FIRM ENTRY, CREDIT SHOCKS AND BUSINESS CYCLES

A Master's Thesis

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September 2012

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

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ABSTRACT

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September 2012

In this thesis, we investigate whether, modelling firm dynamics together with credit markets in a two country frame, can provide additional information on international real business cycles in matching certain moments and explain other stylized statistics on business entry. Our motivation is the fact that, in the latest financial crisis, firm entry behavior is quite different between high income and low income countries. Solution of the model is provided with both productivity and credit shocks. Both kinds of shocks match a subset of stylized international business cycle facts. Plus in both kinds of shocks model exhibits the fact that volatility of new entrant firms are higher than incumbent ones. We show that credit shocks are better at explaining highly volatile business cycles in financially less developed countries. In the existence of country-specific credit shocks we observe contagion of crisis, comovements across countries do only exist with global credit shocks. We find out that the firm entry behaviour seen in latest financial crisis that financially developed countries has more volatile firm entry, is only possible with global shocks.

Keywords: Endogenous Firm Entry, Finance of Firms, Real Business Cycles

ÖZET

FİRMA GİRİŞİ, KREDİ ŞOKLARI VE REEL DEVREVİ HAREKETLER

KARASOY, Hatice Gökçe

Yüksek Lisans, Ekonomi Bölümü

Tez Yöneticisi: Doç. Dr. Selin Sayek Böke

Eylül 2012

Bu tez firma dinamiklerinin kredi piyasaları ile etkileşimini modellemekte ve bu teşebbüsün firma girişi istatistikleri ile uluslararası devresel hareketleri açıklamadaki başarısını ölçmeyi amaçlamaktadır. Temel motivasyonumuz, son küresel finansal krizde firma girişinin, yüksek ve düşük-gelir grubundaki ülkelerde farklı davranmasıdır. Modelin çözumü hem üretkenlik şokları ile hem de kredi şokları ile incelenmiştir. Her iki şok türü de gözlenen uluslararası devresel hareketlerin bir kısmını sergilemektedir. Ayrıca her iki şok türünde de yeni giren firma sayısı, zaten var olanlara göre daha çok dalgalanmaktadır. Kredi şokları, finansal olarak daha az gelişmiş ülkelerin daha çok dalgalanan devresel hareketlere sahip olduğunu açıklamakta daha başarılıdır. Kredi şokları tek bir ülkeye özgü olduğunda, kriz bulaşıcılığı gözlemlenirken, eşanlı kriz, ortak kredi şoklarının varlığında mümkün olmaktadır. Son olarak, finansal krizde gözlemlenen, finansal olarak gelişmiş ülkelerin daha çok dalgalanan firma girişine sahip olmasının yalnızca küresel kredi şokları ile mümkün olabileceğini iddia edilmektedir.

Anahtar Kelimeler: Endojen Firma Girişi, Reel Devrevi Hareketler

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For any errors, they may remain in this work, the responsibility is my own.

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CHAPTER 1

INTRODUCTION

The international business cycle literature investigates comovements in aggregate variables across countries usually relying on dynamic models with productivity shocks. These models mostly investigate comovements between aggregate variables such as GDP, consumption, investment and the relation between net exports and exchange rates. Findings of these papers verify the existence of both global and country-specific shocks in shaping both the within country cycles and international comovements (see for example, Boileau et al. (2010), Glick and Rogoff(1993), and Kose et al. (2003) among others). With a few exceptions the models rarely attempt to include firm dynamics [1] to their models. The usual perception is that using a representative firm framework without any dynamics in the market may represent the real economy, and key macroeconomic variables quite well. However, of those that take into account firm dynamics Ghironi and Melitz (2005) model a two-country

[1] Although ″firm dynamics″ may capture different aspects about the distribution of firms in their expansion/contractions, entry/exit decisions or changes in age structure, this paper is specifically interested in "firm entry". Literature verifies the place of entry in business cycles. For example, Lewis (2006) and Devereux et al.(1996) show that entry is procyclical and tends to lead output by one quarter, and similar to capital investment, entry and net entry are more volatile than output over cycle. Moreover, firm entry behaviour can capture important characteristics. For example, the number of producing firms can tell a lot about the market structure, competition, product variety; and the comparison between the number of new entrant firms and already-producing firms can tell the age distribution of firms.

world with heterogeneous firms and study dynamics of international trade and macroeconomic variables, concluding that firm entries and entry costs are important mechanisms for transmission of productivity shocks. They provide an endogenous, micro founded explanation for a Harrod Balassa-Samuelson effect in response to aggregate productivity differentials and deregulation in an IRBC frame. Again with including endogenous firm entry Bilbiie et al. (2012) present an RBC model that does at least as good as the standard RBC model at matching US economy moments, plus their model explains procylicality of entry. Auray and Eyquem (2011), build a two country DSGE model with both real and monetary policy shocks; aiming match international business cycle statistics, and documenting the important role played by firm dynamics, sticky prices, and financial market incompleteness.

Reliance solely on technology (or productivity) shocks in explaining business cycles has become questionable in the light of latest financial crisis. Recent studies have indeed documented evidence pointing to the similarly significant role played by credit shocks in explaining business cycles. For example Kalemli-Ozcan et al. (2012) claim that especially in crisis times the source of volatility is mainly credit shocks. Furthermore Christiano et al. (2010) verify that financial shocks explain fluctuations not only for crisis periods but also for longer periods. Plus, Jermann and Quadrini (2009) build a general equilibrium model and shows that financial shocks together with productivity shocks match the dynamics of US real and financial variables moments much better than the model only with productivity shocks. In most of these papers financial markets are modelled to only include primary financial institutions, such as banks, whereas the role played by secondary financial institutions such as the stock market, is also of great importance. To the best of our knowledge most of these papers model financial shocks, while not accounting for firm dynamics, despite the documentation of the role

of such financial shocks in firm entry/exit decisions (see for example Arellano et al. (2009)). In this paper, we model not only productivity shocks but also credit/financial shocks in an environment where both kinds of financial institutions; banks and the stock market exist for the finance of firms.

