_{t+h}^{ns}\right)$, with the horizon $h$ on the x-axis. The right panel reports the change in capital at horizon $h = 7$ across firms sorted by pre-shock default probability. In both panels, the solid black line shows the total effect and the solid brown line shows the risk channel. The dotted blue and red lines show the competitiveness and debt-revaluation channels, respectively. The decline in foreign demand enters the competitiveness channel.

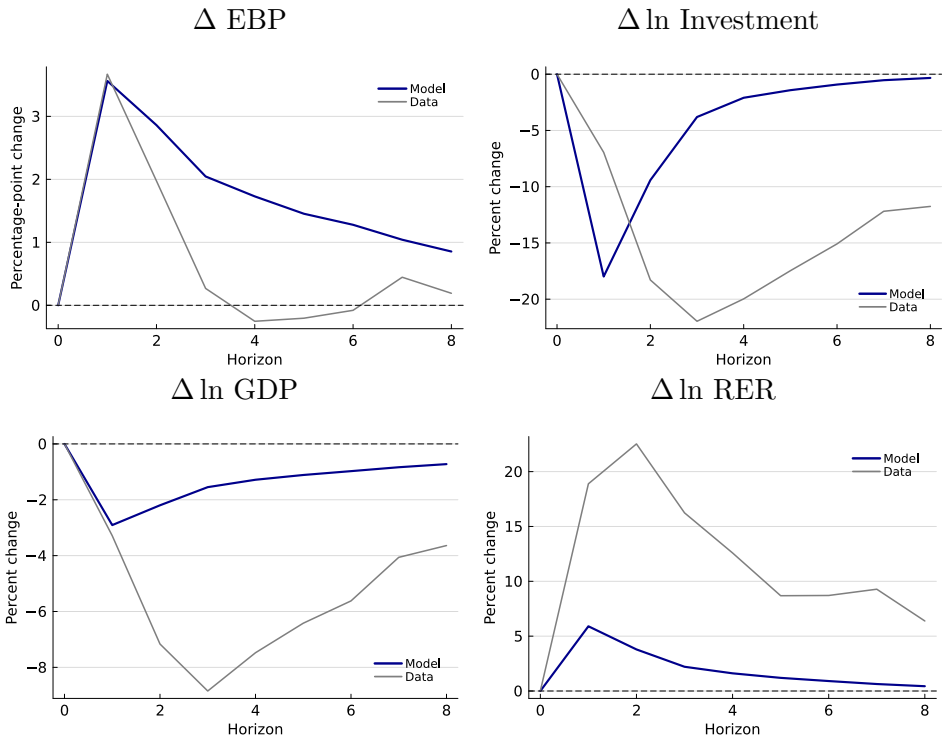
### C.5.2. The Global Financial Crisis

The results in Figure 5 capture the average effects of changes in the EBP over the 1997–2019 period. Figure C.5 analyzes the dynamics of the EBP, investment, GDP, and the real exchange rate around the Global Financial Crisis of 2008. This event led to an increase in the EBP of about three standard deviations (as shown in Figure 2). In episodes like this one, the increase in the global price of risk coincides with other large shocks that are absent from the baseline model, such as collapses in external demand and in commodity prices. To quantify how much of these dynamics can be explained by changes in the price of risk, we compare them with the responses implied by the model.

In the quantitative analysis, the process for $\kappa_t \in \{\kappa_L, \kappa_H\}$ is disciplined to match a one-standard-deviation increase in the EBP, smaller than the increase observed during this episode. To match the larger increase in the EBP, the model responses in Figure C.5 are constructed from a counterfactual transition in which lenders' price of risk is larger than in the baseline calibration.

We solve the counterfactual as a finite-horizon transition, following the approach of

**Figure C.5:** Aggregate Responses during the Global Financial Crisis




*Note:* The figure compares the model-implied dynamics with those in the data around the Global Financial Crisis. The panels report the EBP, investment, GDP, and the real exchange rate, with the x-axes showing the horizon in quarters. Blue lines depict the model and gray lines the data. The model responses are constructed from the counterfactual transition with the rescaled stochastic discount factor described in this appendix. The empirical responses show the cumulative change in each variable relative to 2008.Q3, the quarter of the collapse of Lehman Brothers, averaged across the Latin American countries in our sample.

Appendix C.3. This approach preserves the nonlinear responses of firms' policies, default decisions, and prices to a shock of this size. Let $t$ denote the period of the shock. The economy returns to the baseline environment at some large $T > t$, where continuation values and bond-price schedules are set to those of the baseline economy. Along this transition, the lenders' stochastic discount factor becomes

$$\Lambda^{\star,\text{crisis}}_{t,t+1} = \beta^\star \times \exp\left(-\mu^{\text{crisis}}\,\kappa_t\,\sigma_A\,\epsilon^A_{t+1} - \frac{1}{2}\left(\mu^{\text{crisis}}\,\kappa_t\right)^2\,\sigma_A^2\right), \tag{C.5}$$

with $\mu^{\text{crisis}} \geq 1$. Relative to Equation (12), the effective price of risk in the high-risk state is $\mu^{\text{crisis}}\,\kappa_H$, larger than the baseline $\kappa_H$. Since $\kappa_L = 0$, the stochastic discount factor is unchanged in the low-risk state.[25] We recompute firms' policies and debt-price schedules

[25] A large $\mu^{\text{crisis}}$ places most of the weight of the stochastic discount factor on the worst realizations of $\epsilon^A$. To compute lenders' expectations accurately, we use a finer grid for $\epsilon^A$ in the pricing equation. In addition, we rescale the stochastic discount factor so that it integrates to $\beta^\star$, which leaves the risk-free rate unchanged.

backward from $T$, over the complete firm and aggregate state space, under this counterfactual stochastic discount factor. Firms and lenders continue to integrate over future idiosyncratic and aggregate shocks, including transitions in $\kappa$, and firms forecast the aggregate co-states $(\tilde{K}', Z')$ using the baseline laws of motion.

The impulse responses are constructed as in the baseline exercise. At the time of the shock, $\kappa_t$ increases from $\kappa_L$ to $\kappa_H$, and the multiplier $\mu^{\text{crisis}}$ turns on unexpectedly.[26] From that period onward, firms and lenders understand that $\mu^{\text{crisis}}$ remains in place along the transition and reverts to one after period $T$. We simulate the economy forward from the same initial firm distribution and using the same sequences of exogenous shocks as in the baseline impulse responses. The firm distribution evolves under the counterfactual policies, and at each date we re-solve market clearing. Thus, $\tilde{K}_t$, $Z_t$, real wages, relative prices, and the real exchange rate evolve endogenously along the transition. The responses are computed as the average paired difference between the shock and no-shock paths.

Lastly, we measure the model-implied EBP as in Appendix C.2 and choose $\mu^{\text{crisis}}$ so that the impact increase in the EBP matches that of the Global Financial Crisis, of about three standard deviations.[27]

The on-impact increase in the EBP matches its empirical counterpart by construction. The model explains more than two-thirds of the peak contraction in investment, although it overshoots the initial response, and about a third of the peak contraction in output. As for the real exchange rate, the model accounts for about a quarter of the peak depreciation.

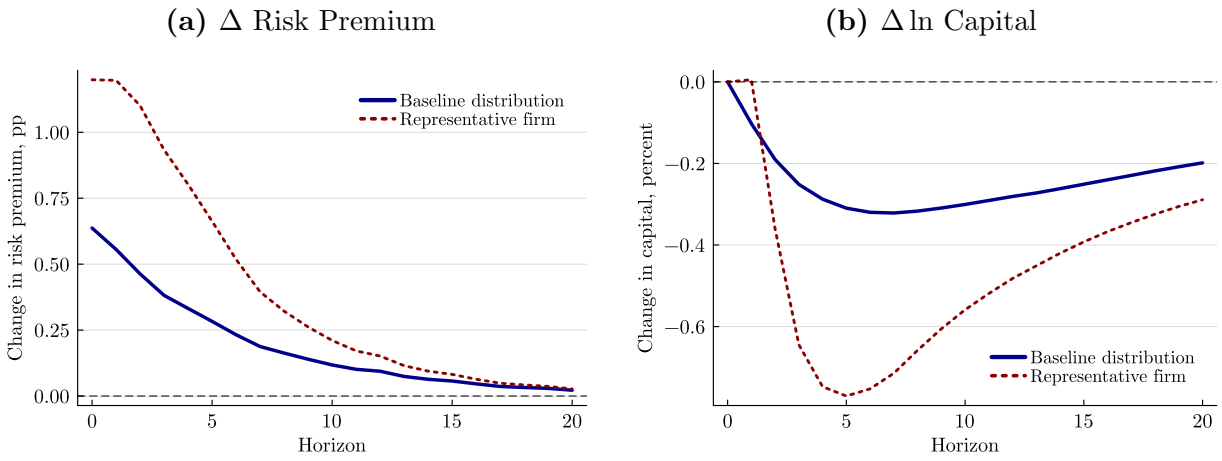
### C.5.3. The Role of Firm Heterogeneity

We quantify the role of the firm distribution in the transmission of shocks to the global price of risk. We compare the baseline impulse responses with those of a representative-firm counterfactual. In this counterfactual, we concentrate the firm distribution at the time of the shock at a single representative firm with average idiosyncratic productivity. The capital and debt of the representative firm reproduce the economy's aggregate production

[26] Since the $\mu^{\text{crisis}}$ shock is unexpected, we do not re-estimate the perceived laws of motion or the stationary equilibrium, which remain at their baseline values.

