Recessions and Recoveries. Multinational Banks in the Business Cycle [*]

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Abstract

This paper studies the influence of multinational banks on the dynamics, depth and duration of business cycles. In our economy, 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 can moderate the contractionary phase and the depth of the recession but slow down the subsequent recovery. A calibration to data on the Polish economy suggests that multinational banks reduce the depth of recessions by about 10% but increase their duration by 5%.

Keywords: Multinational Banks; Business Cycle Dynamics; Recoveries

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1 Introduction

The dynamics of business cycles in advanced and emerging economies and the forces that shape these dynamics have been the object of an intense debate in recent years (Reinhart and Rogoff, 2014; Cecchetti et al., 2009). Concerns have grown about the protracted 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 sharp rebounds (Friedman and Schwartz, 2008; Wynne and Balke, 1992), evidence on recent recessionary episodes suggests that disruptions of the banking sector trigger deep recessions, slow recoveries, and persistent output losses (Reinhart and Rogoff, 2014). Interestingly,

the depth and duration of recessions appears not only to have gradually evolved over time but also to exhibit pronounced cross-country differences (Claessens et al., 2011).

The structure of a country's financial sector is often mentioned as a determinant of the dynamics of business cycles. Yet, important aspects of this influence remain to be understood. This paper focuses on a key feature of the banking sector, its openness to multinational banks. 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. In Poland, Hungary and Estonia, for example, the share of assets held by branches and subsidiaries of multinational banks was as high as 70% in 2009 (Allen et al., 2013). And the expansion of multinational banks is accelerating in transition countries, such as China and Russia (BIS, 2016).

How does the expansion of multinational banks influence the dynamics of business cycles of host countries? Do multinational banks moderate or exacerbate the depth of recessions following banking disruptions and real shocks? Do they impact the length of recoveries in the same way as they affect the depth of recessions or does their expansion generate trade-offs between amplitude and length of downturns?

The goal of this paper is to address these questions qualitatively and quantitatively. We first present motivational evidence on business cycle dynamics and multinational banks' presence from a broad range of economies observed over four decades (1970-2012). The evidence points to a different impact of multinational banks on the contractionary and recovery phases of the business cycle. We then embed multinational banks into a dynamic stochastic general equilibrium model with two countries (henceforth, 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. 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 banking literature has extensively 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) local entrepreneurs' collateralizable assets.[1] Several banking studies document multinational banks' limited experience and information about assets and activities of local borrowers (Giannetti and Ongena, 2012; Mian, 2006),

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[1]To allow for a role of the credit market, we posit that firms face collateral constraints when borrowing.

especially small and medium-sized informationally opaque firms or firms with limited international engagement (e.g., in real estate or in other non-tradable sectors).[2]

We next 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 recession) and its medium-run response (speed of the recovery). For example, following 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. This is not feasible for local banks, which rely on domestic liquidity. However, over the medium run, this entails a progressive reallocation of local firms' borrowing 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 economy. On impact multinational banks amplify the shock by repatriating liquidity to their parents in the foreign country. However, again, a trade-off emerges between depth of the recession and speed of the recovery: 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).

We 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 the economy and banking regulation of Poland, a country featuring a significant presence of multinational banks (nearly 70% of bank assets in 2009). In the simulated economies, the presence of multinational banks reduces the average depth of recessions (output drop, peak to trough) up to 10% but it lengthens their average duration (years from peak to recovery) by about 5%. Aggregating these two effects through the Reinhart and Rogoff (2014) composite measure of severity of recessions, the presence of multinational banks raises the severity index by more than 25%. This suggests that the increased sluggishness of recoveries plays a larger role than the reduced depth of recessions.

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[2]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; Giannetti and Ongena, 2012; 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 (Hermalin et al., 1999; Rajan and Zingales, 1998). According to a survey on lending practices to SMEs (Jenkins, 2002), international banks have little interest in the market for small firms loans due to high administrative costs and lack of network and personnel.

In the last part of the paper, we examine whether structural regulations and cyclical policies (in the form of loan-to-value ratio policies) ameliorate the trade-offs induced by multinational banks. A higher degree of consolidation of multinational banks' balance sheets (due, e.g., to regulations that incentivize entry through branches rather than subsidiaries) mitigates the negative short-run effect following a banking shock without lengthening the recovery. By contrast, regulations that increase the costs of multinational banks' transfers through internal capital markets or that encourage some types of transfers (e.g., loans rather than equity injections) have an ambiguous effect, reducing the length of the recovery but also the stabilizing role of multinational banks in the contractionary phase. The analysis also reveals that countercyclical loan-to-value ratio (LTV) policies ameliorate the trade-offs as long as they target firms' borrowing from multinational banks. Instead, little benefit appears to arise from LTV policies that do not differentiate between local and multinational bank loans.

The remainder of the paper unfolds as follows. In the next section, we relate the analysis to prior literature. Section 3 provides suggestive evidence from a broad panel of countries that motivates our focus. Section 4 lays out the model and solves for agents' decisions. Section 5 presents the calibration and the simulation results. In Section 6, we study structural and cyclical policies. Section 7 concludes. The online Appendix contains additional analysis and some details on the derivations.

2 Prior Literature

2.1 Empirical and theoretical underpinnings

In characterizing multinational banks, we build on a broad empirical literature on the liquidity and lending management of multinational banks. Several studies document that following domestic liquidity shocks multinational banks can withstand the shocks better than domestic banks and be a stabilizing force by transferring liquidity across borders through internal capital markets (see, e.g., De Haas and Van Lelyveld (2010) and Cetorelli and Goldberg (2012b)). However, multinational banks also exhibit less experience and inside information about domestic activities and assets (Detragiache et al., 2008). This can result into tighter financing constraints for small and medium-sized local enterprises as foreign banks may primarily allocate liquidity to big and transparent customers (Cárdenas et al., 2003). A broad number of studies obtain evidence that multinational banks are at a disadvantage at lending to informationally difficult local firms and at recovering value from local firms' projects and assets in the event of firms' default (see, e.g., Giannetti and Ongena (2012) and Degryse et al. (2012) for Eastern European countries, Mian (2006) for Pakistan, and Clarke et al. (2006) and Gormley (2010) for other sets of countries).

Our characterization of multinational banks is also akin to theoretical studies in banking. Dell'Ariccia et al. (1999), Gormley (2010), and Detragiache et al. (2008) study static

models in which multinational banks have better 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 implies an ambiguous impact of multinational banks on the depth of local credit markets (Detragiache et al., 2008; Gormley, 2010). We share the key ingredients of multinational banks with these studies, but we pursue a different goal and approach. In particular, we find that embedding these features of multinational banks into a dynamic general equilibrium model can yield insightful implications for the dynamics of recessions, recoveries and business cycles.

2.2 Related studies

There is a growing theoretical literature on the macroeconomic impact of multinational banks.[3] Kalemli-Ozcan et al. (2013), Guerrieri et al. (2012), Lakdawala et al. (2018), Meier (2013), Iacoviello and Minetti (2006), and Niepmann (2016) stress the "common lender effect" of multinational banks, that is, their lending to customers of 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 this class of models which highlight the international transmission of shocks, we focus on the impact of multinational banks on the depth and duration of business cycles of host countries, finding that multinational banks can have strikingly opposite effects on the contraction and recovery phases of the business cycle. The paper can then help relate the literature on multinational banks to the debate on business cycle dynamics and on the depth and duration of recessions (Reinhart and Rogoff, 2014; Claessens et al., 2011).

The evidence on the impact of multinational banks on the business cycles of host countries is mixed, with the results suggesting that multinational banks can be a buffer or an amplifier depending on conditions and types of 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; Rai and Kamil, 2010). On the other hand, De Haas and Van Lelyveld (2014) conclude that during the 2008-09 financial crisis the affiliates of multinational banks acted as destabilizers by curtailing credit more than domestic banks. Our analysis can help reconcile these empirical findings by dissecting the different influence of multinational banks on contractions and recoveries. The paper can thus offer insights to a strand of studies that have started to test the impact of a country's financial structure on the various phases of the business cycle (Cecchetti et al., 2009; Bordo and Haubrich, 2010; Claessens et al., 2012). In the next section, we provide motivational evidence that builds on these empirical studies.

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[3]For earlier work on financial factors in international business cycles, see, e.g., Kehoe and Perri (2002).

3   Some Motivational Evidence

This section presents preliminary evidence on the impact of multinational banks' presence on business cycle dynamics using information from a panel of 24 countries over a 40-year period (1970-2012).[4]   The methodology follows prior empirical studies 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. We use real GDP to identify peaks and troughs for each country by running a variation of the Bry and Boschan (1971) algorithm. This allows us to construct two indicators for phases of the business cycle: a 0/1 indicator variable for "contraction" phases, defined as periods from peaks to troughs of the business cycle; and a 0/1 indicator for "recovery" phases, defined as periods from troughs to the level of GDP reached at the previous peak. Second, we exploit information from the World Bank Global Financial Development (GFD) Database to construct our proxy for the presence of multinational banks in a country, the ratio of loans from foreign banks over total domestic credit in the country ($ForBank$). Third, we aggregate the information provided by the Romer and Romer (2017) biannual measure of financial distress to capture the nature of the shocks (financial or non-financial) that trigger recessions ($FinDis$). As noted, the theoretical model predicts a different impact of multinational banks depending on the nature of the shocks.

Our annual frequency panel comprises 24 countries from 1970 to 2012, which is the last date the Romer and Romer's measure of financial distress is available. We estimate the following regression:

$$GDP_{it} = \alpha_i + \alpha_t + \sum_{j=1}^{4} \beta_j GDP_{i,t-j} + \gamma Contr_{it} + \delta Recov_{it} + \zeta ForBank_{i,t-1} +$$

$$+ \sum_{s=0}^{4} \eta_s FinDis_{i,t-s} + \theta \left(Contr_{it} \times ForBank_{i,t-1} \times FinDis_{it} \right) +$$

$$+ \iota \left(Recov_{it} \times ForBank_{i,t-1} \times FinDis_{it} \right) + \kappa \mathsf{Double} + \lambda \mathsf{Z}_{it} + \epsilon_{it}$$

where GDP_{it} refers to GDP growth in country i and year t; $Contr_{it}$ is a dummy that takes the value of one in contraction phases of the business cycle, zero otherwise; $Recov_{it}$ is a dummy that takes the value of one in recovery phases of the business cycle, zero otherwise; $ForBank$ refers to the ratio of foreign bank loans to total domestic credit; and Z_{it} is a vector of further time-varying attributes of the country. The regression includes the double interaction terms among $Contr$ (or $Recov$), $ForBank$, and $FinDis$, captured by the Double vector, as well as the triple interaction terms. The interactions containing $Contr$ (or $Recov$) and $ForBank$ are our main variables of interest as they capture the impact of multinational banks on GDP growth during contractions and recoveries. The

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

empirical specification allows the impact of multinational banks to depend on the financial or non-financial nature of the shocks, as captured by the financial distress variable. We estimate the regression using fixed effects and time dummies as suggested by Judson and Owen (1999), and using lagged values of the foreign bank ratio to minimize the risk of endogeneity.[5] In richer specifications, we control for further time-varying characteristics of the financial sector (FDI net inflows and mutual fund assets, as percentages of the GDP) as well as the real effective exchange rate.