One of the main motivations of this paper is the World Bank report: "Entrepreneur Snapshots 2010: Measuring The Impact of the Financial Crisis on New Business Registration". This report documents differences in density of firm entry between high income and low income countries during the latest crisis period, pointing out that density of firm entry is highly correlated to financial development. These countries can also be identified respectively as financially developed and financially less developed countries. [2] The World Bank defines density of new business entry as the number of newly registered limited liability companies per 1,000 working age (1564) people [3]

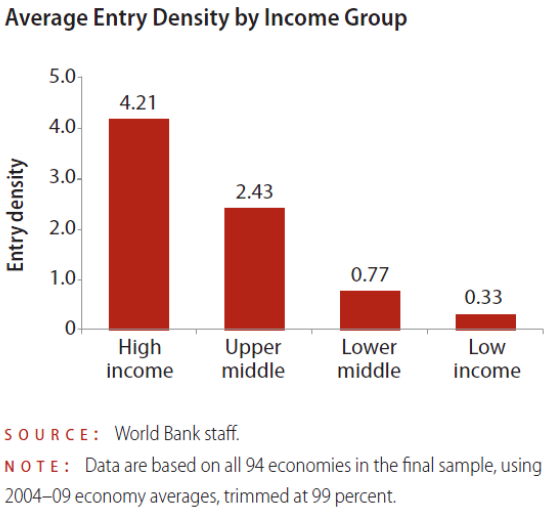
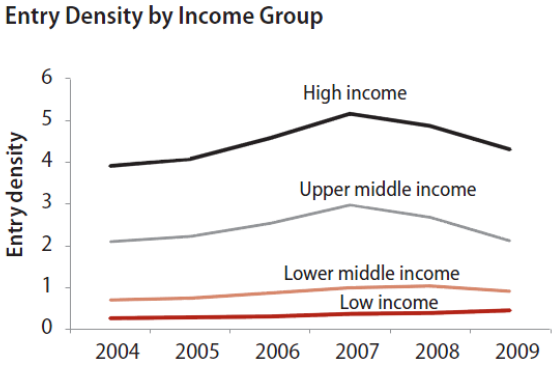


Figure 1.1: World Bank Entrepreneur Snapshots 2010

[2]The World Bank presents firm entry statistics in the mentioned report and analyzes firm entry behaviour across countries using these terms (high income-financially developed, low/middle income-financially less developed interchangeably)

[3]We are well aware that, this analysis uses annually data. Since The World Bank collects firm entry data annually, while this may seem inconsistent with a business cycle research motivation, we do think that if the data were collected quarterly the volatility difference between high-income (financially developed) and low-income (financially less developed) countries would stay similar

Figure 1.1 and Figure 1.2 provides some basic statistics. As it is evident in Figure 1.1 and Figure 1.2 at all data points high income (financially developed) countries have higher entry density. Figure 2 shows in the latest financial crisis, high income (middle income) countries experienced a more volatile (less volatile) entry density. For low income countries it is almost constant. The correlation between financial development and entry density can be seen in Figure 1.3.



SOURCE: World Bank staff.
NOTE: Figure based on 83 economies in the final sample with 2009 data, trimmed at 99 percent.

Figure 1.2: World Bank Entrepreneur Snapshots 2010

The relation between firm entry and finance has been studied frequently by empirical researchers. For example, Aghion et al. (2007) investigate firm entry and expansion of firms after entry focusing on financial development and credit constraints, using firm level data. They found size-dependent results as follows; access to finance matters especially for the small firms while for the large firms financial development seem to have no or minor effect. Considering new entrant firms usually have smaller size compared to incumbent firms Gil (2009); empirical studies tell us that mostly small and new entrant (young) firms suffer from credit contractions and they are also the first ones who gain from credit booms. For example, Beck et al. (2008) find that small firm industries take advantage from financial development before large firm

industries. Demirguc-Kunt and Maksimovic (1996) empirically analyze the effect of stock market development on firm's financing choices and conclude that small firms do not seem to be affected by stock market developments. This study may be seen as a reflection of the fact that small firms usually finance via private equity or credit markets. Berger and Udell (1998) show that smaller and younger firms tend to rely on initial insider finance and trade credit. As the firm grows it uses venture capital, bank and finance companies channels. In the final stage of growth the firm eventually accesses to public equity and debt markets. Moreover, Weinberg (1994) and Watson and Wilson (2002) verify that younger firms pay lower dividends and are more reliant on debt finance.

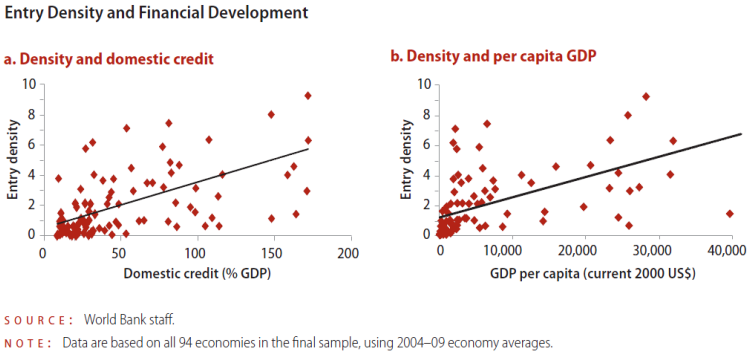


Figure 1.3: World Bank Entrepreneur Snapshots 2010

To summarize, the empirical regularities that motivate our study and we expect to reflect in our model are as follows;

- The financially developed countries tend to have a more volatile density of firm entry (with the available data).
- The correlation between entry density and financial development is significantly positive.
- Smaller and younger firms (loosely new entrants) benefit more from improvements in financing channels,. [4]

[4]In the remainder of the paper, we mainly focus on the age of the firm (new entrant

- In the absence of private equity, younger firms use credit channels, whereas older firms can access stock and debt markets.

- Young firms tend to pay less amounts of dividend in the stock markets.

Keeping all these empirical regularities in mind, the last financial crisis can be thought as an important credit shock on both financially developed and less developed countries, as the literature suggests (see for example Cetorelli and Goldberg (2010) and Kose et al. (2010)). Of course, this shock did not influence all countries equally; the conventional wisdom suggests the crisis emerged in high-income countries and other countries were affected from the crisis via several transmission channels. As Cetorelli and Goldberg (2010) document other countries (especially emerging markets) were affected from the crisis, mainly via three lending channels. These channels include (1) contraction in cross-border lending by foreign banks, (2) contraction in local lending by affiliates of foreign banks in emerging markets and (3) contraction in lending supply by domestic banks resulting from funding shock to their balance sheet. The strength of the global shock depends on how much these channels are active.

Kose et al. (2010) examine the importance of credit market shocks in driving global business cycles, and conclude that credit shocks originating in the US have an significant effect on the evolution of world growth during global recessions. Kalemli-Ozcan et al. (2012) empirically show that when the productivity shocks are the main source of fluctuations more financial integration results in less synchronized business cycles, however, if the credit shocks are the dominant source of fluctuations then more financial integration results in more synchronized business cycles. They claim also that the countries with more direct and indirect links to the US financial system ex-

or not), without taking into account size differences. The fact that small firms are usually the younger ones, the regularity is in accordance with our model.

perienced more synchronized cycles during the last crisis. The literature on synchronization is actually indeed very large. For example, Frankel and Rose (1998) show the importance of trade channels, Imbs (2006) points out the importance of financial linkages. Besides these, Altug et al. (2012) document the importance of institutional characteristics for synchronization.