[27] We do not re-run the projection of spreads on default risk on the counterfactual data. We use the same mapping estimated in the baseline model.

**Figure C.6:** The Role of Firm Heterogeneity:
Responses to Global Price of Risk Increases




*Note:* Impulse responses to an increase in the global price of risk ($\Delta\kappa > 0$). Solid blue lines show the baseline economy. Dotted red lines show the representative-firm counterfactual, in which the firm distribution at the time of the shock is concentrated at a representative firm that reproduces the economy's aggregate production capacity and leverage, and both economies follow the baseline aggregate price paths. Panel (a) shows the change in the average risk premium and Panel (b) the change in aggregate capital. The x-axes show the horizon $h$.

capacity and aggregate leverage. We then impose the baseline shock and no-shock paths for the aggregate states, so the counterfactual economy faces the same aggregate prices as the baseline economy, and we simulate firms' responses using the solved baseline policies. After the shock, the distribution evolves endogenously. The exercise therefore isolates the role of the pre-shock distribution of firms, holding constant the aggregate environment and the model's policies.

Figure C.6 presents the results. Panel (a) shows that the increase in the risk premium is about twice as large for the representative firm as in the baseline economy. Panel (b) shows that the contraction in capital is also more than twice as large. The representative firm carries the economy's aggregate leverage and an average level of productivity, which makes it riskier than the capital-weighted average firm in the baseline economy. In the baseline distribution, a large share of capital is held by safe firms with low leverage and a close-to-zero quantity of risk, which dampens the aggregate response to the shock. A representative-firm economy calibrated to the aggregate balance sheet therefore overstates the transmission of the global price of risk.

### C.5.4. Larger RER Depreciation

The debt-revaluation channel is small in the baseline economy because the targeted depreciation is modest. In the data, a one-standard-deviation increase in the EBP of 1.2 percentage points is associated with a depreciation of 1.7 percent, an elasticity of about 1.5. During the Global Financial Crisis, for instance, this elasticity was much larger. The real exchange rate depreciated by 21 percent while the EBP increased by about 3 standard deviations (3.7 percentage points), implying an elasticity of about 6 (Figure C.5). We complement this evidence by analyzing the behavior of the RER and the EBP around currency crises. Crisis dates are taken from the Global Crises Data by Country database, maintained by the Behavioral Finance and Financial Stability Project at Harvard Business School, which builds on Reinhart and Rogoff (2009). There are 14 crisis episodes in our sample of countries (Table C.6), around which we compute the average responses of the two variables.[28] On impact, the real exchange rate depreciates by about 14 percent, while the EBP increases by about 1.8 percentage points. Together, these estimates imply an elasticity of about 8.

**Table C.6:** Currency-Crisis Episodes

| Country | Start quarter | Country | Start quarter |
|---|---|---|---|
| Argentina | 2008.Q4 | Chile | 2014.Q1 |
| Argentina | 2014.Q1 | Colombia | 1997.Q4 |
| Brazil | 1999.Q1 | Colombia | 2002.Q3 |
| Brazil | 2001.Q2 | Colombia | 2014.Q4 |
| Brazil | 2008.Q4 | Mexico | 1998.Q3 |
| Brazil | 2013.Q3 | Mexico | 2008.Q4 |
| Chile | 2008.Q4 | Peru | 1998.Q3 |

*Note:* The table lists the currency-crisis episodes used in the event analysis. Episodes are identified with the annual currency-crisis indicator of the Global Crises Data by Country database (Reinhart and Rogoff, 2009), maintained by the Behavioral Finance and Financial Stability Project at Harvard Business School. The start quarter within the crisis year is assigned based on the largest quarterly depreciation of the RER.

We next assess whether the debt-revaluation channel becomes quantitatively important under a depreciation of that size and how its magnitude compares with the risk channel. We

[28] For each episode, we compute the cumulative change in the crisis country's log RER and EBP relative to the quarter before the start of the crisis, and average these responses across the 14 episodes at each horizon. The construction follows the event analysis of the Global Financial Crisis in Appendix C.5.2. The RER is measured in log points and the EBP in percentage points.

do so with a counterfactual in which we increase the RER depreciation.

To construct this counterfactual, we impose a larger RER depreciation that affects firms' debt-service burden. The exercise follows the approach of the channel decomposition in Appendix C.3. That is, we take the model-implied path of the RER after a $\kappa$ shock and rescale it, so that the impact depreciation implies an elasticity of about 8, in line with the currency-crisis episodes. Let $\bar{\Delta}_h^{\mathrm{CF}}$ be given by

$$\bar{\Delta}_h^{\mathrm{CF}} = \lambda^{\mathrm{CF}}\, \bar{\Delta}_h, \tag{C.6}$$

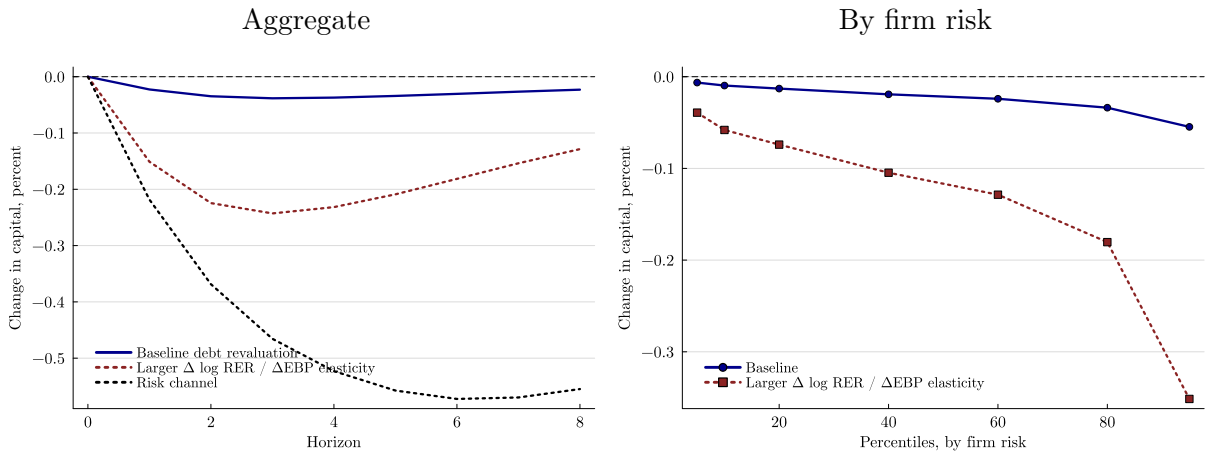
where $\bar{\Delta}_h$ is defined in Equation (C.2), and $\lambda^{\mathrm{CF}} > 1$ is a constant that rescales the model-implied impact depreciation to the targeted elasticity and preserves the shape of the path. The dividend at date $h$ of the transition becomes

$$d^{\mathrm{CF}}\left(k, b, z, \boldsymbol{S}; h\right) = d\left(k, b, z, \boldsymbol{S}\right) - \mathbb{I}\{\kappa = \kappa_H\}\, \left(\bar{\Delta}_h^{\mathrm{CF}} - \bar{\Delta}_h\right) (1-m)^h \left[m + (1-m)\upsilon\right] b. \tag{C.7}$$

The dividend $d\left(k, b, z, \boldsymbol{S}\right)$ already includes the debt service implied by the equilibrium depreciation of the baseline economy, so the additional term charges only the difference between the two paths. By construction, the larger depreciation affects only the debt-service burden of the debt inherited at the time of the shock. The RER in all other parts of the firm's problem, as well as all aggregate prices, follows the path of the baseline economy. We first re-solve firms' dynamic problem and bond-price schedules backward over the complete state space. In forming expectations, firms use the baseline laws of motion for $Z_t$ and $\tilde{K}_t$ but account for the additional foreign-currency debt-service burden associated with the larger RER depreciation. We then simulate the counterfactual forward. For each paired simulation, we evaluate the resulting policies along the simulation-specific shock and no-shock paths of $(Z_t, \tilde{K}_t)$ obtained from the baseline impulse responses. For the channel decomposition, we compensate firms for the increase in foreign-currency debt service implied by the total RER depreciation, including both its baseline and additional components.