Table 1 presents the results on the main effects of interest; the full results are in Supplementary Table A.1. The coefficient estimates suggest that, when recessions are characterized by severe financial distress in the country, multinational banks can significantly slow down the recovery; when the level of financial distress is low, they tend to accelerate the recovery. Further, when financial distress is severe, multinational banks do not exacerbate the output drop during the contractionary phase. While these trade-offs that emerge from the estimates are suggestive, they appear to be broadly consistent with the predictions of the theoretical model, as we will elaborate in the following analysis.

4 The Model Economy

4.1 Environment

Preferences. Time is discrete and the horizon infinite. To model the operations of multinational banks, we consider an economy with two countries, the host country and the foreign country. 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; agents' decisions in the foreign country are symmetric, unless otherwise specified.[6] The preferences of households are given by

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\left(C_t - \frac{H_t^{1+\epsilon}}{1+\epsilon}\right)^{1-\gamma} - 1}{1-\gamma},$$

where C_t denotes households' consumption and H_t denotes labor. The preferences of entrepreneurs are given by

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta_e^t \frac{(C_t^e)^{1-\gamma_e} - 1}{1-\gamma_e}.$$

To generate an incentive for entrepreneurs to borrow, we assume that they are less patient than households, i.e., $\beta_e < \beta$.

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[5]Since our data set is a "large T, small N" panel we do not incur in the dynamic bias issue (Nickell, 1981). Moreover, the large time dimension prevents Anderson-Hsiao or Arellano-Bond estimation.

[6]The whole equilibrium system is listed in the Appendix. Figure A.1 in the Appendix displays the structure of the model economy.

Technology. Entrepreneurs have access to a constant-returns-to-scale production technology that uses labor and capital to produce goods used for consumption and investment:

$$Y_t = A_t K_{t-1}^{\alpha} H_t^{1-\alpha}. \tag{1}$$

There is a capital-good production firm, which is owned by the representative household. 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 accumulation follows the laws of motion

$$K_t = (1 - \delta)K_{t-1} + I_t, \tag{2}$$

where δ denotes the capital depreciation rate.

4.2 Households

We model the household sector in a way similar to Gertler and Karadi (2011), which preserves the tractability of the representative agent approach. 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.[7] 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 of the total assets of exiting bankers.

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:

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

$$\text{s.t.} \quad C_t = W_t H_t + \Pi_t + R_{t-1}^D D_{t-1} - D_t, \tag{3}$$

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.

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[7]As capital constraints bind for bankers around the steady state (see below), bankers will always retain earnings while in business and pay dividends upon exiting.

4.3 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.[8] 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.

4.3.1 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

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

$$\text{s.t.} \quad X_t^g = N_t^g + Z_t^g + D_t^g, \qquad\qquad\qquad [\lambda_t^g] \qquad (4)$$

$$R_t^D D_t^g + \theta Z_t^g \leq \xi \left[(1-\phi)R_t^{X,g} X_t^g + \phi R_t^{X,g,*} X_t^{g,*} \right], \qquad [\mu_t^g] \qquad (5)$$

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 defined as $N_{t+1}^g = R_t^{X,g} X_t^g - R_t^D D_t^g$. The affiliate takes as given the parent bank'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 (4) is the flow of funds (resource) constraint. Equation (5) is a (regulatory or market) capital constraint, which requires that the weighted sum of bank liabilities (deposits and transfers received from the parent) cannot exceed a fraction ξ of bank assets. The constraint (partially) consolidates the assets of the affiliate and the parent bank, where the weight on the parent is $\phi \leq 0.5$. $\phi = 0.5$ implies full consolidation; $\phi = 0$ implies complete separation.[9] $\theta \leq 1$ captures the fact that the transfer Z_t^g from the parent to the affiliate may be subject to a lower capital requirement than deposits $R_t^D D_t^g$, to the extent that it consists of an equity injection rather than a loan.

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[8]Therefore, our economy resembles the case where one country exports banking services to another country, e.g., the case of German banks entering Poland or Spanish banks entering Argentina.

[9]Given that we impose a symmetric constraint for the parent, if the parameter ϕ also multiplied liabilities in (5), the balance sheets of parent and affiliate would be decoupled. Details are available from the authors.

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

$$[\partial X_t^g]: \quad -\lambda_t^g + \xi(1-\phi)\mu_t^g R_t^{X,g} + \mathbb{E}_t \Lambda_{t,t+1}^* \left(1 - \sigma + \sigma\lambda_{t+1}^g\right) R_t^{X,g} = 0, \tag{6}$$

$$[\partial D_t^g]: \quad \lambda_t^g - \mu_t^g R_t^D - \mathbb{E}_t \Lambda_{t,t+1}^* \left(1 - \sigma + \sigma\lambda_{t+1}^g\right) R_t^D = 0. \tag{7}$$

Equation (6) equalizes the marginal cost to the marginal benefit of granting loans. The marginal cost is given by a tightening of the current resource constraint (λ_t^g). The marginal benefit is 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 (7) equalizes the marginal cost of deposits to their marginal benefit. The envelope condition reads:

$$\frac{\partial V_t^g}{\partial Z_t^g} = \lambda_t^g - \theta\mu_t^g. \tag{8}$$

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:

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

$$\text{s.t.} \quad X_t^{g,*} = N_t^{g,*} + Z_t^{g,*} - \frac{\psi}{2}\left(Z_t^{g,*} - \bar{Z}^{g,*}\right)^2 + D_t^{g,*}, \qquad [\lambda_t^{g,*}] \tag{9}$$

$$R_t^{D,*} D_t^{g,*} + \theta Z_t^{g,*} \leq \xi \left[(1-\phi)R_t^{X,g,*} X_t^{g,*} + \phi R_t^{X,g} X_t^g\right], \qquad [\mu_t^{g,*}] \tag{10}$$

where net worth is $N_{t+1}^{g,*} = R_t^{X,g,*} X_t^{g,*} - R_t^{D,*} D_t^{g,*}$. Similar as before, the capital constraint (10) (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 flow of funds constraint (9) where $\bar{Z}^{g,*}$ is the steady-state value of the transfer (see De Haas and Van Lelyveld, 2010, and the discussion below for examples of such costs). The first order conditions for loans and deposits are isomorphic to those of the affiliate. The marginal value of the transfer at the parent is

$$\frac{\partial V_t^{g,*}}{\partial Z_t^{g,*}} = \lambda_t^{g,*} - \theta\mu_t^{g,*} - \psi\left(Z_t^{g,*} - \bar{Z}^{g,*}\right)\lambda_t^{g,*}. \tag{11}$$

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

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

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

The first order condition equalizes the marginal values of transfers at the parent and the affiliate in (8) and (11), that is,

$$\lambda_t^{g,*} - \theta\mu_t^{g,*} - \psi\left(Z_t^{g,*} - \bar{Z}^{g,*}\right)\lambda_t^{g,*} = \lambda_t^g - \theta\mu_t^g. \tag{12}$$

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

4.3.2   Local banks

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

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

$$\text{s.t.} \quad X_t^l = N_t^l + D_t^l, \qquad\qquad\qquad [\lambda_t^l] \tag{13}$$

$$R_t^D D_t^l \leq \xi R_t^{X,l} X_t^l, \qquad\qquad\qquad [\mu_t^l] \tag{14}$$

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. The local banks' problem differs from the global banks' in that (i) the local banks do not receive or make any transfer; (ii) their capital constraint (14) only involves their own balance sheets.

4.4   Entrepreneurs

The representative entrepreneur uses labor H_t and capital K_{t-1} to produce output Y_t. To finance consumption and purchases of capital, entrepreneurs can take loans from global banks (X_t^g) and local banks (X_t^l) by pledging capital stocks as collateral. Collateral is necessary because of enforcement problems (see, e.g., Kiyotaki and Moore, 1997).

To capture the disadvantage of global banks due to their more limited experience and inside information about local firms 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 (a

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[10]A broad literature analyzes banks' technology for collateral liquidation and monitoring (see, e.g., Minetti, 2011, and references therein). In Aiyagari and Gertler (1991), while "households" are not specialists and face quadratic costs in trading assets, "traders" are specialists and face proportional costs. One can think that in our economy, if their local experience and knowledge were as abundant as for local banks,

possible microfoundation is in the Appendix).

The entrepreneur solves the following problem:

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

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

$$R_t^{X,g} X_t^g \leq \kappa^g \left[(1-f_t) Q_t K_t - \frac{\nu}{2\bar{Q}\bar{K}} (1-f_t)^2 Q_t^2 K_t^2 \right], \qquad [\omega_t^g] \qquad (15)$$

$$R_t^{X,l} X_t^l \leq \kappa^l \left(f_t Q_t K_t \right), \qquad\qquad\qquad\qquad\qquad [\omega_t^l] \qquad (16)$$

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

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

$$[\partial K_t] \quad - Q_t U_{c^e,t} + \kappa_t^g \omega_t^g \left[(1-f_t) Q_t - \frac{\nu}{\bar{Q}\bar{K}} (1-f_t)^2 Q_t^2 K_t \right] + \kappa^l \omega_t^l f_t Q_t, \qquad (17)$$

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

$$[\partial f_t] \quad f_t = 1 - \frac{\bar{Q}\bar{K}}{\nu Q_t K_t} \frac{\kappa^g \omega_t^g - \kappa^l \omega_t^l}{\kappa^g \omega_t^g}, \qquad\qquad\qquad (18)$$

Equation (18) shows that the allocation of collateral and borrowing between local and multinational banks depends on the tightness of the collateral constraints as well as on the value of collateral $(Q_t K_t)$.

To recapitulate, in our model economy, at the liquidity origination stage, global banks have the advantage that the affiliates can quickly obtain funds from the parent offices (or repatriate liquidity to the parents) 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. As noted, large 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. However, as they delve deeper into the local credit market, turning to fund smaller, locally oriented and informationally opaque businesses, their scarce experience and inside information about local borrowers and assets may kick in, hindering their credit provision (Detragiache et al., 2008). Stiglitz (2003, p.69), for example, succinctly summarizes this

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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.

point: "while the [foreign] banks easily provide funds to multinationals, and even large domestic firms, small and 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 credit curtailed by local banks).[11] In the Appendix (Section A.1), we provide a possible microfoundation for the collateral liquidation technology of multinational banks which allows for firm heterogeneity in terms of the informational complexity of collateralizable capital.

