Firms' Risk and the Transmission of the Global Financial Cycle*

Caitlin Hegarty
Williams College

Matias Moretti
University of Rochester

Pablo Ottonello
University of Maryland and NBER

Diego J. Perez
New York University and NBER

March 20, 2025

Abstract

We study the role of firm heterogeneity for economic transmission in open economies. Using firm-level data from a panel of emerging markets, we document that increases in the global price of risk are followed by heterogeneous investment dynamics, with contractions for risky firms and expansions for risk-free firms. By developing a quantitative heterogeneous-firm open economy model, we show that these cross-sectional empirical patterns can be explained by the presence of indirect channels that mitigate the negative response to external shocks. We use the model to assess macroeconomic transmission during external crises and sudden stops. Our findings indicate that allowing the exchange rate to depreciate during downturns plays a stabilizing role, by reducing risk exposure and facilitating the reallocation of economic activity across firms through larger relative price adjustments.

Keywords: Investment dynamics, sudden stops, global financial cycle, default risk, firm heterogeneity, exchange rates, international transmission.

*Caitlin Hegarty (ceh10@williams.edu): Williams College, Department of Economics. Matias Moretti (matias.moretti@rochester.edu): University of Rochester, Department of Economics. Pablo Ottonello (ottonell@umd.edu): University of Maryland, Department of Economics and NBER. Diego Perez (diego.perez@nyu.edu): New York University, Department of Economics and NBER. We thank Mark Aguiar, Andy Atkeson, Ariel Burstein, Moritz Lenel, Andy Neumeyer, Hélène Rey, 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.

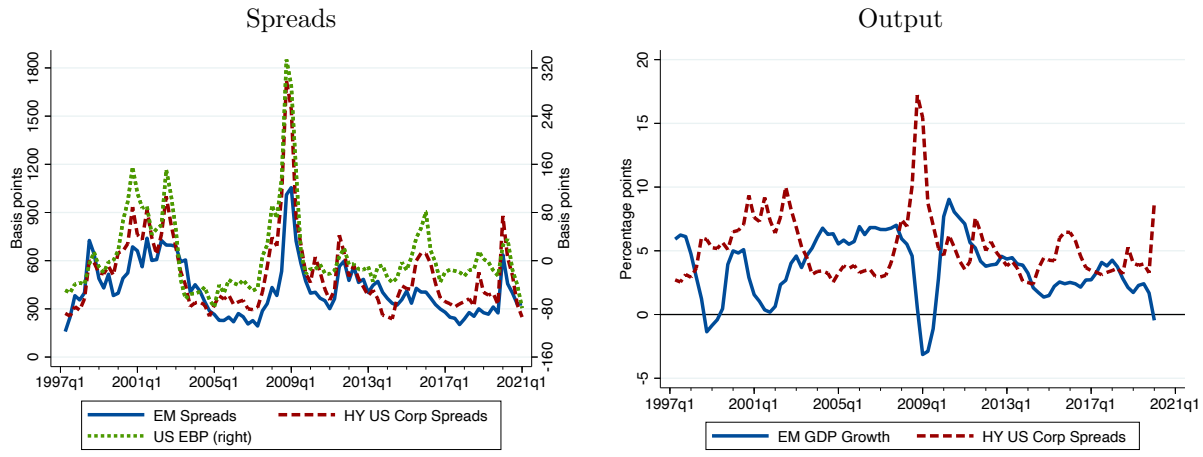
1. Introduction

Risky asset prices and capital flows in the global economy tend to be highly synchronized, reflecting the presence of a "global financial cycle" (Rey, 2013; Kalemli-Ozcan, 2019). As illustrated in Figure 1, emerging markets appear particularly exposed to this cycle, experiencing large swings in economic activity, investment, and exchange rates following changes in global financial conditions. Based on these patterns, a key question is what drives the real transmission of the global financial cycle. This is often framed as a "luck vs. policy" debate (Calvo, 2005): Do surges in global borrowing costs primarily drive investment adjustments, or are these adjustments amplified by currency depreciations and other macroeconomic policies implemented in response to changes in global financial conditions?

In this paper, we address this question 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. Our analysis highlights firms' risk as a key element 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 channel gives rise to a central risk dimension through which macroeconomic policies can stabilize fluctuations. For instance, flexible exchange rate regimes mitigate the aggregate effects of changes in the global price of risk not only through the classic effect of Mundellian channels but also through the effect these channels have on reducing firms' quantity of risk.

The paper begins by documenting the empirical relationship between the global price of risk and firms' investment in emerging markets. For this, we combine data on firm-level balance sheets and external borrowing costs. Using the decomposition of borrowing costs by Gilchrist and Zakrajšek (2012), we document that during external crises (such as those in Figure A.2), the bulk of increases in firms' borrowing costs can be accounted for by increases in the excess bond premium, i.e., the component of firms' spreads orthogonal to their default risk (measured with Merton (1974)'s default model). We then show that increases in the excess bond premium tend to be followed by heterogeneous investment dynamics across firms,

Figure 1: US Borrowing Costs and Emerging Market Outcomes



Note: Panel (a) shows the average corporate bond spread in our emerging market data described in Section 2, Barclays U.S. Corporate High Yield Spread, and the U.S. Excess Bond Premium. Panel (b) plots average U.S. spreads with the average year-over-year growth rate of real GDP in the same sample of emerging markets as panel (a). The emerging markets included are Argentina, Brazil, Chile, Colombia, India, Korea, Mexico, Peru, the Philippines, Thailand, Turkey, and Ukraine. Appendix Figure A.1 shows additional results for investment and real exchange rates.

with contractions for risky firms and expansions for risk-free firms. These heterogeneous dynamics are observed within different sectors, using alternative measures of risk, and cannot be accounted for by other firm-level characteristics or changes in global economic activity.

We then construct a quantitative model that is consistent with the micro-level patterns to study macroeconomic transmission during sudden stops. The model structure is that of a canonical open-economy framework, in which households consume goods produced by the home economy and the rest of the world. In this framework, we introduce heterogeneity and financial frictions for domestic firms in the open economy, that finance their investment with debt subject to default risk. External credit is provided by risk-averse foreign investors, leading to external fluctuations in the required premium for risk. In this environment, fluctuations in the global risk premium affect economic activity through two channels. One is a direct channel, by which changes in the global risk premium affect firms' marginal cost of finance and their investment. The other is an indirect channel, which stems from the feedback between firms' responses, domestic aggregate demand, and exchange rate policy.

Our model analysis indicates that the cross-sectional patterns observed empirically can

be explained by the presence of strong direct channels combined with indirect channels that mitigate the effects of the global risk premium. Since risk-free firms are not affected by direct channels—their borrowing costs remain invariant to changes in the risk premia—their investment expansion following increases in the global risk premium is indicative of the presence of expansionary indirect channels. In our model this is because the decline in labor demand from risky firms induces contractions in real wages and the price of capital goods, which stimulates the investment of risk-free firms through increases in cash flows and the marginal revenue product of capital. During sudden stops, we estimate that the contraction of aggregate investment would be roughly twice as large in the absence of the price changes induced by general equilibrium effects.

Lastly, we use our model as a laboratory to analyze how exchange-rate policy can stabilize/amplify fluctuations in the global risk premium. Our model highlights the role of flexible exchange rates as risk stabilizers. Allowing for exchange rate depreciations in response to increases in the global price of risk mitigates the negative effects in economic activity for two reasons. First, by facilitating the adjustment of factor inputs prices (i.e., speeding up the contraction on wages and the price of capital) currency depreciation free-up firm cash flows during bad times and reduces their default risk. Second, these relative price adjustments facilitates the reallocation of factors toward risk-free firms, which are less financially constrained and increase their scale when the global price of risk increases.

Related literature Our paper contributes to various strands of the literature. First, our paper is related to the literature that studies the global financial cycle and imperfect international capital markets (see, e.g., Rey, 2013; Maggiori, 2021, and references therein). We contribute to this literature by studying the channels of transmission of fluctuations in the global price of risk and their implications for macroeconomic policies. In this sense, our work complements two strands of literature. One that studies the transmission of the shocks in global capital markets to open economies (see, e.g., Baskaya, di Giovanni, Kalemli-Ozcan and Ulu, 2017; Hassan, Schreger, Schwedeler and Tahoun, 2021; Akinci, Kalemli-Ozcan and Queralto, 2022). Another is the closed-economy literature that stresses the relevance of risk premia and

agents' risk-bearing propensity in macroeconomic fluctuations (see, e.g., Bernanke, Gertler and Gilchrist, 1999; He and Krishnamurthy, 2013; Kekre and Lenel, 2022).[1]

Second, our paper contributes to the literature on international business cycles and sudden stops (see, for example, Backus, Kehoe and Kydland, 1992; Aguiar and Gopinath, 2007; Mendoza, 2010). A strand of this literature analyzes the role of fluctuations in external borrowing costs on business cycles in open economies (see, for example, Neumeyer and Perri, 2005; Garcia-Cicco, Pancrazi and Uribe, 2010). We contribute to this literature by using a "micro-to-macro" approach, which combines evidence on microlevel responses to external shocks with a heterogeneous-firm framework to study business cycles in open economies.

Third, our paper is related to the literature on exchange rates and the macroeconomy. The classic Mundellian view is that currency fluctuations mitigate the effects of nominal rigidities and act as shock stabilizers (see, for example, Gali and Monacelli, 2005; Schmitt-Grohé and Uribe, 2016). Another strand of the literature highlights the tight connection between exchange rates and international capital markets (Gabaix and Maggiori, 2015; Itskhoki and Mukhin, 2021). Our paper connects these views by highlighting the stabilizing role of flexible exchange rates in reducing firms' risk exposure to fluctuations in international capital markets. In this sense, our paper provides an additional channel for the expansionary effects of currency devaluations that have been documented empirically (e.g., Fukui, Nakamura and Steinsson, 2023).

Finally, we build on the literature that analyzes the link between firm dynamics and macroeconomic fluctuations (see, for example, Khan and Thomas, 2008; Ottonello and Winberry, 2020). In open economies, firm heterogeneity has been shown to play a central role during crises and sudden stops (examples include Gopinath and Neiman, 2014; Blaum, 2019; Ates and Saffie, 2021; Castillo-Martinez, 2020). Methodologically, our work is related to Arellano, Bai and Bocola (2020) and Aruoba, Fernandez, Lopez-Martin, Lu and Saffie (2022), who analyze how heterogeneity in firms' leverage informs the channels of transmission of

[1] A related literature in asset pricing studies the role of fluctuations in the risk premium (see Cochrane, 2011, for a survey). In the international asset pricing, risk premium fluctuations have been relevant in explaining cross-sectional currency and sovereign risk (see, for example, Lustig and Verdelhan, 2007; Longstaff, Pan, Pedersen and Singleton, 2011; Gilchrist, Yue and Zakrajsek, 2012).

sovereign risk and monetary policy, respectively.

2. Empirical Evidence

This section studies the relationship between external borrowing costs and firms' investment at the micro level. Section 2.1 describes our data and measurement. Section 2.2 provides a decomposition of firms' external borrowing costs and highlights the role of the excess bond premium component. Section 2.3 documents the heterogeneous investment dynamics following changes in the systemic component of the excess bond premium.

2.1. Data and measurement

Our empirical analysis uses bond- and firm-level data for emerging markets. Our baseline analysis focuses on Latin America, which is the region with the most complete data coverage across all datasets. We use data from other emerging market countries for additional validation. The Latin American countries in our sample are Argentina, Brazil, Chile, Colombia, Mexico, and Peru. The non-Latin American countries are India, Korea, the Philippines, Thailand, Turkey, and Ukraine. These are the countries with a sufficiently large number of observations to conduct the empirical analysis. See Appendix A for further details.

Bond-level data. We collect bond-level data from Bloomberg. For each country in our sample, we gather information on all corporate bonds denominated in U.S. dollars, with available price information for the period 1997 to 2021, which results in a merged sample of 561 bonds issued by 173 firms, of which 240 of these bonds are from Latin America. For each bond, we obtain information on its daily price, amount issued, coupon structure, maturity, and other characteristics. We also use data on US Treausury bond prices for different maturities, which we use to compute emerging market bond spreads. Appendix A provides additional details on these data. We measure firms' external borrowing costs as the time-varying yield-to-maturity of their bonds. The median bond in our sample has a nominal yield of 5.1 percentage points. Additional summary statistics are reported in Tables

A.3 and A.4.

Firm-level data. Our empirical analysis uses balance-sheet data from Global Compustat. In addition, in our model analysis we use ORBIS data, which features information about private firms.

In the empirical analysis, our main variables of interest are firms' investment and Merton (1974)'s "distance-to-default" as a measure of their default risk. We define these variables following standard practices in the literature. We measure firms' investment with log change in the book value of its gross plant, property, and equipment. We measure its distance to default as $\text{dd}_{jt} = \frac{\log(\frac{V_{jt}}{D_{jt}})+(\mu_{jt}-0.5\sigma_{jt}^2)}{\sigma_{jt}}$, where V_{jt} denotes the total value of the firm, μ_{jt} the firm's annual expected return, σ_{jt} the annual volatility of its value, and D_{jt} the firm's debt. The interpretation of this measure is the number of standard deviations by which $\log V_{jt}$ must deviate from its mean for the firm to default within a year (assuming the firm defaults when $V_{jt} < D_{jkt}$). We provide more details on the data cleaning procedure and construction of variables used in the empirical analysis in Appendix A.2. Appendix Table A.7 reports summary statistics of our variables of interest. We observe 736 unique Latin American firms, featuring roughly 29,000 firm-quarter observations. Table A.8 reports additional summary statistics by firm risk and Table A.9 by country.

Finally, we also use data from ORBIS for the quantitative analysis of the model. This dataset covers information about the annual balance-sheet of private firms. We follow standard processing procedures as described in Kalemli-Özcan, et al. (2024), and make sample restrictions that closely mimick our main Compustat sample for Latin America. Full details are provided in Appendix B.3. We construct cross-sectional moments with a sample of roughly 62,000 firms in 2012, which is the year that provides best coverage across countries. Appendix Table B.1 reports the total number of firms and the number of public firms by country. The sales-weighted share of public firms varies from 13% for Colombia to 62% for Chile. Appendix Table B.2 reports additional summary statistics by country.

2.2. Decomposing Emerging Markets Corporate Borrowing Costs

Fluctuations in firms' borrowing costs can be empirically decomposed into three components: a risk-free compensation, a component capturing the variation in expected default rates, and an excess bond premium (Gilchrist and Zakrajšek, 2012). Following this approach, we disentangle these components in two steps. We first separate the yields of each bond into a risk-free rate and a spread component, using a synthetic risk-free security with the same coupon structure as the bond.

Panel (a) of Figure 2 reports the dynamics of yields, spreads and the risk-free component. From this figure, one can see that spreads account for the majority of fluctuations in yields at a business cycle frequency, with their cyclical components (computed with an HP Filter) featuring a correlation of 86%. The risk-free component of spreads play an important role explaining the secular decline in rates since the late 1990s. Based on this decomposition, we henceforth focus on understanding the role of spreads driving fluctuations in borrowing costs.

In the second step, we further decompose the bond spreads by projecting them onto distance-to-default and bond-specific characteristics. In particular, our baseline specification estimates the following regression:

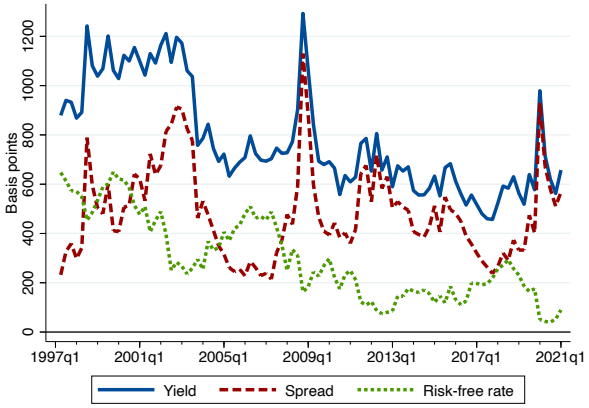
$$\log S_{it} = \beta \mathrm{dd}_{jt} + \gamma' \boldsymbol{Z}_{it} + \epsilon_{it}, \tag{1}$$

where S_{it} is the spread of bond i in period t; dd_{jt} measures distance-to-default of firm j (issuer of bond i) in period t, $\boldsymbol{Z}_{it}$ is the vector of bond-level characteristics; and ϵ_{it} denotes a normal randomly 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 meausured in logs; an indicator for whether the bond is callable; and fixed effects by sector, type of first coupon issued, and quarter interacted with coupon frequency and first coupon month.

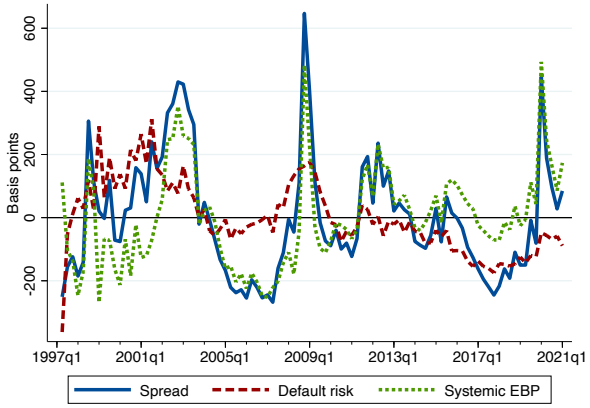
Appendix Table A.5 reports the results from estimating (1) for the Latin American sample as well as those of other emerging markets. These estimates indicate that firms with larger distance to default have lower bond spreads, and that roughly 50% of the variation in

Figure 2: External borrowing costs

(a) Yield dynamics



(b) Spread decomposition



Note: Panel (a) shows the dynamics of average yields, spreads, and risk-free components. Panel (b) shows the decomposition of average spreads into the portion predicted by default risk and the bond-specific excess bond premium, as defined in equation (2). All series are demeaned.

spreads can be accounted for by distance to default and other covariates included in $\boldsymbol{Z}_{it}$. Our baseline specification (1) assumes a homogeneous loading of spreads on distance-to-default for all bonds. In robustness analysis, we relax this assumption by estimating heterogeneous loadings across bonds of different countries and credit ratings.

Using the estimates from (1), we estimate the excess bond premium of a bond as:

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

where $\hat{\sigma}$ is the mean-squared error of the estimated ϵ_{it} shocks.

Finally, we construct measures of the systemic component of the excess bond premium by estimating:

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

where ρ_k and ρ_t denote country and time fixed effects. We refer to ρ_t as the systemic excess bond premium, and to v_{it} as its idiosyncratic component. The R^2 of this regression is 0.29 for the Latin America subsample and 0.19 for the full emerging market sample.

Figure 2 Panel (b) shows that systemic excess bond premium is the main driver behind the dynamics of average spreads, accounting for 69% of its variance and for the bulk of its increase during crisis periods, such as the Global Financial Crisis or the Covid-19 Pandemic. Additionally, Appendix Figure A.4 shows similar dynamics of the excess bond premium for other regions and individual countries. As detailed in the next section, fluctuations in the excess bond premium can be linked to changes in the global price of risk. Consistent with this view, Appendix Figure A.5 shows that the systemic excess bond premium for both Latin America and the full emerging market sample is highly correlated with other common measures of global risk, such as the VIX or the U.S. excess bond premium, again reflecting the high correlation of risky asset prices in the global economy.

2.3. External Borrowing Costs and Investment

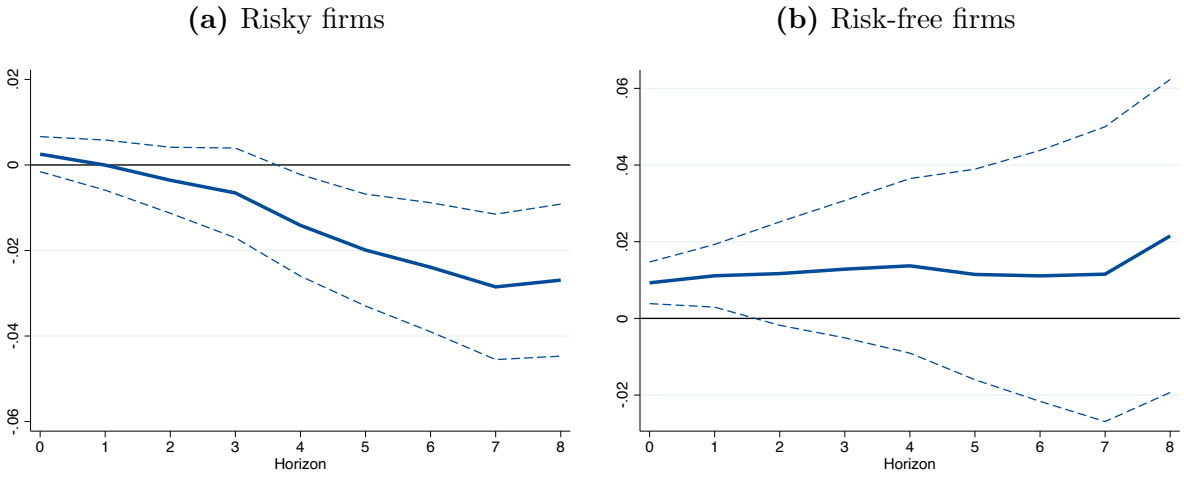
As motivated in Appendix Figure A.1, increases in global borrowing costs are correlated with decreases in investment growth in emerging markets. In this section, we study how changes in the systemic excess bond premium transmit to the investment and borrowing costs of firms with different default risk.

We use the following local Jorda (2005) projection model:

$$\Delta_h log(k_{jt+h}) = \alpha_{hj} + \underbrace{\beta_h^R \times \rho_t \times \mathbb{I}_{j \notin \mathcal{R}_{t-1}^f}}_{\text{Risky Firms}} + \underbrace{\beta_h^F \times \rho_t \times \mathbb{I}_{j \in \mathcal{R}_{t-1}^f}}_{\text{Risk-Free Firms}} + \omega_h' Z_{jt-1} + \epsilon_{jth}, \qquad (4)$$

where $\Delta_h \log(k_{jt+h}) \equiv \log(k_{jt+h}) - \log(k_{jt-1})$ denotes period t log cumulative change for h quarters in firm j's capital; α_{hj} denotes firm fixed effects; ρ_t measures the excess bond premium in period t; $\mathcal{R}_t^f$ denotes the set of risk-free firms; and Z_{jt} is a vector of firm-level covariates. In our baseline model, we measure the set of risk-free firms as those in the top 90th percentile of the distribution of distance-to-default, and include in the vector Z_{jt} measures of firms' size (measured as log total assets), capital growth, sales growth, fiscal quarter, and current assets relative to total assets. In robustness analysis, we consider alternative

Figure 3: Heterogeneous Dynamics and the Excess Bond Premium



Note: The figure shows the estimated β_h^R and β_h^F coefficients of Equation (4), which correspond to the cumulative log change in capital stock in response to the excess bond premium in period t for risky and risk-free firms. The variable ρ_t is standardized so that the units are standard deviations. The x-axes show the horizon h (quarterly frequency). The vector of controls includes firms' sales growth, investment, fiscal quarter, size, and share of current assets. All controls are standardized. Standard errors are clustered by firm and time with Driscoll and Kraay adjustment. Dashed lines represent 90% confidence intervals.

measures of risk-free firms and controls.

Figure 3 reports the results from estimating equation (4) and highlights two main results. First, Panel (a) shows that increases in the excess bond premium are associated with an average contraction in risky firms' investment, which is large and persistent: A 1-standard-deviation increase in the excess bond premium is associated with a 2.7% cumulative decline in the capital stock, which peaks 8 quarters after the shock. Second, Panel (b) shows that increases in the excess bond premium are not associated with declines in investment for risk-free firms. A 1-standard-deviation increase in the excess bond premium is associated with a 2% cumulative increase in the capital stock, which also peaks 2 years after the shock, though the effects are statistically indistinguishable from zero at later horizons. Thus, the aggregate decrease in capital appears to be driven by risky firms and somewhat attenuated by risk-free firms.

Table 1 shows that the finding that the negative effects of the excess bond premium on investment are concentrated among risky firms is robust to alternative specifications, with

further details provided in Appendix A.3.

First, the results are consistent across alternative measures of the set of risk-free firms using credit ratings rather than distance to default, and other threshold levels of risk.

Second, our results are robust to considering alternative measures of the systemic component of the excess bond premum. This includes a measure of the excess bond premium estimated on data from all emerging markets (not only Latin America), and measures of the excess bond premium in which we estimate (1) allowing for heterogeneous loadings by country and bond credit rating. Tables A.10 and A.11 report details on the estimation of these measures and Figure A.9 shows the resulting time series. Our results are similar across all of these measures (Figure A.10).

Third, our results are not driven by heterogeneous responses of firms' investment to changes in other US variables, including its GDP growth, inflation, or risk-free corporate interest rates (Figure A.11).

Fourth, our results are robust to including other types of controls, such as the interaction of the excess bond premium with other firm characteristics. We include these interactions to ensure that our results are not driven by other characteristics that could be correlated with risk, such as firm size (measured as log total assets), sales growth, capital growth, or age (Figure A.12).

Fifth, we use alternative model specifications that allow for interactions between the controls and firm risk (Figure A.13), time fixed effects (Figure A.14), and a continuous measure of firm risk (Figure A.15).

In addition, we examine heterogeneity by sector (Figure A.16), exchange-rate regime (Figure A.17), or sample of countries (Figure A.18).

Table 1: Sensitivity of results to alternative specifications

	Risky		Risk-free		
	Peak	SE	Peak	SE	R^2
Baseline	-0.029	(0.009)	0.011	(0.004)	0.059
Alternative measures of risk					
A- or higher	-0.024	(0.007)	0.012	(0.006)	0.047
Investment grade	-0.025	(0.007)	0.010	(0.004)	0.048
Alternative measures of EBP					
Emerging market sample	-0.020	(0.007)	0.012	(0.006)	0.058
Heterogeneity by country	-0.027	(0.009)	0.014	(0.007)	0.059
Heterogeneity by rating	-0.029	(0.010)	0.011	(0.005)	0.059
Controlling for interactions of firms' risk with U.S. variables					
GDP growth	-0.025	(0.011)	0.010	(0.004)	0.059
Inflation	-0.023	(0.008)	0.023	(0.011)	0.067
AAA bond yields	-0.035	(0.015)	0.019	(0.010)	0.059
Controlling for interactions of EBP with (lagged)					
Size	-0.030	(0.010)	0.010	(0.004)	0.059
Sales growth	-0.028	(0.009)	0.011	(0.004)	0.059
Capital growth	-0.028	(0.010)	0.011	(0.004)	0.059
Controlling for interactions of firms' risk with firms' characteristics	-0.029	(0.009)	0.013	(0.007)	0.059
Sector					
Tradable	-0.025	(0.010)	0.020	(0.011)	0.066
Nontradable	-0.023	(0.014)	0.021	(0.013)	0.066
Exchange rate regime					
Flexible	-0.026	(0.010)	0.012	(0.007)	0.058
Fixed	-0.032	(0.018)	0.003	(0.004)	0.058

Note: This table summarizes the robustness exercises described in detail in Appendix A.3. Peaks are defined as the β_h^R and β_h^F from equation (4) with the highest absolute value among the set of β_h's with p-values of less than 0.1. For example, the risky peak in the baseline specification corresponds to the point estimate from horizon $h = 7$, as shown in Panel (a) of Figure 3, and the risk-free peak in this row corresponds to the point estimate from horizon $h = 1$, as shown in Panel (b). For exercises in which there are no horizons with point estimates that meet this statistical significance criterion, the point estimate with the lowest p-value is reported. The corresponding standard error of each point estimate is reported in parentheses. R^2 is the average across all horizons of the within R-squared.

3. The Model

We consider a world economy composed of a domestic small open economy and the rest of the world. Among these economies, there is trade of goods (home H and foreign F) and international lending. The domestic economy is the main focus of the model and is populated by a representative household and a set of heterogeneous firms. Domestic firms produce the home good using capital and labor as inputs, and finance their investment by borrowing from investors in the rest of the world subject to endogenous default risk. The global economy is subject to two sources of aggregate risk: productivity shocks and shocks to the market price of risk. The latter capture fluctuations in the premium required by global investors for holding risky assets and it is the main focus of our analysis.

