Recessions and Recoveries. Multinational Banks in the Business Cycle*

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Abstract

How does the expansion of multinational banks influence the business cycle of host countries? We study an economy where multinational banks can transfer liquidity across borders through internal capital markets but are hindered in their allocation of liquidity by limited knowledge of local firms' assets. We find that, following domestic banking shocks, multinational banks moderate the depth of the contraction but slow down the recovery. A calibration to Polish data suggests that multinational banks reduce the average depth of recessions by about 5% but increase their duration by 10%. The predictions are broadly consistent with evidence from a large panel of countries.

Keywords: Multinational Banks; Business Cycle Dynamics; Recoveries

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1. Introduction

The dynamics of business cycles in advanced and emerging economies have been the object of an intense debate in recent years (Reinhart and Rogoff, 2014; Cecchetti et al., 2009). Concerns have grown about the length of recessions, especially following shocks to the banking sector (Cerra and Saxena, 2008). While in the past a popular view was that deep recessions would be accompanied by quick recoveries (Friedman and Schwartz, 2008), evidence on recent recessionary episodes suggests that banking disruptions trigger deep recessions and persistent output losses. Reinhart and Rogoff (2014) document that in 23 out of 30 episodes of banking disruptions occurred after 1990 the length

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of the recession from peak to recovery was no lower than 5 years and its depth (output drop, peak to trough) exceeded 5%. Cerra and Saxena (2008) estimate an output impact of 7% of banking crises, with the output drop remaining above 6% at a 10-year horizon. This debate calls for a deeper understanding of the forces that shape the dynamics of business cycles (Claessens et al., 2011).

The structure of a country's financial sector is often considered to be a driver of the dynamics of business cycles (Claessens et al., 2011; Bordo and Haubrich, 2010). This paper studies qualitatively and quantitatively to what extent a key feature of the financial sector, its openness to multinational banks, can affect the depth and duration of recessions, possibly helping explain cross-country differences, and the evolution over time, of business cycle dynamics. In recent decades, following the relaxation of foreign bank entry restrictions, multinational banks have significantly expanded their presence in advanced and emerging countries (Claessens and van Horen, 2014). The international claims of BIS reporting banks rose from $6 trillion in 1990 to $37 trillion in 2007, over 70% of world GDP (BIS, 2008). In Latin America and in Central and Eastern Europe, large European and U.S. banks have broadened their networks of affiliates, reaching a credit market share of over 25% in several countries, and above 50% in some countries (Allen et al., 2013). And the expansion of multinational banks is accelerating in transition countries, such as China and Russia.

How does the expansion of multinational banks influence the dynamics of business cycles of host countries? Do multinational banks attenuate or exacerbate the depth of recessions following banking disruptions and real shocks? Do they have the same impact on contractions and recoveries? To address these questions, we first present motivational evidence on the impact of multinational banks on business cycle dynamics. Using information from a broad panel of economies over the last three decades, we carry out a case study analysis of recessionary episodes as well as a regression analysis based on prior studies on business cycle dynamics. The evidence points to a different impact of multinational banks on the severity of contractions and recoveries in a country. We then embed multinational banks into a dynamic stochastic general equilibrium model with two countries (the host or domestic country and the foreign country). In both countries firms can borrow from local banks, which operate within the country's borders, and multinational banks, which have parent offices in the foreign country and affiliates in the host country.

In the model, we characterize multinational banks by taking a leaf from the banking literature. First, we posit that multinational banks have internal capital markets which allow them to transfer liquidity, subject to costs, as well as (partly) consolidated balance sheets between parents and affiliates. The literature has documented multinational banks' reliance on internal capital markets, which allow them to transfer liquidity across borders in a timely manner without the need to resort to costly local deposits (Cetorelli and Goldberg, 2012b). Second, we posit that multinational banks experience disadvantages in allocating their liquidity to firms in the host country due to lower ability than local banks at extracting value from (monitoring, managing and liquidating) firms' collateralizable assets. Several studies document multinational banks' limited experience and information about assets and activities of local borrowers (Giannetti and Ongena, 2012; Mian, 2006), especially small and medium-sized informationally opaque firms or firms with limited international engagement.[1]

We analyze and quantify the impact of multinational banks on the depth and duration of recessions by calibrating parameter values and shock processes of the host country to data on Poland, a country featuring a significant presence of multinational banks. We ask our model: how do multinational banks shape the dynamics of business cycles in the host country? The analysis delivers a nuanced answer: depending on the nature of the shock, multinational banks can act as a stabilizer or an amplifier in the short-run, contractionary phase. Most interestingly, their presence can induce a trade-off between the short-run response of the economy (depth of the contraction) and its medium-run response (speed of the recovery). Consider first a negative shock to the capitalization of the domestic banking sector. Multinational banks can supplant the liquidity shortage in the host country through cross-border transfers to their affiliates via internal capital markets, playing a stabilizing role in the contractionary phase. However, over the medium run, this entails a progressive reallocation of local firms' borrowing and collateral assets from domestic banks, more expert about local firms' assets, to the less expert multinational banks. This reallocation in the credit market slows down the recovery of collateral asset values, credit, and output. Consider next a domestic TFP shock, which reduces multinational banks' return from lending to firms in the host country. On impact multinational banks amplify the shock by repatriating liquidity to their parents in the foreign country. However, in the medium run the reallocation of borrowing in the credit market (towards local banks this time) makes the economy rebound more quickly. Thus, depending on the nature of the shock, multinational banks can act as a stabilizer or an amplifier in the short-run, contractionary phase but their presence can be the source of a trade-off between the short-run response of the economy (depth of a recession) and its medium-run response (speed of the recovery).

When we assess the effects quantitatively, we obtain that in the simulated economies the presence of multinational banks reduces the average depth of recessions (output drop, peak to trough) by up to 5% but it lengthens their average duration (years from peak to recovery) by about 10%. Aggregating these effects through the Reinhart and Rogoff (2014) composite measure of severity of recessions, multinational banks raise the severity index by about 8%.

In the last part of the paper, we examine whether banking regulations and macroprudential policies ameliorate the trade-offs induced by multinational banks. Regulations that increase the costs of multinational banks' transfers accelerate the recovery after a banking shock but reduce the stabilizing role of multinational banks in the contractionary phase. By contrast, higher consolidation of multinational banks' balance sheets (due, e.g., to regulations that incentivize entry through branches rather than subsidiaries) accelerates the recovery after a banking shock without diluting

[1]Foreign banks can have limited knowledge of local markets, assets, and legal procedures, especially when assets are inherently local and non-tradable, and when markets are informationally opaque (Mian, 2006; Dell'Ariccia et al., 1999). Domestic banks may possess private information not available to multinational banks. Further, foreign banks often have a shorter history in lending to local firms than domestic banks and, hence, may have to resort to expensive local experts (Giannetti and Ongena, 2012).

the short-run stabilizing role of multinational banks. The analysis also reveals that macroprudential policies that set countercyclical loan-to-value ratios ameliorate the trade-offs if they target multinational banks' loans.

The paper unfolds as follows. The next section relates the analysis to prior literature. Section 3 provides motivating evidence. Section 4 lays out the model and solves for agents' decisions. Section 5 presents the calibration and the simulation results. Section 6 studies regulations and policies. Section 7 examines alternative model specifications and robustness. Section 8 concludes. The online Appendix contains additional analysis.

2. Prior Literature

Our characterization of multinational banks builds on a broad empirical literature. Multinational banks can withstand domestic liquidity shocks better than local banks by transferring liquidity across borders through internal capital markets (De Haas and Van Lelyveld (2010); Cetorelli and Goldberg (2012b)). However, multinational banks also exhibit less experience and inside information about domestic activities and assets (Detragiache et al., 2008) and are often found to be at a disadvantage at extracting value from (monitoring, managing and liquidating) local firms' assets (see, e.g., Giannetti and Ongena (2012), Mian (2006), and Gormley (2010)). This can result into tighter financing constraints for small and medium-sized local enterprises as foreign banks may primarily allocate liquidity to big and informationally transparent customers (Cárdenas et al., 2003; Stiglitz, 2003).

Our characterization of multinational banks is also akin to static models in banking in which multinational banks have easier access to liquidity but face obstacles in allocating liquidity to local firms. This reduces their ability to replace local banks' credit (Dell'Ariccia et al., 1999) and to deepen credit markets (Detragiache et al., 2008; Gormley, 2010). We find that embedding these features of multinational banks into a dynamic general equilibrium model can yield insightful implications for recessions, recoveries and business cycles.

The paper also relates to a growing literature on the macroeconomic impact of multinational banks. On the theoretical side, Kalemli-Ozcan et al. (2013), Guerrieri et al. (2012), Meier (2013), Iacoviello and Minetti (2006), and Niepmann (2016) stress the "common lender effect" of multinational banks, that is, their lending to multiple countries and, hence, their impact on the cross-country business cycle comovement. Fillat et al. (2018) investigate how the mode of entry through branches or subsidiaries and the structure of multinational banks affect the international transmission of shocks. Unlike these models, we focus on the effects of multinational banks on the depth and duration of business cycles of host countries, finding different effects on contractionary and recovery phases. The paper can then help relate the theoretical literature on multinational banks to the debate on business cycle dynamics and on the depth and duration of recessions (Reinhart and Rogoff, 2014).

