Financial Crisis and Firm Entry in Emerging Economies

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June 8, 2018

Abstract

This paper studies the effects of financial shocks on firm entry dynamics and the real economy in the context of emerging economies. It introduces a small open economy model with endogenous firm entry and external financing of production and startup costs. An adverse financial shock tightens a collateral constraint for short-term borrowing by firms, leading to a decline in real macroeconomic variables, equity price, international debt and firm entry. The model is evaluated based on results from a panel VAR and it captures the empirical finding that firm entry and GDP declined during the last financial crisis in a group of emerging countries.

Keywords: Financial crises, Firm entry, Small open economy, Financial markets, Business fluctuations, Emerging economies, Financial Frictions

JEL Classification: D21, E23, F41, G01

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1 Introduction

The global recession of 2008-2012 caused economic turmoil in both emerging and advanced economies. The emerging economies were primarily affected by external shocks originating from advanced economies through international trade and financial channels, as studied in Tsangarides (2012) and Blanchard et al. (2010). While emerging economies have experienced a long series of financial crises, the global recession stands out with its synchronized spreading to a large number of countries. Along with production, the financial crisis led to a fall in firm entry in emerging economies, as shown in figure 1 for a group of 20 countries.\(^1\)

To study the financial side explanation for the declines in both GDP and firm entry, I introduce a small open economy model with endogenously determined firm entry and financially constrained firms. Closed economy models with endogenous firm entry have previously been studied in Bilbiie et al. (2012) and Bergin et al. (2018). This paper builds on the earlier contributions by introducing an open economy model that accounts for the experiences in emerging economies. In order to capture the characteristics of emerging markets, the model incorporates features such as foreign currency denominated borrowing, exogenous pricing for goods that are traded globally and an exogenous real interest rate. Financial shocks that reduce the borrowing of new and old firms are able to generate substantial falls in firm entry, output, foreign debt and equity prices.

The economy has both monopolistically competitive firms and a fully competitive sector. Monopolistic profits attract new firms to enter the market for differentiated goods, and consequently, the number of firms fluctuates procyclically. Monopolistic incumbents and entrants have access to both domestic equity and international debt that they use to finance their production. The capital structure reallocation is at the center of the dynamics of the paper. The equity financing of start-up costs is more expensive than debt to the new entrants and this prevents potential entrants from entering the market. Short-term international debt taken by the firms is bound by an enforcement constraint that is subject to external financial shocks that decrease

\(^1\)Klapper et al. (2015) provide empirical evidence for a large panel of 109 countries.
the value of firm’s collateral, and this causes restructuring in firm’s financing, as it reduces the foreign debt holdings and amplifies the decline in firm entry and production. This financial friction is similar to the collateral constraint presented in Kiyotaki and Moore (1997), and the capital structure of a firm follows the macro-finance structure of Jermann and Quadrini (2012) and Bergin et al. (2018). The fall in firm entry, on the one hand, moderates the negative effect of the shock on individual-level firm production and debt because the incumbent firms benefit from a decrease in the competition. On the other hand, a decline in firm entry has long lasting effects on the aggregate values, since the aggregate production recovers at a slower rate than its individual-level counterpart due to a lower number of firms in the economy.

In order to evaluate the model, I estimate a panel VAR for output and firm registrations with an exogenous financial crisis indicator, as in Cerra and Saxena (2008). This empirical estimation for a panel of 20 countries shows that the financial crisis had persistent negative effects on firm entry and real GDP. The purpose of this study is to examine the role of a financial shock that cuts foreign lending during the crisis and its success in generating the observed negative effects. The resulting
impulse response functions are used in the estimation of some key parameters in
the model. The evaluation of the model against empirical evidence shows that an
adverse financial shock in a small open economy framework is able to account for
the strong persistent decline of firm entry while the response of real GDP in the
model is volatile but less persistent.

This paper contributes to two strands of literature by combining an endoge-
nous firm entry model presented in Bilbiie et al. (2012) with financial frictions as
in Kiyotaki and Moore (1997). Growing literature studies the role of new firm cre-
ation for the propagation of business cycle fluctuations, and more recently, for the
transmission of financial shocks. The earlier research on this topic has shown that
endogenous firm entry is important for assessing business cycle fluctuations. My
paper contributes to this literature by studying firm entry dynamics in emerging
economies. Research at the intersection of the endogenous entry and financial fric-
tions literature is not new. Financial frictions and endogenously fluctuating firms or
varieties have previously been analyzed in Gourio et al. (2016), Bergin et al. (2018),
Guerron et al. (2016), Casares and Poutineau (2013) and Macnamara (2014). I
depart from these papers with a small open economy model with firm’s financing
of production and entry using international debt. The model presented here is the
closest to the research by Bergin et al. (2018), who show in a closed economy setting
that when firms rely on external financing for their initial start-up costs, adverse
financial shock leads to a fall in firm entry, equity price and various real variables.
Complementing these results, I show that a financial shock has negative effects on
the firm entry, aggregate international debt and real GDP in an emerging economy
framework.

The article is structured as follows. Section 3 introduces the model, and Section
4 presents the results from the model. Section 5 concludes with discussion about
the findings and describes further venues for research.

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2Influential research studying the importance of endogenous entry or market structures for the
propagation of business cycles includes closed economy studies of Bilbiie et al. (2012), Colciago and
Etro (2010), Colciago (2016), Jaimovich and Floetotto (2008), Bergin et al. (2018), Lewis and Poilly
(2012) to name a few. Cavallari (2010), Cavallari (2013) and Cavallari (2015) study productivity and
monetary policy shocks in large open economies.
2 International banking linkages in emerging countries

Global banking linkages had a central role in transmitting the financial crisis of 2008–2009 to emerging countries.

3 Model

I construct a two-sector small open economy model with endogenous entry and financial frictions. The model follows the same sectoral structure as the small open economy of Obstfeld and Rogoff (1995, appendix) and many other models with tradable and non-tradable sectors in emerging economy literature. Since the tradable good producers face perfect competition from abroad, firm dynamics in this model are transmitted through monopolistic non-tradable good production.\(^3\) Monopolistic profits attract new firms to the monopolistically competitive non-tradable sector, and as a result the number of firms fluctuates procyclically. Entry in the model is determined by a zero profit condition, stating that the potential entrants of an unbounded mass have free entry to the market and enter as long as the value of entry is non-negative, as in the seminal paper of Bilbiie et al. (2012). This leads to procyclical entry. Appendix C illustrates the timing of entry and financial decisions of the monopolistic firms and the structure of the economy.