In Subsection 3.1, we detail the heterogeneous firms' problem, which constitutes the main block of our model. Subsection 3.2 describes the global investors' problem and characterizes their stochastic discount factor, which allows us to introduce global risk premia. In Subsection 3.3, we briefly summarize the rest of the model, which includes the domestic households' problem, nominal rigidities, and the rest of the world.

3.1. Heterogeneous Firms

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

$$y_{i,t} = (A_t z_{i,t})^{\varsigma} \left(k_{i,t}^{\alpha} l_{i,t}^{1-\alpha}\right)^{\chi}, \tag{5}$$

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.[2] We assume that both $z_{i,t}$ and A_t follow first-

[2] As in Gilchrist, Sim and Zakrajšek (2014), we introduce this normalization so that firms' profits are linear in their productivity A_t and $z_{i,t}$.

order autoregressive processes given by $\ln(z_{i,t+1}) = (1-\rho_z)\ln(z^\star) + \rho_z \ln(z_{i,t}) + \sigma_z \epsilon^z_{i,t+1}$ and $\ln(A_{t+1}) = (1-\rho_A)\ln(A^\star) + \rho_A \ln(A_t) + \sigma_A \epsilon^A_{t+1}$, where $\epsilon^z_{i,t+1}$ and ϵ^A_t are Gaussian shocks.

Firms have access to a technology to accumulate capital by investing out of the final good subject to adjustment costs:

$$k_{i,t+1} = (1-\delta)\, k_{i,t} + I_{i,t} - \Psi_k\left(k_{i,t+1}, k_{i,t}\right), \tag{6}$$

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

Firms sell their H-good output and hire labor inputs in competitive markets. For a given choice of labor, their profits are given by $\Pi_{i,t} = (1-\tau)\left(P_{H,t}\, y_{i,t} - W_t\, l_{i,t}\right)$, where τ is the corporate tax rate, $P_{H,t}$ is the price of the H-good, and W_t is the nominal wage. From the firms' static first-order condition with respect to $l_{i,t}$, the demand for labor is given by

$$l^d_{i,t} = A_t\, z_{i,t}\, \left(k_{i,t}\right)^{\frac{\alpha\chi}{\varsigma}} \left(\frac{1-\varsigma}{W_t/P_{H,t}}\right)^{\frac{1}{\varsigma}}. \tag{7}$$

After replacing $l^d_{i,t}$ in the profit function, we get that real profits, in terms of the consumption bundle good c, are given by

$$\pi_{it} = (1-\tau)\,\varsigma\, A_t\, z_{i,t}\, \left(k_{it}\right)^{\frac{\alpha\chi}{\varsigma}} \left(\frac{1-\varsigma}{w_t}\right)^{\frac{1-\varsigma}{\varsigma}} \left(p_{H,t}\right)^{\frac{1}{\varsigma}}, \tag{8}$$

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

On the funding side, firms finance their investment by borrowing from investors in the rest of the world. Firms face frictions from default risk (as in Khan, Senga and Thomas, 2020; Ottonello and Winberry, 2020). In particular, firms have limited commitment and can endogenously default on their debt obligations. If they do, they exit the industry and are

replaced by a new entrant. We consider long-term debt contracts denominated in foreign currency (dollars) that mature probabilistically (e.g., Chatterjee and Eyigungor, 2012). Each bond matures in the next period with probability m and, if it does not mature, the firm pays a constant coupon υ. Let $q^{\star}_{i,t} = q^{\star}_{t}(k_{i,t+1}, b_{i,t+1}, z_{i,t})$ denote the unit foreign-currency price of a bond for a firm with productivity $z_{i,t}$ and whose next-period stock of capital and debt is $(k_{i,t+1}, b_{i,t+1})$. Let $\Delta\mathcal{B}^{\star}_{i,t} \equiv \Delta\mathcal{B}^{\star}_{t}(b_{i,t+1}, b_{i,t})$ denote the foreign-currency proceeds from issuing new debt, net of debt payments that are due today.[3] This is given by

$$\Delta\mathcal{B}^{\star}_{t}(b_{i,t+1}, b_{i,t}) = q^{\star}_{i,t}\left[b_{i,t+1} - (1-m)b_{i,t}\right] - \left[(1-m)\upsilon + m\right] b - \Psi_{b}(b_{i,t+1}, b_{i,t}), \tag{9}$$

where the term $q^{\star}_{i,t}\left[b_{i,t+1} - (1-m)b_{i,t}\right]$ denotes the proceeds from issuing new bonds and $\left[(1-m)\upsilon + m\right] b_{i,t}$ denotes current debt services. The $\Psi_{b}(b_{i,t+1}, b_{i,t})$ function captures convex debt adjustment costs, which are given by $\Psi_{b}(b_{i,t+1}, b_{i,t}) \equiv \frac{\psi_{b}}{2}\left(\frac{b_{i,t+1}-(1-m)b_{i,t}}{b_{i,t}}\right)^{2} b_{i,t}$.

Under these assumptions, the firm's real dividends are given by

$$d_{i,t} = (1-\tau)\,\pi_{i,t} - p_{k,t}\,I_{i,t} + \varepsilon_{t}\,\Delta\mathcal{B}^{\star}_{i,t}, \tag{10}$$

where $p_{K,t} = \frac{P_{K,t}}{P_{t}}$ denotes the relative price of the capital good, $\varepsilon_{t} = \frac{\xi_{t}}{P_{t}}$ is the real exchange rate, and ξ_{t} is the nominal exchange rate. Firms are subject to a non-negative dividend constraint, $d_{i,t} \geq 0$. If a firm cannot satisfy this constraint (and to the extent that it does not default), it has to raise equity $e_{i,t} > 0$, which is financed by the domestic households. We assume that equity issuance is costly, in the sense that households' transfers to the firm are subject to a cost given by $\mathcal{C}(d_{i,t}) = -\mathbb{I}_{\{d_{it}<0\}}\varphi d_{i,t}$ (as in Cooley and Quadrini, 2001; Gilchrist *et al.*, 2014).

Firms' Recursive Problem

A firm's state space can be written as the n-tuple $(k, b, z, \boldsymbol{S})$, where $\boldsymbol{S}$ denotes the aggregate state, which includes the firm distribution, Ω, and all the aggregate exogenous variables (i.e.,

[3] Clearly, $B_{t}(b_{i,t+1}, b_{i,t})$ is also a function of $k_{i,t+1}$ and $z_{i,t}$ since they affect the bond price $q^{\star}_{t}(k_{i,t+1}, b_{i,t+1}, z_{i,t})$. We omit this dependency for ease of exposition.

the global productivity and price of risk). Conditional on repaying its debt, the equity value of a firm (in terms of the c good) solves the following Bellman equation:

$$V^r(k,b,z,\boldsymbol{S}) = \max_{k',b'} \; d + \mathbb{E}_{\left(z',\boldsymbol{S}',\epsilon'^d\right)|(z,\boldsymbol{S})}\left[\Lambda(\boldsymbol{S},\boldsymbol{S'})\; V\left(k',b',z',\boldsymbol{S}',\epsilon'^d\right)\right] \tag{11}$$

$$\text{s.t. } d\left(1-\mathcal{C}(d)\right) = (1-\tau)\;\pi(k,z,\boldsymbol{S}) - p_k(\boldsymbol{S})\,I(k',k) + \varepsilon(\boldsymbol{S})\,\Delta\mathcal{B}^{\star}(b',b,\boldsymbol{S})$$

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

where $\Lambda(\boldsymbol{S},\boldsymbol{S'})$ denotes households' stochastic discount factor, and $\Upsilon(\boldsymbol{S})$ denotes the conjectured law of motion for all of the aggregates and for the firm distribution, Ω.

At the beginning of each period, and after observing the realization of a default value, ϵ^d, the firm chooses whether to default or not. We interpret ϵ^d as an exogenous outside option, with $\epsilon^d \sim_{iid} N(0,\sigma^d)$. Given this outside option, the firm's value is $V\left(k,b,z,\boldsymbol{S},\epsilon^d\right) = \max\left\{V^r(k,b,z,\boldsymbol{S}),\epsilon^d\right\}$, and the firm defaults whenever $V^r(k,b,z,\boldsymbol{S}) < \epsilon^d$. Before the outside option shock is realized, the firm valuation is $V(k,b,z,\boldsymbol{S}) = \mathbb{E}_{\epsilon^d}\left[V\left(k,b,z,\boldsymbol{S},\epsilon^d\right)\right]$ and its default probability can be written as

$$h(k,b,z,\boldsymbol{S}) = \int_{V^r(k,b,z,\boldsymbol{S})}^{\infty} \mathrm{d}\Phi(\epsilon^d) = 1 - \Phi\left(V^r(k,b,z,\boldsymbol{S})\right), \tag{12}$$

where $\Phi(\epsilon^d)$ is the cumulative density function of a normal distribution with zero mean and standard deviation σ^d. In the case of a default, the firm liquidates all of its assets and permanently exits the economy (after production takes place). Firms that exit are replaced by an equal mass of new entrants. The initial stocks of capital, debt, and productivity for all entrants are drawn from a uniform distribution with supports $\{\underline{x},\bar{x}\}$ for $x = \{k,b,z\}$.

3.2. Global Investors

The global economy features a set of international investors who provide perfectly elastic supply of international credit to domestic firms and price firms' debt. We denote with $\Lambda_F^{\star}(\boldsymbol{S},\boldsymbol{S'})$ the investors' stochastic discount factor. Given a firm's current choice of k' and

b', its debt price schedule is given by

$$q^{\star}\left(k', b', z, \boldsymbol{S}\right) = \mathbb{E}_{(z', \boldsymbol{S'})|(z, \boldsymbol{S})}\left[\Lambda_F^{\star}(\boldsymbol{S}, \boldsymbol{S'})\mathcal{R}_f\left(k', b', z', \boldsymbol{S'}\right)\right], \tag{13}$$

where $\mathcal{R}_f\left(k', b', z', \boldsymbol{S'}\right)$ is the next-period firm's repayment, which depends on the next-period default decision. That is,

$$\mathcal{R}_f\left(k', b', z', \boldsymbol{S'}\right) \equiv \left[1 - h\left(k', b', z', \boldsymbol{S'}\right)\right]\ \mathcal{R}_f^r\left(k', b', z', \boldsymbol{S'}\right) + h\left(k', b', z', \boldsymbol{S'}\right)\ \mathcal{R}_f^d\left(k', b', z', \boldsymbol{S'}\right), \tag{14}$$

where $\mathcal{R}_f^r(k', b', z', \boldsymbol{S'}) \equiv (1-m)\left(\upsilon + q\left(k'', b'', z', \boldsymbol{S'}\right)\right) + m$ denotes the next-period repayment if the firm does not default. This, in turn, depends on the next-period bond price, which is a function of next-period firm's choices $k'' \equiv k'(k', b', z', \boldsymbol{S'})$ and $b'' \equiv b'(k', b', z', \boldsymbol{S'})$. In the event of default, the lenders' recovery rate (in foreign currency units) is given by

$$\mathcal{R}_f^d\left(k, z, \boldsymbol{S}\right) = \lambda\, \frac{(1-\tau)\,\pi\left(k, z, \boldsymbol{S}\right) + (1-\delta)\,k\,p_k\left(\boldsymbol{S}\right)}{b}\, \frac{1}{\varepsilon(\boldsymbol{S})}, \tag{15}$$

where λ captures the share of resources recovered by the lender.

We parameterize the global investors' stochastic discount factor as

$$\Lambda_{F,(t,t+1)}^{\star} = \beta^{\star} \times \exp\left(-\kappa_t\, \epsilon_{t+1}^A - \frac{1}{2}\kappa_t^2\, \sigma_A^2\right), \tag{16}$$

where $\beta^{\star}$ is the rest of the world's discount factor; κ_t is a stochastic exogenous variable that captures the market price of risk; and ϵ_{t+1}^A are the innovations of the global productivity process. We let κ_t to take two values, $\{\kappa_L, \kappa_H\}$, and we assume that the process for $\{\kappa_t\}$ is govern by a Markov transition matrix, Π_κ. This type of formulation of foreign investors' stochastic discount factor has been used in the sovereign debt literature (Arellano and Ramanarayanan, 2012; Bianchi, Hatchondo and Martinez, 2018) to provide a tractable representation that captures changes in the global price of risk. Under this formulation, global investors value bond payoffs more in states in which firms are more likely to default.

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:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u\left(c_t, l_t\right), \tag{17}$$

here $\beta \in (0,1)$ denote the subjective discount factor. Households are risk neutral and have the following utility function over consumption and labor: $u(c_t, l_t) = c - \psi_l \frac{l^{1+\theta}}{1+\theta}$, where θ is the inverse of the Frisch elasticity. Given the these preferences, the labor supply is given by

$$l_t^S = \left(\frac{1}{\psi_l} w_t\right)^{\frac{1}{\theta}}. \tag{18}$$

The consumption good is a composite of home and foreign goods, with a constant elasticity of substitution aggregation technology

$$c_t = \mathcal{C}\left(c_{H,t}, c_{F,t}\right) = \left[\omega_H^{1/\eta} \left(c_{H,t}\right)^{1-1/\eta} + \left(1-\omega_H\right)^{1/\eta} \left(c_{F,t}\right)^{1-1/\eta}\right]^{\frac{\eta}{\eta-1}}, \tag{19}$$

where $c_{H,t}$ and $c_{F,t}$ denote consumption of home and foreign goods; $\eta > 0$ is the elasticity of substitution; and ω_H captures the degree of home bias. Households are hand-to-mouth, they do not have direct access to international lending, and they cannot sell their equity shares in domestic firms—in the appendix we relax these assumptions, and assume that households can save in domestic deposits. Their budget constraint is given by

$$P_t\, c_t = W_t\, l_t + P_t\, d_t + P_t\, t_t, \tag{20}$$

where $P_t \equiv \left[\omega_H P_{H,t}^{1-\eta} + \left(1-\omega_H\right) P_{F,t}^{1-\eta}\right]^{\frac{1}{1-\eta}}$ is the price aggregator and $P_{H,t}$ and $P_{F,t}$ are the prices of the home and foreign goods (in local currency). The term $W_t\, l_t$ is the labor income; d_t is the aggregate real dividend paid by the firms (net of households' transfers to firms); and t_t are the government's lump-sum transfers, in terms of the c-bundle good. Under our

CES structure, the optimal allocation of expenditures between domestic and foreign goods can be expressed as

$$c_{H,t} = \omega_H \left(\frac{P_{H,t}}{P_t}\right)^{-\eta} c_t \tag{21}$$

$$c_{F,t} = (1-\omega_H) \left(\frac{P_{F,t}}{P_t}\right)^{-\eta} c_t, \tag{22}$$

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 a formulation similar to that of Schmitt-Grohé and Uribe (2016) by assuming that the nominal wage faces downward rigidity, i.e., $W_t \geq \bar{W}$, where $\bar{W}$ captures the degree of nominal rigidities.[4] 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.

From Equation (7), we can integrate across firms to compute the aggregate demand for labor, which is given by

$$l_t^d \equiv \int_i l_{i,t}^d = A_t \, \tilde{K}_t \left[\frac{1-\varsigma}{w_t} p_{H,t}\right]^{\frac{1}{\varsigma}}, \tag{23}$$

where $\tilde{K}_t \equiv \int_i z_{i,t} \left(k_{i,t}\right)^{\frac{\alpha\chi}{\varsigma}}$ captures the productive 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 rigid nominal wages, the labor market may not clear. At any point in time, wages and employment must thus satisfy the following slackness condition:

$$\left(l_t^s - l_t^d\right)\left(W_t - \bar{W}\right) = 0. \tag{24}$$

That is, in periods of unemployment, the wage constraint binds. If the constraint does not bind, then it must be the case that the economy is in full employment. Combining Equations

[4] 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 (2023).

(18) and (23), the full-employment (FE) real wage can be expressed as

$$w_t^{FE} = \left[(1-\varsigma)\, p_{H,t}\right]^{\frac{\theta}{\varsigma+\theta}} \times (\psi_l)^{\frac{\varsigma}{\varsigma+\theta}} \times \left(A_t \tilde{K}_t\right)^{\frac{\theta\varsigma}{\varsigma+\theta}}. \tag{25}$$

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, ξ_t:

$$w_t = \max\left\{w_t^{FE}, \frac{\bar{W}}{\xi_t} \times \varepsilon_t\right\}, \tag{26}$$

where $\varepsilon_t \equiv \xi_t / P_{H,t}$ is the real exchange rate.

Capital good producer. We follow Ottonello and Winberry (2020) and assume that there is a representative capital good producer who produces new capital based on the $\Phi\left(I/\tilde{K}\right)\tilde{K}$ technology. In each period, the capital good producer chooses I to maximize its profits: $\max_I p_k \Phi\left(I/\tilde{K}\right)\tilde{K} - p_H I$. In our quantitative analysis, we let $\Phi\left(I/\tilde{K}\right) = \frac{(i^\star)^{1/\phi}}{1-1/\phi}\left(I/\tilde{K}\right)^{1-\frac{1}{\phi}} - \frac{i^\star}{\phi-1}$, where $i^\star$ is the investment rate in an economy without aggregate shocks. It is easy to show that this specification leads to the following relative price for the capital good:

$$p_k = p_H \left(\frac{I/\tilde{K}}{i^\star}\right)^{1/\phi}. \tag{27}$$

Government. The government collects corporate taxes, gives transfers to households, and sets the path for the nominal exchange rate, $\{\xi_t\}$. For the latter, the government can set any linear combination between a fixed exchange rate regime and a flexible one that guarantees full employment. Let ξ_t^{Flex} denote the flexible exchange rate that achieves full employment in period t. From Equation (26), this is given by $\xi_t^{Flex} = \frac{1}{w_t^{FE}}\bar{W}\varepsilon_t$.[5] The exchange rate policy can be written as $\xi_t = \varrho\xi_t^{Flex} + (1-\varrho)\xi^{Peg}$, where, following our previous normalization for $P_F^\star$, we let $\xi^{Peg} = 1$. The parameter ϱ can be interpret as the degree of exchange rate flexibility. Notice that when $\varrho = 1$, the government effectively eliminates the effects of the

[5] Obviously, any ξ_t larger than ξ_t^{Flex} would also lead to full employment.

wage rigidity—so our model boils down to a model without nominal frictions.

As for its fiscal policy, the government collects taxes on firms and uses those proceeds to give lump-sum transfers to households. For simplicity, the government does not have debt. Its budget constraint is thus $t_t = \tau \times \int_i \pi_{i,t}$. We consider in the appendix a richer fiscal policy in which the government taxes firms' debt issuances as a macro-prudential policy.

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 foreign demand for the H-good given by

$$c_{H,t}^\star = \left(\frac{P_{H,t}^\star}{P_F^\star}\right)^{-\eta} c_t^\star, \tag{28}$$

where $c_t^\star$ denotes total consumption by the rest of the world, and $P_{x,t}^\star$ is the foreign-currency price of good $x = \{H, F\}$. For simplicity, we assume a constant $c_t^\star$ so that changes in the foreign demand only come from changes in relative prices. We also assume a constant price for the foreign good $P_F^\star$, which we normalize to one. Both the home and foreign good 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, the foreign demand is then given by $c_{H,t}^\star = \left(\frac{P_{H,t}}{\xi_t}\right)^{-\eta} c^\star$.

3.4. Equilibrium

***Definition* 1.** *Let $\boldsymbol{S} = (A, \kappa, \Omega)$ denote the aggregate state, where A is the global TFP component, κ is the market price of risk, and Ω is the distribution of firms across the idiosyncratic states (k, b, z). Let Ω^{ND} and Ω^D denote the distribution of non-defaulting and defaulting firms, respectively. Given a nominal exchange-rate policy, a recursive competitive equilibrium is a set of*

1. *Value functions for firms $\{V(k, b, z, \boldsymbol{S}), V^r(k, b, z, \boldsymbol{S})\}$,*
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 $q^\star(., \boldsymbol{S})$,*

4. *A real wage* $w(\boldsymbol{S}) = W(\boldsymbol{S})/P(\boldsymbol{S})$ *and a real exchange rate* $\varepsilon(\boldsymbol{S}) = \xi(\boldsymbol{S})/P(\boldsymbol{S})$,

5. *A conjectured law of motion for the aggregates* $\Upsilon(\boldsymbol{S})$,

such that:

i *Given prices and the perceived* $\Upsilon(\boldsymbol{S})$, $l^d(.,\boldsymbol{S})$ *is given by Equation (7); the policies* $\{k'(.,\boldsymbol{S}), b'(.,\boldsymbol{S}), h(.,\boldsymbol{S})\}$ *solve the maximization problem in Equation (11); and* $V(.,\boldsymbol{S})$ *and* $V^r(.,\boldsymbol{S})$ *are the associated value functions.*

ii *Given firms' optimal policies, the bond pricing kernel* $q^\star(.,\boldsymbol{S})$ *satisfies Equation (13).*

iii *Given prices and* $\Upsilon(\boldsymbol{S})$, $\{c(\boldsymbol{S})\, l^s(\boldsymbol{S})\}$ *solve the households' problem, as defined in Equations (17)-(18).*

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

v *The H-good market clears:*

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

where $Y(\boldsymbol{S})$ *denotes aggregate output, which is given by* $Y(\boldsymbol{S}) = \int y(.,\boldsymbol{S})\, d\Omega(.,\boldsymbol{S})$, *where* $y(.,\boldsymbol{S})$ *is defined in Equation (5).*[6] *The term* $I(\boldsymbol{S})$ *denotes aggregate investment:* $I(\boldsymbol{S}) = \int (I(.,\boldsymbol{S}) + \mathcal{C}(d))\, d\Omega^{ND}(.,\boldsymbol{S}) + \int \left(\bar{k} - (1-\delta)k\right) d\Omega^{D}(.,\boldsymbol{S})$, *where* $I(.,\boldsymbol{S})$ *is the investment function of non-defaulting firms, as defined in Equation (6);* $\mathcal{C}(d) \equiv -\mathbb{I}_{\{d<0\}}\varphi \times d$ *captures equity issuance costs; and* $\bar{k} - (1-\delta)k$ *is the (net) investment of a new entrant that replaces a defaulting firm. Lastly,* $c_H(\boldsymbol{S})$ *and* $c_H^\star(\boldsymbol{S})$ *denote private domestic and foreign consumption of the H-good, as defined in Equations (21) and (28), respectively.*

vi *The balance of payment (BOP) is satisfied:*

$$Y(\boldsymbol{S}) - I(\boldsymbol{S}) - P/P_H(\boldsymbol{S})\, c(\boldsymbol{S}) = (-)\xi/P_H(\boldsymbol{S}) \left(\int \Delta\mathcal{B}^\star(.,\boldsymbol{S})\; d\Omega^{ND} - \int \mathcal{R}_f^d(.,\boldsymbol{S})\, b(.)\; d\Omega^{D} \right),$$

where $\Delta\mathcal{B}^\star(.,\boldsymbol{S})$ *denotes net debt payments to the rest of the world for non-defaulting firms, as defined in Equation (9), and* $\int \mathcal{R}_f^d(.,\boldsymbol{S})\, b(.)\; d\Omega^D$ *denotes the payments of defaulting firms, where* $\mathcal{R}_f^d(.,\boldsymbol{S})$ *is defined in Equation (15).*

vii *The condition* $l^d(\boldsymbol{S}) \leq l^s(\boldsymbol{S})$ *and the slackness condition of Equation (24) are both satisfied.*

[6] The timing assumption is such that firms that default at time t also produce.

3.5. Transmission Channels of Global Price of Risk

This section describes how a shock to the global price of risk transmit to the domestic economy, distinguishing between two sources of transmission: a risk channel and indirect channels, which depend on general equilibrium responses to the shock—adjustment of prices, real exchange rate, and wages.

Risk channel. We define the risk transmission channel as the impact of fluctuations in the global price of risk—reflected in changes in borrowing costs—on firms' output and investment. To better illustrate this channel, it is helpful to express the bond price equation (16) with a first-order approximation:

$$q^{\star}\left(k', b', z, \boldsymbol{S}\right) \approx \beta^{\star}\, \mathbb{E}_{(z', \boldsymbol{S}')|(z, \boldsymbol{S})}\left[\mathcal{R}_f\left(k', b', z', \boldsymbol{S}'\right)\right] - \beta^{\star}\, \kappa\, \mathbb{C}ov_{(z', \boldsymbol{S}')|(z, \boldsymbol{S})}\left[\epsilon_A', \mathcal{R}_f\left(k', b', z', \boldsymbol{S}'\right)\right]. \tag{29}$$

This equation decomposes the bond price into a risk-neutral expected repayment component and a risk-premium term, which depends on the global price of risk, κ, and the covariance between firms' next-period repayment and innovations to aggregate productivity, $\mathbb{C}ov_{(z', \boldsymbol{S}')|(z, \boldsymbol{S})}\left[\epsilon_A', \mathcal{R}_f\left(k', b', z', \boldsymbol{S}'\right)\right]$. This covariance is non-negative because firms are more likely to default in bad times (i.e., when the aggregate productivity shock is lower), capturing their exposure to fluctuations in the global price of risk.

In what follows, we refer to this covariance as a firm's exposure to the global financial cycle—per unit of debt. When $\kappa > 0$, lenders demand a premium beyond default risk, lowering bond prices, raising firms' marginal financing costs, and reducing investment. A key aspect of our analysis is that these effects vary across firms. For risk-free firms—those with a constant next-period repayment—the covariance term is zero, meaning they have no exposure to changes in the global price of risk, and their investment and output remain unaffected by a higher κ. In contrast, for riskier firms, the covariance term is larger since their repayment is more sensitive to future aggregate productivity, making them more exposed to changes in κ. As a result, borrowing costs for these firms increase more, leading to a larger decline in output and investment.

Indirect channels. The other transmission channels operate through general equilibrium forces, driven by endogenous adjustments in relative prices and wages. The magnitude of these adjustments is closely tied to a country's aggregate exposure to fluctuations in the global price of risk. For a given increase in κ, a higher aggregate exposure leads to a greater decline in investment and output, resulting in more pronounced adjustments in prices and wages. More importantly for our analysis, the way prices and wages adjust also influences the economy's exposure to fluctuations in the price of risk. For instance, consider an economy where real wages remain rigid during recessions. In this case, the covariance term $\mathbb{C}ov_{(z',\boldsymbol{S}')|(z,\boldsymbol{S})}\left[\epsilon'_A, \mathcal{R}_f\left(k', b', z', \boldsymbol{S}'\right)\right]$ would be larger, amplifying firms' exposure to changes in κ.

In what follows, we make a few simplifying assumptions that allow us to better characterize the two channels of transmission and to highlight their dependence. In particular, we assume that there are no adjustment costs; no recovery value; and we disregard the effects of changes in capital on bond prices—see Appendix for the full list of assumptions and derivations. Under these assumptions, one can show that the firm's optimal choice of b' satisfies the following first-order condition:

$$\mu\left(\cdot\right) q^{\star}(k', b', z, \boldsymbol{S}) = \beta \mathbb{E}_{(z',\boldsymbol{S}')|(z,\boldsymbol{S})}\left[\frac{\varepsilon'}{\varepsilon}\mu'\left(\cdot\right)\mathcal{R}_f\left(k', b', z', \boldsymbol{S}'\right)\right] - \mu\left(\cdot\right)\frac{\partial q^{\star}(k', b', z, \boldsymbol{S})}{\partial b'}\Delta b', \tag{30}$$

where $\Delta b' \equiv b' - (1-m)b$ and $\mu\left(\cdot\right) \equiv 1 + \varphi \mathbb{I}_{e>0}$ is the he Lagrange multiplier associated with the non-negative dividend constraint. When $\mathbb{I}_{e>0} = 1$ that constraint binds, which forces the firm to raise costly equity.

The left-hand side of Equation (30) represents the benefits of an additional unit of debt, which include the proceeds from issuing debt, $q^{\star}(.)$, and how much those resources alleviate the non-negative dividend constraint. The right-hand side reflects the marginal costs from an additional debt unit. They include the increased debt burden in the subsequent period and the negative impact of an additional unit of debt on bond prices.