On the empirical side, the evidence on the impact of multinational banks on the business cycle of host countries is mixed, with the results suggesting that they can be a buffer or an amplifier depending on conditions and shocks. Multinational banks have been shown to maintain credit amidst a negative financial shock in a host country thanks to cross-border internal flows (Cetorelli and Goldberg, 2012a). On the other hand, De Haas and Van Lelyveld (2014) find that during the 2008-09 crisis they acted as destabilizers by curtailing credit more than domestic banks. Our analysis can help reconcile these findings by dissecting the difference between contractions and recoveries in the influence of multinational banks.

3. Some Motivational Evidence

This section presents motivational evidence on the impact of multinational banks on business cycle dynamics using information from a panel of 25 countries. The panel comprises high-income and upper-middle-income economies with a non-trivial presence of foreign banks and that are not offshore financial centers.[2] The period of observation is dictated by data availability and ranges from a maximum span of three decades (1983-2014) for annual data to a shorter span (from 2000Q1 to 2014Q4) for additional analysis with quarterly data.

Case studies. We first conducted a case study analysis, exploring whether in our panel episodes of recessions point to the patterns predicted by the model. In the Appendix, we discuss the early 2000s recession in Turkey, and the mid-1990s and early 2000s recessions in Chile and Mexico. In 2000, a wave of non-performing loans hit Turkish banks' net worth. Since their entry in the 1980s, multinational banks had remained confined to specific activities, such as the financing of large companies. This limited the accumulation of experience about small and medium-sized local firms. During the 2000-2002 contractionary phase, multinational banks significantly expanded their lending to Turkish businesses, partially replacing the retrenching credit of domestic banks. This allegedly moderated the contraction of credit and output. However, in the following years, concerns rose about multinational banks' ability to smoothly replace domestic banks, due to their limited local experience. The recovery was relatively slow; in 2009, for example, unemployment was still above pre-crisis levels. Overall, multinational banks allegedly helped smooth the contraction, but the costly adjustment process associated with their expansion in the credit sector appeared to complicate the path to the recovery.

In the Appendix, we provide more details on this recession of Turkey and also compare the early 2000s recession of Chile (a country with a significant presence of multinational banks at the time) with the 1990s recession of Mexico (a country with a limited presence of multinational banks at the time). This comparison further suggests that, following domestic banking disruptions, multinational banks help mitigate contractions but the reallocation in the credit market induced by their expanding presence can slow down the recoveries.

Regression analysis. To conduct a regression analysis we follow the methodology of prior studies

[2] See the Appendix for details on the countries.

on business cycle dynamics (Reinhart and Rogoff, 2014; Cecchetti et al., 2009; Cerra and Saxena, 2008). Three sources of information are used. First, we use the real GDP series from the Penn World Table, measured in international U.S. dollars. By running a variation of the Bry and Boschan (1971) algorithm, we use real GDP to identify business cycle peaks and troughs for each country and construct two 0/1 indicators: one for "contractions" ($Contr$), defined as periods from peaks to troughs of the business cycle; and one for "recoveries" ($Recov$), defined as periods from troughs to the GDP level of the previous peak. Second, we exploit information from the World Bank Global Financial Development Database and the BIS International Banking Statistics to construct a proxy for the relative presence of multinational banks in a country, the ratio of foreign banks' credit over total domestic credit ($ForBank$). We mainly focus on this ratio in first differences but also experiment with it in levels. Third, we use proxies for financial disruptions ($FinDis$) to capture the financial or non-financial nature of the recessionary shocks. The first is the financial distress measure of Romer and Romer (2017). This ranges from 0 to 14 and can help capture the intensity of financial disruptions but it is not available for our entire panel. The second is the 0/1 indicator of occurrence of banking and financial crises of Laeven and Valencia (2018).

Inspection of the data reveals that on average in the 1983-2014 period an economy in our panel was in a recessionary phase (a contraction or a recovery) in one out of six years. About 60 percent of the recession years featured financial disruption, according to the Laeven and Valencia index. In the economies for which the Romer and Romer index is available, financial distress occurred in 25 recessions, about 50 percent of the recessionary episodes; the mean value of the index was 4.49 conditional on financial distress occurring. On average the ratio of foreign banks' credit to total domestic credit equaled 0.26; its standard deviation was 0.18, with the between and within standard deviations equalling 0.16 and 0.07, respectively.

We estimate the following empirical model

$$\begin{aligned} GDP_{it} = \alpha_i + \alpha_t + \sum_{j=1}^{p} \beta_j GDP_{i,t-j} + \gamma Contr_{it} + \delta Recov_{it} + \zeta ForBank_{i,t-1} + \\ + \eta FinDis_{i,t} + Contr_{it} \times ForBank_{i,t-1} \times (\theta_1 + \theta_2 FinDis_{it}) + \\ + Recov_{it} \times ForBank_{i,t-1} \times (\iota_1 + \iota_2 FinDis_{it}) + \kappa \mathsf{Double} + \lambda \mathsf{Z}_{it} + \epsilon_{it} \end{aligned} \tag{1}$$

where GDP_{it} is the percent GDP growth in country i and year (or quarter) t; $Contr_{it}$ and $Recov_{it}$ are dummies that respectively take the value of one in contractions and in recoveries, zero otherwise; $ForBank$ refers to the ratio of foreign bank credit to total domestic credit, expressed in first differences; and $FinDis$ is the Romer and Romer (RR) or the Laeven and Valencia (LV) index for financial disruption.[3] The regression includes double and triple interaction terms containing $Contr$ (or $Recov$), $ForBank$, and $FinDis$. We are mainly interested in the coefficients on the double and triple interactions containing $Contr$ (or $Recov$) and $ForBank$ (θ_1, θ_2, ι_1, ι_2),

[3] For the lagged GDP growth, we set $p = 1$ with annual data and $p = 4$ in the additional tests with quarterly data. The results are robust to alternative lag structures.

highlighted in (1). These reflect multinational banks' impact on GDP growth during contractions and recoveries. In particular, the triple interactions allow this impact to depend on the financial or non-financial nature of the recessionary shocks (proxied by $FinDis$). We estimate the regression using country (α_i) and time (α_t) fixed effects and lagged values of $ForBank$ to minimize the risk of endogeneity.[4] However, we also experiment with dropping either the time or the country fixed effects to assess whether the results are mostly driven by cross-country differences or by intertemporal changes in recession patterns. In augmented specifications, we add further controls (Z_{it}) for FDI net inflows and total bank assets, as percentages of the GDP, and the real effective exchange rate. In our large T, small N setting, we also allow for cross sectional dependence (spatial correlation) as in Vogelsang (2012).[5]

Table 1, Panel A, presents the estimates of the main coefficients of interest (see Appendix Table A.1 for the full results); Panel B presents alternative specifications. Multinational banks appear to slow down the recoveries from recessions accompanied by financial disruption. For example, in the specification with the Laeven and Valencia index of financial disruption (Panel A, column 2), the sum of the coefficients on the double interaction $Recov_{it} \times ForBank_{i,t-1}$ and the triple interaction $Recov_{it} \times ForBank_{i,t-1} \times FinDis_{it}$ suggests that during a recovery from financial disruption a 5 percentage points larger increase in foreign bank presence is associated with a 0.25 percentage points lower GDP growth. On the other hand, we find no evidence that multinational banks deepen the contractionary phase during financial disruptions. If anything, the alternative specification with $ForBank$ in levels in column 7 of Panel B suggests that they could mitigate such contractions.

A different impact of multinational banks between contractions and recoveries emerges also for recessions not accompanied by financial disruption. However, unlike for financial disruptions, in this case multinational banks appear to contribute to faster recoveries. For example, the coefficient on $Recov_{it} \times ForBank_{i,t-1}$ in Panel A, column 2, suggests that a 5 percentage points larger increase in foreign bank presence is associated with a 0.45 percentage points higher GDP growth during the recoveries from such recessions.

In columns 4-5 we reestimate the regressions by dropping the time or the country fixed effects. We find that both cross-sectional and time-series effects play a role in the results.

To summarize, the data suggest two patterns. First, multinational banks appear to have a different impact on contractions and recoveries. Second, depending on the financial or non-financial origin of recessions, multinational banks appear to slow down the recoveries (financial shocks) or accelerate the recoveries (non-financial shocks). These patterns are broadly consistent with the predictions of the theoretical model, as we elaborate below.[6]

[4] Since our data set is a "large T, small N" panel we do not incur in the dynamic bias issue. Moreover, the large time dimension prevents Anderson-Hsiao or Arellano-Bond estimation.

[5] In particular, we implement fixed-b critical values (Vogelsang, 2012).

[6] The data are ill-suited to separate foreign banks' cross-border claims from their local claims, which are closer to our theoretical specification. For example, BIS data on cross-border claims include local claims in foreign currency, a relevant and volatile component of local claims in several countries. Nonetheless, we also reestimated the regressions using local and cross-border claims separately (see Appendix Table A.2). The results suggest that the patterns are more pronounced when using local claims. Thus, if anything, including cross-border claims can lead to underestimate the effects of foreign banks. While suggestive because of data limitations, this is consistent with results of the

4. The Model Economy

Time is discrete and the horizon infinite. To model the operations of multinational banks, we consider an economy with two countries, "host" and "foreign". There are a continuum of representative households and a continuum of representative entrepreneurs in each country. We focus on agents' decisions in the host country; decisions in the foreign country are symmetric, unless otherwise specified.[7] Households' and entrepreneurs' preferences are

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\left(C_t - \frac{H_t^{1+\epsilon}}{1+\epsilon}\right)^{1-\gamma} - 1}{1-\gamma}, \quad \text{and} \quad \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_e^t \frac{(C_t^e)^{1-\gamma_e} - 1}{1-\gamma_e}, \tag{2}$$

where C_t and C_t^e denote households' and entrepreneurs' consumption, respectively, and H_t denotes labor. To generate an incentive for entrepreneurs to borrow, we assume that they are less patient than households, i.e., $\beta_e < \beta$.