3.1 Non-tradable sector: monopolistic competition and firm entry

This section presents the optimization problem of the old, established firms and then introduces the optimal entry of firms.

3.1.1 Established firms

There is a continuum of monopolistically competitive firms, each producing a different variety \(h\). For simplicity, it is assumed that each firm can produce only one variety, such that the number of firms in the economy corresponds to the number of

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\(^3\)Non-tradable goods are usually classified as the products that either cannot be traded internationally due to high transportation costs or trade policies or, more broadly, are traded only in very small amounts. (See for instance Lombardo and Ravenna (2012).) Arellano et al. (2017) find that during crises the largest declines in output and credit are experienced in non-tradable sectors.
products. All contracts are written in nominal terms but since the prices are flexible, we solve for the real variables. Firms are owned by domestic households and thus the firm’s discount factor is given by $m_{t+1} = \beta(1 - \delta) \frac{UC_t}{UC_{t+1}}$. The firms’ objective is to maximize the beginning-of-period market value including dividends $V_{h,t}(b_{h,t-1}^*)$:

$$V_{h,t}(b_{h,t-1}^*) = \max_{p_{N_{h,t}}^N, b_{h,t}^*, l_{h,t}} \left\{ d_{h,t} + E_t \left[ m_{t+1} V_{h,t+1}(b_{h,t}^*) \right] \right\},$$

(1)

with the dividends that are given by:

$$d_{h,t} = \frac{p_{N_{h,t}}^N}{P_t} y_{N_{h,t}}^N - w_t l_{h,t}^N - e_t (b_{h,t-1}^* - \frac{b_{h,t}^*}{R^*}),$$

(2)

where $d_{h,t}$, $e_t$ and $w_t$ are, respectively, dividends, real exchange rate and wage. An individual firm chooses the nominal price $p_{N_{h,t}}^N$ and disregards the effects on the aggregate price index $P_t$. Firms use labor $l_{h,t}$ for their production of good $y_{N_{h,t}}^N$ and pay dividends to the household. Firms have access to the foreign financial market and are able to take on inter-period debt $b_{h,t}^*$ from abroad with an exogenously determined world interest rate $R^*$. At the beginning of period $t$, firms have a predetermined amount of international debt inherited from the previous period. They have to pay for the old debt, and decide how much new debt $b_{h,t}^*$ to take.

In addition to the inter-period debt, firms have to take an intra-period loan from the international financial markets to finance the production costs, the wage to its workers $w_t l_{h,t}^N$, prior to production and pay it back after the revenue from production has realized. This intra-period borrowing has no interest but is subject to financial frictions. The financial friction is captured in the enforcement constraint that arises

$^4$Real variables are defined as nominal priced divided by the consumer price index $P_t$.

$^5$I assume, akin to Obstfeld and Rogoff (1995) and Céspedes et al. (2004), that the foreign currency price of the tradable good is given externally to the small open economy and is normalized to 1: $P_{T}^{*t} = 1$. Since the law of one price holds, the domestic currency price of the tradable good is equal to $P_{T}^{t} = \varepsilon_t P_{T}^{*t} = \varepsilon_t$, where the nominal exchange rate $\varepsilon_t$ is given by the domestic CPI over the world CPI. The real exchange rate is given by $e_t = \frac{\varepsilon_t}{P_{T}^{t}} = \frac{P_{T}^{*t}}{P_{T}^{t}}$. Higher $e_t$ implies depreciation of real exchange rate.

$^6$All exogenous international variables, such as foreign currency prices, foreign demand and international bonds are denoted with an asterisk.

$^7$The assumption that firms have to finance some part of their production costs prior to production is used in many dynamic models with collateral constraints, such as in sudden stop literature following Mendoza (2010), or in financial shock literature related to Jermann and Quadrini (2012) and Bergin et al. (2018). The constraint binds intra-period debt rather than the new inter-period debt $b^*$ in order to ensure that the established firms and the entrants have the same asset portfolios when they proceed to the next period. This removes heterogeneity in firms after the entry period.
from the firm’s ability to default on the intra-period debt after the firm has collected the revenue from its production:

\[ \kappa_t E_t[m_{t+1} V_{h,t+1}(b^*_{h,t})] = w_t l^N_{h,t}, \]  

(3)

where \( \kappa_t \) is the financial shock. The lenders of an intra-period loan know that firms can default on the debt at the end of the period, and thus they are willing to lend up to the amount that they can recover in case of firm default. The dividends of the firm are easily diverted and thus the lender accepts only the end-of-period value of the firm, \( E_t[m_{t+1} V_{h,t+1}(b^*_{h,t})] \), as a collateral. There is a liquidation loss \( \kappa_t \) that the international investor takes into account when deciding how much to lend to the small firms. Thus, each monopolistic firm is only able to borrow up to \( \kappa_t E_t[m_{t+1} V_{h,t+1}(b^*_{h,t})] \). \( \kappa_t \) is given exogenously in the model and is subject to a shock that follows an AR(1) process.

Production of these firms requires only one factor, labor. The production function of firm \( h \) is:

\[ y^N_{h,t} = Z^N_t l^N_{h,t}, \]  

(4)

where \( Z^N_t \) is an aggregate productivity shock.

The demand for the output of each non-tradable firm \( h \), is determined by the optimal allocation of consumption between non-tradable differentiated goods:

\[ y^N_{h,t} = (1 - \psi) \left( \frac{P^N_{h,t}}{P^N_t} \right)^{-\theta} \left( \frac{P^N_t}{P_t} \right)^{-\eta} C_t, \]  

(5)

where \( P^N_t \) is the constant elasticity of substitution (CES) aggregator over non-tradable goods. \( \psi \) is the relative weight of tradable goods in consumption and \( \theta \) and \( \eta \) are elasticities of substitution. The calculations for the demand of non-tradable goods are given in full detail in the appendix B

During each period \( t \), the firm \( h \) chooses the amount of labour input \( l^N_{h,t} \), the domestic price for its non-tradable product \( P^N_{h,t} \) and new international debt \( b^*_{h,t} \) to maximize its beginning-of-period market value given by the equation (1) with
the dividend equation (2), subject to the enforcement constraint (3) and taking into account that the output of firm h’s production given in (4) has to equal in equilibrium the demand for good h, as given in (5).