Recently, there is a boom in the number of articles that incorporate endogenous entry into macro DSGE models together with different kinds of market forms. In the theoretical macro literature these dynamics are either modelled; as heterogeneous firms with respect to productivity or as firms in a monopolistically competitive market, while with imposing an equilibrium condition for entry using entry costs. Imposing firm heterogeneity mostly follows Melitz (2003). Taking cue from the latter modelling of firm dynamics, one of most relevant papers for this study is Bilbiie et al. (2012). They build a very simple real business cycle framework with endogenous firm entry. Their main conclusion is that their model is at least as good as the base real business cycle models plus it is able to explain the procyclical number of entrants and countercyclical mark-ups. Since they use monopolistic competition in their model, they accept a broader definition of entry capturing product creation relying on the fact that new product creation is also strongly procylical. Plus, the model has a steady state in which share of profits in capital is constant and there is a positive correlation between the share of investment and share of profits.

Furthermore Bilbiie et al. (2012) model financing intermediation for firms via only stock market, and use the stock price as a propagation mechanism in the model. They do not include any other financing channel in the model. Later Ghironi and Stebunovs (2010) use the same baseline model, extending it to a two country frame where firms are financed via only banks. They show that if one country's banking system's monopoly power declines, then

that country experiences an increase in the producer number, appreciation of local currency and current account deficit. Arellano et al. (2009) build a general equilibrium model, based on bank lending, to show that differences in financial development do capture the differences in growth rates between firms of different size. They model financial development with a credit cost factor.

So, we mainly ask, including "firm entry" together with financial development differences in a business cycle model explain business cycle and new business formation facts across countries when the model is simulated with productivity and credit shocks? As we stated earlier, this paper builds a DSGE model that incorporates endogenous firm entry as the propagation mechanism of fluctuations when credit shocks as well as productivity shocks are due. So different than the DSGE model constructed in Kalemli-Ozcan et al. (2012) we take into account firm dynamics and in our model the source of the shock matters by means of global and country specific chocks as its importance is shown by Kose et al. (2010). In our set-up firms compete in monopolistic competition fashion and there are sunk entry costs to enter the market. Firms are either financed via perfectly competitive banks or fully efficient stock markets. All producing firms are engaged in trade with melting iceberg trade costs, in both countries. The finance choice is not left to firms; instead, new firms have to borrow from banks for making up their sunk entry cost; and once they paid their loan back in the following period, they start to issue stocks in the stock market. Firms that are paying their loan back to banks do not distribute dividends to households. Individuals take dividends only from remaining producing firms. Producing firms issue stock in the stock market, plus in each period they have to borrow a constant share of their labor costs from banks. Since this is a two country open economy model, households can freely hold deposits in both countries' banks. So the

model captures both trade and financial channels across countries. Based on the fact that high income countries and low income countries differ substantially in their financial development level, to analyze endogenous entry we focus the difference in financial development level between two countries keeping everything else symmetric.

Financial development is captured via the variable *lending cost*,[5], that banks have to bear when they lend to firms. That cost will be a combination of country-specific and global components. The global component is common for all countries; the country-specific component, on the other hand, is the one that identifies financial development of a country. The processes for global and country specific components are estimated from data. We will present responses of aggregate variables to orthogonalized shocks to both country-specific productivity and global and country-specific credit shocks.

Solving the model both with productivity and credit shocks we show that both shocks are able to match a subset of international business cycle statistics. Plus in both kinds of shocks, the volatility of new entrant firms is higher than the volatility of incumbent ones, as the mentioned literature expects. Different than productivity shocks, credit shocks also reveals the fact that financially less developed countries have more volatile business cycles compared to financially developed ones. Plus, when business cycles are driven by credit shocks, the model also exhibits the empirical fact that financially less developed countries have more correlated consumption and GDP and also more correlated investment and GDP. If we restrict the model to work with only global shocks, or specify country-specific shocks being equal, the model also matches higher volatility of firm entry in high-income (financially) developed countries. However we doubt that this is a business cycle fact; because imposing the shocks as the real data suggests the volatility of new entrants

[5]Actually this lending cost can be named as monitoring cost, or risk factor which is simply the cost creates difference between deposit rate and lending rate.

also seem to be higher in less financially developed countries. This is mainly because of the fact that, historically these countries face credit shocks that have larger variances. Since we have very limited entry data across countries, we do not have a chance to look at what the real data suggests about the differences in volatility of entry between high income and low income countries.

In our set-up responses to productivity shocks are not symmetric. When there is shock to either country, both countries increase their consumption. When the source of the productivity shock is home country, aggregate variables' in foreign country behave exactly same as corresponding aggregate variables in home country. However when the source of the productivity shock is foreign country this is not the case. In such a case, the GDP of home country decreases! Investment, number of producing firms, number of new entrants and labour first fall below their steady state level but then increase. Responses to country-specific credit shocks, on the other hand, are symmetric and we see the contagion of country-specific crisis after some periods, in variables, consumption, investment, labour supply, number of producing firms and new entrants. If the credit shock is not country-specific but instead global then we observe a synchronized recession. While both countries have decline in their consumption and output, financially developed country initially experiences a current account deficit which later turns to a surplus. For the less financially developed country the reverse argument is valid. Looking at annual but not quarterly data, real data matches with this proposition.

The structure of the paper is as follows. Section 2 presents the model. Section 3 provides the solution of the model, presenting, steady state, calibration and impulse responses and comparison of second moments with literature. Section 4 summarizes the findings and conclude for future work.

CHAPTER 2

MODEL AND MODEL SOLUTION

2.1 THE MODEL

The model is a two-country DSGE model which is heavily influenced by Bilbiie et al. (2012) and Ghironi and Stebunovs (2010). These two countries are symmetric in their every aspect except for their bank's lending costs which are exposed to global and country specific shocks. In the model all contracts and prices are written in nominal terms, prices are flexible; so we will only solve for real variables. Since they are symmetric, we will explain the model from home country's perspective, foreign country's economy will follow similarly with stars for their corresponding variables.

2.1.1 Household Preferences and Intertemporal Choices

Just as in Bilbiie et al. (2012) both economies are populated by unit mass of identical households. Labor markets are competitive so for nominal wage rate W_t representative home household maximizes expected intertemporal utility;

$$E_t \sum_{s=t}^{\infty} \beta^{s-t} U(C_s, L_s) \tag{2.1}$$

where C_t denotes consumption, L_t denotes labor supplied by consumer at time t and $\beta \in (0,1)$ is the subjective discount factor.

The period utility function takes the form:

$$U(C_t, L_t) = \ln C_t - \chi L_t^{1+\frac{1}{\varphi}}/(1+\frac{1}{\varphi}) \tag{2.2}$$

where $\chi > 0$ and $\varphi \geq 0$ are the Frisch elasticity of labor supply to wages and intertemporal elasticity of substitution in labor supply respectively.