Entrepreneurs have access to a constant-returns-to-scale production technology that uses labor and capital to produce goods used for consumption and investment: $Y_t = A_t K_{t-1}^{\alpha} H_t^{1-\alpha}$.

There is a capital-good production firm, which is owned by households. The capital-good producer can invest in I_t units of capital goods, which cost $I_t \left[1 + f\left(\frac{I_t}{I_{t-1}}\right)\right]$ units of consumption goods. $f(.)$ captures the adjustment cost in the capital-producing technology, and satisfies $f(1) = 0$, $f'(1) = 0$, and $f''(.) > 0$. Capital depreciates at the rate δ.

4.1. Households

We model households in a way similar to Gertler and Karadi (2011). Within the representative household there is a continuum of members of two types: workers and bankers. Each worker supplies labor in a competitive labor market and earns wage income. Each banker operates a bank and transfers dividends to the household. Within the household there is perfect consumption insurance. We assume an exogenous turnover between bankers and workers to limit bankers' ability to save to overcome financial constraints (described below). In every period, with an i.i.d. probability $1-\sigma$ a banker exits her business and becomes a worker. Upon exiting, she transfers her retained earnings to the household.[8] An equal mass of workers become bankers in each period. Each new banker receives a startup transfer from the household, as a small and exogenous fraction $\frac{\zeta}{1-\sigma}$ of the total assets of exiting bankers.

theoretical model (see Section 5.2). There is also a data-driven reason why we do not expect cross-border claims to drive the estimates. Such claims often consist of government bond holdings, rather than credit to firms. For example, partial BIS data suggest that in 2007, on average, in our countries, about 20% of such claims consisted of credit to private firms.

[7] Figure A.1 in the Appendix displays the structure of the model economy.

[8] Like in Gertler and Karadi (2011) and an extensive literature, capital constraints always bind for bankers in the neighborhood of the steady state (see below and the Appendix for details). Thus, bankers will always retain earnings while in business and pay dividends upon exiting.

A household can deposit funds in banks (other than the ones it owns). It maximizes its lifetime utility by choosing consumption C_t, deposits D_t, and labor supply H_t:

$$\max_{\{C_t, H_t, D_t\}_{t\geq 0}} \quad \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\left(C_t - \frac{H_t^{1+\epsilon}}{1+\epsilon}\right)^{1-\gamma} - 1}{1-\gamma}, \tag{3}$$

$$\text{s.t.} \quad C_t = W_t H_t + \Pi_t + R_{t-1}^D D_{t-1} - D_t, \tag{4}$$

where Π_t denotes the net transfers received from bankers and capital-good producers, $W_t H_t$ is labor income and $R_{t-1}^D D_{t-1}$ denotes repayments on deposits.

4.2. Banks

There are two types of banks. The first is a local bank (l) which gathers deposits from host-country households and extends loans to host-country entrepreneurs (and analogously for a local bank in the foreign country). The second type is a global (or multinational) bank (g). A global bank consists of a parent that operates (gathers deposits and extends loans) in the foreign country and an affiliate that operates in the host country. A global bank can make transfers between the parent and the affiliate subject to a cost. It is run by a pair of bankers from the foreign country household. When the bankers exit, they terminate the business at both the parent and the affiliate.

The sequence of events in period t is the following. First, aggregate shocks realize. Then, production takes place. Thereafter, banks learn whether they exit and new banks enter the business. Finally, surviving banks take deposits from households and extend loans to entrepreneurs. Global banks also make transfers between the parent and the affiliate.

4.2.1. Multinational banks

We first describe the decision problem of a global bank. After the aggregate shocks realize, the affiliate chooses loans to entrepreneurs in the host country X_t^g and deposits D_t^g to maximize the expected discounted sum of dividend distributions to the foreign household

$$V_t^g \equiv \max_{\{X_{t+j}^g, D_{t+j}^g\}_{j\geq 0}} \quad \mathbb{E}_t \sum_{j=0}^{\infty} (1-\sigma)\sigma^j \Lambda_{t,t+j+1}^* N_{t+j+1}^g \tag{5}$$

$$\text{s.t.} \quad X_t^g = N_t^g + Z_t^g + D_t^g, \qquad [\lambda_t^g] \tag{6}$$

$$R_t^D D_t^g + \theta Z_t^g \leq \xi \left[(1-\phi) R_t^{X,g} X_t^g + \phi R_t^{X,g,*} X_t^{g,*}\right], \qquad [\mu_t^g] \tag{7}$$

where $\Lambda_{t,t+j+1}^*$ is the foreign household's stochastic discount factor, R_t^D is the gross deposit rate, $R_t^{X,g}$ is the gross loan rate charged by the affiliate, and net worth is $N_{t+1}^g = R_t^{X,g} X_t^g - R_t^D D_t^g$. The affiliate takes as given the parent's portfolio choice and the transfer Z_t^g from the parent (or to the parent, if $Z_t^g < 0$), which is determined at the conglomerate level. Equation (6) is the resource constraint. Equation (7) is a (regulatory or market) capital constraint, which requires that the weighted sum of bank liabilities cannot exceed a fraction ξ of bank assets. The constraint (partially) consolidates the assets of the affiliate and the parent, where the weight on the parent is $\phi \leq 0.5$. $\phi = 0.5$ implies full consolidation; $\phi = 0$ implies complete separation.[9] θ captures the weight on the transfer Z_t^g in the constraint.

The first order conditions w.r.t. loans X_t^g and deposits D_t^g are

$$[\partial X_t^g]: \quad -\lambda_t^g + \xi(1-\phi)\mu_t^g R_t^{X,g} + \mathbb{E}_t \Lambda_{t,t+1}^* \left(1 - \sigma + \sigma \lambda_{t+1}^g\right) R_t^{X,g} = 0, \tag{8}$$

$$[\partial D_t^g]: \quad \lambda_t^g - \mu_t^g R_t^D - \mathbb{E}_t \Lambda_{t,t+1}^* \left(1 - \sigma + \sigma \lambda_{t+1}^g\right) R_t^D = 0. \tag{9}$$

Equation (8) equalizes the marginal cost of loans, given by a tightening of the current resource constraint (λ_t^g), to their marginal benefit, given by a relaxation of the current-period capital constraint (μ_t^g) and the next-period resource constraint (λ_{t+1}^g). Likewise, equation (9) equalizes the marginal cost and benefit of deposits. The envelope condition reads:

$$\frac{\partial V_t^g}{\partial Z_t^g} = \lambda_t^g - \theta \mu_t^g. \tag{10}$$

It states that a larger transfer received from the parent relaxes the resource constraint of the affiliate but can tighten its capital constraint by a factor θ.

The parent bank solves a similar problem, taking the transfer as given:

$$V_t^{g,*} \equiv \max_{\{X_{t+j}^{g,*}, D_{t+j}^{g,*}\}_{j \geq 0}} \quad \mathbb{E}_t \sum_{j=0}^{\infty} (1-\sigma)\sigma^j \Lambda_{t,t+j+1}^* N_{t+j+1}^{g,*}, \tag{11}$$

$$\text{s.t.} \quad X_t^{g,*} = N_t^{g,*} + Z_t^{g,*} - \frac{\psi}{2}\left(Z_t^{g,*} - \bar{Z}^{g,*}\right)^2 + D_t^{g,*}, \qquad [\lambda_t^{g,*}] \tag{12}$$

$$R_t^{D,*} D_t^{g,*} + \theta Z_t^{g,*} \leq \xi \left[(1-\phi) R_t^{X,g,*} X_t^{g,*} + \phi R_t^{X,g} X_t^g\right], \qquad [\mu_t^{g,*}] \tag{13}$$

where net worth is $N_{t+1}^{g,*} = R_t^{X,g,*} X_t^{g,*} - R_t^{D,*} D_t^{g,*}$, and an upper bar denotes steady-state value. Similarly as before, the capital constraint (13) (partially) consolidates the balance sheets of the parent and the affiliate, where $\phi \leq 0.5$ is the weight on the affiliate. Transfers between the parent and the affiliate incur a quadratic cost as in the resource constraint (12) (see De Haas and Van Lelyveld, 2010, and the discussion below for examples of such costs).

The parent's first order conditions for loans and deposits are isomorphic to those of the affiliate. The marginal value of the transfer at the parent is

$$\frac{\partial V_t^{g,*}}{\partial Z_t^{g,*}} = \lambda_t^{g,*} - \theta \mu_t^{g,*} - \psi\left(Z_t^{g,*} - \bar{Z}^{g,*}\right) \lambda_t^{g,*}. \tag{14}$$

[9] Given that we impose a symmetric constraint for the parent, if the parameter ϕ also multiplied liabilities in (7), the balance sheets of parent and affiliate would be decoupled. Details are available from the authors.