4.5 Capital good producers

The rest of the model is standard. The capital-good producer chooses investment to maximize the present discounted value of lifetime profits, that is

$$
\max_{\{I_t\}_{t \geq 0}} \quad \mathbb{E}_0 \sum_{t=0}^{\infty} \Lambda_{0,t} \left\{ Q_t I_t - \left[1 + f \left(\frac{I_t}{I_{t-1}} \right) \right] I_t \right\}.
$$

From the profit maximization condition, the price of capital goods is equal to the marginal cost of producing capital goods:

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

4.6 Closing the model

We posit that each entering banker receives a fraction $\frac{\zeta}{1-\sigma}$ of the total asset values of exiting bankers. Accordingly, the following are the evolution of the aggregate net worth of the affiliates of multinational banks and of the local banks:

$$
N_{t+1}^g = \sigma \left(R_t^{X,g} X_t^g - R_t^D D_t^g \right) + \zeta R_t^{X,g} X_t^g, \tag{19}
$$

$$
N_{t+1}^l = \sigma \left(R_t^{X,l} X_t^l - R_t^D D_t^l + \overline{N}^l \epsilon_t^N \right) + \zeta R_t^{X,l} X_t^l. \tag{20}
$$

The market clearing condition for the deposit market is

$$
D_t = D_t^g + D_t^l. \tag{21}
$$

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[11] One may argue that the liquidation technology of the parent in the foreign country is more efficient than that of the affiliate in the host country. We conducted robustness analysis by allowing multinational banks to experience lower diseconomies to scale in collateral liquidation in the foreign economy than in the host economy. The results remain virtually unchanged (details available from the authors).

The social resource constraint requires that world goods markets clear:

$$C_t + C_t^* + C_t^e + C_t^{e,*} + I_t \left[1 + f \left(\frac{I_t}{I_{t-1}} \right) \right] + I_t^* \left[1 + f \left(\frac{I_t^*}{I_{t-1}^*} \right) \right] + \frac{\psi}{2} \left(Z_t^{g^*} - \bar{Z}^{g,*} \right)^2 = Y_t + Y_t^*.$$

In the Appendix, we also present formulas for the net transfers received by households (Π_t) as well as the definition of equilibrium, which is standard.

5 Results

This section presents the main results. We first study the impulse responses of the model to net worth shocks of domestic banks and to TFP shocks (Sections 5.1-5.3). For this impulse response analysis, we use fairly standard parameters for preferences, technology and shock processes and choose parameters for the banking sector in the ballpark of what is observed in a range of economies. From the impulse responses, it will become clear that after negative shocks the presence of multinational banks induces a trade-off between the short-run response of the host economy during the contractionary phase (and, possibly, the depth of the recession) and the duration of the recession. These responses are broadly consistent with the suggestive evidence in Section 3. Next, we calibrate the banking sector parameters and the shock processes of the host country to data on the economy and banking regulation of Poland, a country featuring a significant presence of multinational banks (Section 5.4). We simulate the model, study conditional variances at various horizons, and quantify the impact of multinational banks on the depth and duration of recessions.

5.1 Calibration

The model is solved numerically by locally approximating around the non-stochastic steady state. Parameters are shown in Table 2. We use standard values for most parameters regarding agents' preferences and production technology. We set the discount factor of entrepreneurs β_e 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.

The parameters governing the tightness of the bank capital constraint are the weight on bank assets in the constraint ξ, the bankers' probability of survival σ, and the fraction of assets brought by new bankers ζ. We choose $\xi = 0.880$, so that bank leverage equals 8.33 in steady state. This is consistent with the aggregate bank leverage for the United States in the FRED database and is in the ballpark of the aggregate bank leverage for a broad range of economies. For example, the World Development Indicators database reveals that, on average, in the 2013-2017 period aggregate bank leverage equaled 8.33 in countries of Europe and Central Asia (excluding high-income countries); in the same region, in 2017

14

aggregate bank leverage equaled 8.5. For all low and middle income countries, aggregate bank leverage equaled 8.72 in 2017. Following Gertler et al. (2012), we set $\sigma = 0.969$, implying that bankers survive for eight years on average. We set the percentage of assets brought in by new bankers, ζ, such that the steady-state spread between the loan rate and the deposit rate is 100 basis points per year.

The parameters κ^L, κ^G and ν dictate the tightness of entrepreneurs' collateral constraints. We set $\kappa^L = 0.6$ to match the loan-to-value ratio observed in a wide range of countries. Jácome and Mitra (2015), for instance, report that 60% loan-to-value ratios are within the LTV limits for several countries (including, e.g., Argentina, Brazil, Hungary, Korea, Singapore and Spain). We set $\kappa^G = 0.65$, higher than κ^L, and we set ν such that local bank loans are about three times as large as global bank loans.[12]

The parameter ϕ governs the consolidation of global bank balance sheets: as noted, $\phi = 0.5$ indicates full consolidation; $\phi = 0$ indicates complete separation. Since typically branches are allowed for consolidation and subsidiaries are not, we interpret ϕ as especially reflecting the share of multinational bank loans accounted for by foreign branches (rather than subsidiaries): under this interpretation, full consolidation emerges when affiliates consist only of branches and no subsidiaries; complete separation emerges when there are only subsidiaries and no branches in the host country. Empirically the share of branches relative to subsidiaries varies depending on the specific host country (Fiechter et al., 2011). For example, in emerging (e.g., Eastern European) countries subsidiaries generally account for a larger share of foreign bank assets than branches. Based on this observation, and on the figures in Allen et al. (2013), we pick a value of ϕ such that the share of bank foreign assets held by branches equals 0.4 ($\phi = 0.286$).[13] We also show the sensitivity of results as ϕ varies from 0 to 0.5. The parameter θ is the weight of transfers in the bank capital constraint. The few studies on the composition of liquidity flows in internal capital markets conclude that loans generally account for the largest share of transfers between parents and affiliates (see, e.g., Allen et al., 2013; Vujić, 2015). We set θ to 0.6.

In steady state, the net export of the host country is 0.46% of the GDP. The steady-state value of the transfer is 0.

5.2 Banking shocks

Following prior studies (see, e.g., Gertler and Karadi, 2011; Guerrieri et al., 2012) we experiment with a one-time and serially uncorrelated unexpected drop of 5% in 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.[14] The results are in Figures 1, 2 and A.2. To better grasp the role of multinational

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

[13]Allen et al. (2013) document substantial variation in the share of assets accounted for by foreign branches vs. subsidiaries. For example, in 2009, the share of bank foreign assets held by branches equaled 37.0% in Greece, 53.5% in Netherlands, and 27.4% in Estonia.

[14]The shock 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 we posit that the shock takes the form of a

banks, we compare the responses in our benchmark economy with two alternative settings. The first alternative is an economy where multinational banks cannot make transfers, that is, internal capital markets are shut down (Figure 2). In this case, the only links between host and foreign country are that the affiliates of multinational banks in the host country are owned by foreign households, and that the parents' and affiliates' balance sheets are partially consolidated. The second alternative is an economy where entrepreneurs cannot alter the allocation of collateral between local and multinational banks, that is, f_t is constant (Figure A.2).

A reduction in the net worth of local banks in the host country tightens their capital constraint and thereby lowers their loan supply (Figure 1). This, in turn, causes the marginal value of liquidity in the affiliate offices of multinational banks to rise. The parents thus make a transfer to the affiliates (Z_t^g), 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 that they pledge to local banks. In the short-run, contractionary phase (first few quarters after the shock) 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 impulse responses in our economy (solid lines in Figure 2) with those of the economy in which multinational banks' transfers are muted (dashed-dotted lines in Figure 2).

In the medium-long run, however, the presence of multinational banks turns 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 muted transfers of multinational banks.

The role of multinational banks can also be grasped by comparing our economy with a second alternative model in which the share of capital pledged to local banks (f_t) is fixed at its steady-state value (see Figure A.2). Once again, the impulse response functions show a milder short-run contractionary effect, and a longer recovery in the benchmark model.

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transfer from local banks to households, rather than a deadweight loss for the local banking sector (details are available from the authors).

5.3 TFP shocks

In this section, we experiment with a negative 1% shock to total factor productivity in the host country. We assume that $\log(A_t)$ follows an AR(1) process. The results of this experiment are displayed in Figure 3 for both the benchmark model (solid line) and the alternative model where multinational banks' transfers are fixed at their steady-state value of zero. In the host country, lower TFP reduces the marginal product of capital and leads to a fall in the capital price Q_t. As a result, the collateral value of entrepreneurs falls, causing them to take fewer loans from both global and local banks and contract their investment. In our model economy, the parents repatriate funds from the affiliates in the host country (negative Z_t^g). 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 model economy. In line with the findings of the empirical literature, following a drop in returns in the host country, multinational banks act as a destabilizer of the negative shock because they repatriate liquidity to their parent offices.

Again, however, a trade-off arises between the impact during the contractionary phase 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 from the TFP shock. In conclusion, in this case multinational banks act as an amplifier of the shock in the short run but speed up the recovery.

5.4 From model to data: an application to Poland

We take the model to the data to assess the extent to which the mechanisms illustrated by the impulse response analysis can help account for macroeconomic fluctuations. We use Poland as an example of a host economy with a marked presence of multinational banks: in 2009 branches and subsidiaries of multinational banks held 68% of total bank assets in the country (Allen et al., 2013). We first illustrate the trade-off between short and medium run by examining conditional variances at various horizons. Then, following Reinhart and Rogoff (2014), we study quantitatively how the presence of multinational banks affects the depth, duration and overall severity of recessions.

We calibrate the host-country's banking sector parameters to Poland and estimate the shock processes for both the net worth of local banks and the TFP. We assume independent $AR(1)$ processes of the local banks' net worth shock, ϵ_t^N, and the TFP shock, A_t, in the host country. Bank net worth data are from the database of the Central Bank of Poland for the 1997-2014 period. TFP at constant national prices for the 1970-2014 period is

obtained from the Penn World Tables version 9.0 (Feenstra et al., 2015).[15] The data are logged and Kalman-filtered. According to our estimates, the persistences of the TFP and bank net worth shocks are 0.556 and 0.8739, and the standard deviations are 0.0065 and 0.0209, respectively. We choose $\xi = 0.867$, so that bank leverage equals 7.53 in steady state, the average in Polish data in 1997-2014. ϕ is set 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). We retain the value of $\theta = 0.6$ chosen in Section 5.1 for the weight on transfers in capital requirements. According to Allen et al. (2013), on average in 2007-2009, for Unicredit, an Italian multinational bank with a large network of affiliates in Eastern Europe, the flows between Polish affiliates and the parent bank consisted for about 57% of loans and other non-equity flows. For Citigroup, in 2007, the flows between Polish affiliates and the parent bank consisted for 60% of loans and other non-equity flows. We calibrate κ^l to 0.7 to match LTV ratios that are typically observed in Poland. κ^g is set to 0.76 and ν is chosen as 0.171, so that multinational banks account for 50% of the total loans in the host country, as documented by reports of the Polish Bank Association.