Figure C.7 compares the debt-revaluation channel in the baseline economy and in this exercise. With the larger elasticity, the channel is about six times larger than in the baseline economy (Panel a). Panel (b) shows that the channel scales up by a similar factor at every point of the risk distribution, and remains monotonically larger for riskier firms: at the peak horizon it rises from $-0.01$ to $-0.04$ percent for the safest firms and from $-0.05$ to $-0.35$

**Figure C.7:** The Debt-Revaluation Channel under a Larger $\Delta \log \text{RER}/\Delta\text{EBP}$ Elasticity




*Note:* The figure compares the debt-revaluation channel in the baseline economy (solid blue line) with that in the counterfactual featuring a larger $\Delta \log \text{RER}/\Delta\text{EBP}$ elasticity (dotted brown line). Panel (a) reports the aggregate capital responses attributable to the debt-revaluation channel and, for comparison, the baseline risk channel (dotted black line). Panel (b) reports the debt-revaluation channel at horizon $h = 7$ across firms sorted by pre-shock default risk.

percent for the riskiest ones. Even under this larger depreciation, the channel remains about one-third as large as the risk channel, which is unchanged by construction.

## C.6. The Risk Dimension of Macroeconomic Policies

This appendix expands on the risk dimension of the macroeconomic policies studied in the main text. We first present additional results for exchange rate regimes and then turn to macroprudential policy.

### C.6.1. Exchange Rate Regimes

Tables C.7 and C.8 compare the targeted moments across exchange rate regimes. All parameters are the same as in the main text, and only $\varrho$ changes. Aggregate volatility is higher under more rigid regimes. The standard deviation of GDP rises from 2.5 percent under the flexible regime to 3.2 percent under the rigid regime, and the relative volatility of investment increases as well. In line with the impulse responses in the main text (Figure 8), the pass-through of the global price of risk to the EBP also increases with the degree of rigidity. The same shock raises the EBP by 1.2 percentage points under the flexible regime and by 1.7 percentage points under the rigid regime, reflecting the higher quantity of risk documented

in the main text. As a consequence, firms borrow less and, facing higher borrowing costs, the riskiest firms exit more often. Average leverage falls from 0.34 in the flexible regime to 0.27 in the rigid regime, the dispersion of leverage is smaller, and the exit rate rises from 5.1 to 7.2 percent.

Two features of Table C.8 are worth noting. First, as $\varrho$ increases, the correlation between unemployment and GDP becomes monotonically stronger in magnitude. Second, the depreciation of the real exchange rate per unit of EBP response falls monotonically with the degree of rigidity. These two moments discipline $\varrho$ in the calibration.

**Table C.7:** Targeted Cross-Sectional Moments Across Exchange Rate Regimes

| Moment | Data | $\varrho = 0$ (flexible) | $\varrho = 0.25$ | $\varrho = 0.50$ | $\varrho = 0.75$ | $\varrho = 1$ (rigid) |
|---|---|---|---|---|---|---|
| Leverage | 0.29 | 0.34 | 0.32 | 0.30 | 0.28 | 0.27 |
| Exit rate | 5.5% | 5.1% | 5.6% | 6.0% | 6.5% | 7.2% |
| Investment/k (cs std) | 0.25 | 0.23 | 0.23 | 0.24 | 0.24 | 0.24 |
| Leverage (cs std) | 0.22 | 0.28 | 0.27 | 0.26 | 0.25 | 0.24 |
| Correlation size and age | 0.27 | 0.24 | 0.25 | 0.25 | 0.25 | 0.25 |
| Recovery rate | 25% | 27% | 28% | 29% | 30% | 31% |
| Share firms issuing equity | 8% | 10% | 10% | 10% | 9% | 10% |
| Age median public firm | 30 | 31 | 30 | 30 | 30 | 29 |
| Empl. share, age $\leq 1$ | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 |
| Empl. share, $1 <$ age $\leq 10$ | 0.21 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 |

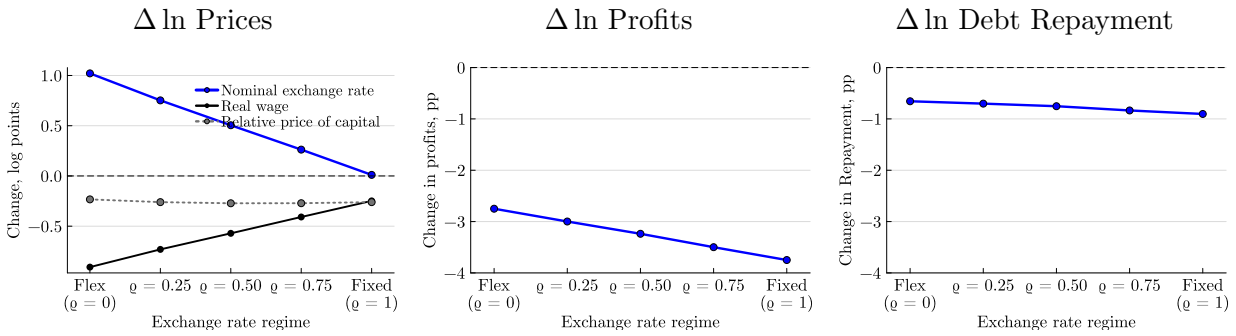
*Note:* The table reports the targeted cross-sectional moments in the exchange rate economies indexed by $\varrho$. All economies keep the baseline calibration.

**Table C.8:** Targeted Aggregate Moments Across Exchange Rate Regimes

| Moment | Data | $\varrho = 0$ (flexible) | $\varrho = 0.25$ | $\varrho = 0.50$ | $\varrho = 0.75$ | $\varrho = 1$ (rigid) |
|---|---|---|---|---|---|---|
| Exports/GDP | 19.7% | 18.7% | 18.7% | 18.7% | 18.8% | 18.8% |
| $\sigma(GDP)$ | 2.3% | 2.5% | 2.6% | 2.8% | 3.0% | 3.2% |
| $\sigma(I)/\sigma(GDP)$ | 2.91 | 3.18 | 3.22 | 3.38 | 3.68 | 3.94 |
| $\rho(Unemprate, GDP)$ | $-0.61$ | – | $-0.58$ | $-0.63$ | $-0.67$ | $-0.71$ |
| $\Delta$ log RER / $\Delta$ EBP | 1.46 | 1.50 | 1.31 | 1.13 | 1.06 | 0.94 |
| $\Delta$ EBP(*) | 1.2% | 1.2% | 1.3% | 1.5% | 1.6% | 1.7% |

*Note:* The table reports the targeted aggregate moments in the exchange rate economies indexed by $\varrho$. All economies keep the baseline calibration. The asterisk denotes moments computed for the pool of Compustat firms used in our empirical analysis.

**Figure C.8:** Exchange Rate Policies: Effects on Prices, Profits, and Repayment




*Note:* The figure reports impulse responses to a contractionary global productivity shock across exchange rate regimes indexed by $\varrho$. Panel (a) shows the nominal exchange rate, the real wage, and the relative price of capital. Panel (b) reports firm profits, and Panel (c) reports debt repayment values.

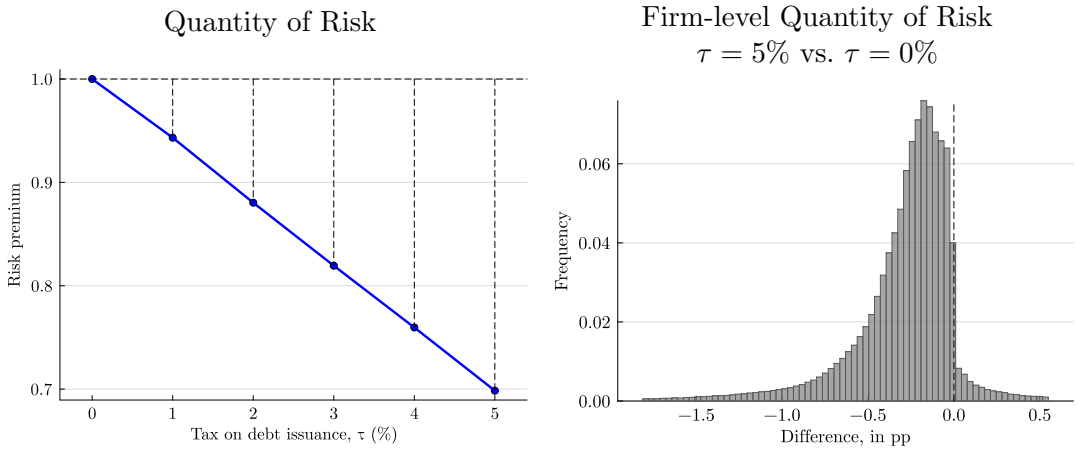
A key result of the main text is that firms' quantity of risk, $\mathbb{C}ov_t(\sigma_A \epsilon^A_{t+1}, \mathcal{R}_{i,t+1})$, differs across exchange rate regimes. In part, this difference is shaped by the response of prices to global productivity shocks, since they influence $\mathcal{R}_{i,t+1}$.