Combining the first-order conditions for \( l_{h,t}^N \) and \( p_{h,t}^N \) gives the firm’s optimal price setting:

\[
p_{h,t}^N = \sigma \frac{w_l l_{h,t}^N}{y_{h,t}^N} (1 + \mu_t),
\]

with \( \sigma = \frac{\theta}{\sigma - 1} \) being the markup and \( \mu_t \) is the Lagrange multiplier of the enforcement constraint.

The first-order condition for debt \( b_{h,t}^* \) is:

\[
\mu_t = \frac{\kappa_t}{E_t m_{t+1} \kappa_{t+1}} E_{t+1} m_{t+1} \kappa_{t+1} + 1,
\]

where \( \mu_t \) measures the tightness of the financial conditions and \( \mu_t \) increases as the enforcement constraint becomes tighter.

### 3.1.2 Firm entry

Each period, there is an unbounded mass of prospective entrants. These prospective entrants are able to anticipate their expected future profits correctly, and thus firms decide to enter the market if the net value of entry, given by \( V_{h,t}^E \), is positive. All new firms enter the period \( t \) with no prior debt. New firms pay a one-time sunk entry cost when they enter and start production during that period.\(^8\) The value of entering the market \( V_{h,t}^E \) is given by:

\[
V_{h,t}^E = \max_{p_{h,t},p_{h,t}^E,b_{h,t},l_{h,t}^E} \left\{ d_{h,t}^E + E_t [m_{t+1} V_{h,t+1}(b_{h,t}^*,E_t)] \right\},
\]

with the dividends of the entrants \( d_{h,t}^E \) given by:

\(^8\)This assumption differs from the time-to-build specification in Bilbiie et al. (2012) but has also been adopted in Bergin et al. (2018). The benefit from this timing of production is that all firms, both incumbents and entrants, choose the same amount of new debt that has to be paid back at the beginning of the next period thus preventing firms from having heterogeneity in their capital structures and allowing for full business cycle analysis.
\[ d_{h,t}^E = \frac{p_{h,t}^E y_{h,t}^E}{P_t} - w_{t} l_{h,t}^E + \frac{e_t b_{h,t}^E}{R_t} - K_t^E, \]  \\(9\)

where \(p_{h,t}^E, y_{h,t}^E, l_{h,t}^E, b_{h,t}^E\) and \(K_t^E\) are, respectively, the price, output, labor input, international debt and sunk entry costs of the entrant firm \(h\).

Entering the market, small firms have to pay an entry cost of \(K_t^E\), given in the units of the final good. The sunk entry cost takes a similar form as the quadratic adjustment cost for investment in physical capital:

\[ K_t^E = \left( \frac{N_t^E}{N_{t-1}^E} \right)^7. \]  \\(10\)

The level of entry cost at each period depends on the evolution in the number of entrants \(N_t^E\). Entry becomes more expensive when a greater number of new entrants enter in a given period.\(^9\) This specification of entry cost is used in the model to ensure that entry is not too volatile.

Substituting the dividends given by (9) into the value of entering (8) and noting that free entry drives the net value of entry \(V_{h,t}^E\) to zero, we get the free entry condition:

\[ e_t b_{h,t}^E + E_t[ m_{t+1} V_{h,t+1}(b_{h,t}^E)] + \frac{p_{h,t}^E y_{h,t}^E}{P_t} - w_{t} l_{h,t}^E = K_t^E. \]  \\(11\)

This equation implies that the initial period value of firm’s assets, bonds and its equity value, together with its profit is equal to the entry cost.

When the new firm has decided to enter the market, it makes the decision of producing a monopolistic good \(h\) using the same production technology and facing the same demand for its good as the old firms. A new firm chooses \(p_{h,t}^E, l_{h,t}^E\) and \(b_{h,t}^E\) to maximize the value of entry (8) subject to dividends (9), enforcement constraint taking the same form as for the old firms (3), and production technology and demand for its output as in (4) and (5), respectively. As a result, the first order conditions take the same form as (6) and (7). Thus, \(b_{h,t}^E = b_{h,t}^E, p_{h,t}^E = p_{h,t}, y_{h,t}^E = y_{h,t}^E, l_{h,t}^E = l_{h,t}^E\) and \(\pi_{h,t}^E = \pi_{h,t}^E\). Dividends \(d_{h,t}^E\) and the value of entering \(V_{h,t}^E\), however, differ from

\(\text{---}^9\)This type of an entry cost has previously been used, for example, in Lewis (2009) and Bergin et al. (2018).
the values for incumbents.

Both the entrants and the established firms are hit by an exogenous, constant exit shock that forces $\delta \in (0, 1)$ of these firms to exit at the very end of each period. Thus, the amount of firms in the economy consists of the new firms and the old firms of the previous period that did not exit.

$$N_t = (1 - \delta)(N_{t-1} + N^E_t),$$  \hspace{1cm} (12)

where $N_{t-1}$ is the number of old firms surviving from period $t - 1$ and that are producing at $t$ and $N^E_t$ is the number of entrants at that period.

### 3.2 Households

The household in the small open economy consumes a final consumption good $C_t$, provides labor $L_t$ for both tradable and non-tradable good producing domestic firms with a real wage $w_t$ and chooses its equity share holdings of the non-tradable firms. The households own all the small monopolistic firms in the domestic economy through mutual fund shares $x_t$ that are traded domestically. All households are identical in this economy and a representative household maximizes its expected lifetime utility:

$$E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, L_t),$$  \hspace{1cm} (13)

$$U(C_t, L_t) = \frac{(C_t - \frac{L_t^\omega}{\omega})^{1 - \gamma} - 1}{1 - \gamma},$$  \hspace{1cm} (14)

where the preferences are non-separable. $^{10}$ $\beta \in (0, 1)$ is the household’s discount factor, $\gamma > 0$ is the household’s relative risk aversion and $\omega > 0$ is the inverse of the Frisch elasticity of labor supply.