We then feed the estimated processes into our benchmark model and compute conditional variances at various horizons (see Table 3). We also compute conditional variances for the alternative models with no transfers ($Z^g = 0$) and with a fixed share of collateral pledged to domestic banks (constant f). We then calculate the ratios of conditional variances in our benchmark 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 through global banks' internal capital markets, and a destabilizing effect at longer horizons (sluggishness in the recovery) due to the reallocation of borrowing towards global banks. Figure 4 confirms these predictions. First, as the horizon increases the ratio of variances in the benchmark model to those in the model with no transfers rises as the stabilizing effect of the transfers fades from the benchmark model but, by construction, not from the alternative model without transfers (Figure 4(a)). For example, going from the 8th to the 28th quarter, the ratio increases by 1.90 times for output. Second, as the horizon increases the ratio of variances in the benchmark model to those in the alternative model with fixed f rises as the destabilizing effect of collateral reallocation starts kicking in in the benchmark model but, by construction, not in the model with fixed f (Figure 4(b)). Going from the 8th to the 28th quarter, the ratio increases by 2.29 times for output. For further comparison, in Figure A.3 we also display the ratios of conditional variances using shock processes as in the experiments of Section 5.2. The insights carry through.

For TFP shocks, recall that the impulse responses show a destabilizing effect in the short run due to repatriation of liquidity from affiliates to parent offices, and a stabilizing effect at longer horizons due to reallocation of collateral towards domestic banks (more efficient at monitoring and managing collateral). The calculated ratios are again consistent with

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[15]As the TFP data are at the annual frequency, we first estimate the $AR(1)$ process at the annual frequency and then convert parameters to values at quarterly frequency.

these predictions. As the horizon increases, the ratio of variances in the benchmark model to those in the alternative models with no transfers or with fixed f drops (see again 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 15,000-quarter stochastic time-series simulation, drop the initial 5,000 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 (Braun and Larrain, 2005; Abiad et al., 2011). The start of a recession is identified as the quarter following the peak. We compute the duration of a recession as the number of years it takes for output to return to the pre-recession peak and compute the depth of a recession as the peak-to-trough percentage output drop. 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 1,000 times, collect all recessionary episodes, and calculate the average depth, duration and severity across all recessions.

Results are displayed in Table 4, Panel A.[16] Once 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. Panel A of Table 4 shows that, for the calibrated Polish economy, the benchmark model features less deep recessions but more sluggish recoveries than the alternative economies. This indicates that the effects of multinational banks following bank net worth shocks play a larger role than their effects following TFP shocks. Table 4, Panel A, for example, shows that, relative to the no-transfer alternative model, the average depth of recessions is about 10% smaller (4.32% versus 4.75%), while the average duration is roughly 5% longer (14.35 rather than 13.7 years). Relative to the fixed-f alternative model, the average depth of recessions is slightly smaller (4.32% versus 4.35%), whereas the average duration is significantly longer (14.35 rather than 10 years). We aggregate these effects through the composite measure of severity of recessions. In the benchmark economy the average value of the severity index is 18.66. For comparison, Reinhart and Rogoff (2014) report an average value of the index of 16.9 across 63 episodes of recessions in advanced economies driven by bank turmoils (15.7 in post-World War II recessions). The average value of the severity index in our benchmark model is nearly 30% higher than its average value in the fixed-f alternative model (column 4) and slightly exceeds its average value in the no-transfer alternative model. Overall, the increased sluggishness of recoveries induced by multinational banks appears to outweigh their benefit in terms of reduced depth of recessions.

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[16]To facilitate comparisons, to simulate the benchmark and the alternative economies, we use the same shock processes which are used to compute the statistics in Table 4. The benchmark model features average depth and length of recessions in the ballpark of what is documented by Reinhart and Rogoff (2014), although it somewhat underpredicts the depth and somewhat overpredicts the length of recessions.

6 Structural and Cyclical Policies

We investigate how structural regulations of foreign banking (Section 6.1) and cyclical policies (Section 6.2) affect the trade-offs uncovered in the model. Throughout, we focus on banking shocks, but the insights can easily be adapted to TFP shocks.

6.1 Structural regulation

Figure 5(a) illustrates the role of the costs of making transfers (ψ) following a host country banking shock. In recent years, various countries have implemented regulatory reforms that have altered the cost of transferring funds for global banks (Nowotny et al., 2014). Higher costs mean smaller transfers. Thus, as ψ rises, the stabilizing property of transfers in the short run weakens. On the other hand, the switch from local to global banks is dampened, too, and this means that in the medium-long run the reduction in collateral pledgeability gets moderated and the recovery is faster.

Figure 5(b) considers the capital requirement (θ) on transfers through internal capital markets. Some countries discourage some types of transfers (see, e.g., the commercial code of Estonia or the recommendations of Polish supervisory authorities). A higher θ means that transfers consist more of loans than of equity injections and hence are subject to tighter capital requirements. Thus, when an affiliate receives a transfer, its capital constraint tightens more than in the case of a lower θ, so that the transfer contributes less to boosting the affiliate's lending capacity. Parent offices internalize this effect and transfer a smaller amount. Through this channel, a higher θ dilutes the stabilizing role of multinational banks in the short run, but also reduces their cost in terms of slower recovery.

Figure 5(c) considers the degree of 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 offices of global 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 the 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 also a faster recovery (see Figure 5(c)).

To wrap up, the experiments suggest that regulations that influence the cost of transfers via internal capital markets or that favor some types of transfers have an ambiguous impact a priori: they can make multinational banks better short-run stabilizers following a banking shock but also a bigger hindrance to the recovery. By contrast, regulations that push towards a branch-based network of multinational banks appear to unambiguously increase macroeconomic stability following banking shocks. To build intuition, we repeat the quantitative exercise of Section 5.4 for different values of ψ, ϕ, and θ, with results displayed in Panel B of Table 4. Raising the degree of consolidation ϕ by 10 percent reduces the

severity index by nearly 1 percent. This can lend support to regulations that incentivize global banks to open up branches rather than subsidiaries (Allen et al., 2013).

6.2 Cyclical policies

We model cyclical policies as an adjustment of firms' loan-to-value ratio in the host country (see, e.g., Bierut et al., 2015, for the case of Poland and other Eastern European countries). We first consider a policy that discriminates between the loans of local and global banks.[17] We posit that when a firm borrows from global banks its loan-to-value ratio is adjusted according to the output-contingent 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. We focus on counter-cyclical policies ($\chi < 0$). In particular, $\chi = -5$, 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 local bank net worth shock in the countercyclical-policy scenario (dash-dotted line) and in the benchmark case with a constant κ^g (solid line). As output gradually declines after the shock, κ^g increases. The higher κ^g directly expands credit; it also has the indirect effect of inducing firms to switch to global banks (reduce f_t), which at the margin are less efficient at monitoring and liquidating collateral. The indirect effect initially dominates, depressing firms' access to credit. However, after a few periods the direct effect of the policy gains strength and relaxes firms' collateral constraint, accelerating the recovery.

Next, we experiment with an alternative LTV policy which relaxes the loan-to-value ratio of borrowing from the two types of banks in the same way, that is, $\tilde{\kappa}_t^g = \chi \tilde{Y}_t$ and $\tilde{\kappa}_t^l = \chi \tilde{Y}_t$. We set $\chi = -1.25$: in steady state multinational bank loans are about one fourth of total loans, so that a χ of -1.25 implies that the overall responsiveness of the policy is similar to the previous experiment. Figure 5(d) shows the responses to a local bank net worth shock. The first, direct effect of the policy is a relaxation of LTV ratios, which acts as a stabilizer. The second effect is a reduced incentive of entrepreneurs to demand capital for collateral purposes, since now the borrowing constraint is looser. This tends to depress the collateral price, incentivizing entrepreneurs to switch to multinational banks (reduce f_t). The latter effect tends to slow down the recovery. The impulse responses suggest that the direct (stabilizing) effect is dominated both in the short and the medium-long run, which implies a larger negative response of the economy when this policy is implemented.

7   Conclusion

This paper has studied the impact of multinational banks on the dynamics, depth and duration of business cycles of host economies. The analysis builds on two well-documented

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[17]While the regulatory framework might prevent from explicitly applying discriminatory regulations to different types of institutions, policy makers can enact policies that differentially target different categories of loans (e.g., based on the loan currency denomination or maturity). By so doing, they can target loans that are more likely to be granted by multinational banks.

features of multinational banks. Multinational banks can swiftly transfer liquidity across borders through internal capital markets but may encounter difficulties in allocating liquidity to local firms. We have found that the interaction between these two forces is the source of a trade-off between the short-run and the medium-run response of the economy to domestic shocks. For example, following a domestic banking shock, multinational banks can moderate the contractionary phase, reducing the depth of the recession, but slow down the subsequent recovery.

The analysis suggests that the openness to multinational banks can help explain cross-country differences in business cycle dynamics. And the expansion of multinational banks may be partly behind the progressive changes in the depth and sluggishness of recessions. On the policy front, the paper suggests that countercyclical credit policies targeting multinational banks and structural regulations affecting their mode of entry can enhance the stabilizing role of multinational banks. By capturing in reduced form entry via subsidiaries or branches, we have taken a first step towards investigating the role of entry modes. However, multinational banks can also enter host countries via brownfield investments (e.g., acquiring local banks) rather than greenfield entry, and this could also have consequences for multinational banks' behavior over the business cycle. We leave these and other issues to future research.

References

Abiad, A., Dell'Ariccia, G., and Li, B. (2011). Creditless recoveries. IMF Working Papers 11/58, International Monetary Fund.

Aiyagari, S. R. and Gertler, M. (1991). Asset returns with transactions costs and uninsured individual risk. *Journal of Monetary Economics*, 27(3):311–331.

Allen, F., Gu, X., and Kowalewski, O. (2013). Corporate governance and intra-group transactions in European bank holding companies during the crisis. In *Global Banking, Financial Markets and Crises*, pages 365–431. Emerald Group Publishing Limited.

Bierut, B. K., Chmielewski, T., Glogowski, A., Stopczyński, A., and Zajaczkowski, S. (2015). Implementing loan-to-value and debt-to-income ratios: Learning from country experiences. The case of Poland. *Narodowy Bank Polski Working Paper No. 212*.

BIS (2008). Bank for International Settlements 78th annual report.

BIS (2016). International banking and financial market developments. *BIS Quarterly Review*, March:1–29.

Bordo, M. D. and Haubrich, J. G. (2010). Credit crises, money and contractions: An historical view. *Journal of Monetary Economics*, 57(1):1–18.

Braun, M. and Larrain, B. (2005). Finance and the business cycle: international, inter-industry evidence. *The Journal of Finance*, 60(3):1097–1128.

Bry, G. and Boschan, C. (1971). Programmed selection of cyclical turning points. In *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs*, pages 7–63. NBER.

Cárdenas, J., Graf, J. P., and O'Dogherty, P. (2003). Foreign banks entry in emerging market economies: a host country perspective. Bank for International Settlements working paper.

Cecchetti, S. G., Kohler, M., Upper, C., et al. (2009). Financial crises and economic activity. In *Proceedings-Economic Policy Symposium-Jackson Hole*, pages 89–135. Federal Reserve Bank of Kansas City.

Cerra, V. and Saxena, S. C. (2008). Growth dynamics: The myth of economic recovery. *American Economic Review*, 98(1):439–57.

Cetorelli, N. and Goldberg, L. S. (2012a). Banking globalization and monetary transmission. *Journal of Finance*, 67(5):1811–1843.