The transfers Z_t^g and $Z_t^{g,*}$ are chosen at the conglomerate level:

$$\max_{Z_t^g, Z_t^{g,*}} \quad V_t^g + V_t^{g,*}, \tag{15}$$

$$\text{s.t.} \quad Z_t^g + Z_t^{g,*} = 0. \tag{16}$$

The first order condition equalizes the marginal values of transfers at the parent and the affiliate in (10) and (14), that is,

$$\lambda_t^{g,*} - \theta\mu_t^{g,*} - \psi\left(Z_t^{g,*} - \bar{Z}^{g,*}\right)\lambda_t^{g,*} = \lambda_t^g - \theta\mu_t^g. \tag{17}$$

When there is no adjustment cost of making transfers ($\psi = 0$) and transfers from the parent are not subject to a capital requirement ($\theta = 0$), the shadow value of net worth is equalized between the parent and the affiliate ($\lambda_t^{g,*} = \lambda_t^g$).

4.2.2. Local banks

Local banks make decisions on deposit taking and loan extension to maximize their value

$$V_t^l \equiv \max_{\{X_{t+j}^l, D_{t+j}^l\}_{j\geq 0}} \quad \mathbb{E}_t \sum_{j=0}^{\infty} (1-\sigma)\sigma^j \Lambda_{t,t+j+1} N_{t+j+1}^l, \tag{18}$$

$$\text{s.t.} \quad X_t^l = N_t^l + D_t^l, \qquad [\lambda_t^l] \tag{19}$$

$$R_t^D D_t^l \leq \xi R_t^{X,l} X_t^l, \qquad [\mu_t^l] \tag{20}$$

where net worth is $N_{t+1}^l = R_t^{X,l} X_t^l - R_t^D D_t^l + \bar{N}^l \epsilon_t^N$. ϵ_t^N is an exogenous shock to local banks' net worth. Unlike global banks, (i) local banks do not receive or make any transfer; (ii) their capital constraint (20) only involves their own balance sheets.

4.3. Entrepreneurs

The representative entrepreneur uses labor H_t and capital K_{t-1} to produce output Y_t. Entrepreneurs can take loans from global banks (X_t^g) and local banks (X_t^l) but must pledge capital as collateral because of enforcement problems (see, e.g., Kiyotaki and Moore, 1997).

To capture global banks' disadvantage due to their more limited experience and inside information about local firms and assets in the host country, we posit different collateral liquidation technologies of global and local banks. In case of debt repudiation, local banks can liquidate a fraction κ^l of the collateral; global banks can liquidate a fraction $\kappa^g > \kappa^l$ of the collateral, but they also need to pay a convex liquidation cost. That is, global banks are more efficient at liquidating collateral when the amount of collateral is small (perhaps because of their more sophisticated lending technologies), but their liquidation technology exhibits decreasing returns to scale.[10] Below, we further elaborate on this specification.

The entrepreneur solves the following problem:

$$\max_{\{H_t, C_t^e, K_t, X_t^g, X_t^l, f_t\}_{t\geq 0}} \qquad \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_e^t \frac{(C_t^e)^{1-\gamma_e} - 1}{1-\gamma_e} \tag{21}$$

$$\text{s.t.} \quad C_t^e + Q_t K_t + R_{t-1}^{X,g} X_{t-1}^g + R_{t-1}^{X,l} X_{t-1}^l = X_t^g + X_t^l + Y_t - W_t H_t + (1-\delta) Q_t K_{t-1}, \tag{22}$$

$$R_t^{X,g} X_t^g \leq \kappa^g \left[(1-f_t) Q_t K_t - \frac{\nu}{2\bar{Q}\bar{K}} (1-f_t)^2 Q_t^2 K_t^2 \right], \qquad [\omega_t^g] \tag{23}$$

$$R_t^{X,l} X_t^l \leq \kappa^l \left(f_t Q_t K_t \right), \qquad [\omega_t^l] \tag{24}$$

where f_t is the fraction of capital that is pledged as collateral to the local bank, $1-f_t$ is the fraction that is pledged to the multinational bank, and Q_t is the price of capital.

The first order conditions for capital demand K_t and collateral allocation f_t read:

$$[\partial K_t] \quad -Q_t U_{c^e,t} + \kappa_t^g \omega_t^g \left[(1-f_t) Q_t - \frac{\nu}{\bar{Q}\bar{K}} (1-f_t)^2 Q_t^2 K_t \right] + \kappa^l \omega_t^l f_t Q_t, \tag{25}$$

$$+ \beta_e \mathbb{E}_t \left[(1-\delta) Q_{t+1} + \frac{\alpha Y_{t+1}}{K_t} \right] U_{c^e,t+1} = 0,$$

$$[\partial f_t] \quad f_t = 1 - \frac{\bar{Q}\bar{K}}{\nu Q_t K_t} \frac{\kappa^g \omega_t^g - \kappa^l \omega_t^l}{\kappa^g \omega_t^g}. \tag{26}$$

The allocation f_t of collateral and borrowing between local and multinational banks depends on the tightness of collateral constraints as well as on the value of collateral ($Q_t K_t$).

To recapitulate, at the liquidity origination stage global banks' affiliates can quickly obtain funds from parents (or repatriate funds) through transfers. At the liquidity allocation stage, global banks have a collateral liquidation technology that is initially more efficient than local banks but exhibits decreasing returns to scale. Multinational banks may count on more sophisticated lending techniques when financing high-end projects and borrowers, such as large and internationally active companies in a host country (BIS, 2008). However, as they delve deeper into the local credit market, turning to fund smaller, locally oriented and informationally opaque businesses, their scarce experience and information about local borrowers and assets may hinder their credit provision (Detragiache et al., 2008). Stiglitz (2003, p.69), for example, summarizes this point: "while the [foreign] banks easily provide funds to multinationals, and even large domestic firms, small and

[10] One can think that in our economy, if their local experience and knowledge were as abundant as for local banks, multinational banks would have a linear liquidation technology with a lower average liquidation cost than local banks. Yet they suffer from diseconomies of scale. Hence, for sufficiently high values of collateral, the advantage due to their organized offices is offset by their limited local experience.

medium-size firms complained of a lack of access to capital. International banks' expertise - and information base - lies in lending to their traditional clients." We capture this aspect by positing that multinational banks' ability to monitor and liquidate the collateral assets of local firms worsens as they expand the volume of loans granted in the local economy (possibly in substitution of local banks). The Appendix provides a microfoundation based on firm heterogeneity in the informational complexity of collateralizable capital as well as suggestive bank-level evidence.

4.4. Closing the model

The rest of the model is standard. The capital-good producer chooses investment to maximize the present discounted value of lifetime profits. From the profit maximization condition, the price of capital goods is equal to the marginal cost of producing capital goods:

$$Q_t = 1 + f\left(\frac{I_t}{I_{t-1}}\right) + \frac{I_t}{I_{t-1}} f'\left(\frac{I_t}{I_{t-1}}\right) - \mathbb{E}_t \Lambda_{t,t+1} \left(\frac{I_{t+1}}{I_t}\right)^2 f'\left(\frac{I_{t+1}}{I_t}\right). \tag{27}$$

In the Appendix, we present the rest of the equilibrium conditions.

5. Results

This section takes the model to the data and presents the main results. For calibration, we use fairly standard parameters for preferences and technology and calibrate the banking sector parameters and the shock processes of the host country to data on Poland, a country featuring a significant presence of multinational banks (Allen et al., 2013). We first study the impulse responses to net worth shocks of domestic banks and to TFP shocks (Sections 5.2-5.3). From the responses, it will become clear that after negative shocks the presence of multinational banks induces a trade-off between the depth of contractions and the duration of recoveries. These responses are broadly consistent with the evidence in Section 3. Next, we simulate the model, study conditional variances at various horizons, and quantify the impact of multinational banks on the depth and duration of recessions (Section 5.4).

5.1. Calibration

We solve the model numerically by linearly approximating it around the non-stochastic steady state. Parameters are shown in Table 2. The discount factor of entrepreneurs β_e is set to 0.98, smaller than the household discount factor β, which is set to 0.99. This is necessary to generate borrowing of entrepreneurs from bankers in the household. We let entrepreneurs be risk neutral and set $\gamma_e = 0$. Following Gertler et al. (2012), we set $f''(1) = 1$, so that the steady-state elasticity of capital price to investment is 1.

We estimate independent $AR(1)$ processes for the local banks' net worth shock, ϵ_t^N, and the

TFP shock, A_t, in the host country.[11] Bank net worth data are from the Central Bank of Poland for the 1997-2017 period. TFP at constant national prices for 1990-2017 is from the Penn World Tables version 9.1 (Feenstra et al., 2015). The data are logged and Kalman-filtered. The estimated persistences of the TFP and bank net worth shocks are 0.877 and 0.875, and the standard deviations are 0.0068 and 0.0194, respectively. The parameters governing the bank capital constraint are the weight on bank assets ξ, the bankers' probability of survival σ, and the fraction of assets brought by new bankers ζ. We choose $\xi = 0.863$ in the host country, so that bank leverage is 7.42 in steady state, the average in Polish data in 1997-2017. We choose $\xi = 0.878$ in the foreign country, so that bank leverage is 8.3 in steady state. This is consistent with the aggregate bank leverage for several economies. For example, World Development Indicators data reveal that on average in 2010-2014 aggregate bank leverage was 8.2 in the United States and that in 2014 it was 8.6 in countries of Central Europe and of the Baltic Region. Following Gertler et al. (2012), we set $\sigma = 0.969$, implying that bankers survive for eight years on average. We set ζ such that the steady-state spread between the loan rate and the deposit rate is 100 basis points per year.