The period budget constraint is expressed in units of consumption:

$^{10}$Following Mendoza (1991), and many others in the emerging market business cycle literature, I assume that the household’s preferences have a non-separable structure studied in Greenwood et al. (1988) (GHH). GHH preferences imply no wealth effect in labor supply, since the marginal rate of substitution between consumption and labor is independent of consumption. This preference structure is important for crisis dynamics, since with wealth effect on labor supply the household could react to lack of resources during a crisis by working more, leading to an economic expansion.
\[ q_t(N_{t-1} + N_t^E)x_t + C_t = (d_t + q_t)N_{t-1}x_{t-1} + w_t L_t, \]  
\( (15) \)

where, on the income side, the household earns labor income, equity sales with the end-of-period value \( q_t \) and dividends \( d_t \) from \( N_{t-1} \) firms according to its share holdings \( x_{t-1} \) inherited from the previous period. On the expenditure side, the household consumes a final good and decides the corporate share holdings for the beginning of the next period. Each period \( N_t^E \) firms enter the market for monopolistic goods adding to the number of firms in the mutual fund, \( N_{t-1} + N_t^E \).

Household’s first-order conditions for \( C_t \) and \( L_t \) give the equation for labor-leisure trade-off:

\[ w_t = \frac{U_{L,t}}{U_{C,t}}, \]  
\( (16) \)

and the Euler equation for corporate shares \( x_t \) is:

\[ q_t = E_t \left[ \beta (1 - \delta) \frac{U_{C,t+1}}{U_{C,t}} (d_{t+1} + q_{t+1}) \right]. \]  
\( (17) \)

Forward iteration of this equation together with the forward iteration of the monopolistic firm’s market value in equation (1) show that the value of firm’s equity \( q_t \) equals the end-of-period value of firms \( E_t[m_{t+1} V_{h,t+1}(b_{h,t}^*)] \).

### 3.3 Tradable sector: perfect competition

Tradable goods can flow freely across borders and their price is determined abroad, such that domestic tradable good firm is a price taker. Thus, the tradable firms’ problem can be fully captured using a representative firm. Under perfect competition, the profits are always zero and there are no firm dynamics. The tradable firm maximizes its profits by choosing labor input:

\[ \max_{L_t^T} P_t^T Y_t^T - w_t L_t^T, \]  
\( (18) \)

subject to the production function
\[ Y_t^T = Z_t^T L_t^T, \quad (19) \]

where \( P_t^T, Y_t^T, L_t^T \) and \( Z_t^T \) are the tradable good world market price, output, labor input and productivity shock, respectively.

The tradable firm’s first-order condition is:

\[ \frac{w_t}{e_t} = \frac{Y_t^T}{L_t^T}, \quad (20) \]

which determines the relation between the wages and the real exchange rate.

### 3.4 Final good aggregation

The perfectly competitive final good firm produces a consumption good using a non-tradable composite good and a tradable good that can be produced either domestically or abroad as inputs. It allocates the expenditure optimally by minimizing the cost of purchasing these input baskets. Details of the cost minimization problem of the final good firm are given in the appendix B. The domestic consumer price index is given by:

\[ P_t = \left[ (1 - \psi)(P_t^N)^{1-\eta} + \psi(P_t^T)^{1-\eta} \right]^{\frac{1}{1-\eta}}, \quad (21) \]

and the optimal demand for non-tradable sectoral-level output is:

\[ Y_t^N = (1 - \psi) \left( \frac{P_t^N}{P_t} \right)^{-\eta} C_t, \quad (22) \]

where \( \psi \) is the weight of tradable goods in the consumption bundle and \( \eta \) is the elasticity of intratemporal substitution between tradable and non-tradable goods.

Since we are solving for the model in real terms, we can replace the nominal prices \( P_t, P_t^N \) and \( P_t^T \) with the relative price of non-tradable good \( \rho_t^N \equiv \frac{P_t^N}{P_t} \) and the real exchange rate \( e_t \equiv \frac{P_t^T}{P_t} \) in these equations.

Finally, we can aggregate the individual firms’ output

\[ Y_t^N = y_t^N (N_{t-1} + N_t^E)^\sigma, \quad (23) \]
where $Y_t^N$ is the non-tradable sectoral level output. In the equilibrium, this equation is used to aggregate the monopolistic firm’s first order conditions, production function and dividends over all the firms that are producing at time $t$, as given in appendix B.3. In these aggregated equations, the nominal prices are replaced with the real prices.

### 3.5 Equilibrium

The labor is divided between production in tradable and non-tradable entry sectors:

$$L_t = L_t^T + N_t^N(N_t - 1 + N_t^E).$$  \hspace{1cm} (24)

To ensure a unique labor market, the labor services are perfectly substitutable between all sectors. Good markets clear, such that all non-tradable monopolistic output is demanded by the final good producer and the final good firm’s output is fully consumed by the domestic household.

Moreover, the domestic market of corporate shares clear and the shares $x_t$ are normalized to 1. Substituting the non-tradable firms’ dividends, the tradable firm’s zero profit condition and the expenditure of entrant firms into the household’s budget constraint gives the resource constraint:

$$e_t \left[ \frac{b_t^*}{R_t}(N_t - 1 + N_t^E) - b_{t-1}^*N_{t-1} \right] = C_t + K_t^E N_t^E - (e_t Y_t^T + \rho_t^N Y_t^N).$$  \hspace{1cm} (25)

This equation implies that accumulation of foreign debt is positively connected with trade deficit. When a country imports more than it exports, it is only able to do so by taking more foreign debt.

The equilibrium consists of 16 equations and variables. From the non-tradable firms’ problem we get the enforcement constraint (3), the incumbent firm’s dividends (2), the non-tradable production function (4), and the firms’ first order conditions (6) and (7), together with the free entry condition for the entrants (11) and the accumulation of the non-tradable firms (12). Also, we have the household’s first order con-
ditions (16) and (17). Moreover, we need the tradable sector’s production function (19) and the first order condition (20), the consumer price index (21) and the final good demand for non-tradables (22). The last equations in the equilibrium are the market clearing condition (24), and the resource constraint of the economy (25). The equations above solve for: \( \{C_t, L^N_t, L^T_t, Y^N_t, Y^T_t, e_t, \rho_t^N, w_t, q_t, d_t, N_t, N_t^E, b^*_t, \mu_t\} \). Appendix A lists all equilibrium equations.

In addition to these equations, the financial shock \( \{\kappa_t\} \) is given by an AR(1) process:

\[
\kappa_t = (1 - \rho^\kappa)\bar{\kappa} + \rho^\kappa \kappa_{t-1} + \epsilon_t^\kappa, \tag{26}
\]

where \( \epsilon_t^\kappa \) is a normally distributed financing innovation.