Cetorelli, N. and Goldberg, L. S. (2012b). Liquidity management of US global banks: Internal capital markets in the great recession. *Journal of International Economics*, 88(2):299–311.

Claessens, S., Kose, M. A., and Terrones, M. E. (2011). Financial cycles: What? How? When? In *NBER International Seminar on Macroeconomics*, volume 7, pages 303–344.

Claessens, S., Kose, M. A., and Terrones, M. E. (2012). How do business and financial cycles interact? *Journal of International Economics*, 87(1):178–190.

Claessens, S. and van Horen, N. (2014). Foreign banks: Trends and impact. *Journal of Money, Credit and Banking*, 46(s1):295–326.

Clarke, G. R., Cull, R., and Martinez Peria, M. S. (2006). Foreign bank participation and access to credit across firms in developing countries. *Journal of Comparative Economics*, 34(4):774–795.

De Haas, R. and Van Lelyveld, I. (2010). Internal capital markets and lending by multinational bank subsidiaries. *Journal of Financial Intermediation*, 19(1):1–25.

De Haas, R. and Van Lelyveld, I. (2014). Multinational banks and the global financial crisis: Weathering the perfect storm? *Journal of Money, Credit and Banking*, 46(s1):333–364.

Degryse, H., Havrylchyk, O., Jurzyk, E., and Kozak, S. (2012). Foreign bank entry, credit allocation and lending rates in emerging markets: Empirical evidence from Poland. *Journal of Banking & Finance*, 36(11):2949 – 2959.

Dell'Ariccia, G., Friedman, E., and Marquez, R. (1999). Adverse selection as a barrier to entry in the banking industry. *RAND Journal of Economics*, 30(3):515–534.

Detragiache, E., Tressel, T., and Gupta, P. (2008). Foreign banks in poor countries: theory and evidence. *Journal of Finance*, 63(5):2123–2160.

Feenstra, R. C., Inklaar, R., and Timmer, M. P. (2015). The next generation of the penn world table. *American Economic Review*, 105(10):3150–82.

Fiechter, J., Ötker-Robe, I., Ilyina, A., Hsu, M., Santos, A. O., and Surti, J. (2011). Subsidiaries or branches: Does one size fit all? IMF Staff Discussion Notes 11/04, International Monetary Fund.

Fillat, J. L., Garetto, S., and Götz, M. (2018). To branch or not to branch? A quantitative evaluation of the consequences of global banks' organization. Unpublished manuscript, Boston University.

Friedman, M. and Schwartz, A. J. (2008). *A monetary history of the United States, 1867-1960.* Princeton University Press.

Gertler, M. and Karadi, P. (2011). A model of unconventional monetary policy. *Journal of Monetary Economics*, 58(1):17–34.

Gertler, M., Kiyotaki, N., and Queralto, A. (2012). Financial crises, bank risk exposure and government financial policy. *Journal of Monetary Economics*, 59:S17–S34.

Giannetti, M. and Ongena, S. (2012). "Lending by example": Direct and indirect effects of foreign banks in emerging markets. *Journal of International Economics*, 86(1):167–180.

Gormley, T. A. (2010). The impact of foreign bank entry in emerging markets: Evidence from India. *Journal of Financial Intermediation*, 19(1):26–51.

Guerrieri, L., Iacoviello, M., and Minetti, R. (2012). Banks, sovereign debt, and the international transmission of business cycles. *NBER International Seminar on Macroeconomics*, 9(1):181–213.

Hermalin, B., Rose, A. K., Garber, P. M., Crockett, A., and Mullins Jr, D. W. (1999). Risks to lenders and borrowers in international capital markets. In *International Capital Flows*, pages 363–420. University of Chicago Press.

Iacoviello, M. and Minetti, R. (2006). International business cycles with domestic and foreign lenders. *Journal of Monetary Economics*, 53(8):2267–2282.

Jácome, L. I. and Mitra, M. S. (2015). LTV and DTI limits—Going granular. IMF Working Papers 15/154.

Jenkins, H. (2002). Are commercial banks really absent from micro and small enterprise finance? Development Discussion Papers 2002-12, JDI Executive Programs.

Judson, R. A. and Owen, A. L. (1999). Estimating dynamic panel data models: a guide for macroeconomists. *Economics letters*, 65(1):9–15.

Kalemli-Ozcan, S., Papaioannou, E., and Perri, F. (2013). Global banks and crisis transmission. *Journal of International Economics*, 89(2):495–510.

Kehoe, P. J. and Perri, F. (2002). International business cycles with endogenous incomplete markets. *Econometrica*, 70(3):907–928.

Kiyotaki, N. and Moore, J. (1997). Credit cycles. *Journal of Political Economy*, 105(2):211–248.

Lakdawala, A., Minetti, R., and Olivero, M. P. (2018). Interbank markets and credit policies amid a sovereign debt crisis. *Journal of Economic Dynamics and Control*, forthcoming.

Meier, S. (2013). Financial globalization and monetary transmission. Globalization and monetary policy institute working paper No. 145, Federal Reserve Bank of Dallas.

Mian, A. (2006). Distance constraints: The limits of foreign lending in poor economies. *Journal of Finance*, 61(3):1465–1505.

Minetti, R. (2011). Informed finance and technological conservatism. *Review of Finance*, 15(3):633–692.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica*, pages 1417–1426.

Niepmann, F. (2016). Banking across borders with heterogeneous banks. International Finance Discussion Papers 1177, Board of Governors of the Federal Reserve System.

Nowotny, E., Ritzberger-Grünwald, D., and Backé, P. (2014). *Financial cycles and the real economy: Lessons for CESEE countries*. Edward Elgar Publishing.

Rai, K. and Kamil, H. (2010). The global credit crunch and foreign banks' lending to emerging markets: Why did latin america fare better? IMF Working Papers 10/102, International Monetary Fund.

Rajan, R. G. and Zingales, L. (1998). Power in a theory of the firm. *Quarterly Journal of Economics*, 113(2):387–432.

Reinhart, C. M. and Rogoff, K. S. (2014). Recovery from financial crises: Evidence from 100 episodes. *American Economic Review*, 104(5):50–55.

Romer, C. D. and Romer, D. H. (2017). New evidence on the aftermath of financial crises in advanced countries. *American Economic Review*, 107(10):3072–3118.

Stiglitz, J. E. (2003). *Globalization and its Discontents.* New York, NY: W. W. Norton & Company.

Vujić, V. (2015). Internal capital markets and crisis transmission: evidence from foreign bank subsidiaries in CESEE. *Focus on European Economic Integration*, 3:39–56.

Wynne, M. A. and Balke, N. S. (1992). Are deep recessions followed by strong recoveries? *Economics Letters*, 39(2):183–189.

Table 1: Foreign Bank Impact over Recessions and Recoveries

	(1)	(2)	(3)
Contraction * Foreign Bank Ratio	0.629	0.537	0.493
	(0.4205)	(0.4729)	(0.5888)
Contraction * Foreign Bank Ratio * Financial Distress	-0.136	-0.122	-0.025
	(0.0661)	(0.0675)	(0.0299)
Recovery * Foreign Bank Ratio	0.970	1.066	2.226*
	(0.4932)	(0.5206)	(0.8029)
Recovery * Foreign Bank Ratio * Financial Distress	-0.159**	-0.154**	-0.104*
	(0.0482)	(0.0528)	(0.0398)
+ FDI net inflow and Effective Exchange Rate	N	Y	Y
+ Mutual Fund Assets	N	N	Y
N	903	841	360

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, differentiated according to the degree of financial distress in the country. The full estimation results are in Appendix Table A.1. The definition of the variables and the empirical specification are detailed in Section 3. Column 2 controls for FDI net inflows (as % of GDP) and column 3 also controls for mutual fund assets (as % of GDP) and for the real effective exchange rate. *, **, *** denote statistically significant at the 5%, 1%, and 0.1% level, respectively.

Table 2: Calibration

Parameter	Symbol	Baseline calibration (Section 4.1-4.3)	Calibration to Poland (Section 4.4)
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	0.880	0.867
Weight of foreign assets in constraint	ϕ	0.286	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	0.700
% assets liquidated by global banks	κ^g	0.650	0.760
Cost of global bank liquidation	ν	0.308	0.171
% assets brought by new bankers	ζ	$1.358e-04$	
Probability of surviving bankers	σ	0.969	

Note: a missing value in the last column means that the same value as in the baseline calibration was used for that parameter.

Table 3: Conditional variances

	Bank net worth shock				TFP shock			
	8Q	16Q	28Q	60Q	8Q	16Q	28Q	60Q
(a) Shocks calibrated to the Polish economy (Section 4.4)								
I_t	1.55	3.98	7.18	11.55	0.54	0.56	0.57	0.57
K_t	0.02	0.15	0.73	3.63	0.01	0.03	0.04	0.06
Y_t	0.00	0.03	0.17	0.88	1.39	1.40	1.40	1.41
(b) Shocks as in the baseline experiments (Section 4.1-4.3)								
I_t	0.29	0.33	0.37	0.43	3.57	7.16	8.91	9.34
K_t	0.00	0.02	0.04	0.10	0.04	0.31	1.04	2.55
Y_t	0.00	0.00	0.01	0.03	0.78	1.40	2.08	2.84

Note: this table shows the conditional variances for various periods in the benchmark model. Numbers are multiplied by 1e4. Panel (b) uses persistences of shocks in the baseline experiments in Sections 4.1-4.3: the bank net worth shock is i.i.d. and the persistence of the TFP shock is 0.95.

