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Domestic barriers to entry and external vulnerability in emerging economies ☆

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ABSTRACT

Emerging economies (EMEs) exhibit high regulatory costs of firm creation. At the same time, lower firm-creation costs are associated with greater financial development and use of formal credit, which can expose EME firms to external financial shocks that propagate to EMEs via the banking system such as those that EMEs experienced during the Global Financial Crisis. We present evidence showing that in response to an adverse shock to the US banking system, EMEs with low firm-creation costs exhibit smaller contractions and earlier recoveries in cross-border bank flows, domestic bank credit, and GDP compared to EMEs with high firm-creation costs. A two-country model with banking frictions, cross-border bank flows, and endogenous firm entry can successfully capture this evidence. Our findings suggest that greater domestic credit-market deepening via lower barriers to firm entry in EMEs need not be associated with greater macro and domestic credit-market volatility.

1. Introduction

Compared to small advanced economies, emerging economies (EMEs) have historically been particularly vulnerable to changes in global financial conditions. The Global Financial Crisis of 2008-2009 (GFC), characterized by a sharp deterioration in US banking-sector conditions that propagated to EMEs via cross-border financial flows and resulted in a contraction in EME aggregate economic activity, is a case in point.

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From a domestic standpoint, post-GFC, EMEs have led efforts to bolster economic dynamism and resilience by addressing the high regulatory barriers to firm entry in their economies: while the median regulatory cost of creating a firm represents less than 3 percent of income per capita in advanced economies, the cost in EMEs is at least 5 times as high. These entry barriers have broader relevance for EME credit markets and therefore aggregate economic activity: firm registration with local authorities—a central component of the regulatory cost of creating a firm—is often a prerequisite for accessing domestic bank credit. This suggests that lowering these costs in EMEs may not only incentivize greater firm entry but also facilitate EME firms' access to and use of bank credit. While participation in the domestic banking system brings about several benefits to firms, usage of bank credit may also increase firms' exposure to financial disruptions and potentially lead to macro and credit-market instability. However, little is known about the role of domestic barriers to firm entry in shaping EMEs' response to foreign financial shocks, especially those that propagate via the global banking system.

In this paper, we present panel-VAR evidence showing that in response to an increase in US bank net charge-offs—an adverse shock to the US banking system—EMEs with lower firm-creation costs (low-cost EMEs for short) exhibit smaller contractions and earlier recoveries in cross-border bank liabilities, domestic bank credit, and GDP compared to EMEs with higher firm-creation costs (high-cost EMEs for short). Absent micro-level firm data that could shed light on the underlying reasons why low-cost EMEs may be more resilient to foreign-financial shocks that originate in the US-banking system, we build a two-country model with cross-border bank flows between the United States and EMEs, banking frictions and bank credit that finances firms' physical capital purchases, and endogenous firm entry subject to sunk entry costs in EMEs. Consistent with empirical evidence, we assume that US banks lend to EME banks via cross-border bank flows. Thus, US banking-sector shocks are primarily transmitted to EMEs via the banking system.

Leveraging the VAR evidence, we feed the estimated response of US bank net charge-offs to the model and calibrate it to match the empirical responses of US asset prices and cross-border bank flows between the United States and high-cost EMEs to the increase in US bank net charge-offs. Having established this baseline, we analyze how reducing the firm-creation cost in the EME block to match the average cost of low-cost EMEs *alone* shapes the EME's response to the same US banking-sector shock, holding all other parameters at their baseline (high-cost EME) values. The model can quantitatively capture a significant portion of the differential responses of EME cross-border liabilities, EME GDP, and EME bank credit between high-cost and low-cost EMEs to the rise in US bank net charge-offs in the data.

Further model analysis shows that, by facilitating firm entry and fostering an increase in the average number of EME firms, lower EME firm-creation costs increase EME firms' demand for capital. Since firms borrow from domestic banks to finance capital purchases, the increase in the number of EME firms stemming from lower firm-creation costs increases the average amount of EME banks' assets. EME banks, in turn, increase their average-foreign borrowing, including from US banks, to meet the increase in demand for domestic bank credit. The net impact of greater domestic bank lending is an increase in EME bank average assets and net worth. Critically, the increase in the average amount of EME bank assets makes EME banks more resilient to foreign financial shocks, even as these banks rely more on foreign borrowing from US banks. Importantly, in the context of an adverse US banking-sector shock, having greater average assets and net worth allows EME banks to be less reactive and reduce their foreign borrowing by less in response to the shock compared to a scenario where these banks' average assets and net worth are lower. This more limited reaction is important as it can limit the rise in domestic lending spreads that would otherwise occur in response to the shock, and therefore the damage of foreign adverse banking-sector conditions on EME bank credit and economic activity compared to high-cost EMEs. By limiting the initial adverse effects of the shock on the EME banking system, these more subdued dynamics also contribute to an earlier recovery in low-cost EMEs.

Of course, other structural differences between EME groups—in average TFP, the degree of banking frictions and domestic financial development, and the strength of institutional quality, among others—may also influence the response of EMEs to US banking-sector shocks through similar mechanisms as those described above. As part of our analysis, we show that plausible differences in these factors between the two EME groups are unable to *quantitatively* rationalize the differential responses between the EME groups in the data, suggesting that domestic firm-creation costs may indeed be important in shaping the macroeconomic resilience of EMEs to US banking-sector shocks.

Existing studies highlight the relevance of barriers to entry for firm creation, firm growth, and overall economic development. Using European data, Klapper et al. (2006) document that entry regulations limit the creation of new firms and also can reduce the growth of incumbent firms. Using firm-level data for a select group of developed and emerging economies, Aghion et al. (2007) point to the relevance of implementing policies that target the reduction of entry barriers for new firms and promoting firm dynamism in the economy, and the importance of access to finance for small-firm creation and new-firm expansion. In more recent work that exploits the phased introduction of a deregulation program in China, Barwick et al. (2022) find that reductions in the regulatory barriers to entry bolster firm entry and increase the productivity of new entrants. In related work, Herrendorf and Teixeira (2011) study the quantitative importance of barriers to entry in explaining income differences between the United States and low-income economies. Their analysis suggests that these barriers can explain almost 50 percent of the income gap in the data. Barseghyan and DiCecio (2011) use a framework with endogenous entry to analyze how entry costs across countries shape misallocation, TFP, and output. Similar to our model and consistent with the data, lower entry costs generate greater firm entry and new firm density. Dabla-Norris et al. (2015) study the role of barriers to financial inclusion in shaping inequality and GDP in developing and emerging economies using a model with financial constraints and participation costs. They find that lower participation costs in credit markets, which represent a particular type of entry barrier, introduce a tradeoff between inequality and GDP. In our model, firms that enter the market after incurring a sunk cost—a cost that can be interpreted as the regulatory cost of creating a firm—have access to bank credit, which firms use to finance their capital purchases. Since formal credit access often entails proof of registration, firm-creation costs can also be interpreted as embodying part of the cost of credit-market access. A key distinction between these studies and ours is that we focus on how domestic entry barriers play a role in shaping the economy's response to shocks—a theme that has received much less attention in the literature on barriers to firm entry.

In this sense, our work is closest to the macro literature on banking frictions and financial shocks, which in the aftermath of the GFC has primarily focused on the United States and other advanced economies (Gertler and Kiyotaki, 2010; Gertler and Karadi, 2011; Gertler et al., 2012); to recent studies that extend these models to EMEs (Aoki et al., 2015; Cuadra and Nuguer, 2018); and to the literature on endogenous firm entry and macroeconomic fluctuations rooted in Bilbiie et al. (2012). Examples of the Bilbiie et al. (2012) framework extended to a two-country environment include Ghironi and Melitz (2005); Cacciatore et al. (2015, 2016b,a), all of which focus on advanced economies and abstract from banking frictions. Studies on the role of firm entry in international business cycles include Cavallari (2013), Cooke (2016), and Bergin and Corsetti (2020), among others. Closest to our economic environment are Rossi (2015) and La Croce and Rossi (2018), who introduce a monopolistically-competitive banking system into the (closed-economy) Bilbiie et al. (2012) framework and show that endogenous firm entry amplifies shocks in the presence of imperfect banking-sector competition. Our work contributes to this literature by focusing on banking-sector frictions amid firm entry and highlighting how lower firm-creation costs in EMEs and their impact on firm creation can reduce the responsiveness of bank credit and economic activity in EMEs to foreign financial shocks that propagate via the global banking system, thereby bolstering the domestic resilience of EMEs to external financial disturbances.

The rest of the paper is structured as follows. Section 2 presents key facts on firm-creation costs and average new firm creation in EMEs and summarizes the main results from our VAR analysis, whose details and robustness are relegated to the Appendix for expositional brevity. Section 3 describes the model. Section 4 presents our quantitative analysis and main findings, and discusses the economic mechanisms behind our quantitative results. Section 5 concludes.

2. Empirical motivation: firm creation costs in EMEs and the response of EMEs to US banking-sector shocks

We focus on a well-established group of EMEs that has been extensively studied in the EME business cycle literature (Neumeyer and Perri, 2005; Uribe and Yue, 2006; Akinci, 2013; Fernández and Gulan, 2015), and that includes countries that have uninterrupted quarterly time series on both cross-border bank flows between the United States and each EME and EME domestic bank credit—two variables that are important to assess the cross-border transmission of US financial shocks. The set of EMEs that meet these two criteria are: Brazil, Chile, Colombia, Indonesia, Malaysia, Mexico, Thailand, South Africa, and Turkey (Figs. B.19–B.27).[1]

Firm creation costs and new firm entry in EMEs Using annual data, Table 1 shows that the median regulatory cost of creating a business—specifically, the cost of procedures required to create and operate a commercial or industrial business—is 15.4 percent of income per capita in EMEs. For reference, the corresponding cost in advanced economies is 2.7 percent of income per capita. In turn, new firm density—a normalized proxy of new firm creation that is comparable across countries, defined as the number of new firm registrations per 1000 individuals—is 1.06 in EMEs versus 4.25 in advanced economies.

Further inspection reveals a non-trivial degree of heterogeneity in firm-creation costs within EMEs, with some EMEs having costs that are comparable to those of advanced economies. Separating EMEs into two categories—high-cost and low-cost—based on their average cost of starting a business relative to the median EME cost reveals that EMEs with lower firm-creation costs also tend to have greater new firm density (i.e., greater new firm creation) compared to higher-cost EMEs. Figs. B.14, B.15, and B.16 in Appendix B use pooled data for EMEs and for advanced economies to highlight the strength of the negative relationship between entry costs and new firm creation. Figs. B.12 and B.13 in Appendix B.1 also show that economies with lower firm-creation costs tend to exhibit greater domestic financial development (as reflected in higher average bank credit-to-GDP ratios; this holds in both our EME sample and in a pooled sample of advanced economies and EMEs).

Finally, while the frequency and time span of our data on new firm density in our EME group prevents us from conducting a detailed empirical analysis on the behavior of firm entry over the business cycle, Table B.1 in Appendix B suggests that during economic booms, EMEs with low average firm-creation costs exhibit greater new firm density than their high firm-creation-cost counterparts (a similar pattern holds for advanced economies).

Response of EMEs to US banking-sector shocks: summary of panel-VAR evidence In this section, we present panel VAR-evidence showing that EME cross-border bank flows, domestic bank credit, and GDP exhibit a more subdued response to an adverse shock to the US banking system in EMEs with low firm-creation costs compared to EMEs with high firm-creation costs.

For expositional brevity, we only summarize our main VAR findings and relegate specific details pertaining to our analysis—the data sources and time coverage, the variable ordering and identification assumptions, and the estimation methodology—to Appendix B.2. The same Appendix presents an extensive set of additional results and robustness checks that validate our main findings.

Following Lambertini and Uysal (2013) and Cuadra and Nuguer (2018), we assume that adverse US banking-sector shocks are reflected in an increase in US commercial bank net charge-offs. The rationale for this choice is simple: bank net charge-offs embody the value of bank loans that banks consider will not be repaid. Thus, an increase in US net charge-offs represents a fall in the value

[1] Ecuador, Peru, and the Philippines do not have available data on cross-border bank flows and/or domestic bank credit and therefore cannot be included in our analysis. Also, given our focus on cross-border bank flows between the United States and EMEs, our baseline sample excludes Argentina because the country's international financial record since the early 2000s makes it a clear outlier compared to other EMEs. Results in Section B.2.5 of the Appendix confirm that the main findings from our VAR analysis remain unchanged if we include Argentina.

Table 1
Cost of starting a business and new firm density, advanced economies and EMEs.

Emerging Economies			Advanced Economies		
	Cost of starting a business	New firm density		Cost of starting a business	New firm density
Low cost of starting a business					
Brazil	5.23	0.93	Australia	1.03	12.19
Chile	8.86	5.39	Canada	0.52	0.06
South Africa	3.82	8.11	Denmark	0.09	7.54
Thailand	11.01	0.75	Finland	0.98	3.59
			France	0.95	2.81
			Ireland	1.85	5.42
			New Zealand	0.29	14.71
			Norway	1.83	6.95
			Sweden	0.60	5.93
			United Kingdom	0.53	11.71
			United States	1.12	
Average	***7.23***	***3.80***		***0.89***	***7.09***
High cost of starting a business					
Colombia	15.36	1.66	Austria	5.31	0.62
Indonesia	16.55	0.26	Belgium	6.50	3.06
Malaysia	17.68	2.30	Germany	5.94	1.28
Mexico	17.75	0.48	Greece	15.98	0.92
Turkey	21.08	1.06	Italy	17.48	2.24
			Japan	7.50	0.09
			Luxembourg	3.68	11.61
			Netherlands	6.78	4.33
			Portugal	5.66	4.51
			Spain	10.16	3.17
			Switzerland	3.58	4.25
Average	***17.68***	***1.15***		***8.05***	***3.28***
Total Median	**15.36**	**1.06**		**2.72**	**4.25**

Note: Authors' calculations using data from the World Bank Doing Business Report (WBDB) (cost of starting a business, available annually, from 2004 to 2018) and World Bank Entrepreneurship Report (WBER) (new firm density, available annually, from 2006 to 2018). The cost of starting a business is expressed as a share of annual income per capita. New firm density is defined as the number of new firm registrations per 1000 individuals per year. Per the methodologies used in the WBDB and WBER, the cost of creating a business and new firm density are comparable across countries. The categorization of countries by income group (advanced economy or EME) follows BIS classification criteria. Countries with a low (high) cost of starting a business are those below (above) their country-group (advanced economy or EME)-specific median.

of US bank assets or, more broadly, an adverse shock to the US banking system. This shock then propagates from the United States to EMEs via cross-border bank flows.

We consider a parsimonious six-variable VAR setting with US bank net charge-offs, US real asset prices (the S&P 500), real cross-border bank flows between the United States and each EME (EME cross-border liabilities), EME real GDP, EME real domestic bank credit, and the real effective exchange rate between each EME and the United States. We estimate two separate panel structural vector autoregressions (SVAR), one for the group of low-cost EMEs and one for the group of high-cost EMEs as defined in Table 1.

Fig. 1 shows the response of the high-cost EME group (solid-blue line) and the low-cost EME group (dashed-red line) to a temporary 25-percent increase in US bank net charge-offs (roughly one standard deviation of the time series). The shock is for all intents and purposes identical in the two EME groups. Moreover, the feedback effects from EMEs to the United States are associated with insignificant differences in the post-shock evolution of US net charge-offs between the two EME groups. The response of US asset prices is also virtually the same in the two estimations. In contrast, cross-border liabilities in low-cost EMEs contract by less and recover much earlier compared to those of high-cost EMEs. Furthermore, while the initial contraction in EME GDP and domestic bank credit and the depreciation of the real exchange rate are similar in the two EME groups, the medium-term recovery in GDP and bank credit occurs much earlier in low-cost EMEs, with both variables overshooting their pre-shock level before they return back to trend.

Fig. 2 provides a clearer graphical summary of the smaller overall contraction in EME cross-border liabilities as well as the earlier medium-term recoveries in cross-border bank flows, GDP, and domestic bank credit in low-cost EMEs compared to high-cost EMEs amid an adverse US banking sector shock.

Specifically, Fig. 2 plots the estimated differences in the impulse responses of each variable between the low-cost EME and high-cost EME groups for a 10-quarter post-shock time horizon, with an indicator of statistical difference in the responses of the two EME groups using bootstrap methods as in Born et al. (2013). The response of cross-border liabilities between low-cost and high-cost EMEs is significantly different in the first two years after the shock. The largest deviations occur during the first 4 quarters, with cross-border liabilities in high-cost EMEs falling by an additional 2 percent relative to trend compared to low-cost EMEs. Similarly,

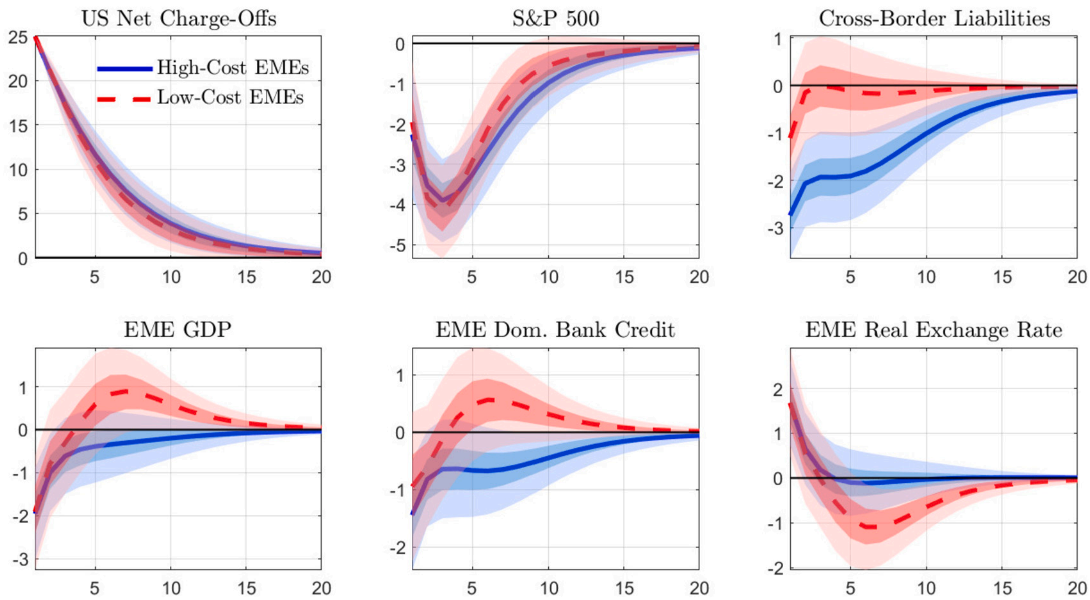

Fig. 1. Orthogonalized impulse response to a temporary 25-percent increase in US bank net charge-offs: high-firm-creation-cost EMEs vs. low-firm-creation-cost EMEs. *Note:* The S&P 500 Index embodies real US asset prices. Cross-border liabilities represent real cross-border bank flows between the United States and each EME and are given by real all-maturities total cross-border liabilities of US banks on EME banks that report to the BIS Locational Banking Statistics. EME GDP (expressed in real US dollars) is constructed using data on GDP in domestic currency at constant prices from Datastream and the real effective exchange rate between each EME in our sample and the United States (expressed in terms of EME currency relative to the US dollar). EME domestic bank credit is given by real bank credit to the private non-financial sector. Time span of data is based on uninterrupted time-series availability and covers 2007Q3-2019Q3. All real variables are logged and detrended using the Hodrick-Prescott filter with smoothing parameter 1600 to obtain their cyclical component. The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-cost EMEs are shown around the solid line, in light and darker color, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-cost EMEs are shown around the dashed line, in light and darker color, respectively. (For interpretation of the colors in the figure(s), the reader is referred to the web version of this article.)

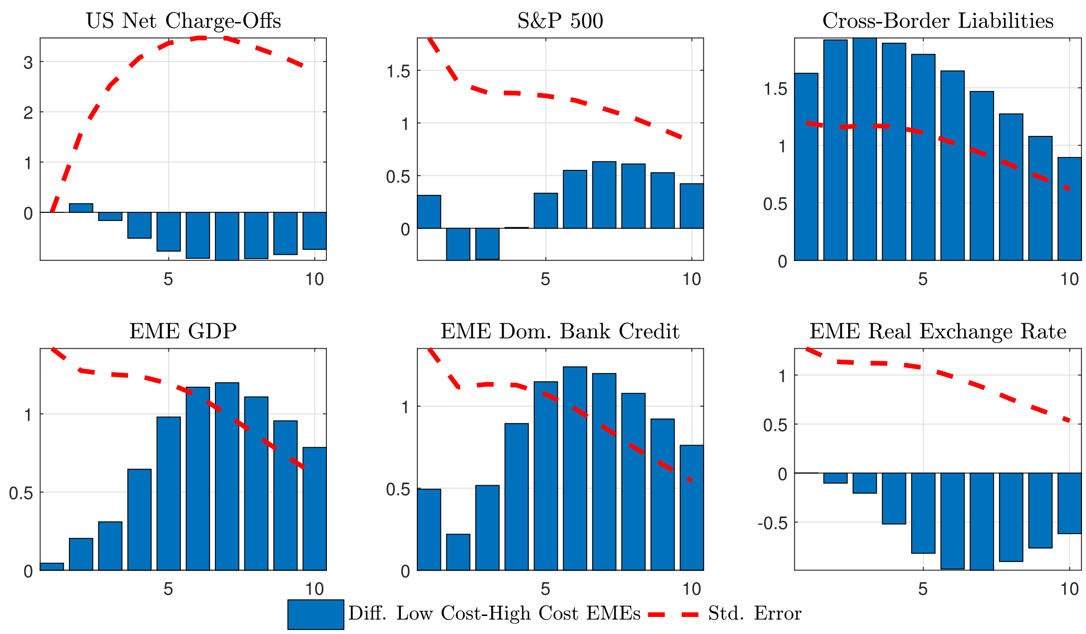

Fig. 2. Differences in response to an increase in US commercial banks' net charge-offs between low-firm-creation-cost EMEs and high-firm-creation-cost EMEs. *Note:* The vertical axis shows the percentage-point difference between the bootstrapped impulse responses of low-cost EMEs and those of high-cost EMEs to an increase in US bank net charge-offs for each corresponding variable. The horizontal axis shows the number of quarters after the shock. The dashed-red line reports the differences corresponding to the 68 percent confidence bounds computed by bootstrap sampling using 10,000 repetitions.

the larger contractions in both GDP and domestic bank credit in high-cost EMEs are clearly apparent after 4 quarters, with GDP and domestic bank credit falling by an additional 1 percent relative to trend compared to low-cost EMEs.

Determining the driving mechanisms behind these findings requires comparable panel micro data on EME firms and EME banks' balance sheets (net worth, loan portfolios, the composition of bank funding), which is not available across EMEs. Therefore, we use a model to shed light on these mechanisms, using the results from the VAR to discipline our quantitative experiments.

3. The model

We enrich a two-country RBC model with banking frictions as in Gertler and Kiyotaki (2010) and cross-border bank flows by introducing endogenous firm entry in the spirit of Bilbiie et al. (2012) (henceforth BGM). A two-country environment with these features embodies the minimum set of elements required to shed light on the differential response to US banking-sector shocks in low-entry-cost and high-entry-cost EMEs in Section 2.[2]

There are two economies, Home (H) and Foreign (F). Economy H is of size $0 < m < 1$ and represents the United States, while economy F is of size $1 - m$ and represents the EME. Following Cuadra and Nuguer (2018), we assume that US banks lend to EME banks via cross-border bank flows.

Each economy is comprised of households, banks, capital producers, domestic intermediate goods firms, and domestic goods-producing firms. Intermediate-goods firms use domestic labor and capital to produce intermediate goods used by domestic goods-producing firms whose entry is endogenous and subject to sunk entry costs. The output of domestic goods-producing firms is combined with imported goods to produce a final good. Capital producers accumulate physical capital and sell it to domestic intermediate-goods firms. Following Gertler and Kiyotaki (2010) and Cuadra and Nuguer (2018), these firms rely on domestic bank credit to finance their capital purchases, and asymmetric information between banks and depositors gives rise to banking frictions. Households in each economy supply deposits to domestic banks and labor to domestic intermediate-goods firms; they are the ultimate owners of their economy's firms, banks, and capital producers. In contrast to existing models with banking frictions, households in each country also use resources to cover the sunk entry costs associated with the creation of domestic goods-producing firms.

We follow the convention in the literature by presenting the model for economy H with analogous conditions for F unless otherwise noted. Furthermore, the only differences between H and F beyond parameter values pertain to features of the banking system in economy F whereby banks in F borrow from banks in H, and face an external finance premium when doing so. For ease of exposition, Foreign (F)-economy variables are denoted with a * superscript.

A note on firm informality It is well known that a significant share of firms in EMEs is informal. Even though these firms are primarily small, they account for a non-trivial share of total employment and are often excluded from participating in the domestic banking system. Our framework abstracts from modeling this segment of firms, not because we deem them unimportant, but because the main model mechanisms and quantitative findings remain unchanged in the presence of informal firms. The reason for this is simple: in EMEs, medium-sized and large firms represent a very small share of the universe of firms but account for a significant share of aggregate economic activity and for the bulk of domestic bank credit. Given our focus on these two variables and not on the labor market, our framework with a single category of domestic firms proves sufficient.

3.1. Final goods

A final goods aggregator in economy H combines total domestic output, $Y_{H,t}$, and imported output from economy F, $Y_{F,t}$, to produce final output, Y_t, using the CES technology $Y_t = \left[\alpha_a^{\frac{1}{\phi_a}} Y_{H,t}^{\frac{\phi_a-1}{\phi_a}} + (1-\alpha_a)^{\frac{1}{\phi_a}} Y_{F,t}^{\frac{\phi_a-1}{\phi_a}}\right]^{\frac{\phi_a}{\phi_a-1}}$, where $0 < \alpha_a < 1$ determines the degree of home bias and $\phi_a > 1$ is the elasticity of substitution between domestic and imported output. The corresponding aggregate price index is $P_t = \left[\alpha_a P_{H,t}^{1-\phi_a} + (1-\alpha_a) P_{F,t}^{1-\phi_a}\right]^{\frac{1}{1-\phi_a}}$. The relative demands for domestic output and imports from F are standard and given by $Y_{H,t} = \alpha_a \left(\rho_{H,t}\right)^{-\phi_a} Y_t$ and $Y_{F,t} = (1-\alpha_a)\left(\rho_{F,t}\right)^{-\phi_a} Y_t$, respectively. The real prices in H, $\rho_{H,t} = P_{H,t}/P_t$ and $\rho_{F,t} = P_{F,t}/P_t$, are defined with respect to the price of the final good in H. Following the literature and assuming that the law of one price holds for each good $Y_{F,t}$, it follows that: $P_{H,t} = NER_t P^*_{H,t}$ and $P_{F,t} = NER_t P^*_{F,t}$, where NER_t is the nominal exchange rate.

3.2. Domestic production

To make the production environment as comparable as possible to both standard models with banking frictions and standard models of endogenous firm entry, we divide domestic production into two categories without loss of generality. The first category is comprised of a measure one of perfectly competitive intermediate-goods firms that use domestic labor and capital as inputs, where capital purchases are financed with domestic bank credit. The second category is comprised of monopolistically competitive

[2] A small open economy model is able to qualitatively generate the more subdued response of low-cost EMEs to US banking-sector shocks in the data, but faces severe limitations in capturing the quantitative differences with respect to high-cost EMEs. This result highlights the role of explicitly modeling cross-border bank flows between the United States and EMEs as well as the impact of foreign financial shocks on EMEs' foreign demand for a better understanding of the responsiveness of EME economic activity to foreign banking-sector shocks.

goods-producing firms. These firms use domestic intermediate goods as inputs to produce domestic goods. They have an unbounded measure and their entry is endogenous and subject to sunk firm-creation costs.[3] Domestic goods are ultimately combined with imported goods to produce final goods.

3.2.1. Intermediate-goods firms

Perfectly competitive intermediate-goods firms use labor, L_t, and capital, k_t, to produce. As in Gertler and Kiyotaki (2010), capital purchases are financed with domestic bank credit, s_t. Firms choose L_t, k_{t+1}, and s_t to maximize the expected present discounted value of real profits

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \Xi_{t|0} \left\{ mc_t z_t k_t^{\alpha} L_t^{1-\alpha} - w_t L_t - Q_t \left[\frac{k_{t+1}}{\Psi_{t+1}} - \left(1-\delta_k\right) k_t \right] + Q_t s_t - R_{k,t} Q_{t-1} s_{t-1} \right\},$$

where $\Xi_{t|0}$ is the household's stochastic discount factor (defined in the household's problem further below), mc_t is the real price of intermediate goods, z_t is exogenous aggregate productivity, $0<\alpha<1$ is the capital share, Q_t is the price of capital, $0<\delta_k<1$ is the exogenous capital depreciation rate, $R_{k,t}$ represents the cost of bank credit (the gross lending rate), and Ψ_{t+1} is a shock to the quality of capital that can be interpreted as a banking-sector shock (Gertler and Kiyotaki, 2010). The optimal demand for labor is standard and given by $w_t = (1-\alpha)\, mc_t z_t k_t^{\alpha} L_t^{-\alpha}$. In turn, combining the optimality conditions for physical capital and bank credit, we can write

$$R_{k,t+1} = \frac{\Psi_{t+1} \left[\alpha mc_{t+1} z_{t+1} k_{t+1}^{\alpha-1} L_{t+1}^{1-\alpha} + Q_{t+1} \left(1-\delta_k\right) \right]}{Q_t}. \tag{1}$$

3.2.2. Capital producers

Perfectly competitive capital producers sell capital to intermediate-goods firms. They choose investment in physical capital i_t to maximize their expected discounted profits $\mathbb{E}_t \sum_{s=t}^{\infty} \Xi_{t|s} \left\{ Q_s i_s - i_s - \Phi\left(i_s/i\right) \right\}$ subject to $i_s = s_s - (1-\delta_k) k_{s-1}$, where $\Phi\left(i_s/i\right)$ is a convex investment adjustment cost function and i denotes steady-state investment. The first-order conditions yield a standard expression for the equilibrium price of capital given by $Q_t = 1 + [\Phi'(i_t/i)](1/i)$.

3.2.3. Monopolistically competitive goods-producing firms

We focus on incumbent domestic goods-producing firms and delegate the decisions over the creation of these firms to the household's problem. Following BGM, there is an unbounded number of potential domestic goods-producing entrants. Each incumbent firm produces a single differentiated good ω using a unit of domestic intermediate goods, so that ω denotes both the good produced by the firm and the firm itself. Then, total output by these firms is given by $Y_{D,t} = \left[\int_{\omega\in\Omega} y_{D,t}(\omega)^{\frac{\varepsilon-1}{\varepsilon}} d\omega \right]^{\frac{\varepsilon}{\varepsilon-1}}$ where Ω denotes the potential mass of goods-producing firms, $y_{D,t}(\omega)$ represents output of firm ω, and $\varepsilon > 1$ is the elasticity of substitution between individual firms' output. The price index of total domestic goods-producing-firm output is given by $P_{D,t} = \left[\int_{\omega\in\Omega} p_{D,t}(\omega)^{1-\varepsilon} d\omega \right]^{\frac{1}{1-\varepsilon}}$, where $p_{D,t}(\omega)$ is the nominal price of firm ω's output.

Each incumbent firm ω purchases domestic intermediate goods at real price mc_t, with the real price of their output being $\rho_t(\omega) = p_{D,t}(\omega)/P_t$. Then, individual profits for firm ω are $d_t(\omega) = [\rho_t(\omega) - mc_t] y_t(\omega)$. It is easy to show that the optimal price of firm ω's output is $\rho_t(\omega) = \left[\varepsilon/(\varepsilon-1)\right] mc_t$, a standard markup over marginal cost. Anticipating a symmetric equilibrium, we note that average individual-firm profits can be written as $d_t = [\rho_t - mc_t] y_t$ where $\rho_t = \left[\varepsilon/(\varepsilon-1)\right] mc_t$.

3.3. Households and firm creation

There is a measure one of identical households that own all domestic firms and banks. The representative household chooses real consumption, c_t, labor supply, L_t, real domestic deposits, $B_{d,t}$, the desired number of domestic goods-producing firms next period, N_{t+1}, and the number of new goods-producing firms, $N_{E,t}$ needed to reach their desired N_{t+1} to maximize $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta u(c_t, L_t)$ subject to the budget constraint

$$c_t + \psi N_{E,t} + B_{d,t} = w_t L_t + R_{t-1} B_{d,t-1} + d_t N_t + \Pi_t + \Pi_{k,t} + \Pi_{b,t},$$

and the evolution of domestic goods-producing firms

$$N_{t+1} = (1-\delta) N_t + N_{E,t}, \tag{2}$$

where ψ is the sunk cost of creating goods-producing firms, R_{t-1} is the real gross interest rate on domestic deposits, w_t is the real wage, and d_t are average (symmetric-equilibrium) individual-firm profits, which the household takes as given. Π_t denotes total real profits from domestic intermediate-goods firms, $\Pi_{k,t}$ are total real profits from capital producers, and $\Pi_{b,t}$ denotes total real profits

[3] One way to interpret the separation between intermediate-goods firms and goods-producing firms is to think of downstream and upstream domestic producers, with the two categories of firms combined comprising the domestic production sector. This separation of firm categories is analogous to the separation of intermediate goods and price-making firms in standard New-Keynesian models.

from banks. Following the macro literature on endogenous firm entry, $0 < \delta < 1$ is the exogenous exit probability of goods-producing firms.[4]

The households' optimal decisions over labor supply and domestic deposits are standard and given by $-u_{L,t} = w_t u_{c,t}$ and $1 = \mathbb{E}_t \Xi_{t+1|t} R_t$, respectively, where the household's stochastic discount factor is defined as $\Xi_{t+1|t} = \beta u_{c,t+1}/u_{c,t}$. Finally, the firm creation condition for domestic goods-producing firms is given by

$$\psi = \mathbb{E}_t \Xi_{t+1|t} \left[d_{t+1} + (1-\delta)\psi \right]. \tag{3}$$

The firm creation condition equates the marginal cost of creating one more goods-producing firm—the sunk firm-creation cost—to the expected marginal benefit, which is given by the expected present discounted value of average individual-firm profits and the continuation value if the firm survives into the next period with probability $(1-\delta)$.