4 Effects of a financial shock

4.1 Parameter values

Parameter values are taken from the small open economy and endogenous firm entry literature. Since the data is annual, the household’s discount factor is set at \( \beta = 0.96 \). Mendoza (2010) targets a debt-to-output ratio of 0.86 that is achieved with the annual gross real interest rate of 5% in my model. The elasticity of intertemporal substitution is \( \gamma = 2 \) and the wage elasticity of labor supply is \( \omega = 2 \). Both of these are standard values in the literature. The annual exit rate of firms is set at \( \delta = 0.1 \), consistent with the quarterly rate in Bilbiie et al. (2012). The elasticity of substitution across the monopolists’ non-tradable varieties is \( \theta = 5 \). The elasticity of intratemporal substitution in consumption between tradables and non-tradables is set at \( \eta = 1.5 \). The share of tradable good in the consumption basket is \( \psi = 0.55 \), following the estimates given in Lombardo and Ravenna (2012). The enforcement parameter in the financial shock process of equation (26) is \( \bar{\kappa} = 0.25 \), which roughly corresponds to the long-term average rate of lender’s ability to recover the loan in case of the borrower’s default for the USA given in Bruche and González-Aguado (2010).
Table 1: Parameter Values

<table>
<thead>
<tr>
<th>Parameters from literature</th>
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<tbody>
<tr>
<td>Household’s discount factor</td>
<td>$\beta = 0.96$</td>
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<tr>
<td>Household’s relative risk aversion</td>
<td>$\gamma = 2$</td>
</tr>
<tr>
<td>Wage elasticity of labor supply</td>
<td>$\omega = 2$</td>
</tr>
<tr>
<td>Relative weight of tradable goods in consumption</td>
<td>$\psi = 0.55$</td>
</tr>
<tr>
<td>Elasticity of substitution between tradable and non-tradable goods</td>
<td>$\eta = 1.5$</td>
</tr>
<tr>
<td>Elasticity of substitution across non-tradable varieties</td>
<td>$\theta = 5$</td>
</tr>
<tr>
<td>Firm exit rate</td>
<td>$\delta = 0.1$</td>
</tr>
<tr>
<td>Interest rate on foreign borrowing</td>
<td>$R^* = 1.05$</td>
</tr>
<tr>
<td>Enforcement parameter</td>
<td>$\bar{\kappa} = 0.25$</td>
</tr>
<tr>
<td>Standard deviation of financial shock</td>
<td>$(\sigma^\kappa)^2 = 0.36$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Calibrated parameters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Entry adjustment cost</td>
<td>$\tau = 2.17$</td>
</tr>
<tr>
<td>Persistence of financial shock</td>
<td>$\rho^\kappa = 0.92$</td>
</tr>
</tbody>
</table>

I calibrate the parameter related to the sunk entry adjustment cost $\tau$ in equation (10) and the persistence of the financial shock $\rho^\kappa$ based on empirical impulse responses described in the section 4.2. The entry cost parameter $\tau$ controls for the relative response in the target variables real output and firm entry. Lowering this parameter increases the response of firm entry and decreases it for real GDP. The persistence parameter $\rho^\kappa$ adds to the length of the crisis, but does not affect the variables as strongly. Small changes in $\rho^\kappa$ have a substantially large effect on the persistence of firm entry but do not affect the persistence in GDP as much. The standard deviation of financial shock $\sigma^\kappa$ is set to match the initial response in real output, leading to a high value of the parameter.

4.2 Empirical impulse responses

To estimate the effects of the global financial crisis in emerging economies, I apply an approach that is similar to Cerra and Saxena (2008), and also used in Queraltó (2013).\textsuperscript{11} I am using annual panel data from World Bank for 20 emerging countries.

\textsuperscript{11}The former research paper estimates an autoregressive model to illustrate the persistence of output losses after banking, currency, and twin financial crises, political disruptions and civil wars using a large panel of countries, with dummy variables indicating the occurrence of financial or political crises.
Details of the countries and datasets are provided in the appendix F. Estimated impulse responses are obtained using GMM estimation of panel VAR with 1 lag, country-specific fixed effects and global financial crisis dummy as an exogenous variable:

\[ X_{i,t} = u_i + AX_{i,t-1} + BD_t + \varepsilon_{i,t}, \]  

where \( X_{i,t} = [\log(Y_{i,t}) \log(N_{i,t}^{FE})]' \) are the endogenous variables GDP and new business registrations, \( u_i \) is the country fixed effect and \( D_t \) is a dummy that indicates the 2009 crisis. Although the crisis starts in late 2008, the annual data requires the use of the first full year in the estimations. The model is transformed using Arellano and Bover (1995) forward orthogonal deviations and Holtz-Eakin et al. (1988) GMM type instruments, as in Love and Zicchino (2006).

The estimation of the VAR model provides the group averages of the impulse responses of GDP and new business registrations. The lag length is 1 which is supported by MBIC and MAIC criteria but also necessary given the short time dimension of the data. The panel VAR satisfies the stability condition of the estimates as all modulus of the eigenvalues lie inside the unit circle. The 95% confidence bands are estimated with a Gaussian approximation based on Monte Carlo draws from the estimated model. These are used to estimate the key parameters of the log-linear theoretical model. The theoretical model is estimated using cumulative dynamic multiplier functions. The parameter values are estimated based on the minimization of the GMM criterion.

Figure 2 shows the cumulative empirical impulse responses together with the impulse responses from the model. The empirical impulse responses, marked with blue with the 95% confidence bands, show that both real GDP and number of firms declined strongly in 2009. The theoretical impulse responses, marked with black, show that the theoretical variables decline as a response to the financial shock and the effect on firm entry is very persistent. They also highlight a trade-off related to adjusting the entry adjustment cost parameter \( \tau \). Increasing the persistence in output reduces the initial response in firm entry, and vice versa.
4.3 Theoretical impulse responses

Figure 3 shows the impulse responses of the real, financial, and firm dynamics variables to an adverse financial shock. For the real macroeconomic variables, the sign of the response in the model follows the common empirical findings that production, consumption and labor decline as a result to a negative financial shock. The decline in the real GDP is driven by the decline in the non-tradable production. Since this model does not restrict the flow of tradable goods, the firms operating in the tradable sector benefit from a decline in the wage level, as this reduces their production input costs, and they increase their production temporarily.