Panel (a) of Appendix Figure C.8 shows the response of prices to a contractionary global productivity shock across exchange rate regimes. The nominal exchange rate depreciates more under flexible regimes, which lowers real wages and helps restore employment. Under more fixed regimes, this adjustment is muted, so real wages fall by less. Movements in the relative price of capital are broadly similar across values of $\varrho$, so they do not explain the differences across regimes. Panels (b) and (c) show how these price responses affect firms' profits and debt repayment. Profits decline more under fixed regimes because the smaller real-wage adjustment keeps labor costs higher in the downturn. Debt repayment values are less affected under fixed regimes, because the smaller depreciation reduces the revaluation of firms' foreign-currency debt. Quantitatively, however, the decline in profits dominates. As a result, firms' repayment values are more sensitive to bad productivity states under fixed regimes, which increases their quantity of risk.

### C.6.2. Macroprudential Policies

Appendix Figures C.9 and C.10 expand on the macroprudential-policy exercise in Section 5.2 and show how a debt tax operates through the risk dimension emphasized in the main text. By making debt issuance more costly, the tax lowers firms' leverage and reduces the

**Figure C.9:** Risk and Debt Tax Policies



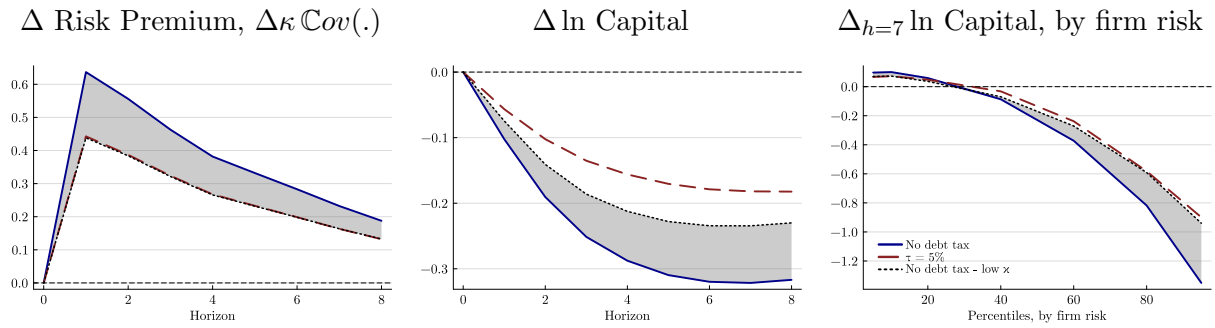

*Note:* The figure reports the effect of a debt tax $\tau$ on firms' quantity of risk. Panel (a) compares the quantity of risk across the baseline economy and the economy with the debt tax. Panel (b) reports the firm-level difference in the quantity of risk between an economy under $\tau = 5\%$ and the baseline economy.

covariance between aggregate shocks and repayment values, $\mathbb{C}ov_t(\sigma_A \epsilon^A_{t+1}, \mathcal{R}_{i,t+1})$. Figure C.9 documents this mechanism. Panel (a) shows that the quantity of risk is lower in the economy with the debt tax. Panel (b) shows that the quantity of risk falls for most firms in the economy.

Figure C.10 shows the macroeconomic implications. With a lower quantity of risk, the same increase in $\kappa$ generates a smaller increase in risk premia (Panel a) and a milder contraction in aggregate capital (Panel b).

We isolate the risk dimension of the policy following the same logic as in our analysis of exchange rate regimes. We consider a counterfactual increase in $\kappa$ in the baseline economy, without debt taxes, that leads to the same increase in risk premia as that observed in the economy with $\tau = 5\%$ (Panel a). The gray area in Panel (b) shows that the risk dimension accounts for about three-fifths of the attenuation of the capital contraction induced by the tax. Panel (c) shows that the effects of the tax are concentrated among the riskiest firms, and that for those firms the risk dimension accounts for nearly all of the attenuation. These firms are the most leveraged, so the tax reduces their debt exposure the most and their borrowing costs respond less to the shock.

**Figure C.10:** The Risk Dimension of Debt Tax Policies:
Responses to Global Price of Risk Increases




*Note:* Impulse responses to a shock to the global price of risk ($\Delta\kappa > 0$) in the baseline economy and in an economy with a debt tax $\tau = 5\%$. Blue (red) lines show the dynamics in the baseline economy (in the economy with the debt tax). The black dotted lines report the results for the baseline economy in which we adjust the $\kappa$ shock so that the dynamics of the risk premium match those in the economy with the debt tax. The gray area captures the attenuation attributable to the lower quantity of risk induced by the tax. Panel (a) reports the response of the risk premium component $\Delta\kappa\,\mathbb{C}ov(.)$. Panel (b) reports the response of aggregate capital. Panel (c) reports the response of capital at horizon $h = 7$ across firms sorted by pre-shock default risk.

## C.7. Alternative Economic Environments

This appendix provides further details on the model variants studied in Section 6. We begin with the targeted moments across variants and then describe each variant in detail.

Tables C.9 and C.10 report the targeted cross-sectional and aggregate moments in the model variants. We do not recalibrate the model in each variant. Some moments therefore change, reflecting changes in the stationary distribution of firms. In the domestic-debt economy, firms' debt payments accrue to households rather than to foreign lenders. This raises household income and the demand for home goods, so the downward wage constraint essentially never binds and average unemployment falls from 1.5 percent to close to zero. With unemployment at zero most of the time, its correlation with GDP is close to zero. The correlation is also somewhat weaker in the economy with imported investment goods, in which part of investment demand falls on foreign goods.

**Table C.9:** Targeted Cross-Sectional Moments Across Model Variants

| | | | Firm discount factor | | | Imported goods | |
|---|---|---|---|---|---|---|---|
| Moment | Baseline | Local currency debt | Risk-averse domestic investors | Risk-averse foreign investors | Domestic debt and banks | Investment goods | Intermediate inputs |
| Leverage | 0.32 | 0.31 | 0.23 | 0.25 | 0.38 | 0.32 | 0.33 |
| Exit rate | 5.6% | 5.4% | 17.7% | 13.4% | 5.0% | 5.6% | 5.5% |
| Investment/k (cs std) | 0.23 | 0.23 | 0.29 | 0.27 | 0.23 | 0.23 | 0.23 |
| Leverage (cs std) | 0.27 | 0.27 | 0.23 | 0.24 | 0.30 | 0.27 | 0.28 |
| Correlation size and age | 0.25 | 0.24 | 0.31 | 0.30 | 0.24 | 0.26 | 0.26 |
| Recovery rate | 28% | 29% | 33% | 31% | 26% | 27% | 27% |
| Share firms issuing equity | 10% | 10% | 12% | 11% | 11% | 10% | 10% |
| Age median public firm | 30 | 31 | 26 | 27 | 31 | 30 | 30 |
| Empl. share, age $\leq 1$ | 0.04 | 0.04 | 0.07 | 0.06 | 0.03 | 0.04 | 0.04 |
| Empl. share, $1 <$ age $\leq 10$ | 0.26 | 0.25 | 0.37 | 0.35 | 0.24 | 0.26 | 0.26 |

*Note:* The table reports the targeted cross-sectional moments in the baseline economy and in the model variants of Section 6. All baseline parameters are held fixed, except for the parameters and normalizations that define each variant.

**Table C.10:** Targeted Aggregate Moments Across Model Variants

| | | | Firm discount factor | | | Imported goods | |
|---|---|---|---|---|---|---|---|
| Moment | Baseline | Local currency debt | Risk-averse domestic investors | Risk-averse foreign investors | Domestic debt and banks | Investment goods | Intermediate inputs |
| Exports/GDP | 18.7% | 18.7% | 18.4% | 18.3% | 17.2% | 22.1% | 28.0% |
| $\sigma(GDP)$ | 2.6% | 2.6% | 2.7% | 2.6% | 2.4% | 2.5% | 2.5% |
| $\sigma(I)/\sigma(GDP)$ | 3.22 | 3.26 | 4.42 | 3.34 | 3.59 | 3.41 | 3.47 |
| $\rho(Unemprate, GDP)$ | −0.58 | −0.54 | −0.54 | −0.51 | −0.06 | −0.47 | −0.45 |
| $\Delta$ log RER | 1.7% | 2.0% | 1.1% | 2.1% | 0.2% | 1.5% | 1.2% |
| $\Delta$ EBP(*) | 1.3% | 1.2% | 1.6% | 1.4% | 1.0% | 1.3% | 1.2% |

*Note:* The table reports the targeted aggregate moments in the baseline economy and in the model variants of Section 6. All variants keep the baseline calibration. The asterisk denotes moments computed for the pool of Compustat firms used in our empirical analysis.