The parameter ϕ governs the consolidation of global banks' balance sheets. Typically branches are allowed for consolidation and subsidiaries are not. We set ϕ to 0.069, reflecting the share of foreign bank assets accounted for by branches in Poland around the mid-point of the 1997-2014 period (Allen et al., 2013). θ is the weight of transfers in the bank capital constraint, as determined by regulatory or market requirements and by the composition of flows in internal capital markets. In line with other studies on the composition of flows, Allen et al. (2013) report that in 2007-2009 for Unicredit and Citigroup, banks with large networks of affiliates in Eastern Europe, the flows between Polish affiliates and the parent consisted for 60% of loans and other non-equity flows. We set θ to 0.6. The parameters κ^l, κ^g and ν dictate the tightness of entrepreneurs' collateral constraints. We calibrate κ^l to 0.6 to match LTV ratios that are typical for Poland. κ^g is chosen as 0.65, higher than κ^l, and ν as 0.292, so that multinational banks account for 30% of loans in the host country, in line with reports of the Polish Bank Association for the mid-point of the period under consideration. In the foreign country, κ^l and κ^g are also set to 0.6 and 0.65, respectively, to match the LTV ratio observed in a wide range of countries (Jácome and Mitra, 2015). We set ν such that local bank loans are about three times as large as global bank loans.[12]

5.2. Banking shocks

Following prior studies (e.g., Gertler and Karadi, 2011; Guerrieri et al., 2012) we experiment with an unexpected one-standard-deviation negative shock (-1.94%) to the net worth of local banks in the host country (N_t^l), that is, a shock to ϵ_t^N as defined in Section 4.3.2.[13] The impulse responses for the

[11] In robustness analysis, we also estimated the shock processes jointly using a VAR (see the Appendix).

[12] In 2007, the world foreign bank assets represented about 25% of total bank assets (Global Financial Development Database, World Bank).

[13] This can represent (in reduced form) a wave of defaults hitting banks' portfolios or a drop in banks' asset values. The results remain virtually unaffected if the shock takes the form of a transfer from local banks to households, rather than a deadweight loss for local banks (details available from the authors).

host country are in Figures 1 and 2 (solid lines).[14] To better grasp the role of multinational banks, we compare the responses in our benchmark economy with three alternative settings (dashed-dotted lines). In the first (Figure 1) multinational banks cannot alter transfers (Z_t^g is fixed). In the second (Figure 2) entrepreneurs cannot alter the allocation of collateral between local and multinational banks (f_t is fixed). In the third (detailed in the Appendix) global banks grant cross-border loans to entrepreneurs in the host country rather than through affiliates (see, e.g., Dedola et al., 2013).

A reduction in the net worth of local banks in the host country tightens their capital constraint and thereby lowers their loan supply (solid lines in Figure 1). This, in turn, causes the marginal value of liquidity in the affiliates of multinational banks to rise. The parents thus increase transfers (Z_t^g) to the affiliates, boosting their loanable liquidity. As a result of the lower loan supply of local banks and the larger loan supply of multinational banks' affiliates, entrepreneurs lower the share f_t of collateral pledged to local banks. In the contractionary phase multinational banks thus mitigate the impact of the shock on investment, capital and output, attenuating the depth of the recession. Thanks to the increase in the loan supply of multinational banks' affiliates, facilitated by the transfers from the parents, the collateral constraint for entrepreneurs is relaxed and they can afford to cut their investment by less during the first few periods after the shock. This can be grasped by comparing the responses with those of the economy with fixed transfers (dashed-dotted lines).

In the medium to long run, however, multinational banks turn into an obstacle to the recovery. As entrepreneurs reduce their pledges to local banks (lower f_t), their borrowing gets reallocated towards multinational banks. Since at the margin multinational banks exhibit a less efficient technology for collateral monitoring and liquidation, this progressively reduces the average pledgeability of capital as collateral. There is also a general equilibrium effect: the marginal value of capital as collateral keeps dropping as entrepreneurs switch to the less efficient collateral users, so entrepreneurs' demand for collateral tends to drop, too, slowing down the recovery of the collateral price Q_t. These effects cause a slower recovery than in the alternative setting with fixed transfers of multinational banks.

Figure 2 shows the comparison with a second alternative model in which the share of capital pledged to local banks (f_t) is fixed at its steady-state value. Again, the responses reveal a milder contraction but a longer recovery in the benchmark model. Finally, in the Appendix we show that a similar conclusion can be reached when comparing our benchmark economy with a model featuring international banking through cross-border claims.[15]

[14] See the Appendix for the impulse responses of the foreign country. In the Appendix, we also show the responses of the Lagrange multipliers on banks' capital constraints.

[15] In our economy banks' balance sheet consolidation is inherently lower than in the alternative economy with banks' cross-border claims. As shown in Section 6, this tends to increase the sluggishness of recoveries. On the other hand, affiliates can fund loan expansion through transfers from parents (e.g., equity transfers) which tighten capital constraints less than deposit gathering ($\theta < 1$). As shown in Section 6, this may ease loan expansion and mitigate contractions. These differences may explain why our economy exhibits milder contractions but slower recoveries. Further, granting cross-border loans can imply a less efficient collateral liquidation technology than lending through the expertise of local affiliates. As shown in the Appendix, this further accentuates the difference between the two economies.

5.3. TFP shocks

In this section, we experiment with a one-standard-deviation negative TFP shock in the host country (-0.68%). The results are in Figure 3 for both the benchmark model (solid line) and the alternative model where multinational banks' transfers are fixed. In the host country, lower TFP reduces the marginal product of capital and the capital price Q_t. As a result, the collateral value falls, causing entrepreneurs to take fewer loans from both global and local banks and contract their investment. In our economy, the parents repatriate funds from the affiliates in the host country. Therefore, loans by multinational banks drop by more than in the alternative economy. Loans by local banks decrease by less to compensate for the global banks' loan cut, but the overall loan supply still decreases by more in our benchmark economy. In line with the findings of the empirical literature, following a drop in returns in the host country, multinational banks initially act as a destabilizer by repatriating liquidity.

Again, however, a trade-off arises between the contraction and the recovery. In our economy, entrepreneurs in the host country now pledge a larger fraction of collateral to local banks (f_t increases). This sustains the demand for capital (since its marginal value as collateral is now higher), causing the value of collateral to drop but less than in the alternative setting. As a result, entrepreneurs' collateral constraints tighten by less in our economy than in the alternative, which helps the host economy to recover faster. In conclusion, in this case multinational banks amplify the shock in the short run but accelerate the recovery.

5.4. A quantitative assessment

We assess the extent to which the mechanisms illustrated by the impulse responses can help account for macroeconomic fluctuations. We first illustrate the trade-off between short and medium run by examining conditional variances at various horizons. Then, we quantify the impact of multinational banks on the depth and duration of recessions.

We feed the estimated processes for the local banks' net worth shock and for the TFP shock into our benchmark model and compute conditional variances at various horizons (see Table 3). We also compute conditional variances for the models with fixed transfers (constant Z_t^g) and with a fixed allocation of collateral (constant f_t). We then calculate the ratios of conditional variances in our model to those in the alternative models (Figure 4) and study the dynamics of these ratios at various horizons for bank net worth and TFP shocks.

For bank net worth shocks, recall that the impulse responses show a stabilizing effect in the short run and a destabilizing effect at longer horizons (sluggish recovery). Figure 4 confirms these predictions. First, as the horizon increases the ratio of variances in our model to those in the fixed-transfer model rises as the stabilizing effect of global banks' transfers fades from our model but, by construction, not from the model with fixed transfers (Figure 4(a)). For example, from the 8th to the 28th quarter, the ratio increases by 2.02 times for output. Second, as the horizon increases the ratio of variances in our model to those in the model with fixed f_t rises as the destabilizing effect of collateral reallocation towards global banks starts kicking in in our model but, by construction, not in the fixed-f_t model (Figure 4(b)). From the 8th to the 28th quarter, the ratio increases by 2.26 times for output.

For TFP shocks, recall that the impulse responses show a destabilizing effect in the short run due to repatriation of liquidity to parents, and a stabilizing effect at longer horizons due to reallocation of borrowing towards domestic banks (more efficient at managing collateral). Consistent with these predictions, as the horizon increases, the ratio of variances in the benchmark model to those in the alternative models drops (Figure 4).

Next, we quantify the impact of multinational banks on the depth and duration of recessions by simulating the benchmark and the alternative models using random draws of bank net worth shocks and TFP shocks. We conduct a 11,000-quarter stochastic time-series simulation, drop the initial 1,000 quarters, and use the remaining data to identify recessionary periods. We identify recessions for the host country whenever its output series is more than one standard deviation below zero (Abiad et al., 2011). The start of a recession is identified as the quarter following the peak. We compute the depth of a recession as the peak-to-trough percentage output drop and compute the duration of a recession as the number of years it takes for output to return to the pre-recession peak. Following Reinhart and Rogoff (2014), we also compute a composite measure of severity of a recession as the sum of the depth and duration of the recession. We simulate the model 3,000 times, collect all recessionary episodes, and calculate the average depth, duration and severity across all recessions.