3.4. Banks

The description of financial intermediaries follows Cuadra and Nuguer (2018), who adapt the banking frictions in Gertler and Kiyotaki (2010) to a two-country (US-EME) setup.

Banks use their net worth, nw_t, and funds obtained from domestic households, $b_{d,t}$, to lend to domestic intermediate-goods firms. Due to asymmetric information between banks and households, banks are constrained by how much they can borrow from their respective domestic households. In order to limit the bankers' ability to save enough to overcome their financial constraints, there is turnover between bankers and workers inside households: with i.i.d. probability $0 < \sigma < 1$ a banker survives into the next period. If the banker exits with probability $1-\sigma$, all retained earnings are transferred back to the household and the banker becomes a worker. Each period a fraction of workers become bankers so as to keep the total number of workers and bankers constant. Given that a bank needs positive funds to operate, every new banker receives a fraction $0 < \xi < 1$ of the total assets of the bank as start-up funds.

Cross-border bank flows from economy H to economy F arise because H banks are larger relative to the size of their economy, and F banks are smaller relative to the size of their economy. Therefore, H banks lend to F banks. This assumption is consistent with cross-border bank flows between the United States (economy H) and EMEs (economy F) in the data. From the perspective of economy F, external funds obtained by F banks from H banks are denoted by b_t^*.

After determining their liabilities and net worth, domestic banks decide how much to lend to domestic intermediate-goods firms. Since there are no frictions when transferring resources to these firms (a standard assumption in models with banking frictions), domestic intermediate-goods firms offer banks a perfect state-contingent security. The price of the security (or loan) is Q_t, which is also the price of bank assets. In other words, Q_t is the market price of the bank's claims on the future returns on one unit of capital used by firms at the end of period t, which is in process for period $t+1$.

3.4.1. Banks in H

The balance sheet of an individual bank in H is such that the total value of the loans to domestic firms funded in that period $Q_t s_t$ plus any cross-border bank flows $Q_{b,t} b_t$ is equal to the sum of the bank's net worth and domestic deposits $Q_t s_t + Q_{b,t} b_t = nw_t + b_{d,t}$, where $Q_{b,t}$ represents the real price of cross-border bank flows. Let $R_{b,t}$ be the real rate of return from period $t-1$ to t on cross-border bank flows that banks in F pay to banks in H. Then, the real net worth of an individual bank in H in period t, nw_t, is the payoff from assets funded in $t-1$ net of borrowing costs:

$$nw_t = \left[r_t + (1-\delta_k) Q_t \right] s_{t-1} \Psi_t + R_{b,t-1} Q_{b,t-1} b_{t-1} - R_{t-1} b_{d,t-1},$$

where r_t is the real dividend payment at t on loans funded in the previous period. r_t also represents the marginal product of capital of intermediate-goods firms.

At the end of period t, the bank maximizes the present value of future dividends taking into account the probability of continuing to be a banker next period. The value of the bank is then defined as

$$V_t = \mathbb{E}_t \sum_{s=1}^{\infty} (1-\sigma)\sigma^{s-1} \Xi_{t+s|t} nw_{t+s}.$$

Following the literature on banking frictions, a simple agency problem motivates the limited ability of the bank to obtain funds. After the bank obtains domestic deposits, the bank may transfer a fraction $0 < \theta < 1$ of assets back to its own household. Given this friction, households will limit the funds supplied to domestic banks. If a bank diverts assets, it defaults on its debt and shuts down. Its creditors can then reclaim the remaining $1-\theta$ fraction of assets.

Let $V(s_t, b_t, b_{d,t})$ be the maximized value of V_t given an asset and liability structure at the end of period t. Then, the following incentive constraint must hold for each individual bank to ensure that the bank does not divert funds: $V\left(s_t, b_t, b_{d,t}\right) \geq \theta \left(Q_t s_t + Q_{b,t} b_t\right)$. This borrowing constraint captures the fact that for households to be willing to supply funds to a bank, the value of the bank must be at least as large as the benefit from diverting funds.

[4] Assuming that the cost of firm creation and the exit probability are explicitly affected by the cost of bank credit and financial conditions, with firm-entry costs and firm exit both increasing in response to adverse financial conditions, does not change our main findings.

At the end of period $t-1$, the value of the bank satisfies the following Bellman equation

$$V\left(s_{t-1}, b_{t-1}, b_{d,t-1}\right) = \mathbb{E}_{t-1}\Xi_{t|t-1}\left\{(1-\sigma)nw_t + \sigma\left[\max_{s_t,b_t,b_{d,t}} V\left(s_t, b_t, b_{d,t}\right)\right]\right\}. \tag{4}$$

The problem of the bank is then to maximize (4) subject its incentive constraint. Following the approach in Gertler and Kiyotaki (2010) and outlined in Cuadra and Nuguer (2018), we guess and verify that the form of the value function of the Bellman equation is linear in assets and liabilities.

Letting Λ_{t+1} be the marginal value of the net worth of the bank at date $t+1$, we can write the optimality conditions as

$$\vartheta_{d,t} = \mathbb{E}_t\Xi_{t+1|t}\Lambda_{t+1}R_t, \tag{5}$$

$$\mu_t = \mathbb{E}_t\Xi_{t+1|t}\Lambda_{t+1}(R_{k,t+1} - R_t), \tag{6}$$

$$\Lambda_t = (1-\sigma) + \sigma(\vartheta_{d,t} + \phi_t\mu_t), \tag{7}$$

where $\vartheta_{d,t}$ denotes the marginal cost of domestic deposits, and μ_t is the excess value of a unit of assets relative to domestic deposits. $\phi_t \equiv \frac{\vartheta_{d,t}}{\theta-\mu_t}$ denotes the bank's leverage and shows that when banks are more constrained (reflected in a higher θ), the ratio between assets and net worth falls since banks have fewer resources available. When the value of an extra unit of assets increases relative to the cost of holding domestic deposits (a higher μ), leverage falls due to the greater accumulation of assets.

The equation for Λ_t provides information on the shadow value of the bank's net worth. In particular, the first term denotes the probability of exiting the banking sector. The second term represents the marginal benefit of continuing to be a banker, which is given by the marginal value of an extra unit of domestic deposits, $\vartheta_{d,t}$, plus the payoff of holding assets (that is, the leverage ratio times the excess value of loans, $\phi_t\mu_t$).

The bank's optimal choices are such that the marginal value of cross-border bank lending equals the marginal value of assets, $\vartheta_{s,t}/Q_t = \vartheta_{b,t}/Q_{b,t}$. This implies that the discounted rate of return on domestic assets in H equals the discounted rate of return on cross-border bank flows. That is, in equilibrium, H banks are indifferent between providing funds to firms in H and to banks in F:

$$\mathbb{E}_t\Xi_{t+1|t}\Lambda_{t+1}R_{k,t+1} = \mathbb{E}_t\Xi_{t+1|t}\Lambda_{t+1}R_{b,t+1}. \tag{8}$$

3.4.2. Banks in F

The problem of banks in F is similar to the one of banks in H, except for one feature: cross-border bank flows, b_t^*, represent a liability for banks in F. Therefore, the balance sheet of a bank in F reads

$$Q_t^* s_t^* = nw_t^* + b_{d,t}^* + Q_{b,t}^* b_t^*.$$

The net worth of a bank is the payoff from assets funded in period $t-1$ net of borrowing costs, where the latter include cross-border bank loans:

$$nw_t^* = \left[r_t^* + (1-\delta_k^*)Q_t^*\right]s_{t-1}^* - R_{b,t-1}^* Q_{b,t-1}^* b_{t-1}^* - R_{t-1}^* b_{d,t-1}^*.$$

The interpretation of the variables in these conditions is analogous to the one for banks in H above. Moreover, as was the case for these banks, the borrowing constraint for banks in F must hold for each bank individually to ensure that banks do not divert funds:

$$V^*\left(s_t^*, b_t^*, b_{d,t}^*\right) \geq \theta^*\left(Q_t^* s_t^* - Q_{b,t}^* b_t^*\right). \tag{9}$$

This last expression establishes that banks in F cannot divert funds from banks in H. Following the same approach outlined in Cuadra and Nuguer (2018), it is straightforward to show that the shadow value of domestic-foreign assets is equal to the shadow cost of cross-border bank flows: $\vartheta_{s,t}^*/Q_t^* = \vartheta_{b,t}^*/Q_{b,t}^*$. In terms of returns, we have

$$\mathbb{E}_t\Xi_{t+1|t}^*\Lambda_{t+1}^*R_{k,t+1}^* = \mathbb{E}_t\Xi_{t+1|t}^*\Lambda_{t+1}^*R_{b,t+1}^*. \tag{10}$$

In this framework, the return on cross-border bank flows transmits shocks that originate in the banking system of economy H to economy F through the return on domestic assets. Additionally, the expected discounted rate of return on cross-border bank assets is equal to the one on loans to firms in H. Finally, H and F loan markets behave in a similar way.

3.4.3. Aggregate banking conditions

Aggregating across banks in H, we can write

$$Q_t S_t + Q_{b,t} B_t = \phi_t NW_t, \tag{11}$$

where capital letters indicate aggregate variables in the banking sector. The law of motion for aggregate bank net worth in economy H is therefore

$$NW_t = (\sigma+\xi)\left(R_{k,t}Q_{t-1}S_{t-1} + R_{b,t}Q_{b,t-1}B_{t-1}\right) - \sigma R_{t-1}B_{d,t-1}. \tag{12}$$

For banks in F, the corresponding aggregate conditions are

$$Q_t^* S_t^* - Q_{b,t}^* B_t^* = \phi_t^* N W_t^*, \tag{13}$$

$$N W_t^* = (\sigma^* + \xi^*) R_{k,t}^* Q_{t-1}^* S_{t-1}^* - \sigma^* R_{b,t}^* Q_{b,t-1}^* B_{t-1}^* - \sigma^* R_{t-1}^* B_{d,t-1}^*. \tag{14}$$

In equilibrium, banks in H lend to banks in F because economy H has excess resources relative to what it needs. Given the agency problem in each banking system, lending to banks in F by banks in H results in a stronger borrowing constraint in economy F. Moreover, following the literature, we assume that banks in F need to pay a premium on borrowing from banks in H, which is reflected in the interest rate on international borrowing being debt elastic (Schmitt-Grohé and Uribe, 2003). Then, equation (8) becomes

$$\mathbb{E}_t \Xi_{t+1|t} \Lambda_{t+1} R_{k,t+1} = \mathbb{E}_t \Xi_{t+1|t} \Lambda_{t+1} R_{b,t+1} + \eta_b \left[\exp(B_t - B) - 1\right]. \tag{15}$$

The last term is the risk premium associated with lending to banks in F, where parameter η_b dictates the elasticity of steady-state deviations in cross-border bank flows.

Turning to the interest rate on cross-border bank flows, the return on loans to banks F by banks in H is $\mathbb{E}_t(R_{b,t+1}) = \mathbb{E}_t(R^*_{b,t+1})\text{RER}_{t+1}/\text{RER}_t$, where $\text{RER}_t = \text{NER}_t P_t^*/P_t$ denotes the real exchange rate. We assume that banks in F bear all the risk from exchange-rate fluctuations. This particular channel plays an important role in the transmission of shocks: when the currency in F depreciates, the collateral in F expressed in foreign currency falls, which makes H banks lend less to F banks: the fall in collateral value puts upward pressure on the risk that F banks run away with resources from H banks. In equilibrium, H banks are indifferent between lending to F banks or domestic firms in H. Moreover, F banks do not have excess returns from borrowing from H banks, so the return on loans to F banks is equal to the interest rate charged by H banks. Thus, there is perfect asset-market integration.

3.5. Market clearing

Total demand for output produced in H must be equal to what is produced domestically:

$$Y_{H,t} + \left(\frac{1-m}{m}\right) Y_{H,t}^* = Y_{D,t}, \tag{16}$$

with an analogous condition holding for economy F.

Following BGM, we focus on a symmetric equilibrium. Then, market clearing in the domestic production of goods is given by

$$N_t y_t = z_t k_t^{\alpha} L_t^{1-\alpha}. \tag{17}$$

This last condition implies that a given production firm's average output is $y_t = z_t k_t^{\alpha} L_t^{1-\alpha}/N_t$ and that in symmetric equilibrium, there is a natural and direct relationship between the output of intermediate-goods firms (and therefore their input decisions) and goods-producing firm output.

The economy's resource constraint is

$$Y_t = c_t + i_t + \psi N_{E,t}, \tag{18}$$

and the current account can be written as

$$Q_{b,t} B_t - R_{b,t} Q_{b,t-1} B_{t-1} = \left(\frac{1-m}{m}\right) Y_{H,t}^* \frac{P_{H,t}}{P_t} - Y_{F,t} \text{ToT}_t \frac{P_{H,t}}{P_t}, \tag{19}$$

where ToT_t denotes the terms-of-trade. Finally, cross-border bank flows are in zero-net-supply so that $B_t = B_t^*(1-m)/m$. Appendix D presents the list of equilibrium conditions. Of note, since we focus on shocks that originate in the United States and are transmitted to EMEs, we abstract from banking-sector shocks that originate in EMEs. Thus, $s_t = k_{t+1}/\Psi_{t+1}$ but $s_t^* = k_{t+1}^*$.

4. Quantitative analysis

To discipline our quantitative experiments, the baseline calibration replicates the increase in US bank net charge-offs, the overall VAR response of US asset prices, and the average response of cross-border bank flows for the high-cost EME group in Fig. 1. Having successfully replicated these responses, we analyze how the response of the EME in the model changes when we reduce the cost of firm creation to match the cost of the low-cost EME group.

When comparing variables in models with endogenous firm entry to their counterparts in the data, model variables must be adjusted to abstract from the variety effect that is absent in empirical measurements of these variables but inherent to models with firm entry (Bilbiie et al., 2012). Section C.5 of the Appendix presents the transformation of model variables into data-consistent model variables. In what follows, all relevant model variables are expressed in data-consistent terms unless otherwise noted.

4.1. Calibration of baseline economy

Functional forms Following the literature on banking frictions, we assume i.i.d. shocks to the quality of capital in the United States $\ln(\Psi_t) = \varepsilon_t$, where $\varepsilon_t \sim N(0, \sigma_\Psi)$.

Per Section 3, the production function of intermediate-goods firms is Cobb-Douglas with capital share $0 < \alpha < 1$ in the United States and $0 < \alpha^* < 1$ in the EME, total domestic output is a Dixit-Stiglitz aggregator of output from individual goods-producing firms, and final goods in each economy are produced using a CES aggregator of total domestic production and imported output.

The functional forms for household utility and investment adjustment costs in the United States are

$$u(c_t, L_t) = \frac{c_t^{1-\sigma_c}}{1-\sigma_c} - \frac{\kappa}{1+\chi}\left(L_t\right)^{1+\chi},$$

and

$$\Phi\left(\frac{i_t}{i}\right) = \frac{\phi_k}{2}\left(\frac{i_t}{i} - 1\right)^2,$$

where $\sigma_c > 0, \kappa > 0, \chi > 0, \phi_k > 0$, with analogous functional forms for the EME differentiated by a *. Given the magnitude of the shock that replicates the increase in US bank net charge-offs in the VAR, and for the purposes of properly calibrating the US side of the model, we introduce similar adjustment costs associated with the creation of firms *on the US side of the model only*.[5]

Finally, the inability to generate quantitatively-factual cyclical real-exchange-rate movements in international RBC models is well known, and our framework is no exception. However, this particular limitation is not critical for our purposes since our objective is not to explain the real exchange rate dynamics in EMEs. Given the magnitude of the shock we consider, the response of the model-based real exchange rate after an increase in US bank net charge-offs is excessive as well. Then, in order to replicate the magnitude of the responses of high-cost EMEs in the data as part of our baseline calibration—this includes the fact that the EME real exchange rate remains very close to its trend level in the short-to-medium term after a short-lived initial depreciation—we introduce adjustment costs to the real exchange rate akin to those associated with foreign borrowing by EMEs (i.e., adjustment costs that do not affect the steady state).[6]

Parameters from literature Our main focus is on the response of EMEs to US banking-sector shocks, so we set exogenous aggregate productivity in both economies to $z = z^* = 1$ for all t. Following the international RBC literature, we set $\sigma_c = \sigma_c^* = 2$, $\beta = \beta^* = 0.985$, $\chi = \chi^* = 0.1$, and $\delta_k = \delta_k^* = 0.02$ in both economies (all standard values in the literature on the United States and on EMEs). We set $\alpha = \alpha^* = 0.40$ and $\delta = \delta^* = 0.02$, which are consistent with the average capital shares as well as the destruction rates of firms in the United States and in our group of EMEs per available data from the OECD. We set the elasticities of substitution of firm output $\varepsilon = 6$ and $\varepsilon^* = 4$, which delivers price markups consistent with estimates for the United States and EMEs, respectively (Díez et al., 2019).

Turning to the trade structure, we follow Cuadra and Nuguer (2018) and set the country size for the United States $m = 0.9$, noting that alternative values do not change our conclusions. Also, the degree of home bias α_a is influenced by the economy's degree of openness λ such that $\alpha_a = 1 - (1 - m)\lambda$ (see Cuadra and Nuguer, 2018). Analogously, the degree of home bias in the EME is given by $\alpha_a^* = 1 - m\lambda$. In both economies, the degree of substitution between total domestic output and imported output is set to $\phi_a = \phi_a^* = 1.5566$, a standard value in the international RBC literature. Turning to the banking sector parameters, we follow Gertler and Kiyotaki (2010) and set $\sigma = \sigma^* = 0.972$ and $\xi = \xi^* = 0.002$. Robustness analysis confirms that alternative parameter values do not change our main conclusions.

Calibrated parameters We calibrate parameters κ, κ^*, ψ, ψ^*, θ, and θ^* to match the following first moments based on commonly adopted targets in the international RBC and EME business cycle literatures, US data, and data averages for the high-cost EME (baseline) group: total hours worked of 0.33 for each economy; a cost of creating a firm in the United States of 1 percent of income per capita in the United States (per World Bank Doing Business data); an average cost of creating an EME firm of 17.68 percent of income per capita (consistent with the average cost of starting a business in the high-cost EME group per World Bank Doing Business data); and an average annual interest-rate premium of 110 basis points in both economies as in Cuadra and Nuguer (2018). The resulting parameter values are: $\kappa = 2.271$, $\kappa^* = 2.724$, $\psi = 0.1102$, $\psi^* = 1.6779$, $\theta = 0.5062$, and $\theta^* = 0.8945$.

The shock and adjustment-cost parameters σ_Ψ, ϕ_n, ϕ_k, ϕ_k^*, and η_b directly shape the dynamic response of US and EME variables to shocks. To discipline these parameters, recall from Section 1 that we use US bank net charge-offs as our measure of US banking-sector conditions from the point of view of EMEs. In the model, loans granted to firms to buy capital represent bank assets. In turn, a shock

5 Specifically, the total cost of creating firms that households incur on the US side of the model becomes $\psi N_{E,t} + \frac{\phi_n}{2}\left(\frac{N_{E,t}}{N_E} - 1\right)^2$ with $\phi_n > 0$. Then, the firm-creation condition for the United States inclusive of these adjustment costs becomes $\psi + \frac{\phi_n}{N_E}\left(\frac{N_{E,t}}{N_E} - 1\right) = \mathbb{E}_t \Xi_{t+1|t}\left\{d_{t+1} + (1-\delta)\left[\psi + \frac{\phi_n}{N_E}\left(\frac{N_{E,t+1}}{N_E} - 1\right)\right]\right\}$ (the corresponding expression for the EME presented in Section 3.3 remains the same). While the model can successfully replicate the U-shaped response of US asset-price dynamics in the VAR with investment adjustment costs alone, in the absence of adjustment costs for firm creation on the US side of the model, the quantitative magnitude of the response of US asset prices (as proxied by the S&P 500) would be too large compared to the VAR evidence that our baseline calibration aims to replicate, even if the overall U-shaped response remains unchanged. The reason for this is simple: new firm creation can be considered another type of investment (see BGM). Then, given the magnitude of the increase in US bank net charge-offs in the VAR, the drop in US firm creation would be excessively large. In turn, this would make the drop in US asset prices excessively large as well. Since this shock does not have a direct impact on the EME, these adjustment costs are not needed on the EME side of the model.

6 Fig. F.2 in Appendix F shows results for our benchmark model with and without these adjustment costs to illustrate the (ir)relevance of these costs for capturing the differences in the response between low-cost and high-cost EMEs. The figure broadly supports our main conclusions: even in the absence of these adjustment costs, our model can successfully rationalize the differential responses between high-cost and low-cost EMEs to US banking-sector shocks. The adjustment costs merely limit the *absolute* percent changes in EME variables in response to the shock, but do not affect the differential responses between low-cost and high-cost EMEs, which is ultimately what we are interested in.

to the quality of capital in the United States (i.e., a decrease in Ψ_t) leads to a decrease in the value of bank assets in the US. Thus, a shock to the quality of capital in the United States is negatively related to a shock to US bank net charge-offs in the data.

Then, we calibrate the shock series to the quality of capital in the US, which is shaped by σ_Ψ, so that our model reproduces exactly the estimated path of US bank net charge-offs in Fig. 1. Having done so, we choose ϕ_n, ϕ_k, ϕ_k^*, and η_b such that our benchmark calibration matches the overall empirical response (fall and shape of recovery) of the US S&P 500 as well as the overall response (fall and shape of recovery) of real foreign claims on US banks in the high-cost EME per Fig. 1. The resulting parameter values are: $\phi_n = 2$, $\phi_k = 0.09$, $\phi_k^* = 0.5$, and $\eta_b = 0.25$. Table E.2 in Appendix E summarizes the list of parameters and the corresponding parameter values.

Response of high-cost EMEs to an increase in US bank net charge-offs: data vs. baseline model calibration Fig. 3 shows the outcome of the baseline calibration. By construction, the model replicates the shock to US bank net charge-offs, the fact that the real exchange rate in high-cost EMEs remains little-changed in the medium term, and the overall post-shock dynamics of cross-border liabilities and US asset prices.

The responses of EME GDP and domestic bank credit are both an outcome and are not targeted. The model is able to capture the overall fall and recovery in EME bank credit in high-cost EMEs even though the recovery is somewhat faster than in the data. This is partly driven by the steady recovery in cross-border liabilities in the medium term.[7] In contrast, the model generates a significantly larger initial contraction in EME GDP and a more persistent response compared to the data.

The sharp initial contraction of EME GDP in the model is driven by the large contraction in EME firms in response to the shock. This is confirmed by an experiment where we compare the response of EME GDP in the benchmark model and in a model with fixed firm-entry dynamics outside of the steady state to a single-period shock to US net charge-offs. In turn, the sequence of shocks that is needed to match the response of US net charge-offs in the VAR, coupled with the response of EME firm entry to the shocks, is responsible for the U-shaped response of EME GDP in the model (in response to a one-time US net charge-offs shock with no persistence, EME GDP contracts sharply on impact and subsequently bounces back). The number of firms plays an important role in shaping the productive capacity of the economy. Therefore, if an adverse shock leads to a reduction in new firm entry and in the number of firms, the response of GDP will be greater compared to an environment where the number of firms does not respond to shocks.

Since our primary focus is on understanding the differential response between high-cost and low-cost EMEs to the same US shock, the fact that our model generates a larger fall in GDP of the high-cost EME compared to our VAR evidence is not, by itself, a limiting factor for the broader validity of our analysis. Crucially, the U-shaped response of EME GDP in the model is present in both the high-cost and low-cost EME groups. As such, our focus on the differential responses between the two EME groups remains informative, even if we may not match the dynamics of GDP in a given EME group.

4.2. Differential responses to US bank net charge-offs in high-cost and low-cost EMEs: data vs. model

We reduce the cost of creating a firm in the baseline high-cost EME to match the average cost in the low-cost EME group—a reduction from 17.68 percent of income per capita to 7.23 percent per Table 1—holding all other parameters at their baseline values. Then, we feed the estimated process for US bank net charge-offs from the low-cost EME VAR into the model with lower firm-creation costs, which delivers model-based impulse responses for the low-cost EME that are comparable to those in the VAR. Finally, we take the difference between the model-based impulse responses of the low-cost EME and the high-cost EME for each relevant variable and compare them to the corresponding differences that emerge from our VAR analysis.[8]

Fig. 4 shows the outcome of this exercise, where the blue bars represent the data and the orange bars represent the benchmark model. By construction, the benchmark model exactly matches the differences in the evolution of US bank net charge-offs in the two EME groups. Most notably, the model is able to generate a significant share of the post-shock differences in cross-border liabilities and EME domestic bank credit between the two EME groups. At the same time, the model is able to generate virtually all of the differences in EME GDP in the short-to-medium term (that is, 5 quarters after the shock). These happen to be the differences that are significant per Fig. 2, even as the model overestimates the empirical differential response of EME GDP in the first few quarters after the initial shock. All told, differences in firm-creation costs between EME groups alone are able to generate a significant fraction of the empirical differences in the responses of cross-border flows, GDP, and domestic bank credit between EME groups to an increase in US bank net charge-offs.

4.3. Model mechanisms and quantitative importance of firm-creation costs

4.3.1. Impact of lower firm-creation costs on EME steady state and EME response to shocks

In the model, lower firm-creation costs bolster steady-state EME firm entry, which generates greater demand for capital by EME firms. Given the tight link between capital and bank credit, greater EME firm entry contributes to an expansion in the steady-state portfolio of bank loans held by EME banks, and specifically an expansion in their assets. While the expansion in EME banks' portfolio

[7] One reason why the recovery in EME bank credit in the model takes place earlier compared to the data may be due to the fact that our model only focuses on bank credit that finances capital investment. If bank credit is used to cover other firm expenses, the recovery may be more gradual.

[8] Fig. F.1 in Appendix F shows a version of Fig. 1 with the model-based impulse responses superimposed.

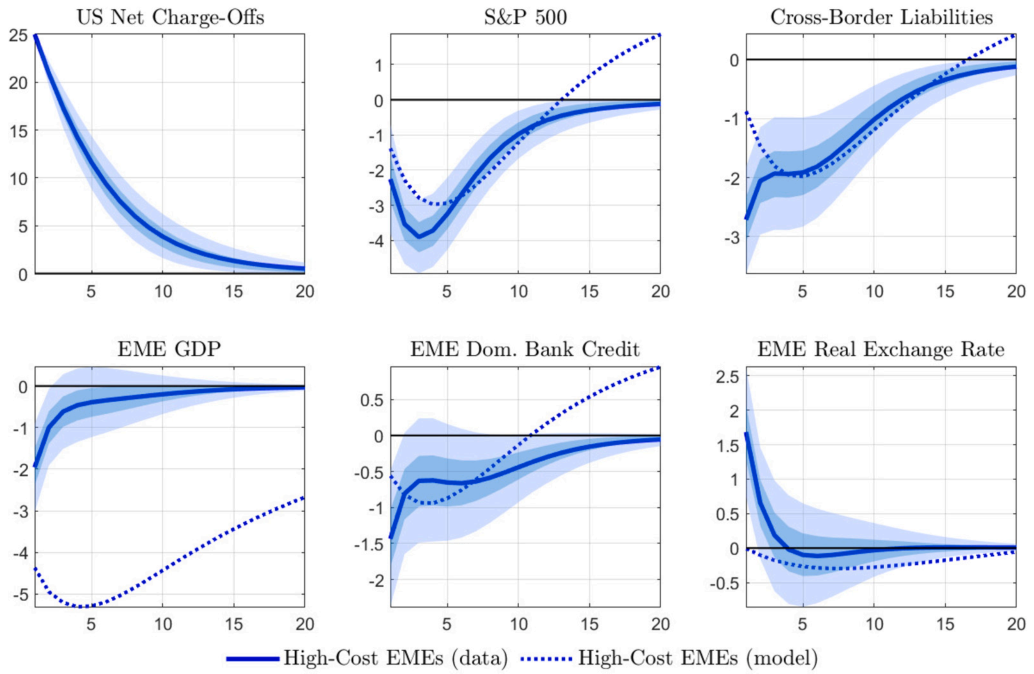

Fig. 3. Empirical and model-based impulse responses to an increase in US bank net charge-offs: baseline high-firm-creation-cost EMEs. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis corresponds to quarters after the shock.

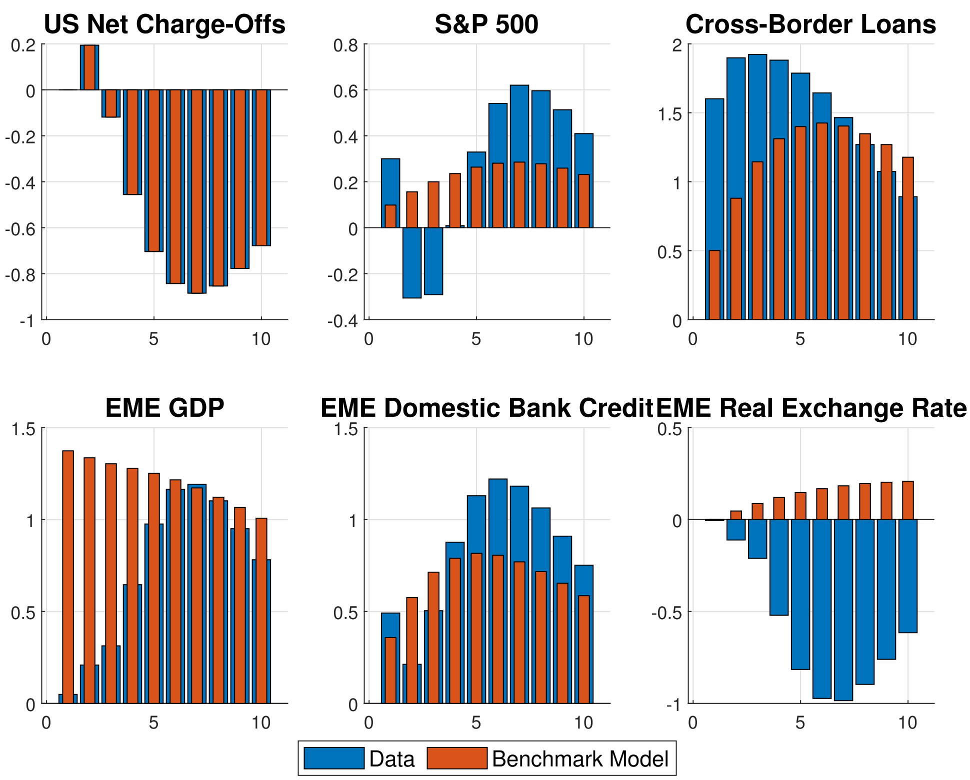

Fig. 4. Differences between EMEs to an increase in US bank net charge-offs: data vs. benchmark model, differences in average firm-creation costs. *Note:* The vertical axis shows the percentage-point difference between the impulse responses of low-cost EMEs and those of high-cost EMEs to an increase in US bank net charge-offs for each corresponding variable in the data (blue bars) and in the benchmark model (orange bars). The horizontal axis shows the number of quarters after the shock.