### C.7.1. Local-Currency Debt

Our baseline model assumes that firms' debt is denominated in foreign currency. In this variant, we instead assume that firms' debt is denominated in local currency. The key difference is that repayments are now fixed in domestic currency from the firm's perspective, while foreign lenders are exposed to exchange rate risk. The bond-price schedule is therefore

$$q\left(k', b', z, \boldsymbol{S}\right) = \mathbb{E}_{(z', \boldsymbol{S}')|(z, \boldsymbol{S})}\left[\Lambda^{\star}(\boldsymbol{S}, \boldsymbol{S}')\, \frac{\xi\left(\boldsymbol{S}\right)}{\xi\left(\boldsymbol{S}'\right)}\, \mathcal{R}\left(k', b', z', \boldsymbol{S}'\right)\right]. \tag{C.8}$$

When debt is denominated in local currency, firms' dividends are given by

$$d = \pi(k, z, \boldsymbol{S}) - p_k(\boldsymbol{S}) I\left(k', k\right) + \frac{1}{P(\boldsymbol{S})} \Delta\mathcal{B}(b', b, \boldsymbol{S}), \tag{C.9}$$

where $\Delta\mathcal{B}\left(b', b, \boldsymbol{S}\right)$ is defined analogously to Equation (6), except that the debt contract is denominated in local currency:

$$\Delta\mathcal{B}\left(b', b, \boldsymbol{S}\right) = q(.)\left[b' - (1-m)b\right] - \left[(1-m)\upsilon + m\right] b - \Psi_b\left(b', b\right).$$

Analogously, in the event of exit, lenders' recovery value, expressed in local currency, is $\mathcal{R}^{\text{exit}}\left(k, b, z, \boldsymbol{S}\right) = \lambda \frac{\pi(k,z,\boldsymbol{S}) + (1-\delta)\, k\, p_k(\boldsymbol{S})}{b} P\left(\boldsymbol{S}\right)$.

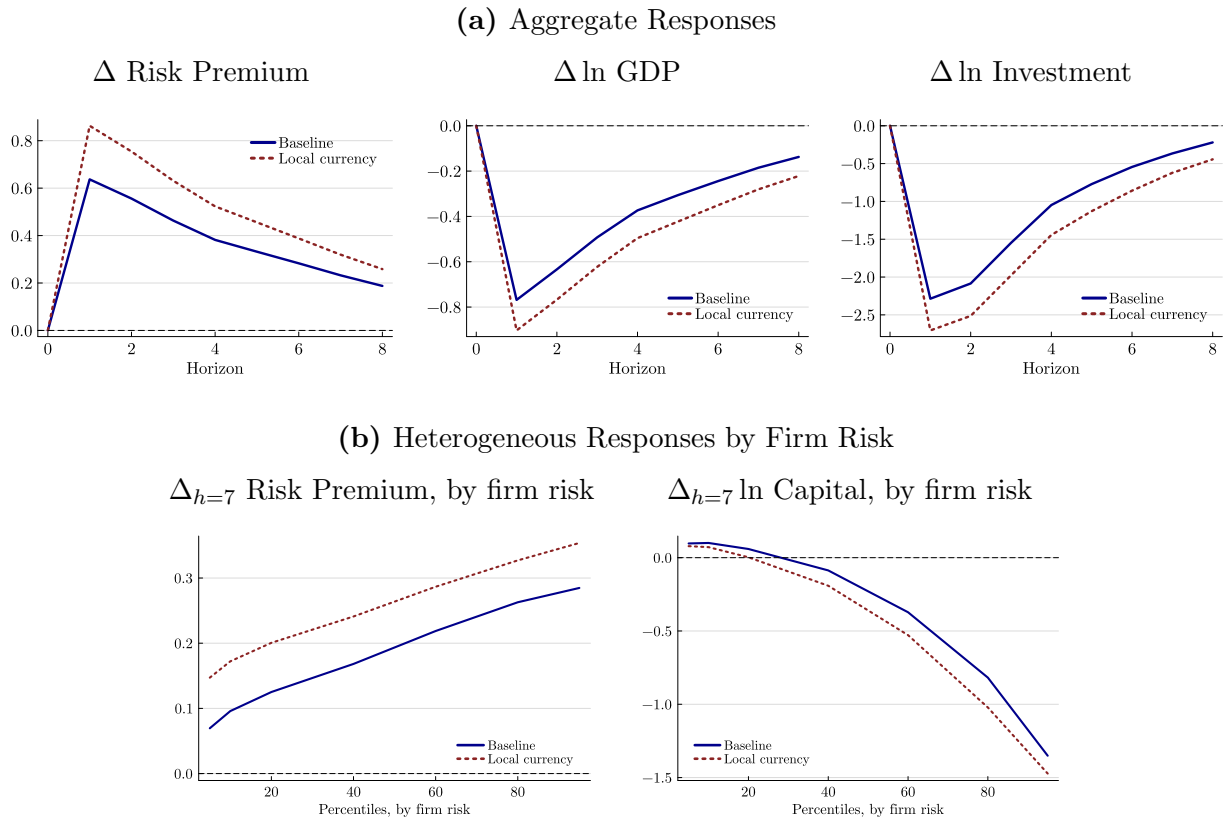
As in the main text, it is useful to write the pricing equation using the covariance representation:

$$\begin{aligned} q\left(k', b', z, \boldsymbol{S}\right) \approx \beta^\star\, \mathbb{E}_{(z', \boldsymbol{S}')|(z,\boldsymbol{S})} \left[\frac{\xi}{\xi'} \mathcal{R}\left(k', b', z', \boldsymbol{S}'\right)\right] \\ - \beta^\star\, \kappa\, \mathbb{C}ov_{(z', \boldsymbol{S}')|(z,\boldsymbol{S})} \left[\sigma_A \epsilon^{A\prime}, \frac{\xi}{\xi'} \mathcal{R}\left(k', b', z', \boldsymbol{S}'\right)\right], \end{aligned} \tag{C.10}$$

which corresponds to Equation (24) in the main text. A firm's exposure to the global financial cycle now depends on the covariance between aggregate productivity innovations and the foreign-currency value of local-currency repayments, $\frac{\xi}{\xi'}\mathcal{R}(.)$. In bad aggregate states, the domestic currency tends to depreciate, lowering the value of local-currency repayments from the perspective of foreign lenders. This introduces a currency-risk component in the quantity of risk. Thus, even though local-currency debt protects firms from the direct debt-revaluation channel, it shifts exchange rate risk to foreign lenders and can raise the risk premium they require.

**Positive analysis.** Figure C.11 compares the response to an increase in the global price of risk in the baseline economy with foreign-currency debt and in the alternative economy with local-currency debt. In both cases, the government follows the exchange rate policy calibrated in the main text. The local-currency economy generates a larger increase in risk premia because foreign lenders bear currency risk. This leads to a larger contraction in aggregate output and investment: as reported in Table 4, the capital contraction is about 30 percent larger than in the baseline economy. The cross-sectional pattern of firm responses remains similar to the baseline specification.

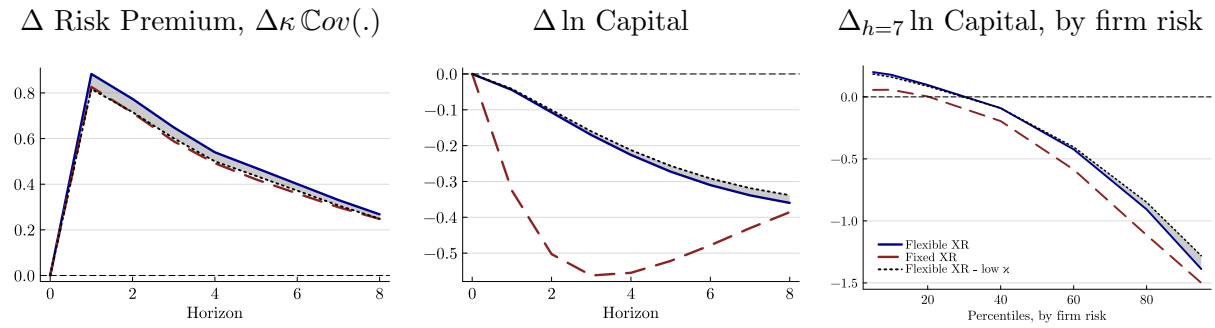
**Figure C.11:** Responses to Global Price of Risk Increases: The Role of Debt Denomination




*Note:* Panel (a) shows aggregate impulse responses to an increase in the global price of risk ($\Delta\kappa > 0$). The panels report the dynamics of the aggregate risk premium, GDP, and investment. Panel (b) shows responses by firm risk at horizon $h = 7$. Firms are sorted by their pre-shock default probability. The left panel shows the change in firm-level risk premia and the right panel shows the change in firms' capital. Solid blue lines show the baseline economy with foreign-currency debt. Dotted red lines show the economy with local-currency debt.

**Normative analysis.** Figure C.12 repeats the exchange rate regime comparison of Section 5.1 for the economy with local-currency debt. The left panel shows that the increase in the risk premium is now similar across regimes. Recall from Figure 8 that the fixed regime features a higher quantity of risk because its price responses are muted. Under local-currency debt, the flexible regime adds the currency risk described above, which offsets most of this difference. The middle panel shows the implications for capital. As in Section 5.1, the gray area is the difference between the flexible-regime response and the response of the same economy to a rescaled shock that replicates the fixed-regime risk-premium path. It therefore isolates the contribution of the risk dimension. With similar risk-premium responses across regimes, this area is small, and the difference in capital mostly reflects the response of prices.