Households consume the basket of goods C_t defined over a continuum of goods Ω for time t. The preferences are in CES form as in Dixit and Stiglitz (1977). There are no non-traded goods in the economy, however there is a home bias in the preferences as in Ghironi and Stebunovs (2010). Household's consumption basket C_t is consisting of two sub baskets; $C_{D,t}$ which denotes the sub-basket of traded goods those produced at home, and $C_{M,t}$ denoting sub-basket of traded goods produced in foreign country. So for $\theta > 1$ being the symmetric elasticity of substitution across sub-baskets, C_t can be written as follows;

$C_t = \left(\nu^{1/\theta}(C_{D,t})^{\frac{\theta-1}{\theta}} + (1-\nu)^{1/\theta}(C_{M,t})^{\frac{\theta-1}{\theta}}\right)^{\frac{\theta}{\theta-1}}$

Here ν is the positive parameter of home bias, measuring weight of home sub-basket in the overall home consumption basket; $\nu > 1/2$ captures home bias. In the CES formulation $C_{D,t}$ and $C_{M,t}$ are;

$C_{D,t} = \left(\int_{\omega\in\Omega} c_{D,t}(\omega)^{\theta-1/\theta} d\omega\right)^{\theta/\theta-1}$

$C_{M,t} = \left(\int_{\omega^*\in\Omega^*} c_{F,t}(\omega^*)^{\theta-1/\theta} d\omega^*\right)^{\theta/\theta-1}$

Here, θ again is the symmetric elasticity of substitution across individual goods, and at any given time t only a subset of home goods $\Omega_t \subset \Omega$ and foreign goods $\Omega_t^* \subset \Omega$ is available to home and foreign households.

We denote $P_{D,t}$ and $P_{M,t}$ for the home currency price indexes respectively for home and foreign sub-baskets and assume export prices are denominated in the currency of target country. Then the consumption-based price index

for home country is;

$P_t = \left(\nu(P_{D,t})^{1-\theta} + (1-\nu)(P_{M,t})^{1-\theta}\right)^{\frac{1}{1-\theta}}$

Sub-basket prices will follow similarly, denoting $p_{D,t}(\omega)$ and $p^*_{X,t}(\omega^*)$ for home currency prices of home and foreign goods;

$P_{D,t} = \left(\int_{\omega\in\Omega_t} p_{D,t}(\omega)^{1-\theta} d\omega\right)^{1/1-\theta}$

$P_{M,t} = \left(\int_{\omega^*\in\Omega^*_t} p^*_{X,t}(\omega^*)^{1-\theta} d\omega^*\right)^{1/1-\theta}$

So the demand for each home and foreign variety will be;

$c_{D,t}(\omega) = \nu\left(\frac{p_{D,t}(\omega)}{P_t}\right)^{-\theta} C_t$

$c_{M,t}(\omega^*) = (1-\nu)\left(\frac{p^*_{X,t}(\omega^*)}{P_t}\right)^{-\theta} C_t$

And finally define relative domestic and export prices;

$\rho_{D,t}(\omega) = \frac{p_{D,t}(\omega)}{P_t}$

$\rho_{X,t}(\omega) = \frac{p_{X,t}(\omega)}{P^*_t}$

Assuming there are N_t variety producers in home country and N^*_t variety produces in foreign country, one can rewrite price index equation as;

$$\left(\nu N_t(\rho_{D,t})^{1-\theta} + (1-\nu)N^*_t(\rho^*_{X,t})^{1-\theta}\right) = 1 \tag{2.3}$$

When we specify preferences in CES form the mark-up ($\mu_t = \theta/(\theta-1)$) is independent from number of firms producing in the market (so the number of goods).

2.1.2 Production and Pricing

There is a continuum of firms, each producing a different variety $\omega \in \Omega$ in a monopolistic competition environment. Production requires only one factor labor, following Ghironi and Stebunovs (2010). Aggregate labor productivity is denoted as Z_t. Each firm is producing $y_t(\omega) = Z_t l_t(\omega)$ where $l_t(\omega)$ is the amount of labor that firm ω hires for production. Unit production cost, measured in home consumption basket C_t is w_t/Z_t. Trade is not costless

there is melting iceberg trade cost $\tau_t \geq 1$. We denote consumption based real exchange rate with Q_t showing units of home consumption basket per unit of foreign consumption basket, that is actually $Q_t = \varepsilon \frac{P_t^*}{P_t}$, ε being the nominal exchange rate. Then the previously defined relative prices will be as follows;

$\rho_{D,t}(\omega) = \mu \frac{w_t}{Z_t}$

$\rho_{X,t}(\omega) = \mu \frac{w_t}{Z_t} \tau Q^{-1}$

Private equity is not allowed in the model. To enter the market, prospective firms have to borrow $f_{e,t}$ amounts of labor which is equivalently $f_{e,t} w_t / Z_t$ amounts of home consumption basket from banks. A new entrant firm at time t, borrows $H_t = \frac{f_{E,t} w_t}{Z_t}$ amounts of consumption good to make up its entry cost and repays it with the same interest rate, q_t, Entry to the market is endogenous, whereas, exit is exogenous induced by a death rate δ. At each period $N_{E,t}$ number of firms enter to the market and the survival probability is $(1 - \delta)$ for each period, the law of motion for the producing firms can be written as;

$$N_t = (1 - \delta)(N_{t-1} + N_{E,t-1}) \tag{2.4}$$

Since each producing firm is also exporting, a firm's profits will come from domestic sales and foreign sales. It is straightforward to write these profits respectively;

$\pi_{D,t} = \nu \frac{1}{\theta} C_t (\rho_{D,t})^{1-\theta}$

$\pi_{X,t} = (1 - \nu) Q_t \frac{1}{\theta} C_t^* (\rho_{X,t})^{1-\theta}$

Then total profit that firm ω makes,

$d_t = \pi_{D,t} + \pi_{X,t}$

In our set-up, the producing firms are financed by both the stock markets and banks. It is assumed that at each period producing firms need to borrow ψ portion of their costs, in the same sense as Kalemli-Ozcan et al. (2012) and Neumeyer and Perri (2005). Next period they will repay this amount with interest rate q_t. It can be easily shown that the total cost that each firm

bears each period is $(\theta - 1)d_t$.

If a firm enters to the market at time t, it will only start producing at time t+1 due to sunk entry cost and one period lag to produce. At time t+1 the firm will start to produce and also pay its loan back to bank. Plus the firm now able to supply its shares to stock market, noting consumers decide on which firms to finance in one period advance. So at time t+1 the firm will have stock value; however it will not able to distribute dividends. Then, at time period t, $N_{t-1}(1-\delta)$ number of firms distribute dividends, $N_{E,t-1}(1-\delta)$ number of firms are experiencing their first period of production and repaying their loans and issuing stock and again taking loans for the next period's cost. Dividend amount for each firm then will be equal to total profits minus payments of borrowings.