On the other hand, the first-order condition for next-period stock of capital, k', is given

by:

$$\mu(\cdot)\ p_k = \beta \mathbb{E}_{(z',\boldsymbol{S}')|(z,\boldsymbol{S})}\Big[\left[1-h\left(k',b',z',\boldsymbol{S}'\right)\right]\ \mu'(\cdot)\ MRPK\left(k',z',\boldsymbol{S}'\right)\Big]. \tag{31}$$

The left-hand side represents the marginal cost of investment—that is, how much the firm values the additional cost of acquiring one more unit of capital—, while the terms in the right capture the marginal benefit. The latter consists of how much the firm values the expected marginal revenue product of capital, given by $MRPK\left(k',z',\boldsymbol{S}'\right) = \frac{\partial \pi(k',z',\boldsymbol{S}')}{\partial k'} + (1-\delta)p'_k$.

Equations (29)-(31) summarize the mechanisms of our model. An increase in the price of risk lowers $q^\star(.)$, raising a firm's borrowing costs and tightening the dividend constraint. This results in a higher marginal cost of investment, ultimately leading to a decline in investment levels. From Equation (31), we can see that these direct responses are influenced by current and future changes in the relative price of the home good p_H and real wages w (through their effect on $\pi_{k'}$). A depreciation of the real exchange rate (i.e., an increase in ε'/ε) also affects these responses, as it raises the next-period debt burden (i.e., a balance-sheet mechanism) and further tightens the current non-negative dividend constraint (as shown in Equation 30).

3.6. Discussion of Assumptions

For our baseline specification we have assumed that i) firms' debt is denominated in foreign currency; ii) firms borrow exclusively from global investors and households are hand to mouth; and iii) firms are owned and priced by domestic households. In the appendix, we relax these assumption and analyze their implications.

First, for our baseline analysis, we assume that firms' debt is denominated in foreign currency. We do this to better disentangle the changes in risk premia that are driven by changes in default risk and those driven by currency risk. In Appendix B.7, we consider an extension in which firms' debt is denominated in local currency. From the perspective of a foreign investor, this introduces currency risk, which will be reflected in the pricing kernel of firms' debt. We show that our conclusions and main messages are robust to this alternative specification.

Second, we consider in Appendix B.8 an extension in which firms' debt is financed by

a domestic bank, which collects deposits from households and has access to international markets. The bank is owned by domestic households and foreign investors. What matters for our analysis is that its marginal investors are the global investors. This implies that firms' debt pricing function still reflects their stochastic discount factor, $\Lambda^{\star}(.)$. We show that all of our main results hold in this alternative case.

Third, we consider a specification in which firms' are priced by foreign investors (Appendix B.9). In this case, firms discount future dividend payoffs based on the stochastic discount factor of global investors. Changes in the global price of risk, thus, affects firms' discounting, and directly influences their investment and debt issuance decisions. Under this setup, we show that the heterogeneous effects across firms that we document in our empirical analysis are flipped. In particular, we find that the subset of *safer* firms are the ones that reduce their investment the most. We take this evidence as suggesting that the marginal investors of these firms are domestic households.

4. The Transmission of the Global Financial Cycle

In this section, we combine our data and model to quantitatively study the transmission of changes in the global price of risk. Section 4.1 details the model's parameterization and compares its predictions to their empirical counterparts. Section 4.2 uses the calibrated model to analyze the channels through which changes in the global price of risk transmit.

4.1. Parameterization and Model Fit

Our quantitative analysis targets a prototypical emerging market economy. Specifically, we calibrate the model to the average Latin American country.[7] Given the importance of risk in our heterogeneous-agent framework, we solve the model using global methods and an approximation of the distributions that constitute the state vector. Appendix B.2 summarizes the computational algorithm.

[7] We use the same sample of countries as in the empirical analysis of Section 2.3, consisting of Argentina, Brazil, Chile, Colombia, Mexico, and Peru.

The calibration is done at a quarterly frequency and targets both macro and micro moments to capture heterogeneity across domestic firms. We proceed in two steps. First, we fix a subset of parameters to standard values commonly used in the literature, listed in Panel (a) of Table 2. For technologies, we set the capital share to $\alpha = 0.3$, the degree of decreasing returns to scale to $\chi = 0.85$ (as in Gilchrist *et al.*, 2014), and the depreciation rate to $\delta = 0.0275$. For preferences, we set the (inverse) Frisch elasticity to $\theta = 0.5$, the degree of home bias in consumption to $\omega_H = 0.66$, and the elasticity of substitution between home and foreign goods to $\eta = 1.5$ (as in Itskhoki and Mukhin, 2021). Regarding firms' bond structures, we set m to match the average duration of nonfinancial firms' debt in our sample, and υ to target the (annualized) observed coupon yield (as shown in Table A.4). For foreign lenders, we fix the discount factor $\beta^\star$ to target a 3% annual risk-free rate. We also fix the Markov transition matrix governing the price of risk, Π_κ, to capture a quarterly crisis probability of 2.5% and an average crisis duration of 5 quarters. Finally, we set the tax parameter τ to target a corporate tax rate of 27.5%.

In the second step, we calibrate the parameters governing a set of firms' cross-sectional moments—Panel (b) of Table 2. To compute most of these data moments, we use our Orbis dataset (unless stated otherwise) and average across all countries in our sample (see Appendix B.3 for details). Although all calibrated parameters influence all moments in the model, we discuss the calibration in terms of the main moments affected by each parameter. The parameters related to the idiosyncratic productivity processes, ρ_z and σ_z, are calibrated to match the dispersion of firms' investment rates. Specifically, we set $\rho_z = 0.95$ and calibrate σ_z to match the cross-sectional standard deviation of firms' investment rates. We calibrate the discount factor β and firms' outside option volatility σ_d to match an annual exit rate of 7.5% and the observed leverage ratio.[8] The debt adjustment cost parameter, ψ_b, is calibrated to match the cross-sectional standard deviation of leverage, and the capital adjustment cost parameter, ψ_k, to match the correlation between firm size and age. The recovery value

[8]We view this target as a conservative estimate, as it is in line with estimates for the U.S. nonfinancial sector. For instance, Hopenhayn, Neira and Singhania (2022) report an average annual exit rate of 7.5%. Our target is also consistent with recent studies on emerging markets. Andreasen, Bauducco, Dardati and Mendoza (2023) report an average exit rate of 8% for the universe of Chilean manufacturing establishments, and Majerovitz (2023) finds an average of 7.5% for Indonesian manufacturing establishments.

Table 2: Model Parameters

(a) Fixed Parameters

Parameter	Description	Value
Panel 1. Domestic Economy		
α	Capital share	0.3
χ	Dec. returns to scale	0.85
δ	Depreciation rate	0.0275
τ	Corporate tax rate	0.275
m	Bond maturity	0.052
c	Bond coupon	0.018
θ	Frisch elasticity	0.5
ω_H	Home bias	0.66
η	Elasticity of substitution	1.5
Panel 2. Rest of the World		
$\tilde{\beta}$	Lenders' discount factor	0.992
$\Pi_\kappa(\kappa_L, \kappa_H)$	Probability of global crisis	0.025
$\Pi_\kappa(\kappa_H, \kappa_L)$	Duration of global crisis	0.2

(b) Calibrated Parameters

Parameter	Description	Value
Panel 1. XS Moments		
β	Firms' discount factor	0.966
ρ_z	TFP, persistence	0.95
σ_z	TFP, volatility	0.15
ψ_k	Capital adjustment costs	0.4
ψ_b	Debt adjustment costs	3.0
λ	Recovery rate	0.1
σ_d	Exit value	2.32
φ	Equity issuance cost	0.1
Panel 2. Aggregate Moments		
ρ_A	Aggregate TFP, persistence	0.97
σ_A	Aggregate TFP, volatility	0.029
ϕ	p_k elasticity	0.14
$\bar{W}$	Wage rigidity	1.02
κ_H	Price of risk	60.0

Note: Panel (a) shows the set of parameters that are fixed in our calibration. The top panel shows the set of parameters for domestic firms and the bottom panel shows the parameters relevant to foreign lenders. Panel (b) shows the set of calibrated parameters. The top panel shows parameters for domestic firms that govern the targeted cross-sectional moments and the bottom panel shows parameters that govern aggregate responses.

parameter, λ, targets an average recovery rate of 33%.[9] Lastly, we calibrate the equity issuance cost parameter to match an annual frequency of equity issuance of 14%.[10]

In the third step, we calibrate the parameters related to aggregate responses. The data sources for these moments are described in Appendix B.3. For the global productivity process, we calibrate ρ_A and σ_A to match the observed autocorrelation and volatility of GDP. For the market price of risk, we normalize κ_L to 0 and calibrate κ_H so that the on-impact

[9]For the U.S., the average recovery rate is close to 40%, as reported in Khan *et al.* (2020). We target a slightly lower recovery rate to capture additional market imperfections in emerging economies. This is in line with Arellano, Bai and Zhang (2012), who target an average recovery rate of 25% for nonfinancial firms in an emerging economy.

[10]We do not observe actual equity issuances in our dataset, so we compute this value by identifying firms with large jumps in their reported equity book value. In particular, we classify a firm as issuing equity if its equity value increases by more than 50% in one year. Our target implies a value for φ of 0.15, 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: Moments

(a) Cross-sectional Moments

Moment	Data	Model
Panel 1. Targeted		
Leverage	0.29	0.28
Exit rate	7.5%	7.68%
Investment/k (cs std)	0.25	0.23
Leverage (cs std)	0.22	0.25
Correlation size and age	0.28	0.34
Recovery Value	33.0%	26.25%
Share firms issuing equity	14.0%	35.74%
Panel 2. Untargeted		
Distribution of leverage		
perc 10	0.04	0.04
perc 25	0.11	0.07
perc 50	0.25	0.20
perc 75	0.44	0.43
perc 90	0.62	0.64
Spreads(*)	4.57%	6.59%
Spreads(*) (cs std)	3.66%	5.81%
Quarterly Profits-to-Capital	9.00	8.08%
Age median firm	10.0	13.3
Age median public firm	30.0	39.9
Share public firms	13.0%	30.9%

(b) Aggregate Moments

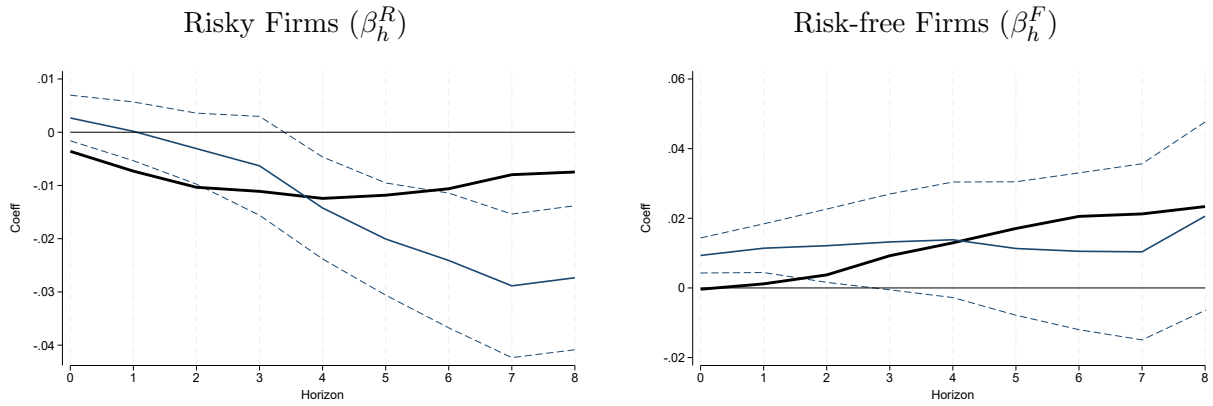
Moment	Data	Model
Panel 1. Targeted		
$\sigma(GDP)$	2.3%	2.53%
GDP autocorrelation	0.93	0.91
$\sigma(I)/\sigma(GDP)$	2.9	4.047
Avg. unemployment rate	2.9%	4.05%
$\sigma(Emp)/\sigma(GDP)/$	3.02%	2.35%
Δ Risk premium	0.65%	0.61%
Panel 2. Untargeted		
$\rho(I, GDP)$	0.84	0.803
$\rho(C, GDP)$	0.8	0.977
$\sigma(C)/\sigma(GDP)$	1.0	0.734
$\rho(GDP, Spreads)$	-0.55	-0.455
$\rho(I, Spreads)$	-0.48	-0.558

Note: The table shows the model-implied moments and their data counterparts. Panel (a) shows targeted and untargeted cross-sectional moments. Panel (b) shows aggregate moments.

increase in the risk premium during a global crisis (i.e., when moving from $\kappa_{t-1} = \kappa_L$ to $\kappa_t = \kappa_H$) corresponds to a one-standard-deviation increase in the data.[11] For our analysis, we assume that foreign consumption, $c_t^\star$, is constant and orthogonal to changes in the global price of risk. In reality, increases in the global price of risk may coincide with a contraction in $c_t^\star$, lowering foreign demand for the H-good and affecting investment and output. By keeping $c_t^\star$ fixed, we use the model to isolate the aggregate implications of a shock to the global price of risk. We set the ϕ parameter to match the observed volatility of aggregate investment relative to output. Lastly, we calibrate the parameter governing the exchange rate policy, ϱ,

[11] Our empirical analysis identifies changes in the EMEBP but cannot pin down its level. For this reason, we set $\kappa_L = 0$ in our calibration and calibrate κ_H to match the observed EMEBP volatility.

Figure 4: Heterogeneous Responses to Changes in Global Price of Risk

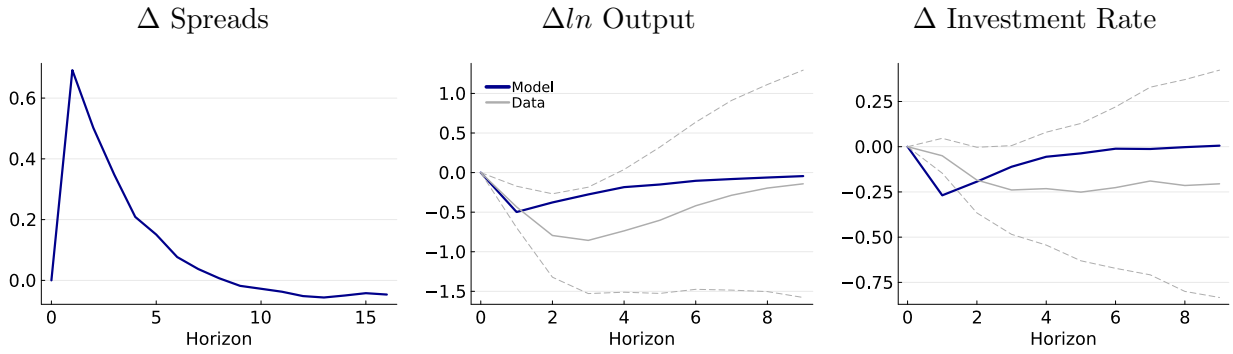


Note: The figure compares the model-implied estimates for the local projections with those of our empirical analysis. It shows the estimated β_h^R and β_h^F coefficients of Equation (4), which correspond to the cumulative log change in capital stock in response to the global risk premium, ρ_t, for risky and risk-free firms. Blue lines show the empirical estimates and the 90% confidence intervals. Black lines show the model-implied estimates. In both cases, the variable ρ_t is standardized based on its empirical standard deviation. For the model-generated data, we only keep periods in which $\Delta\kappa \neq 0$. The x-axes show the horizon h.

and the nominal wage rigidity parameter, $\bar{W}$, to match the average unemployment rate and its volatility.

The top panels of Table 3 compare the model-implied cross-sectional and aggregate targeted moments with their data counterparts. The bottom panels report a set of untargeted moments. Key to our analysis, the model closely replicates the distribution of firms' leverage based on our Orbis data—an essential feature for drawing implications about changes in risk and borrowing costs. The model is also consistent with the empirical findings in Section 2 for our sample of Compustat firms. To account for selection into Compustat, we condition on firms' age (as in Ottonello and Winberry, 2020). The median firm in our Compustat dataset is three times older than the median firm in Orbis (30 years versus 10 years, respectively). In the model, we define "Compustat" firms as those with $age > \overline{age}$, and we set $\overline{age}$ to match this relative age. After conditioning on age, we compare the model's predictions to the empirical results. Figure 4 shows that the model replicates the documented differential response of risky and risk-free firms' investment to a shock to the price of risk.

Figure 5: Aggregate Responses to Changes in Global Price of Risk



Note: Impulse responses to a shock to the global price of risk ($\Delta\kappa > 0$). The panels display the dynamics of firms' average borrowing spreads, aggregate output, and the aggregate investment rate. Blue lines depict model-implied dynamics; gray lines show estimated responses from the data.

4.2. Transmission Channels of the Global Financial Cycle

Next, we quantify the macroeconomic responses to changes in the global price of risk and decompose the transmission mechanisms. Figure 5 (blue lines) shows that a one-standard-deviation shock to the market price of risk raises bond spreads by about one percentage point and reduces economic activity by half a percentage point. The investment rate—defined as investment over output—declines by about a quarter percentage point. Although untargeted in our calibration, these model-implied dynamics align with those observed in the data following a one-standard-deviation increase in the EMEBP measure (gray lines).

In Appendix Figure B.3, we compare the 2008 global financial crisis to our model's response to a rise in the market price of risk, calibrated to match the EMEBP surge around the Lehman collapse (a four-standard-deviation shock). The model accounts for nearly the entire contraction in investment, highlighting the role of global conditions—particularly the price of risk—in driving investment in emerging economies. For output, the model explains about a quarter of the GDP drop, suggesting additional contributing factors.

Channel Decomposition. To analyze the transmission channels, we construct a counterfactual in which prices (including the nominal exchange rate) do not react to changes in κ. This exercise isolates the risk channel of a given price-of-risk shock, absent any price-

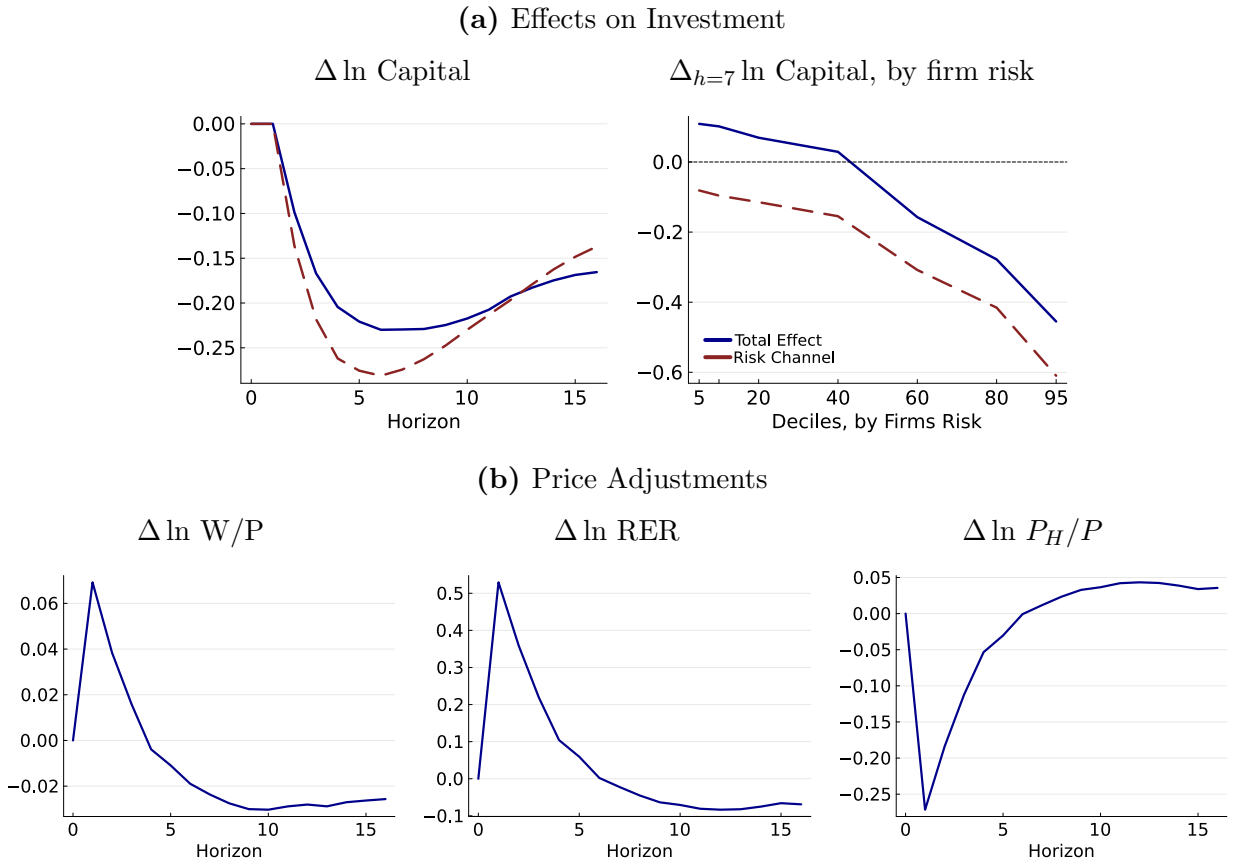
adjustment mechanism.

The top panel of Figure 6 shows the cumulative effect of a global price-of-risk shock on investment. Blue lines depict the total effect (risk channel and indirect channels), while dotted red lines isolate the effect from our risk channel. The gap between the total and risk-channel effects captures the contribution of indirect forces. The figure shows that indirect channels substantially mitigate the drop in investment. At its peak, these mechanisms dampen the contraction in firms' cumulative investment by about 25%. The right panel shows changes in cumulative investment by firms' risk. To construct this figure, we first sort firms by their pre-shock default probability and compute the cumulative change in investment at the crisis peak. For the safest firms (i.e., those with near-zero default risk), changes in the market price of risk have little impact on borrowing costs—the risk channel is negligible. As default risk rises, the effect of the risk channel becomes more pronounced.

These results highlight the role of firms' risk distribution for aggregate outcomes. In Appendix B.6, we extend the analysis by studying more formally the implications of firm heterogeneity for aggregates. We compare our model-implied aggregate dynamics to a counterfactual in which all firms are identical. We show that, after a shock to the global price of risk, the aggregate contraction in capital in this counterfactual is more than 40% larger than in our baseline model. This exercise underscores the importance of accounting for firm heterogeneity when assessing the aggregate impact of risk premia.

The bottom panel of Figure 6 analyzes the mechanisms behind the indirect channels. It shows the responses of real wages, the real exchange rate, and the relative price of the home good following a shock to the global price of risk. On impact, the real wage w_t decreases, which raises firms' profits π_{it} (from Equation 8), increases the marginal revenue product of capital ($MRPK_{i,t} = \frac{\partial \pi_{i,t}}{\partial k_{i,t}} + (1-\delta)$), and attenuates the drop in investment. The real exchange rate ε_t depreciates, increasing the debt burden of dollar-denominated debt, lowering dividends, and raising default risk. Higher default risk, in turn, increases firms' borrowing costs, reinforcing the initial decline in investment. Lastly, the relative price of the home good $p_{H,t}$ decreases, with two implications. On the one hand, it lowers firms' profits $\pi_{i,t}$ and the $MRPK_{i,t}$, further contracting investment. On the other hand, it lowers the relative price of

Figure 6: Direct and Indirect Channels of Transmission



Note: The figure quantifies the risk channel and other indirect effects of a shock to the price of risk ($\Delta\kappa > 0$). The top panel shows the dynamics for aggregate capital and its heterogeneous response across firms with different levels of risk. The blue lines show the total effect and the gray dashed lines show the direct effect. The left panel depicts the aggregate dynamics for capital for different horizons h. The right panel shows the heterogeneous effects, by firm risk (at a fixed horizon). RF denotes risk-free firm. The bottom panel shows the price adjustments.

capital—from Equation (27)—, which boosts investment. Quantitatively, we find that the expansionary channels dominate, and thus the indirect channels dampen the contractionary effects of a shock to the price of risk.

5. Policy Implications

Next, we compare the effects of a shock to global price of risk under a fully flexible ($\varrho = 1$) and a fixed ($\varrho = 0$) exchange-rate regime. In doing so, we describe how the presence of a

fixed exchange-rate regime attenuates relative price adjustments and dampens the indirect channels.

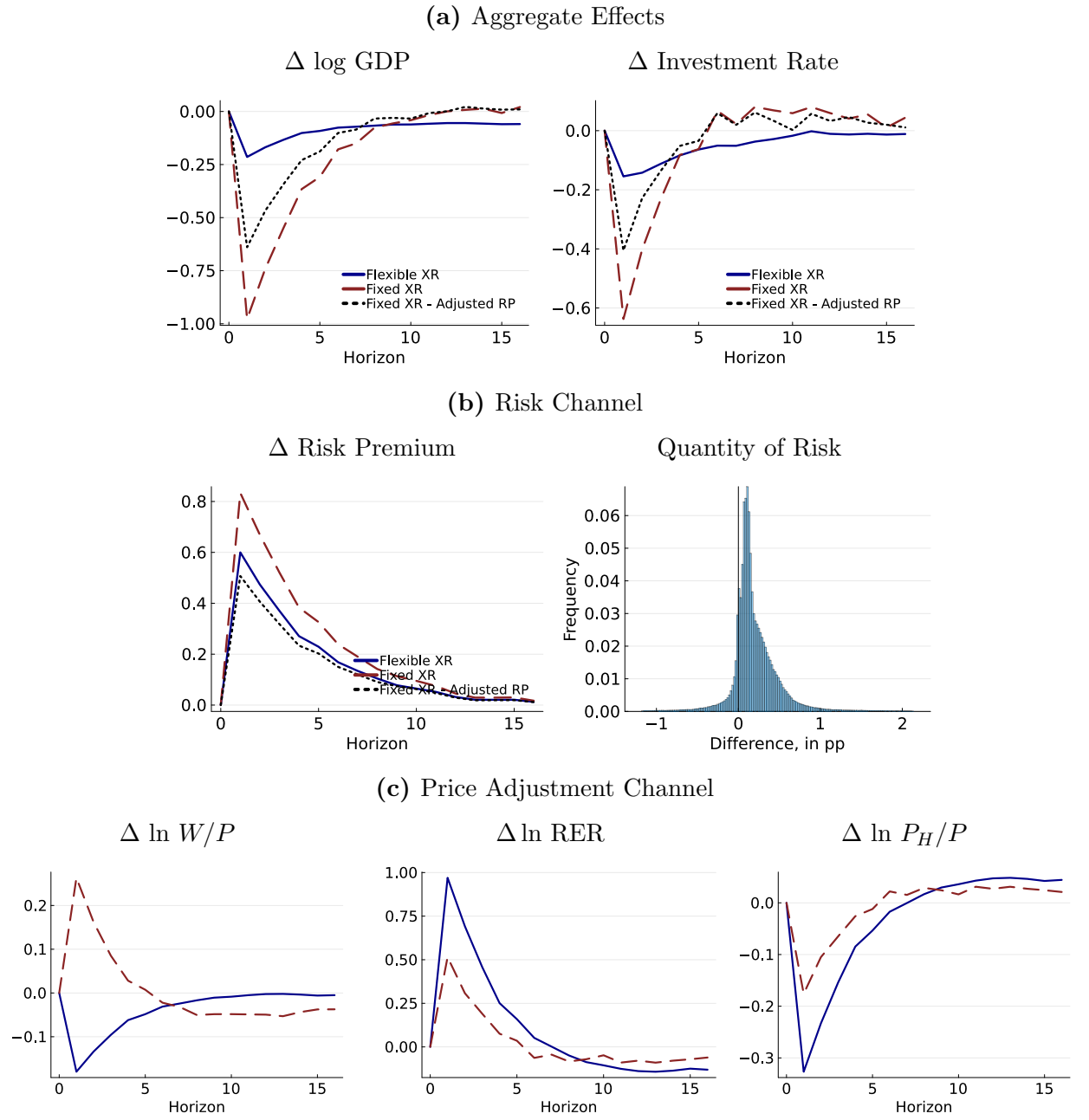
Figure 7 shows the impulse responses to a price-of-risk shock under the two regimes. Panel (a) compares the dynamics of aggregate output and the investment rate. Blue (red) lines show the dynamics under a flexible (fixed) exchange rate. Overall, the fixed exchange-rate regime leads to a much larger contraction in output and investment.