**Figure C.12:** The Risk Dimension of Exchange Rate Regimes:
Responses to Global Price of Risk Increases, Local-Currency Debt




*Note:* Impulse responses to a shock to the global price of risk ($\Delta\kappa > 0$) under local-currency debt. Blue (red) lines show the dynamics under a flexible (fixed) exchange rate regime. The black dotted lines report the flexible-regime results after adjusting the $\kappa$ shock so that the risk-premium dynamics match those under the fixed regime. The gray area captures the additional contraction attributable to the larger risk dimension under the flexible regime when debt is denominated in local currency.

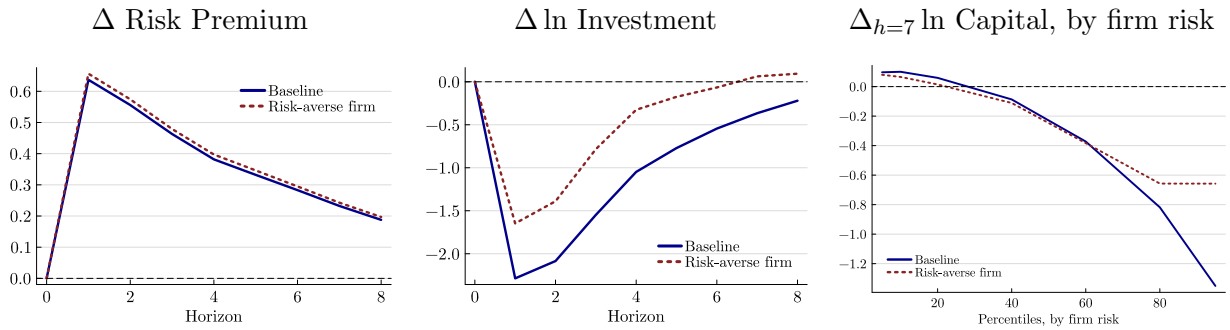
The right panel shows a similar pattern across firms.

### C.7.2. Other Model Variants

**Risk-averse domestic investors.** In the baseline model, households have linear utility, so firms discount future dividends at the constant factor $\beta$. In this variant, we consider an economy in which firms' owners are risk averse and value dividends with the stochastic discount factor in Equation (25), with a constant domestic price of risk $\kappa_D$. We set $\kappa_D$ to the unconditional average of $\kappa$. Given the calibrated transition probabilities, the economy spends one-fourth of the time in the high-$\kappa$ state, so $\kappa_D = 12.5$. The rest of the model is unchanged. In particular, foreign lenders continue to price firms' debt with the time-varying price of risk $\kappa_t$, so the shock still raises borrowing costs as in the baseline economy. The only difference is that firms now discount their own future payoffs with risk-adjusted weights.

Table 4 shows that domestic risk aversion dampens the transmission: the peak capital contraction is about half as large as in the baseline economy. The reason is that risk-averse owners place a higher value on payoffs in bad aggregate states, so firms operate with lower leverage (Table C.9). With less debt outstanding, the increase in the global price of risk affects a smaller share of firms' financing, which reduces its pass-through to investment. Figure C.13 illustrates this result. The risk-premium response is similar to the baseline,

**Figure C.13:** Responses to Global Price of Risk Increases: Risk-Averse Domestic Investors




*Note:* The figure shows impulse responses to an increase in the global price of risk ($\Delta\kappa > 0$). The left and middle panels report the dynamics of the aggregate risk premium and investment. The right panel reports the change in firms' capital at horizon $h = 7$ across firms sorted by pre-shock default probability. Solid blue lines show the baseline economy, in which firms discount future dividends at the constant factor $\beta$. Dotted red lines show the economy in which firms' owners are risk averse, with $\kappa_D = 12.5$.

while the contraction in investment is smaller. The dampening is concentrated among the riskiest firms, which reduce their debt the most in this economy.

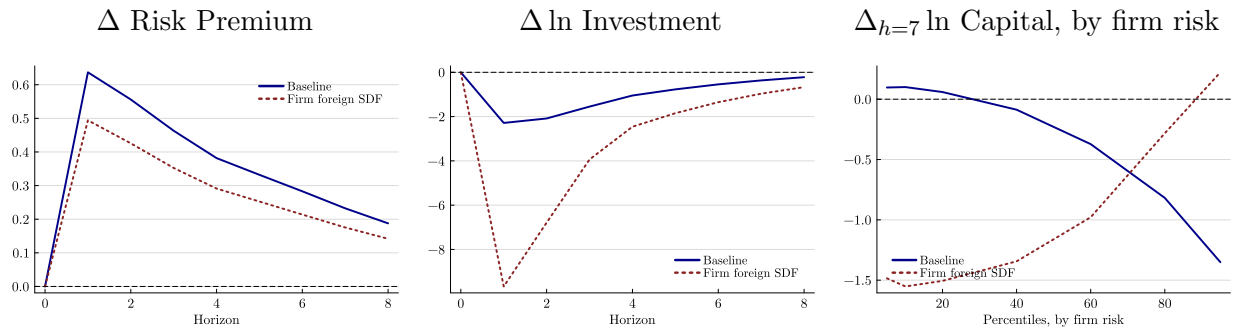
**Foreign investors' discount factor.** In the baseline model, firms discount future payoffs using domestic households' stochastic discount factor. In this variant, we instead consider an economy in which firms discount payoffs using the global investors' stochastic discount factor, adjusted for changes in the real exchange rate:

$$\Lambda_{t,t+1} = \beta^\star \times \exp\left(-\kappa_t\,\sigma_A\,\epsilon^A_{t+1} - \frac{1}{2}\kappa_t^2\,\sigma_A^2\right) \times \frac{\varepsilon_t}{\varepsilon_{t+1}}, \tag{C.11}$$

where $\frac{\varepsilon_t}{\varepsilon_{t+1}}$ converts foreign-currency payoffs into units of the domestic consumption bundle. In the baseline model, households have discount factor $\beta$, calibrated with $\beta < \beta^\star$ to match average leverage in the data. In this variant, we instead set households' discount factor to $\beta^\star$, but introduce an exogenous firm survival probability $\varpi$ such that $\beta = \beta^\star\varpi$, as in Cooley and Quadrini (2001). This reduces firms' effective discount factor and allows the economy to match a similar average leverage without recalibrating the full model. The remaining parameters are kept at the values reported in Tables 2 and C.2.

Figure C.14 presents the results. When firms discount payoffs with the global investors' stochastic discount factor, an increase in the global price of risk raises the weight firms place on bad aggregate states, in which the return to capital is low. This lowers the present value of future payoffs and leads them to reduce investment. The contraction in aggregate capital

**Figure C.14:** Responses to Global Price of Risk Increases: Foreign Investors' Discount Factor




*Note:* The figure compares changes in risk premia and investment responses to an increase in the global price of risk ($\Delta\kappa > 0$). Blue lines show the baseline model, in which firms discount payoffs using households' stochastic discount factor. Red lines show the counterfactual economy in which firms discount payoffs using global investors' stochastic discount factor. The right panel shows investment responses by firm risk at horizon $h = 7$.

is therefore larger than in the baseline economy. The risk channel is much larger, and the stronger contraction triggers a larger decline in prices, so the competitiveness channel offsets part of this effect (Table 4). More importantly, the cross-sectional pattern is reversed. Safer firms reduce investment the most, and the capital of the riskiest firms expands at the peak horizon. This is the opposite of the empirical pattern documented in Section 2. Through the lens of the model, this result supports the baseline assumption that firms discount payoffs with the stochastic discount factor of domestic households rather than that of global investors.

**Domestic debt and financial intermediaries.** Our baseline model assumes that firms borrow directly from risk-averse global investors. In this variant, we consider an extension in which firms borrow from a domestic bank. The bank finances its lending with a mix of domestic deposits and bonds issued in international markets. Firms' debt remains denominated in foreign currency, as in the baseline model.

The domestic bank's balance sheet is

$$\xi_t \int_i q^B_{i,t} B_{i,t+1} = q^N_t N_{t+1} + \xi_t q^F_t F^\star_{t+1}, \tag{C.12}$$

where $\int_i q^B_{i,t} B_{i,t+1}$ denotes the value of the bank's loans to domestic firms in foreign currency, $q^N_t N_{t+1}$ is the market value of domestic deposits, and $q^F_t F^\star_{t+1}$ captures foreign-currency bond

issuance in international markets.[29] The exchange rate $\xi_t$ converts foreign-currency assets and liabilities into domestic currency.

We let $\omega_t$ denote the bank's share of external liabilities relative to total liabilities:

$$\omega_t \equiv \frac{\xi_t q_t^F F_{t+1}^\star}{q_t^N N_{t+1} + \xi_t q_t^F F_{t+1}^\star}. \tag{C.13}$$

From the bank's balance sheet, we get that

$$\omega_t = \frac{q_t^F F_{t+1}^\star}{\int_i q_{i,t}^B B_{i,t+1}}.$$

Solving for deposits,

$$N_{t+1} = \frac{\xi_t}{q_t^N}(1-\omega_t)\int_i q_{i,t}^B B_{i,t+1}. \tag{C.14}$$

Using this expression, bank profits in domestic currency are

$$\Pi_t^B = \xi_t \int_i \mathcal{R}_{i,t} B_{i,t} - N_t - \xi_t F_t^\star, \tag{C.15}$$

where $\mathcal{R}_{i,t}$ denotes the foreign-currency loan repayment of firm $i$ as defined in Equation (B.4).