Table 4, Panel A, displays the results. Again, recall that the benchmark economy features short-run stabilization and long-run sluggishness in the recovery for bank net worth shocks but the opposite for TFP shocks. For the calibrated Polish economy, relative to the fixed-transfer model, in the benchmark model the average depth and duration of recessions are about 5% smaller and 5% longer, respectively (6.51% versus 6.72% for the depth; 16.47 versus 15.71 years for the duration). Relative to the fixed-f_t model, the average depth is slightly smaller (6.63% versus 6.72%), whereas the average duration is 12% longer (16.47 versus 14.66 years). In the benchmark model the mean value of the severity index is 22.98 (Reinhart and Rogoff, 2014, report a mean index of 19.84 across 100 recessions). This is 8% higher than in the fixed-f_t model and slightly higher than in the fixed-transfer model.

6. Regulations and Policies

This section investigates how banking regulations and macroprudential policies affect the trade-offs following banking shocks. The insights can easily be adapted to TFP shocks.

Figure 5(a) illustrates the role of the costs of making transfers (ψ) following a banking shock. In recent years, various countries have introduced regulations that have altered the cost of transferring funds for global banks (Allen et al., 2013). Higher costs mean smaller transfers and this weakens the stabilizing property of transfers in the short run. However, the switch from local to global banks is dampened, too. Thus, in the medium run the reduction in collateral pledgeability gets moderated and the recovery is faster than with a lower ψ.

Figure 5(b) considers the capital requirement (θ) on transfers (as reflecting, e.g., regulations that encourage transfers through loans rather than equity injections). A higher θ means that, when an affiliate receives a transfer, its capital constraint tightens more than with a lower θ. This deters transfers, diluting the stabilizing role of multinational banks in the contractionary phase but also their cost in terms of slower recovery.

Figure 5(c) considers the consolidation of multinational banks' balance sheets (ϕ). As noted, ϕ may reflect the share of affiliates consisting of branches rather than subsidiaries. When balance sheets are consolidated (higher ϕ), parent banks know that, by boosting affiliates' loans, they also relax their own capital constraint. Thus, they have the incentive to make larger transfers. On the other hand, higher consolidation implies that affiliates' assets matter less for their own capital constraint. This lowers affiliates' marginal value of lending, reducing the reshuffling from local to multinational banks. All in all, higher consolidation entails no short-run cost and a less extreme reshuffling of borrowing, and hence a faster recovery. The experiments thus suggest that stability can be enhanced by regulations that push multinational banks towards a branch-based network (Allen et al., 2013). Table 4, Panel B, repeats the quantitative exercise of Section 5.4 for different values of ψ, θ, and ϕ. As the panel shows, raising consolidation (ϕ) consistently reduces the severity index.

In Figure 5(d), we study macroprudential policies that set countercyclical loan-to-value (LTV) ratios in the host country. We first posit that when a firm borrows from global banks its LTV ratio is adjusted according to the rule $\tilde{\kappa}_t^g = \chi \tilde{Y}_t$, where $\tilde{\kappa}_t^g$ and $\tilde{Y}_t$ denote percentage deviations from steady-state values.[16] We let $\chi = -5$, that is, κ^g increases by 5% from its steady-state value (0.65) when output drops by 1%. Figure 5(d) compares the responses to a banking shock with the benchmark case. As output declines, κ^g increases. This directly expands credit; it also induces firms to switch to global banks (reduce f_t), which at the margin are less efficient at managing collateral. This indirect effect initially dominates, depressing access to credit. However, after a few periods the direct effect gains strength, accelerating the recovery. Next, in Figure 5(d) we experiment with an LTV policy that applies also to local banks' loans ($\tilde{\kappa}_t^g = \chi \tilde{Y}_t$ and $\tilde{\kappa}_t^l = \chi \tilde{Y}_t$). In steady state multinational banks grant 30% of total loans, so setting $\chi = -1.5$ implies that the policy response is similar to the previous experiment. Following a banking shock, the policy relaxes LTV ratios, which acts as a stabilizer. It also reduces entrepreneurs' incentive to demand capital as collateral, since the borrowing constraint is looser. This depresses the collateral price, incentivizing entrepreneurs to switch to multinational banks (reduce f_t) and, hence, slowing down the recovery. Figure 5(d) suggests that the stabilizing effect gains strength slowly and that this policy is a less effective stabilizer than a policy that targets multinational banks' loans.

[16] While regulations may not target multinational banks, they can target loans that are more likely to be granted by multinational banks (e.g., be based on the loan currency denomination or maturity).

7. Robustness and Alternative Specifications

In this section, we consider alternative specifications of the banking sector.

Bank equity: book and market values. In the model, we specified banks' capital requirement using the book value of banks' equity. This can reflect the practice of regulators and supervisors to focus on the book value of banks' assets in assessing capital adequacy, due also to bank managers' discretion in updating the valuation of assets. In the Appendix, we show the robustness of the results to considering market values of banks' equity.

Bank financing: loans and risk bearing. In the model, banks grant non-contingent loans to entrepreneurs. This differs, for example, from Gertler and Karadi (2011) and Gertler et al. (2012) in which financial institutions hold equity shares in firms. In their context, banks' equity holding captures a broad notion of financial institutions, including banks and shadow banks. In our setting, we aim instead at capturing multinational banks' role in extending financing in the credit market. The shadow banking system has still scarce diffusion in many countries where multinational banks account for a relevant share of financing (Ghosh et al., 2012). Moreover, BIS data show that multinational banks' claims often consist of non-contingent assets such as loans. Finally, as noted, the decreasing returns in multinational banks' collateral liquidation technology can reflect their difficulty in financing local, small firms. Such firms predominantly rely on bank loans when tapping external finance.

The modelling of financial contracts as loans implies that banks bear no risk related to the value of firm shares. More broadly, it has implications for risk bearing. Since loan returns are predetermined, loans are risk-free assets for banks. Similarly, they are risk-free liabilities for entrepreneurs: when they agree on a loan, they know what the cost of the loan will be. This specification allows TFP shocks and bank net worth shocks to be fundamentally different from each other. The risk directly induced by TFP shocks is borne by entrepreneurs, while the risk directly induced by bank net worth shocks is borne by bankers (as is typical with credit contracts, there is no risk sharing). Thus, shocks tend to be initially borne by the sector where they hit and then affect the other sector through the credit market.[17]

Bank lending technology. An alternative way to model multinational banks' disadvantages could be to assume that they face a (convex) cost in the value of loans, rather than assuming a cost in collateral management and liquidation on borrowers' side. Our specification builds on the evidence that in host countries relevant difficulties arise for foreign banks in collateral management

[17] Recall also that there is no default occurring in equilibrium in our economy. In an economy in which entrepreneurs default, a TFP shock could trigger defaults, directly eroding banks' net worth. Such a shock would then effectively be a hybrid between the TFP shock and the bank net worth shock of our analysis. We expect that the mechanisms in the model would carry through. Depending on whether the drop in entrepreneurs' returns or the bank net worth loss play a predominant role, the response of global banks, and hence of the host economy, could be more similar to the response to the TFP or the bank net worth shock.

and liquidation and in loan recoveries, due to limited knowledge of local asset markets, legal procedures, and of the subtleties of property registration and asset recovery in local courts or in private restructurings (see, e.g., Mian, 2006; Qian and Strahan, 2007; Bakker and Chapple, 2003). These difficulties typically arise when multinational banks expand loan portfolios to finance small and medium-sized informationally opaque businesses.

From an aggregate perspective, our approach captures the two key components of our transmission mechanism. The first consists of the transfers through internal capital markets. The second consists of the reallocation of borrowing and collateral in the host country. The reallocation of collateral between local and multinational banks alters entrepreneurs' incentive to demand capital assets for collateral purposes, given the different abilities of the two types of banks to manage collateral. The resulting dynamics of collateral asset prices is important in driving banks' lending and net worth and, hence, in the depth and length of recessions. Both components find support in the data. We have discussed the evidence on internal capital markets. There is also broad evidence on the role of asset prices in transmitting recessions, especially financial disruptions (Claessens et al., 2011).[18]

8. Conclusion

Building on well-documented features of multinational banks, this paper has studied multinational banks' impact on the dynamics of business cycles of host economies, especially the depth and duration of recessions. In our economy, multinational banks can swiftly transfer liquidity across borders through internal capital markets but encounter difficulties in allocating liquidity to local firms. We have found that, following negative domestic shocks, the interaction between these two forces is the source of a trade-off between the depth of the contraction and the speed of the recovery. For example, following a banking shock, multinational banks can moderate the depth of the recession but slow down the recovery.

The analysis suggests that the openness to multinational banks can help explain cross-country differences as well as changes in the depth and length of recessions. It also suggests that macroprudential policies targeting multinational banks and regulations affecting their entry through subsidiaries or branches can enhance stability. However, multinational banks can also engage in brownfield investments (e.g., acquire local banks), and this can influence their behavior over the business cycle. We leave these and other issues to future research.