Then, total dividend payment that goes to households is;

$TD_t = N_{t-1}(1-\delta)(d_t - (1+q_{t-1})\psi(\theta-1)d_{t-1})$

2.1.3 Firm Entry and Banking

The banking sector is perfectly competitive, so we use a representative bank framework. We assume the banks gather deposits from households, paying risk-free interest rates (deposit rate in this model is risk free) , and using the deposits to finance new entrant and producing firms. Since this is an open economy model, the home bank is also able to collect deposits from foreign households. At time t, home individuals decide to save as deposit B_{t+1} amounts of consumption good in home bank, and foreign individuals make so B^*_{t+1} amounts of home consumption good for the next period. (Similarly, foreign households save as deposit $B^*_{*,t+1}$ amounts of foreign consumption good in foreign banks, home households make so $B_{*,t+1}$ amounts of foreign consumption good.)

However, credit market is not fully efficient; there is a lending cost for new entrant firms which is a fraction of loan borrowed; $m_t H_t$ or $m_t \psi d_t(\theta - 1)$, in the next period if the firm survives it will repay this loan with interest rate q_t. Here H_t denotes the entry cost, to be borrowed from banks by new entrants. If a firm dies without being able to repay its loan, the bank takes nothing. Home banks will collect deposits from households and repayments of borrowings from survived firms, It will then make the repayments for bonds with risk-free interest rate and finance new entrants and producing firms. Denoting the risk free deposit rate with r_t, the flow budget of the bank is as follows;

$$B_{t+1} + B^*_{t+1} + (1 + q_{t-1})(1 - \delta)\left(H_{t-1}N_{E,t-1} + \psi(\theta - 1)d_{t-1}N_{t-1}\right) =$$
$$(1 + m_t)\left(H_t N_{E,t} + \psi(\theta - 1)d_t N_t\right) + (1 + r_t)(B_t + B^*_t)$$

Also imposing the additional constraint (perfectly competitive banks are making zero profit, just financing new entrants with bond investments) which is, $B_{t+1} + B^*_{t+1} = (1 + m_t)\left[H_t N_{E,t} + \psi(\theta - 1)d_t N_t\right]$ we reach the equation for determination of lending rate[1], q_t;

$$1 + q_t = \frac{(1 + r_{t+1})(1 + m_t)}{1 - \delta} \tag{2.5}$$

In the literature there is no obvious way to model the functional form of lending cost, consisting of global and country-specific components. The same argument is valid also for productivity shocks. To investigate common and country specific productivity shocks, Glick and Rogoff (1993) used the functional form of $A_t = A^W_t A^C_t$ where A^W_t stands for world components, A^C_t stands for country specific component. Whereas Boileau et al. (2010) preferred summation for productivity processes and modelled total productivity

[1]If we embed bank's constraint into households' budget constraint and let the household decide which new entrants should be financed we would reach the equivalent result, that is quite intuitive keeping in mind banks are perfectly competitive and households own them.

as $A_t = A_t^W + A_t^C$.

We model lending cost as $m_t = (e^{s_t} - e^{-g_t})$ for home country and $m_t^* = (e^{s_t^*} - e^{-g_t})$ for foreign country, clearly g_t is the common global component and s_t and s_t^* are the country specific components. One reason for this functional form is that we want adding global component to lending cost should decrease it, because as Buch et al. (2005) states financial openness leads to financial improvement in terms of this kind of costs. At the same time the country is expected to become open to global shocks (So the derivative of m with respect to g should be positive). [2] The global and country specific components have the following reduced form representation such that u_t, ε_t and ε_t^* are i.i.d. Plus, since they are estimated with an reduced form VAR, this also provides boundaries for used functional form.

$$\begin{pmatrix} g_t \\ s_t \\ s_t^* \end{pmatrix} = \begin{pmatrix} g_d \\ s_d \\ s_d^* \end{pmatrix} + \begin{pmatrix} \gamma & \phi_1 & \phi_2 \\ \phi_3 & \kappa & \phi_4 \\ \phi_5 & \phi_6 & \kappa^* \end{pmatrix} \begin{pmatrix} g_{t-1} \\ s_{t-1} \\ s_{t-1}^* \end{pmatrix} + \begin{pmatrix} u_t \\ \varepsilon_t \\ \varepsilon_t^* \end{pmatrix} \tag{2.6}$$

Free Entry Condition:

The free entry condition will specify, if a firm decides to enter this period whether in the next period its value (which is actually the sum of future discounted profits) plus its period-profit is higher or equal than its loan repayment amount. The equilibrium imposes;

$$F.E.C.: \quad E_t(d_{t+1} + v_{t+1}) = (1 + q_t)H_t \tag{2.7}$$

[2] The model's implications are robust for all functional forms we have tried satisfying mentioned properties. We have chosen this one because of its simplicity.

2.1.4 Households' Intertemporal Optimization

In this model households only finance producing firms via stock markets. They do not prefer to finance new entrants who are in their investment process, having one period lag to produce.

Hence, the household's period budget constraint will be as follows in terms of consumption good;

$B_{t+1} + Q_t B_{*,t+1} + \frac{\eta}{2} B_{t+1}^2 + \frac{\eta}{2} Q_t B_{*,t+1}^2 + v_t N_t x_{t+1} + C_t = (1 + r_t) B_t + (1 + r_t^*) Q_t B_{*,t} + T_t^f + w_t L_t + x_t N_{t-1}(1 - \delta)(d_t + v_t - \psi(\theta - 1)(1 + q_{t-1}) d_{t-1})$

Considering the above explanation, the households can take dividend payment and sales revenues from stock shares only from $N_{t-1}(1 - \delta)$ number of firms. In addition x_{t+1} denotes the fraction of producing firms that household decides to invest at time t, and v_t is the value of the firm such that transactions in the stock market made at this price.

Households can freely hold both domestic and foreign deposits, with bearing holding costs. $\frac{\eta}{2} B_{t+1}^2$ and $\frac{\eta}{2} Q_t B_{*,t+1}^2$ are symmetric deposit holding costs. These holdings costs are equal to T_t^f in equilibrium.