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	4.31	14.23	18.54
No transfer	4.75	13.70	18.45
Fix f	4.34	9.94	14.28

(b) Structural regulation and severity index

Tighter regulation	$\psi = 1$	$\theta = 1$	$\phi = 0.076$
	17.66	18.19	18.41
Benchmark	$\psi = 0.1$	$\theta = 0.6$	$\phi = 0.069$
	18.54	18.54	18.54
Looser regulation	$\psi = 0$	$\theta = 0$	$\phi = 0$
	18.78	18.71	19.68

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 structural policies that vary the cost of making transfers (ψ), the degree to which transfers are subject to capital requirement (θ), and the degree of consolidation of multinational banks' balance sheets (ϕ).
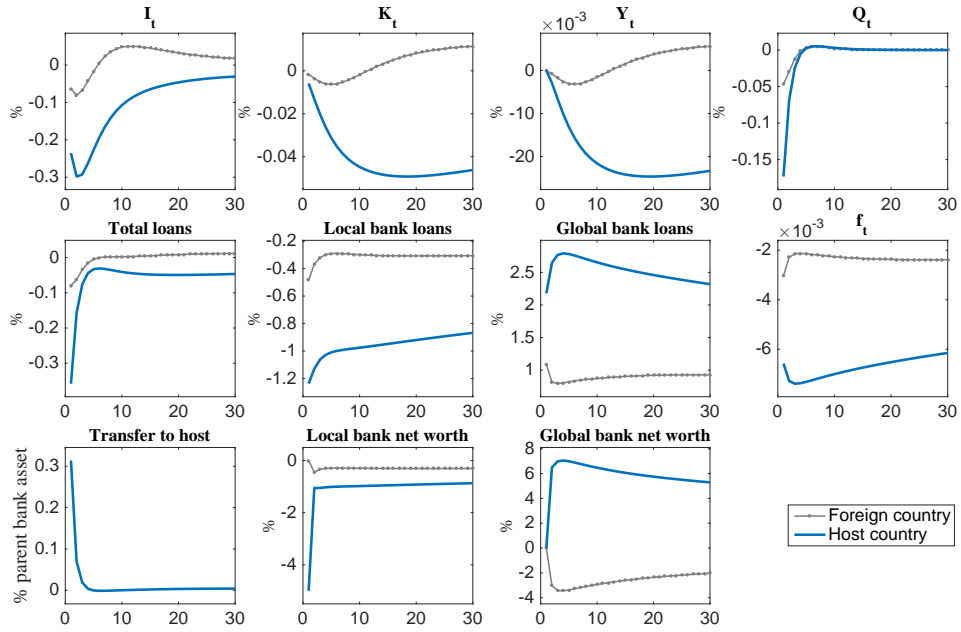
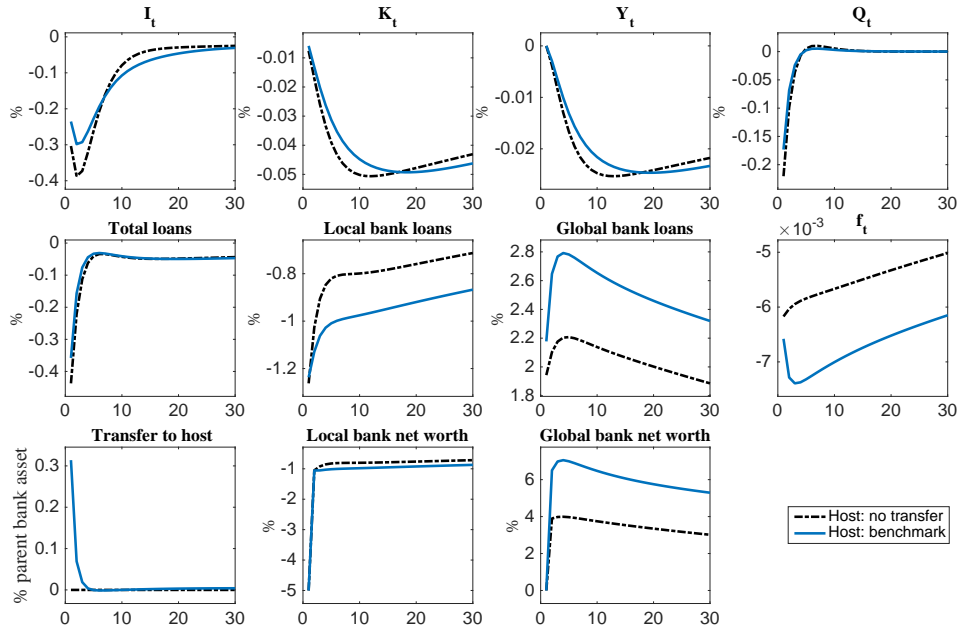Figure 1: Benchmark model: IRFs to a 5% negative shock to net worth of local banks in the foreign/host country.

Figure 2: Shutdown the internal capital market of multinational banks. The figure shows impulse responses to a negative 5% local bank net worth shock in the host country.
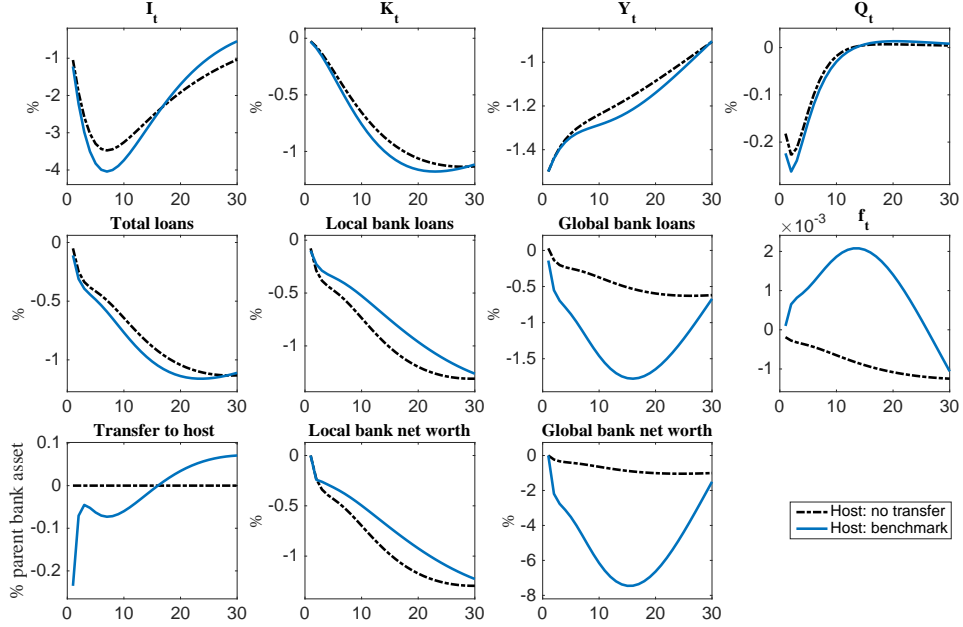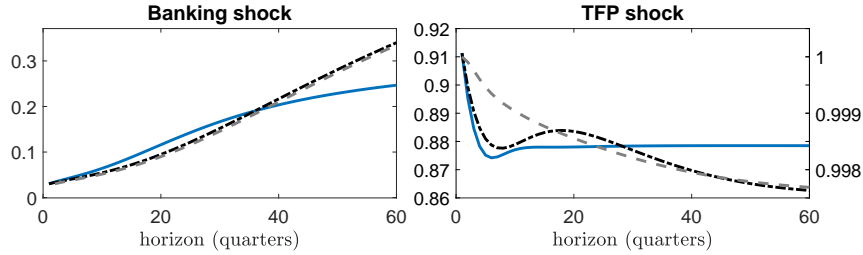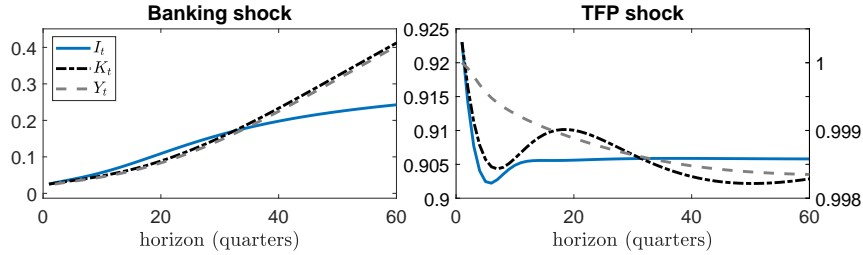
Figure 3: IRFs to a 1% negative shock to TFP in the host country


(a): Benchmark model / the model with no transfers


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

Figure 4: The figure plots the ratio of conditional variances in the benchmark model to conditional vairances in alternative models. For the case of the TFP shock, the red dashed curve for Y_t corresponds to the right Y-axis, and the other two curves correspond to the left Y-axis.
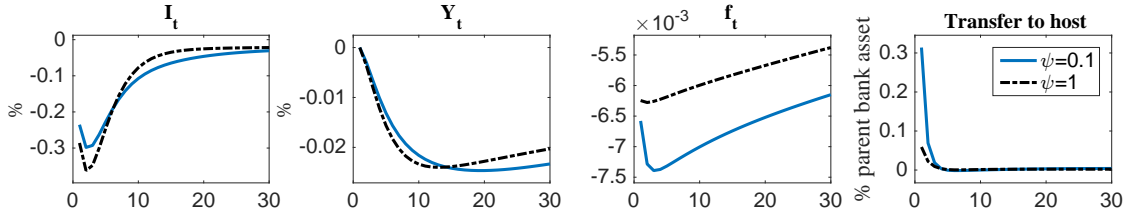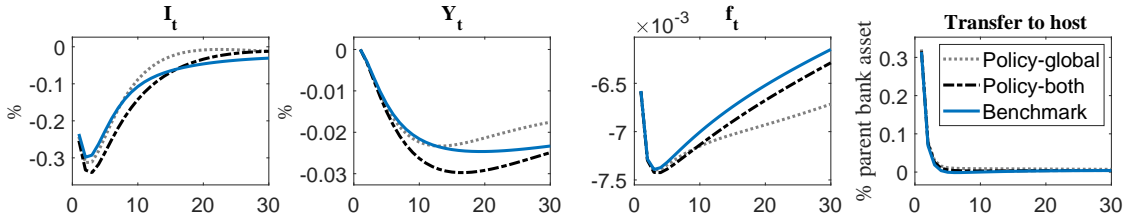
(a): Cost of making transfers ψ
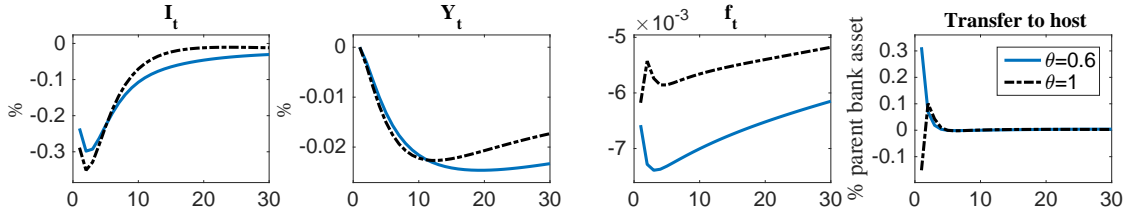
(b): Weight of transfers in global banks' capital constraint θ
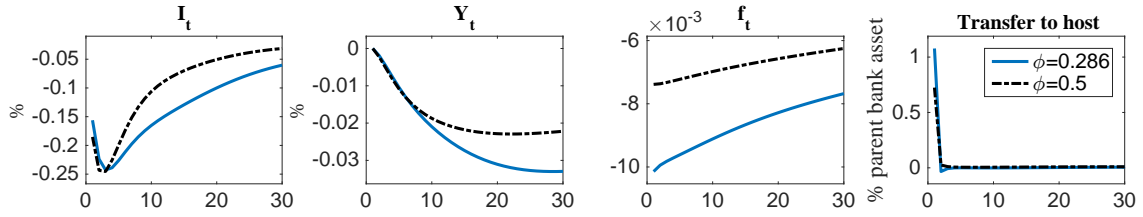
(c): Balance sheets consolidation ϕ

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

Figure 5: Structural and cyclical policies. The figure shows impulse responses to a negative 5% local bank net worth shock in the host country. Panel (a)-(c) show the role of structural regulatory features. Panel (d) shows role of a countercyclical LTV policy. The red dotted line is a policy that targets multinational banks only and χ is set -5. The black dash-dotted line is a policy that apply to both types of banks and χ is set -1.25.