What accounts for this larger contraction? Almost half of the additional drop in GDP can be traced to the effects of a fixed exchange-rate regime on firms' exposure to risk—that is, the $\mathbb{C}ov(.)$ term in the pricing equation (29). To show this, Panel (b) illustrates the dynamics of the risk premium in the two regimes and shows that, on impact, the increase in the risk premium is more than twice as large under a peg. The reason is that, under a flexible regime, the government depreciates its currency during downturns to lower real wages and maintain full employment. In doing so, the nominal exchange rate acts as a countercyclical tool that mitigates firms' risk exposure.

To further clarify this point, the right graph in Panel (b) shows the distribution of the difference in the quantity of risk (as defined in Equation 29) between the fixed and flexible regimes. The entire distribution lies to the right of zero, indicating a higher quantity of risk under a fixed exchange rate regime. To isolate the aggregate implications of a higher quantity of risk, we construct a counterfactual in which the government follows a fixed exchange rate regime, but we adjust the κ shock to match the risk premium dynamics of the flexible regime. As shown in Panel (a) (black dotted lines), in this counterfactual, the drop in output would be dampened by about 50%. Even after adjusting the magnitude of the shock to the price of risk, the contraction in output is still higher relative to the flexible regime. This is explained by the price adjustments (mainly a contraction in the real wage), as shown in Panel (c).

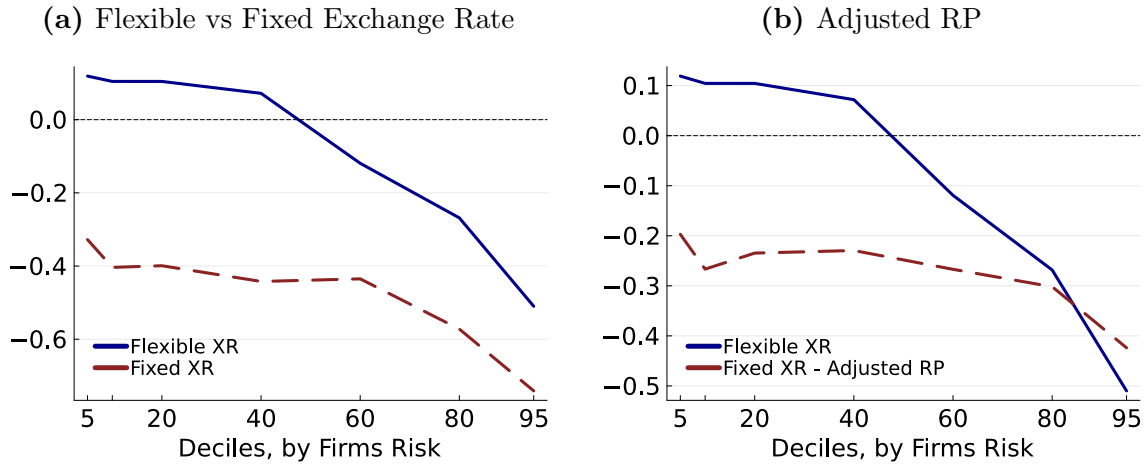
In Figure 8, we analyze the heterogeneous effects of a global price-of-risk shock for the two exchange-rate regimes. Given the larger magnitude of the shock, we find that firms across the entire risk distribution are more affected under a fixed exchange rate regime (Panel a). Once we adjust the κ shock so that the response of the risk premium under a fixed regime is identical to that of the flexible case, we find that riskier firms would be the ones that would

Figure 7: Flexible vs Fixed Exchange Rate: The Role of Risk



Note: Impulse responses to a shock to the global price of risk ($\Delta\kappa > 0$) across exchange rate regimes. Top panel compares the dynamics for aggregate output and investment rate. Blue (red) lines show the dynamics under a flexible (fixed) exchange rate. The black dotted lines show the results for a fixed exchange rate regime case, in which we adjust the κ shock so that the dynamics for the risk premium are identical as the ones under the flexible regime. The bottom panel shows the dynamics for the risk premium and the distribution for the quantity of risk (scaled by κ).

Figure 8: Flexible vs Fixed Exchange-rate Regimes: $\Delta_h \ln k$



Note: Impulse responses to a shock to the global price of risk ($\Delta\kappa > 0$) by firm risk. Firms are sorted into deciles based on their pre-shock default probability. The left panel shows the change in firms' capital and the right panel the change in risk premium. Solid blue lines show the firms' responses when the government follows a flexible exchange-rate regime. Dashed red lines show the same responses when the nominal exchange rate is fixed.

benefit the most from a peg. This is because, the increase in the RER is smaller under the peg, which dampens the increase in the debt burden upon a global price-of-risk shock. For riskier firms, since they have larger leverage, increases in the real exchange rate raise their debt burden, which offsets the benefits of a lower real wage.

Overall, the presence of a flexible or fixed exchange rate not only affects aggregate outcomes, but can also have important distributional consequences across nonfinancial firms.

6. Conclusion

In this paper, we study the macroeconomic transmission of fluctuations in external borrowing costs to open economies. We combine a new measurement of firms' responses to fluctuations in the global risk premium with an open-economy general-equilibrium model of heterogeneous firms subject to default risk. We describe two channels through which the global risk premium affects economic activity. One is a risk channel, through which changes in the global price of risk affect firms' financing costs and their investment. The other is an indirect channel, which stems from the feedback between firms' investment policies, domestic

aggregate demand, and adjustment of the real exchange rate. Our quantitative analysis reveals that heterogeneity is important for understanding the transmission of external shocks. The risk-channel effects of surges in the global price of risk on risky firms in particular drives the contraction. Price adjustments mitigate this contraction by reducing the risk exposure of firms and reallocating economic activity within the economy.

Our findings provide multiple avenues for policymakers to influence the pass-through of external crises. Allowing prices to adjust during downturns, such as allowing exchange rate depreciation, can reduce investment adjustments and sudden stops by minimizing the risk transmission channel and strengthening the indirect transmission channel. Other policies that reduce firms' risk, such as macroprudential policies, can also alleviate investment adjustment.

References

Aguiar, M. and Gopinath, G. (2007). Emerging market business cycles: The cycle is the trend. *Journal of political Economy*, **115** (1), 69–102.

Akinci, O., Kalemli-Ozcan, S. and Queralto, A. (2022). *Uncertainty shocks, capital flows, and international risk spillovers*. Tech. rep., National Bureau of Economic Research.

Andreasen, E., Bauducco, S., Dardati, E. and Mendoza, E. G. (2023). Beware the Side Effects: Capital Controls, Trade, Misallocation and Welfare, nBER Working Paper No. 30963.

Arellano, C., Bai, Y. and Bocola, L. (2020). Sovereign default risk and firm heterogeneity, Working paper.

—, — and Zhang, J. (2012). Firm dynamics and financial development. *Journal of Monetary Economics*, **59** (6), 533–549.

— and Ramanarayanan, A. (2012). Default and the maturity structure in sovereign bonds. *Journal of Political Economy*, **120** (2), 187–232.

Aruoba, B., Fernandez, A., Lopez-Martin, B., Lu, W. and Saffie, F. (2022). *Monetary Policy and Firm Dynamics: The Financial Channel*. Tech. rep., working paper.

Ates, S. and Saffie, F. (2021). Fewer but better: Sudden stops, firm entry, and financial selection. *American Economic Journal: Macroeconomics*, **13** (3), 304–356.

Backus, D. K., Kehoe, P. J. and Kydland, F. E. (1992). International real business cycles. *Journal of political Economy*, **100** (4), 745–775.

Baskaya, Y. S., di Giovanni, J., Kalemli-Ozcan, S. and Ulu, M. F. (2017). International spillovers and local credit cycles, NBER Working Paper 23149.

Bernanke, B. S., Gertler, M. and Gilchrist, S. (1999). The Financial Accelerator in a Quantitative Business Cycle Framework. *Handbook of Macroeconomics*, **1**, 1341–1393.

Bianchi, J., Hatchondo, J. C. and Martinez, L. (2018). International reserves and rollover risk. *American Economic Review*, **108** (9), 2629–2670.

—, Ottonello, P. and Presno, I. (2023). Fiscal stimulus under sovereign risk. *Journal of Political Economy*, **131** (9), 2328–2369.

— and Sosa-Padilla, C. (2023). Reserve Accumulation, Macroeconomic Stabilization, and Sovereign Risk. *The Review of Economic Studies*, **91** (4), 2053–2103.

Blaum, J. (2019). Global firms in large devaluations. *Unpublished Manuscript, Brown University*.

Bocola, L. (2016). The pass-through of sovereign risk. *Journal of Political Economy*, **124** (4), 879–926.

Calvo, G. A. (2005). Emerging capital markets in turmoil: bad luck or bad policy? *MIT Press Books*, **1**.

—, Izquierdo, A. and Talvi, E. (2006). Sudden stops and phoenix miracles in emerging markets. *American Economic Review*, **96** (2), 405–410.

Castillo-Martinez, L. (2020). Sudden stops, productivity, and the exchange rate, Working paper.

Chatterjee, S. and Eyigungor, B. (2012). Maturity, indebtedness, and default risk. *American Economic Review*, **102** (6), 2674–99.

Cochrane, J. H. (2011). Presidential address: Discount rates. *The Journal of finance*, **66** (4), 1047–1108.

Cooley, T. F. and Quadrini, V. (2001). Financial markets and firm dynamics. *American Economic Review*, **91** (5), 1286–1310.

De Leo, P., Gopinath, G. and Kalemli-Özcan, S. (2024). *Monetary Policy and the Short-Rate Disconnect in Emerging Economies*. Tech. rep., nBER Working Paper No. 30458.

Fukui, M., Nakamura, E. and Steinsson, J. (2023). *The Macroeconomic Consequences of Exchange Rate Depreciations*. Tech. rep., working paper.

Gabaix, X. and Maggiori, M. (2015). International liquidity and exchange rate dynamics. *The Quarterly Journal of Economics*, **130** (3), 1369–1420.

Gali, J. and Monacelli, T. (2005). Monetary policy and exchange rate volatility in a small open economy. *The Review of Economic Studies*, **72** (3), 707–734.

Garcia-Cicco, J., Pancrazi, R. and Uribe, M. (2010). Real business cycles in emerging countries? *American Economic Review*, **5**, 2510–31.

Gilchrist, S., Sim, J. W. and Zakrajšek, E. (2014). Uncertainty, financial frictions, and investment dynamics, Working paper.

—, Yue, V. Z. and Zakrajsek, E. (2012). Sovereign risk and financial risk, Working paper.

— and Zakrajšek, E. (2012). Credit spreads and business cycle fluctuations. *American Economic Review*, **102** (4), 1692–1720.

Gomes, J. F. (2001). Financing investment. *American Economic Review*, **91** (5), 1263–1285.

Gopinath, G. and Neiman, B. (2014). Trade adjustment and productivity in large crises. *The American Economic Review*, **104** (3), 793–831.

Gürkaynak, R. S., Sack, B. and Wright, J. H. (2007). The US treasury yield curve: 1961 to the present. *Journal of Monetary Economics*, **54** (8), 2291–2304.

Hassan, T. A., Schreger, J., Schwedeler, M. and Tahoun, A. (2021). *Sources and transmission of country risk*. Tech. rep., National Bureau of Economic Research.

He, Z. and Krishnamurthy, A. (2013). Intermediary asset pricing. *American Economic Review*, **103** (2), 732–70.

Hopenhayn, H., Neira, J. and Singhania, R. (2022). From population growth to firm demographics: Implications for concentration, entrepreneurship and the labor share. *Econometrica*, **90** (4), 1879–1914.

Itskhoki, O. and Mukhin, D. (2021). Exchange rate disconnect in general equilibrium. *Journal of Political Economy*, **129** (8), 2183–2232.

Jorda, O. (2005). Estimation and inference of impulse responses by local projections. *The American Economic Review*, **95**, 161–182.

Kalemli-Ozcan, S. (2019). US monetary policy and international risk spillovers. *Proceedings of the Jackson Hole Symposium*.

Kekre, R. and Lenel, M. (2022). Monetary policy, redistribution, and risk premia. *Econometrica*, **90** (5), 2249–2282.

Khan, A., Senga, T. and Thomas, J. K. (2020). *Default risk and aggregate fluctuations in an economy with production heterogeneity*. Tech. rep., working paper.

— and Thomas, J. K. (2008). Idiosyncratic shocks and the role of nonconvexities in plant and aggregate investment dynamics. *Econometrica*, **76** (2), 395–436.

Krusell, P. and Smith, A. A. (1998). Income and wealth heterogeneity in the macroeconomy. *The Journal of Political Economy*, **106** (5), 867–896.

Longstaff, F. A., Pan, J., Pedersen, L. H. and Singleton, K. J. (2011). How sovereign is sovereign credit risk? *American Economic Journal: Macroeconomics*, **3** (2), 75–103.

Lustig, H. and Verdelhan, A. (2007). The cross section of foreign currency risk premia and consumption growth risk. *American Economic Review*, **97** (1), 89–117.

Maggiori, M. (2021). International macroeconomics with imperfect financial markets, Working Paper.

Majerovitz, J. (2023). Misalloccation and the Selection Channel, working Paper.

Mendoza, E. G. (2010). Sudden stops, financial crises, and leverage. *American Economic*

Review, **100** (5), 1941–66.

Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of Finance*, **29** (2), 449–470.

Moretti, M. (2021). The asymmetric pass-through of sovereign risk, Working paer.

Neumeyer, P. A. and Perri, F. (2005). Business cycles in emerging economies: The role of interest rates. *Journal of Monetary Economics*, **52** (2), 345–380.

Ottonello, P. and Winberry, T. (2020). Financial heterogeneity and the investment channel of monetary policy. *Econometrica*, **88** (6), 2473–2502.

Rey, H. (2013). Dilemma, not trilemma: The global financial cycle and monetary policy cycle. In *Jackson Hole Symposium, Federal Reserve Bank of Kansas City*.

Schmitt-Grohé, S. and Uribe, M. (2016). Downward Nominal Wage Rigidity, Currency Pegs, and Involuntary Unemployment. *Journal of Political Economy*, **124** (5).

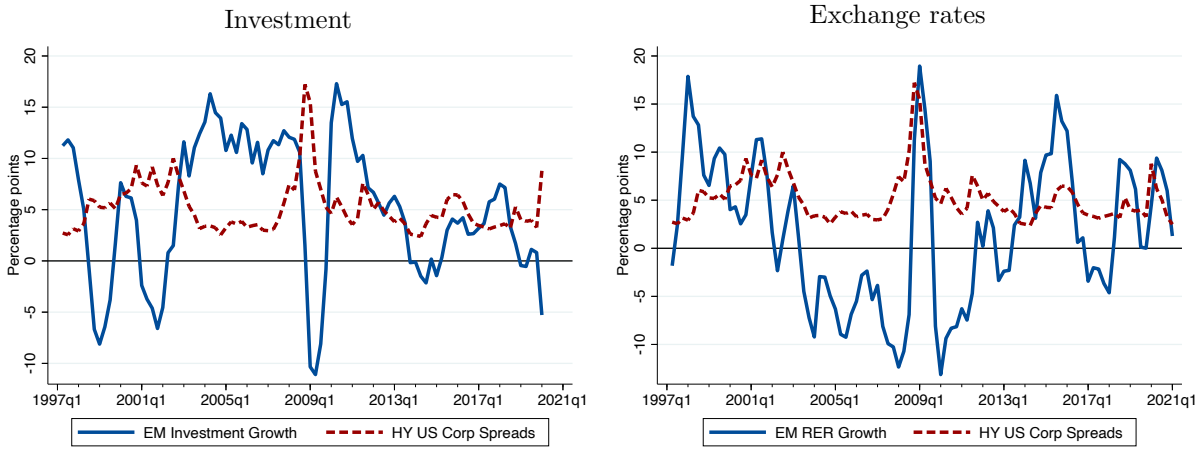
Uribe, M. and Schmitt-Grohé, S. (2017). *Open economy macroeconomics*. Princeton University Press.

A. Empirical Appendix

A.1. Motivating evidence

Figure A.1 shows the comovement of U.S. borrowing costs with investment and exchange rate growth in emerging markets. Consistent with the high syncronization of borrowing costs shown in Figure 1, investment and real exchange rates in emerging markets are negatively correlated with U.S. borrowing costs.

Figure A.1: US Borrowing Costs and Emerging Market Outcomes

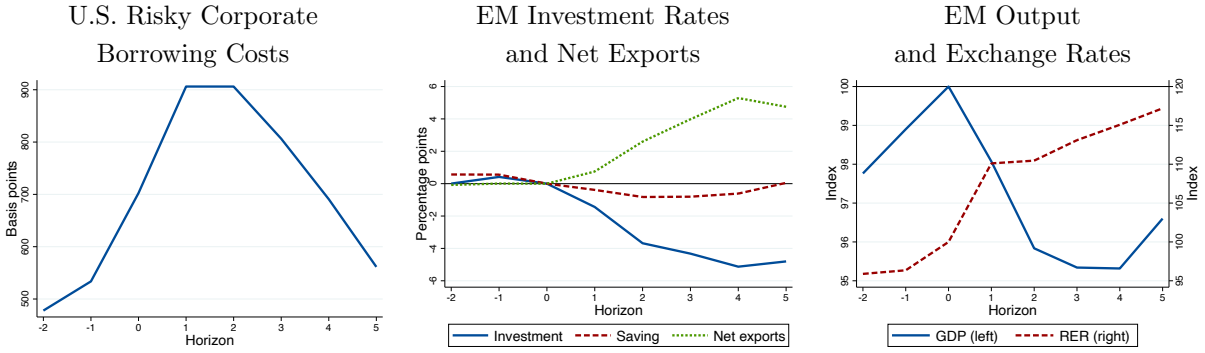


Note: The figure plot average U.S. high-yield corporate spreads with average growth rates of real investment and the real exchange rate with the U.S. dollar in the same sample of emerging markets included in our corporate bond data. Growth rates are calculated as year over year percent changes. The emerging markets included are Argentina, Brazil, Chile, Colombia, India, Korea, Mexico, Peru, the Philippines, Thailand, Turkey, and Ukraine.

The syncronization of risky asset prices and capital flows are especially apparent during systemic crises in emerging markets. As external risky borrowing costs surge, the economy exhibits a sharp contraction of aggregate investment, mirrored by current account adjustment or "sudden stops" in capital flows; economic activity declines and currencies depreciate. Salient examples, illustrated in Figure A.2, include the Latin American debt crises in the early 1980s, the East Asian/Russian crisis in the late 1990s, and the Global Financial Crisis that started in 2008. In particular, we identify sudden stops episodes as those identified by Calvo, Izquierdo and Talvi (2006), update this set to include episodes during the Global

Financial Crisis. We merge crisis dates with macroeconomic data from Uribe and Schmitt-Grohé (2017). We index each crisis episode to the peak of GDP and obtain a set of 33 crises, listed in Table A.1.

Figure A.2: Systemic External Crisis Patterns

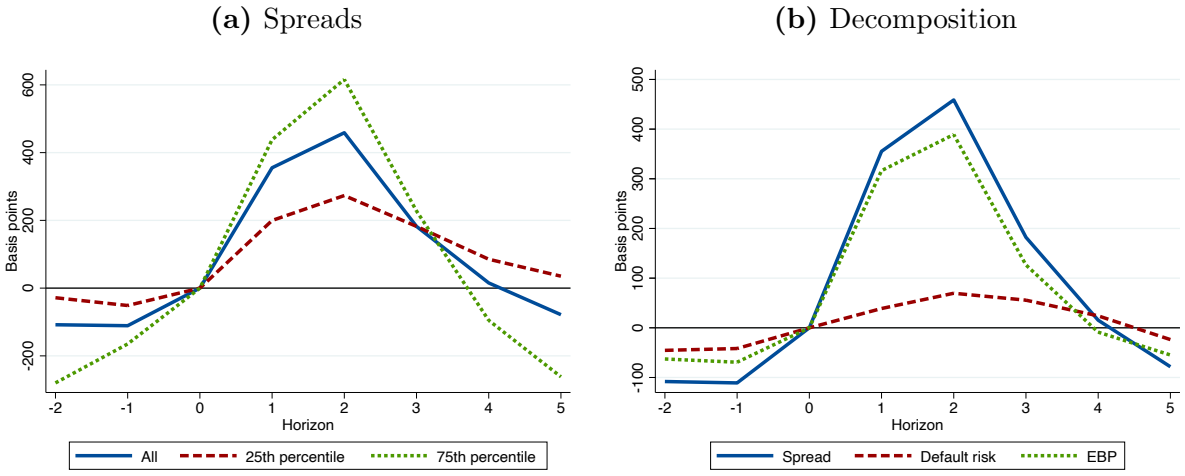


Note: This figure shows selected variables for a set of emerging-market crisis episodes (described in Appendix Table A.1). Data are quarterly and horizon 0 indexes the peak in GDP. Panel (a) shows the average Barclays U.S. Corporate High Yield Spread. Panel (b) plots the difference in percentage points between investment-to-GDP (solid blue line), savings-to-GDP (dashed red line), and net-exports-to-GDP (dotted green line) in each horizon, relative to horizon 0. Panel (c) reports GDP relative to its peak (solid blue line) and the real exchange rate relative to the peak in GDP (dashed red line).

Table A.1: Sudden stop crisis episodes

Country	GDP Peak	Country	GDP Peak
Argentina	1980q3	Mexico	1981q4
	1994q4		1994q4
	1998q2		2008q2
Brazil	1980q4	Peru	1981q1
	2008q3		1997q2
Chile	1981q3		2008q1
	1998q2	South Africa	1981q4
	2008q2		2008q3
Colombia	1998q2	Thailand	1993q4
	2008q3		2008q1
Ecuador	1981q4	Turkey	1993q4
	1998q4		1998q3
	2008q4		2008q1
Korea	1997q3	Uruguay	1981q4
	2008q3		2008q4
Malaysia	1997q4		
	2008q3		

Figure A.3: External crises and external borrowing costs



Note: Panel (a) shows the average change in corporate bond spreads for all bonds and those below the 25th or above the 75th percentiles by spreads at horizon -1. The spreads are measured as the difference between the bond yield-to-maturity and a synthetic risk-free security with the same yield structure. Panel (b) shows the average change in spreads, decomposed into the portion predicted by default risk and the excess bond premium portion. The excess bond premium is defined as in equation (2), where the default risk component is the term subtracted from the total spread. The x-axis indexes quarterly time relative to the peak in GDP. The y-axis units are basis points relative to time 0. The sample includes Argentina 1998Q2, Argentina 2008Q3, Brazil 2008Q3, Mexico 2008Q2, Korea 2008Q3, and Thailand 2008Q1.

Figure A.3 shows that external borrowing costs increase during external crisis periods.[12] Corporate bond spreads exhibit a large and short-lived increase, peaking at 459 basis points above pre-crisis levels and remaining high throughout a year. Panel (a) shows that there is substantial heterogeneity around the increase in external borrowing costs across bonds with different initial spreads. Bonds that had spreads at or below the 25th percentile in the quarter before the onset of the crisis saw their spreads increase by 273 basis points at the peak. Meanwhile, bonds that were priced at or above the 75th percentile experienced a 616 basis point increase in spreads.

[12]We focus on the subset of systemic sudden stop episodes (described in Table A.1) for which we observe at least two bonds in each of the 2 quarters leading up to the peak and the 5 quarters that follow, which gives us a sample of 53 bonds across six episodes: Argentina 1998Q2, Argentina 2008Q3, Brazil 2008Q3, Mexico 2008Q2, Korea 2008Q3, and Thailand 2008Q1.

A.2. Data Description

For our empirical analysis, we combine firm-level data from Global Compustat with corporate bond data from Bloomberg. This section describes the process for cleaning the data and merging across sources.

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. We use WRDS Capital IQ to create crosswalks between the Compustat gvkey and the other identifiers available from Bloomberg. Due to limits imposed by Bloomberg on the amount of data that can be downloaded from the terminal each month, 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 do this by country as a natural way to break the large download into smaller pieces. We exclude local currency bonds because we do not want to capture currency risk in our spreads relative to US 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 1997q2 (11 observations). Table A.2 describes the coverage of our dataset. We have data from 12 countries in total, covering 561 bonds issued by 172 firms. Almost half of our sample is from Latin America.

Table A.2: Sample Composition

	Observations	Bonds	Firms	Min year
Argentina*	733	49	11	1997
Brazil*	563	37	15	1997
Chile*	547	33	7	1998
Colombia*	180	11	2	2005
India†	1313	101	42	2002
Korea†	1453	111	29	1997
Mexico*	1355	95	23	1997
Peru*	301	15	7	2012
Philippines†	494	29	7	1997
Thailand†	468	34	16	1997
Turkey	563	38	12	2002
Ukraine	115	8	1	2009
Total	8085	561	172	.

* Indicates countries in the Latin America subsample.

† Indicates countries in the Asia subsample.

One limitation of our data is that we observe quarterly prices but not the exact date on which the prices are measured, and we observe the first coupon payment date, but not future dates. These limitations introduce noise when we convert prices to yields. 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 (17.6% of our sample).

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

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,

$$P_{it}^{f} = \sum_{s=1}^{S} C_i(s) D(t+s), \tag{A.1}$$

where P_{it}^{f} is the price of the risk-free security that corresponds to bond i in quarter t, $C_i(s)$ is the cash flow from the coupon and principal repayment in that quarter, and $D(t) = e^{-r_t t}$ is the discount function in period t. We implement this equation using the continuously compounded zero-coupon Treasury yields estimated by Gürkaynak, Sack and Wright (2007). Finally, we construct the spread, $S_{ijt} = y_{ijt} - y_{it}^{f}$, where y_{ijt} is the yield of corporate bond i issued by firm j in quarter t and y_{it}^{f} 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). Table A.3 provides descriptive statistics for the bonds in our full sample, and Table A.4 describes the Latin America subsample. Characteristics are relatively similar across the samples.

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, μ_{jt} is the firm's annual expected return, and σ_{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) from Compustat Global. We follow an interative 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.

Table A.3: Summary Statistics of Corporate Bond Characteristics

	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)	394	267	5	362	1779
Maturity at issue (years)	10.57	6.97	1.00	10.00	50.00
Term to maturity (years)	6.26	5.09	1.00	5.00	30.00
Duration (years)	5.03	3.10	0.97	4.48	20.36
Callable (pct.)	0.26	0.44			
Credit rating (Bloomberg)			CCC-	BBB-	AA
Coupon rate (pct.)	6.16	2.39	0.25	5.75	13.00
Nominal effective yield (pct.)	5.93	3.73	0.49	5.06	37.18
Credit spread (basis points)	385	357	5	282	3406

The table reports summary statistics for 561 bonds issued by 173 firms across 12 countries over 1997q2 to 2021q1. 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 184 bonds. The countries are Argentina, Brazil, Chile, Colombia, India, Korea, Mexico, Peru, Philippines, Thailand, Turkey, and Ukraine.

Table A.4: Summary Statistics of Corporate Bond Characteristics, Latin America

	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)	455	325	7	361	1779
Maturity at issue (years)	10.13	5.18	1.00	10.00	40.00
Term to maturity (years)	6.36	4.95	1.00	5.50	30.00
Duration (years)	5.07	2.96	0.97	4.72	19.85
Callable (pct.)	0.44	0.50			
Credit rating (Bloomberg)			CCC-	BB+	A-
Coupon rate (pct.)	7.02	2.21	1.48	6.75	12.75
Nominal effective yield (pct.)	6.79	3.70	0.81	5.96	36.83
Credit spread (basis points)	458	367	6	356	3406

The table reports summary statistics for 238 bonds issued by 64 firms across 6 countries over 1997q2 to 2021q1. 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 184 bonds. The countries are Argentina, Brazil, Chile, Colombia, Mexico, and Peru.