Household will decide, how much to consume, how much to supply labor, how much to hold deposits in domestic and foreign banks, and finally how much to invest in stock shares. Solving household's intertemporal problem with respect to his budget constraint, first order conditions will appear as [3];

$$C_t^{-1}(1 + \eta B_{t+1}) = \beta(1 + r_{t+1}) E_t \left[C_{t+1}^{-1} \right] \tag{2.8}$$

$$C_t^{-1}(1 + \eta B_{*,t+1}) = \beta(1 + r_{t+1}^*) E_t \left[\frac{Q_{t+1}}{Q_t} C_{t+1}^{-1} \right] \tag{2.9}$$

$$\chi L_t^{1/\varphi} = \frac{w_t}{C_t} \tag{2.10}$$

[3] We assume deposit holdings and risk free deposit rates are predetermined variables as in Ghironi and Stebunovs (2010), so they do not appear in "expected" values.

$$v_t = E_t \left\{ \beta(1-\delta)(\frac{C_{t+1}}{C_t})^{-1} \left(d_{t+1} + v_{t+1} - \psi(\theta-1)(1+q_t)d_t\right) \right\} \qquad (2.11)$$

2.1.5 Equilibrium, Aggregate Accounting and Labor Market

First, deposit market equilibrium conditions imply;

$$B_{t+1} + B^*_{t+1} = (1+m_t)\left[H_t N_{E,t} + \psi(\theta-1)d_t N_t\right] \qquad (2.12)$$

$$B_{*,t+1} + B^*_{*,t+1} = (1+m^*_t)\left[H^*_t N^*_{E,t} + \psi(\theta-1)d^*_t N^*_t\right] \qquad (2.13)$$

Aggregating households' budget constraints with imposing equilibrium conditions $x_t = x_{t+1} = 1$ (because of uncertainty the households will invest all firms that issue stock in stock market), we obtain the following aggregate accounting identity;

$B_{t+1} + Q_t B_{*,t+1} + v_t N_t + C_t = (1+r_t)B_t + (1+r^*_t)Q_t B_{*,t} + w_t L_t + N_{t-1}(1-\delta)(d_t + v_t - \psi(\theta-1)(1+q_{t-1})d_{t-1})$

The foreign country's aggregate accounting identity will follow similarly;

$B^*_{*,t+1} + \frac{1}{Q_t} B^*_{t+1} + v^*_t N^*_t + C^*_t = (1+r^*_t)B^*_{*,t} + (1+r_t)\frac{1}{Q_t} B^*_t + w^*_t L^*_t + N^*_{t-1}(1-\delta)(d^*_t + v^*_t - \psi(\theta-1)(1+q^*_{t-1})d^*_{t-1})$

Multiplying foreign households' accounting identity with real exchange rate Q_t and subtracting from home households' identity, using constraints of banks, we reach the law of motion of foreign assets for home country.

$$
\begin{aligned}
Q_t B_{*,t+1} - B^*_{t+1} =& Q_t(1+r^*_t)B_{*,t} - (1+r_t)B^*_t - (1/2)((1+m_t) \\
& (H_t N_{E,t} + \psi(\theta-1)N_t d_t) - Q_t(1+m^*_t)(H^*_t N^*_{E,t} + \\
& \psi(\theta-1)N^*_t d^*_t)) - (1/2)(v_t N_t - Q_t v^*_t N^*_t) - (1/2)(C_t - \\
& Q_t C^*_t) + (1/2)(w_t L_t - Q_t w^*_t L^*_t) + (1/2)((1+r_t)(1+m_{t-1}) \\
& (H_{t-1} N_{E,t-1} + \psi(\theta-1)N_{t-1} d_{t-1}) - Q_t(1+r^*_t)(1+m^*_{t-1}) \\
& (H^*_{t-1} N^*_{E,t-1} + \psi(\theta-1)N^*_{t-1} d^*_{t-1})) + (1/2)(N_{t-1}(1-\delta) \\
& (d_t + v_t - \psi(\theta-1)(1+q_{t-1})d_{t-1}) - Q_t N^*_{t-1}(1-\delta) \\
& (d^*_t + v^*_t - \psi(\theta-1)(1+q^*_{t-1})d^*_{t-1}))
\end{aligned}
$$

The Gross Domestic Products for each economy is just equal to the right or left hand side of aggregated budget balances. Left hand side states GDP from expenditure side, while right hand side states GDP from income side. Notice the fact that GDP equals to the sum of consumption and investment where investment is the sum of stock market investment ($v_t N_t$) and bank investment ($B_{t+1} + Q_t B_{*,t+1}$) on firms.

$$
Y_t = B_{t+1} + Q_t B_{*,t+1} + v_t N_t + C_t \tag{2.14}
$$

$$
Y^*_t = B^*_{*,t+1} + \frac{1}{Q_t} B^*_{t+1} + v^*_t N^*_t + C^*_t \tag{2.15}
$$

Current account balance of home country is;

$$
CA_t = Q_t \left[B_{*,t+1} - B_{*,t} \right] - \left[B^*_{t+1} - B^*_t \right] \tag{2.16}
$$

The export, import and net export in terms of consumption good for home country;

$$
EX = Q_t N_t (1-\nu) C^*_t \rho^{1-\theta}_{X,t} \tag{2.17}
$$

$$IM = N_t^*(1-\nu)C_t\rho_{X,t}^{*1-\theta} \tag{2.18}$$

$$NX = EX - IM \tag{2.19}$$

Investment in this economy is the total of investment that goes for new entrant firm financing, producing firm financing and the stock market finance of producing firms. So total investment for home country;

$$I = (1+m_t)(H_t N_{E,t} + \psi(\theta-1)d_t N_t) + v_t N_t \tag{2.20}$$

Just like in Bilbiie et al. (2012) and contrary to standard RBC model, this model embraces two kinds of labor; some of labor will work in the process of production of consumption good, while rest will work in newly-entrant firms to complete the one-period investment period before starting production. In this model there are two types of labor; one part is working in the production of consumption good while the rest is working in the new entrant firms for sunk entry cost. Denoting these two types of labor with L_t^C and L_t^E, it is clear that;

$L_t^C = N_t l_t$

$L_t^E = \frac{N_{E,t} f_{E,t}}{Z_t}$

$L_t^C + L_t^E = L_t$

Labor market equilibrium condition imply;

$$L = \frac{N_t}{w_t}(\theta-1)\left[\nu\frac{1}{\theta}(\rho_D^{1-\theta})C_t + (1-\nu)\frac{1}{\theta}(\rho_{X,t}^{1-\theta})C_t^* Q_t\right] + N_{E,t}\frac{f_e}{Z} \tag{2.21}$$

In the standard RBC model, if labor supply is fixed, since all labor is used in the production of consumption good, no labor market dynamic will arise. However in our model as in Bilbiie et al. (2012) even if we fix labor supply, $\varphi = 0$, there will be again dynamics in labor market due to the dynamism arising from endogenous entry. Labor will be allocated between new entrants

and producing firms for every period.

Model Summary:

Until now we wrote everything from the perspective of home country. For sure we need to write equilibrium conditions for foreign economy.Overall we have 46 endogenous variables; w_t, w_t^*, $\rho_{D,t}$, $\rho_{D,t}^*$, $\rho_{X,t}$, $\rho_{X,t}^*$, N_t, N_t^*, v_t, v_t^*, q_t, q_t^*, H_t, H_t^*, $N_{E,t}$, $N_{E,t}^*$, d_t, d_t^*, C_t, C_t^*, L_t, L_t^*, r_t, r_t^*, B_t, B_t^*, $B_{*,t}$, $B_{*,t}^*$, Q_t, m_t, m_t^*, s_t, s_t^*, g_t. Of them 8 are predetermined; r_t, r_t^*, B_t, B_t^*, $B_{*,t}$, $B_{*,t}^*$, N_t, N_t^*. To save place, world economy is summarized in Table 2 in the Appendix.