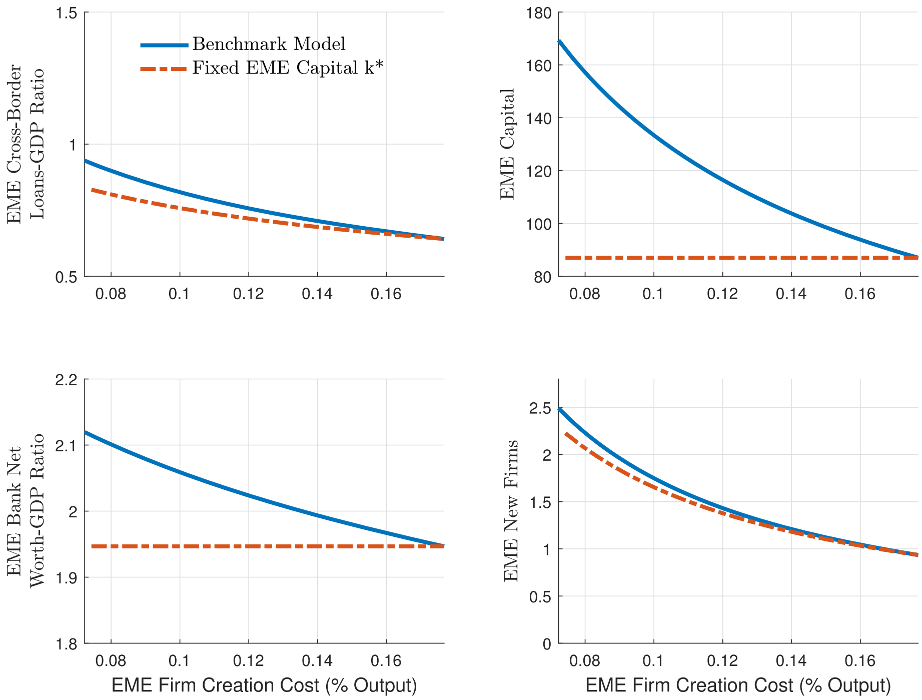

Fig. 5. Changes in firm-creation costs: steady-state equilibria, benchmark model and benchmark model with fixed EME capital k^* (via EME TFP Changes). *Note:* The horizontal axis denotes the cost of creating an EME firm as a share of output. The solid line shows the change in the variable specified on the y axis as we vary the cost of creating an EME firm. The dashed-dotted line shows the change in the same variable as we vary the cost of creating an EME firm holding EME capital, k^*, fixed at its baseline (high-cost-EME) level by adjusting EME TFP. The point where the solid line and the dashed-dotted lines intersect corresponds to the level of each corresponding variable in the baseline (high-cost) EME.

is partly financed by greater borrowing from US banks (i.e., greater cross-border bank flows) which all else equal puts downward pressure on net worth, the steady-state return to bank loans is greater than the cost of foreign borrowing and any liabilities from domestic deposits. As such, the increase in EME firm entry ultimately leads to an increase in steady-state EME bank net worth, both in levels and relative to EME GDP, that is rooted in an increase in their steady-state assets.

Fig. 5 plots the ratio of cross-border loans to EME GDP, EME capital, the ratio of EME bank net worth to GDP, and the measure of EME new firms as we vary the firm-creation cost in the EME. To highlight the role of changes in EME capital, the same figure plots these variables in a counterfactual version of the benchmark model that keeps EME capital fixed at its (high-cost-EME) baseline level.[9] Note that when EME capital is held fixed at its baseline level, the EME bank net worth-to-GDP ratio (but not EME bank net worth) also remains unchanged as we vary the cost of firm creation. This outcome is a direct result of the link between physical capital and bank credit in models with banking frictions.

For future reference when we discuss the response to a US banking-sector shock in EMEs that differ in their firm-creation costs further below, Fig. 6 shows a version of Fig. 5 where instead of maintaining steady-state EME capital fixed at its (high-cost-EME) baseline level, we use the same approach to maintain the level of steady-state EME bank net worth (not the ratio with GDP) fixed at its baseline level. As shown in Fig. 6, in this second experiment, lower firm-creation costs do generate an increase in EME capital, albeit smaller than the increase in the benchmark model where the steady-state level of EME bank net worth is allowed to respond to the change in firm-creation costs.

The increase in steady-state EME capital stemming from lower firm-creation costs makes EME firms, and in turn EME banks, less sensitive to shocks, even if EME banks become more exposed to cross-border financial flows as they increase their foreign borrowing in order to extend bank credit to low-cost-EME firms. Importantly, the resiliency rooted in greater EME capital and bank assets shapes EME banks' decisions over foreign borrowing and loans to EME firms amid shocks, which shapes firm entry and production decisions and ultimately influences the equilibrium response of EME output and bank credit to these same shocks.

To see this more clearly, Fig. 7 compares the model responses of the high-cost (baseline) EME (solid blue line) and the low-cost EME (dashed red line) to a US bank net charge-offs shock for select variables of interest. The figure also plots the responses of the low-cost EME in a setting where we artificially maintain EME capital fixed at its (high-cost EME) baseline (dashed-dotted green line),

[9] We plot EME cross-border loans and EME bank net worth as a share of EME GDP for comparability across equilibria since changes in firm creation costs also affect EME GDP. We maintain EME capital fixed at its baseline level by adjusting EME TFP as we vary firm-creation costs. This is a natural parameter to change since it does not *directly* affect banking-sector variables—it generates a demand-driven change in bank credit and in bank net worth—and allows us to understand the consequences of changes in EME capital for EME banks and their responses to shocks in a clear way. Other parameters that can affect EME capital in the model, such as δ^*, σ^*, and θ^*, would simultaneously change EME bank net worth, and would therefore make our analysis much less transparent and informative.

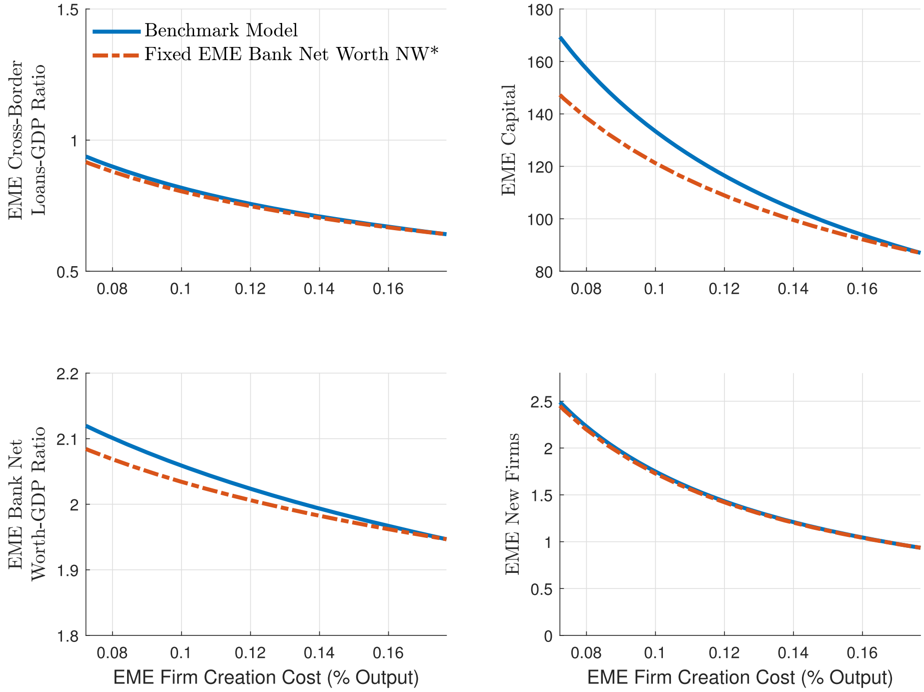

Fig. 6. Changes in firm-creation costs: steady-state equilibria, benchmark model and benchmark model with fixed EME bank net worth NW^* (via EME TFP changes). *Note:* The horizontal axis denotes the cost of creating an EME firm as a share of output. The solid line shows the change in the variable specified on the y axis as we vary the cost of creating an EME firm. The dashed-dotted line shows the change in the same variable as we vary the cost of creating an EME firm holding EME bank net worth, NW^*, fixed at its baseline (high-cost-EME) level by adjusting EME TFP. The point where the solid line and the dashed-dotted lines intersect corresponds to the level of each corresponding variable in the baseline (high-cost) EME.

as in the steady-state experiment shown in Fig. 5, and the response of the low-cost EME in a setting where we artificially maintain EME bank net worth at its (high-cost EME) baseline (dotted magenta line), as in the steady-state experiment shown in Fig. 6.

When lower firm-creation costs lead to an increase in steady-state EME firm entry but the amount of EME capital does not change, steady-state EME bank assets—the loans they make to EME firms—remain effectively unchanged as well. As a result, the response to a US banking-sector shock of low-cost EMEs with an amount of steady-state capital that is unchanged is for all intents and purposes the same as the response of the high-cost EME to the same shock.[10] In contrast, when lower firm-creation costs lead to an increase in both steady-state EME firm entry and capital but no change in steady-state EME bank net worth, the response of the low-cost EME with fixed EME bank net worth is effectively the same as the response of the low-cost EME in our main analysis, where EME bank net worth is allowed to change with changes in firm-creation costs.

More broadly, the results in Figs. 5 and 7 illustrate how changes in EME firm-creation costs shape the response of EME to US banking-sector shocks by changing EME firms' demand for capital, which affect the demand for EME bank credit and bolster EME banks' assets. The increase in EME bank assets provides the necessary resilience for those banks to be less responsive to adverse US banking-sector shocks.

4.3.2. Alternative structural differences between EME groups and the quantitative impact of firm-creation costs

Low-cost EMEs differ from high-cost EMEs in other structural characteristics that may influence their response to US banking-sector shocks. Two of those characteristics are average TFP and institutional quality/property rights, both of which are greater in low-cost EMEs and operate through similar mechanisms to those described above. To highlight the quantitative relevance of differences in firm-creation costs in shaping the response of EMEs to US banking-sector shocks and discard average TFP and institutional quality as alternative driving forces behind the differences in the response of the two EME groups, we consider the quantitative impact of differences in these two structural factors in the model. We first present the results for average TFP and then for institutional quality/property rights.

[10] Fig. G.1 and G.2 in Appendix G plots the differences in impulse responses between low-cost and high-cost EMEs in the data, in the benchmark model, and in the benchmark model with fixed EME capital to highlight the quantitative importance of changes in EME capital and the mechanisms associated with those changes.

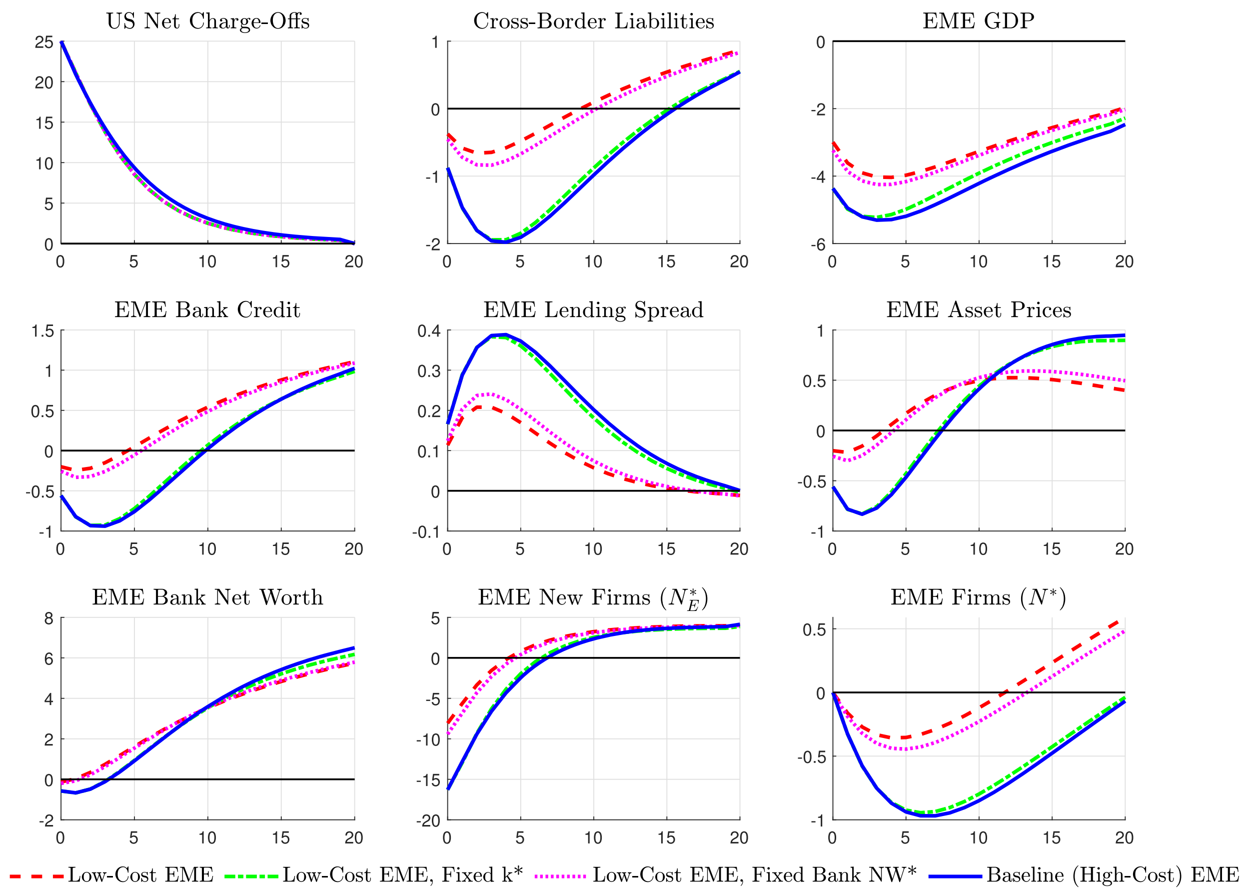

Fig. 7. Model-based impulse response to an increase in US bank net charge-offs: high-firm-creation-cost EME, low-firm-creation-cost EME, low-firm-creation-cost EME with fixed EME capital, and low-firm-creation-cost EME with fixed EME bank net worth. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis corresponds to quarters after the shock.

To discipline the quantitative differences in EME TFP in the model, we use data from the Penn World Tables to compute average TFP for each EME in our sample, and then compute average TFP for the high-cost and low-cost EME groups, respectively. After normalizing average TFP in high-cost EMEs to 1, average TFP in low-cost EMEs relative to high-cost EMEs is 1.01, which is a very small difference.[11]

Qualitatively, an increase in EME TFP has similar effects to a reduction in EME firm-creation costs. However, as shown in Fig. G.3 and G.4 in Appendix G, the data-disciplined quantitative increase in EME TFP is not large enough to generate significant quantitative differences in the response to a US banking-sector shock. Then, the model suggests that plausible empirical differences in TFP between high-cost and low-cost EMEs alone cannot quantitatively explain why low-cost EMEs are less sensitive to US banking-sector shocks.

In the case of institutional quality/property rights, the degree of EME banks' asset diversion θ^* is a natural parameter to vary (a lower θ^* reflects fewer banking frictions due to less asset diversion risk, which can be interpreted as better institutions, stronger property rights, and deeper domestic financial development). We consider reducing θ^* from its EME baseline to the (lower) value we assign to the United States in the model, where the United States is considered to have better institutional quality/property rights.

A reduction in θ^* lowers the incentive of US banks to lend to EME banks since the two economies become more similar from an institutional quality/property rights standpoint, leading to a decline in steady-state EME cross-border bank loans, EME capital, and EME firms. The lower θ^* increases EME bank net worth because EME banks borrow less from US banks, even as fewer loans are extended to EME firms and EME bank assets fall. As shown in Fig. G.5 in Appendix G, differences in institutional quality/property rights are also unable to rationalize the quantitative differential responses between low-cost and high-cost EMEs to US banking-sector shocks.

[11] For transparency, in both experiments, the EME firm-creation cost ψ^* remains at its baseline, high-cost EME value, but EME output Y^* is allowed to vary. The same conclusions hold in alternative experiments where we change EME TFP and θ^* but we keep the ratio ψ^*/Y^* at its baseline level.

5. Conclusion

Compared to advanced economies, emerging economies (EMEs) exhibit high regulatory barriers to firm entry reflected in high firm-creation costs. Lower entry barriers are associated with increased formal credit, which can expose EME firms to external financial shocks that propagate to EMEs via the banking system, such as those that characterized the Global Financial Crisis (GFC) of 2008-2009. To what extent do domestic barriers to firm entry play a role in the response of EMEs to US financial shocks? We present VAR evidence showing that, in response to adverse US financial shocks originating in the US banking system, EMEs with low firm-creation costs exhibit smaller contractions and earlier recoveries in cross-border bank flows, domestic bank credit, and GDP compared to EMEs with high firm-creation costs.

To shed light on the main drivers behind these differences, we build a two-country model with banking frictions and endogenous firm entry subject to sunk entry costs. Calibrating the model to the United States and a representative EME group, we show that our framework can successfully capture the VAR evidence qualitatively and quantitatively. Additional model analysis shows that, by generating greater EME firm entry and demand for capital, lower firm-creation costs expand EME banks' domestic loan portfolios, assets, and net worth, thereby making banks and firms in EMEs with lower firm-creation costs more resilient to US banking-sector shocks. Our findings suggest that cyclical financial policies aimed at stabilizing credit-market fluctuations in EMEs may need to be analyzed within a larger context that takes into account domestic barriers to firm entry, especially if those fluctuations arise from foreign financial shocks that propagate via the banking system.

Appendix A. Data and sources

Cost of Starting a Business The cost of starting a business comes from the World Bank Doing Business (WBDB) report. It is available annually, from 2004 to 2018, as is reported as a share of annual income per capita. We compute the average cost for each country by taking the average over this period. For Brazil, Indonesia, and Mexico, data is not available before 2014, so we compute the average for the period 2014-2018. Then we calculate the "total median" as the median across the nine means in our EME sample. The "low-cost EMEs" group includes those countries below the median, and the rest of the sample (which contains the median country and the ones above the median) comprise the "high-cost EMEs" group.

US NCO: US net charge-offs on all loans and leases, all commercial banks (in millions of US dollars), divided by US consumer price index. Source: Federal Reserve Bank of St. Louis (FRED).

S&P 500: Standard and Poor's 500 stock price index. Source: Federal Reserve Bank of St. Louis (FRED).

Cross-Border Liabilities: Total cross-border liabilities of US banks on EME banks that report to the BIS Locational Banking Statistics, all instruments (in US dollars), divided by US consumer price index. Source: Joint External Debt Hub (JEDH) Creditor/Market Tables, Line 22 and Federal Reserve Bank of St. Louis (FRED).

Foreign Claims on US Banks: US bank foreign claims on with immediate EME counterparties, including banks and non-banks (in millions of US dollars), divided by US consumer price index. Source: Bank for International Settlements (BIS) and Federal Reserve Bank of St. Louis (FRED).

Cross-Border Loans to EME Banks: Gross cross-border loans from US banks to EME banks that report to the BIS Locational Banking Statistics (in US dollars), divided by US consumer price index. Source: Joint External Debt Hub (JEDH) Creditor/Market Tables, Line 1 and Federal Reserve Bank of St. Louis (FRED).

Cross-Border Loans to EME Non-Banks: Gross cross-border loans from US banks to EME non-banks that report to the BIS Locational Banking Statistics (in US dollars), divided by US consumer price index. Source: Joint External Debt Hub (JEDH) Creditor/Market Tables, Line 2 and Federal Reserve Bank of St. Louis (FRED).

GDP: Gross Domestic Product at constant prices, seasonally adjusted (in domestic currency), divided by the real effective exchange rate between each EME and the US. Source: Thomson Reuters Datastream and Bank for International Settlements (BIS). GDP data for Indonesia and Mexico come from the International Financial Statistics (IFS).

Consumption: Private consumption at constant prices, seasonally adjusted (in domestic currency), divided by the real effective exchange rate between each EME and the US. Source: Thomson Reuters Datastream and Bank for International Settlements (BIS).

Bank Credit: Total domestic EME banks' credit to the private non-financial sector, at market value (in billions of US dollars), divided by the US consumer price index. Source: Bank for International Settlements (BIS) and Federal Reserve Bank of St. Louis (FRED).

Real Effective Exchange Rate: Nominal exchange rate in terms of EME domestic currency per US dollar, multiplied by the US consumer price index and divided by the EME consumer price index. Source: Bank for International Settlements (BIS).

A.1. EME time series

Figs. A.1 through A.10 plot the cyclical component of the time series of each variable for each EME in our sample for the period 2007Q3-2019Q3 (each figure includes real private consumption for completeness), where the cyclical component of each series is obtained using an HP filter with smoothing parameter 1600. Fig. A.11 shows the corresponding filtered time series for the US.

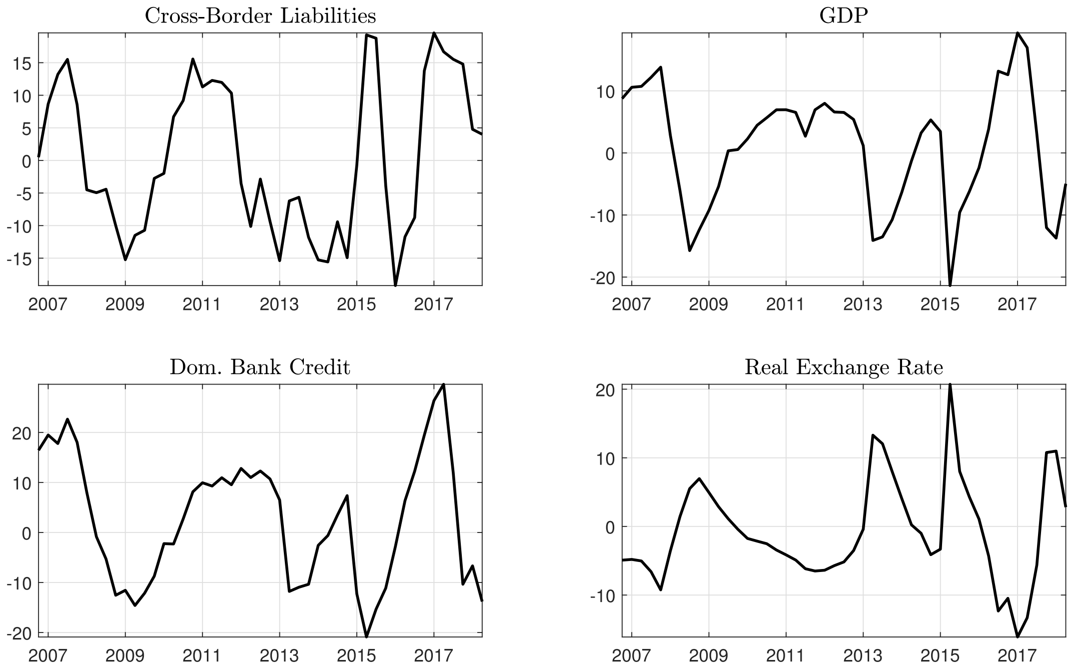

Fig. A.1. Time series of cyclical component of real cross-border liabilities, GDP, domestic bank credit, and real exchange rate: Argentina.

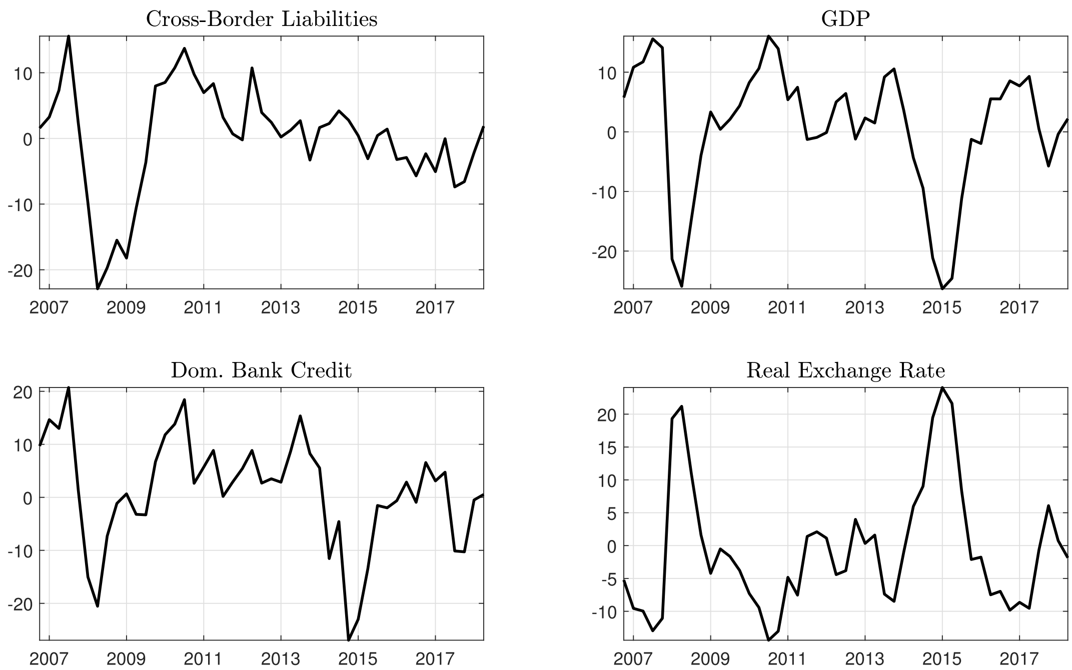

Fig. A.2. Time series of cyclical component of real cross-border liabilities, GDP, domestic bank credit, and real exchange rate: Brazil.

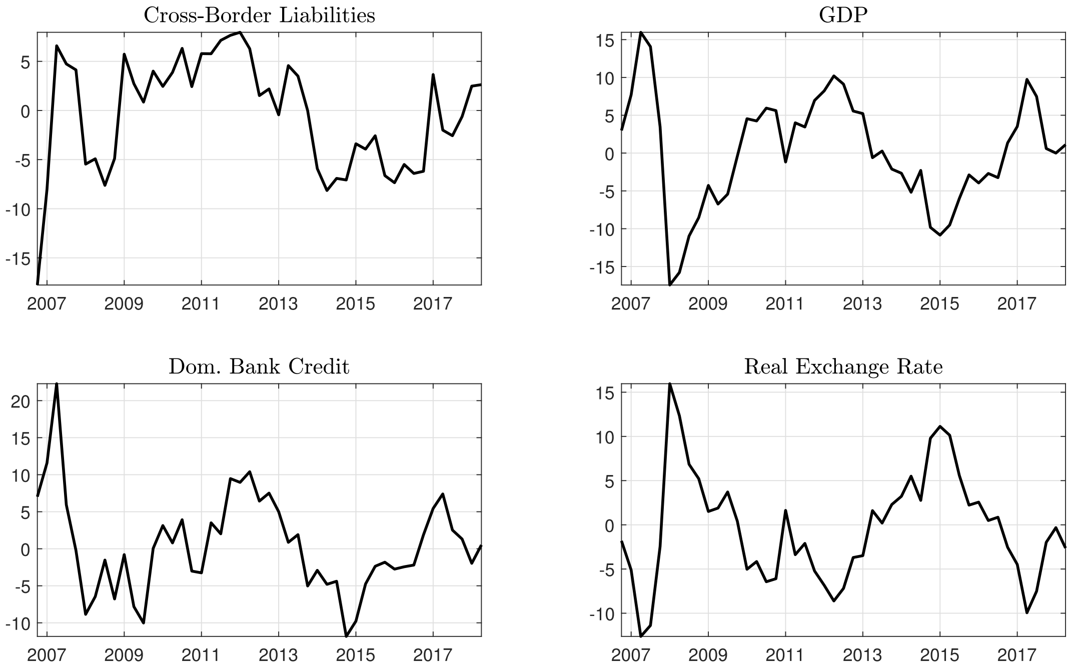

Fig. A.3. Time series of cyclical component of real cross-border liabilities, GDP, domestic bank credit, and real exchange rate: Chile.

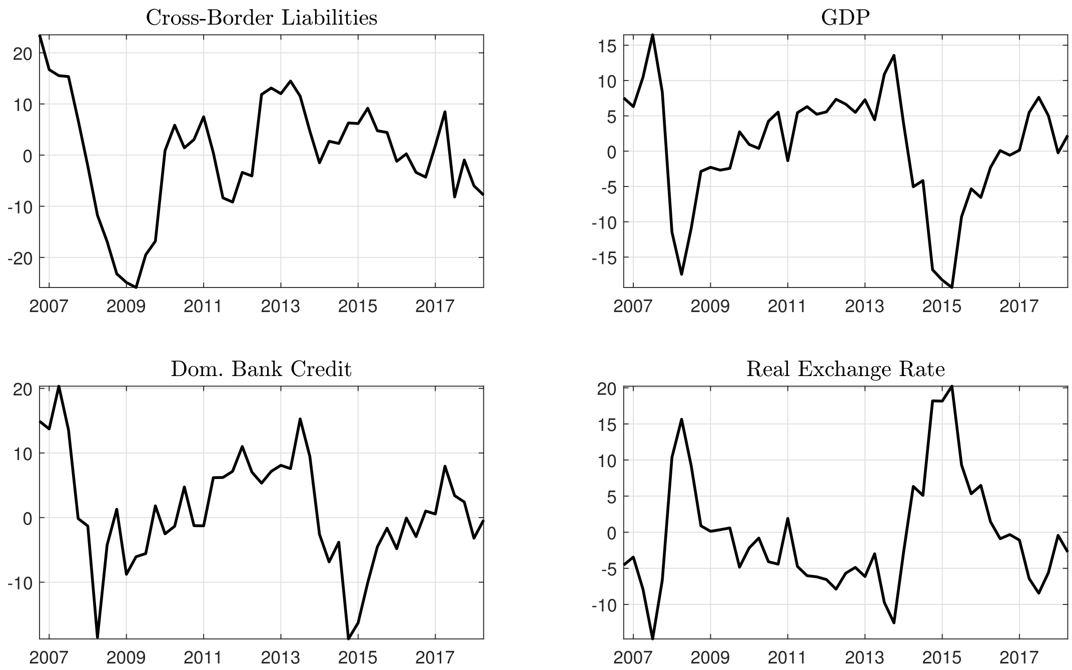

Fig. A.4. Time series of cyclical component of real cross-border liabilities, GDP, domestic bank credit, and real exchange rate: Colombia.

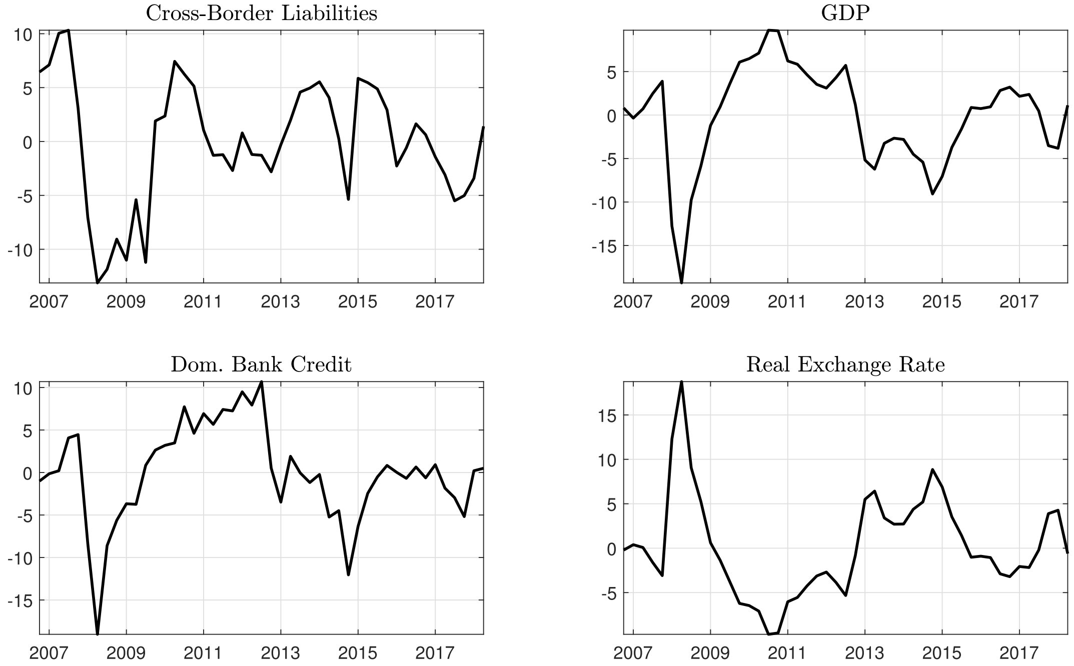

Fig. A.5. Time series of cyclical component of real cross-border liabilities, GDP, domestic bank credit, and real exchange rate: Indonesia.

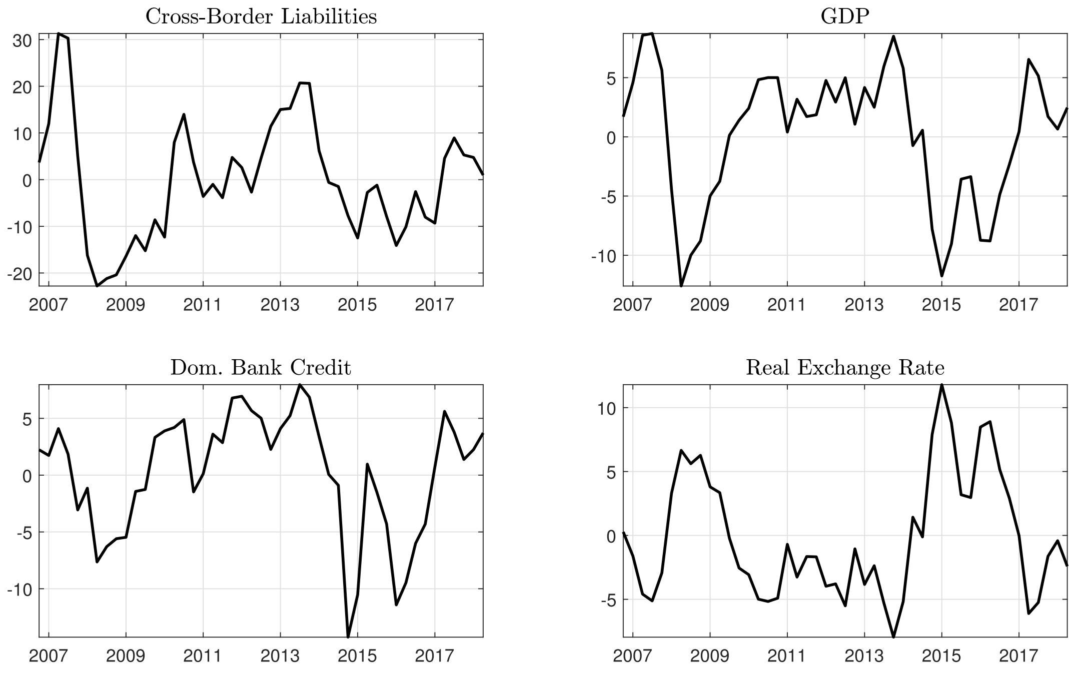

Fig. A.6. Time series of cyclical component of real cross-border liabilities, GDP, domestic bank credit, and real exchange rate: Malaysia.