To keep the model tractable, we abstract from modeling the bank's investment and funding decisions explicitly. Instead, we assume that banks have a pre-existing financial position (as in De Leo, Gopinath and Kalemli-Özcan, 2024). In particular, we treat $\omega_t$ as an exogenous process that determines the share of firms' debt indirectly financed by global investors.

In addition, we assume that the marginal investor behind the local bank is the global investor. This implies that the bank's stochastic discount factor follows the same process as in Equation (12), $\Lambda_{t,t+1}^\star = \beta^\star \times \exp\left(-\kappa_t \sigma_A \epsilon_{t+1}^A - \frac{1}{2}\kappa_t^2 \sigma_A^2\right)$. We adopt this assumption for tractability. In a model in which local banks are risky and financially constrained, changes in firms' riskiness can affect banks' own stochastic discount factor and the supply of credit. This mechanism can generate a feedback loop in which an aggregate shock is amplified by further contractions in credit supply (as in Moretti, 2021).

The household budget constraint is

$$P_t c_t + q_t^N N_{t+1} = W_t l_t + P_t D_t + P_t \Pi_{K,t} + N_t + (1-\hat{\omega}_t)\Pi_t^B, \tag{C.16}$$

[29] We use uppercase $B_{i,t}$ to denote banks' demand for firms' debt. The lowercase $b_{i,t}$ denotes firms' supply of debt.

where $q_t^N N_{t+1}$ denotes households' new deposits, $N_t$ denotes deposits that mature today, and $(1-\hat{\omega}_t)\Pi_t^B$ captures bank profits transferred to households. As in Equation (17), $D_t$ denotes net cash flows between production firms and households and $\Pi_{K,t}$ the profits of capital producers. We allow for $\hat{\omega}_t \in [0,1]$ to capture the fact that a share of the bank may be owned by global investors.

From Equations (C.13)–(C.14), we get that foreign funding and deposits are

$$F_t^\star = \frac{\omega_{t-1}}{q_{t-1}^F}\int_i q_{i,t-1}^B B_{i,t} \quad \text{and} \quad N_t = \frac{\xi_{t-1}}{q_{t-1}^N}(1-\omega_{t-1})\int_i q_{i,t-1}^B B_{i,t}.$$

Replacing these expressions in banks' profits and using the fact that

$$q_t^N N_{t+1} = (1-\omega_t)\,\xi_t \int_i q_{i,t}^B B_{i,t+1},$$

we can rewrite the budget constraint as:

$$P_t\, c_t + \left[(1-\omega_t)\,\xi_t \int_i q_{i,t}^B B_{i,t+1}\right] = W_t\, l_t + P_t D_t + P_t \Pi_{K,t}$$
$$+ \left((1-\hat{\omega}_t)\xi_t \int_i \mathcal{R}_{i,t} B_{i,t} - (1-\hat{\omega}_t)\xi_t \frac{\omega_{t-1}\int_i q_{i,t-1}^B B_{i,t}}{q_{t-1}^F} + \hat{\omega}_t \frac{\xi_{t-1}}{q_{t-1}^N}(1-\omega_{t-1})\int_i q_{i,t-1}^B B_{i,t}\right).$$

Under $\omega_t = \hat{\omega}_t \to 1$, households' budget constraint simplifies to $P_t c_t = W_t l_t + P_t D_t + P_t \Pi_{K,t}$. This case captures the baseline specification in which banks are foreign owned and credit to domestic firms is ultimately provided by global investors. In the opposite case, with $\omega_t = \hat{\omega}_t \to 0$, the budget constraint simplifies to

$$P_t c_t = W_t l_t + P_t D_t + P_t \Pi_{K,t} + \xi_t \left(\int_i \mathcal{R}_{i,t} B_{i,t} - \int_i q_{i,t}^B B_{i,t+1}\right). \tag{C.17}$$

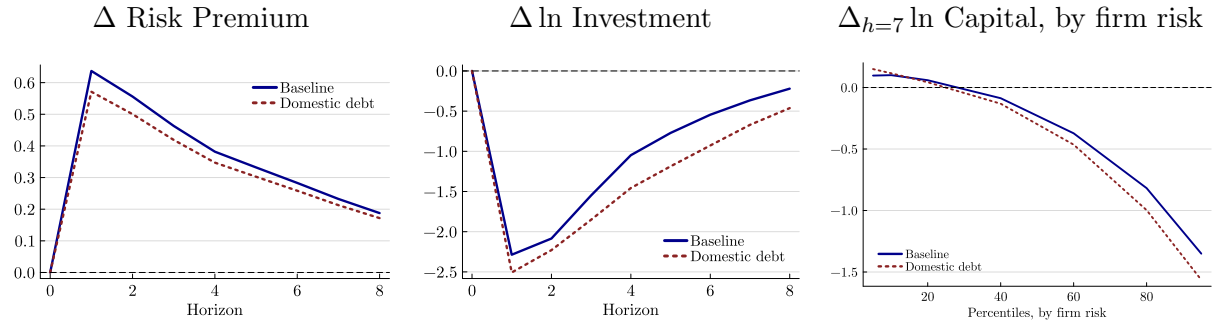
Relative to the baseline specification in Equation (17), local credit intermediated by domestically owned banks introduces an additional term in the households' budget constraint,

$$\xi_t \left(\int_i \mathcal{R}_{i,t} B_{i,t} - \int_i q_{i,t}^B B_{i,t+1}\right).$$

For constant aggregate loan demand ($B_{i,t+1} = B_{i,t}$ for every firm $i$), this term captures the consolidated net gains or losses of the domestic banking sector, converted into domestic currency. More generally, when $B_{i,t+1} \neq B_{i,t}$, it also captures changes in household savings needed to finance changes in credit demand. In the quantitative exercise of Section 6, we solve the case with $\omega_t = \hat{\omega}_t = 0$, in which all debt is domestic. In this case, there are no cross-border capital flows and trade is balanced period by period.

Figure C.15 reports the responses to an increase in the global price of risk in this economy. The increase in the risk premium and the contraction in investment are similar to those in the baseline economy, both in the aggregate and across the firm-risk distribution. Consistent with Table 4, the risk channel is essentially unchanged, while the total contraction is somewhat larger because the competitiveness channel is weaker. Firms' debt payments now accrue to domestic households, which sustains domestic demand and dampens the decline in the prices of the home good and of capital.

**Figure C.15:** Responses to Global Price of Risk Increases:
Domestic Debt and Financial Intermediaries




*Note:* The figure shows impulse responses to an increase in the global price of risk ($\Delta\kappa > 0$). The left and middle panels report the dynamics of the aggregate risk premium and investment. The right panel reports the change in firms' capital at horizon $h = 7$ across firms sorted by pre-shock default probability. Solid blue lines show the baseline economy, in which firms borrow directly from global investors. Dotted red lines show the economy in which all debt is held by domestic banks.

**Investment technology and imported inputs.** We consider two forms of import dependence. In the first, the capital good itself combines home and foreign goods, using the same CES aggregator of the consumption good, so imported goods enter investment expenditure directly. In the second, the heterogeneous firms use an imported intermediate input in production, so imported goods enter the cost of producing every unit of output. A depreciation raises the cost of capital in the first extension and lowers firms' earnings in the second.

In the first extension, the capital producer solves the same problem as in the baseline economy (see Section 3.3), but now the capital good is a CES bundle of home and foreign goods:

$$\Phi_t = \left[\omega_H^{1/\eta} I_{H,t}^{1-1/\eta} + (1-\omega_H)^{1/\eta} I_{F,t}^{1-1/\eta}\right]^{\frac{\eta}{\eta-1}},$$

where $I_{H,t}$ and $I_{F,t}$ denote the home and foreign components of investment. The home-bias weight $\omega_H$ and the elasticity $\eta$ are the same as in the households' consumption bundle, so that the price of one unit of the investment good is $P_{I,t} = P_t$. The term $\Phi_t$ denotes the total quantity of the investment good required to deliver $I_t$ units of installed capital, including the resources used in adjustment costs. Cost minimization gives the demands for the two components,

$$I_{H,t} = \omega_H \, p_{H,t}^{-\eta} \, \Phi_t \qquad \text{and} \qquad I_{F,t} = (1 - \omega_H) \, \varepsilon_t^{-\eta} \, \Phi_t.$$

Unlike the baseline model, only the $I_{H,t}$ component enters the home-good market-clearing condition, which is given by $Y_t = C_{H,t} + I_{H,t} + Z_t + Q_t$, where $C_{H,t}$ and $Q_t$ are as in Appendix B.4, except that the adjustment costs of the capital producer are now part of $\Phi_t$ and therefore of $I_{H,t}$ and $I_{F,t}$.