2. We estimate the mean (μ) and variance (σ) 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 $\delta_1 \equiv \frac{\log(V/D)+(r+0.5\sigma^2)T}{\sigma^2\sqrt{T}}$ 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 because the frequency is daily.

4. We repeat steps (a)-(c) 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 (-1.3 and 25.8).

Excess bond premium Table A.5 shows the results of the first-stage regression of corporate bond spreads on default risk and other bond characteristics, given by equation 1, for the full emerging market sample as well as the Latin America and Asia subsamples. The coefficient on distance to default is negative across all three samples, though the magnitude varies, with Asia exhibiting the largest sensitivity and Latin America the smallest.

We then estimate 3 for each sample. Figure A.4 Panel (a) shows our estimates of the systemic excess bond premium using the full sample of emerging markets along with both regional subsamples. Table A.6 reports the correlations among the series. Panel (b) shows estimates by country for the three largest countries in our Latin America sample. Systemic excess bond premia by country are relatively similar to the aggregate, particularly for Mexico. Argentina experiences the most severe deviations from the aggregate.

Credit Ratings We collect credit ratings from S&P and/or Moodys for the Latin American firms in our 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 for 74% of firms in our bond sample, which cover 85% of bonds. We use a crosswalk from the BIS to locate 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 2 steps for 80% of the remaining observations. Figure A.6 shows the distribution of ratings.

Table A.5: Credit Spreads and Distance to Default

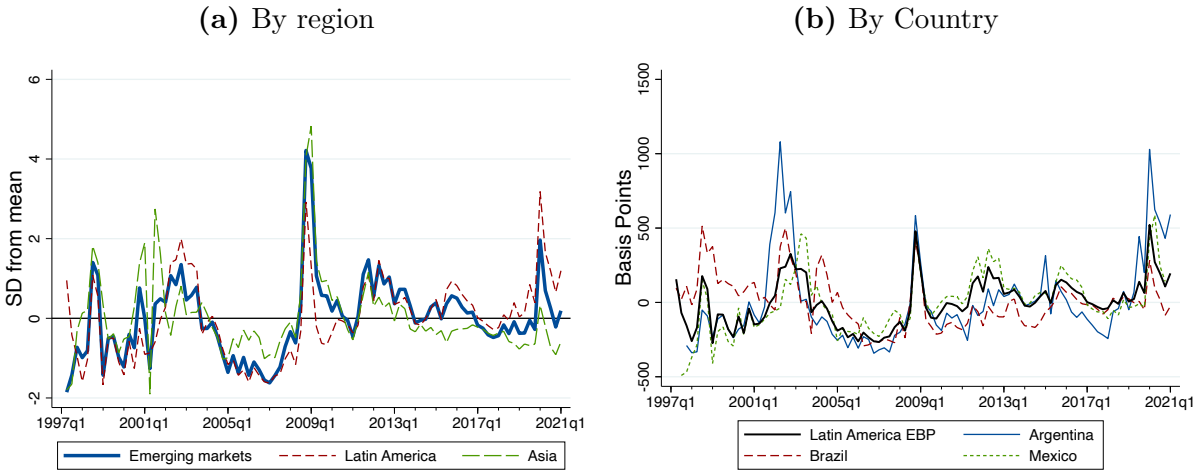
	(1) EMEs	(2) Latin America	(3) Asia
Distance to default	-0.073***	-0.056***	-0.099***
	(0.011)	(0.012)	(0.012)
log(Duration)	-0.009	0.084	0.069**
	(0.038)	(0.063)	(0.035)
log(Amount issued)	-0.039	-0.019	-0.140***
	(0.043)	(0.054)	(0.052)
log(Coupon rate)	0.808***	1.037***	0.415***
	(0.095)	(0.132)	(0.093)
log(Age of issue)	-0.054**	-0.017	0.011
	(0.023)	(0.036)	(0.026)
Callable	0.334***	0.308***	0.211
	(0.056)	(0.064)	(0.141)
Observations	8085	3679	3728
R^2	0.488	0.556	0.510
Root MSE	0.527	0.463	0.511
Number of firms	172	65	94
Number of bonds	561	240	275

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

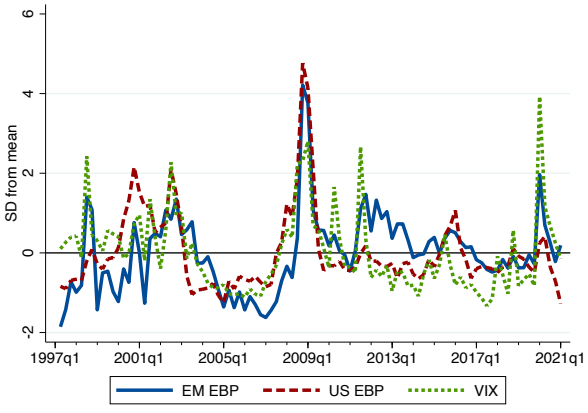
Note: Sample period: 1997q2-2021q1. The table shows the estimated coefficients of Equation (1) for different samples of countries, as defined in Table A.2. The dependent variable is $\log S_{ijkt}$*, the log of the corporate bond spread for bond* i *issued by firm* j *in country* k *and quarter* t*. The model includes fixed effects by sector, type of first coupon issued, and quarter interacted with coupon frequency and first coupon month. Standard errors are clustered by firm and quarter.*

Figure A.4: Excess Bond Premium: Regional Measures



Note: Panel (a) shows excess bond premium estimates (ρ_t from Equation 3) for the regions defined in Table A.2. Panel (b) shows the estimates by country for the three largest countries in the Latin America sample.

Figure A.5: Excess Bond Premium and Global Risk Measures



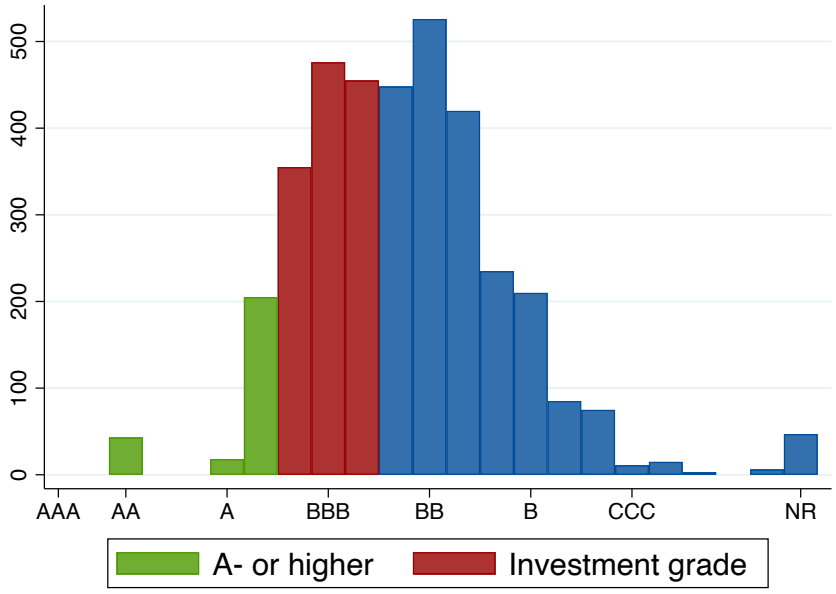
Note: The figure shows our measure of the excess bond premium (ρ_t) and compares it to the U.S. excess bond premium (US EBP) and the VIX. Units are standard deviations from the mean. Correlations are reported in Table A.6.

Table A.6: Global Risk Measure Correlations

	EM EBP	Latin America EBP	Asia EBP	U.S. EBP	VIX
Emerging Market EBP	1.000	.	.	.	.
Latin America EBP	0.797	1.000	.	.	.
Asia EBP	0.772	0.329	1.000	.	.
U.S. EBP	0.622	0.323	0.679	1.000	.
VIX	0.570	0.439	0.567	0.594	1.000

Note: The table reports correlations between the excess bond premium (ρ_t) estimates from Equation 3 across subsamples of countres (as defined in Table A.2), as well as the U.S. Excess Bond Premium and the VIX.

Figure A.6: 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. y-axis reports the number of firm-by-quarter observations.

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. We only interpolate between observations reported in the same currency.

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 US.

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. *Sector:* We identify firms in tradeable and non-tradeable sectors using 2-digit NAICS codes. Tradeable industries are agriculture (11), mining (21), manufacturing (31-33), wholesale trade (42), retail trade (44-45), and transportation and warehousing (48-49). Non-tradeable 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.

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.7: Summary Statistics

	Mean	SD	p10	Med	p90	N
Investment	-0.12	5.93	-4.74	-0.91	4.85	29,386
Real sales growth	1.33	21.59	-20.77	0.81	24.30	29,143
Tradeable sector	0.78	0.41	0.00	1.00	1.00	29,386
Book leverage	0.31	0.34	0.08	0.28	0.52	25,195
Distance to Default	6.57	5.11	1.08	5.38	13.78	17,455
Measures of risk-free						
Above 90th percentile DD	0.10	0.30	0.00	0.00	0.00	17,455
A- or higher rating	0.01	0.09	0.00	0.00	0.00	29,386
Investment grade	0.05	0.22	0.00	0.00	0.00	29,386
Below 10th percentile leverage	0.10	0.30	0.00	0.00	1.00	23,421

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 1997q2 to 2019q4. Investment is defined as the log change in capital stock multiplied by 100. Real sales growth is measured in percentage points. Size is log real total assets, measured in USD. Tradeable and nontradeable sectors are defined in Appendix A.2. Credit ratings are long-term foreign issuer ratings from S&P and/or Moodys, obtained from Bloomberg. Where rating are available from both agencies, the lower rating is used.

Table A.7 reports summary statistics for the Latin America Global Compustat sample. We have 29,030 observations across Argentina, Brazil, Chile, Colombia, Mexico, and Peru over the time period 1997q2 to 2019q4, with considerable variation in investment, sales growth, size, and financial position.

Risky firms Using distance to default, we classify firm-by-quarter observations in our sample as either risky or risk-free, where risk-free firms are those with distance to default above the 90th percentile. Table A.8 summarizes the characteristics of each sample. Unsurprisingly, risky firms have higher leverage. They have slightly lower investment and sales growth, but are comparable in size. Table A.9 summarizes the sample by country. Because the threshold for the risk-free variable is uniform across countries, there is variation in the share of risk-free observations from each country, with Chile having the most risk-free observations and Brazil the fewest.

Table A.8: Summary Statistics by Firm Risk

	Mean	SD	p10	Med	p90	N
Risk-free						
Investment	0.38	5.71	-4.07	-0.35	4.84	1,745
Real sales growth	2.37	18.49	-15.86	1.27	23.05	1,736
Book leverage	0.16	0.12	0.02	0.14	0.34	1,502
Distance to Default	17.60	3.00	14.21	16.94	22.16	1,745
Implied default probability	0.00	0.01	0.00	0.00	0.00	1,745
Tradeable sector	0.76	0.43	0.00	1.00	1.00	1,745
Nontradeable sector	0.19	0.39	0.00	0.00	1.00	1,745
Risky						
Investment	-0.27	5.90	-5.04	-0.99	4.68	15,710
Real sales growth	1.26	20.23	-19.60	0.80	22.52	15,598
Book leverage	0.31	0.24	0.10	0.28	0.51	14,728
Distance to Default	5.35	3.61	0.97	4.81	10.74	15,710
Implied default probability	0.05	0.14	0.00	0.00	0.16	15,710
Tradeable sector	0.77	0.42	0.00	1.00	1.00	15,710
Nontradeable sector	0.15	0.35	0.00	0.00	1.00	15,710

Note: The table reports summary statistics for firm investment and default risk data for risky and risk-free firms. Risk-free firms are those with distance to default above the 90th percentile. Investment is defined as the log change in capital stock multiplied by 100. Real sales growth is measured in percentage points. Size is log real total assets, measured in USD. Tradeable and nontradeable sectors are defined in Appendix A.2. Credit ratings are long-term foreign issuer ratings from S&P and/or Moodys, obtained from Bloomberg. Where rating are available from both agencies, the lower rating is used.

Table A.9: Summary Statistics by Country

	Observations	Firms	DD	Risk-free	Investment	Leverage	Tradeable
Argentina	1,703	56	6.50	0.08	-3.15	0.25	0.76
Brazil	7,075	257	5.25	0.07	-0.19	0.33	0.81
Chile	2,985	103	8.47	0.17	0.22	0.29	0.73
Colombia	501	24	8.15	0.13	1.02	0.21	0.83
Mexico	3,443	105	8.04	0.12	0.26	0.28	0.67
Peru	1,748	64	5.43	0.08	0.65	0.24	0.86

Note: The table reports summary statistics for the sample of Latin American firms with non-missing distance to default (DD). The sample period is 1997q2 to 2019q4. DD, risk-free, leverage, tradeable, and non-tradeable are means by country. Risk-free indicates observations with distance to default above the 90th percentile. Leverage is book leverage.

A.3. Additional Results

Heterogeneity in external borrowing costs The heterogeneous investment dynamics across firms with different risk profiles are consistent with heterogeneity in borrowing cost dynamics. We show that spreads increase more for firms with low credit ratings following increases in the excess bond premium. We use the following specification:

$$S_{ijt+h} = \alpha_{hi} + \beta_h^I \times \rho_t \times \mathbb{I}_{j \in \mathcal{R}_{t-1}^I} + \beta_h^N \times \rho_t \times \mathbb{I}_{j \notin \mathcal{R}_{t-1}^I} + \gamma_h \mathbb{I}_{j \in \mathcal{R}_{t-1}^I} + \omega_h' Z_{ijt-1} + \epsilon_{jth}, \quad \text{(A.2)}$$

where S_{ijt+h} is the spread of bond i issued by firm j at horizon $t+h$, α_{hi} are horizon-bond fixed effects, ρ_t is the excess bond premium estimated on the Latin America sample, R_{t-1}^I is the set of investment-grade firms in $t-1$, and Z_{ijt-1} is a vector of standard firm-level controls and the lagged bond spread.

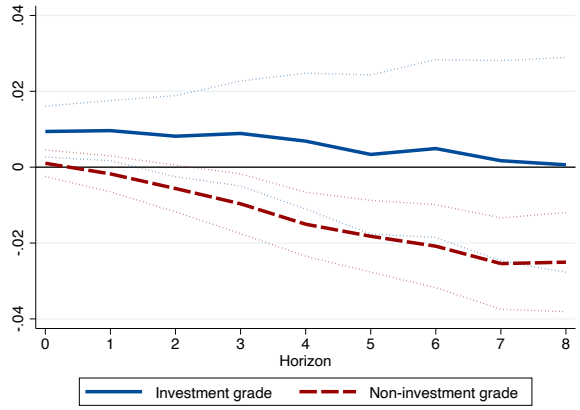
Figure A.7 Panel (a) shows that firms with non-investment grade credit rating experience contractions in investment, consistent with our main results from Figure 3. Panel (b) shows that by the same definition, these firms also see bigger increases in spreads. Firms with an investment-grade or higher credit rating exhibit a 90-basis-point increase in spreads when the excess bond premium is 1 standard deviation higher. Meanwhile, firms with a credit rating below investment grade or not rated at all exhibit a 160-basis-point increase. This figure looks similar if we show the dynamics of bond-level excess bond premia instead of spreads. We interpret these results as suggestive evidence that the pass-through of global increases in borrowing costs is more severe for riskier firms both in terms of investment and financing costs.

Alternative risk-free definitions We construct additional measures of risky and risk-free firms to be used for robustness checks. First, we define risk-free firms as those with a rating of A- or higher and those with an investment-grade rating or higher (BBB-). We classify firms with no rating as risky in these measures.

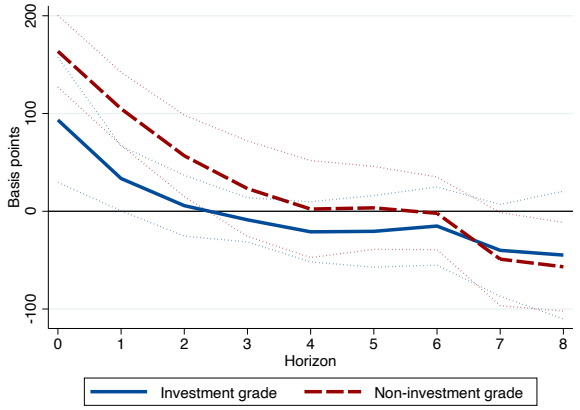
Figure A.8 Panels (a) and (b) shows that the expansionary effects of the excess bond premium on risk-free firms are broadly consistent when we measure risk with credit ratings,

Figure A.7: Heterogeneous Dynamics of Investment and Borrowing Costs

(a) Investment dynamics



(b) Spread dynamics



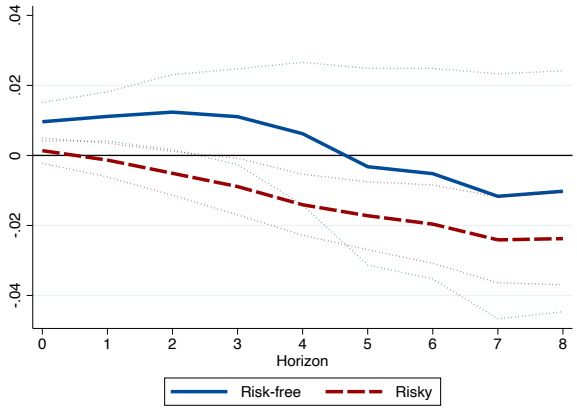
Note: Panel (a) shows the estimated β_h^R and β_h^F coefficients of Equation (4), which correspond to the cumulative log change in capital stock in response to the excess bond premium in period t for investment grade and non-investment grade firms. Panel (b) shows the estimated β_h^I and β_h^N coefficients of Equation (A.2), which correspond to the cumulative change in spreads in response to the excess bond premium in period t for investment grade and non-investment grade firms.

at least in initial quarters after the shock.

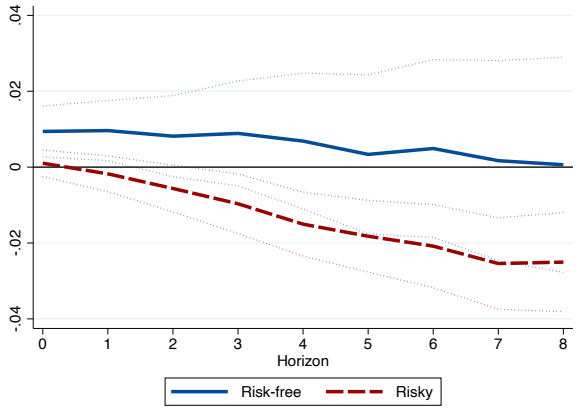
One concern with the ratings data is that these are only available for a small subset of firms, so we may be capturing systematic differences between the types of firms that are rated by Moody's and S&P relative to others. Figure A.8 Panel (c) shows that this does not appear to be driving our results, with rated and unrated firms exhibiting similar overall contractions.

Figure A.8: Risk-free Firms' Investment Responses across Definitions

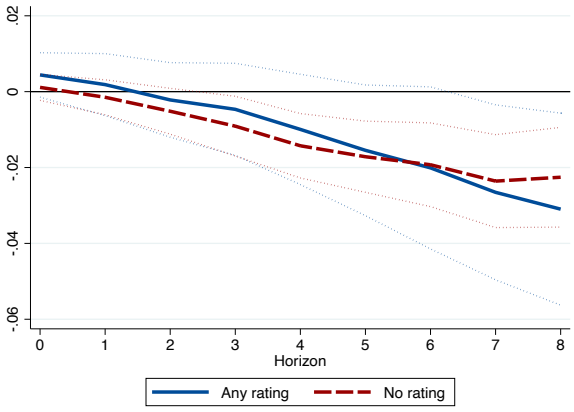
(a) A- rating or higher



(b) Investment-grade rating or higher



(c) Any rating



Note: The figure shows coefficient estimates from Equation (4) with alternative definitions of risk-free firms based on credit ratings.

Alternative excess bond premium specifications We estimate three additional versions of the excess bond premium, in which we modify the model we use for the first stage to 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 1 to include distance to default squared,

$$\log S_{ijkt} = \beta \text{dd}_{jkt} + \omega \text{dd}_{jkt}^2 + \gamma' \boldsymbol{Z}_{it} + \epsilon_{ijkt}. \tag{A.3}$$

Next, we allow heterogeneous effects by firm credit ratings,

$$\log S_{ijkt} = \alpha_l + \beta_l \text{dd}_{jkt} + \gamma' \boldsymbol{Z}_{it} + \epsilon_{ijkt}, \tag{A.4}$$

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,

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

The results for equations (A.3) and (A.4) are reported in Table A.10. Allowing nonlinearity and heterogeneity by credit ratings both improve the fit of the model similarly, increasing the R^2 from 0.56 to 0.59 or 0.60. For the ratings heterogeneity specification, addition of the ratings is more important than the interaction with distance to default.

Results for the country heterogeneity specification, given by equation A.5, are reported in Table A.11. Adding heterogeneous interaction terms and country fixed effects improves the fit of the model substantially, from an R^2 of 0.56 to 0.72. Coefficients on distance to default for the Latin American countries are relatively similar to the baseline, with a weaker pass-through for Brazil and a stronger pass-through for Argentina. Results from estimating Equation (3) with the excess bond premium estimates obtained from each of these models are plotted in Panel (b) of Figure A.9. Across the three specifications, second-stage results look remarkably similar to the baseline.

We examine the sensitivity of our results for investment dynamics to the measure of

Table A.10: Alternative first-stage specifications

	(1) Baseline	(2) Non-linear	(3) Rating heterogeneity
DD	-0.056***	-0.150***	-0.057***
	(0.012)	(0.023)	(0.013)
DD squared		0.006***	
		(0.001)	
Inv grade × DD			-0.004
			(0.021)
Any rating × DD			0.010
			(0.019)
Inv grade			-0.441***
			(0.150)
Any rating			-0.021
			(0.124)
N	3,679	3,679	3,679
R^2	0.556	0.593	0.601
Root MSE	0.463	0.443	0.439
Number of firms	65	65	65
Number of bonds	240	240	240

This table reports the results for estimating equations (A.3) and (A.4), which allow nonlinearity and heterogeneity by credit ratings in the first stage of our excess bond premium estimation. Standard errors in parentheses.

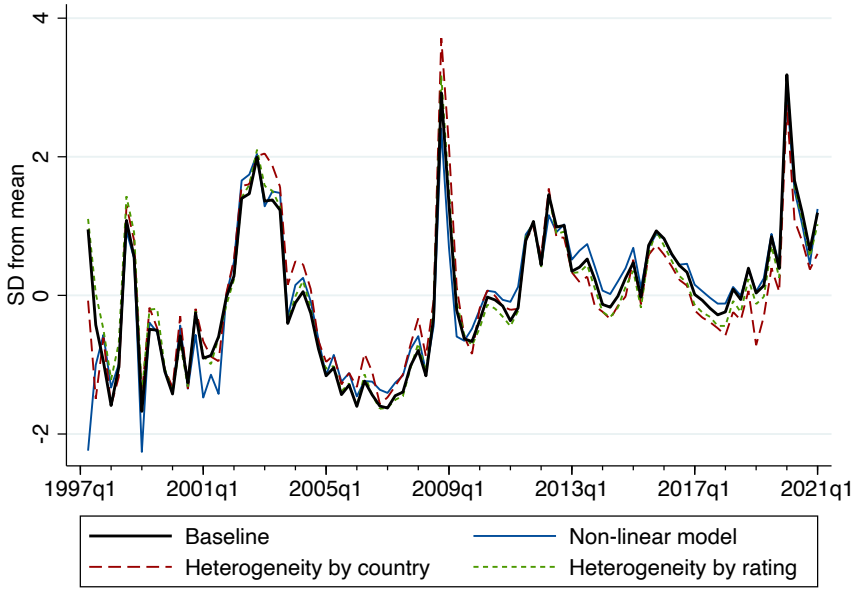
risk premium using alternative measures in Figure A.10. Panel (a) shows results using the excess bond premium estimated on the full set of emerging markets rather than just Latin America. Panels (b)-(d) show results using excess bond premium estimates from the above models that allow for heterogeneous effects of distance to default on spreads in the first stage of the excess bond premium estimation. Panel (b) allows for nonlinearity, Panel (c) heterogeneity by country, and Panel(d) heterogeneity by rating. Our results are similar across measures, which is unsurprising given the high correlation of the different estimates, which are plotted in Figure A.9.

Table A.11: Alternative first-stage specification: Heterogeneity by country

	(1) EMEs	(2) Latin America	(3) Asia	(4) Country Heterogeneity
Distance to default	-0.073***	-0.056***	-0.099***	
	(0.011)	(0.012)	(0.012)	
Argentina × Distance to default				-0.133***
				(0.016)
Brazil × Distance to default				-0.029**
				(0.012)
Chile × Distance to default				-0.056***
				(0.018)
Colombia × Distance to default				-0.055***
				(0.007)
India × Distance to default				-0.116***
				(0.020)
Korea × Distance to default				-0.083***
				(0.018)
Mexico × Distance to default				-0.053**
				(0.021)
Peru × Distance to default				-0.050*
				(0.026)
Philippines × Distance to default				-0.073**
				(0.035)
Thailand × Distance to default				-0.070***
				(0.020)
Turkey × Distance to default				-0.090***
				(0.020)
Ukraine × Distance to default				-0.115***
				(0.017)
Observations	8,085	3,679	3,728	8,085
R^2	0.488	0.556	0.510	0.717
Root MSE	0.527	0.463	0.511	0.404
Number of firms	172	65	94	172
Number of bonds	561	240	275	561

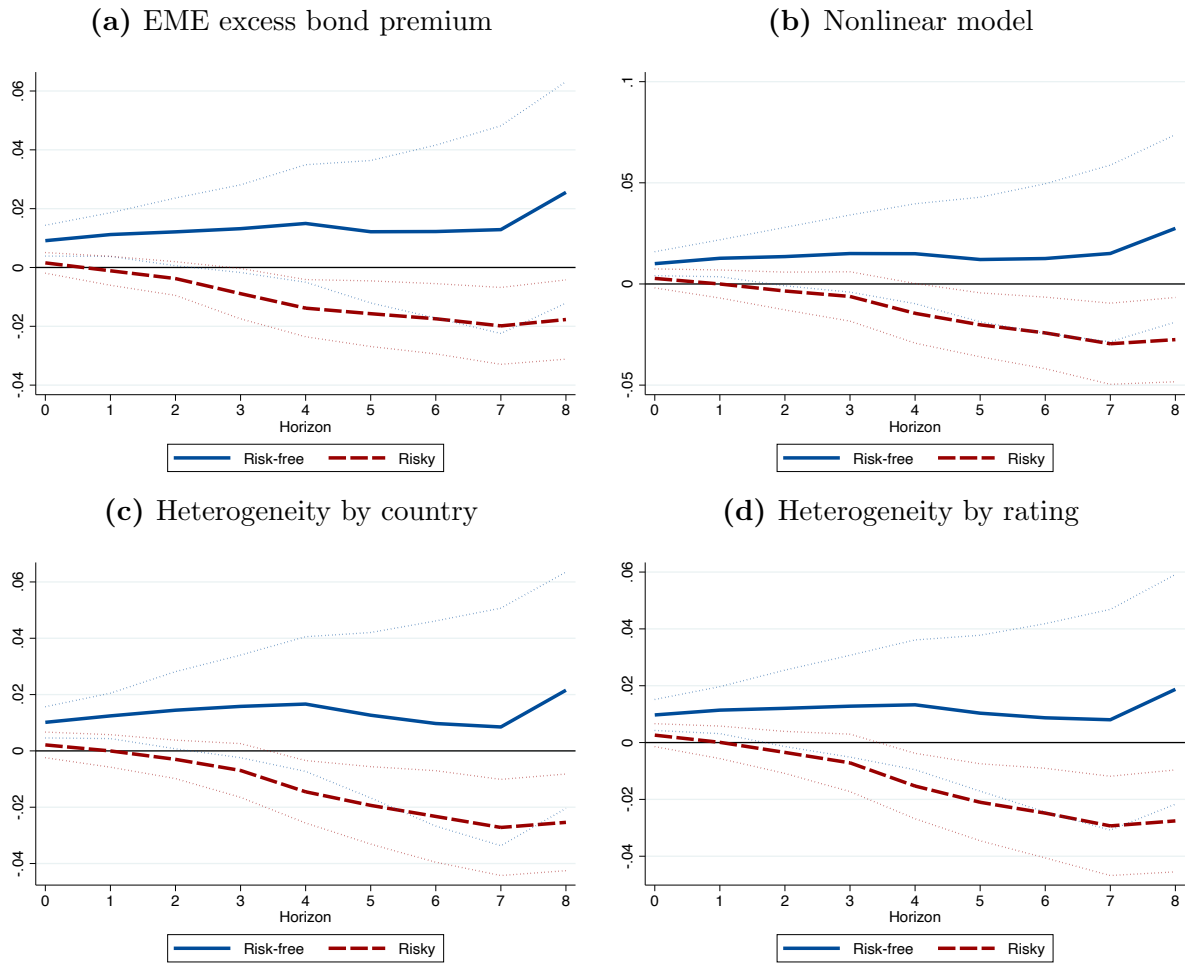
This table reports results for estimating Equation (A.5), which allows for heterogeneity by country in the first stage of our excess bond premium estimation, relative to our baseline estimates of Equation (1) by region. Standard errors in parentheses.