Appendix (Not for Publication)

The empirical analysis is conducted on the following panel of countries: AUS, AUT, BEL, CAN, DNK, FIN, FRA, DEU, GRC, ISL, IRL, ITA, JPN, LUX, NLD, NZL, NOR, PRT, ESP, SWE, CHE, TUR, GBR, USA.

Table A.1 below displays the full estimation results.

Table A.1: Foreign Bank Impact over Recessions and Recoveries

	(1)	(2)	(3)
Contraction	-1.677***	-1.811***	-1.488***
	(0.3511)	(0.3282)	(0.3352)
Foreign Bank Ratio	0.025	0.027	-1.173
	(0.0120)	(0.0133)	(0.9267)
Financial Distress	-0.044	-0.044	-0.013
	(0.0250)	(0.0255)	(0.0112)
Foreign Bank Ratio * Financial Distress	0.098	0.089	0.000
	(0.0498)	(0.0536)	(0.0274)
Contraction * Financial Distress	0.005	0.004	-0.010
	(0.0239)	(0.0237)	(0.0168)
Contraction * Foreign Bank Ratio	0.629	0.537	0.493
	(0.4205)	(0.4729)	(0.5888)
Contraction * Foreign Bank Ratio * Financial Distress	-0.136	-0.122	-0.025
	(0.0661)	(0.0675)	(0.0299)
Recovery	-3.319***	-3.349***	-2.844***
	(0.4976)	(0.5471)	(0.6363)
Recovery * Financial Distress	0.040	0.038	0.072*
	(0.0202)	(0.0201)	(0.0299)
Recovery * Foreign Bank Ratio	0.970	1.066	2.226*
	(0.4932)	(0.5206)	(0.8029)
Recovery * Foreign Bank Ratio * Financial Distress	-0.159**	-0.154**	-0.104*
	(0.0482)	(0.0528)	(0.0398)
Foreign direct investment, net inflows (% of GDP)		0.027*	0.019
		(0.0100)	(0.0111)
Real effective exchange rate index (2010 = 100)			-0.014
			(0.0098)
Mutual fund assets to GDP (%)			0.006
			(0.0034)
N	903	841	360

Note: This table reports coefficient estimates for the effect of foreign banks on GDP growth in contractionary and recovery phases of the business cycle, differentiated according to the degree of financial distress in the country. The definition of the variables and the empirical specification are detailed in Section 3. Column 2 controls for FDI net inflows (as % of GDP) and column 3 also controls for mutual fund assets (as % of GDP) and for the real effective exchange rate. *, **, *** denote statistically significant at the 5%, 1%, and 0.1% level, respectively.

Households

deposits D_t^l dividends   deposits D_t^g dividends   deposits D_t^{g*} dividends   deposits D_t^{l*}

Local Banks

Global Bank
Affiliates

transfers
Z_t^g (Z_t^{g*})

Global Bank
Parents

Local Banks

loans X_t^l loans X_t^g loans X_t^{g*} loans X_t^{l*}
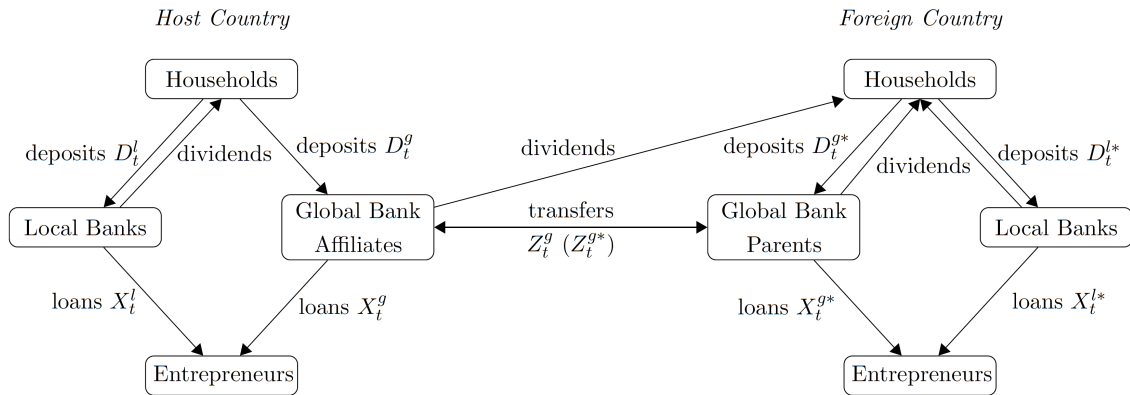
Entrepreneurs

Households

Entrepreneurs
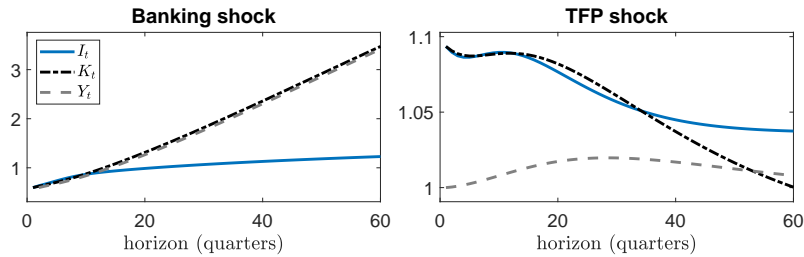
Figure A.1: Financial flows in the model economy
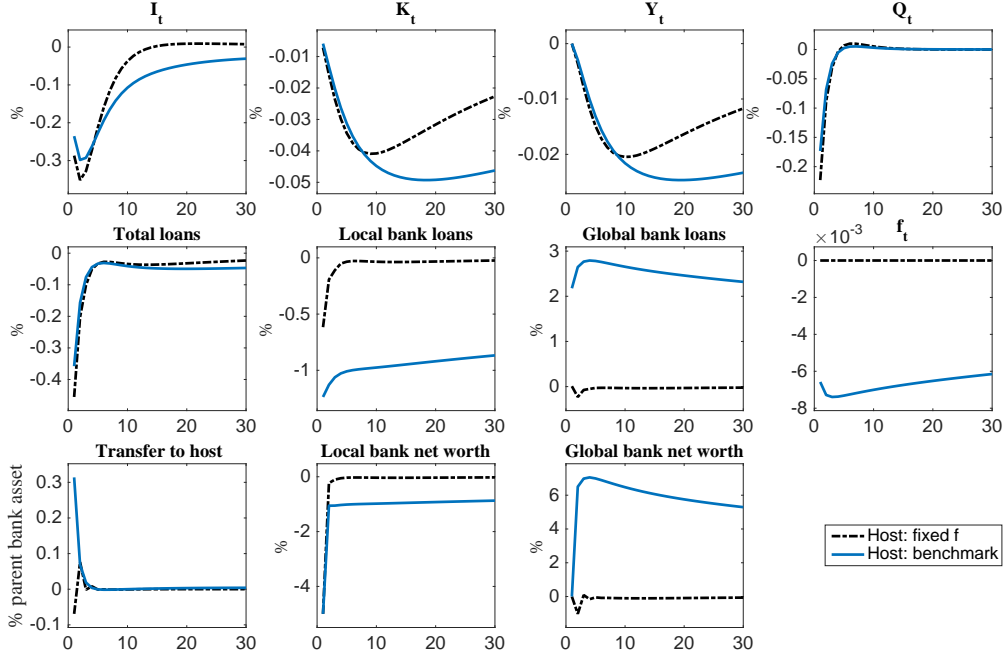
Figure A.2: Shutdown the collateral reallocation between local and multinational banks. The figure shows impulse responses to a negative 5% local bank net worth shock in the host country.
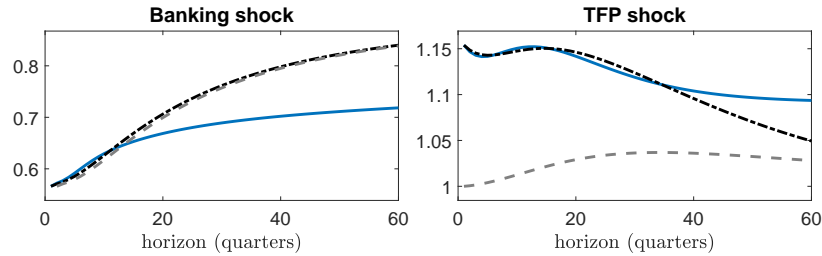
(a): Benchmark model / the model with no transfers

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

Figure A.3: The figure plots the ratio of conditional variances in the benchmark model to those in the alternative models, using persistences in the baseline calibration of Sections 4.1-4.3. The net worth shock is i.i.d. and the persistence of the TFP shock is 0.95.

A.1 A microfoundation of multinational banks' lending technology

We provide here an example of a possible microfoundation of multinational banks' technology for monitoring and liquidating collateral, as presented in eqs. (15) and (16). The example exploits the argument that local firms feature different informational complexity of their collateralizable capital assets and that, unlike local banks, multinational banks are exposed to this informational complexity. Multinational banks charge a loan rate $R_t^{X,g}$. There is a unit measure of firms indexed by $j \in [0,1]$ in the economy and each firm has one unit of collateralizable capital assets. Each firm can invest in a project with return y subject to sustaining an upfront fixed cost ζ. If multinational banks liquidate the collateralized capital of firm j, the liquidation value is $Q_t l_j$, where l_j is uniformly distributed on $[0,1]$ (in what follows, for simplicity we normalize the price of capital Q_t to one). l_j represents the information that a multinational bank has on firm j's collateral asset.

The loan x_{jt}^g that multinational banks extend to firm j has to satisfy the collateral constraint

$$R_t^{X,g} x_{jt}^g \leq \kappa^g l_j.$$

Firm j is willing to invest if and only if

$$y\left(x_{jt}^g - \zeta\right) - R_t^{X,g} x_{jt}^g \geq 0,$$

Denote the threshold $\hat{l} = \frac{\zeta R_t^{X,g} y}{y - R_t^{X,g}}$. The aggregate loan supply is then given by

$$X_t^g = \int_{\hat{l}}^1 x_{jt}^g dl_j = \int_{\hat{l}}^1 \frac{\kappa^g l_j}{R_t^{X,g}} dl_j = \frac{\kappa^g}{2R_t^{X,g}}\left(1 - \hat{l}^2\right).$$

As each investing firm pledges one unit of collateral capital, the total amount of collateralized capital is

$$K = \int_{\hat{l}}^1 1 dl_j = 1 - \hat{l}.$$

The relationship between X_t^g and K is then

$$R_t^{X,g} X_t^g = \kappa^g \left(K - \frac{K^2}{2}\right).$$

This can be compared with the relationship in the main text, when f_t (and for Q_t set to 1):

$$R_t^{X,g} X_t^g \leq \kappa^g \left(K_t - \frac{\nu K_t^2}{2\bar{K}}\right).$$

A.2 Details on Equilibrium System and Definition

The equilibrium is defined in the usual way. We describe the conditions in the host country; conditions in the foreign country are symmetric unless otherwise specified.

(i) Given wage rates, deposit interest rates and profits $\{W_t, D_t, \Pi_t\}$, the representative households in the host country choose $\{C_t, H_t, D_t\}$ to maximize their utility.