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Table 1: Foreign Bank Impact on Contractions and Recoveries

	Panel A: Main Results					Panel B: Other Tests	
	ForBank in first difference					ForBank in level	
	Annual					Annual	Quarterly
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FinDis=RR	FinDis=LV	FinDis=LV	FinDis=RR	FinDis=RR	FinDis=RR	FinDis=RR
Contractions							
Contr*ForBank	-3.773	1.350	2.844	2.497	-1.332	-1.676	-2.199**
	(5.9505)	(6.1873)	(5.8967)	(7.4154)	(6.9141)	(1.4524)	(0.6934)
Contr*ForBank*FinDis	0.125	-7.170	-8.537	0.155	-0.653	-0.085	0.376*
	(0.9379)	(7.0322)	(7.1246)	(1.2117)	(0.4628)	(0.2391)	(0.1732)
Recoveries							
Recov*ForBank	18.225***	9.262***	9.635***	4.086	18.110*	-4.091***	-2.070**
	(5.9426)	(2.2380)	(2.5624)	(6.1699)	(8.7684)	(1.0313)	(0.7810)
Recov*ForBank*FinDis	-4.062*	-14.089*	-14.331*	-2.136*	-3.903*	0.121	0.229
	(1.6291)	(6.9829)	(7.0086)	(1.0111)	(1.9478)	(0.3445)	(0.1901)
+ FDI, Exch. Rate, Bank Assets	N	N	Y	N	N	N	N
Time dummies	Y	Y	Y	N	Y	Y	Y
Country dummies	Y	Y	Y	Y	N	Y	Y
Observations	285	410	383	285	285	305	1036

Note: This table reports selected coefficient estimates for the effect of foreign banks on GDP growth in contractionary and recovery phases of the business cycle. Panel A reports the main results; Panel B reports other tests. Columns 1-6 use annual data from 1983 to 2014. Column 7 uses quarterly data from 2000Q1 to 2014Q4. Full estimation results are in Appendix Table A.1. The definition of the variables and the empirical specification are detailed in Section 3. In columns 1-5, ForBank is in first difference; in columns 6-7, ForBank is in level. Financial distress (FinDis) is captured by the Romer and Romer (RR) index or the Laeven and Valencia (LV) index, as indicated at the top of the columns. Column 3 controls for FDI net inflows (as % of GDP), for bank assets (as % of GDP) and for the real effective exchange rate. *, **, *** denote statistically signicant at the 5%, 1%, and 0.1% level, respectively.

Table 2: Calibration

Parameter	Symbol	Foreign country	Host country
Preferences			
Household discount factor	β	0.990	
Household CRRA	γ	2.000	
Inverse Frisch elasticity	ϵ	1.000	
Entrepreneur discount factor	β_e	0.980	
Entrepreneur CRRA	γ_e	0.000	
Technology			
Capital share of output	α	0.330	
Capital depreciation	δ	0.025	
Inverse elasticity of I_t to Q_t	$f''(1)$	1.000	
Banking sector			
Weight of bank assets in capital constraint	ξ	0.878	0.863
Weight of foreign assets in constraint	ϕ	0.069	
Adjustment cost to transfers	ψ	0.100	
Weight on transfers in the constraint	θ	0.600	
% assets liquidated by local banks	κ^l	0.600	
% assets liquidated by global banks	κ^g	0.650	
Cost of global bank liquidation	ν	0.279	0.292
% assets brought by new bankers	ζ	$4.85e-04$	
Probability of surviving bankers	σ	0.969	

Note: A missing value in the last column means that the same value as in the foreign country was used for that parameter.

Table 3: Conditional variances

	Bank net worth shock				TFP shock			
	8Q	16Q	28Q	60Q	8Q	16Q	28Q	60Q
I_t	3.39	8.79	14.94	21.07	16.97	24.76	25.38	25.49
K_t	0.04	0.34	1.56	6.71	0.21	1.19	2.78	4.20
Y_t	0.01	0.07	0.36	1.64	4.43	5.75	6.52	6.96

Note: This table shows the conditional variances for various periods in the benchmark model. Numbers are multiplied by 1e4.

Table 4: Depth, duration, and severity of recessions

(A) Depth, duration, severity in benchmark and alternative economies			
	Depth: Percentage change peak through trough	Duration: Number of years peak to recovery	Severity index: depth+duration
Benchmark	6.51	16.47	22.98
Fixed transfer	6.72	15.71	22.42
Fixed f_t	6.63	14.66	21.29

	(B) Structural regulation and severity index		
Tighter regulation	$\psi = 1$	$\theta = 1$	$\phi = 0.333$
	22.50	22.78	20.80
Benchmark	$\psi = 0.1$	$\theta = 0.6$	$\phi = 0.069$
	22.98	22.98	22.98
Looser regulation	$\psi = 1e - 5$	$\theta = 0$	$\phi = 0$
	23.13	23.08	23.58

Note: Panel (A) reports the mean depth, duration and severity index from the simulated model calibrated to the Polish economy. Panel (B) shows the mean severity index under different costs of making transfers (ψ), degrees to which transfers are subject to capital requirement (θ), and degrees of consolidation of multinational banks' balance sheets (ϕ). $\phi = 0.333$ reflects that 50% of foreign bank assets are accounted for by branches.

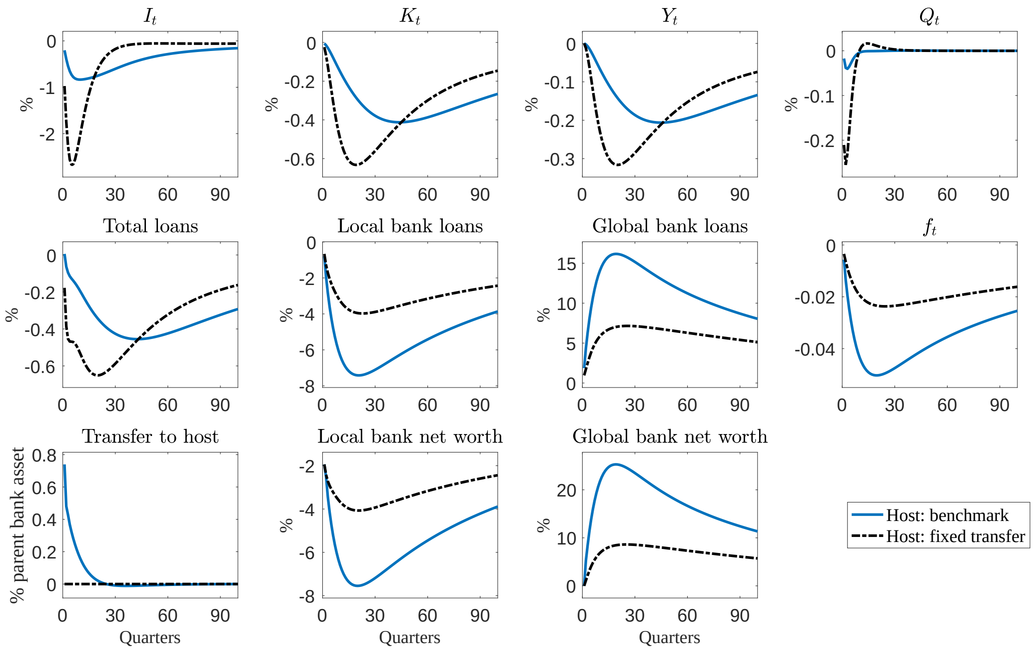


Figure 1: Shut down the internal capital market of multinational banks. The figure shows impulse responses in the host country to a one-standard-deviation negative local bank net worth shock (-1.94%) in the host country.

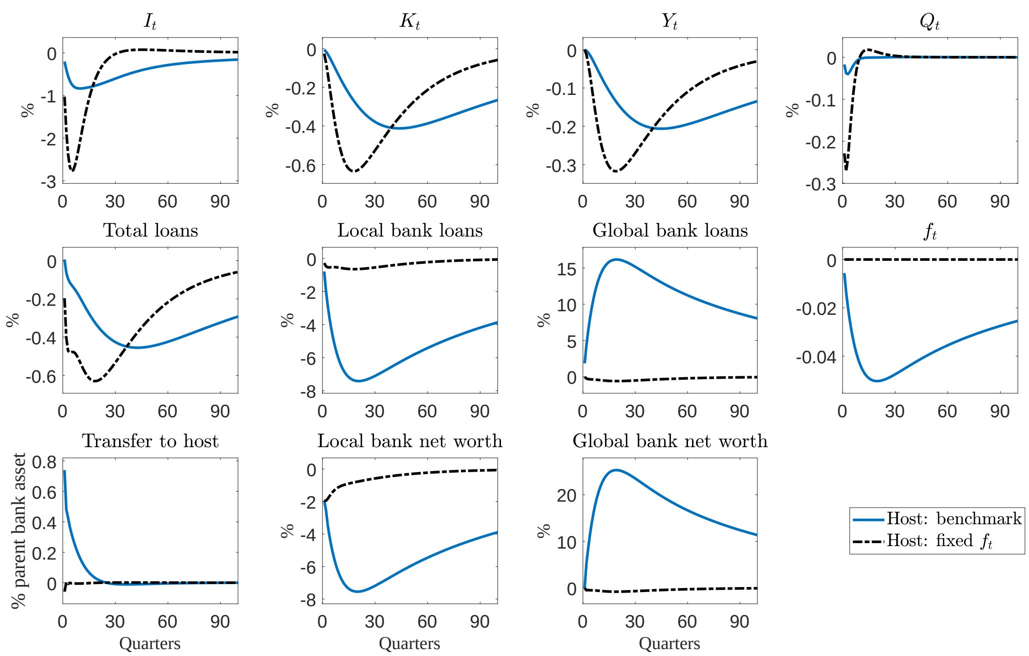


Figure 2: Shut down the collateral reallocation between local and multinational banks. The figure shows impulse responses in the host country to a one-standard-deviation negative local bank net worth shock (-1.94%) in the host country.