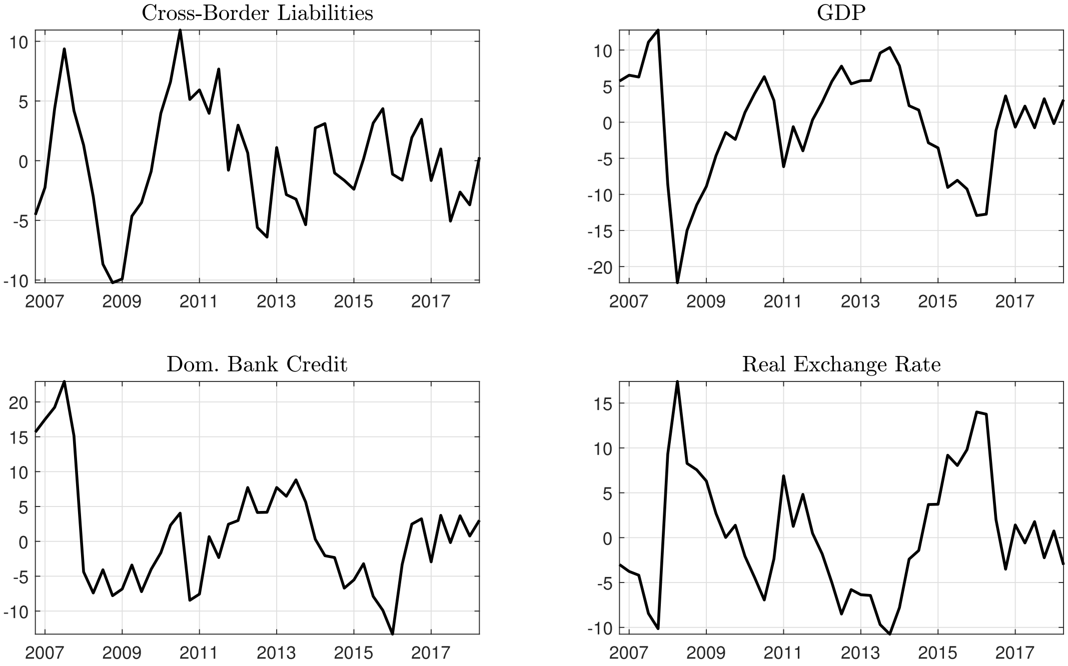

Fig. A.7. Time series of cyclical component of real cross-border liabilities, GDP, domestic bank credit, and real exchange rate: Mexico.

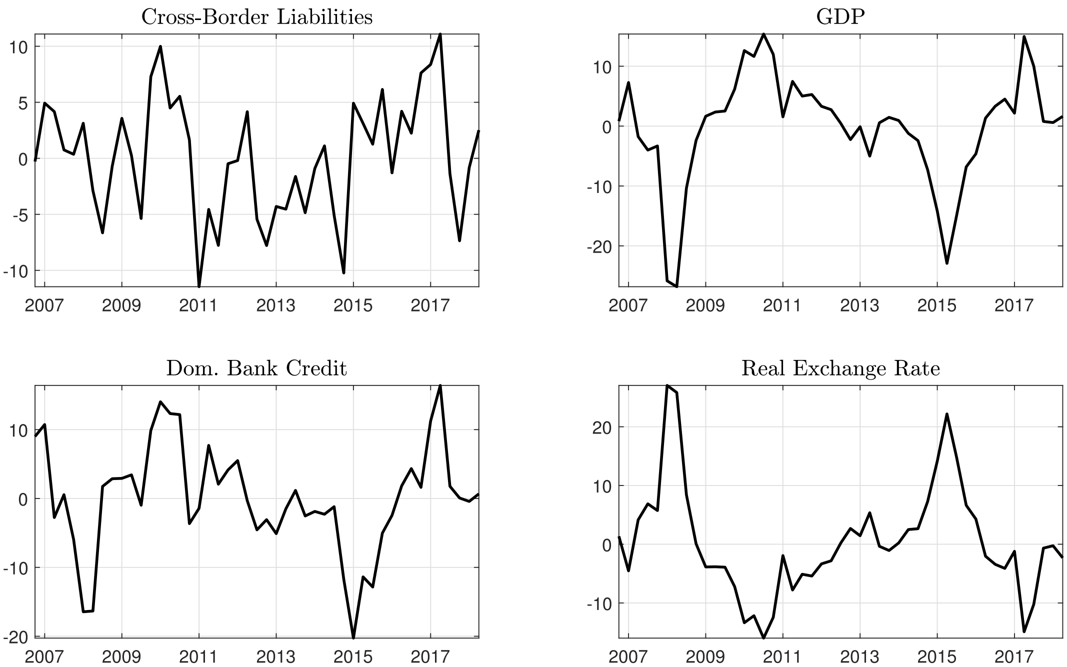

Fig. A.8. Time series of cyclical component of real cross-border liabilities, GDP, domestic bank credit, and real exchange rate: South Africa.

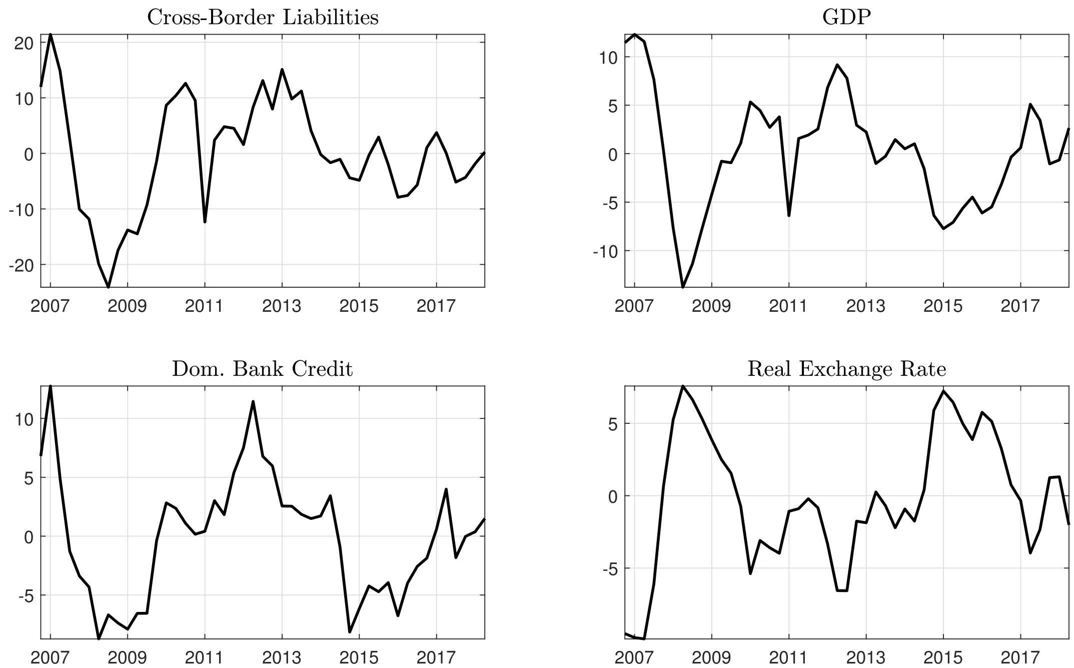

Fig. A.9. Time series of cyclical component of real cross-border liabilities, GDP, domestic bank credit, and real exchange rate: Thailand.

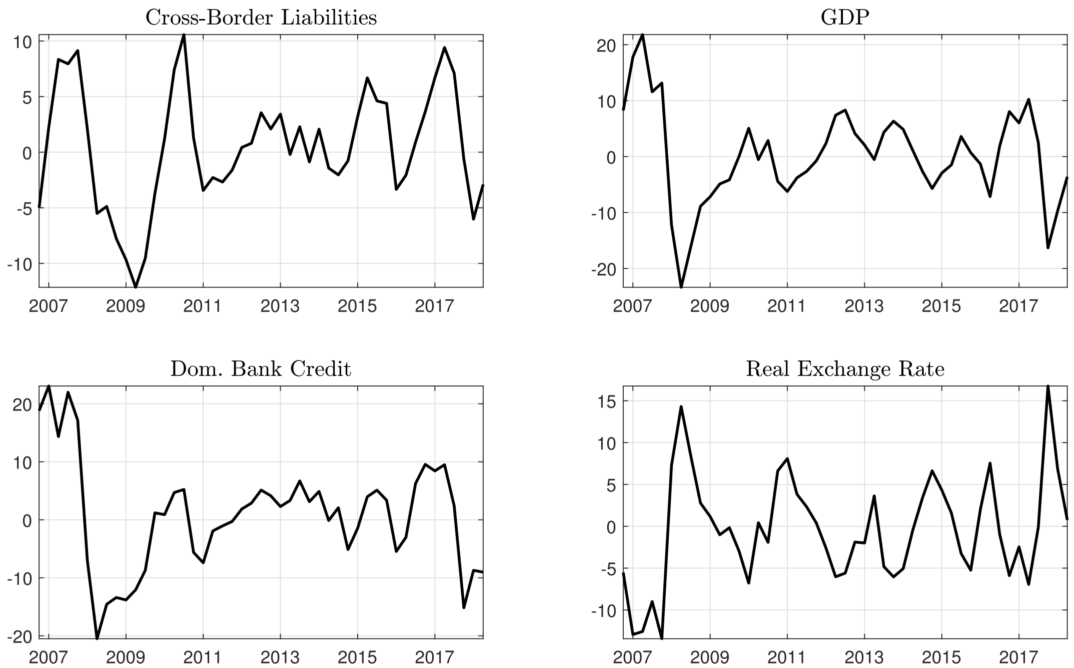

Fig. A.10. Time series of cyclical component of real cross-border liabilities, GDP, domestic bank credit, and real exchange rate: Turkey.

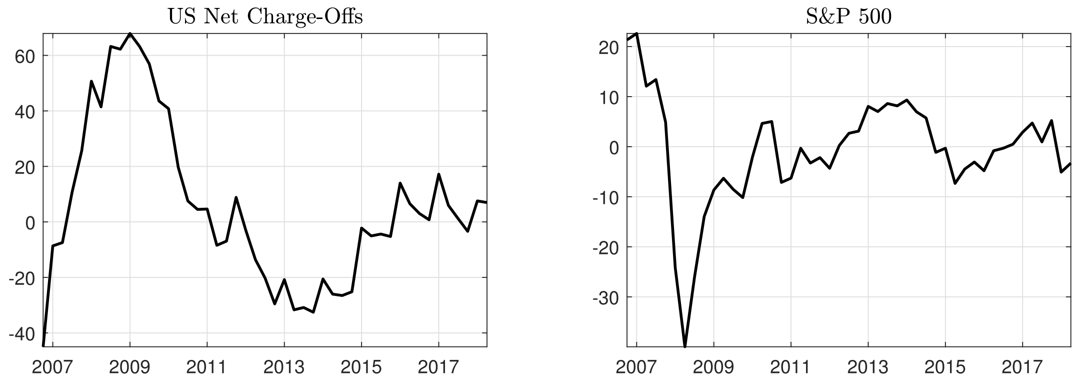

Fig. A.11. Time series of cyclical component of real US bank net charge-offs and S&P 500: United States.

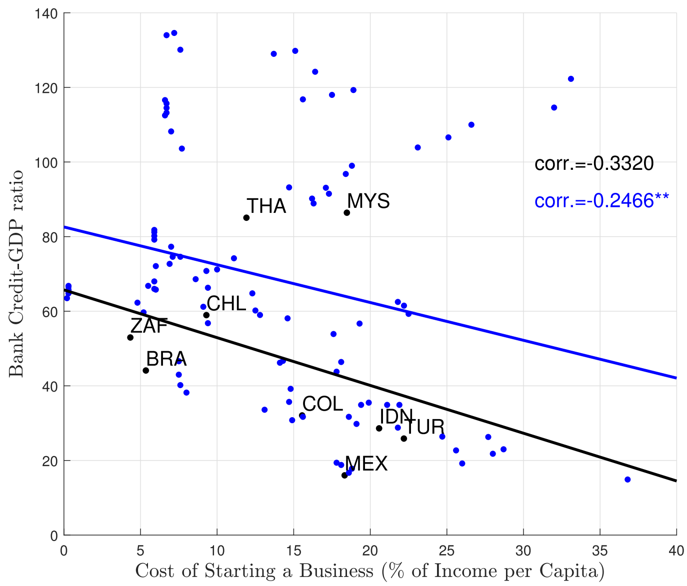

Fig. B.12. Cost of starting a business and domestic financial development: baseline sample of emerging economies. *Note:* Authors' calculations using data from the World Bank Doing Business Report (WBDB) (cost of starting a business) and the Bank for International Settlements (BIS) (domestic bank credit-GDP ratio). ** indicates significance at the 5 percent level.

Appendix B. Empirical evidence

B.1. Firm-creation costs, new firm density, and domestic financial development

Our focus on bank credit as opposed to other sources of formal external finance stems from the fact that bank credit represents the primary source of formal external financing for most firms that use formal external financing (IFC Enterprise Finance Gap Database 2010). To support the link between firm-entry costs and domestic financial development, Fig. B.12 confirms a negative and strong cross-country relationship holds between the cost of creating a business and the average bank credit-GDP ratio in our baseline sample of EMEs (blue dots in the Figure). For completeness, we plot the year-country data as well (black dots in the Figure) and the negative correlation remains. Fig. B.13 confirms the same link when we consider a pooled sample of advanced economies and EMEs.

B.2. Response of EMEs to US banking-sector shocks: panel VAR details, additional results, and robustness checks

Following related literature, we assume that adverse US financial shocks originating in the US banking system are reflected in an increase in US commercial banks' net charge-offs (Lambertini and Uysal, 2013; Cuadra and Nuguer, 2018). The rationale for this choice is simple: banks' net charge-offs embody the value of bank loans that banks consider will not be repaid. Thus, an increase in

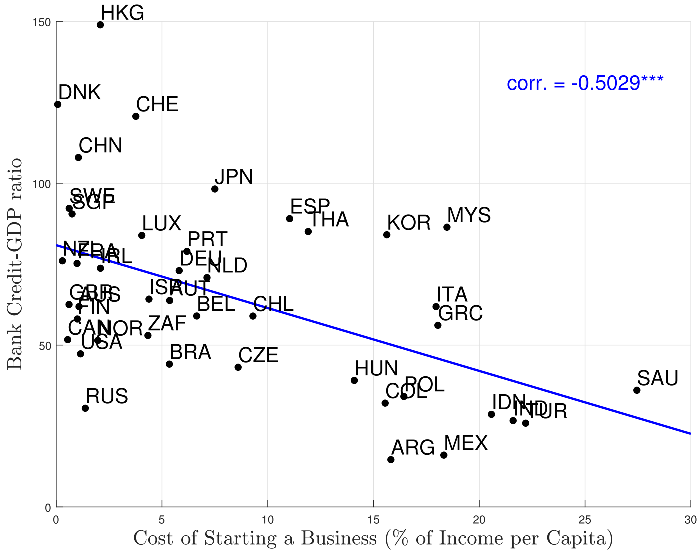

Fig. B.13. Cost of starting a business and domestic financial development across advanced economies and EMEs. *Note:* Authors' calculations using data from the World Bank Doing Business Report (WBDB) (cost of starting a business) and the Bank for International Settlements (BIS) (domestic bank credit-GDP ratio). *** indicates significance at the 1 percent level.

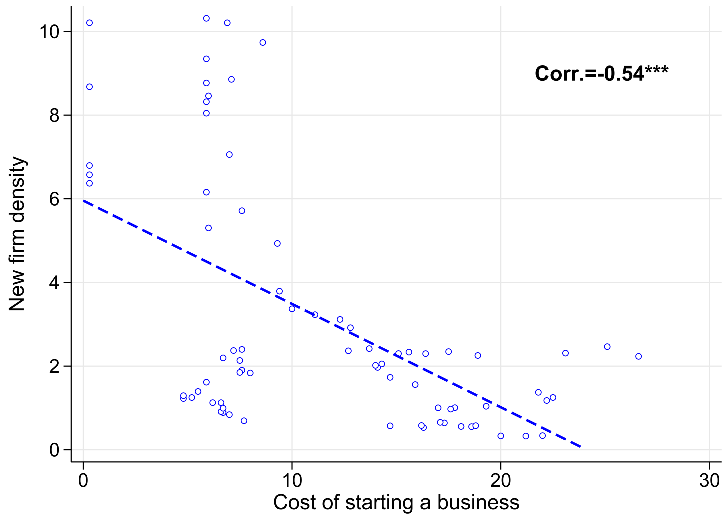

Fig. B.14. Cost of starting a business and new firm density in emerging economies. *Note:* The cost of starting a business is expressed as a share of annual income per capita. New firm density is defined as the number of new firm registrations per 1000 individuals per year. *** indicates significance at the 1 percent level.

US net charge-offs represents a fall in the value of US bank assets or, more broadly, an adverse shock to the US banking system. This shock is in turn transmitted to EMEs via cross-border banking-sector linkages between the US and these economies (Fig. B.17).

Main specification We adopt a parsimonious panel VAR specification comprised of six variables: (1) real US commercial banks' net charge-offs, (2) real US asset prices, (3) real cross-border bank flows between the US and each of the EMEs in our sample, (4) real GDP in each EME, (5) real domestic bank credit to the non-financial private sector in each EME, and (6) the real effective exchange rate between each EME and the US. Since the majority of EME firms that use formal external financing rely primarily on bank credit, EME domestic bank credit allows us to capture the impact of US financial shocks on the EME domestic banking system. Our panel consists of the United States and the baseline sample of EMEs listed in Table 1 in the main text which, as we noted at the beginning of Section 2, is dictated by the availability of uninterrupted quarterly time series for the main variables in our analysis.

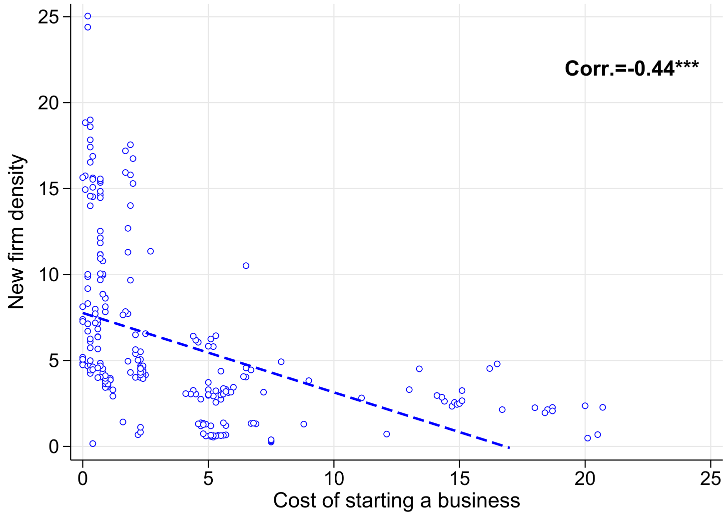

Fig. B.15. Cost of starting a business and new firm density in advanced economies. *Note:* The cost of starting a business is expressed as a share of annual income per capita. New firm density is defined as the number of new firm registrations per 1000 individuals per year. *** indicates significance at the 1 percent level.

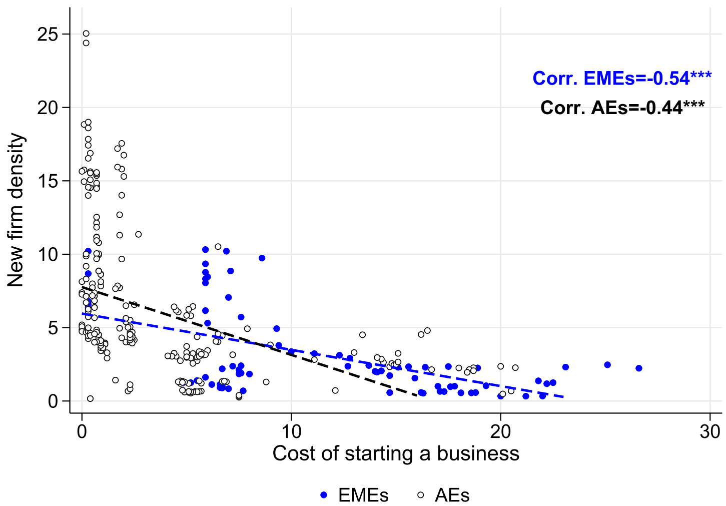

Fig. B.16. Cost of starting a business and new firm density: EMEs and AEs. *Note:* The cost of starting a business is expressed as a share of annual income per capita. New firm density is defined as the number of new firm registrations per 1000 individuals per year. *** indicates significance at the 1 percent level.

Variables, sources, and time coverage Real US commercial banks' net charge-offs on all loans and leases—our main measure of US banking-sector conditions—represent the value of loans that US commercial banks assume will not be repaid. In turn, our baseline measure of real US asset prices is the S&P 500 index (Cuadra and Nuguer, 2018). These series embody US financial conditions and US financial markets, respectively, and are available at a quarterly frequency from the St. Louis Fed FRED database. Our baseline measure of real cross-border bank flows between the United States and each EME—a central variable in our analysis that embodies the transmission channel through which US financial shocks affect EMEs via the banking system—is given by real all-maturities total cross-border liabilities of US banks on EME banks that report to the BIS Locational Banking Statistics. These flows are obtained from the Joint External Debt Hub (JEDH) database and have a balanced coverage for EMEs for the period 2007Q3-2019Q3. Real GDP (expressed in real US dollars) is constructed using data on GDP in domestic currency at constant prices from Datastream and the real effective exchange rate between each EME in our sample and the United States (expressed in terms of EME currency relative to the US dollar), which we construct using CPI and nominal exchange rates from the BIS. Finally, real bank credit to the private non-financial sector is obtained from the BIS. All real variables are logged and detrended using the Hodrick-Prescott filter with smoothing parameter 1600 to obtain their cyclical component. All told, given that the time series for cross-border bank flows begins in 2007Q3 and we adopt a balanced panel, our baseline estimation uses data from 2007Q3 to 2019Q3.

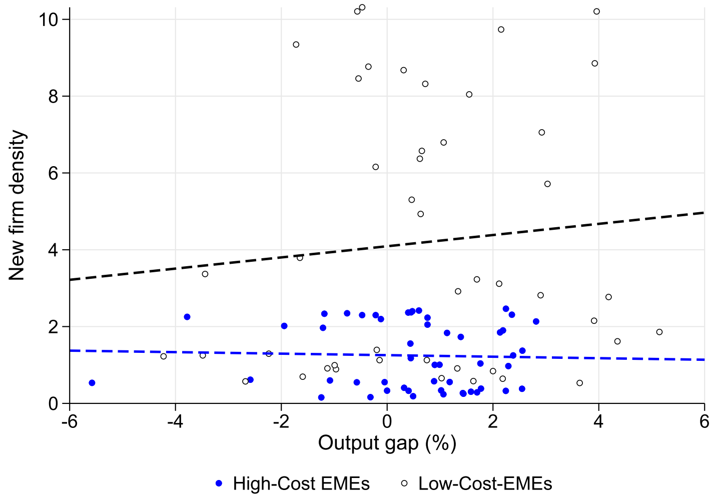

Fig. B.17. Cost of starting a business and new firm density during booms. *Note:* The cost of starting a business is expressed as a share of annual income per capita. New firm density is defined as the number of new firm registrations per 1000 individuals per year. Output gap corresponds to the Hodrick-Prescott cyclical component of real GDP.

Table B.1
New firm density during booms, emerging economies and advanced economies.

Emerging Economies		Advanced Economies	
Low cost of starting a business			
Brazil	2.24	Australia	12.89
Chile	5.42	Canada	0.16
South Africa	7.82	Denmark	8.64
Thailand	0.76	Finland	3.79
		France	4.10
		Ireland	6.36
		New Zealand	20.62
		Norway	8.09
		Sweden	6.34
		United Kingdom	12.99
Average	***4.06***		***8.40***
High cost of starting a business			
Colombia	1.92	Austria	0.62
Indonesia	0.28	Belgium	3.15
Malaysia	2.37	Germany	1.28
Mexico	0.58	Greece	1.42
Turkey	1.23	Italy	2.46
		Japan	0.21
		Luxembourg	15.62
		Netherlands	4.28
		Portugal	4.95
		Spain	3.38
		Switzerland	4.21
Average	***1.27***		***3.78***
Total Median	**1.92**		**4.21**

Note: Authors' calculations using data from the World Bank Doing Business Report (WBDB) (cost of starting a business, available annually, from 2004 to 2019) and World Bank Entrepreneurship Report (WBER) (new firm density, available annually from 2006 to 2018). The cost of starting a business is expressed as a share of annual income per capita. New firm density is defined as the number of new firm registrations per 1000 individuals per year. Per the methodologies used in the WBDB and WBER, the cost of creating a business and new firm density are comparable across countries. The categorization of countries by income group (advanced economy or EME) follows BIS classification criteria. Countries with a low (high) cost of starting a business are those below (above) their country-group (advanced economy or EME)-specific median. Booms are defined as the years in which the Hodrick-Prescott cyclical component of real GDP is positive.

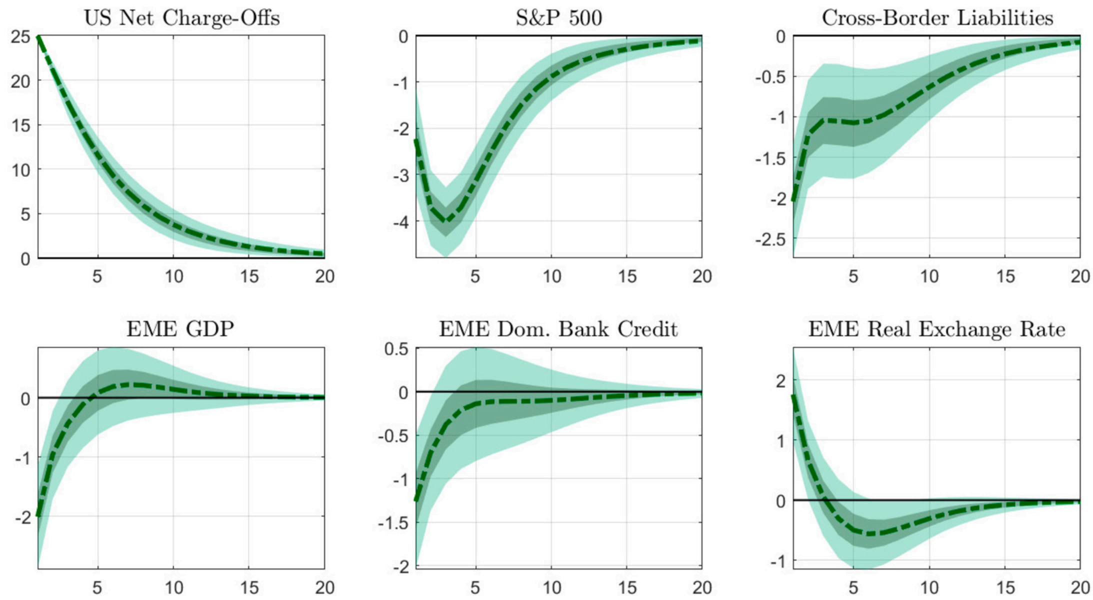

Fig. B.18. Response to an increase in US commercial banks' net charge-offs, full EME sample. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent bootstrap confidence bands are shaded in light and darker color, respectively.

Variable ordering, identification assumptions, and estimation methodology The Cholesky ordering we adopt, which is consistent with related studies, is as follows: real US bank net charge-offs, the S&P 500 index, real cross-border bank flows between the United States and each EME, EME real GDP, EME real domestic bank credit, and the EME real effective exchange rate. The identifying assumption implicit in the recursive ordering of the panel VAR implies that shocks to US bank net charge-offs have a contemporaneous impact on all other variables. Moreover, we allow EME variables to influence US variables with a lag. Of note, we find that the estimated parameters for the two US variables associated with changes in the EME variables are considerably smaller than the estimated parameters for the EME variables associated with changes in the two US variables in the VAR. This outcome is consistent with the well-known fact that EMEs have much less influence on US outcomes relative to the comparatively larger influence of the US on EME outcomes.

Following the panel VAR methodologies adopted in Akinci (2013), Epstein et al. (2019), and others, our panel VAR estimation uses a least-square-dummy variable (LSDV) estimator on pooled data. More specifically, given the number of periods and countries in each sample, we follow Goncalves and Kaffo (2015) and use a recursive-design residual-based bootstrap fixed-effects OLS estimator on pooled data for each of the two EME subgroups (high-cost and low-cost EMEs) as defined in Table 1 in the main text. As noted in Goncalves and Kaffo (2015), the recursive-design bootstrap methodology addresses the bias associated with standard fixed-effects OLS estimators and allows us to consistently estimate the distribution of the standard biased fixed-effects estimator.

Based on this methodology, we estimate two separate panel structural vector autoregressions (SVAR), one for each of the EME subgroups in Table 1 in the main text, using the following specification:

$$\mathbf{A}\mathbf{y}_{i,t} = \alpha_i + \sum_{j=1}^{p} \mathbf{B}_k \mathbf{y}_{i,t-j} + \epsilon_{i,t},$$

where i denotes the country, t is the time period, and p is the number of lags. $\mathbf{A}$ and $\mathbf{B}_k$ are coefficient matrices, α_i denote country fixed-effects, $\mathbf{y}_{i,t}$ denotes the vector of variables in the SVAR described above, and $\epsilon_{i,t}$ is the vector of orthogonal structural innovations. We estimate each SVAR with 1 lag as a baseline and note that using alternative lag orders does not change our main findings.

B.2.1. Impulse responses to US banking-sector shocks

Fig. 1 in the main text shows the orthogonalized impulse response functions to a temporary increase in real net charge-offs on all loans and leases of US banks—that is, a temporary decrease in the value of US bank assets—for the group of high-cost EMEs and low-cost EMEs as defined in Table 1 in the main text (Fig. B.18 presents results for the pooled EME sample). The shock corresponds to a 25 percent increase in US net charge-offs, which is roughly a one standard deviation of the time series. The responses of the high-cost EME group are depicted by the solid-blue line and the responses of the low-cost EME group are depicted by the dashed-red line.

The shock is for all intents and purposes identical in the two EME groups. The (lagged) feedback effects from EMEs to the United States in both EME-group VAR specifications are associated with small but ultimately insignificant differences in the post-shock evolution of US net charge-offs in the two groups, even if the increase in net charge-offs on impact is identical. Second, the response of US asset prices is also virtually the same in the two estimations. Critically, though, cross-border liabilities in low-cost EMEs contract by less and recover much earlier compared to those of high-cost EMEs. Moreover, while the contraction in EME GDP and domestic bank credit in the short term is similar in the two subgroups, the medium-term recovery in GDP and bank credit occurs much earlier in low-cost EMEs, with both variables in this EME subgroup overshooting their pre-shock level 4 quarters after the shock, after which they converge back to trend. Finally, we note that the impact depreciation in the real exchange rate is identical in the two subgroups. However, similar to GDP and bank credit, the real exchange rate overshoots its pre-shock level in low-cost EMEs before returning to trend. All told, we conclude that in response to an adverse financial shock that originates in the US banking system, low-cost EMEs exhibit smaller overall contractions in EME cross-border liabilities as well as earlier medium-term recoveries in cross-border bank flows, GDP, and domestic bank credit compared to high-cost EMEs.

Differential responses of high-cost and low-cost EMEs To provide a clearer graphical summary of the differential responses of low-cost and high-cost EMEs to the same US banking-sector shock, Fig. 2 in the main text plots the differences in the impulse responses between the two EME subgroups for each variable in the VAR system. Following the approach in Born et al. (2013), Fig. 2 includes an indicator of statistical differences in the responses of the two EME subgroups using bootstrap methods. Specifically, the blue bars in Fig. 2 display the estimated differences between the low-cost EMEs and the high-cost EMEs for a 10-quarter post-shock time horizon for each variable, with the dashed-red lines reporting the differences corresponding to the 68 percent confidence bounds computed by bootstrap sampling using 10,000 repetitions.