(ii) Given interest rates $\{R_t^D, R_t^{X,l}\}$, the local banks in the host country choose $\{X_t^l, D_t^l\}$ to maximize their values.

(iii) Given $\{R_t^D, R_t^{X,l}, R_t^{D,*}, R_t^{X,g,*}\}$, the affiliates in the home and foreign countries choose $\{X_t^g, D_t^g, X_t^{g,*}, D_t^{g,*}\}$ to maximize their values. Transfers $\{Z_t^g, Z_t^{g,*}\}$ are chosen at the conglomerate level to maximize the joint value.

(iv) Given $\{W_t, Q_t, R_t^{X,l}, R_t^{X,g}\}$, entrepreneurs in the host country choose $\{H_t, C_t^e, K_t, X_t^g, X_t^l, f_t\}$ to maximize their utility.

(v) Given capital prices $\{Q_t\}$, capital good producers in the host country choose investment $\{I_t\}$ to maximize their profits.

(vi) All markets clear. In particular, the deposit rates $\{R_t^D\}$ clear the host country's deposits market. Other market clearing conditions are already embedded.

We report here the full equilibrium system. The equilibrium involves the following variables.

32 quantities: $Y_t, C_t, C_t^e, K_t, I_t, H_t, X_t^g, X_t^l, f_t, D_t^g, D_t^l, Z_t, N_t^l, N_t^g, D_t, \Pi_t,$
$Y_t^*, C_t^*, C_t^{e,*}, K_t^*, I_t^*, H_t^*, X_t^{g,*}, X_t^{l,*}, f_t^*, D_t^{g,*}, D_t^{l,*}, Z_t^*, N_t^{l,*}, N_t^{g,*}, D_t^*, \Pi_t^*;$

22 prices: $W_t, Q_t, R_t^{X,g}, R_t^{X,l}, R_t^D, \lambda_t^g, \mu_t^g, \lambda_t^l, \mu_t^l, \omega_t^g, \omega_t^l,$
$W_t^*, Q_t^*, R_t^{X,g,*}, R_t^{X,l,*}, R_t^{D,*}, \lambda_t^{g,*}, \mu_t^{g,*}, \lambda_t^{l,*}, \mu_t^{l,*}, \omega_t^{g,*}, \omega_t^{l,*}.$

The system consists of the following equations. The social resource constraint is omitted by the Walras law.

Households. The households budget constraints are

$$C_t = W_t H_t + \Pi_t + R_{t-1}^D D_{t-1} - D_t,$$
$$C_t^* = W_t^* H_t^* + \Pi_t^* + R_{t-1}^{D,*} D_{t-1}^* - D_t^*.$$

The first order conditions of households in the both countries read

$$H_t^\epsilon = W_t,$$
$$\mathbb{E}_t \Lambda_{t,t+1} R_t^D = 1,$$
$$H_t^{*,\epsilon} = W_t^*,$$
$$\mathbb{E}_t \Lambda_{t,t+1}^* R_t^{D,*} = 1.$$

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Banks. Their balance sheet identities are

$$X_t^l = N_t^l + D_t^l,$$
$$X_t^{l,*} = N_t^{l,*} + D_t^{l,*},$$
$$X_t^g = N_t^g + Z_t^g + D_t^g,$$
$$X_t^{g,*} = N_t^{g,*} + Z_t^{g,*} + D_t^{g,*}.$$

Banks' capital constraints read

$$R_t^D D_t^l = \xi R_t^{X,l} X_t^l,$$
$$R_t^D D_t^{l,*} = \xi R_t^{X,l,*} X_t^{l,*},$$
$$R_t^D D_t^g + \theta Z_t^g = \xi \left[(1-\phi) R_t^{X,g} X_t^g + \phi R_t^{X,g,*} X_t^{g,*} \right],$$
$$R_t^{D,*} D_t^{g,*} + \theta Z_t^{g,*} = \xi \left[(1-\phi) R_t^{X,g,*} X_t^{g,*} + \phi R_t^{X,g} X_t^g \right].$$

Below are first-order conditions for loans:

$$- \lambda_t^l + \xi \mu_t^l R_t^{X,l} + \mathbb{E}_t \Lambda_{t,t+1} \left(1 - \sigma + \sigma \lambda_{t+1}^l \right) R_t^{X,l} = 0,$$
$$- \lambda_t^{l,*} + \xi \mu_t^{l,*} R_t^{X,l,*} + \mathbb{E}_t \Lambda_{t,t+1}^* \left(1 - \sigma + \sigma \lambda_{t+1}^{l,*} \right) R_t^{X,l,*} = 0,$$
$$- \lambda_t^g + \xi (1-\phi) \mu_t^g R_t^{X,g} + \mathbb{E}_t \Lambda_{t,t+1}^* \left(1 - \sigma + \sigma \lambda_{t+1}^g \right) R_t^{X,g} = 0,$$
$$- \lambda_t^{g,*} + \xi (1-\phi) \mu_t^{g,*} R_t^{X,g,*} + \mathbb{E}_t \Lambda_{t,t+1}^* \left(1 - \sigma + \sigma \lambda_{t+1}^{g,*} \right) R_t^{X,g,*} = 0.$$

First-order conditions for deposits:

$$\lambda_t^l - \mu_t^l R_t^D - \mathbb{E}_t \Lambda_{t,t+1} \left(1 - \sigma + \sigma \lambda_{t+1}^l \right) R_t^D = 0,$$
$$\lambda_t^{l,*} - \mu_t^{l,*} R_t^{D,*} - \mathbb{E}_t \Lambda_{t,t+1}^* \left(1 - \sigma + \sigma \lambda_{t+1}^{l,*} \right) R_t^{D,*} = 0,$$
$$\lambda_t^g - \mu_t^g R_t^D - \mathbb{E}_t \Lambda_{t,t+1}^* \left(1 - \sigma + \sigma \lambda_{t+1}^g \right) R_t^D = 0,$$
$$\lambda_t^{g,*} - \mu_t^{g,*} R_t^{D,*} - \mathbb{E}_t \Lambda_{t,t+1}^* \left(1 - \sigma + \sigma \lambda_{t+1}^{g,*} \right) R_t^{D,*} = 0.$$

The optimal choice of transfers:

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

The evolutions of aggregate net worths are

$$N_{t+1}^g = \sigma \left(R_t^{X,g} X_t^g - R_t^D D_t^g \right) + \zeta R_t^{X,g} X_t^g,$$

$$N_{t+1}^{g,*} = \sigma \left(R_t^{X,g,*} X_t^{g,*} - R_t^{D,*} D_t^{g,*} \right) + \zeta R_t^{X,g,*} X_t^{g,*},$$

$$N_{t+1}^{l,*} = \sigma \left(R_t^{X,l,*} X_t^{l,*} - R_t^{D,*} D_t^{l,*} \right) + \zeta R_t^{X,l,*} X_t^{l,*},$$

$$N_{t+1}^l = \sigma \left(R_t^{X,l} X_t^l - R_t^D D_t^l + + \overline{N}^l \epsilon_t^N \right) + \zeta R_t^{X,l} X_t^l.$$

Entrepreneurs. Entrepreneurs' budget constraints are

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

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

Collateral constraints for borrowing from both types of banks:

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

$$R_t^{X,l} X_t^l = \kappa^l \left(f_t Q_t K_t \right),$$

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

$$R_t^{X,l,*} X_t^{l,*} = \kappa^l \left(f_t^* Q_t^* K_t^* \right).$$

The entrepreneur's first-order conditions for labor and capital are

$$\frac{(1-\alpha) Y_t}{H_t} = W_t,$$

$$\frac{(1-\alpha) Y_t^*}{H_t^*} = W_t^*,$$

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

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

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

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

The optimal choices of collateral pledging are

$$f_t = 1 - \frac{\bar{Q}\bar{K}}{\nu Q_t K_t} \frac{\kappa^g \omega_t^g - \kappa^l \omega_t^l}{\kappa^g \omega_t^g},$$

$$f_t^* = 1 - \frac{\bar{Q}\bar{K}}{\nu Q_t^* K_t^*} \frac{\kappa^g \omega_t^{g,*} - \kappa^l \omega_t^{l,*}}{\kappa^g \omega_t^{g,*}}.$$

The first order conditions for loans from both types of banks are

$$U_{c^e,t} - \omega_t^g R_t^{X,g} - \beta_e \mathbb{E}_t R_t^{X,g} U_{c^e,t+1} = 0,$$

$$U_{c^e,*,t} - \omega_t^{g,*} R_t^{X,g,*} - \beta_e \mathbb{E}_t R_t^{X,g,*} U_{c^e,*,t+1} = 0,$$

$$U_{c^e,t} - \omega_t^l R_t^{X,l} - \beta_e \mathbb{E}_t R_t^{X,l} U_{c^e,t+1} = 0,$$

$$U_{c^e,*,t} - \omega_t^{l,*} R_t^{X,l,*} - \beta_e \mathbb{E}_t R_t^{X,l,*} U_{c^e,*,t+1} = 0.$$

Capital good producers. Their first order conditions are

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

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

Market clearing conditions and other equations. The market clearing conditions for the deposit markets in each country are

$$D_t = D_t^g + D_t^l,$$

$$D_t^* = D_t^{g,*} + D_t^{l,*}.$$

The market clearing condition for transfer is

$$Z_t^g + Z_t^{g,*} = 0.$$

The transfers received by the host country's household come from local banks' net transfer (dividends of exiting bankers minus transfers to new bankers) and profits earned by capital good producers:

$$\Pi_t = (1 - \sigma)\left(R_t^{X,l} X_t^l - R_t^D D_t^l\right) - \zeta R_t^{X,l} X_t^l + Q_t I_t - \left[1 + f\left(\frac{I_t}{I_{t-1}}\right)\right] I_t.$$

The transfers received by the foreign country's household come from net transfers of local

and global banks and profits earned by capital good producers:

$$
\begin{aligned}
\Pi_t^* =& (1-\sigma)\left(R_t^{X,g,*}X_t^{g,*} - R_t^{D,*}D_t^{g,*}\right) + (1-\sigma)\left(R_t^{X,g}X_t^{g} - R_t^{D}D_t^{g}\right) \\
&+ (1-\sigma)\left(R_t^{X,l,*}X_t^{l,*} - R_t^{D,*}D_t^{l,*}\right) - \zeta(R_t^{X,g,*}X_t^{g,*} + R_t^{X,g}X_t^{g} + R_t^{X,l,*}X_t^{l,*}) \\
&+ Q_t^*I_t^* - \left[1 + f\left(\frac{I_t^*}{I_{t-1}^*}\right)\right]I_t^*.
\end{aligned}
$$

Capital accumulation follows the laws of motion

$$
K_t = (1-\delta)K_{t-1} + I_t,
$$
$$
K_t^* = (1-\delta)K_{t-1}^* + I_t^*.
$$

Aggregate production functions are

$$
Y_t = A_t K_{t-1}^{\alpha} H_t^{1-\alpha},
$$
$$
Y_t^* = A_t^* K_{t-1}^{*\alpha} H_t^{*1-\alpha}.
$$