Figure A.9: Alternative excess bond premium specifications



Note: The figure shows the baseline estimate of ρ_t for the Latin America sample and estimates obtained by replacing equation (1) with equations (A.3)-(A.5) to allow for nonlinearity, heterogeneity by country, and heterogeneity by rating in the relationship between distance to default and bond spreads.

Figure A.10: Risky Firms' Responses to the Exccess Bond Premium, alternative specifications



Note: The figure shows coefficient estimates from Equation (4) with alternative versions of the excess bond premium.

Aggregate conditions We address concerns that our results reflect differences in the responsiveness of risky and risk-free firms to aggregate conditions overall. We perform robustness exercises in which we interact risky and risk-free indicators with U.S. macroeconomic indicators, as given by the following specification:

$$\begin{aligned}\Delta_h log(k_{jt}) =& \alpha_{hj} + \underbrace{\beta_h^R \times \rho_t \times \mathbb{I}_{j \notin \mathcal{R}_t^f}}_{\text{Risky Firms} \times \text{RP}} + \underbrace{\beta_h^F \times \rho_t \times \mathbb{I}_{j \in \mathcal{R}_t^f}}_{\text{Risk-Free Firms} \times \text{RP}} \\ &+ \underbrace{\gamma_h^R \times X_t \times \mathbb{I}_{j \notin \mathcal{R}_t^f}}_{\text{Risky Firms} \times X} + \underbrace{\gamma_h^F \times X_t \times \mathbb{I}_{j \in \mathcal{R}_t^f}}_{\text{Risk-free Firms} \times X} + \omega_h' Z_{jt-1} + \epsilon_{jth}.\end{aligned} \tag{A.6}$$

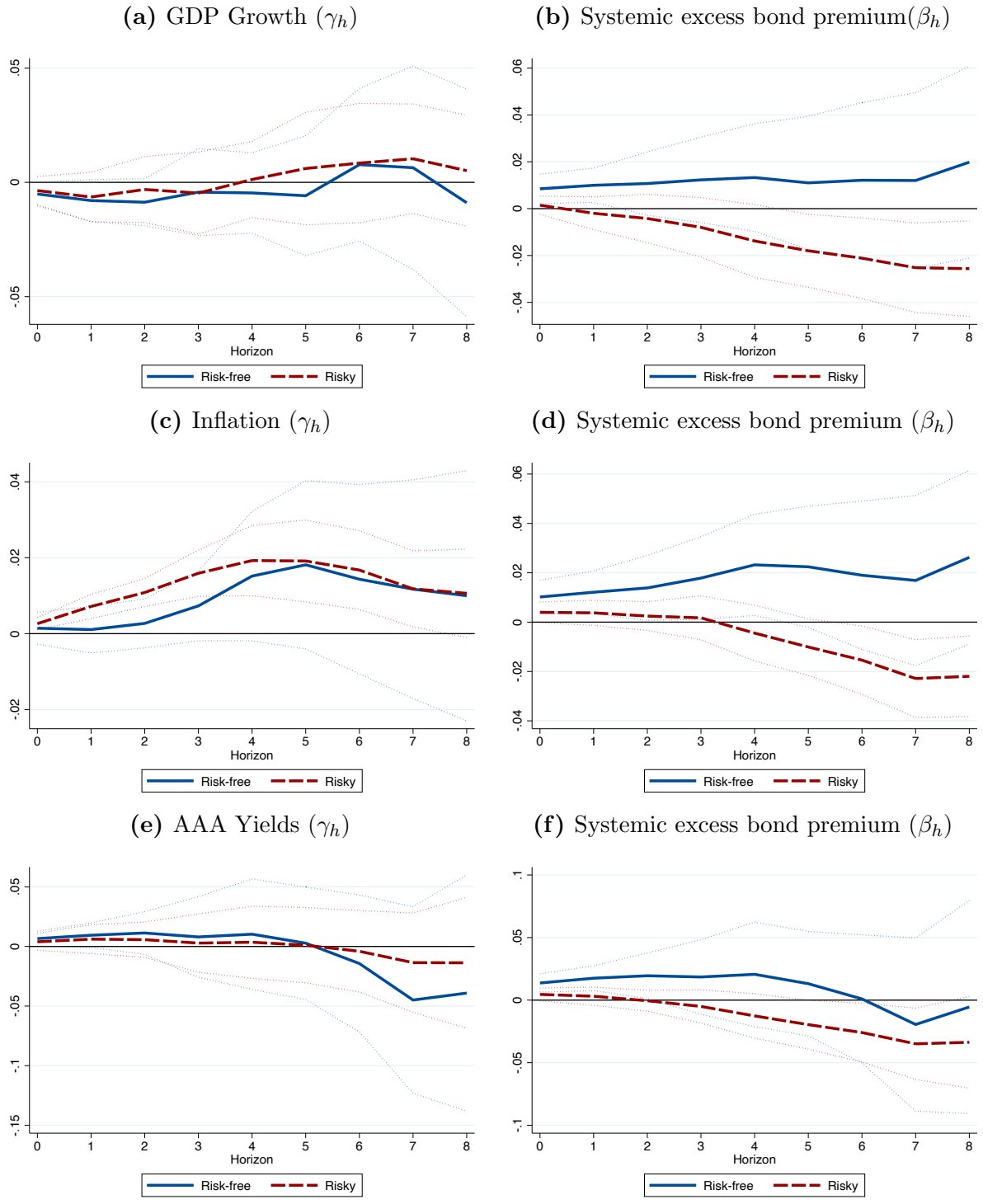
As shown in Figure A.11, risky and risk-free firms respond similarly to U.S. GDP growth, inflation, and movements in AAA yields, whereas responses to the excess bond premium are similar to our baseline results with the inclusion of these additional interactions.

Other firm characteristics To ensure that we are not picking up differences in other firm characteristics and attributing them to firms' risk, we conduct multiple specifications in which we introduce interactions between firms' characteristics and excess bond premium ρ_t,

$$\Delta_h log(k_{jt}) = \alpha_{hj} + \beta_h^z \times \rho_t \times z_{jt-1} + \underbrace{\beta_h^R \times \rho_t \times \mathbb{I}_{j \notin \mathcal{R}_t^f}}_{\text{Risky Firms}} + \underbrace{\beta_h^F \times \rho_t \times \mathbb{I}_{j \in \mathcal{R}_t^f}}_{\text{Risk-Free Firms}} + \gamma_h \mathbb{I}_{j \notin \mathcal{R}_t^f} + \omega_h' Z_{jt-1} + \epsilon_{jth}, \tag{A.7}$$

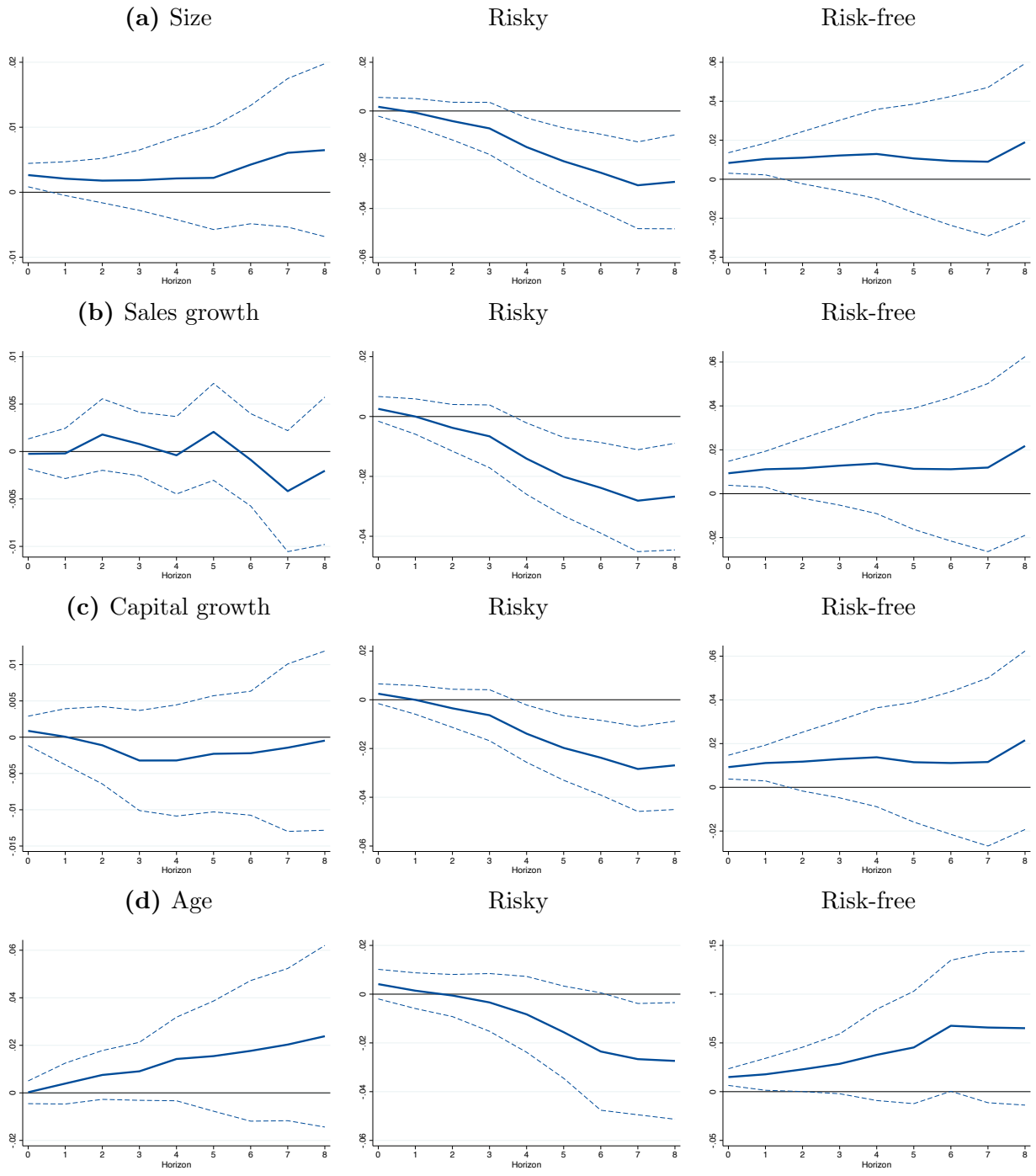
where β_h^R and β_h^F are the coefficients of interest as before, but we add the interaction between variable z_{jt-1} and the excess bond premium. Results are reported in Figure A.12 for several choices of z_{jt-1}. Estimated coefficients β_h^R and β_h^F in Panels (a)-(c) are remarkably similar with added controls for size, sales growth, and capital growth. Results in Panel (d) are noisier because the age variable is missing for many observations, but the pattern is nonetheless qualitatively similar, even in this selected sample.

Figure A.11: Firms' investment responses to aggregate variables



Note: The figure shows coefficient estimates from Equation (A.6), in which U.S. macroeconomic variables are introduced. Left panels show coefficients on the macroeconomic indicator and right panels coefficients on the excess bond premium from that model.

Figure A.12: Heterogeneous Responses to Movements in the Excess Bond Premium with Interactions



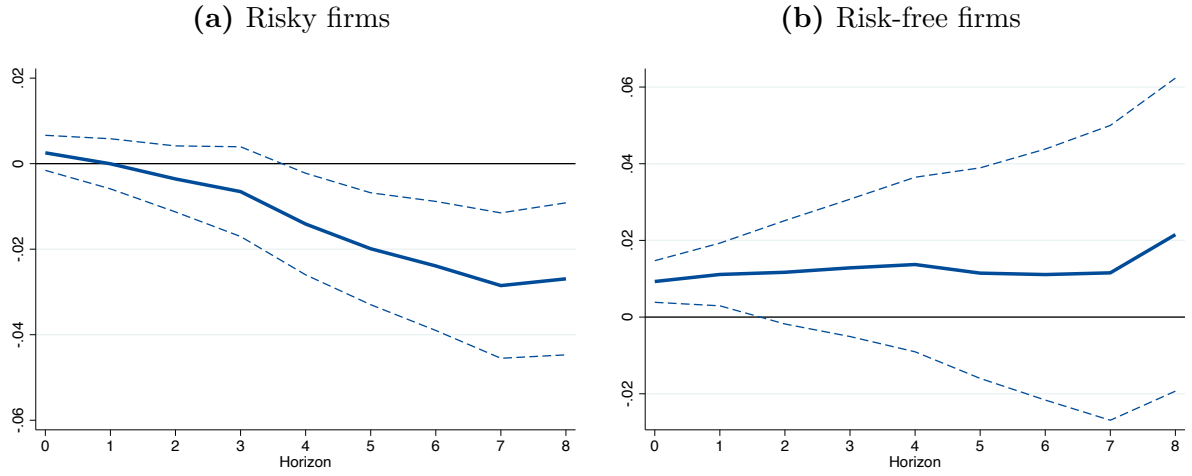
Note: The figure shows coefficient estimates from Equation (A.7). The left panel shows the coefficient β_h^z, from interacting the excess bond premium (ρ_t) with the variable labeled, and the middle and right panels report coefficients β_h^R and β_h^F, respectively. Coefficients in the left panel can be interpreted as the effect of a 1-standard-deviation higher level of each variable —i.e., size —on the cumulative log change in capital stock in response to the excess bond premium shock.

Alternative functional forms To allow for the possibility that risky and risk-free firms also have different patterns of sales growth, size, etc., we allow a version of the model that interacts the risky and risk-free dummies with all of the control variables,

$$\Delta_h log(k_{jt}) = \alpha_{hj} + \underbrace{\left(\beta_h^R \rho_t + \ \omega_h^R Z_{jt-1}\right) \times \mathbb{I}_{j \notin \mathcal{R}_t^f}}_{\text{Risky Firms}} + \underbrace{\left(\beta_h^F \rho_t + \ \omega_h^F Z_{jt-1}\right) \times \mathbb{I}_{j \in \mathcal{R}_t^f}}_{\text{Risk-Free Firms}} + \epsilon_{jth}. \quad \text{(A.8)}$$

Results are shown in Figure A.13, and look very similar to the baseline.

Figure A.13: Heterogeneous Investment Responses with Interacted Controls



Note: The figure shows coefficient estimates from Equation (A.8) with controls fully interacted by risk.

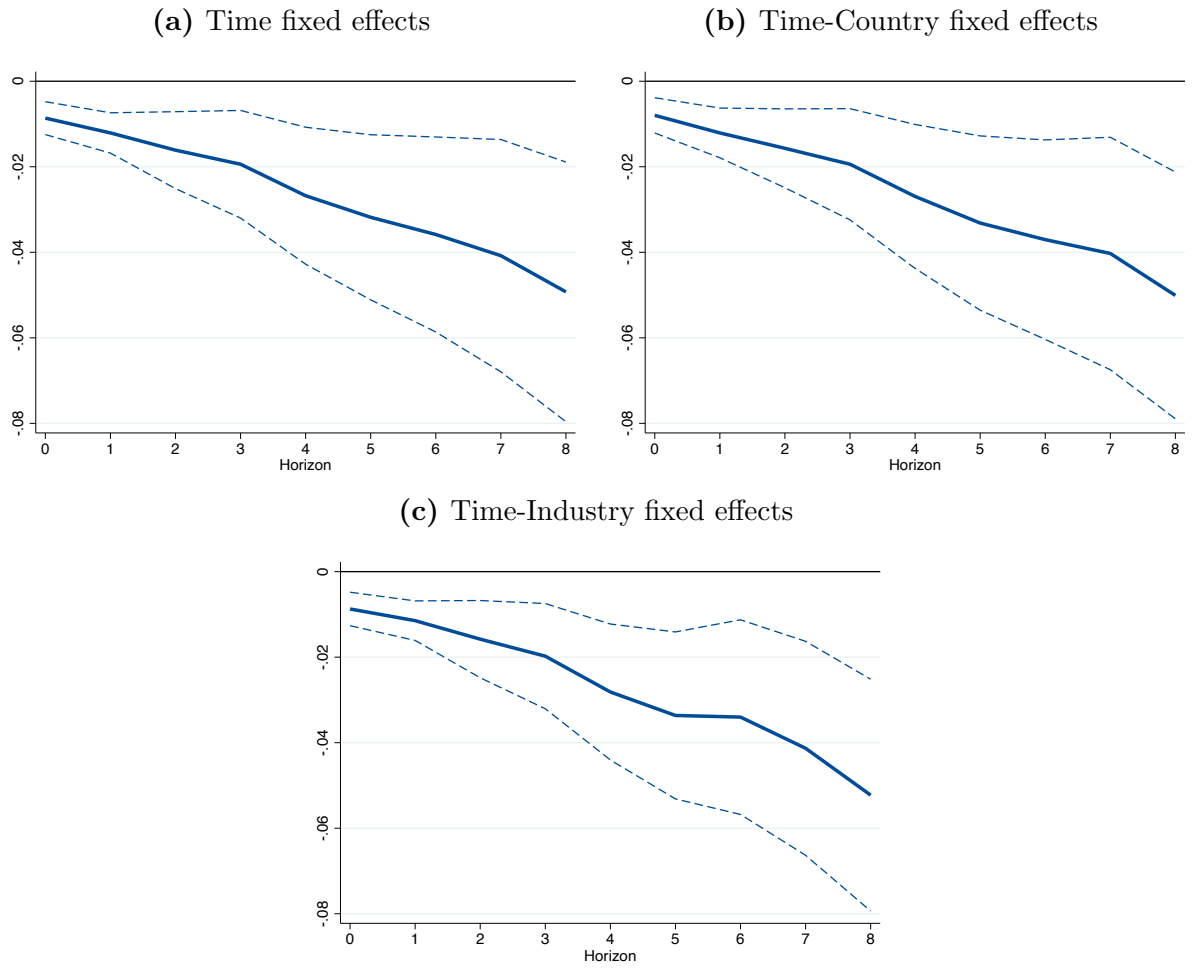
Next, we introduce time-by-country fixed effects to capture any country-specific trends that could be affecting firms' investment with changes in the excess bond premium,

$$\Delta_h log(k_{jkt}) = \alpha_{hj} + \alpha_{hkt} + \underbrace{\beta_h^R \times \rho_t \times \mathbb{I}_{j \notin \mathcal{R}_t^f}}_{\text{Risky Firms}} + \gamma_h \mathbb{I}_{j \notin \mathcal{R}_t^f} \ + \ \omega_h' Z_{jt-1} + \epsilon_{jkth}, \quad \text{(A.9)}$$

where the coefficient of interest is β_h^R, which captures the cumulative change in capital stock for risky firms relative to risk-free, holding fixed conditions in country k in quarter t. Note that the inclusion of time fixed effects means we can only isolate these relative effects for risky firms, rather than the average effects for each group. Results are shown in Figure A.14. Risky firms have lower cumulative change in capital at all horizons relative to risk-free firms,

peaking at 5.4% lower after 2 years.

Figure A.14: Risky Firms' Responses to the Excess Bond Premium, with Time Fixed Effects



Note: The figure shows estimated β_h^R coefficients of Equation (A.9), which correspond to the cumulative (log) change in capital stock in response to the excess bond premium (ρ_t) for risky relative to risk-free firms, with fixed effect specified in the title.

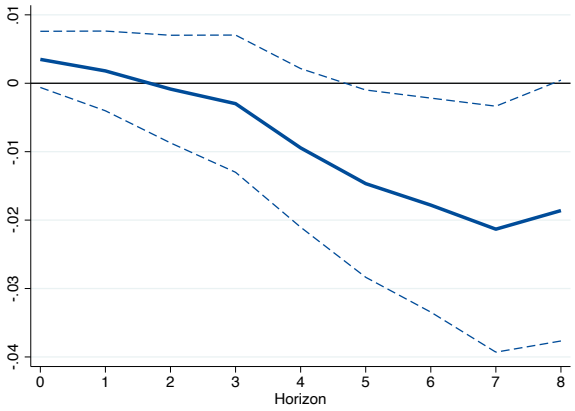
Our baseline specification classifies firms as either risky or risk-free by the quantile of distance to default. We also estimate an interactive model in which we estimate a level effect and an interaction term with distance to default,

$$\Delta_h log(k_{jt}) = \alpha_{hj} + \beta_h \times \rho_t + \beta_h^D \times \rho_t \times \mathrm{dd}_{jt-1} + \gamma_h \mathrm{dd}_{jt-1} + \omega_h' Z_{jt-1} + \epsilon_{jkth}, \qquad \text{(A.10)}$$

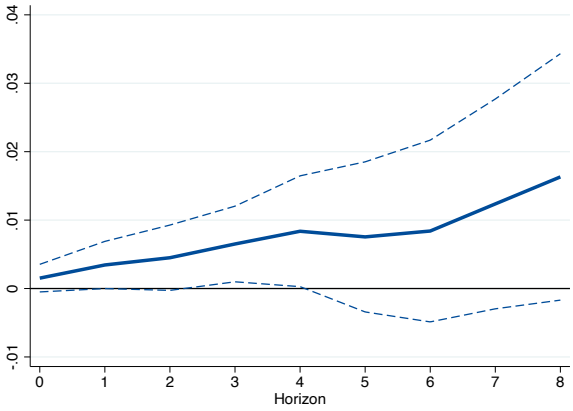
where β_h captures the average cumulative (log) change in capital stock and β_h^D captures the additional change for firms with 1-standard-deviation higher distance to default (less risky). Results are shown in Figure A.15. Consistent with our other baseline, firms with higher distance to default have higher cumulative capital growth. The mean risky firm, as defined in our baseline, has a distance to default of -0.2 standard deviations, relative to 2.2 standard deviations for the mean risk-free firm. Results are similar when we include country-by-time fixed effects, as shown in Figure A.15 Panel (c).

Figure A.15: Heterogeneous Responses to Movements in the Excess Bond Premium, Continuous Measure

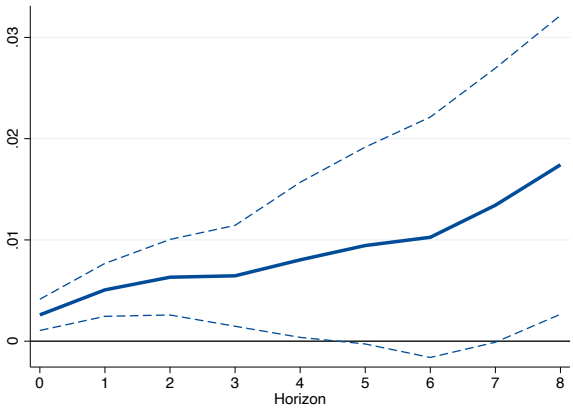
(a) Aggregate effect



(b) Interaction with Distance to Default



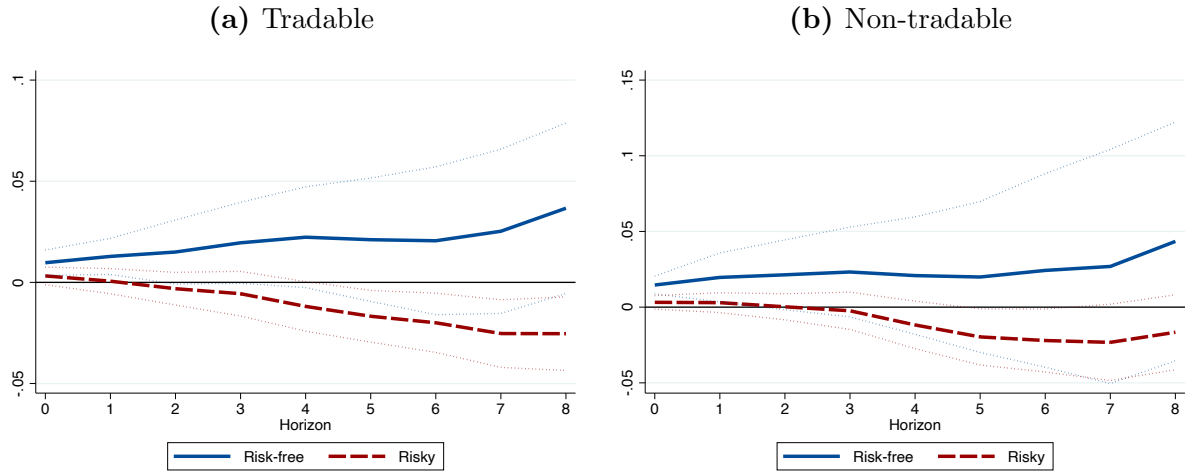
(c) Interaction with Distance to Default, Fixed Effects Model



Note: Panels (a) and (b) show the estimated β_h and β_h^D coefficients of Equation (A.10). The first is the cumulative average (log) change in capital stock in response to the excess bond premium (ρ_t). The variable ρ_t is standardized so the units are standard deviations. The second is the interaction term with distance to default, which is standardized, so the coefficients can be interpreted as the additional cumulative (log) change in capital stock for firms with 1-standard-deviation higher distance to default (i.e., less risky). Panel (c) shows the estimated β_h^D (right panel) coefficients with the addition of country-by-time fixed effects.

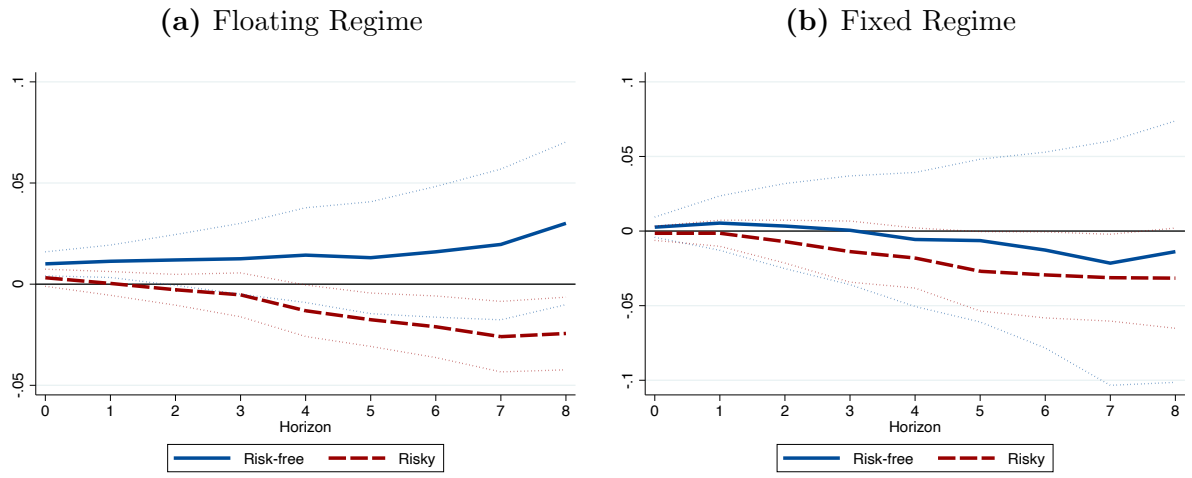
Subsamples Next, we show that our results are not highly sensitive to subsamples of industries or countries. Figure A.16 introduces interactions between risky and risk-free indicators with tradeable and non-tradeable sectors (defined in Appendix A.2). The results are noisier but show that the negative effects of the excess bond premium shock are concentrated among risky firms across both sectors. To address concerns about whether our results are driven by particular countries, we re-estimate Equation 4 on a subsample that drops one country at a time. Results are shown in Figure A.18. Negative results for risky firms are persistent across all subsamples. Results for risk-free firms are unsurprisingly much noisier but are generally positive, with the exception of the latter horizons when we drop Brazil, which accounts for 37% of our total sample. We do not estimate effects separately by country due to the low power of our sample size.