B.2.2. Summary of robustness analysis

To confirm the robustness of our main findings, we perform the same analysis above using: (1) real private consumption instead of real GDP as an alternative measure of economic activity; (2) EME subgroups based on their average share of firms with bank credit as opposed to their average firm-creation costs (this allows us to assess whether domestic financial participation *itself* is associated with differential responses); (3) alternative measures of cross-border bank flows between United States and EME banks; and (4) two alternative modeling assumptions (first, assuming US variables as an exogenous block, thereby shutting down the feedback effects from EMEs back to the US, and second, a small-open-economy (SOE) structure for EMEs, thereby eliminating any spillover effects from US asset prices into EME variables and focusing solely on how US bank net charge-offs affect EME cross-border liabilities).

This Appendix presents results for these alternative specifications. Using EME real consumption delivers similar results to those in Fig. 1 (see Figs. B.30 and B.31 in Appendix B.2.6). Grouping EMEs based on the share of firms participating in the domestic banking system instead of average firm-creation costs suggests that lower barriers to firm entry themselves (and their implications for the number of firms in the economy) may play a more relevant role in contributing to greater EME resiliency against shocks (see Fig. B.32 in Appendix B.2.7). This result lends credence to our focus on firm-creation costs and firm entry as opposed to firm financial participation in the theoretical framework in Section 3. Turning to alternative measures of cross-border bank flows, recall that our baseline specification uses US bank total cross-border liabilities (all instruments) to EME banks as our main measure of cross-border bank flows. This measure provides the closest mapping between the data and our theoretical model. Appendix B.2.8 presents results using the following alternative measures of cross-border flows (all obtained from the BIS): foreign claims of US banks with immediate EME counterparties, including banks and non-banks (see Fig. B.33 for our baseline time span and Fig. B.34 for a longer time span covering 2000Q1-2019Q3); US bank cross-border loans to BIS reporting banks (Fig. B.35); and the sum of US bank cross-border loans to banks and non-banks (Fig. B.36). Using these alternative measures of cross-border bank flows delivers the same overall conclusions as our baseline analysis. Finally, recall that our baseline VAR specification allows feedback effects from the response of EMEs back to the response of US variables, and abstracts from including domestic interest rates. Assuming that (a) US variables as an exogenous block, that (b) a SOE structure for EMEs, or that (c) domestic interest rates are part of the EME block does not change our main conclusions (see Figs. B.37 and B.38, and Figs. B.42, B.43, B.44, B.39, B.40, B.41). A similar claim applies to changing the order of EME bank credit in the VAR (see Figs. B.45–B.50).

B.2.3. Baseline estimation for full EME sample

Fig. B.18 shows the orthogonalized impulse response functions to an increase in real net charge-offs on all loans and leases of US banks, which reflects a decrease in the value of bank assets in the US, using the full EME sample. The shock generates a reduction in the S&P 500 index, a decrease in EME cross-border liabilities, a contraction in EME real GDP and EME real domestic bank credit, and a depreciation of the real exchange rate.

B.2.4. Estimation by country

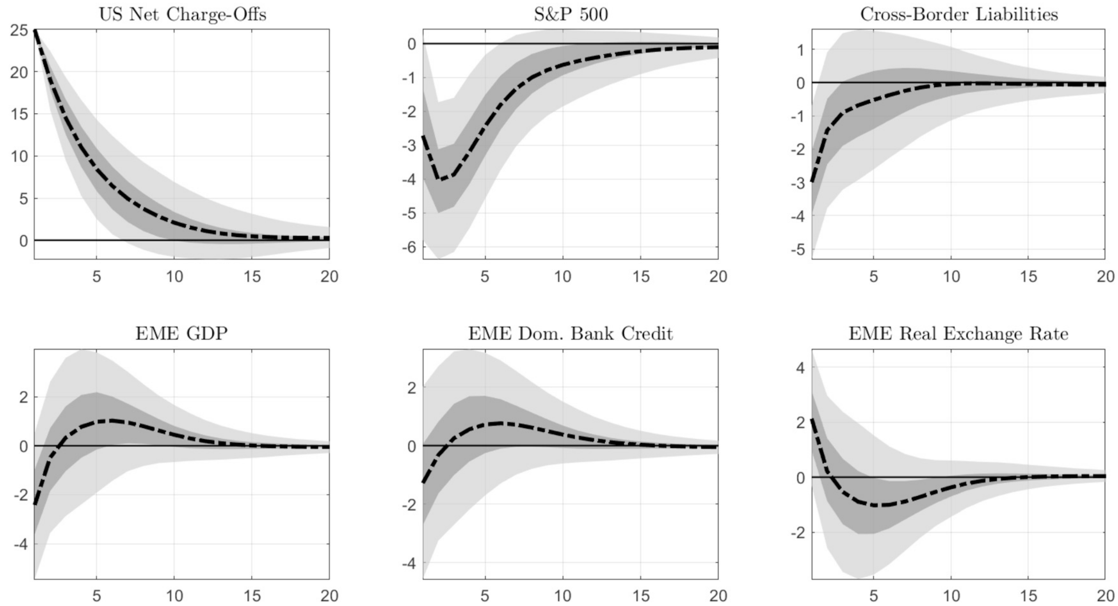

Fig. B.19. Response to an increase in US commercial banks' net charge-offs: Brazil. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the country are shown in light and darker gray, respectively.

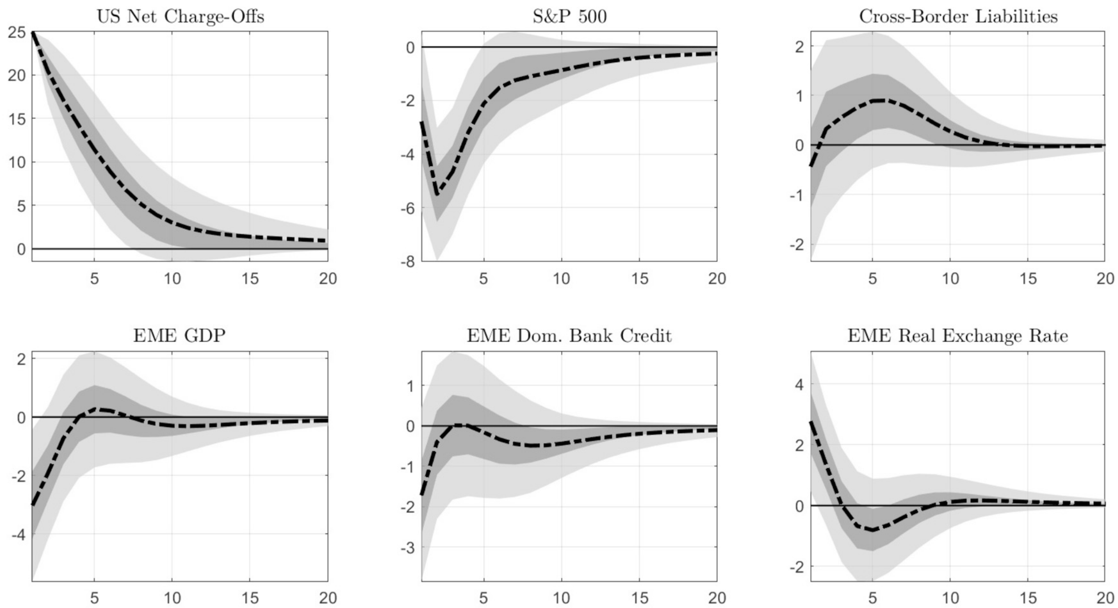

Fig. B.20. Response to an increase in US commercial banks' net charge-offs: Chile. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the country are shown in light and darker gray, respectively.

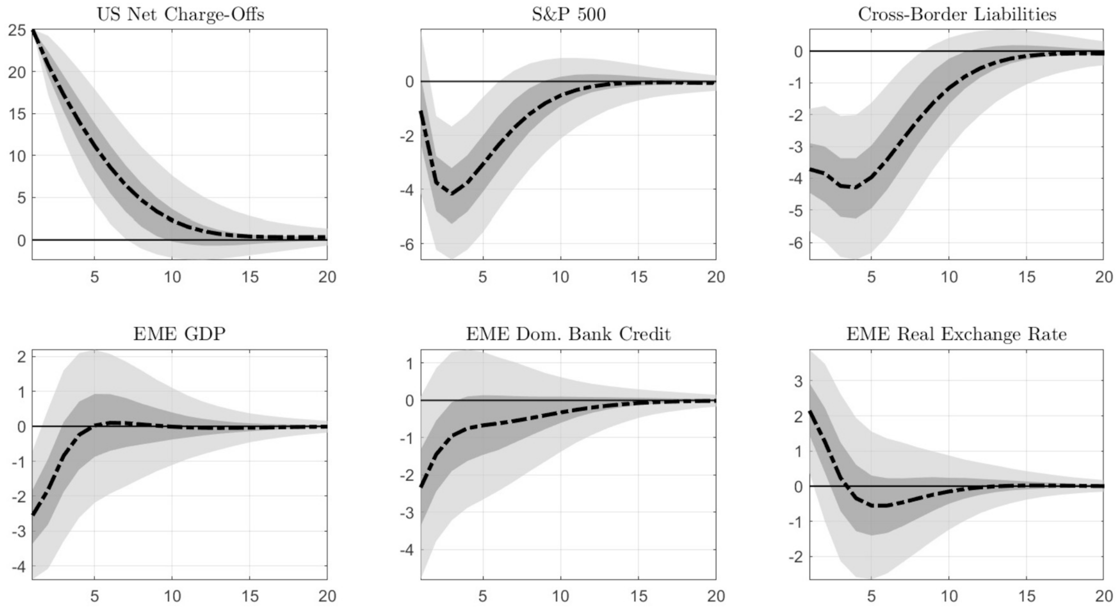

Fig. B.21. Response to an increase in US commercial banks' net charge-offs: Colombia. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the country are shown in light and darker gray, respectively.

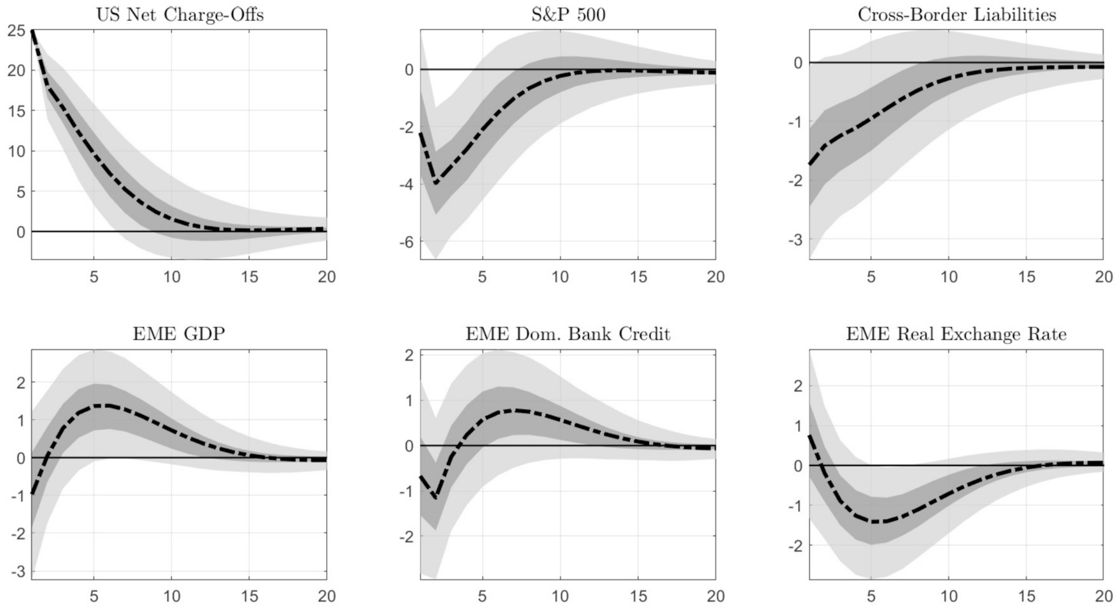

Fig. B.22. Response to an increase in US commercial banks' net charge-offs: Indonesia. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the country are shown in light and darker gray, respectively.

B.2.5. EME sample with Argentina

Fig. B.28, B.29 shows the orthogonalized impulse response functions to an adverse shock to real net charge-offs on all loans and leases of US banks—or US commercial banks' net charge-offs—for an expanded group of EMEs that includes Argentina using the same VAR specification described in the main text for the period 2007Q3-2019Q1.

B.2.6. Replacing real GDP with real private consumption

Our baseline specification uses real GDP as our summary measure of aggregate economic activity. Fig. B.30 shows that replacing real GDP with real private consumption does not change our main conclusions.

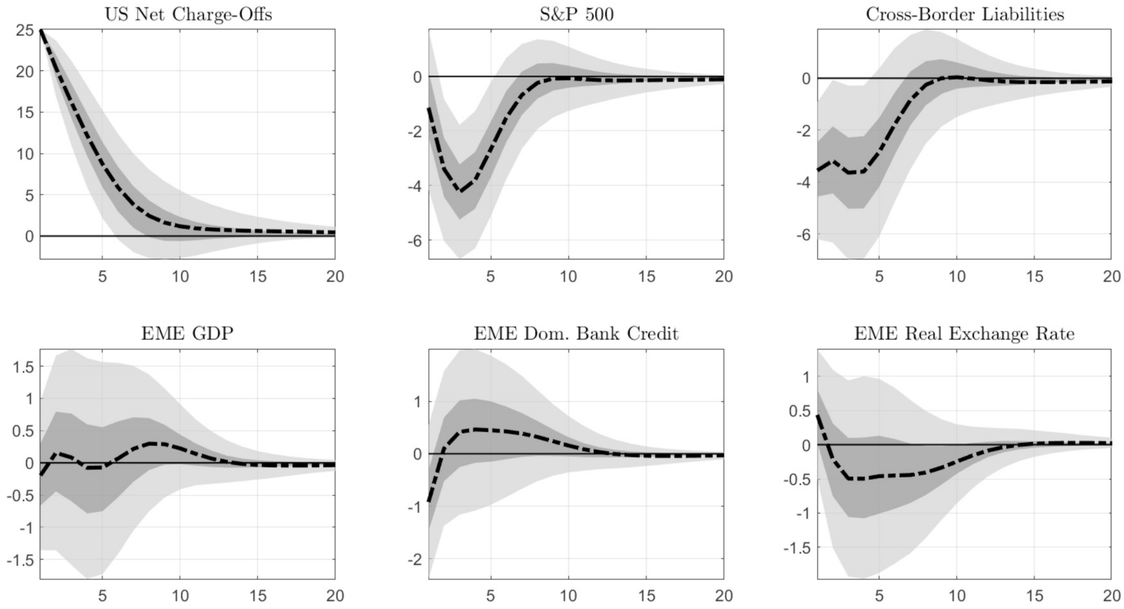

Fig. B.23. Response to an increase in US commercial banks' net charge-offs: Malaysia. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the country are shown in light and darker gray, respectively.

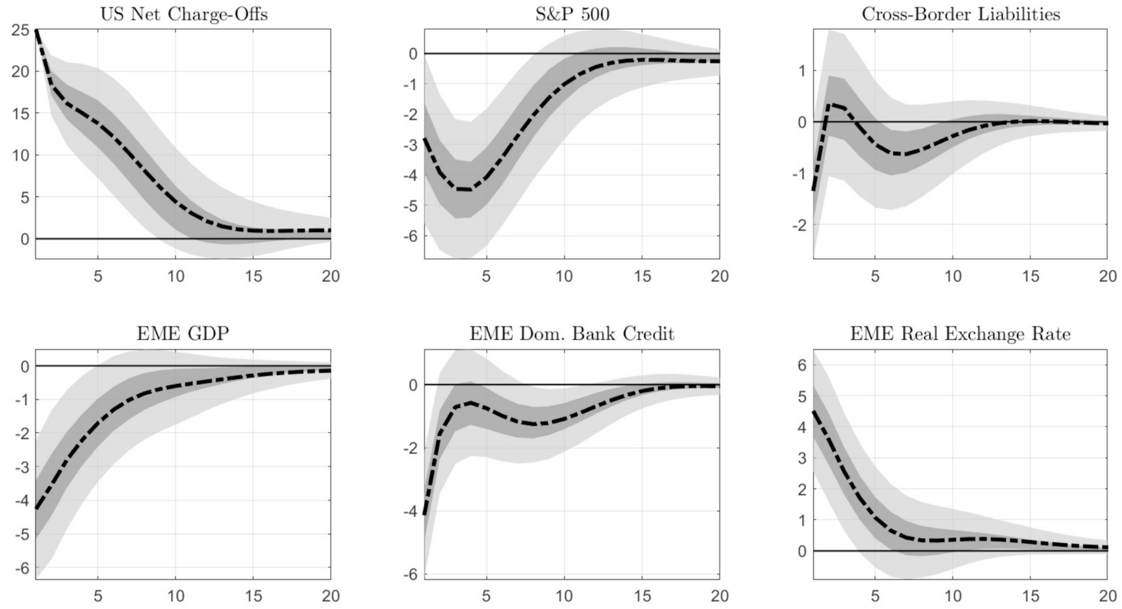

Fig. B.24. Response to an increase in US commercial banks' net charge-offs: Mexico. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the country are shown in light and darker gray, respectively.

For completeness and following the approach in Born et al. (2013), Fig. B.31 presents the counterpart of Fig. 2 in the main text, where once again blue bars display the estimated difference between low-firm-creation-cost and high-firm-creation-cost EMEs for a 10-quarter horizon and the dashed-red line reports the difference corresponding to 68% confidence bounds.

B.2.7. Share of EME firms with bank credit

Our analysis focuses on differences in EMEs that trace back to the (regulatory) costs of firm creation. Fig. B.32 presents results for our baseline VAR specification where, instead of separating EMEs based on their firm-creation costs, we separate them based on whether they have high or low average shares of firms with bank credit (relative to the mean share of firms with bank credit in

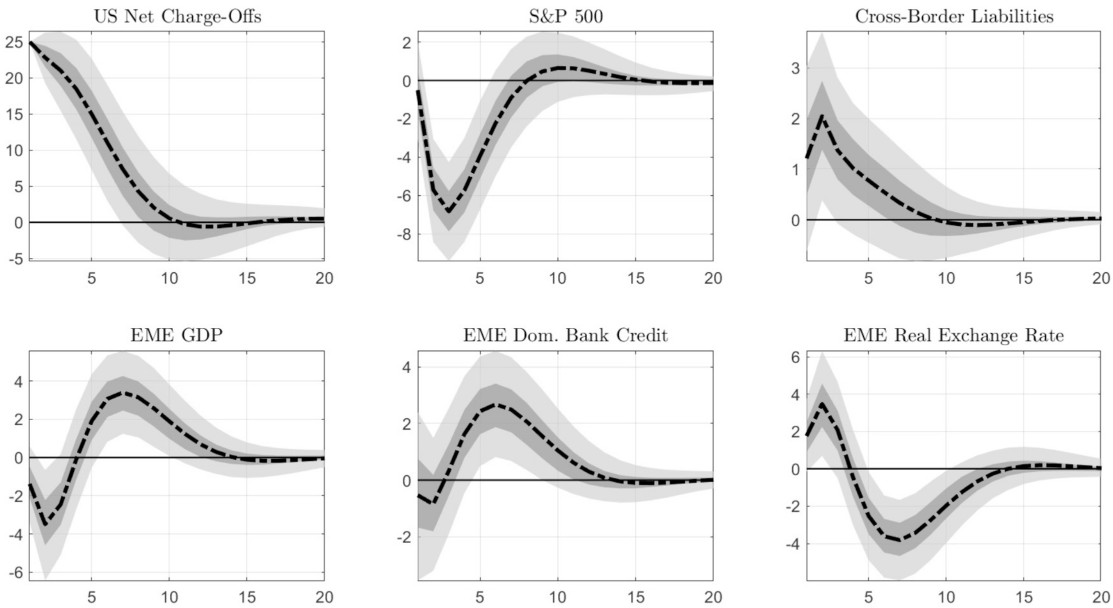

Fig. B.25. Response to an increase in US commercial banks' net charge-offs: South Africa. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the country are shown in light and darker gray, respectively.

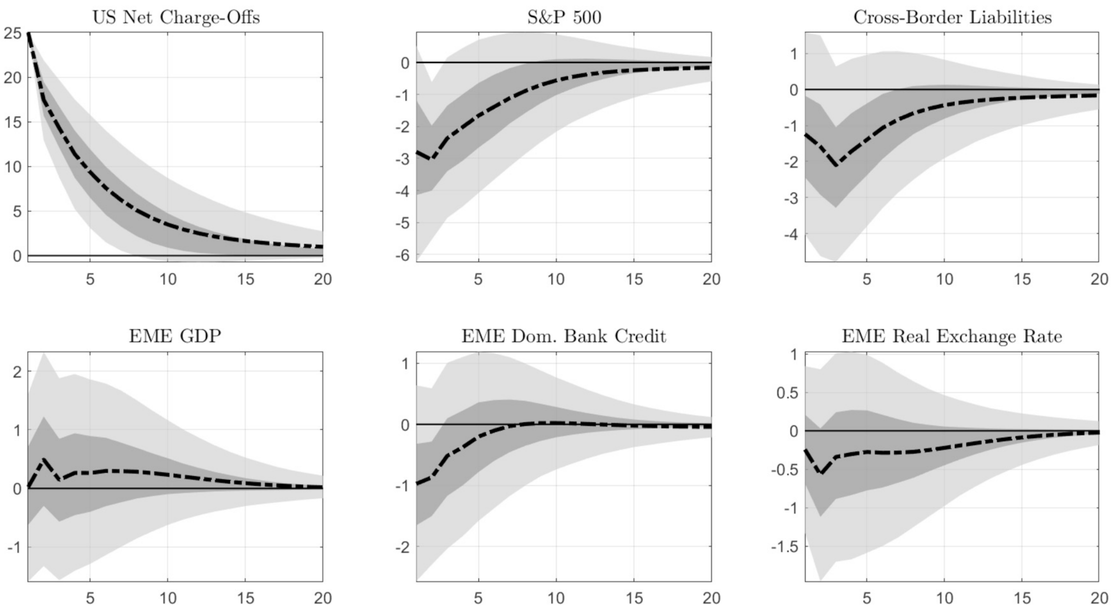

Fig. B.26. Response to an increase in US commercial banks' net charge-offs: Thailand. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the country are shown in light and darker gray, respectively.

the complete EME sample). The figure suggests that differences in the shares of firms with bank credit alone do not seem to play a central role in the transmission of shocks to US bank net charge-offs.

B.2.8. Alternative definitions of cross-border banking flows

The baseline VAR described in the main text uses US bank total cross-border liabilities (all instruments) to EME banks that report to the BIS Locational Banking Statistics as our main measure of cross-border banking flows. This variable has a clear counterpart in the quantitative framework we use to shed light on the economic mechanisms behind the VAR evidence we present. For completeness, we conduct the same VAR analysis using alternative measures of cross-border banking flows. First, we use foreign claims of US banks with immediate EME counterparties, including banks and non-banks as an alternative measure considering our baseline time span and

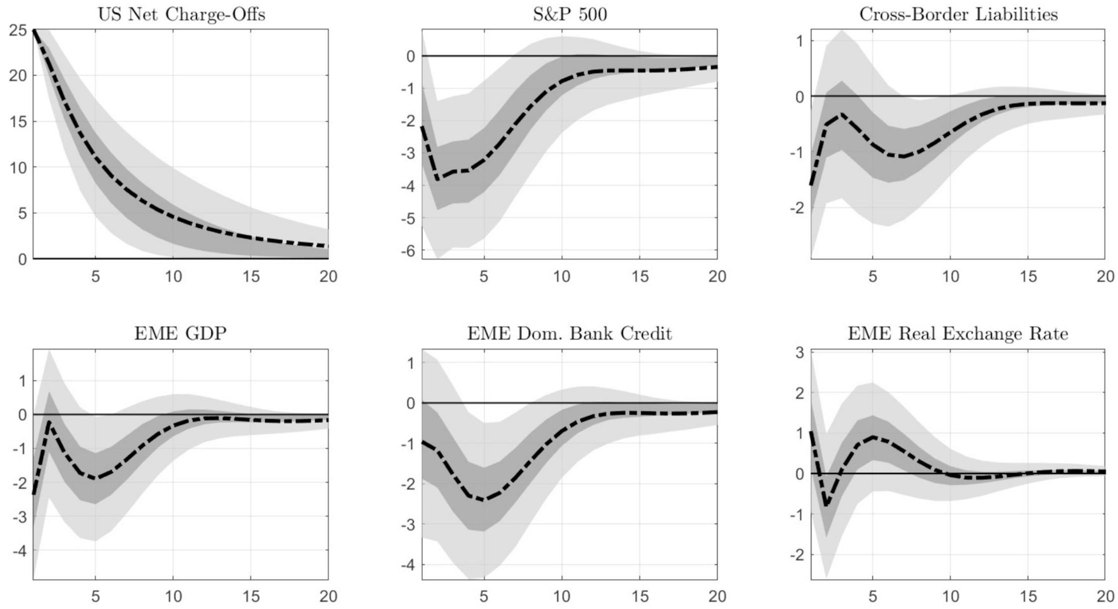

Fig. B.27. Response to an increase in US commercial banks' net charge-offs: Turkey. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the country are shown in light and darker gray, respectively.

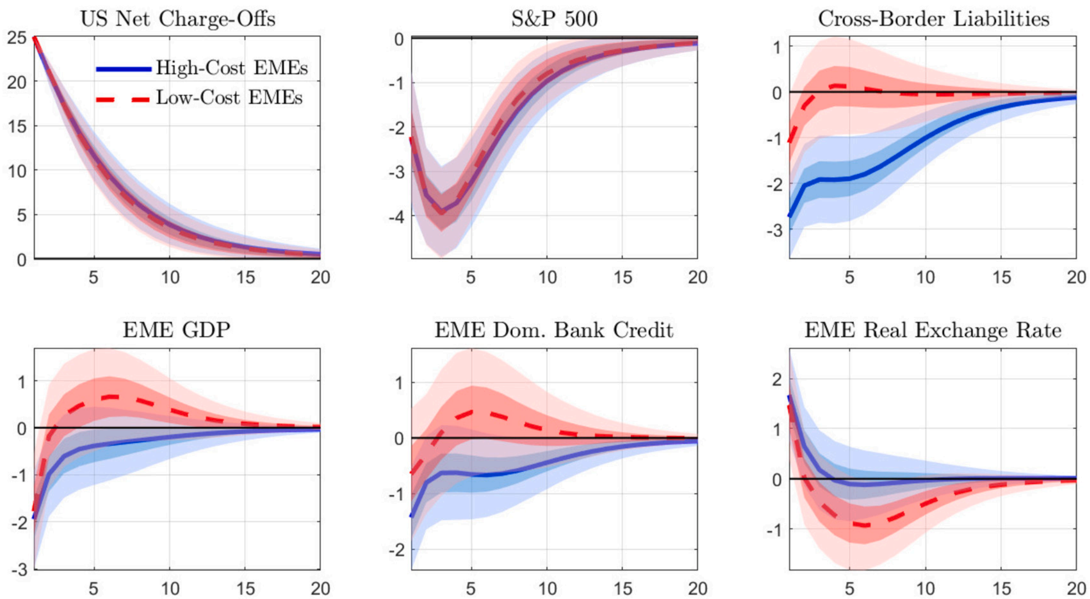

Fig. B.28. Response to an increase in US commercial banks' net charge-offs in high-firm-creation-cost and low-creation-cost EMEs with Argentina in sample. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent bootstrap confidence bands are shaded in light and darker color, respectively.

the 2000Q1-2019Q3 period (see Figs. B.33 and B.34, respectively). Second, we consider US bank cross-border loans to BIS reporting banks and the sum of US bank cross-border loans to banks and non-banks (see Figs. B.35 and B.36) as alternative measures. These variables are obtained from the BIS reporting statistics. While these variables do capture a notion of cross-border banking flows, they have a more inaccurate mapping with cross-border banking flows in our model compared to US bank total cross-border liabilities (all instruments) to EME banks. However, we note that Figs. B.33, B.34, B.35, B.36 confirm that, even if we adopt alternative measures of cross-border banking flows, our main empirical findings remain unchanged.

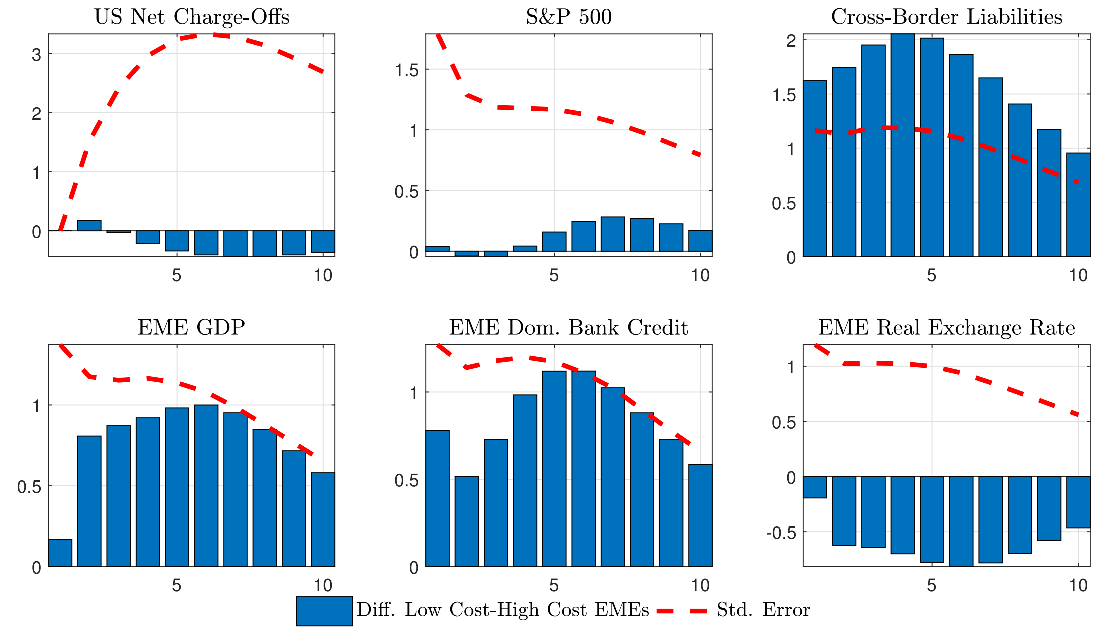

Fig. B.29. Difference in responses to an increase in US commercial banks' net charge-offs between low-firm-creation-cost EMEs and high-firm-creation-cost EMEs, EME sample with Argentina. *Note:* The vertical axis shows the percentage-point difference between the bootstrapped impulse responses of low-cost EMEs and those of high-cost EMEs to an increase in US bank net charge-offs for each corresponding variable. The horizontal axis shows the number of quarters after the shock. The dashed red line corresponds to the standard error for each period (computed by bootstrap sampling using 10,000 repetitions).