Entry recovers slowly and the number of firms stays below the steady state long after the original shock has disappeared and recovers gradually. A decline in the number of entrants benefits existing firms since it decreases competition in the economy. Reflecting this, the individual firm production recovers slightly faster than the aggregate non-tradable output. Lower entry during the crisis reduces competitive pressures on the producers of monopolistic goods. This, combined with an increase in the cost for external financing puts pressure on the firms to increase relative prices. Thus, the model predicts firms are more likely to cut the quantities produced rather than prices. This is in line with Gilchrist et al. (2016), who find that financial frictions create an incentive for firms to increase prices as a response to a financial shock or a demand shock. A similar idea has been presented earlier in Chevalier and Scharfstein (1996) using firm-level data evidence that liquidity-constrained firms increase prices in order to boost their profits.
Figure 3: Impulse responses of the real variables in the model: financial shock that decreases $\kappa_t$. $\epsilon^*_t$ has a variance of 0.36 and persistence of 0.92.
On the financial side, the small open economy’s foreign debt adjustment, the left-hand-side of the resource constraint (25), decreases due to both reduction in individual firms’ borrowing and the number of borrowers. The equity price of firms falls, but the effect improves quickly. In the model, this reflects the incumbent firms pressure to sustain the equity price in order to relax the enforcement constraint. The short-lived effect on equity prices is also visible in data, illustrated in the figure 9 in the appendix F.1 where the average taken over the S&P global equity indices remains negative only in 2009.

4.4 Second moments

The second

5 Conclusion

This article studies how firm entry responds to financial shocks in a small open economy, and compares the results with the experiences in small open emerging economies during the global recession of 2008–2012. I present a small open economy model with endogenous firm entry, financial frictions and firms’ issuance of equity and foreign debt. The model implies that the real variables along with the number of entrants, equity price and aggregate debt decrease as a response to a negative financial shock. The central implications of the model are well in line with the experiences during the crisis.

The findings of the research leave room for new interesting venues for research. One possibility is to explore alternative explanations for the slow recovery of the real gross domestic product in the aftermath of financial crises, complementing the explanation emphasizing the slow-down in R&D activities that has been studied extensively in the literature. This result can be contrasted to the findings in Tsangarides (2012). In this empirical research, the author studies the effects of both financial and trade channels on GDP. He finds that both of the channels are important during the crisis but the trade channel becomes more important during the recovery. As the model omits the trade channel of crisis transmission, and focuses
only on the financial channel, the results in my paper are in line with those of Tsan-
garides (2012). An interesting extension to the framework presented in this paper
is a model that includes both the financial and trade channels to see whether the
trade channel is able to contribute to the persistence in GDP.

Another important dimension to the research comes from extending the data
sources. As discussed in Bilbiie et al. (2012), the macroeconomic data for firm entry
is still scarce, and this is especially true for cross-country data on small emerging
economies. The data has both a small number of cross-sectional units and time di-

cision, and thus issues with consistency prevent strong empirical inference and full
estimation. Moreover, the exact timing of the events cannot be fully captured with
annual data. As such, the empirical studies in this research paper serve as prelimi-
nary results for a more comprehensive examination, and hopefully as a motivation
to further study the role of firm entry during financial crises.

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A Model Equilibrium Conditions

Household:

\[ w_t = L_t^{(1-1)} , \quad (28) \]

\[ q_t = E_t \left[ \beta (1 - \delta) \frac{U_{t+1}^C}{U_t^C} (d_{t+1} + q_{t+1}) \right] , \quad (29) \]

\[ U_t^C = \left( C_t - \frac{L_t^w}{\omega} \right)^{-\gamma} , \quad (30) \]

Entry sector:

\[ \kappa_t q_t (N_{t-1} + N_t^E) = w_t L_t^N , \quad (31) \]

\[ d_t = \rho_t^N \frac{Y_t^N}{N_{t-1} + N_t^E} - w_t \frac{L_t^N}{N_{t-1} + N_t^E} - e_t \left( b_{t-1}^* - \frac{b_t^*}{R^*} \right) . \quad (32) \]

\[ Y_t^N = Z_t^N L_t^N (N_{t-1} + N_t^E)^{\sigma - 1} . \quad (33) \]

\[ \frac{e_t b_t}{R^*} + q_t + \rho_t^N \frac{Y_t^N}{N_{t-1} + N_t^E} - w_t \frac{L_t^N}{N_{t-1} + N_t^E} = \left( \frac{N_t^E}{N_{t-1}^E} \right)^{\tau} . \quad (34) \]

\[ \rho_t^N = \sigma \frac{w_t L_t^N}{Y_t^N} (1 + \mu_t) , \quad (35) \]

\[ \mu_t = \frac{\frac{e_t}{R^*} - E_t \left[ \beta (1 - \delta) \frac{U_{t+1}^C}{U_t^C} \right]}{\kappa_t E_t \left[ \beta (1 - \delta) \frac{U_{t+1}^C}{U_t^C} \right]} , \quad (36) \]

\[ N_t = (1 - \delta) (N_{t-1} + N_t^E) , \quad (37) \]

Perfect competition:
\[ Y_t^T = Z_t^T L_t^T, \tag{38} \]

\[ \frac{w_t}{e_t} = \frac{Y_t^T}{L_t^T}, \tag{39} \]

\[ Y_t^N = (1 - \psi) \left( \rho_t^N \right)^{-\eta} C_t, \tag{40} \]

\[ 1 = (1 - \psi)(\rho_t^N)^{1-\eta} + \psi(e_t)^{1-\eta}, \tag{41} \]

**Market clearing**

\[ Y_t^N = y_t^N \left( N_{t-1} + N_t^E \right)^\sigma, \tag{42} \]

\[ L_t^N = i_t^N \left( N_{t-1} + N_t^E \right), \tag{43} \]

\[ L_t = L_t^T + L_t^N, \tag{44} \]

\[ e_t \left[ \frac{b_t^r}{R^e} \left( N_{t-1} + N_t^E \right) - b_{t-1}^r N_{t-1} \right] = C_t + \frac{(N_t^E)^{1+\tau}}{(N_{t-1}^E)^\tau} - (e_t Y_t^T + \rho_t^N Y_t^N), \tag{45} \]

**Exogenous shocks:**

\[ Z_t^T = (1 - \rho^T) \bar{Z}^T + \rho^T Z_{t-1}^T + \epsilon_t^T, \tag{46} \]

\[ Z_t^N = (1 - \rho^N) \bar{Z}^N + \rho^N Z_{t-1}^N + \epsilon_{t+1}^N, \tag{47} \]

\[ \kappa_t = (1 - \rho^\kappa) \bar{\kappa} + \rho^\kappa \kappa_{t-1} + \epsilon_t^\kappa, \tag{48} \]
B Aggregation Appendix

B.1 Consumption good

The final good firm produces a consumption good using a non-tradable composite good, \( Y_t^N \), and tradable good, \( Y_t^{C,T} \), as inputs. The production function of the final good firm is:

\[
Y_t^C = \left[ (1 - \psi) \left( \frac{P_t^N}{P_t} \right)^{\frac{\eta - 1}{\eta}} + \psi \left( \frac{P_t^{C,T}}{P_t} \right)^{\frac{\eta - 1}{\eta}} \right]^{\frac{\eta}{\eta - 1}}. \quad (49)
\]

The optimal allocation between tradable and non-tradable goods is given by the cost minimization problem of \( P_t^N Y_t^N + P_t^{C,T} Y_t^{C,T} \) subject to (49).