After a depreciation, the price of the home good falls relative to the consumption bundle. In the baseline economy, capital is priced in home goods, so it becomes cheaper and the competitiveness channel is partly a fall in the cost of investment. In this extension, the price of capital is tied to the consumption bundle and falls by less, so that part of the competitiveness channel is weakened, while firms' revenues in units of the consumption bundle are unaffected. The firm problem is otherwise unchanged.

The second extension places the imported intermediate input in the production of the heterogeneous firms. Let $y_{i,t}$ denote value added, produced with the technology in Equation (2). Gross output combines value added with an imported input $M_{i,t}$,

$$\tilde{y}_{i,t} = \mathcal{A}_F \, y_{i,t}^{1-\mu_F} M_{i,t}^{\mu_F}, \quad \text{with} \quad \mathcal{A}_F = \left[ (1 - \mu_F)^{1-\mu_F} \, \mu_F^{\mu_F} \right]^{-1},$$

where $\mu_F$ is the share of the imported input in gross output and $\mathcal{A}_F$ is a normalization constant. As in the first extension, the foreign-currency price of the input is normalized to one, so its price in units of the consumption bundle is $p_{M,t} = \varepsilon_t$. We set $\mu_F = 0.085$ to match the imported-input share of gross output implied by Mendoza and Yue (2012).[30]

The input is bought and used within the period and is paid out of current revenue, so it affects the firm only through current earnings. The first-order condition for the imported

[30] This share combines an intermediate-input share of gross output of 0.43 with an imported share of 0.20 within intermediates.

input sets its cost equal to a constant share of gross revenue, $p_{M,t}\, M_{i,t} = \mu_F\, p_{H,t}\, \tilde{y}_{i,t}$. Substituting this condition into the production function above, gross revenue net of the input bill can be written as

$$p_{H,t}\, \tilde{y}_{i,t} - p_{M,t}\, M_{i,t} = \tilde{p}_{H,t}\, y_{i,t}, \qquad \text{with} \qquad \tilde{p}_{H,t} \equiv p_{H,t} \left( \frac{\xi_t}{P_{H,t}} \right)^{-\frac{\mu_F}{1-\mu_F}}.$$

Firms therefore solve the same dynamic problem as in Section 3.1 with $\tilde{p}_{H,t}$ in place of $p_{H,t}$ in the labor demand and earnings equations (Equations (4) and (5) in the main text).[31] In this extension, a depreciation raises the cost of the imported input and lowers $\tilde{p}_{H,t}$ relative to $p_{H,t}$, which lowers firms' profits and works against the competitiveness channel.

The home-good market-clearing condition is analogous to that of the baseline model,

$$\tilde{Y}_t = C_{H,t} + I_{H,t} + Z_t + Q_t,$$

where the expressions for home-good consumption $C_{H,t}$, investment $I_{H,t}$, and the resource costs $Q_t$ are those in Appendix B.4. Gross output of the home good, $\tilde{Y}_t \equiv \int \tilde{y}_{i,t}\, \mathrm{d}i$, can be written as

$$\tilde{Y}_t = \frac{1}{1-\mu_F} \left( \frac{\xi_t}{P_{H,t}} \right)^{-\frac{\mu_F}{1-\mu_F}} Y_t.$$

In both extensions, introducing imported goods without any other change would alter the stationary real exchange rate. To see this, consider the second extension. Aggregating the firms' first-order condition for the imported input gives $\varepsilon_t M_t = \mu_F\, p_{H,t} \tilde{Y}_t$, so that $p_{H,t}\tilde{Y}_t - \varepsilon_t M_t = \tilde{p}_{H,t} Y_t$. Using this expression and the home-good market-clearing condition,

$$\tilde{p}_{H,t}\, Y_t - C_t - p_{H,t}\, (I_{H,t} + Q_t) = p_{H,t}\, Z_t - \varepsilon_t\, (C_{F,t} + M_t)\,,$$

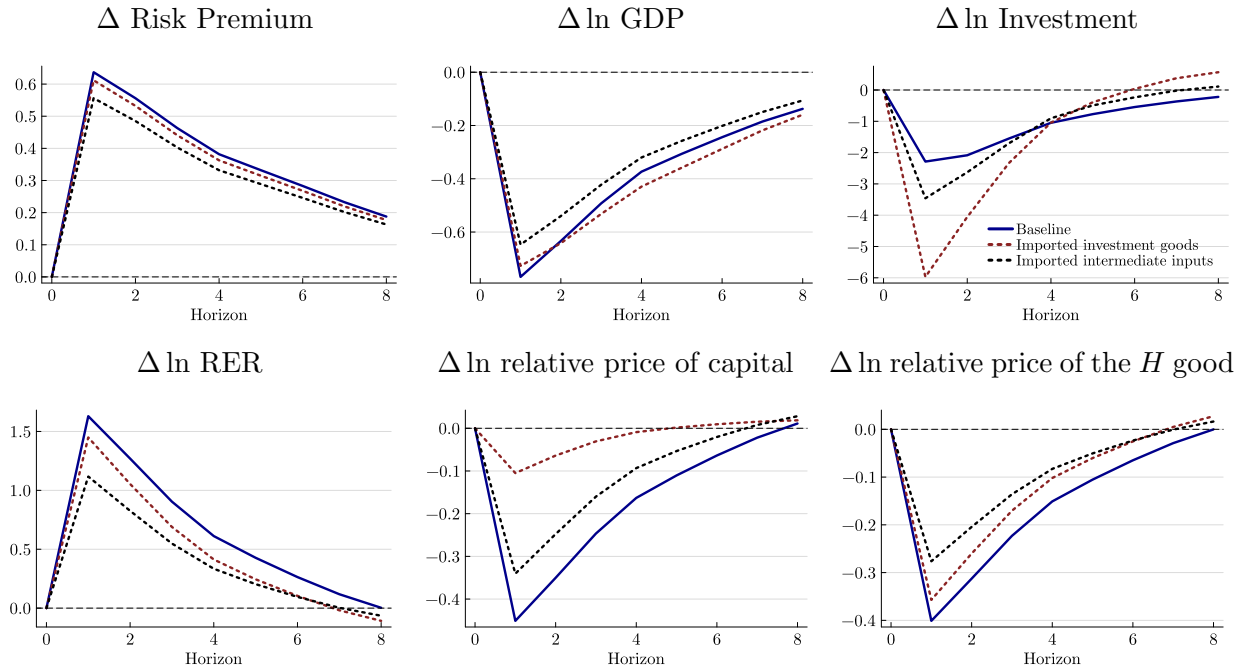
where $C_t = p_{H,t} C_{H,t} + \varepsilon_t C_{F,t}$ is consumption in units of the bundle. The identity for the first extension is the same, with the foreign component of investment $I_{F,t}$ in place of $M_t$. At the stationary terms of trade, the left-hand side of the identity is the same as in the baseline model, while imports are larger by the import bill, the foreign component of investment in the first extension and the intermediate input in the second. Since net debt payments pin down the trade balance, exports must be larger by the same amount, which requires a depreciated real exchange rate unless foreign demand is larger. In both extensions, we therefore shift foreign demand $c^\star$ by the stationary import bill, so that the terms of trade

[31] As defined, the constant $\mathcal{A}_F$ leads to $\tilde{p}_{H,t} = p_{H,t}$ when the imported input and the home good have the same price.

equal one in the stationary state and the stationary equilibrium is that of the baseline model. The shift is the foreign share of investment in the first extension and $\frac{\mu_F}{1-\mu_F}$ times value added in the second.

Figure C.16 compares the responses to an increase in the global price of risk across the baseline economy and the two extensions. The drop in investment is larger in both extensions. As Table 4 in the main text shows, the risk channel is broadly similar across the three economies, though somewhat smaller in the two extensions than in the baseline. The larger drop in investment thus reflects a weaker competitiveness channel. This channel turns mildly contractionary in the CES-investment extension and remains expansionary but about half as large in the imported-inputs extension. The bottom panels of Figure C.16 show the price responses behind these differences. In the baseline economy, the price of capital falls with the price of the home good, which makes investment cheaper. In the first extension, the depreciation raises the cost of the foreign component of investment, so the price of capital falls by less. In the second extension, the price of capital falls somewhat less than in the baseline economy, and, in addition, the depreciation raises the cost of the imported input. The effective price of output, $\tilde{p}_{H,t}$, therefore falls by more than the price of the home good shown in the figure, and firms gain less from the depreciation.

**Figure C.16:** Responses to Global Price of Risk Increases: Investment Technology and Imported Inputs




*Note:* The figure shows aggregate impulse responses to an increase in the global price of risk ($\Delta\kappa > 0$). The top panels report the dynamics of the risk premium, GDP, and investment. The bottom panels report the dynamics of the real exchange rate, the relative price of capital, and the relative price of the home good. Solid blue lines show the baseline economy, in which capital is produced using the home good. Dotted brown lines show the economy with imported investment goods. Dotted black lines show the economy in which heterogeneous firms use imported intermediate inputs in production.