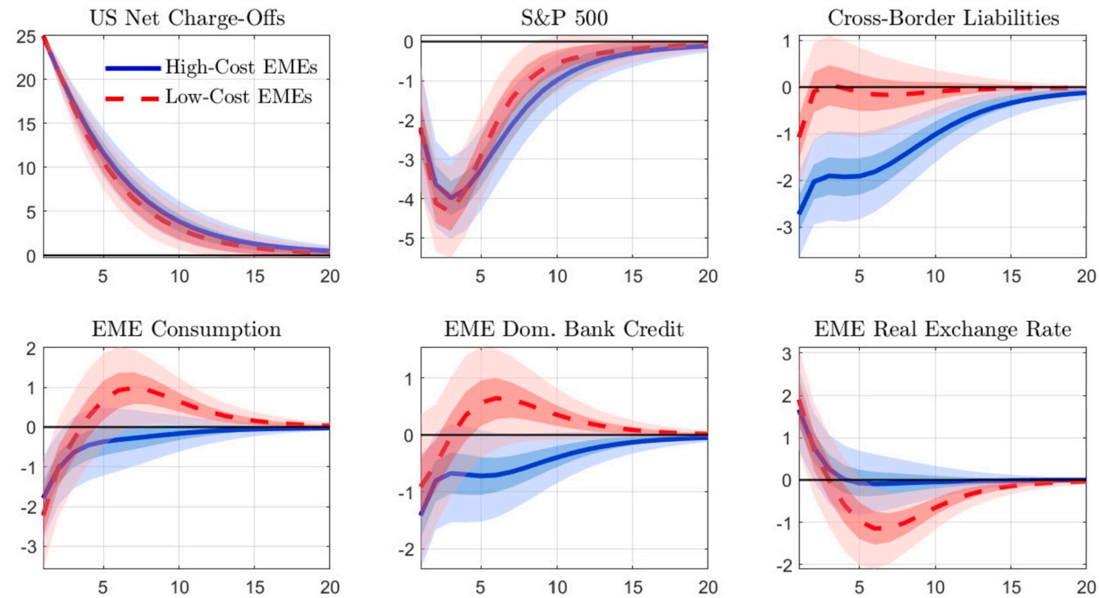

Fig. B.30. Response to an increase in US commercial banks' net charge-offs in high-firm-creation-cost and low-firm-creation-cost EMEs, replacing real GDP with real consumption. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

B.2.9. Alternative VAR assumptions: exogenous block and small open economy

Our baseline VAR specification allows for feedback effects between EMEs and the United States (essentially, a 2-country model structure where EMEs represent one country and the United States another country). As noted in the main text, the coefficients that capture the feedback effects from EMEs back to the US are very close to zero. For completeness, Fig. B.37 presents results for a version of our baseline VAR specification where we shut down the feedback effects from the EMEs back to the US while still allowing for feedback effects *between* US variables. In turn, Fig. B.38 presents results for a version of our baseline VAR specification assuming

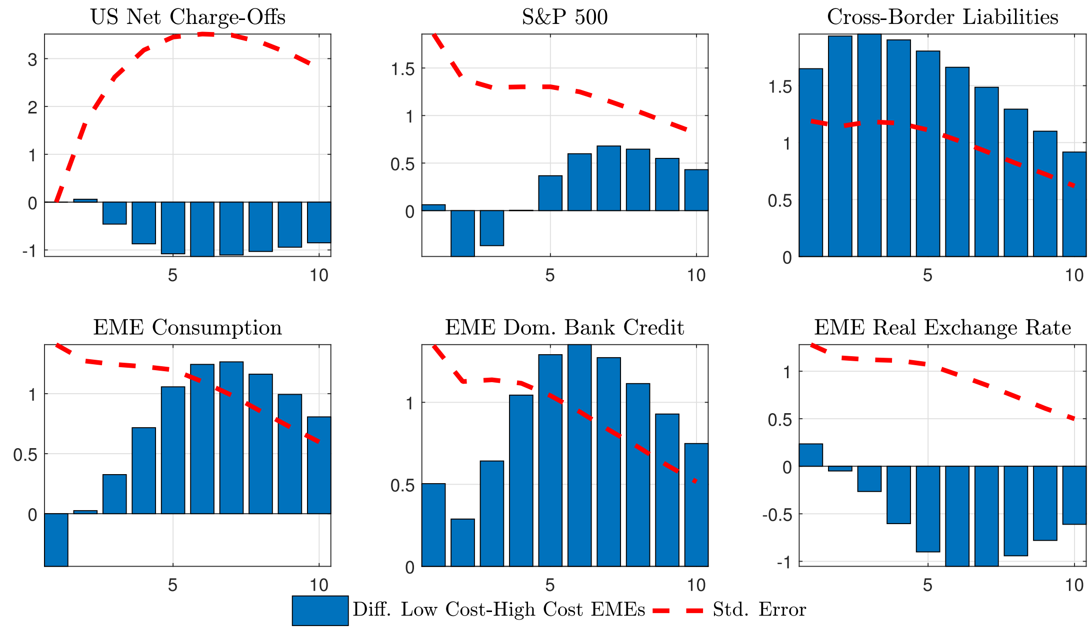

Fig. B.31. Difference in responses to an increase in US commercial banks' net charge-offs between low-firm-creation-cost EMEs and high-firm-creation-cost EMEs. *Note:* The vertical axis shows the percentage-point difference between the bootstrapped impulse responses of low-cost EMEs and those of high-cost EMEs to an increase in US bank net charge-offs for each corresponding variable. The horizontal axis shows the number of quarters after the shock. The dashed red line corresponds to the standard error for each period (computed by bootstrap sampling using 10,000 repetitions).

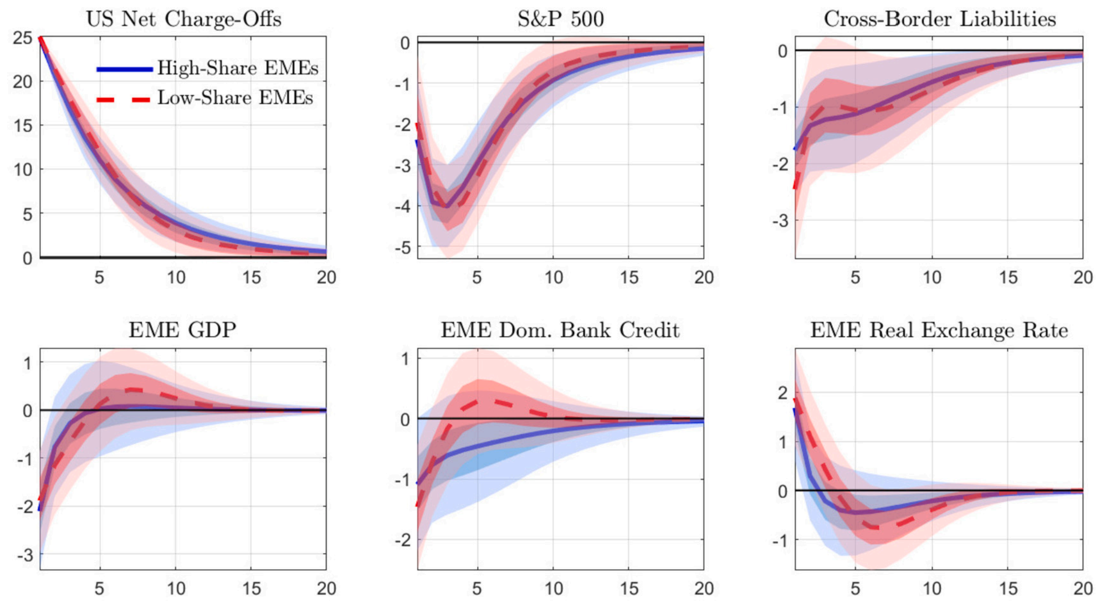

Fig. B.32. Response to an increase in US commercial banks' net charge-offs in EMEs, EME groups based on high and low shares of firms with bank credit. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

a small-open-economy setup for EMEs. In particular, this assumption implies that EMEs are only affected by the shocks to US bank net charge-offs via cross-border liabilities without spillover effects from the S&P 500, suggesting that the transmission channel of the shock originating in the United States is indeed via cross-border banking flows.

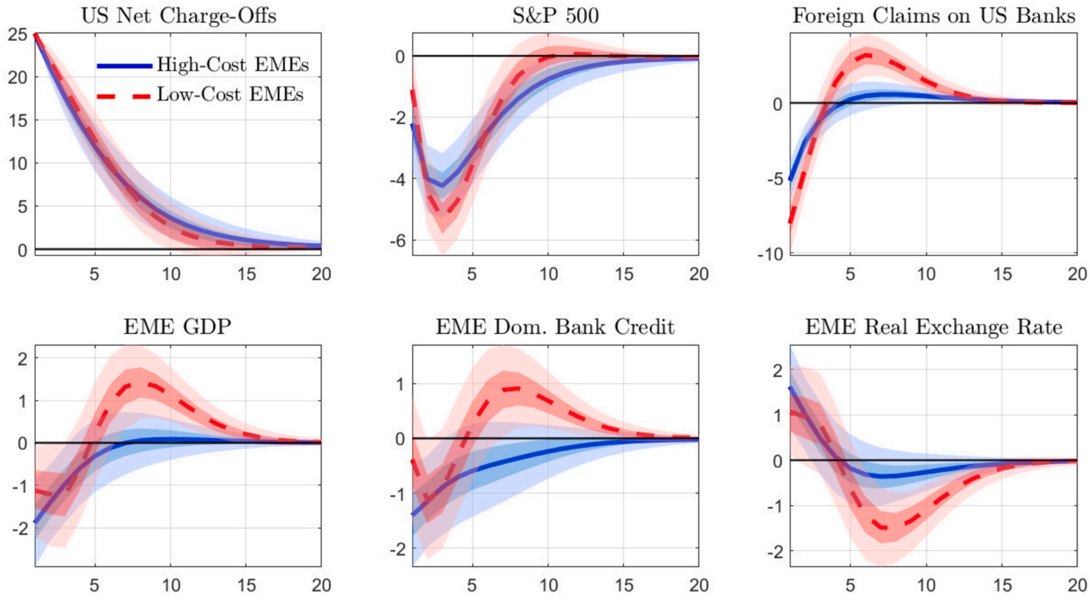

Fig. B.33. Response to an increase in US commercial banks' net charge-offs in high-firm-creation-cost and low-firm-creation-cost EMEs using foreign claims of US banks to EMEs: 2007Q3-2019Q3. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

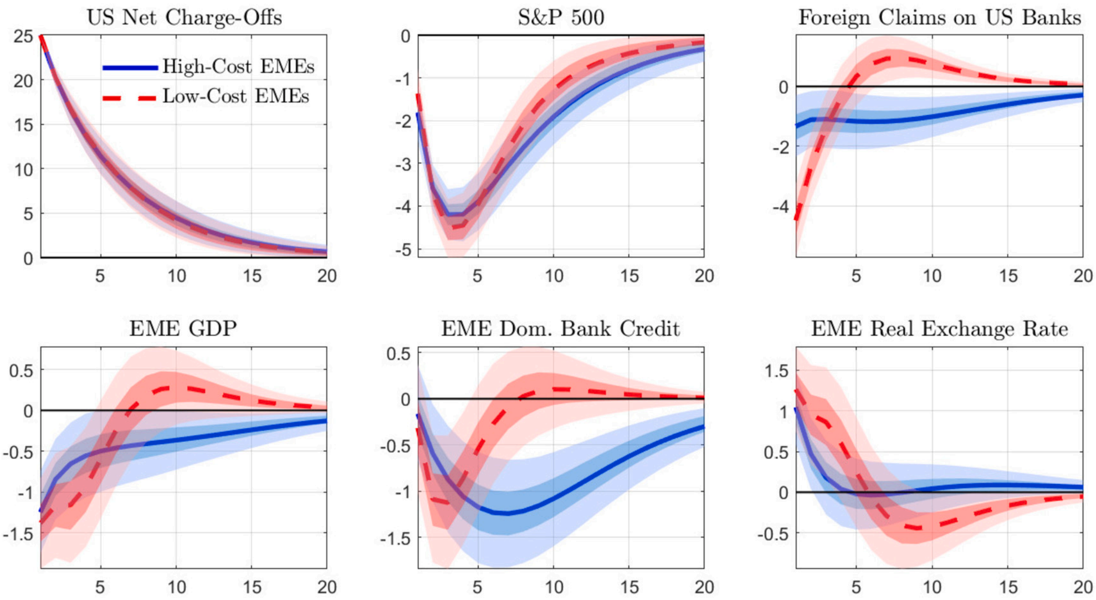

Fig. B.34. Response to an increase in US commercial banks' net charge-offs in high-firm-creation-cost and low-firm-creation-cost EMEs using foreign claims of US banks to EMEs: 2000Q1-2019Q3. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

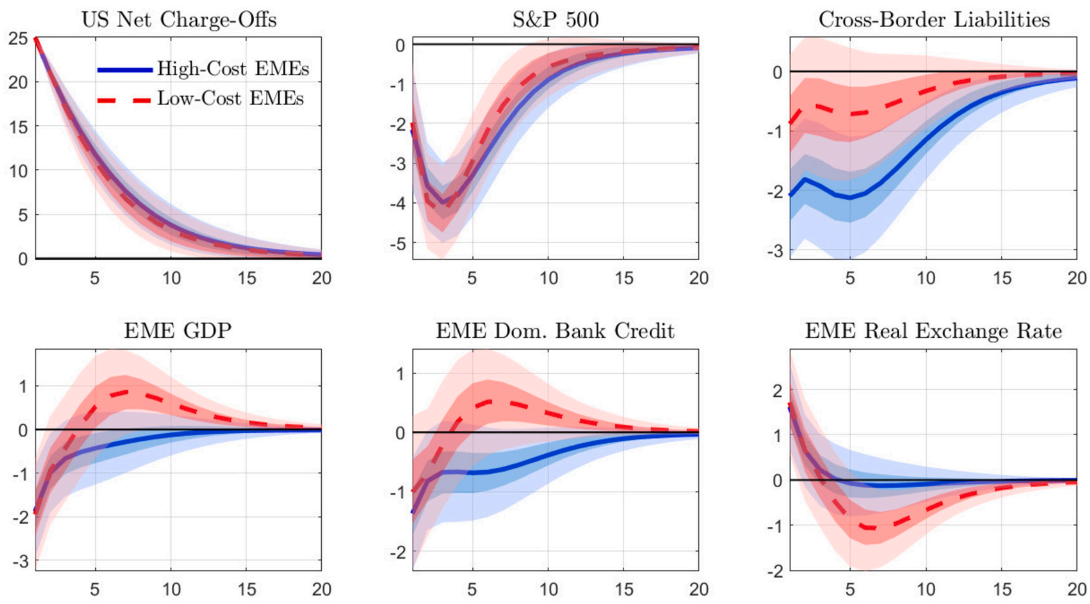

Fig. B.35. Response to an increase in US commercial banks' net charge-offs in high-firm-creation-cost and low-firm-creation-cost EMEs using cross-border Loans from US banks to EME banks. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

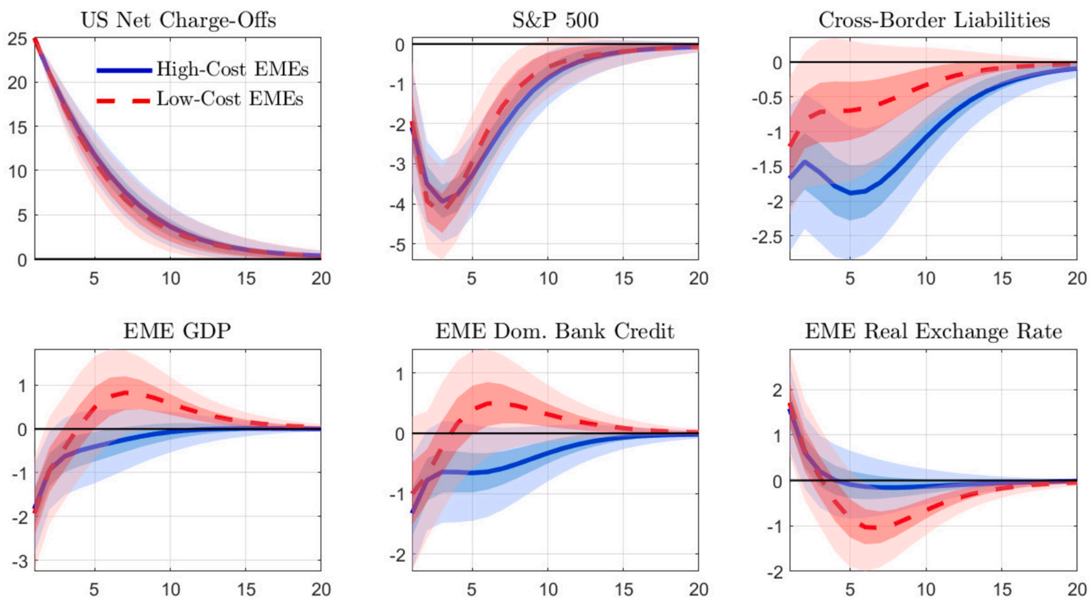

Fig. B.36. Response to an increase in US commercial banks' net charge-offs in high-firm-creation-cost and low-firm-creation-cost EMEs using the sum of cross-border loans from US banks to EME banks and non-banks. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

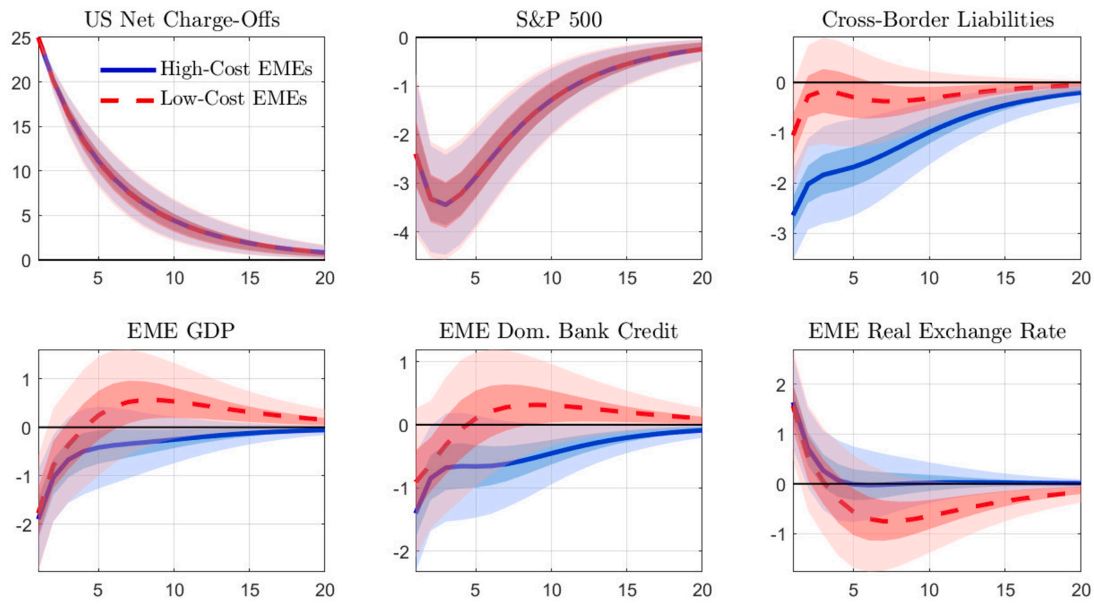

Fig. B.37. Response to an increase in US commercial banks' net charge-offs in high-firm-creation-cost and low-firm-creation-cost EMEs, two-country assumption with exogenous block. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

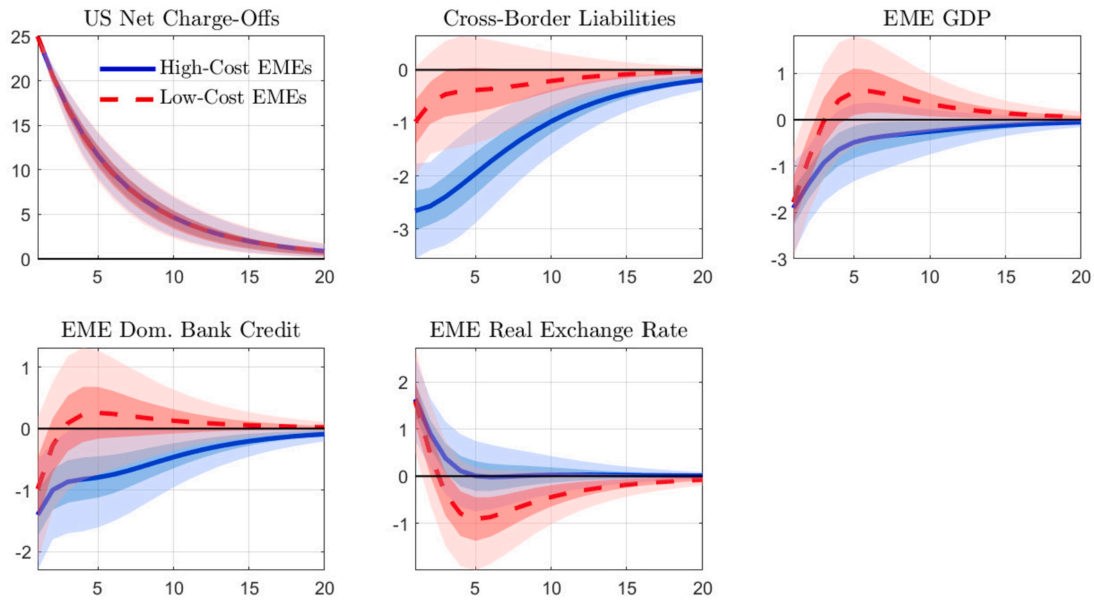

Fig. B.38. Response to an increase in US commercial banks' net charge-offs in high-firm-creation-cost and low-firm-creation-cost EMEs, small-open-economy assumption for EMEs. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

B.2.10. VAR with ex-post and ex-ante domestic interest rates

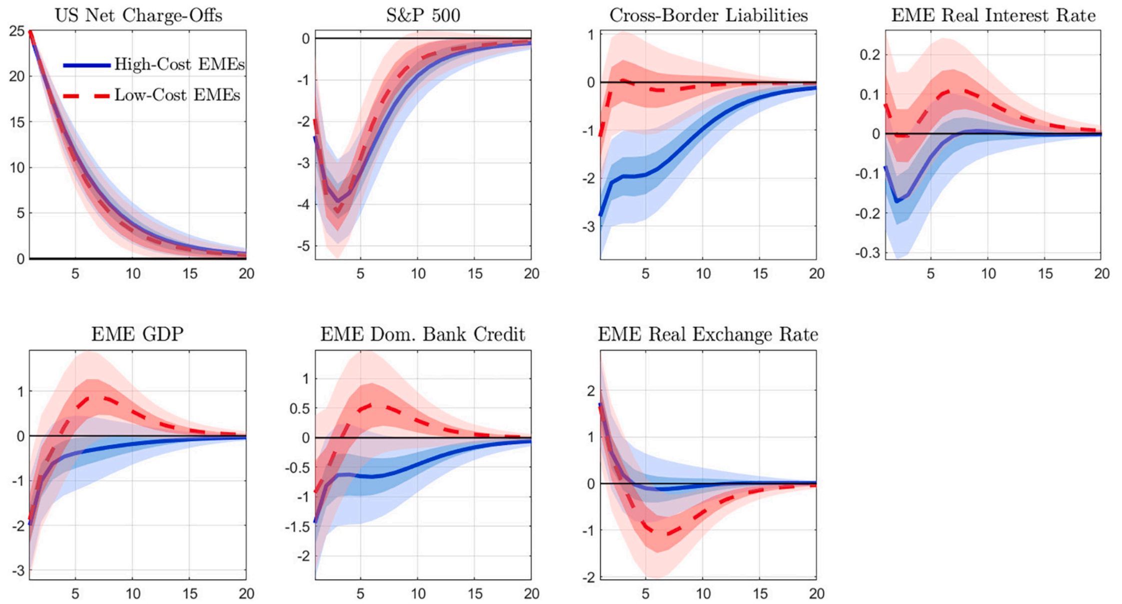

Fig. B.39. Response to an increase in US commercial banks' net charge-offs: high-firm-creation-cost and low-firm-creation-cost EMEs, specification 1 with EME ex-post real interest rates. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

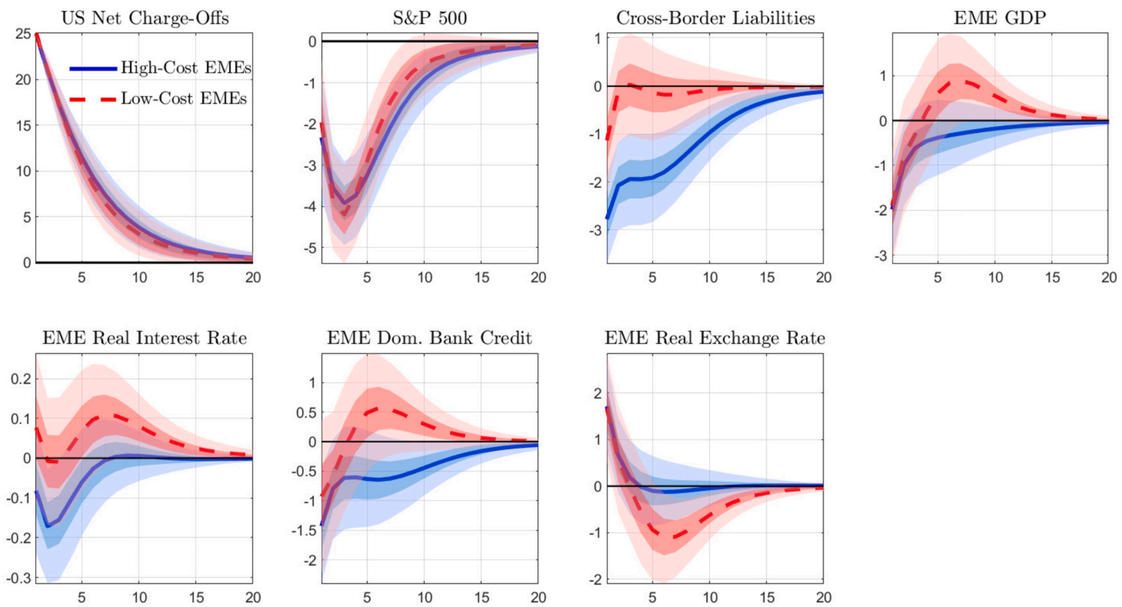

Fig. B.40. Response to an increase in US commercial banks' net charge-offs: high-firm-creation-cost and low-firm-creation-cost EMEs, specification 2 with EME ex-post real interest rates. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

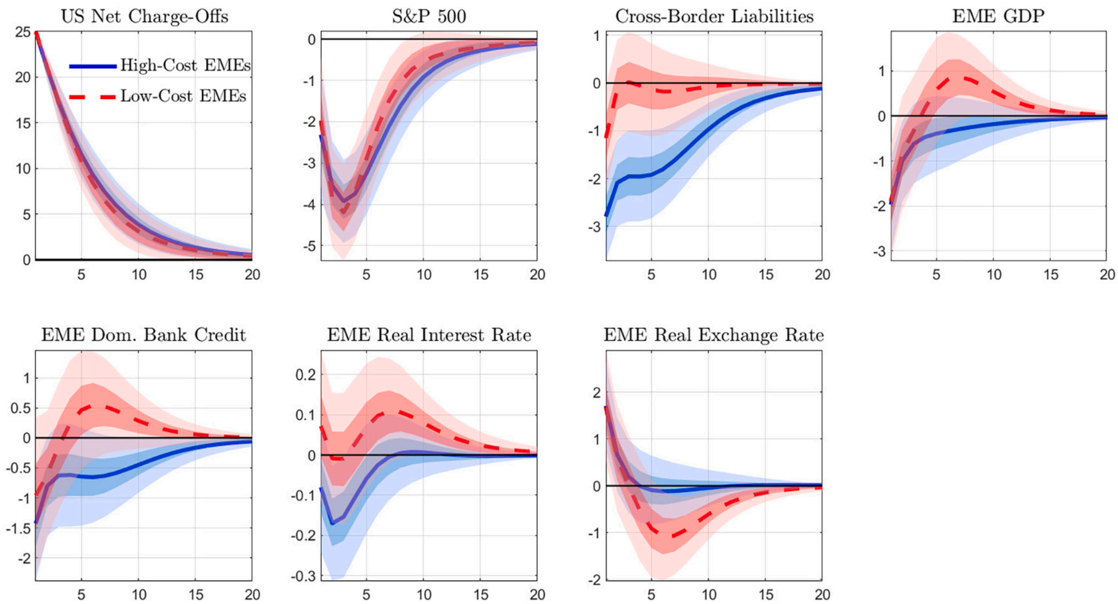

Fig. B.41. Response to an increase in US commercial banks' net charge-offs: high-firm-creation-cost and low-firm-creation-cost EMEs, specification 3 with EME ex-post real interest rates. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

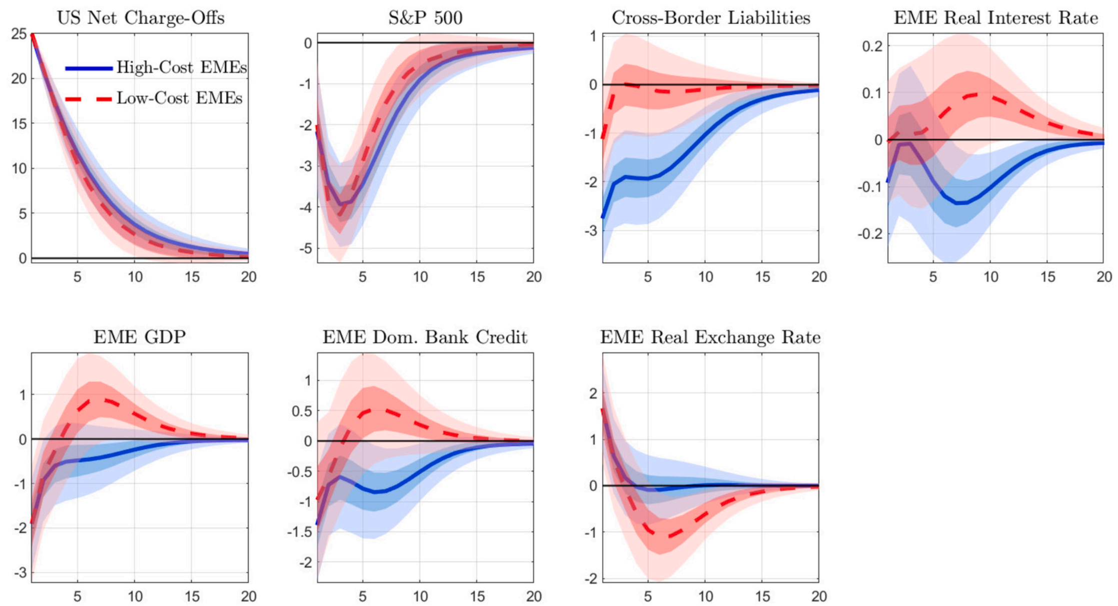

Fig. B.42. Response to an increase in US commercial banks' net charge-offs: high-firm-creation-cost and low-firm-creation-cost EMEs, specification 1 with EME ex-ante real interest rates. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

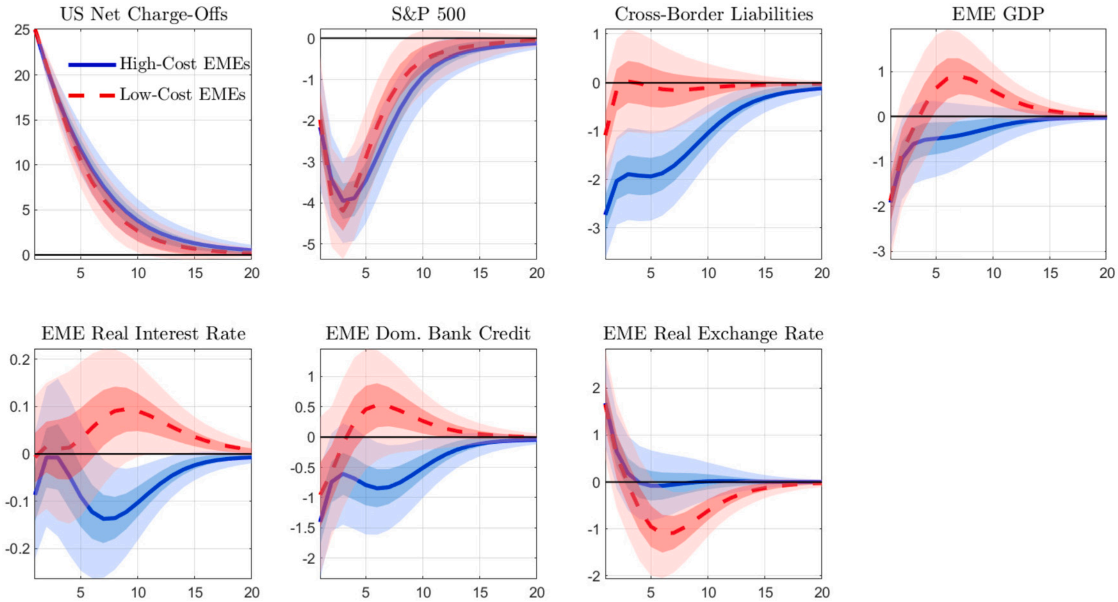

Fig. B.43. Response to an increase in US commercial banks' net charge-offs: high-firm-creation-cost and low-firm-creation-cost EMEs, specification 2 with EME ex-ante real interest rates. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

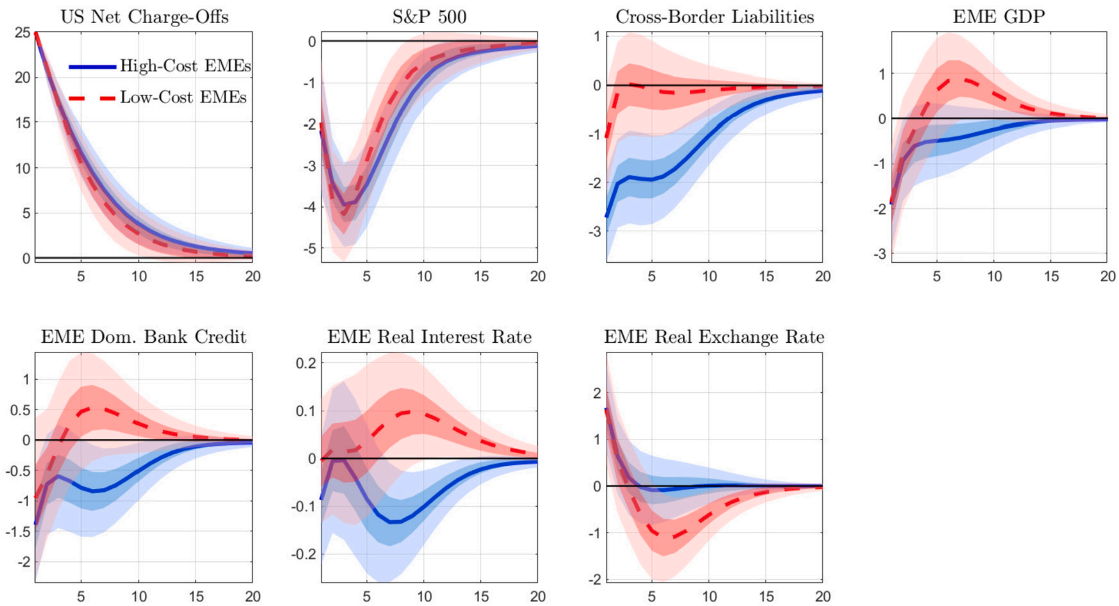

Fig. B.44. Response to an increase in US commercial banks' net charge-offs: high-firm-creation-cost and low-firm-creation-cost EMEs, specification 3 with EME ex-ante real interest rates. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