Forming the firm’s cost function by plugging the conditional factor demand functions into the objective function, it is straightforward to show that the additional cost incurred per unit change in the target output level is given by:

\[
P_t = \left( 1 - \psi \right) \left( \frac{P_t^N}{P_t} \right)^{1 - \eta} + \psi \left( \frac{P_t^{C,T}}{P_t} \right)^{1 - \eta}, \quad (50)
\]

and since the final good firm operates under perfect competitions, this unit cost is also the unit price of the final good paid by the household. By applying Shephard’s lemma, the optimal demands for non-tradable consumption composite and tradable imports are, respectively:

\[
Y_t^N = (1 - \psi) \left( \frac{P_t^N}{P_t} \right)^{-\eta} Y_t^C, \quad (51)
\]

\[
Y_t^{C,T} = \psi \left( \frac{P_t^{C,T}}{P_t} \right)^{-\eta} Y_t^C. \quad (52)
\]

In the equilibrium, the domestic households consume all the final good output, such that \( Y_t^C = C_t \). Since the economy is open, the final good input of tradable goods \( Y_t^{C,T} \) is usually not equal to the production of domestic tradable firms \( Y_t^T \).

I denote the prices of non-tradables and tradables relative to the consumer price index, respectively, with \( \rho_t^N = \frac{P_t^N}{P_t} \) and \( \frac{P_t^{C,T}}{P_t} = \frac{P_t^{C,T}}{P_t} = e_t \).
B.2 Allocation between non-tradable differentiated goods

The non-tradable composite good consists of the output of the domestic monopolistically competitive non-tradable firms each producing one differentiated good $h$. The number of firms is given by $N_t$. The different varieties are aggregated into a consumption composite using a CES aggregator with an elasticity of substitution $\theta > 1$. The production function for the non-tradable composite good is:

$$Y_t^N = \left[ \int_0^{\tilde{n}_t} (y_{h,t}^N)^{\frac{\theta-1}{\theta}} dh \right]^\frac{\theta}{\theta-1},$$

where $\tilde{n}_t = N_{t-1} + N_t^E$ is the number of firms producing during period $t$, since all the firms get to produce prior to the exit of $\delta$ firms. The cost minimization of $\int_0^{\tilde{n}_t} p_{h,t}^N y_{h,t}^N dh$ subject to (53) yields the price index:

$$P_t^N = \left[ \int_0^{\tilde{n}_t} (p_{h,t}^N)^{1-\theta} dh \right]^\frac{1}{1-\theta},$$

and the optimal allocation between the differentiated goods is given by:

$$y_{h,t}^N = \left( \frac{p_{h,t}^N}{P_t^N} \right)^{-\theta} Y_t^N.$$

Moreover, it is shown, using the cost function derived from the firm’s cost minimization problem, that $P_t^N Y_t^N = \int_0^{\tilde{n}_t} p_{h,t}^N y_{h,t}^N dh$.

B.3 Aggregation of Non-tradable Production

I consider the symmetric equilibrium in which the monopolistic firms set the same price and labor demand. Thus, $l_{h,t}^N = l_t^N$, $p_{h,t}^N = p_t^N$, $y_{h,t}^N = y_t^N$, and $d_{h,t}^N = d_t^N$. Let’s denote $n_t = N_{t-1} + N_t^E$.

Using $L_t^N = l_t^N n_t$ and $P_t^N Y_t^N = \int_0^{n_t} p_t^N y_t^N dh = p_t^N y_t^N n_t$, we get

$$Y_t^N = \frac{p_t^N}{P_t^N} y_t^N (N_{t-1} + N_t^E) = y_t^N (N_{t-1} + N_t^E)^{\sigma},$$

since
\[
\frac{p_t^N}{P_t^N} = \frac{p_t^N}{\int_0^{n_t} (p_t^N)^{1-\theta} \, dh} = (N_{t-1} + N_t^E)^{\frac{1}{1-\theta}}.
\]  

(57)

As in Bilbiie et al. (2012), these are used to aggregate the monopolistic firms’ first order conditions and the production function. Aggregated monopolistic firms’ first order condition (6) becomes:

\[
\rho_t^N = \frac{P_t^N}{P_t} = \sigma \frac{w_t L_t^N}{Y_t^N} (1 + \mu_t).
\]

(58)

Aggregated output of the domestic firms is given by:

\[
Y_t^N = Z_t^N L_t^N (N_{t-1} + N_t^E)^{\sigma-1}.
\]

(59)

The dividends are given by:

\[
d_t = \rho_t^N \frac{Y_t^N}{N_{t-1} + N_t^E} - w_t \frac{L_t^N}{N_{t-1} + N_t^E} - c_t \left( b_{t-1}^* - \frac{b_t^*}{R^*} \right).
\]

(60)

Equity price equals the end-of-period value of firms as the equity price equals the expected discounted value of dividend payouts from \( t+1 \) onwards: \( q_t = E_t[m_{t+1} V(b_t)]. \)

\[
\frac{e_t b_t}{R^*} + q_t + \rho_t^N \frac{Y_t^N}{N_{t-1} + N_t^E} - w_t \frac{L_t^N}{N_{t-1} + N_t^E} = K_t^E.
\]

(61)
C  Structure of the Model

C.1  Timing of Entry and Financial Decisions

<table>
<thead>
<tr>
<th>Beginning of period t</th>
<th>Middle of period t</th>
<th>End of period t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exogenous shocks $Z_t^T$, $\kappa_t$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Non-tradable monopolists:
- Dividends and wage payments
- Take short-term loan
- Repay old international debt

Entrants:
- Enter if value of entry $\geq 0$
- Take short-term loan
- Issue new international debt

C.2  Structure of the Economy

D  Additional Impulse Responses

D.1  Shock to Non-tradable Productivity

The shock process is described in equation (47).
Figure 4: Impulse responses of the real variables in the model: non-tradable sector shock that decreases $Z_t^N$. $\epsilon_t^N$ has a standard deviation of 0.02 and persistence of 0.92.