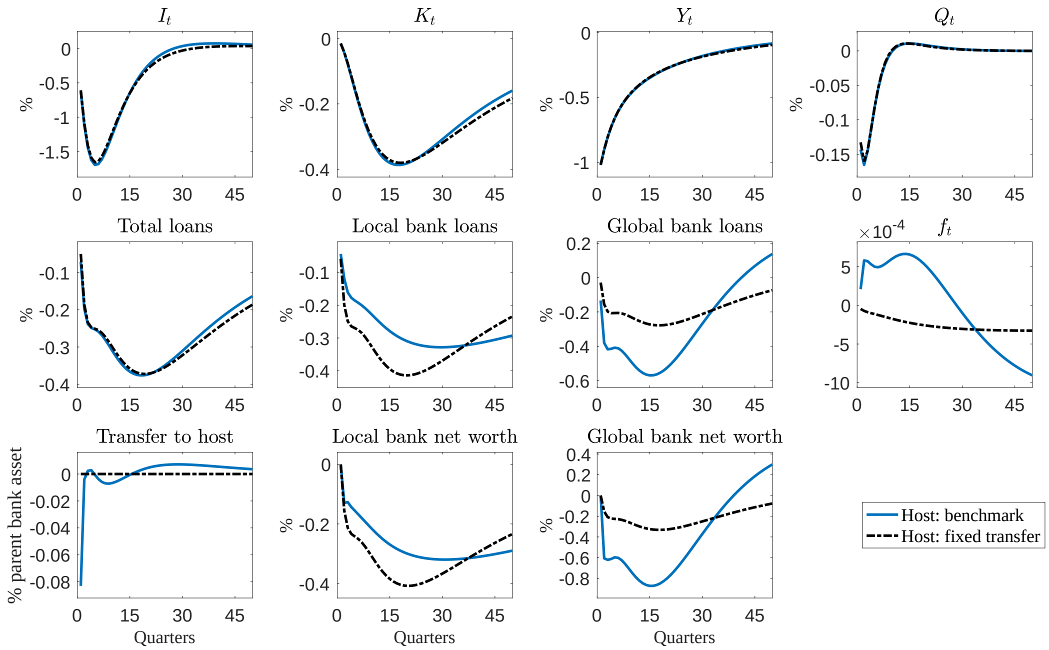
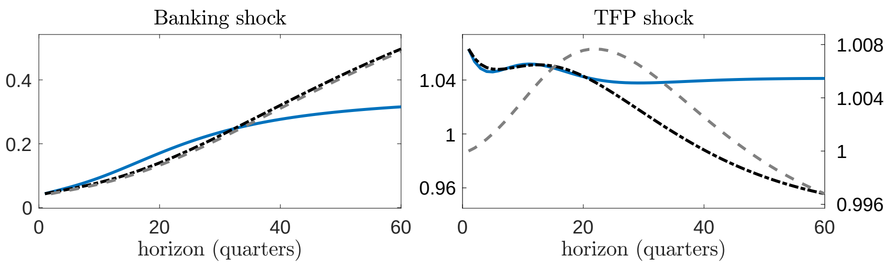
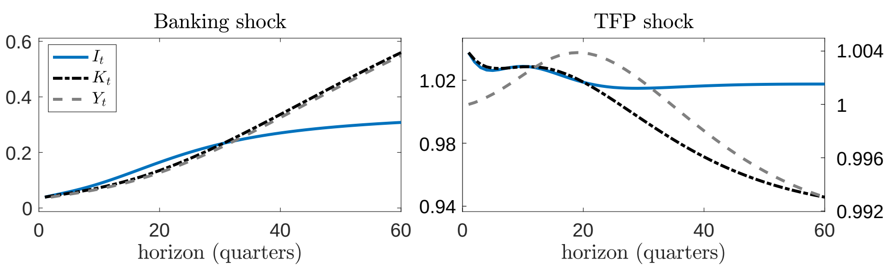


Figure 3: Impulse responses in the host country to a one-standard-deviation negative shock to TFP (-0.68%) in the host country.

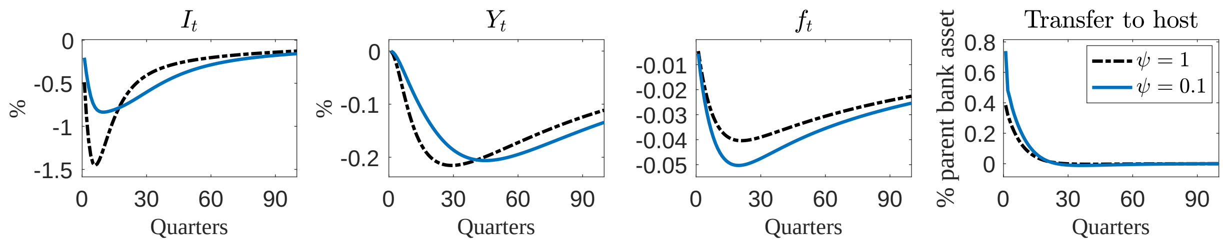


(a): Benchmark model / the model with fixed transfers

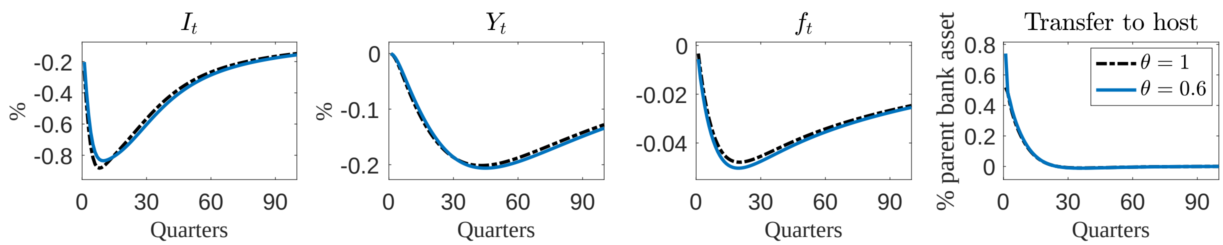


(b): Benchmark model / the model with fixed f_t

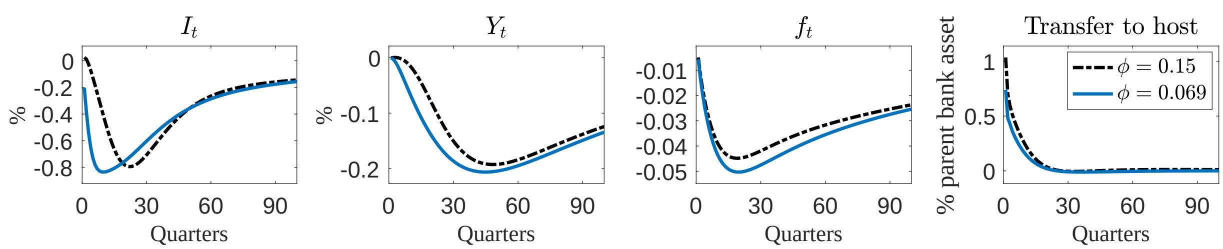
Figure 4: The figure plots the ratio of conditional variances in the benchmark model to conditional variances in alternative models. For the case of the TFP shock, the dashed curve for Y_t corresponds to the right Y-axis, and the other two curves correspond to the left Y-axis.



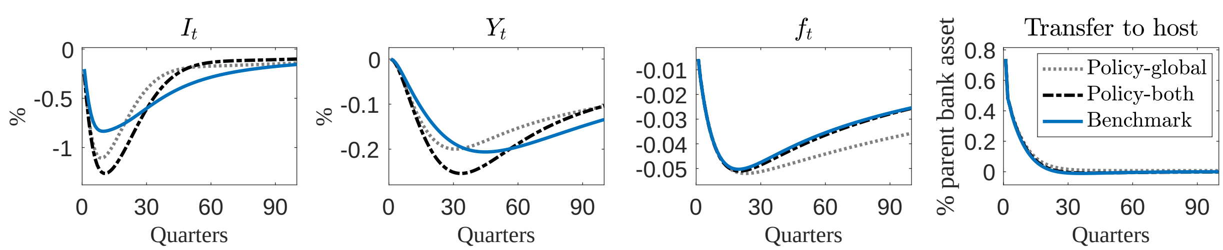
(a): Cost of making transfers ψ



(b): Weight of transfers in global banks' capital constraint θ



(c): Balance sheets consolidation ϕ



(d): Countercyclical policy on loan-to-value ratio κ^g in the host country.

Figure 5: Regulations and policies. The figure shows impulse responses in the host country to a one-standard-deviation negative local bank net worth shock (-1.94%) in the host country. Panels (a)-(c) show the role of structural regulations. Panel (d) shows the role of a countercyclical LTV policy: the dotted line is a policy that targets multinational banks only and χ is set to -5; the dash-dotted line is a policy that applies to both types of banks and χ is set to -1.5.