Figure A.16: Heterogeneous Responses to Movements in the Excess Bond Premium by Sector



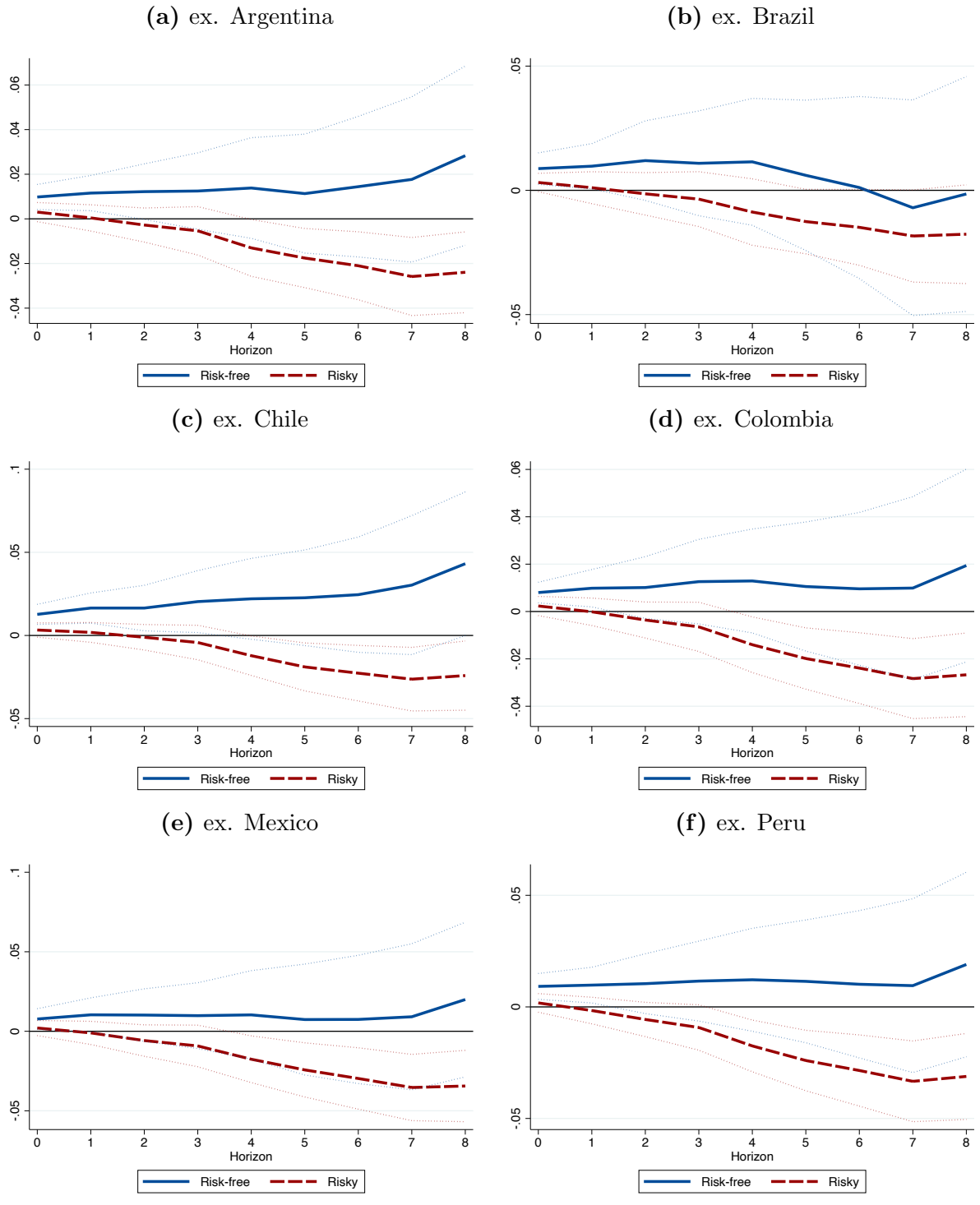
Note: The figure shows coefficient estimates from Equation (4) with additional interactions between tradeable and non-tradeable sectors.

Figure A.17: Heterogeneous Responses to Movements in the Excess Bond Premium by Exchange Rate Regime



Note: The figure shows coefficient estimates from Equation (4) with additional interactions for exchange rate regime.

Figure A.18: Heterogeneous Responses to Movements in the Excess Bond Premium by Country Sample



Note: The figure shows coefficient estimates from Equation (4), excluding one country at a time.

B. Quantitative Appendix

B.1. Model-implied Measure of Risk Premia

We describe here the process to construct the model-implied measure of risk premia. We first define the internal rate of return of a bond b 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 spread of the bond with respect to the risk-free rate, r_f, is defined as $sp(k', b', z, \boldsymbol{S}) = \left(\frac{1+r(k', b', z, \boldsymbol{S})}{1+r_f}\right) - 1$. To compute the model-implied measure of the risk premium, we need to solve for debt prices under a hypothetical risk-neutral lender. Taking the firms' optimal default and debt policies as given, the risk-neutral pricing kernel would be given by

$$\tilde{q}\left(k', b', z, \boldsymbol{S}\right) = \mathbb{E}_{(z', \boldsymbol{S'})|(z, \boldsymbol{S})}\Bigg[\beta^{\star}\Bigg(\left[1 - h\left(k', b', z', \boldsymbol{S'}\right)\right] \times \mathcal{R}_f^r(k', b', z', \boldsymbol{S'}) + \\ + h\left(k', b', z', \boldsymbol{S'}\right) \times \mathcal{R}_f^d\left(k', z', \boldsymbol{S'}\right)\Bigg)\Bigg],$$

where $\mathcal{R}_f^r(k', b', z', \boldsymbol{S'}) \equiv (1-m)\left(\upsilon + \tilde{q}\left(k'', b'', z', \boldsymbol{S'}\right)\right) + m$, and the next-period policies h', k'', and b'' are obtained under the assumption that foreign lenders are risk averse. Let $\tilde{sp}(.)$ be the spread of the bond under risk-neutral pricing. Our model-implied measure of risk premium is given by

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

B.2. Computational Algorithm

Our model features several state variables, including the firm distribution (an infinite dimensional object) and aggregate uncertainty, which renders it challenging to solve. The aggregate state of the problem can be written as $\boldsymbol{S} \equiv (A, \kappa, \Omega)$, where $\boldsymbol{s} = (A, \kappa)$ denotes the exogenous processes and Ω denotes the firms' distribution across the three idiosyncratic

states (k, b, z).

To solve for the equilibrium of the model numerically, we follow a bounded rationality type of approach, as in Krusell and Smith (1998), and use as state variables a set of statistics that summarize the distribution of firms. Such a distribution is a relevant variable to solve firms' problem because of its implications for the economy's aggregates, prices, and real wages. First, let $\tilde{K}_t \equiv \int z_{i,t} \times (k_{it})^{\frac{\alpha\chi}{\varsigma}}$ denote the economy's production capacity. Notice that this is just a function of the economy's stock of capital, weighted by each firm's productivity. It is useful to include this variable as a state, since it allows us to pin down wages. Second, we use the economy's exports, $Z_t = \left(\frac{\xi_t}{P_{H,t}}\right)^{\eta} Y_F^{\star}$, as an auxiliary variable (i.e., a co-state). Although Z_t is not observed at the beginning of each period, we include Z_t as an auxiliary aggregate variable in the firms' problem and, in the simulation stage, we then solve for the value of Z_t such that the H-good market clears. Once we know $(\tilde{K}_t, Z_t)$, we can compute all of the prices of the economy. Combined with a conjectured law of motion for $(\tilde{K}_t, Z_t)$, we then have all the information needed to solve for firms' and households' problems.

Embedded inside $(\tilde{K}_t, Z_t)$, we have all of the relevant information describing the firms' distribution. Other firms' moments, such as average leverage or the cross-sectional standard deviation of capital, are only relevant to improve the forecast of $(\tilde{K}_{t+1}, Z_{t+1})$. However, to keep the solution tractable, we assume a forecasting rule independent of other moments of the firm distribution. Let $\tilde{\boldsymbol{S}} = \left(A, \kappa, \tilde{K}, Z\right)$ denote the (bounded) state space. We consider the following forecasting rule for $\tilde{K}'$:

$$\tilde{H}_K\left(\tilde{\boldsymbol{S}}\right) = e^{\Lambda_0 + \Lambda_1(\tilde{\boldsymbol{S}})}. \tag{B.2}$$

As for $\tilde{Z}'$, we consider the following state-contingent forecasting rule:

$$\tilde{H}_Z\left(\tilde{\boldsymbol{S}}, A', \kappa', \tilde{K}'\right) = e^{\Theta_0 + \Theta_1\left(\tilde{\boldsymbol{S}}, A', \kappa', \tilde{K}'\right) + \Theta_2(Z)}. \tag{B.3}$$

The algorithm consists of three main steps. First, we guess the coefficients of the conjectured law of motions. Given these conjectures, we solve for firms' optimal choices

following these sub-steps:

1. Guess the value function $V^r\left(k, b, z, \tilde{\boldsymbol{S}}\right)$ and the pricing kernel $q\left(k', b', z, \tilde{\boldsymbol{S}}\right)$ for each point of the state space and for each possible choice of (k', b').

2. Taking the pricing kernel as given, solve the firms' problem and update the value function accordingly.

3. Using the optimal policies computed in the previous step, update the pricing function.

4. Iterate until convergence of both $V^r(.)$ and $q(.)$.

Since the firms' problem presents several non-convexities, we use a global optimization algorithm to solve for k' and b'. This step of the algorithm relies on the use of graphics processing units (GPUs) to speed computation. We approximate all functions using linear interpolation. The firm's idiosyncratic productivity (z) and the aggregate TFP processes (A) are discretized using Tauchen's method. Grids of evenly distributed points are constructed for all states. We use 20 points for k, 20 points for b, 9 points for z, 7 points for A, 2 points for κ, 5 points for $\tilde{K}$, and 5 points for Z.

The last step of the algorithm consists of simulating the economy in order to update the aggregate conjectures. The simulation follows Young's (2010) non-stochastic approach. By not relying on the simulation of individual firms, this approach avoids the sampling error associated with individual firm simulation. This is important in the context of the model, given that due to the firm's default cutoff, small sampling errors may lead to large swings in the aggregate default rate, and thus in Z and $\tilde{K}'$. In each step of the simulation, we use a simple bisection algorithm to solve for the value of Z such that the H-good market clears. We simulate the economy for T periods and use the simulated objects to update the coefficients of the aggregate conjectures $\tilde{H}_{\tilde{K}}$ and $\tilde{H}_Z$. We iterate on this algorithm until convergence of these coefficients.

B.3. Calibration Data

Cross-sectional moments. 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. We process the historical vintages of Orbis data using the guide provided by Kalemli-Özcan, et al. (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 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 (longtermdebt+loans+creditors) to total assets (totalassets).
- *Real sales growth:* We define real sales growth as the percent change in sales deflated by the GDP deflator.
- Size: We define size as the log of tangible fixed assets.
- *Liquidity:* We define liquidity as the ratio of net current assets (currentassets-currentliabilities) to total assets (totalassets).
- *Age:* We define firm age as the number of years since the incorporation date (dateofincorp).
- *Public/Private:* We define public and private firms based on firms' listed status (listed-delistedunlisted). We define public firms as listed firms and private firms as unlisted firms. Note that firms' listed status is a snapshot and will not vary over time, so we could theoretically miss firms that change status, though we think this issue is small in the short sample we focus on.

Table B.1: Orbis sample description

	Argentina	Brazil	Chile	Colombia	Mexico	Peru
Number of firms	158	3,431	205	55,886	1,424	900
Number of public firms	52	181	101	35	90	83

The table reports the number of firms used in our Orbis sample and the composition of public firms.

- *Equity issuance:* We proxy equity issuance as a percent change in shareholders' funds (shareholdersfunds) greater than 50%.

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 NAICS22) industries.
3. We exclude firm-year observations with negative 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.

Table B.1 provides a summary of the size of our Orbis sample and the composition of private and public firms.

We construct the cross-sectional moment targets using the average of the country-specific moments. Table B.2 reports the disaggregated moments by country. For the age

Table B.2: Orbis summary statistics by country

(a) Targeted cross-sectional moments

	Target	Argentina	Brazil	Chile	Colombia	Mexico	Peru
Leverage	0.29	0.36	0.25	0.38	0.14	0.35	0.25
Investment/k (cs std)	0.25	0.26	0.26	0.15	0.28	0.29	0.25
Leverage(cs std)	0.22	0.21	0.25	0.23	0.22	0.23	0.20
Correlation size and age	0.28	0.22	0.19	0.20	0.35	0.36	0.34
Share firms issuing equity	0.14	0.14	0.06	0.12	0.17	0.18	0.15

(b) Untargeted cross-sectional moments

	Target	Argentina	Brazil	Chile	Colombia	Mexico	Peru
Ratio median age	2.99	1.77	1.50	1.92	3.80	1.64	1.43
Age median firm	10.00	21.00	27.00	16.00	10.00	15.00	14.00
Age median public firm	29.92	34.50	39.00	25.00	38.00	23.00	20.00
Share public firms, sales	0.13	0.61	0.58	0.62	0.13	0.46	0.14

The table reports summary statistics for the Orbis data by country relative to the aggregate moments used in the model calibration.

of median firm and share of public firm in sales, we target the moments from Colombia rather than the averages, since the representation of private firms is best. Because we do not observe employment in Orbis, we calculate the share of public firms in terms of sales.

The moments for the risk profile for Compustat firms reported in Table **??** Panel 3 are calculated using the pooled sample across countries and time of the spreads from our corporate bond dataset described in Appendix A.2.

Aggregate moments. We collect quarterly real national accounts data for Argentina, Brazil, Chile, Colombia, Mexico, and Peru from the IMF's International Financial Statistics database or OECD's Main Economic Indicators, as available via FRED. For Argentina, Colombia, and Peru, we supplement these 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 calculate standard deviations and correlations separately by country and then take the average across countries to generate the moments presented in Tables **??** and **??**. We compute the change in risk premium as the average first difference in the Latin America

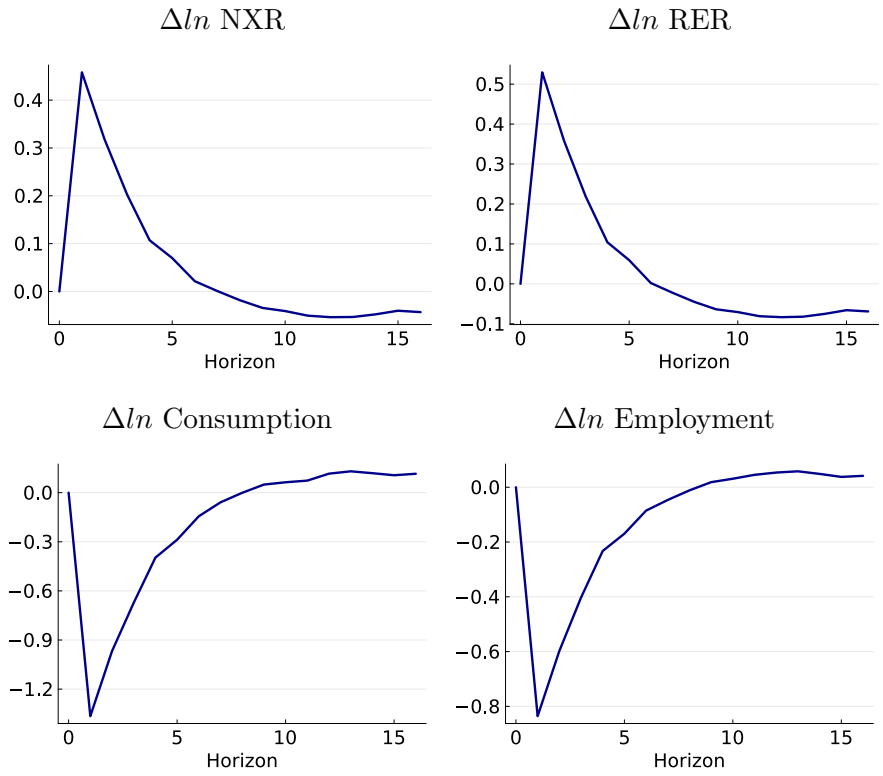
excess bond premium described in Appendix A.2, expressed in percentage points.

B.4. Additional Figures

Figure B.1 shows the responses of the exchange rate, consumption, and employment to a one standard deviation shock to the market price of risk.

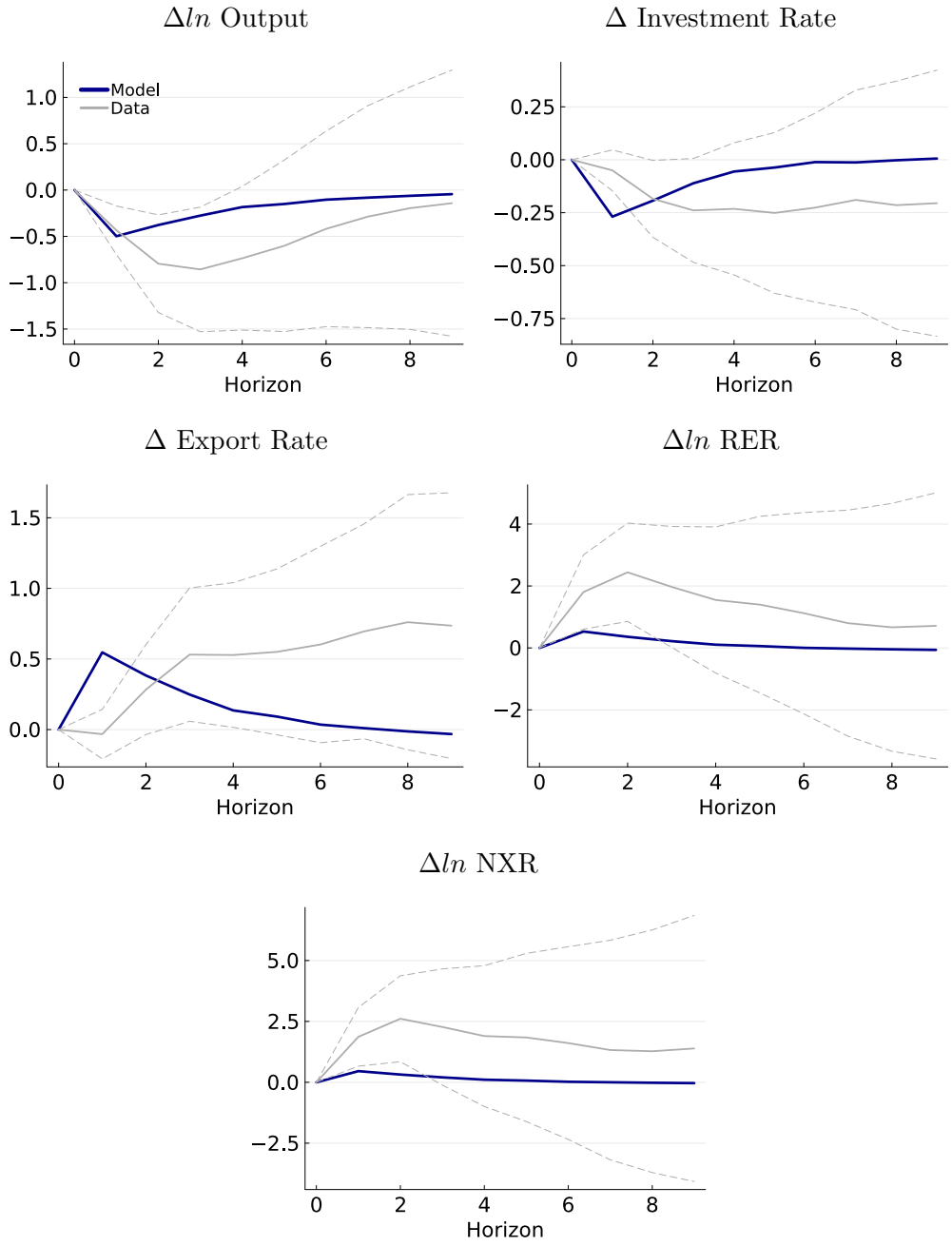
Figure B.2 shows the model-implied impulse response to an increase in the global price of risk ($\Delta\kappa > 0$) with those obtained in the data (based on a one-standard-deviation increase in the EMEBP measure). While untargeted, the model-implied dynamics for changes in the investment rate are very well in line with those of the data. The model does a relatively good job in matching the evolution of export rates and the real exchange rate. However, it is not able to account for the large drop in output that we observe in the data (although these estimates are quite noisy and, for most of the horizons, not significant).

Figure B.1: Aggregate Responses to an Increase in Global Risk Premium



Note: Impulse responses to an increase in the global price of risk ($\Delta\kappa > 0$). The panels show the dynamics for the nominal exchange rate (NXR), the real exchange rate (RER), consumption, and employment.

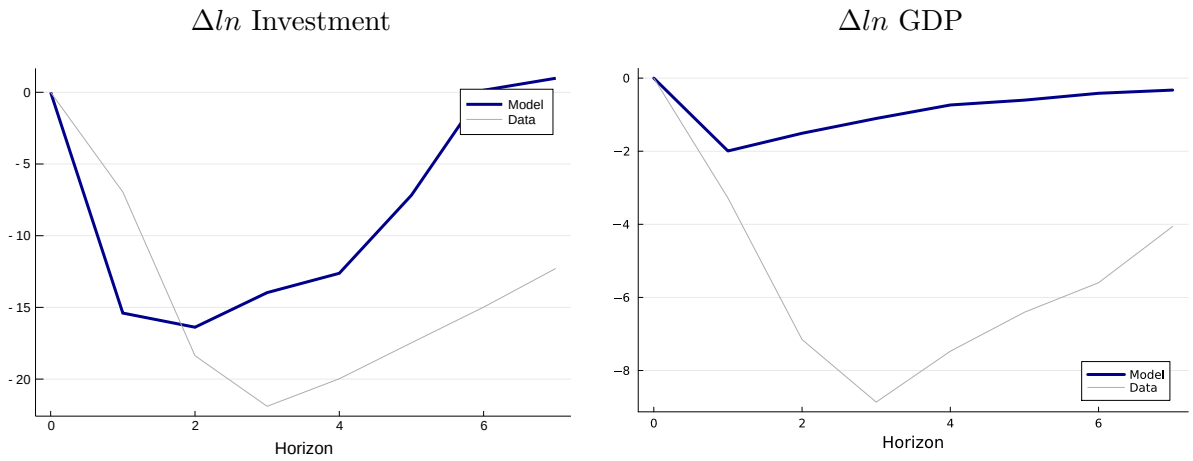
Figure B.2: Aggregate Responses: Model vs Data



Note: The figure compares the model-implied impulse response to an increase in the global price of risk ($\Delta\kappa > 0$ with those obtained in the data.

Figure B.3 compare our model-implied dynamics for investment, GDP, and the real exchange rate during the Lehman Episode in 2008. To this end, we construct an impulse response to a 4-standard deviation risk premia shock, which is in line with the increase in

Figure B.3: Aggregate Responses during the Lehman Episode

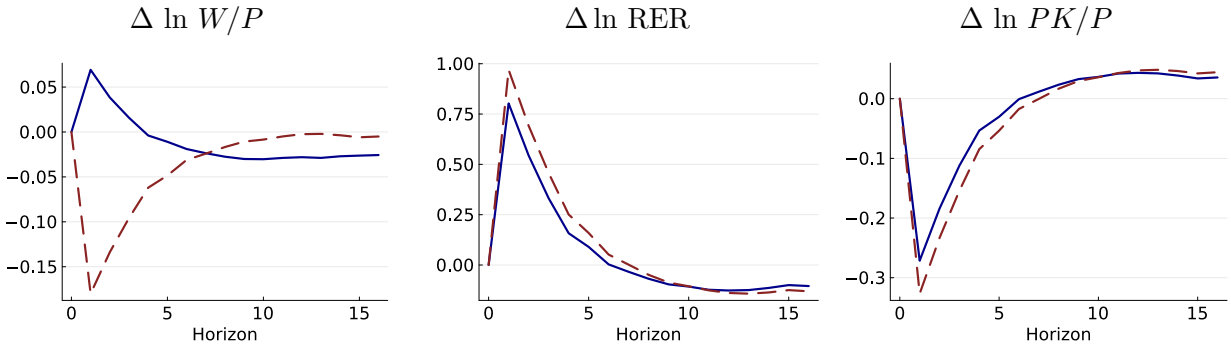


Note: The figure compares the model-implied dynamics with those of the data around the collapse of Lehman in 2008.Q3.

EBP that we document in Figure 2.[13]

Figure B.4 shows the price adjustment under a flexible exchange rate and a fixed exchange rate.

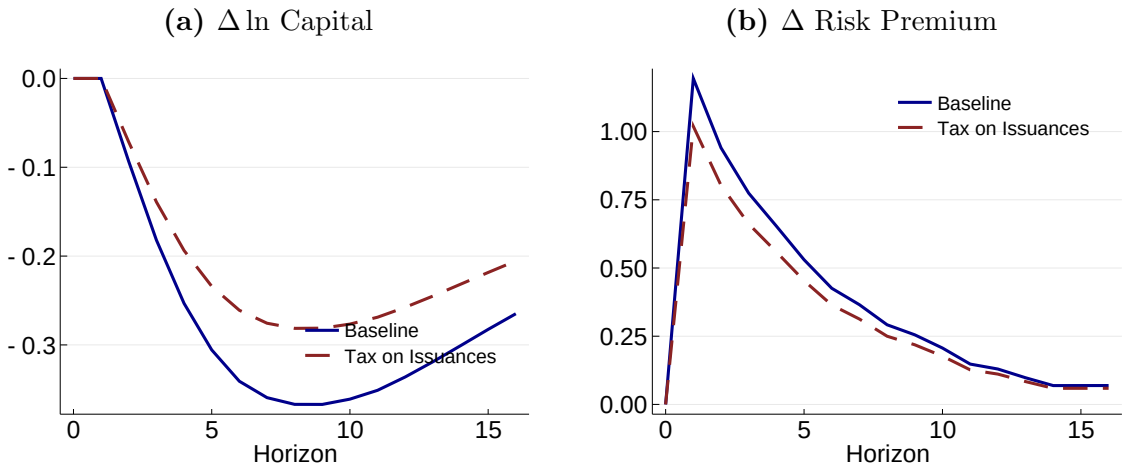
Figure B.4: Price Adjustment Channel



Note: Impulse responses to a risk-premium shock ($\Delta\kappa > 0$). The left panel shows the dynamics for real wages and the right panel the dynamics for the real exchange rate. The x-axes show the horizon h.

[13] In our quantitative analysis, we discipline the $\kappa = \{\kappa_L, \kappa_H\}$ process to match a 1-standard deviation increase in risk premia. To construct this figure, we linearly extrapolate the dynamics to a 1-standard deviation shock.