Figure 5: Impulse responses of the real variables in the model: non-tradable sector shock that decreases $Z_t^N$. $\epsilon_t^N$ has a standard deviation of 0.02 and persistence of 0.92.
D.2 Shock to Tradable Productivity

The shock process is described in equation (46).

![Graph of impulse responses](image)

Figure 6: Impulse responses of the real variables in the model: tradable sector shock that decreases $Z^T_t$. $\epsilon^T_t$ has a standard deviation of 0.02 and persistence of 0.92.

![Graph of impulse responses](image)

Figure 7: Impulse responses of the real variables in the model: tradable sector shock that decreases $Z^T_t$. $\epsilon^T_t$ has a standard deviation of 0.02 and persistence of 0.92.
E  Estimation Appendix

E.1  Data

The time series for GDP is from the World Development Indicators database and the new business registrations is from the Entrepreneurship database, both provided by World Bank. Countries included in the sample are: Algeria, Belize, Belarus, Bolivia, Chile, Croatia, Czech Republic, Estonia, Hungary, Georgia, Israel, Jordan, Latvia, Lithuania, Malaysia, Mexico, Morocco, Peru, Romania and Slovak Republic. The data is annual and covers the years from 2002 to 2014, since this is the longest period for which the data for new business registrations is available. The selection of the emerging countries included in the panel data is chosen such that there are no missing observations in the dataset, and thus the panel is balanced. I use log values of the variables per mean of the country’s population.

E.2  Panel VAR

The estimated impulse responses are obtained using GMM estimation of panel VAR with 1 lag, country-specific fixed effects and global financial crisis dummy as an exogenous variable.

\[ X_{i,t} = u_i + AX_{i,t-1} + BD_t + \varepsilon_{i,t}, \]  

where \(X_{i,t} = [\log(Y_{i,t}) \, \log(N_{i,t}^E)]'\) are the endogenous variables GDP and new business registrations, \(u_i\) is the country fixed effect and \(D_t\) is a dummy that indicates a crisis in 2009. The model is transformed using Arellano and Bover (1995) forward orthogonal deviations and Holtz-Eakin et al. (1988) GMM type instruments. The lag length is 1, which is supported by MBIC and MAIC criteria, but also necessary given the short time dimension of the data. The panel VAR satisfies the stability condition of the estimates, as all modulus of the eigenvalues lie inside the unit circle.
E.2.1 Using VIX as the exogenous crisis indicator

CBOE volatility indicator (VIX) is often used as an indicator for global financial conditions.

F Data for Cross-Country Variables

F.1 Net financial account and S&P global equity indexes

Figure 9: Cross-country averages for financial account and S&P global equity index for individual emerging countries in the sample. Source: World Bank, World Development Indicators Database. Countries included are Chile, Croatia, Czech Republic, Estonia, Hungary, Israel, Latvia, Lithuania, Malaysia, Mexico, Romania, Slovak Republic, and Slovenia.
Figure 10: Average GDP per capita growth in emerging economies in Latin America, Asia and Europe. Asia: Indonesia, South Korea, Malaysia, Philippines, Thailand and Vietnam. Europe: Belarus, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Romania, Slovak Republic, Slovenia and Turkey. Latin America: Argentina, Belize, Bolivia, Chile, Colombia, Dominican Republic, Mexico, Peru, Venezuela. Middle East: Algeria, Egypt, Israel, Jordan, Morocco and Tunisia. Source: World Bank.

F.2 Emerging Economies and Great Recession of 2007–2009

The financial crisis originated in the USA in 2007 and turned global when Lehman Brothers filed for bankruptcy in September 2008. It soon reached the open economies in the latter half of 2008. Although emerging economies have experienced multiple financial crisis episodes before, the great recession of 2007–2009 stands out from the previous crises in how widely it spread and how simultaneously the global economy responded. To demonstrate the simultaneity and the coverage of the global turmoil figure 10 shows the average gross domestic product growth in emerging countries between different continents. It illustrates how the previous emerging economy crises, such as the East Asian crisis of 1997-1998, the Russian crisis in 1998–1999, the Argentinian great depression in 1998–2002 and the South American economic crisis of 2002, compare with the global recession in 2008–2012. Notably, the adverse response of GDP during the recession was quite simultaneous across regions. This is likely to be caused by the global source for the shocks that depressed the emerging economies. East European emerging economies were affected the most, while the
emerging economies in Asia managed to sustain GDP growth better on average, and the Middle East and North African countries stand out with low volatility during the crisis.

### F.3 Emerging and Advanced Economies

![Figure 11: GDP and firm entry growth rates in emerging and advanced economies.](image)

**Source:** World Bank, World Development Indicators Database. Emerging countries are Chile, Croatia, Czech Republic, Estonia, Hungary, Israel, Latvia, Lithuania, Malaysia, Mexico, Romania, Slovak Republic, and Slovenia. Advanced countries are: Austria, Canada, Finland, France, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Singapore, Sweden.

Emerging countries are, in general, globally financially integrated and this integration grew especially fast during the years prior to the global recession in 2008–2009.

### G Note about informal sector

One concern when assessing the data about new firm registrations in emerging economies arises from the inability of the data to assess the fluctuations in informal sector. In countries with a large informal sector, a big share of firms never show up in the formal registers. In order to evaluate the effects of informal sector, I compare the results if I exclude countries in which the informal sector is estimated to be very large. I base this evaluation on World Banks estimates on informality. Schneider et al. (2010) estimate the size of shadow economies 162 advanced, emerging and developing economies. Since there is no threshold that determines when a country has a large informal sector or when is it small, I consider the countries with an esti-
mate for the size of the shadow economy smaller than the average of the countries in 2007: 31.2 %.\textsuperscript{12} This sample includes Chile, Croatia, Czech Republic, Estonia, Hungary, Israel, Latvia, Lithuania, Malaysia, Mexico, Romania, Slovak Republic, and Slovenia. The empirical results do not change substantially with this smaller sample of countries.

\footnote{The maximum value in high income OECD countries is 28 \%.}