B.2.11. VAR with alternative ordering of financial variables

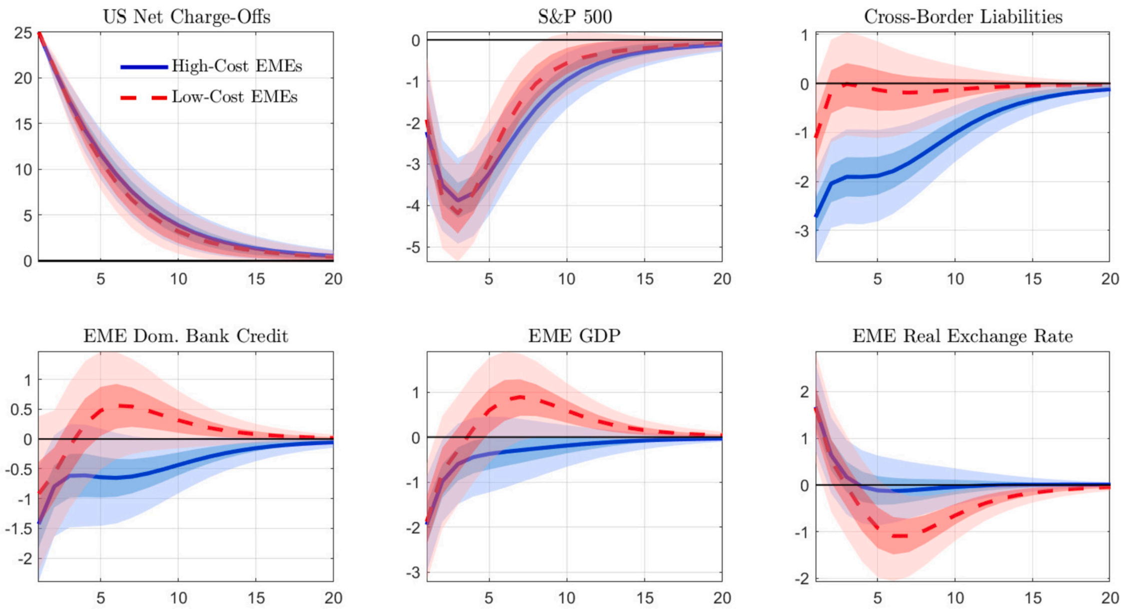

Fig. B.45. Response to an increase in US commercial banks' net charge-offs: high-firm-creation-cost and low-firm-creation-cost EMEs, domestic credit before GDP. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

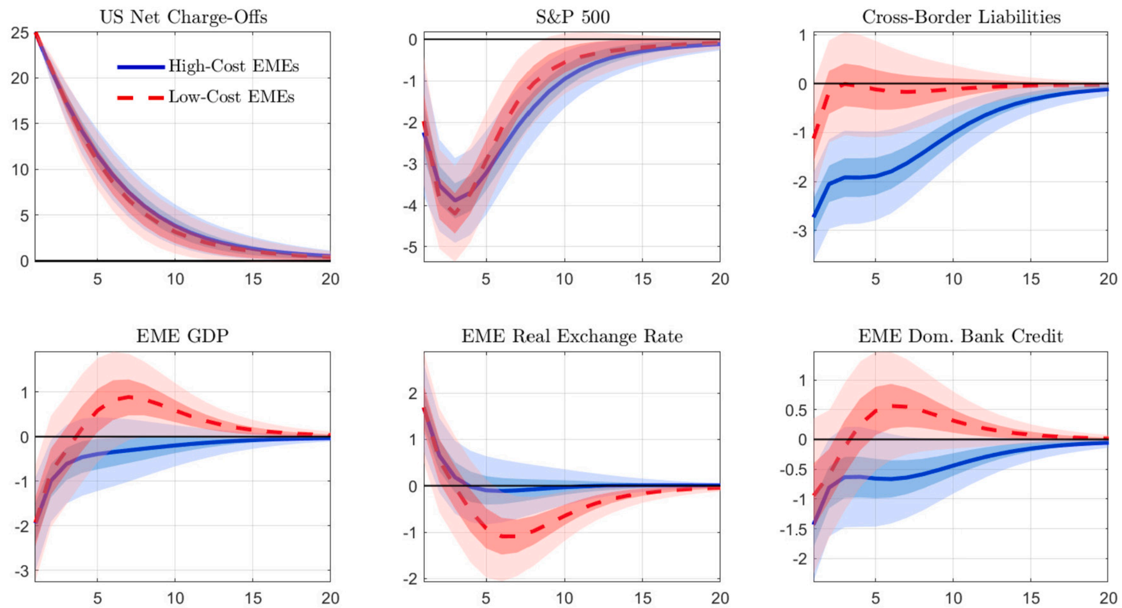

Fig. B.46. Response to an increase in US commercial banks' net charge-offs: high-firm-creation-cost and low-firm-creation-cost EMEs, domestic credit after real exchange rate. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

B.2.12. EME division based on average share of investment financed with trade credit

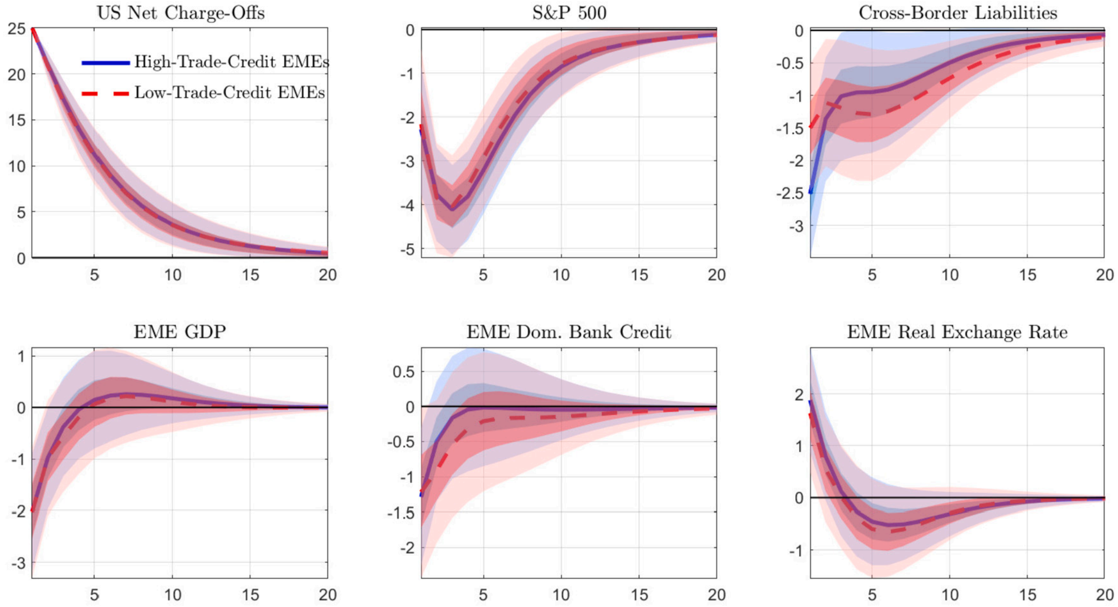

Fig. B.47. Response to an increase in US commercial banks' net charge-offs: high-trade-credit and low-trade-credit EMEs. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-trade-credit EMEs are shown in light and darker blue, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-trade-credit EMEs are shown in light and darker red, respectively. "High-Trade-Credit EMES" includes Brazil, Chile, Indonesia, Malaysia, and Mexico. "Low-Trade-Credit EMEs" includes Colombia, South Africa, Thailand, and Turkey.

B.2.13. EME division based on political stability index

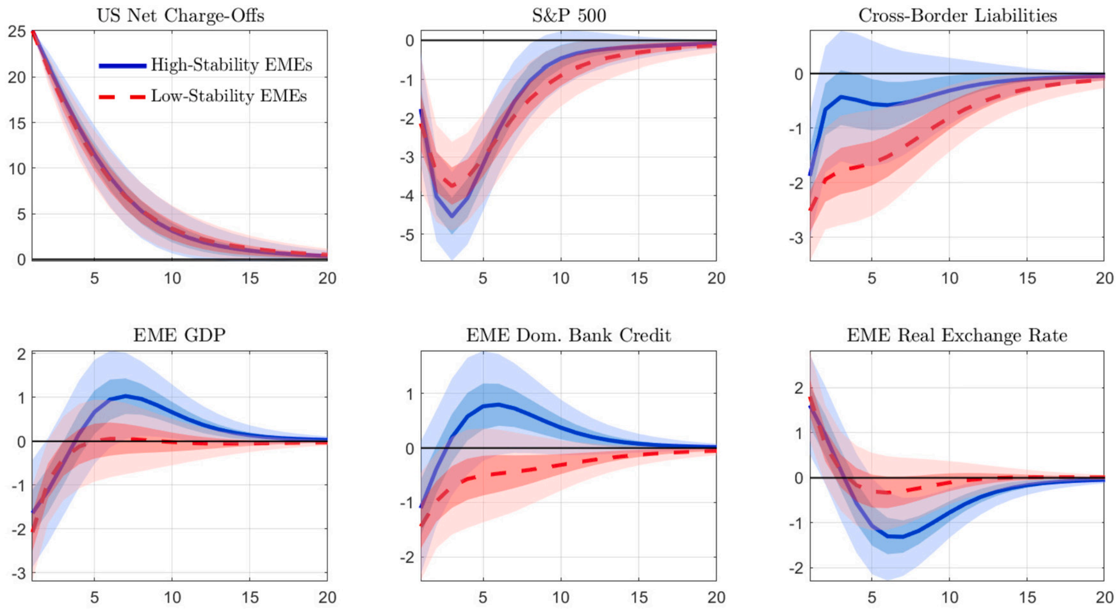

Fig. B.48. Response to an increase in US commercial banks' net charge-offs: high-political-stability and low-political-stability EMEs. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-political stability EMEs are shown in light and darker blue, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-political stability EMEs are shown in light and darker red, respectively.

B.2.14. EME division based on trade openness

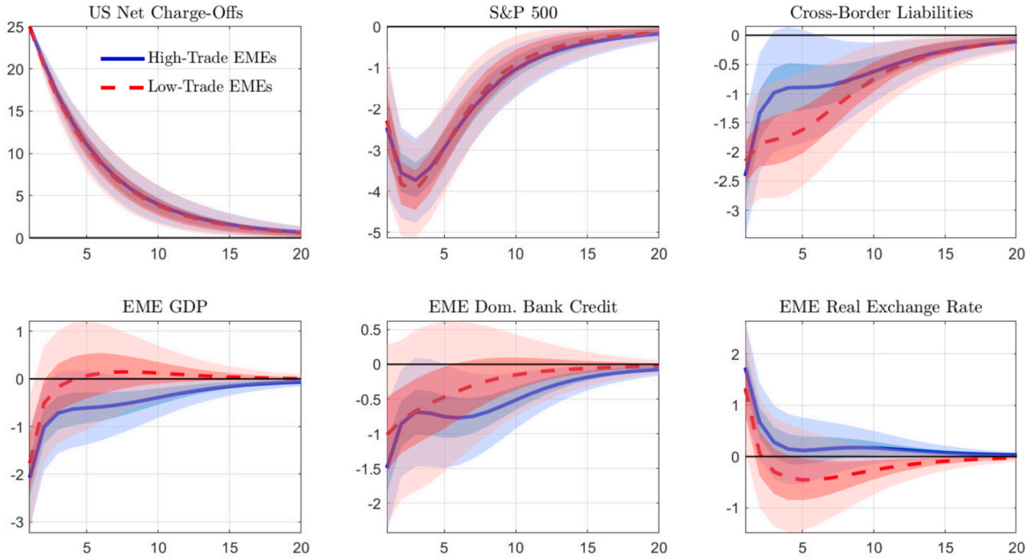

Fig. B.49. Response to an increase in US commercial banks' net charge-offs: high-trade-openness and low-trade-openness EMEs. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-trade-openness EMEs are shown in light and darker blue, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-trade-openness EMEs are shown in light and darker red, respectively. Trade openness is defined by the sum of exports and imports of goods and services measured as a share of gross domestic product. Data comes from the World Bank national accounts data, and OECD National Accounts data files. "High-Trade EMES" includes Chile, Mexico, Malaysia, Thailand and South Africa. "Low-Trade EMEs" includes Brazil, Colombia, Indonesia and Turkey.

B.2.15. EME division based on bank regulation

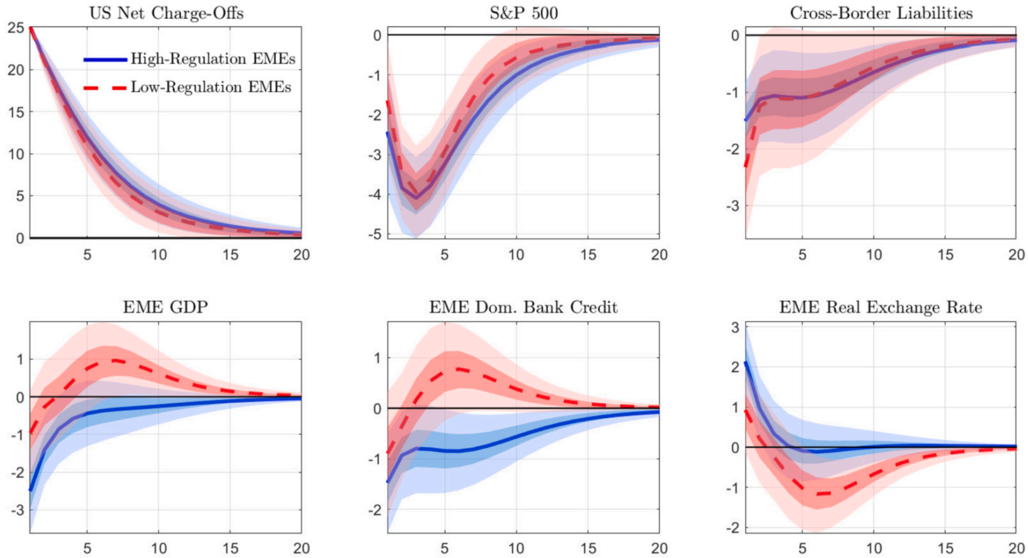

Fig. B.50. Response to an increase in US commercial banks' net charge-offs: high-banking-regulation and low-banking-regulation EMEs. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the high-regulation EMEs are shown in light and darker blue, respectively. 68 and 87 percent (1 and 1.5 standard-deviation) bootstrap confidence bands for the low-regulation EMEs are shown in light and darker red, respectively. "Banking regulation" corresponds to the sum between the regulation and supervision indexes from Kladakis, Chen, and Bellos (2022). The regulation index is constructed by calculating the sum of the activity restrictions and capital regulations indexes using data from the 2019 Bank Regulation and Supervision Survey of the World Bank. It ranges from 3 to 22 and higher values indicate stricter bank regulation. The supervision index is constructed by calculating the sum of the official supervisory power and mitigation of moral hazard indexes from the 2019 Bank Regulation and Supervision Survey of the World Bank. It ranges from 0 to 17 and higher values indicate greater levels of bank supervision. "High-Regulation" refers to the countries that have an average regulation index greater or equal to the median of our sample, and includes Chile, Colombia, Indonesia, Mexico, and Turkey. "Low-Regulation" refers to the countries that have an average regulation index lower than the median of our sample, and includes Brazil, Malaysia, South Africa, and Thailand.

Appendix C. Benchmark model derivations and details

In what follows, we present additional details pertaining to the benchmark model's derivations.

C.1. Final goods

C.1.1. Final goods firms in home (H) economy

Total output in the home (H) economy is given by

$$Y_t = \left[\alpha_a^{\frac{1}{\phi_a}} Y_{H,t}^{\frac{\phi_a - 1}{\phi_a}} + (1-\alpha_a)^{\frac{1}{\phi_a}} Y_{F,t}^{\frac{\phi_a - 1}{\phi_a}} \right]^{\frac{\phi_a}{\phi_a - 1}}, \tag{C.1}$$

where the aggregate price index is

$$P_t = \left[\alpha_a P_{H,t}^{1-\phi_a} + (1-\alpha_a) P_{F,t}^{1-\phi_a} \right]^{\frac{1}{1-\phi_a}}.$$

The first-order conditions yield the following relative demands for domestic goods and imported goods:

$$Y_{H,t} = \alpha_a \left(\frac{P_{H,t}}{P_t} \right)^{-\phi_a} Y_t = \alpha_a \left(\rho_{H,t} \right)^{-\phi_a} Y_t, \tag{C.2}$$

and

$$Y_{F,t} = (1-\alpha_a) \left(\frac{P_{F,t}}{P_t} \right)^{-\phi_a} Y_t = (1-\alpha_a) \left(\rho_{F,t} \right)^{-\phi_a} Y_t, \tag{C.3}$$

where the real prices $\rho_{H,t} = \frac{P_{H,t}}{P_t}$ and $\rho_{F,t} = \frac{P_{F,t}}{P_t}$. Defining the terms-of-trade (ToT) as the ratio of the price of imports to the price of exports, $ToT_t = P_{F,t}/P_{H,t}$, we can write

$$\frac{P_t}{P_{H,t}} = \left[\alpha_a + (1-\alpha_a) \left(ToT_t \right)^{1-\phi_a} \right]^{\frac{1}{1-\phi_a}},$$

and

$$\frac{P_t}{P_{F,t}} = \frac{P_t}{P_{H,t}} \frac{1}{ToT_t} = \frac{\left[\alpha_a + (1-\alpha_a) ToT_t^{1-\phi_a} \right]^{\frac{1}{1-\phi_a}}}{ToT_t}.$$

Then, the relative demands above can be expressed using the ToT as follows:

$$Y_{H,t} = \alpha_a \left\{ \left[\alpha_a + (1-\alpha_a) ToT_t^{1-\phi_a} \right]^{\frac{\phi_a}{1-\phi_a}} \right\} Y_t, \tag{C.4}$$

and

$$Y_{F,t} = \alpha_a \left\{ ToT_t^{-\phi_a} \left[\alpha_a + (1-\alpha_a) ToT_t^{1-\phi_a} \right]^{\frac{\phi_a}{1-\phi_a}} \right\} Y_t. \tag{C.5}$$

C.1.2. Final goods firms in foreign (F) economy

Total output in the foreign (F) economy is given by

$$Y_t^* = \left[(\alpha_a^*)^{\frac{1}{\phi_a^*}} \left(Y_{F,t}^* \right)^{\frac{\phi_a^* - 1}{\phi_a^*}} + (1-\alpha_a^*)^{\frac{1}{\phi_a^*}} \left(Y_{H,t}^* \right)^{\frac{\phi_a^* - 1}{\phi_a^*}} \right]^{\frac{\phi_a^*}{\phi_a^* - 1}}, \tag{C.6}$$

where the aggregate price index is

$$P_t^* = \left[(\alpha_a^*) \left(P_{F,t}^* \right)^{1-\phi_a^*} + (1-\alpha_a^*) \left(P_{H,t}^* \right)^{1-\phi_a^*} \right]^{\frac{1}{1-\phi_a^*}}.$$

The first-order conditions yield the following relative demands for domestic goods and imported goods:

$$Y^*_{F,t} = \alpha^*_a \left(\frac{P^*_{F,t}}{P^*_t} \right)^{-\phi^*_a} Y^*_t = \alpha^*_a \left(\rho^*_{F,t} \right)^{-\phi^*_a} Y^*_t, \tag{C.7}$$

and

$$Y^*_{H,t} = (1-\alpha^*_a) \left(\frac{P^*_{H,t}}{P^*_t} \right)^{-\phi^*_a} Y^*_t = (1-\alpha^*_a) \left(\rho^*_{H,t} \right)^{-\phi^*_a} Y^*_t, \tag{C.8}$$

where $\rho^*_{H,t} = \frac{P^*_{H,t}}{P^*_t}$ and $\rho^*_{F,t} = \frac{P^*_{F,t}}{P^*_t}$.

Following the literature and assuming that the Law of One Price (LOP) holds, we have $P_{H,t} = NER_t P^*_{H,t}$ and $P_{F,t} = NER_t P^*_{F,t}$. Then, recalling that $ToT_t = P_{F,t}/P_{H,t}$, we can write

$$ToT_t = \frac{P_{F,t}}{P_{H,t}} = \frac{NER_t P^*_{F,t}}{NER_t P^*_{H,t}} = \frac{P^*_{F,t}}{P^*_{H,t}}.$$

Then, noting that

$$\frac{P^*_t}{P^*_{F,t}} = \left[(\alpha^*_a) + (1-\alpha^*_a) \left(ToT_t \right)^{\phi^*_a - 1} \right]^{\frac{1}{1-\phi^*_a}},$$

and

$$\frac{P^*_t}{P^*_{H,t}} = \frac{P^*_t}{P^*_{F,t}} ToT_t = ToT_t \left[(\alpha^*_a) + (1-\alpha^*_a) \left(ToT_t \right)^{\phi^*_a - 1} \right]^{\frac{1}{1-\phi^*_a}},$$

we can write

$$Y^*_{F,t} = \alpha^*_a \left\{ \left[(\alpha^*_a) + (1-\alpha^*_a) \left(ToT_t \right)^{\phi^*_a - 1} \right]^{\frac{\phi^*_a}{1-\phi^*_a}} \right\} Y^*_t, \tag{C.9}$$

and

$$Y^*_{H,t} = (1-\alpha^*_a) \left\{ ToT_t^{\phi^*_a} \left[(\alpha^*_a) + (1-\alpha^*_a) \left(ToT_t \right)^{\phi^*_a - 1} \right]^{\frac{\phi^*_a}{1-\phi^*_a}} \right\} Y^*_t. \tag{C.10}$$

C.2. Real exchange rate

Define the real exchange rate as $RER_t = NER_t P^*_t / P_t$. Then, by the LOP, we have

$$P_{H,t} = NER_t P^*_{H,t},$$

or

$$NER_t = \frac{P_{H,t}}{P^*_{H,t}}.$$

We can then write

$$RER_t = \frac{NER_t P^*_t}{P_t}$$

$$RER_t = \frac{P_{H,t}}{P^*_{H,t}} \frac{P^*_t}{P_t}$$

$$RER_t = \frac{P_{H,t}}{P_t} \frac{P^*_t}{P^*_{H,t}},$$

or

$$RER_t = \frac{\left[(\alpha^*_a) \left(ToT_t \right)^{1-\phi^*_a} + (1-\alpha^*_a) \right]^{\frac{1}{1-\phi^*_a}}}{\left[\alpha_a + (1-\alpha_a) \left(ToT_t \right)^{1-\phi_a} \right]^{\frac{1}{1-\phi_a}}}. \tag{C.11}$$

C.3. Aggregation of domestic output in economies F and H

Recall that total domestic output in economy F are given by

$$Y^*_{D,t} = \left(\int_{\omega^* \in \Omega^*} y^*_{D,t}(\omega^*)^{\frac{\varepsilon^*-1}{\varepsilon^*}} d\omega^* \right)^{\frac{\varepsilon^*}{\varepsilon^*-1}},$$

and the associated price index is

$$P^*_{D,t} = \left(\int_{\omega^* \in \Omega^*} p^*_{D,t}(\omega^*)^{1-\varepsilon^*} d\omega^* \right)^{\frac{1}{1-\varepsilon^*}}.$$

In symmetric equilibrium, we have

$$Y^*_{D,t} = y^*_{D,t} \left(N^*_t \right)^{\frac{\varepsilon^*}{\varepsilon^*-1}}.$$

Note that we can write the real price of domestic output as

$$\frac{P^*_{D,t}}{P^*_t} = \rho^*_{D,t} \left(N^*_t \right)^{\frac{1}{1-\varepsilon^*}},$$

where $\rho^*_{D,t} = \left[\varepsilon^* / (\varepsilon^* - 1) \right] mc^*_t$. Analogous expressions hold for $Y_{D,t}$.

C.4. Market clearing

C.4.1. Total domestic output

From economy H's perspective, total demand for output produced in H must be equal to what is produced, so that

$$Y_{H,t} + \left(\frac{1-m}{m} \right) Y^*_{H,t} = Y_{D,t},$$

where $Y_{D,t}$ denotes total production in H. Analogously, economy F faces a similar market clearing condition:

$$\left(\frac{m}{1-m} \right) Y_{F,t} + Y^*_{F,t} = Y^*_{D,t}.$$

Formally, domestic aggregators in H choose $Y_{H,t}$ and $Y^*_{H,t}$ to maximize

$$\left[\frac{P_{H,t}}{P_t} Y_{H,t} + \frac{NER_t P^*_{H,t}}{P_t} \left(\frac{1-m}{m} \right) Y^*_{H,t} - \frac{P_{D,t}}{P_t} Y_{D,t} \right],$$

subject to

$$Y_{H,t} + \left(\frac{1-m}{m} \right) Y^*_{H,t} = Y_{D,t},$$

where NER_t denotes the nominal exchange rate.

The first-order conditions yield

$$\frac{P_{H,t}}{P_t} = \frac{P_{D,t}}{P_t},$$

or

$$\frac{P_{D,t}}{P_t} = \left[\alpha_a + (1-\alpha_a) \left(ToT_t \right)^{1-\phi_a} \right]^{\frac{-1}{1-\phi_a}},$$

and

$$\frac{NER_t P^*_{H,t}}{P_t} = \frac{P_{D,t}}{P_t},$$

which we can rewrite as

$$\frac{P^*_t NER_t}{P_t} \frac{P^*_{H,t}}{P^*_t} = \frac{P_{D,t}}{P_t},$$

or

$$\frac{P^*_{H,t}}{P^*_t} = \frac{P_{D,t}}{P_t} \frac{1}{RER_t}.$$

Similarly, domestic aggregators in F choose $Y_{F,t}$ and $Y^*_{F,t}$ to maximize

$$\left[\frac{P^*_{F,t}}{P^*_t}Y^*_{F,t}+\frac{P_{F,t}}{P^*_t NER_t}\left(\frac{m}{1-m}\right)Y^*_{F,t}-\frac{P^*_{D,t}}{P^*_t}Y^*_{D,t}\right],$$

subject to

$$\left(\frac{m}{1-m}\right)Y_{F,t}+Y^*_{F,t}=Y^*_{D,t},$$

The first-order conditions yield

$$\frac{P^*_{F,t}}{P^*_t}=\frac{P^*_{D,t}}{P^*_t},$$

or

$$\frac{P^*_{D,t}}{P^*_t}=\left[(\alpha^*_a)+(1-\alpha^*_a)\left(ToT_t\right)^{\phi^*_a-1}\right]^{\frac{-1}{1-\phi^*_a}},$$

and

$$\frac{P_{F,t}}{P^*_t NER_t}=\frac{P^*_{D,t}}{P^*_t},$$

which we can rewrite as

$$\frac{P_{F,t}}{P_t}\frac{P_t}{P^*_t NER_t}=\frac{P^*_{D,t}}{P^*_t},$$

or

$$\frac{P_{F,t}}{P_t}=\frac{P^*_{D,t}}{P^*_t}RER_t.$$

Market clearing for domestic producers in F and H is given by

$$N^*_t y^*_{D,t}=z^*_t(k^*_t)^{1-\alpha^*}(L^*_t)^{\alpha^*}, \tag{C.12}$$

and

$$N_t y_{D,t}=z_t(k_t)^{1-\alpha}(L_t)^{\alpha}, \tag{C.13}$$

respectively.

C.5. Data-consistent model variables

Following Bilbiie et al. (2012), when comparing a model with endogenous firm entry to the data, model variables must be adjusted to account for the variety effect inherent to models with firm creation. In particular, recall that in economy F,

$$P^*_t=\left[\alpha^*_a\left(P^*_{H,t}\right)^{1-\phi^*_a}+(1-\alpha^*_a)\left(P^*_{F,t}\right)^{1-\phi^*_a}\right]^{\frac{1}{1-\phi^*_a}},$$

where $P^*_{H,t}=P^*_{D,t}=p^*_{D,t}\left(N^*_t\right)^{\frac{1}{1-\epsilon^*}}$. Following the notation in Barattieri et al. (2018), we denote $\Delta^*_{P,t}\left(N^*_t\right)^{\frac{1}{1-\epsilon^*}}$ and define $\widetilde{P}^*_{P,t}$ as the average price such that $P^*_{D,t}=\Delta^*_{P,t}\widetilde{P}^*_{P,t}$. Then, we can write

$$P^*_t=\Delta^*_t\widetilde{P}^*_t=\left[\alpha^*_a\left(\Delta^*_{P,t}\widetilde{P}^*_{P,t}\right)^{1-\phi^*_a}+(1-\alpha^*_a)\left(P^*_{F,t}\right)^{1-\phi^*_a}\right]^{\frac{1}{1-\phi^*_a}}, \tag{C.14}$$

where $\widetilde{P}^*_t$ is the data-consistent aggregate price index, and

$$\Delta^*_t=\left[\alpha^*_a\left(\Delta^*_{P,t}\right)^{1-\phi^*_a}+(1-\alpha^*_a)\right]^{\frac{1}{1-\phi^*_a}}. \tag{C.15}$$

Then, if variable x^*_t in the model is expressed in final consumption units, the data-consistent counterpart of model-variable x^*_t is given by

$$x^*_{data,t}=\Delta^*_t x^*_t. \tag{C.16}$$

Analogous steps allow us to define the corresponding data-consistent variables for economy H.