Figure B.5: Tax on Debt Issuances



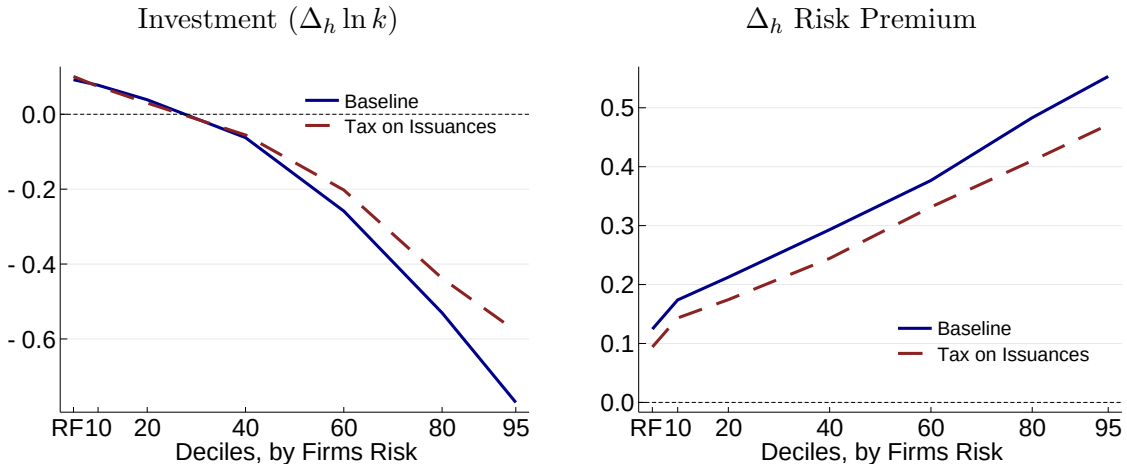
Note: Impulse responses to a risk-premium shock ($\Delta\kappa > 0$). The blue lines show the dynamics for aggregate capital and risk premia for our baseline model. The red lines show the dynamics for an economy in which the government imposes a tax on debt issuances.

B.5. Tax on Debt as a Macro-prudential Tool

As we have described in the main text, changes in global risk premia are transmitted to the domestic economy through firms' exposure to foreign lenders. A lower exposure to such lenders should thus dampen the economy's contraction upon a risk premium shock. In this appendix, we analyze a simple tax on foreign debt as a potential macro-prudential policy that is targeted to reduce the economy's exposure to international capital markets. For simplicity, we assume that the government imposes a 2% tax rate on the proceeds from new issuances of foreign debt.

Figure B.5 shows the effects of a risk premium shock. It compares the aggregates dynamics for capital and risk premium between our baseline model and a counterfactual in which the tax on debt is in place. Overall, the tax reduces the increase in risk premium and dampens the contraction in aggregate capital. Figure B.6 shows that the dampened response is mostly coming from a smaller contraction in the investment of riskier firms. The response of risk-free firms is mostly unaffected.

Figure B.6: Tax on Debt Issuances: Heterogeneous Effects



Note: Impulse responses to a risk-premium shock ($\Delta\kappa > 0$) by firm risk. Firms are sorted into deciles based on their pre-shock default probability. The left panel shows the change in firms' capital and the right panel the change in risk premium. The blue lines show the results for our baseline model and the red lines show the results for an economy in which the government imposes a tax on debt issuances.

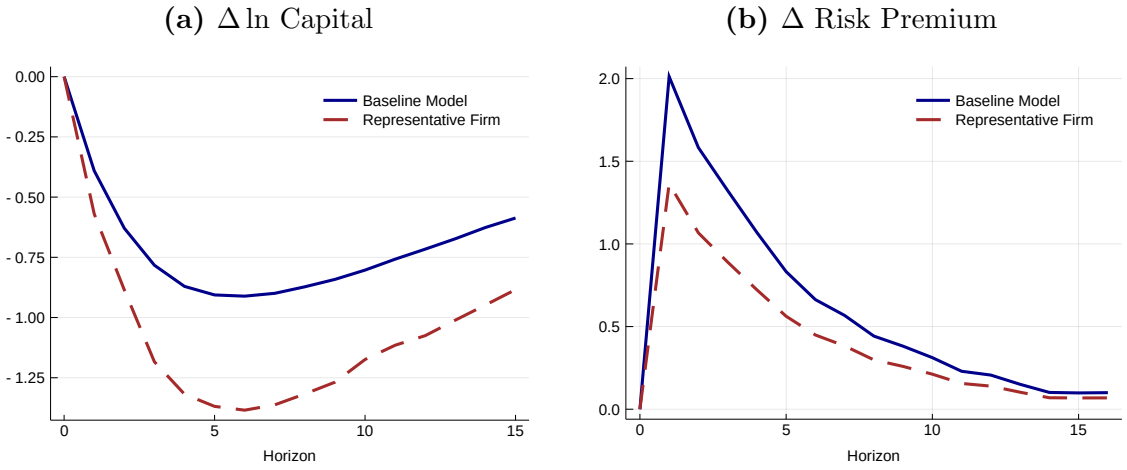
B.6. The Role of Firm Heterogeneity

In this appendix, we analyze the aggregate implications of firm heterogeneity for a global risk-premium shock. We provide a partial-equilibrium counterfactual in which we compare our model-implied aggregate dynamics relative to an economy in which all firms are identical. That is, we consider an economy in which all prices are fixed, we shock such economy with a risk-premium shock, and we compare the outcomes of our baseline model with a representative-firm economy (i.e., an economy in which all firms are identical in terms of $\{k, b, z\}$). In this counterfactual, the only source of (ex-post) heterogeneity is the realization of the exit shock ϵ^d, which is iid. In both cases, the model calibration is the same as that of Table 2a and Table 2b in the main text.

The advantage of focusing on a partial-equilibrium setting is that we can better isolate the direct effect of a risk-premium shock absent any price adjustment. This is important because those general-equilibrium adjustments could be quite different in a representative firm economy, which makes it hard to assess the importance of firm heterogeneity in the transmission of a global risk-premium shock.

Figure B.7 presents the results. It shows that the aggregate contraction in capital is

Figure B.7: Implications of Firm Heterogeneity



Note: Impulse responses to a risk-premium shock ($\Delta\kappa > 0$). The blue lines show the dynamics for aggregate capital and risk premia for our baseline model with firm heterogeneity. The red lines show the dynamics for an economy with a representative firm. The x-axes show the horizon h.

almost 40% *smaller* in our baseline model with heterogeneous firms. This is surprising, since the increase in risk premium is 50% *higher* in our baseline model. That is, the smaller aggregate contraction in capital in a model with firm heterogeneity is not driven by a milder aggregate response of risk premium. More generally, this simple exercise highlights (i) the importance of accounting for firm heterogeneity when analyzing the effects of changes in risk premia, and (ii) the difficulty in extrapolating firm-level responses to the aggregate economy.

B.7. Local Currency Debt

For our baseline model, we have assumed that firms' liabilities are denominated in foreign currency. In this appendix, we consider a case in which firms' debt is denominated in terms of the H-good. Since $\mathcal{R}_f(.)$ are now payments denominated in terms of the H-good, the bond price function in Equation (13) is replaced with:

$$q\left(k', b', z, \boldsymbol{S}\right) = \mathbb{E}_{(z', \boldsymbol{S'})|(z, \boldsymbol{S})}\left[\Lambda_F^{\star}(\boldsymbol{S}, \boldsymbol{S'})\, \frac{\varepsilon\left(\boldsymbol{S}\right)}{\varepsilon\left(\boldsymbol{S'}\right)}\, \mathcal{R}_f\left(k', b', z', \boldsymbol{S'}\right)\right]. \tag{B.4}$$

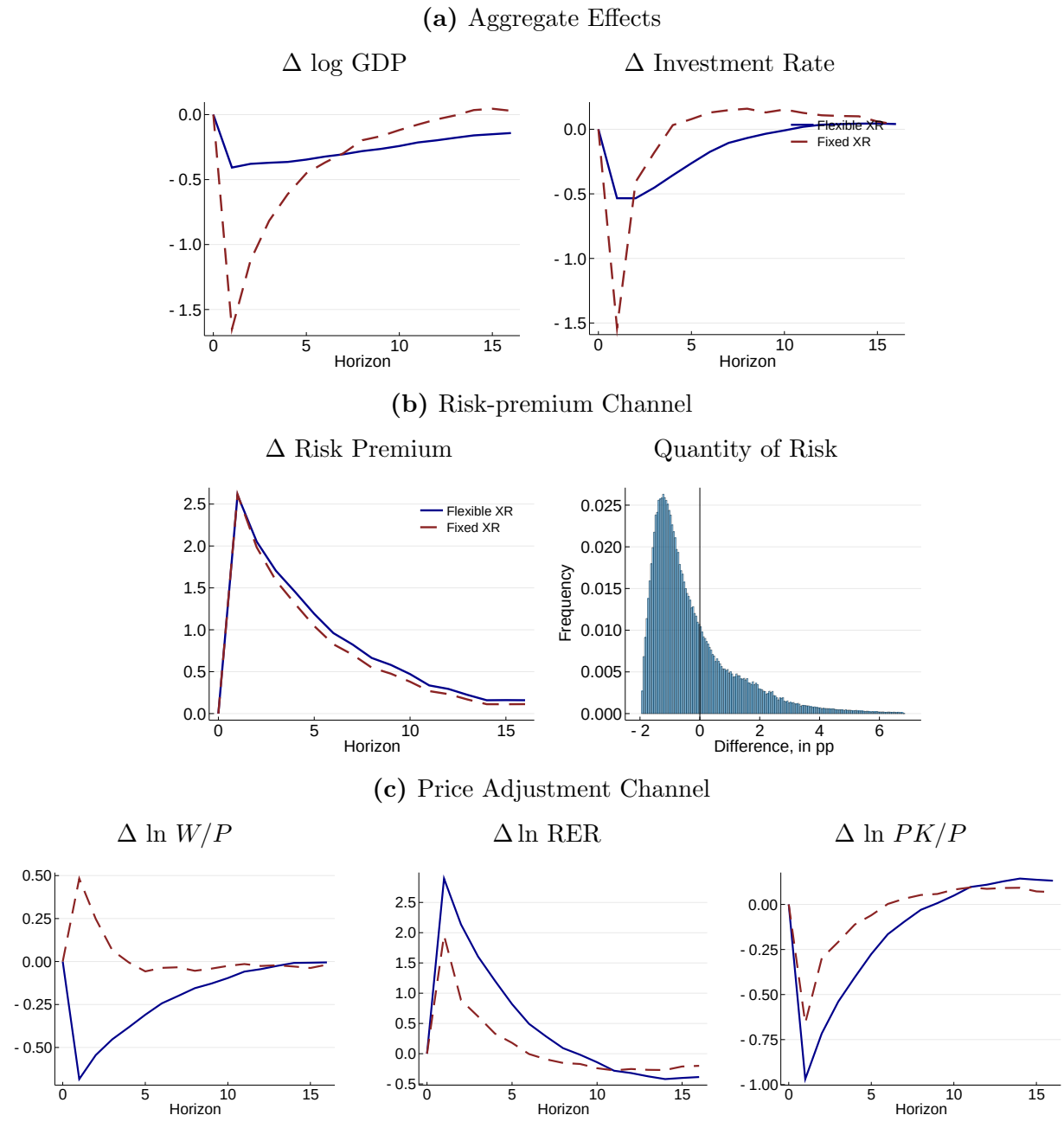
Firms' dividends are now given by

$$d(1-\mathcal{C}(d)) = (1-\tau)\,\pi(k,z,\boldsymbol{S}) - I\,(k',k) + \Delta\mathcal{B}(b',b,\boldsymbol{S}), \tag{B.5}$$

where $\Delta\mathcal{B}\,(b',b,\boldsymbol{S})$ is defined analogously to the expression in the main text (Equation (9)). That is, $\Delta\mathcal{B}\,(b',b,\boldsymbol{S}) = q(.)\,[b'-(1-m)b] - [(1-m)\upsilon+m]\,b - \Psi_b\,(b',b)$.

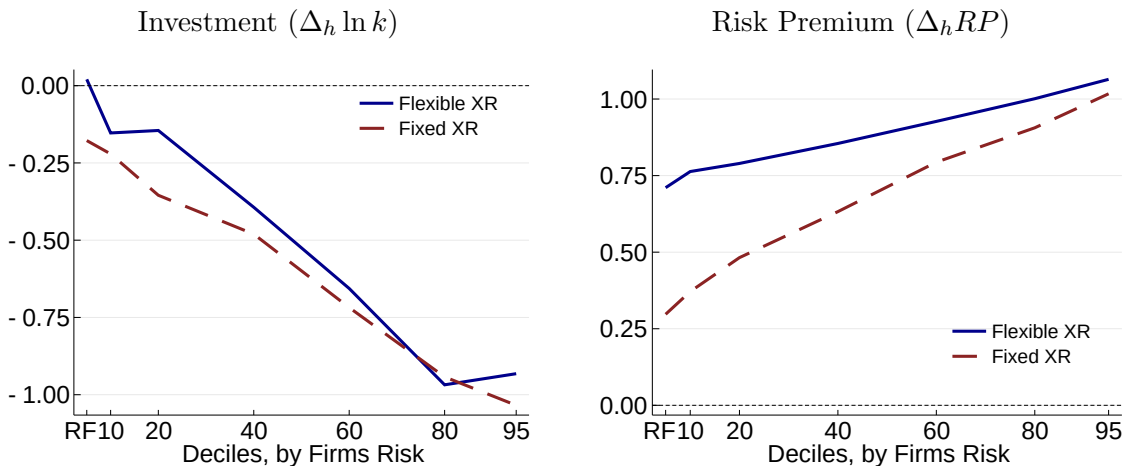
Unlike the dollar-denominated debt case, when debt is denominated in terms of the H-good, changes in the real exchange rate do not affect debt service payments, $[(1-m)\upsilon+m]\,b$. Firms are thus not subject to a negative balance-sheet type of channel. As shown in Figures B.8 and B.9, this, in turn, implies a smaller increase in risk premium, for any given $\Delta\kappa > 0$ shock and a smaller contraction in aggregate capital. Importantly, the heterogeneous effects across firms with different levels of risk are still preserved.

Figure B.8: Flexible vs Fixed Exchange Rate: Local Currency



Note: Impulse responses to a risk-premium shock ($\Delta\kappa > 0$). The left panel shows the dynamics for real wages and the right panel the dynamics for the real exchange rate. The x-axes show the horizon h.

Figure B.9: Flexible vs Fixed Exchange-rate Regimes: Heterogeneous Effects



Note: Impulse responses to a risk-premium shock ($\Delta\kappa > 0$) by firm risk. Firms are sorted into deciles based on their pre-shock default probability. The left panel shows the change in firms' capital and the right panel the change in risk premium. Solid blue lines show the firms' responses when the government follows a flexible exchange-rate regime. Dashed red lines show the same responses when the nominal exchange rate is fixed.

B.8. Local Banks

In the main text, we have assumed that firms get all their financing from a risk-averse global investor. In this section, we relax that assumption and allow the firms to borrow from a domestic bank. This domestic bank, in turn, have local and foreign liabilities in the form of deposits and bonds issued in international markets.

For the case in which firms' debt is denominated in local currency, the domestic bank balance sheet identity can be written as:

$$\int_i q^B_{i,t} B_{i,t+1} = q^D_t D_{t+1} + \xi_t q^F_t F^\star_{t+1}, \tag{B.6}$$

where $\int_i q^B_{i,t} B_{i,t+1}$ denotes the bank's loans to the domestic firms; $q^D_t D_{t+1}$ is the market value of the bank's deposits; and $q^F_t F^\star_{t+1}$ captures dollar-denominated bond issuances in international markets.[14]

We let ω_t to denote the bank's share of external liabilities relative to total liabilities:

$$\omega_t \equiv \frac{\xi_t q^F_t F^\star_{t+1}}{q^D_t D_{t+1} + q^F_t F^\star_{t+1}}. \tag{B.7}$$

From the bank's balance sheet, we get that $\omega_t = \frac{\xi_t q^F_t F^\star_{t+1}}{\int_i q^B_{i,t} B_{i,t+1}}$. Solving for D_{t+1},

$$D_{t+1} = \frac{1}{q^D_t} (1 - \omega_t) \int_i q^B_{i,t} B_{i,t+1}. \tag{B.8}$$

Using this expression, we can write bank's profits (in local currency) as follows:

$$\Pi^B_t = \int_i \mathcal{R}^f_{i,t} B_{i,t} - D_t - \xi_t F^\star_t, \tag{B.9}$$

where $\mathcal{R}^f_{i,t}$ denotes the loan repayment of firm i (as defined in Equation 14).

To keep the model tractable, we abstract from modeling the bank's investment and funding decision explicitly. Instead, we simply assume that banks have some pre-existing

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

financial position (as in De Leo, Gopinath and Kalemli-Özcan, 2024). In particular, we view ω_t as an exogenous process that determines the share of the stock of firms' debt that is 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 stochastic discount factor of the bank follows the same process as the one in Equation (16), $\Lambda^{\star}_{F,(t,t+1)} = \beta^{\star} \times \exp\left(-\kappa_t \, \epsilon^{A}_{t+1} - \frac{1}{2}\kappa_t^2 \, \sigma_A^2\right)$. We follow such assumption for tractability. In a model in which banks are local and engaged in risky lending, changes in the firms' riskiness affects banks' own SDF and the credit supply (see for instance Bocola, 2016). This type of mechanism can lead to a doom-loop in which an aggregate shock is amplified by further contractions in the credit supply (as in Moretti, 2021). Since we abstract from these mechanisms, we see the magnitudes of our quantitative results as a lower bound.

With banks that are partially owned by the domestic households, their budget constraints is given by

$$P_t c_t + q_t^D D_{t+1} = W_t l_t + P_t d_t + P_t t_t + D_t + (1 - \hat{\omega}_t)\Pi_t^B, \tag{B.10}$$

where $q_t^D D_{t+1}$ denotes households' new deposits, D_t are deposits that mature today, and $(1-\hat{\omega}_t)\Pi_t^B$ captures the bank's profits that are transferred to the household. Notice that we allow for $\hat{\omega}_t \in [0,1]$ to capture the fact that a share of the bank may be owned by the global investor.

From Equations (B.7)-(B.8), we get that foreign funding is $F_t^{\star} = \frac{1}{\xi_{t-1} q_{t-1}^F} \omega_{t-1} \int_i q_{i,t-1}^B B_{i,t}$ and deposits are $D_t = \frac{1}{q_{t-1}^D} (1 - \omega_{t-1}) \int_i q_{i,t-1}^B B_{i,t}$. Replacing with these expressions in banks' profits and using the fact that $q_t^D D_{t+1} = (1-\omega_t) \int_i q_{i,t}^B B_{i,t+1}$, we can rewrite the budget constraint as:

$$\begin{aligned} P_t \, c_t + \left[(1-\omega_t) \int_i q_{i,t}^B B_{i,t+1} \right] &= W_t \, l_t + P_t d_t + P_t t_t + \\ + \left((1-\hat{\omega}_t) \int_i \mathcal{R}_{i,t}^f B_{i,t} - (1-\hat{\omega}_t) \xi_t \frac{\omega_{t-1} \int_i q_{i,t-1}^B B_{i,t}}{\xi_{t-1} q_{t-1}^F} + \hat{\omega}_t \frac{1}{q_{t-1}^D} (1-\omega_{t-1}) \int_i q_{i,t-1}^B B_{i,t} \right). \end{aligned}$$

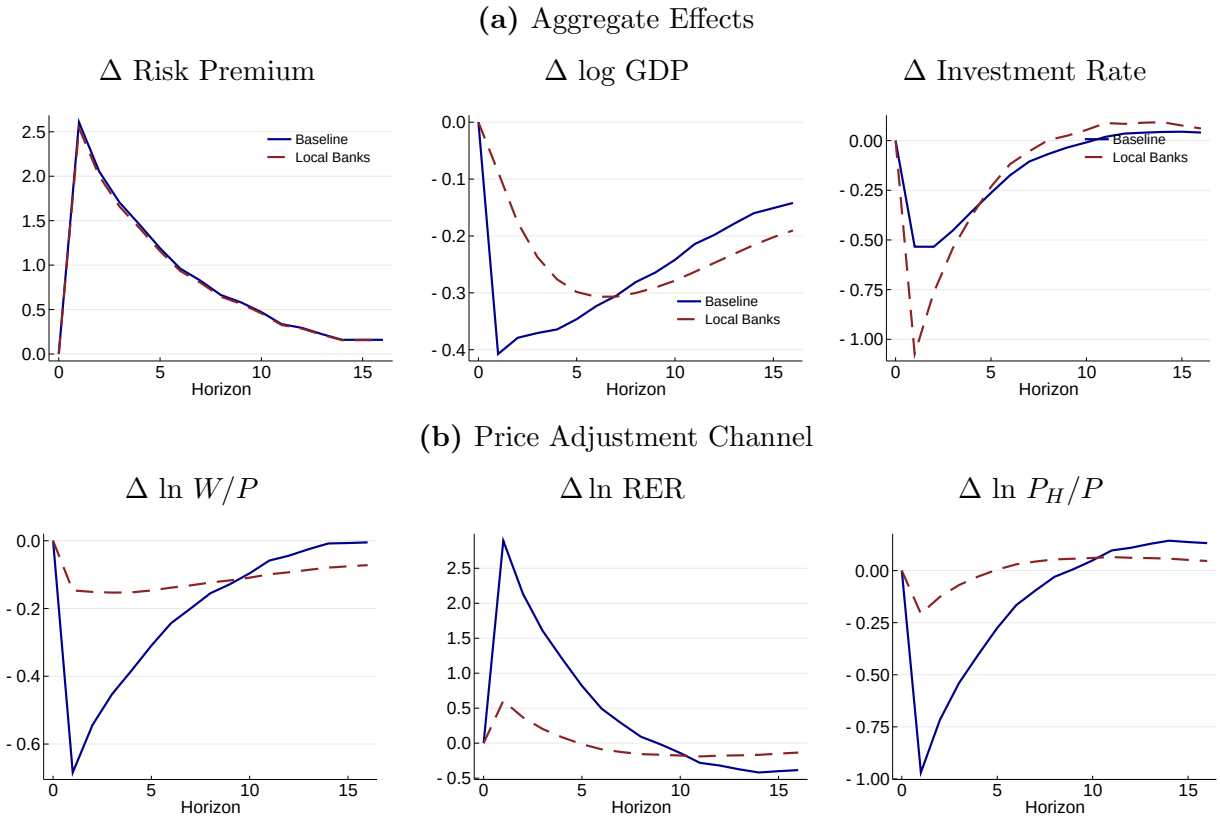
Under $\omega_t = \hat{\omega}_t \to 1$, households' budget constraint simplifies to $P_t\, c_t = W_t\, l_t + P_t d_t + P_t d_t$. This case, thus, captures our baseline specification in which banks are foreign-owned and all the credit to the domestic firms are provided by global investors. In the opposite case with $\omega_t = \hat{\omega}_t \to 0$ (i.e., under financial autarky), the budget constraint simplifies to:

$$P_t\, c_t = W_t\, l_t + P_t d_t + P_t d_t + \left(\int_i \mathcal{R}^f_{i,t} B_{i,t} - \int_i q^B_{i,t} B_{i,t+1} \right). \tag{B.11}$$

Relative to our baseline specification (Equation 20), adding local credit and banks that are fully owned by households, thus introduces an additional term in the households' budget constraint, $\int_i \mathcal{R}^f_{i,t} B_{i,t} - \int_i q^B_{i,t} B_{i,t+1}$. For a constant aggregate loan demand ($B_{i,t+1} = B_{i,t}$ for every firm i), this term can be viewed as capturing the consolidated net gains (or losses) of the domestic banking sector. In the more general case in which $B_{i,t+1} \neq B_{i,t}$, it also captures changes in consumers' aggregate savings needed to finance the higher (lower) demand for credit.

In Figure B.10, we analyze the effects of a shock to the price of risk in an scenario in which banks are fully owned by the domestic households and banks

Figure B.10: Debt Held by Domestic Banks



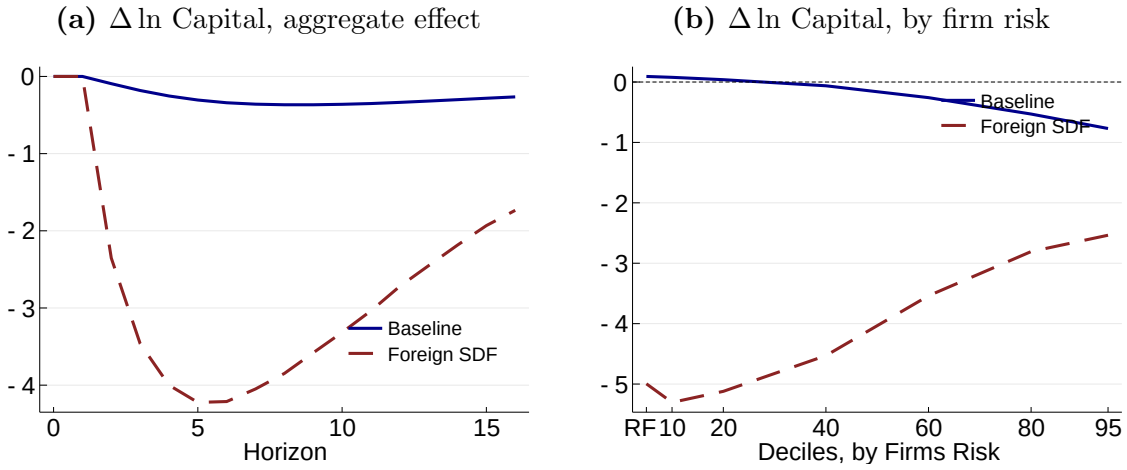
Note: Impulse responses to a risk-premium shock ($\Delta\kappa > 0$) across exchange rate regimes. Top panel compares the dynamics for aggregate output and investment rate. Blue (red) lines show the dynamics under a flexible (fixed) exchange rate. The black dotted lines show the results for a fixed exchange rate regime case, in which we adjust the κ shock so that the dynamics for the risk premium are identical as the ones under the flexible regime. The middle panel shows the dynamics for the risk premium and the distribution for the quantity of risk (scaled by κ). The bottom panel shows the dynamics for prices.

B.9. Global Investors Pricing the Domestic Firms

In the main text, we have assumed that firms' are owned by domestic households and they discount payoffs based on households' SDF. In this appendix, we relax this assumption and consider an economy in which firms discount their payoffs using the foreign lenders' SDF. Based on Equation (16) (which describes the lenders' SDF), the firms' SDF is now given by:

$$\Lambda_{(t,t+1)} = \beta^{\star} \times \exp\left(-\kappa_t\, \epsilon^{A}_{t+1} - \frac{1}{2}\kappa_t^2\, \sigma_A^2\right) \times \frac{\varepsilon_t}{\varepsilon_{t+1}}, \tag{B.12}$$

Figure B.11: Foreign Lenders' SDF: Aggregate and Heterogeneous Responses



Note: The figure compares the responses of firms' investment to a risk-premium shock ($\Delta\kappa > 0$). The blue lines show the effects in our baseline model, in which firms' discount payoffs based on the households SDF. The red lines show a counterfactual in which firms discount payoffs based on the foreign lenders' SDF. The left panel shows the aggregate effect. The right panel shows the heterogeneous effects, by firm risk (at a fixed horizon). RF denotes risk-free firm.

where $\frac{\varepsilon_t}{\varepsilon_{t+1}}$ captures the next-period change in the real exchange rate. In the baseline model, we assumed that household have a discount rate of β and we calibrated $\beta < \beta^\star$ in order to match the average leverage that we observe in the data. For this appendix, instead, we assume that household's discount rate is $\beta^\star$ (i.e., that of the lenders) but firms have an exogenous death rate of ϖ such that $\beta = \beta^\star \times \varpi$ (similarly to Cooley and Quadrini (2001)). This exogenous exit rate effectively reduces the firms' discount factor and allows us to match a similar average leverage without the need of recalibrating the model.[15]

Figure B.11 presents the results. When firms are priced by foreign lenders, their SDF decreases upon a risk-premium shock (i.e., they are more impatient) and they optimally choose to reduce their investment. The drop in aggregate capital, thus, is significantly larger compared to our baseline economy (Panel a). More importantly, the heterogeneous effects across firms with different levels of risk are flipped. If firms' are priced by risk-averse foreign lenders, we find that the subset of *safer* firms are the ones that reduce their investment the most (Panel b). This is the opposite to what we find in our empirical analysis and it can be interpreted as evidence suggesting that the marginal investors of these firms are domestic

[15]The rest of the calibration for this economy is identical to that Table 2a and Table 2b in the main text.

households.