2.2 MODEL SOLUTION

2.2.1 Steady State

We present a symmetric steady state of both countries in the case of balanced trade, no bond holding costs and no bond trade. So the steady state (S.S.) is simply the closed economy steady state replicated for both home and foreign countries.

Risk free interest rate (which is also deposit rate in this model) given as r equals to $\frac{1-\beta}{\beta}$, in other words β equals to $\frac{1}{1+r}$. Since m and r are exogenous and δ is a parameters than the lending rate, will be determined as a function of these; so it is decided exogenously too.

The values of selected variables as a function of parameters at steady state are available in the Appendix. Using Dynare software the model is approved to have a numerical steady state when the bond trade and bond holding costs added, controlled with many different numerical trials for parameters. Numerical exercise indicates that in steady state current account balances are 0 for both countries and the exchange rate is one.

2.2.2 Calibration

Since our aim is to focus on financing channels and its affects on business cycle and firm dynamics, the key parameter for our model is the lending cost. So taking all the other parameters same for these two countries, but letting them differ only in their lending cost is an acceptable assumption for now. So we will take all the parameters same as Bilbiie et al. (2012), which are actually US parameters.

Since we are actually interested in different firm dynamics and business cycle implications of high income (financially developed) and low/middle income (less financially developed) countries, the appropriate approach would be calibrating lending cost capturing these two groups.

However due to the lack of data, we choose two representative countries; one high-income and one middle income: [4] UK and South Africa to calibrate the model. There are a few reasons why we have chosen these two countries. The first reason is they have a long time series data for their lending premium as US. In accordance with World Bank's definition, the Financial Development Report 2011 of the World Economic Forum states the financial development indexes of UK and South Africa as 5.0 and 3.6 respectively using a scale from 1 to 7. [5] Their financial development levels differ, but they are not two very distinct countries. UK is an OECD country, and South Africa is an enhanced engagement country for the OECD. [6] The entry density differences of these two countries provided in Figure 2.1.

As stated, to calibrate the US parameters we follow mainly Bilbiie et al. (2012). So survival rate of firms, $1 - \delta$ is set to 0.975 to match the US job destruction rate which is 0.10 per year. β is taken 0.99 to match annualized

[4] According to World Bank's definitions: http://data.worldbank.org/about/country-classifications

[5] $http://www3.weforum.org/docs/WEF_FinancialDevelopmentReport_2011.pdf$

[6] $http://www.oecd.org/countrieslist$

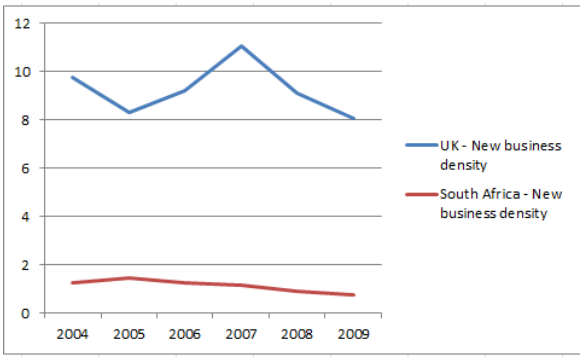


Figure 2.1: Firm Entry in UK and South Africa.
Data: World Bank's Entrepreneurship Survey and Database

average interest rate, 0.04. θ is taken as 3.8 to fit US plant and macro trade data. Frisch elasticity of labor, φ is taken as 4. The home bias parameter, ν is calibrated as 0.755 matching the US data, and melting iceberg trade cost τ and the deposit holding cost parameter, η, are taken as 1.33 and 0.0025, respectively, as in Ghironi and Stebunovs (2010). We calibrated ψ arbitrarily, and chose 0.10; producing firms need to borrow 10 percent of their labor costs from banks.

To calibrate the lending cost part, we followed the model's determination of lending rates;

$1 + q_t = \frac{(1+r_{t+1})(1+m_t)}{1-\delta}$

For now ignore, $(1 - \delta)$, which is actually some number close 1,

$1 + q_t \approx (1 + m_t)(1 + r_{t+1})$

$1 + q_t \approx 1 + r_{t+1} + m_t + r_{t+1}m_t$

With plausible calibration, we restrict m_t to the interval 0-1, so the final term $r_{t+1}m_t$ will be some number close to 0. Ignoring this term;

$m_t \approx q_t - r_{t+1}$

This final equation demonstrates a way to calibrate lending cost part that appears to be the premium. In our model, deposit holders take their return without no risk. So risk free rate and deposit rate coincide in this model. We will gather lending rates and risk-free treasury bills rates time series of US,

UK and South Africa [7], differencing these two variables and then applying HP Filter, we will estimate a multivariate process for lending costs. [8]

The resulting process is;

$$\begin{pmatrix} g_t \\ s_t \\ s_t^* \end{pmatrix} = \begin{pmatrix} 0.0039 \\ 0.0034 \\ 0.0074 \end{pmatrix} + \begin{pmatrix} 0.55 & 0 & 0 \\ 0 & 0.33 & 0 \\ 0 & 0 & 0.64 \end{pmatrix} \begin{pmatrix} g_{t-1} \\ s_{t-1} \\ s_{t-1}^* \end{pmatrix} + \begin{pmatrix} u_t \\ \varepsilon_t \\ \varepsilon_t^* \end{pmatrix} \tag{2.22}$$

Here g_t, global component stands for US, s_t is for UK and s_t^* is for South Africa. The off-diagonal elements in the matrix are taken as 0 since the null hypotheses of being zero can not be rejected in the 5 percent level. One may argue that, the t ratio tests are not compatible with VAR spirit, but looking at impulse responses and Granger causality tests, we conclude at 95 percent confidence interval, the premiums only response to their own shocks. So taking off-diagonal elements as 0 is acceptable and eases the analysis and interpretation. [9]

At steady state, home country (UK) has a lending cost of 1.3 percent whereas foreign country (South Africa) has a lending cost of 2.9 percent. Number of new entrants is 1.4 percent higher and number of producing firms is 1.8 percent higher in home country compared to foreign country.

[7] Data is collected from IFS quarterly, http://elibrary-data.imf.org/

[8] Due to structural breaks experienced in US especially in 70s and in early 80s, as Jermann and Quadrini (2009), we used quarterly data from 1984 first quarter to 2012 first quarter. When modelling the premiums with VAR certain tests are made and it is shown that premiums are best represented with a VAR(1) process.

[9] We are aware that identification of this VAR is indeed a problem, we want to extract out identified shocks for US, UK and South Africa, however it does not seem to possible with reduced form or restricted VAR. A different approach like, making a decomposition, may be needed and left as a future work.