Appendix D. Equilibrium conditions: benchmark model

The endogenous variables $\left\{Y_{D,t}, Y^*_{H,t}, ToT_t, Y_{H,t}, Y_t, \frac{P_{H,t}}{P_t}, c_t, RER_t, L_t, i_t, w_t, r_t, R_t, k_t, \rho_{D,t}\right\}$,

$$\left\{mc_t, \rho^*_{D,t}, mc^*_t, Y^*_{D,t}, \frac{P^*_{D,t}}{P^*_t}, Y_{F,t}, Y^*_{F,t}, Y^*_t, \frac{P^*_{F,t}}{P^*_t}, N^*_t, N_t, d^*_t, d_t, N^*_{E,t}, N_{E,t}, y^*_{D,t}, y_{D,t}, c^*_t, L^*_t, i^*_t\right\},$$

$\left\{w^*_t, r^*_t, R^*_t, k^*_t, \phi_t, B^*_t, s_t, s^*_t, \vartheta_t, \mu_t, \Lambda_t, NW_t, B_{d,t}, R_{k,t}, \phi^*_t, \vartheta^*_t, \mu^*_t, \Lambda^*_t, NW^*_t, B^*_{d,t}, R^*_{k,t}, \mu^*_{b,t}\right\}$, and $\left\{\phi^*_{b,t}, R^*_{b,t}, Q^*_{b,t}, B_t\right\}$ satisfy the following equations:

$$Y_{H,t} + \left(\frac{1-m}{m}\right) Y^*_{H,t} = Y_{D,t}, \tag{D.1}$$

$$RER_t = \frac{\left[(\alpha^*_a)\left(ToT_t\right)^{1-\phi^*_a} + (1-\alpha^*_a)\right]^{\frac{1}{1-\phi^*_a}}}{\left[\alpha_a + (1-\alpha_a)\left(ToT_t\right)^{1-\phi_a}\right]^{\frac{1}{1-\phi_a}}}, \tag{D.2}$$

$$Y_{H,t} = \alpha_a \left(\left[\alpha_a + (1-\alpha_a) ToT_t^{1-\phi_a}\right]^{\frac{\phi_a}{1-\phi_a}}\right) Y_t, \tag{D.3}$$

$$Y_t = \left[\alpha_a^{\frac{1}{\phi_a}} Y_{H,t}^{\frac{\phi_a-1}{\phi_a}} + (1-\alpha_a)^{\frac{1}{\phi_a}} Y_{H,t}^{\frac{\phi_a-1}{\phi_a}}\right]^{\frac{\phi_a}{\phi_a-1}}, \tag{D.4}$$

$$\frac{P_{H,t}}{P_t} = \frac{P_{D,t}}{P_t}, \tag{D.5}$$

$$N_t y_{D,t} = z_t (k_t)^{1-\alpha} (L_t)^{\alpha}, \tag{D.6}$$

$$Y_t = c_t + i_t + \psi N_{E,t}, \tag{D.7}$$

$$Q_{b,t} B_t - R_{b,t} Q_{b,t-1} B_{t-1} = \left(\frac{1-m}{m}\right) Y^*_{H,t} \frac{P_{H,t}}{P_t} - Y_{F,t} ToT_t \frac{P_{H,t}}{P_t}, \tag{D.8}$$

$$-u_{L,t} = w_t u_{c,t}, \tag{D.9}$$

$$k_{t+1}/\Psi_{t+1} = (1-\delta_k) k_t + i_t, \tag{D.10}$$

$$w_t = mc_t (1-\alpha) z_t (k_t)^{\alpha} (L_t)^{-\alpha}, \tag{D.11}$$

$$r_t = \alpha mc_t z_t (k_t)^{\alpha-1} (L_t)^{1-\alpha}, \tag{D.12}$$

$$1 = \mathbb{E}_t \Xi_{t+1|t} R_t, \tag{D.13}$$

$$Y^*_{D,t} = y^*_{D,t} N_t^{*\frac{\varepsilon^*}{\varepsilon^*-1}}, \tag{D.14}$$

$$\frac{P^*_{D,t}}{P^*_t} = \rho^*_{D,t} N_t^{*\frac{1}{1-\varepsilon^*}}, \tag{D.15}$$

$$\rho^*_{D,t} = \frac{\varepsilon^*}{\varepsilon^*-1} mc^*_t, \tag{D.16}$$

$$Y_{D,t} = y_{D,t} N_t^{\frac{\varepsilon}{\varepsilon-1}}, \tag{D.17}$$

$$\frac{P_{D,t}}{P_t} = \rho_{D,t} N_t^{\frac{1}{1-\varepsilon}}, \tag{D.18}$$

$$\rho_{D,t} = \frac{\varepsilon}{\varepsilon-1} mc_t, \tag{D.19}$$

$$\frac{P^*_{D,t}}{P^*_t} = \left[(\alpha^*_a) + (1-\alpha^*_a)\left(ToT_t\right)^{\phi^*_a-1}\right]^{\frac{-1}{1-\phi^*_a}}, \tag{D.20}$$

$$\left(\frac{m}{1-m}\right) Y_{F,t} + Y^*_{F,t} = Y^*_{D,t}, \tag{D.21}$$

$$Y^*_{F,t} = \alpha^*_a \left(\left[(\alpha^*_a) + (1-\alpha^*_a)\left(ToT_t\right)^{\phi^*_a-1}\right]^{\frac{\phi^*_a}{1-\phi^*_a}}\right) Y^*_t, \tag{D.22}$$

$$Y^*_t = \left[(\alpha^*_a)^{\frac{1}{\phi^*_a}} \left(Y^*_{F,t}\right)^{\frac{\phi^*_a-1}{\phi^*_a}} + (1-\alpha^*_a)^{\frac{1}{\phi^*_a}} \left(Y^*_{H,t}\right)^{\frac{\phi^*_a-1}{\phi^*_a}}\right]^{\frac{\phi^*_a}{\phi^*_a-1}}, \tag{D.23}$$

$$\frac{P^*_{F,t}}{P^*_t} = \frac{P^*_{D,t}}{P^*_t}, \tag{D.24}$$

$$N^*_{t+1} = (1-\delta^*)N^*_t + N^*_{E,t}, \tag{D.25}$$

$$N_{t+1} = (1-\delta)N_t + N_{E,t}, \tag{D.26}$$

$$d^*_t = (\rho^*_{D,t} - mc^*_t)y^*_{D,t}, \tag{D.27}$$

$$d_t = (\rho_{D,t} - mc_t)y_{D,t}, \tag{D.28}$$

$$\psi^* = \mathbb{E}_t\Xi^*_{t+1|t}\left[d^*_{t+1} + (1-\delta^*)\psi^*\right], \tag{D.29}$$

$$\psi = \mathbb{E}_t\Xi_{t+1|t}\left[d_{t+1} + (1-\delta)\psi\right], \tag{D.30}$$

$$N^*_t y^*_{D,t} = z^*_t (k^*_t)^{\alpha^*}(L^*_t)^{1-\alpha^*}, \tag{D.31}$$

$$Y^*_t = c^*_t + i^*_t + \psi^* N^*_{E,t}, \tag{D.32}$$

$$-u_{L^*,t} = w^*_t u_{c^*,t}, \tag{D.33}$$

$$k^*_{t+1} = (1-\delta^*_k)k^*_t + i^*_t, \tag{D.34}$$

$$w^*_t = (1-\alpha^*)mc^*_t z^*_t (k^*_t)^{\alpha^*}(L^*_t)^{-\alpha^*}, \tag{D.35}$$

$$r^*_t = \alpha^* mc^*_t z^*_t (k^*_t)^{\alpha^*-1}(L^*_t)^{1-\alpha^*}, \tag{D.36}$$

$$1 = \mathbb{E}_t\Xi^*_{t+1|t}R^*_t, \tag{D.37}$$

$$R_{k,t+1} = \Psi_{t+1}\frac{\left[r_{t+1} + Q_{t+1}\left(1-\delta_k\right)\right]}{Q_t}, \tag{D.38}$$

$$R^*_{k,t+1} = \frac{\left[r^*_{t+1} + Q^*_{t+1}\left(1-\delta^*_k\right)\right]}{Q^*_t}, \tag{D.39}$$

$$B_t = B^*_t\left(\frac{1-m}{m}\right), \tag{D.40}$$

$$s_t = k_{t+1}/\Psi_{t+1}, \tag{D.41}$$

$$s^*_t = k^*_{t+1}, \tag{D.42}$$

$$\phi_t = \vartheta_t/(\theta - \mu_t), \tag{D.43}$$

$$\phi_t NW_t = Q_t s_t + Q^*_{b,t}B^*_t RER_t, \tag{D.44}$$

$$\mu_t = \mathbb{E}_t\Xi_{t+1|t}\Lambda_{t+1}\left(R_{k,t+1} - R_{t+1}\right), \tag{D.45}$$

$$\Lambda_{t+1} = (1-\sigma) + \sigma(\vartheta_{t+1} + \phi_{t+1}\mu_{t+1}), \tag{D.46}$$

$$NW_t = (\sigma+\xi)\left(R_{k,t}Q_{t-1}s_{t-1} + R^*_{b,t}Q^*_{b,t-1}RER_t B_{t-1}\right) - \sigma R_t B_{d,t-1}, \tag{D.47}$$

$$B_{d,t} = NW_t(\phi_t - 1), \tag{D.48}$$

$$\vartheta_t = \mathbb{E}_t\Xi_{t+1|t}\Lambda_{t+1}R_{t+1}, \tag{D.49}$$

$$\phi^*_t = \vartheta^*_t/(\theta^* - \mu^*_t), \tag{D.50}$$

$$\phi^*_t NW^*_t = Q^*_t s^*_t - Q^*_{b,t}B^*_t, \tag{D.51}$$

$$\mu^*_t = \mathbb{E}_t\Xi^*_{t+1|t}\Lambda^*_{t+1}\left(R^*_{k,t+1} - R^*_{t+1}\right), \tag{D.52}$$

$$\Lambda^*_{t+1} = (1-\sigma^*) + \sigma^*(\vartheta^*_{t+1} + \phi^*_{t+1}\mu^*_{t+1}), \tag{D.53}$$

$$NW^*_t = (\sigma^*+\xi^*)R^*_{k,t}Q^*_{t-1}s^*_{t-1} - \sigma^* R^*_t B^*_{d,t-1} - \sigma^* R^*_{b,t}Q^*_{b,t-1}B^*_{t-1}, \tag{D.54}$$

$$B^*_{d,t} = NW^*_t(\phi^*_t - 1), \tag{D.55}$$

$$\vartheta^*_t = \mathbb{E}_t\Xi^*_{t+1|t}\Lambda^*_{t+1}R^*_{t+1}, \tag{D.56}$$

$$\mu^*_{b,t} = \mathbb{E}_t\Xi^*_{t+1|t}\Lambda^*_{t+1}\left(R^*_{b,t+1} - R^*_{t+1}\right), \tag{D.57}$$

$$\phi^*_{b,t} = \vartheta^*_t/(\theta^* - \mu^*_{b,t}), \tag{D.58}$$

$$R^*_{b,t+1} = \frac{\left[r^*_{t+1} + Q^*_{b,t+1}\left(1-\delta^*_k\right)\right]}{Q^*_{b,t}}, \tag{D.59}$$

$$R_{k,t+1} = R^*_{b,t+1}\left(\frac{RER_{t+1}}{RER_t}\right) + \Phi\left[exp(B_t - B) - 1\right], \tag{D.60}$$

$$\mu^*_{b,t} = \mu^*_t. \tag{D.61}$$

Appendix E. Parameter values: summary of baseline calibration

Table E.2
Calibration of baseline model.

Parameter		Value	Source or Target
β, β^*	US, EME subjective discount factor	0.985	DSGE literature
σ_c, σ_c^*	US, EME relative risk aversion coeff.	2	DSGE literature
χ, χ^*	US, EME inverse Frisch elast. of labor supply	0.1	DSGE literature
δ_k, δ_k^*	US, EME capital depreciation rates	0.02	DSGE literature
δ, δ^*	US, EME firm destruction rates	0.02	Ave. US, EME firm exit rates
α, α^*	US, EME capital shares	0.40	Ave. capital shares
κ	US labor weight on ut. function	2.271	Match SS hours worked of 0.33
κ^*	EME labor weight on ut. function	2.724	Match SS hours worked of 0.33
ψ	Cost of creating firm, United States	0.1102	1% of income per capita
ψ^*	Cost of creating firm, EME	1.6779	17.68% of income per capita
ε	US elast. of subs. of firm output	6	Markup in the United States
ε^*	EME elast. of subs. of firm output	4	Markup in EMEs
ϕ_a, ϕ_a^*	US, EME elast. of subs. of imported goods	1.557	Cuadra and Nuguer (2018)
m	US size	0.900	Cuadra and Nuguer (2018)
ϕ_k	US investment adjustment cost	0.09	Fall of S&P 500
ϕ_k^*	EME investment adjustment cost	0.5	Recovery of cross-border flows*
ϕ_n	US firm-creation adjustment cost	2	Recovery of S&P 500
η_b	EME premium	0.25	Fall in cross-border flows*
η_r	RER adjustment cost	2000	Medium-term response of RER*
σ, σ^*	US & EME bank survival rate	0.972	Gertler and Kiyotaki (2010)
ξ, ξ^*	US & EME bank start-up funds	0.002	Gertler and Kiyotaki (2010)
θ	Fraction of divertable assets in US	0.5062	$R_k - R = 1.10$
θ^*	Fraction of divertable assets in EME	0.8945	$R_k^* - R^* = 1.10$

Note: *The responses are calibrated to the high-cost (baseline) EME group.

Appendix F. Additional benchmark model results

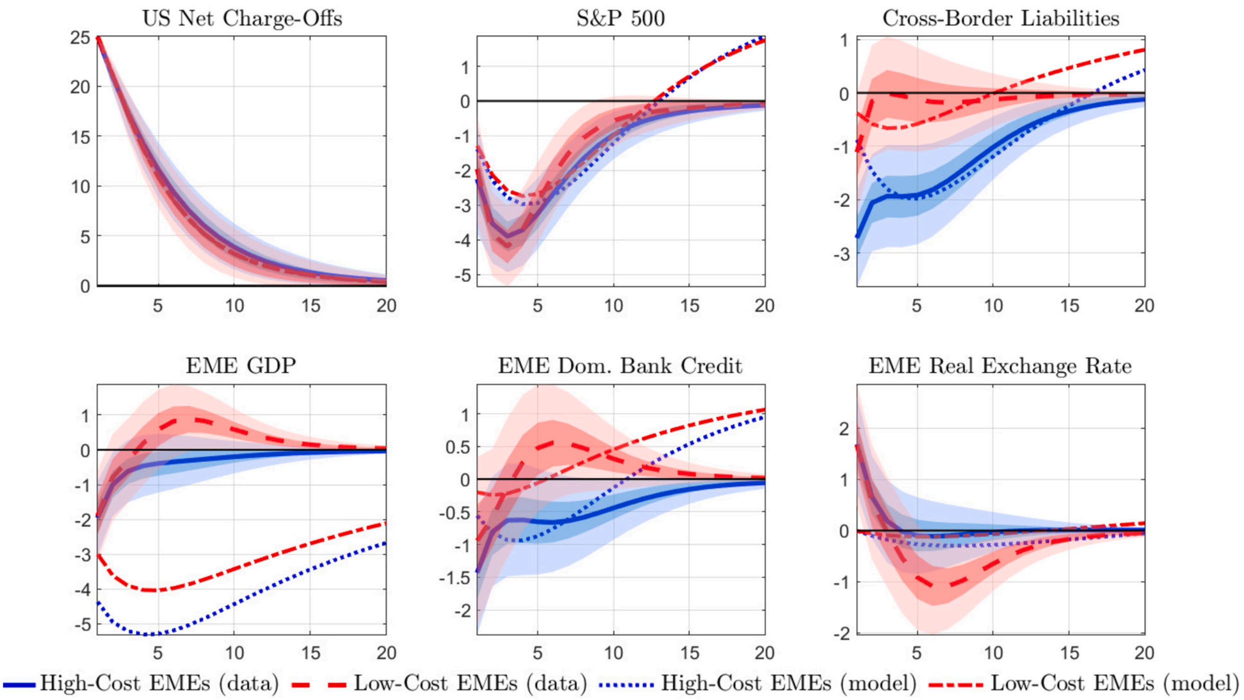

Fig. F.1. Empirical and model-based impulse responses to an increase in US bank net charge-offs: high-firm-creation-cost and low-firm-creation-cost EMEs. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis shows the number of quarters after the shock. Confidence intervals are calculated using bootstrap methods with 10,000 repetitions. 68 and 87 percent bootstrap confidence bands for the high-cost EMEs are shown in light and darker blue, respectively. 68 and 87 percent bootstrap confidence bands for the low-cost EMEs are shown in light and darker red, respectively.

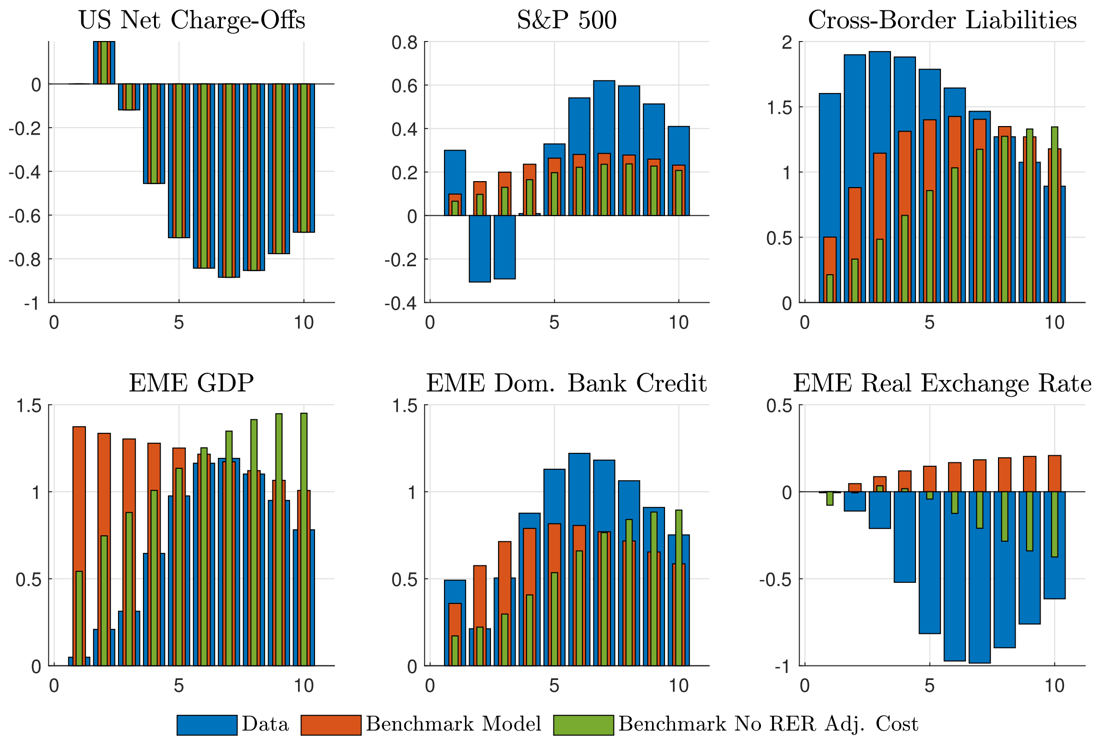

Fig. F.2. Differences in response to an increase in US commercial banks' net charge-offs between low-firm-creation-cost EMEs and high-firm-creation-cost EMEs: benchmark model and model without real-exchange-rate adjustment costs. *Note:* The vertical axis shows the percentage-point differences between the impulse responses of low-cost EMEs and those of high-cost EMEs to an increase in US bank net charge-offs for each corresponding variable in the data (blue bars), in the benchmark model (orange bars), and in the benchmark model without real-exchange-rage adjustment costs (green bars). The horizontal axis shows the number of quarters after the shock.

Appendix G. Additional results: model mechanisms

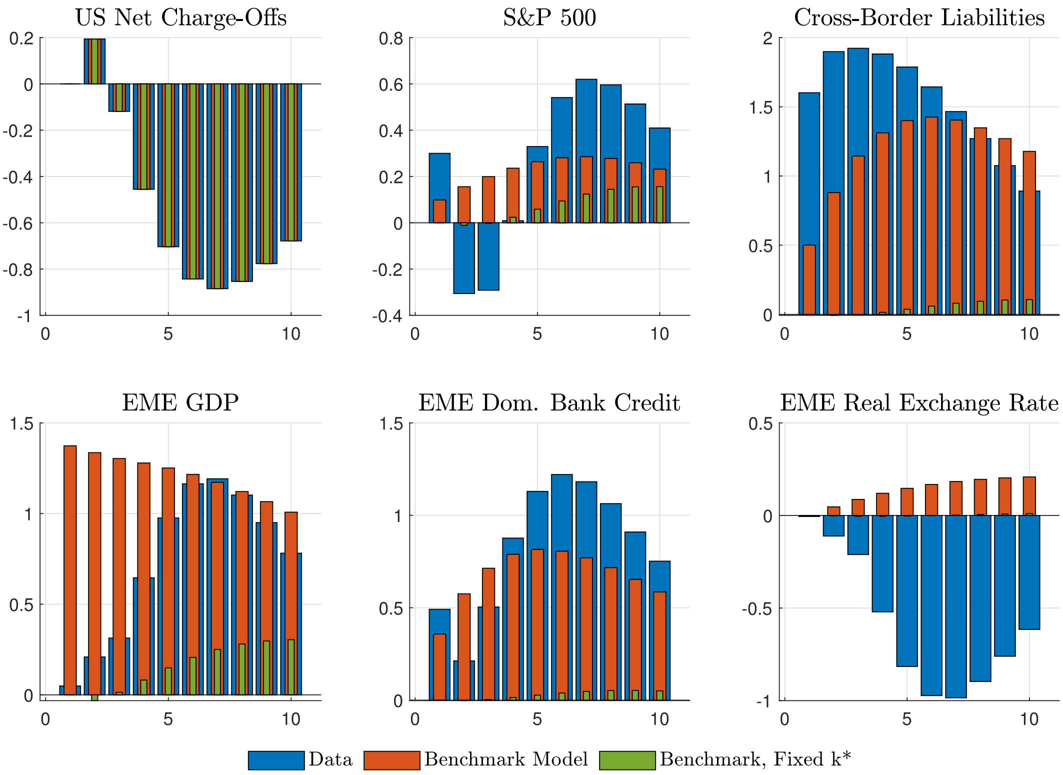

Fig. G.1. Differences in response to an increase in US commercial banks' net charge-offs between low-cost and high-cost EMEs: data, benchmark model, and benchmark model holding k^* fixed. *Note:* The vertical axis shows the percentage-point differences between the impulse responses of the baseline (high-cost) EME and those of the low-cost EME to an increase in US bank net charge-offs for each corresponding variable in the data (blue bars), in the benchmark model (orange bars), and in a version of the benchmark model that keeps k^* fixed at its baseline value (by changing EME TFP). The horizontal axis shows the number of quarters after the shock.

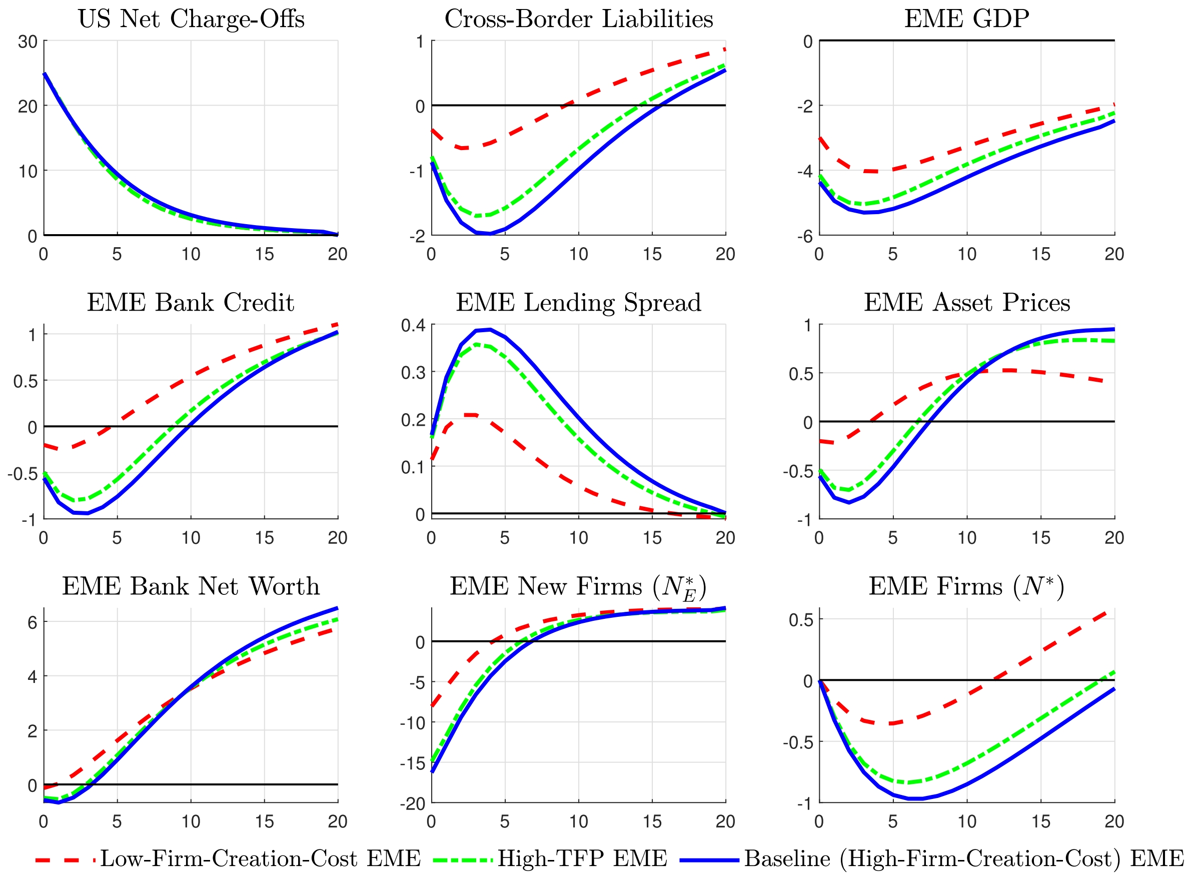

Fig. G.2. Model-based impulse response to an increase in US bank net charge-offs: high-firm-creation-cost EME, and low-firm-creation-cost EME, and high-TFP EME. *Note:* The vertical axis shows percent deviations from trend and the horizontal axis corresponds to quarters after the shock. The high-TFP EME corresponds to a version of the baseline (high-cost) EME with the steady-state (relative) TFP level of low-cost EMEs in the data per Section 4.2 but the same parameter value for the cost of firm creation as the baseline EME. By construction, the responses of US net charge-offs in the low-cost EME and the high-TFP EME are identical (i.e., the dashed red line and the dash-dotted green line overlap since they are subject to the same shock process).

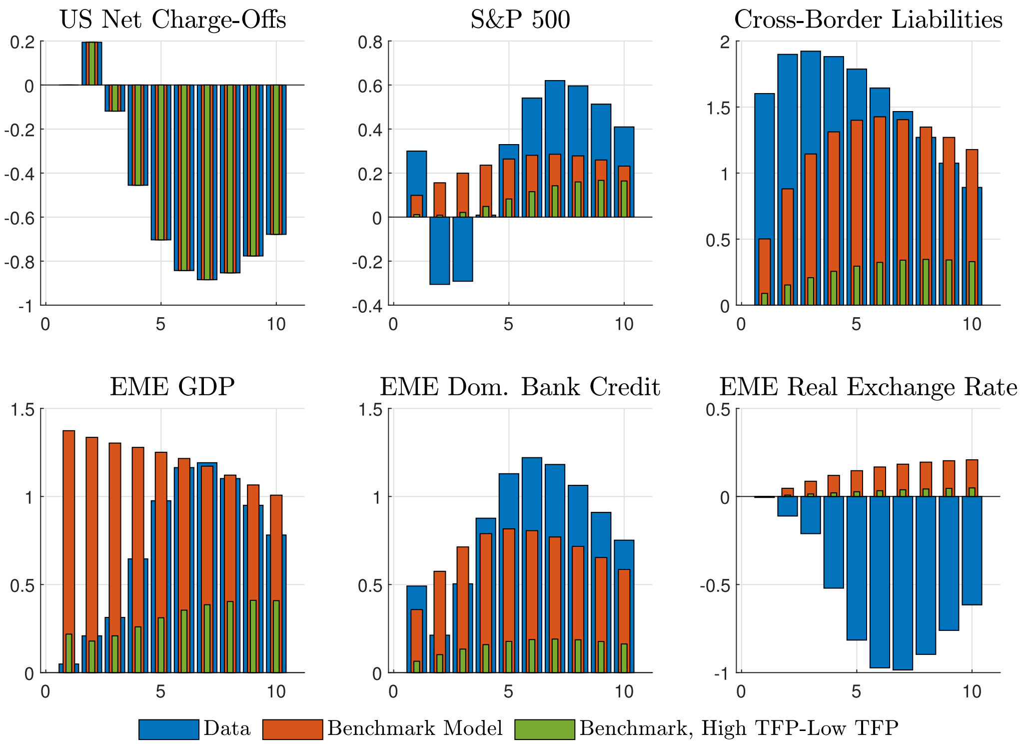

Fig. G.3. Differences between EMEs to an increase in US bank net charge-offs: data vs. benchmark model, differences in average firm-creation costs vs. differences in average TFP. *Note:* The vertical axis shows the percentage-point difference between the impulse responses of low-cost EMEs and those of high-cost EMEs to an increase in US bank net charge-offs for each corresponding variable in the data (blue bars), in the benchmark model (orange bars), and the percentage-point differences in the impulse responses between high-TFP EMEs and low-TFP EMEs (based on average TFP in low-cost EMEs and high-cost EMEs) in the benchmark model (green bars). The horizontal axis shows the number of quarters after the shock. Average TFP in high-cost EMEs is normalized to 1, and average (relative) TFP in low-cost EMEs is 1.014 per data from the Penn World Tables.

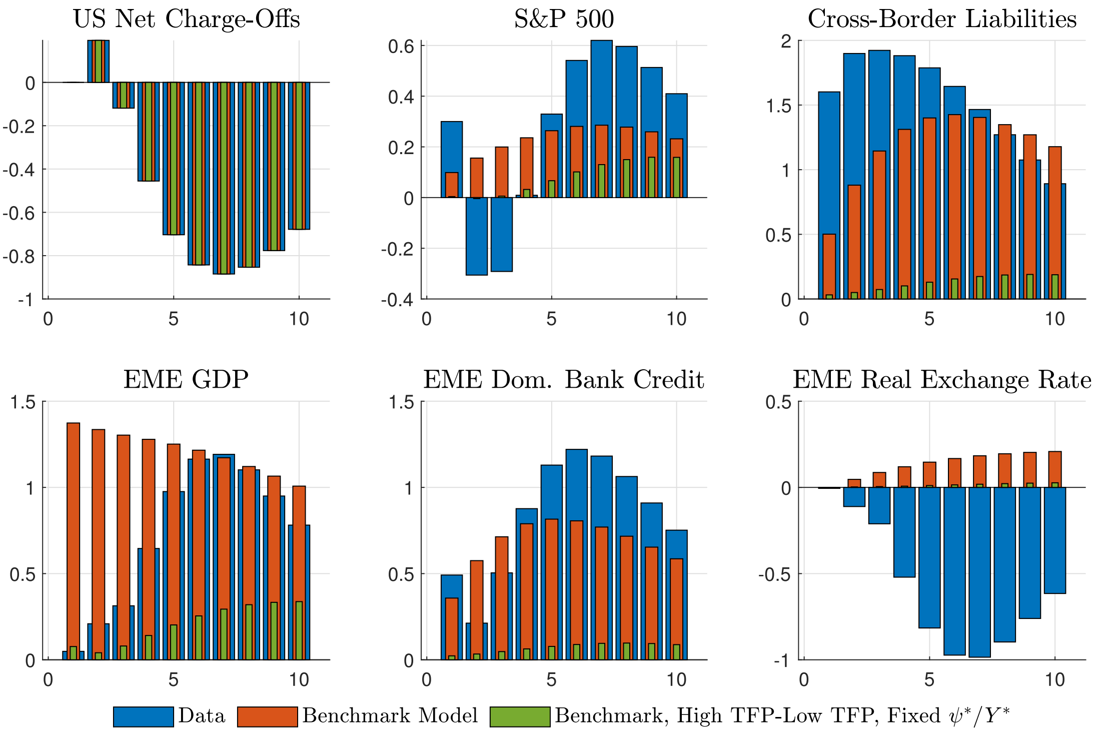

Fig. G.4. Differences in response to an increase in US commercial banks' net charge-offs between EMEs: data and benchmark model, differences in average firm-creation costs vs. TFP with recalibrated cost of creating an EME firm. *Note:* The vertical axis shows the percentage-point differences between impulse responses of low-cost EMEs and those of high-cost EMEs to an increase in US bank net charge-offs for each corresponding variable in the data (blue bars), in the benchmark model (orange bars), and the percentage-point differences in the impulse responses between high-TFP EMEs and low-TFP EMEs (based on average TFP in low-cost EMEs and high-cost EMEs) in the benchmark model holding the cost of creating an EME firm as a share of output at its baseline value (green bars). The horizontal axis shows the number of quarters after the shock. Average TFP in high-cost EMEs is normalized to 1, and average (relative) TFP in low-cost EMEs is 1.014 per data from the Penn World Tables.

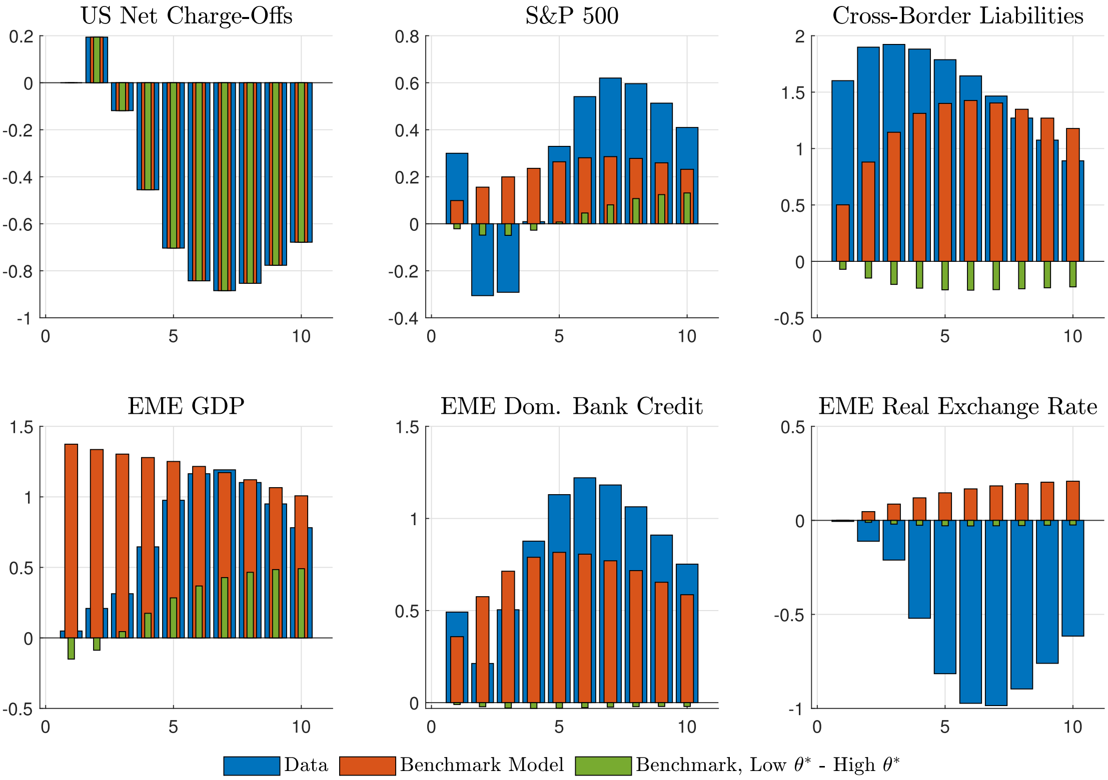

Fig. G.5. Differences in response to an increase in US commercial banks' net charge-offs between EMEs: data, benchmark model, differences in average firm-creation costs vs. differences in θ^* EMEs. *Note:* The vertical axis shows the percentage-point differences between the impulse responses of the baseline (high-cost) EME and the low-cost EME in the data (blue bars), in the benchmark model (orange bars), and in a version of the benchmark model where the baseline (high-cost) EME has a higher θ^* (green bars) to an increase in US bank net charge-offs for each corresponding variable. The horizontal axis shows the number of quarters after the shock.

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