2.2.3 Impulse Responses:

Productivity Shocks

First we present the implications of productivity shocks within our frame. We fix lending costs to their steady state levels, treating them as parameters. For the structure of productivity shocks we follow the literature as Kalemli-Ozcan et al. (2012) and impose persistent productivity process without spillovers;

$$\begin{pmatrix} Z_t \\ Z_t^* \end{pmatrix} = \begin{pmatrix} 0.95 & 0 \\ 0 & 0.95 \end{pmatrix} \begin{pmatrix} Z_{t-1} \\ Z_{t-1}^* \end{pmatrix} + \begin{pmatrix} \varsigma_t \\ \varsigma_t^* \end{pmatrix} \tag{2.23}$$

The residuals, ς_t and ς_t^* have the same variance of 0.7 percent and the correlation of 0.3. Impulse responses are provided in the Appendix. [10]

To look at the impulse responses, as well as second moments, we are always using logged and HP filtered variables that the model implies except for current account, net exports, and deposit holdings. When there is an orthogonalized productivity shock in home country, we see that the real exchange rate increases (that is one unit of foreign consumption basket corresponds more of home consumption basket). Home country experiences both a current account and net export surplus after an initial decline in the first period. After nearly 30 periods of surplus, before returning to their steady state levels, they become deficits, and then they finally go back to their steady state level. Initially GDP increases in both countries, for the home country it never falls below its steady state level until its returns back to steady state level. However this is not the case for foreign country, initially it enjoys home country's productivity shock, its GDP increases, but then it experience a fall on the way to returning back to steady state level. Investment increases in both.

[10] Foreign country's variables (in this case this is South Africa) are denoted with stars for deposit holdings; B is for B_t, stB is for B_t^*, Bst is for $B_{*,t}$ and finally stBst is for $B_{*,t}^*$

Wages, domestic prices, export prices, entry cost and the value of the firms all increase in home country with productivity shock. Consumption, number of producing firms, number of new entrants and labor employed increases as well. Lending rate in home country initially increases but then decreases. Similar to the lending rate, profits in the home country, increases initially but after a few periods thry decline. This is mostly because of the increase in the number of producers. All these variables behave exactly in the same way for the foreign country too, except for labor supply, which in a way fluctuates; initially increases then decreases but then slightly increases on its steady state level again.

When there is orthogonalized productivity shock to foreign country, exchange rate decreases. The behaviors of current account, and net exports are in the same way as home productivity shock. So the country that is the source of shock experiences a current account surplus. The behaviour of GDP is however not in the same way as home productivity shock. After foreign country experiences a productivity shock the GDP of foreign country increases, however GDP of home country decreases! Number of producing firms, number of new entrants, labor supply and investment in the home country decreases initially then after approximately 20 periods it increases upon to its steady state level. Number of producing firms, number of new entrants, labor supply and investment all increase in foreign country. Both domestic and export prices increase in both countries. Value of firms, entry cost, wages, and consumption increases in both countries. Dividends and lending rate first increases, then decreases below its steady state level in both countries.

Table 2.1: Summary of Impulse Responses

Source of Shock	Home Country	Foreign Country
Home Productivity Shock	CA $\uparrow$	CA^* $\downarrow$
	GDP,I, C, L, w $\uparrow$	similar
	ρ_D, ρ_X, H, v, N N_E $\uparrow$	similar
Foreign Country Productivity Shock	CA $\downarrow$	CA^* $\uparrow$
	GDP $\downarrow$; C, H, v, w $\uparrow$.	GDP^*, C^*, H^*, v^*, w^* $\uparrow$.
	I, N, N_E, L first $\downarrow$ then $\uparrow$	I^*, N^*, N_E^*, L^* $\uparrow$
Country-Specific (Home) Credit Shock	CA first $\uparrow$ then $\downarrow$	CA^* first $\downarrow$ then $\uparrow$
	GDP, w, ρ_D, ρ_X, H, v, N $\downarrow$	GDP^* $\uparrow$, w^*, ρ_D^*, ρ_X^*, H^*, N^* first $\uparrow$ then $\downarrow$
	C, v first $\uparrow$ then $\downarrow$	C^*, v^* first $\uparrow$ then $\downarrow$
	L, N_E first $\downarrow$ then $\uparrow$	L^*, N_E^* first $\uparrow$ then $\downarrow$
Global Credit Shock	CA first $\downarrow$ then $\uparrow$	CA^* first $\uparrow$ then $\downarrow$
	GDP, C, L, v, I and N_E first jump then $\downarrow$	similar
	ρ_D, ρ_X, H, v, N $\downarrow$	similar

So we see that the impulse responses to symmetric productivity shock are not symmetric; there are a few differences depending on whether the source of country is financially developed (has lower lending cost) or less developed (has higher lending cost).

Credit Shocks

The estimated VAR process gives the following residual covariance matrix:

Covariance Matrix	u_t	ε_t	ε_t^*
u_t	0.031	0.00379	0.00372
ε_t		0.029	-0.00032
ε_t^*			0.094

To look at the impulse responses, since we are interested in orthogonalized shocks and responses we prefer to give same amount of shock to both country specific error terms, equal to the variance of home country's component 0.029; global component's variance stays as given, 0.031. Covariance terms are saved.

When there is an orthogonalized shock to ε_t, that is when shock comes to financially developed (UK) country's error term, exchange rate initially increases then decreases. The home country experiences an initial current account and net export surplus but then a deficit before returning to steady state. Both the domestic and export prices fall in home country. domestic prices increase in foreign country, however export prices first increases but then decreases. The GDP of home country fall below its steady state level, after a very small jump; that jump is mainly because of trade gains. Because of the credit shock, prices fall and the increase in net exports causes an initial jump in GDP. Foreign country enjoys an increase in GDP and until returning back to steady state it never falls below its steady state level. Investment in home country behaves just like GDP. Investment in foreign country initially increases but after nearly 10 periods it falls below its long-run level.

Wages, number of producing firms, entry cost, all fall in home country. Wages and entry cost increase in foreign country. Labor supply, and number of new entrants behave interestingly; they initially fall but after they increase up to the their steady state level. Labor supply, number of producing firms and number of new entrants initially increase however later they fall in foreign country; a sign of contagion of crisis. Consumption behaves in the same way as investment and GDP; it initially jumps but then falls in home country. The behaviour of consumption is the same for foreign country. Profits at home increase, mainly because of the decrease in producing firms. Value of firms on the other hand initially increases but after a few periods they fall below their steady state level. In foreign country profits falls and value of firms increase initially. Profits increase after a few periods, value of firms turn back to its steady state level after a slight fall.

The interpretation of an orthogonalized shock to ε_t^* follows the same sense of a shock to ε_t. So impulse responses are symmetric when there is a country specific shock in world economy.

The orthogonalized shocks to u_t makes similar effects to both countries. Obviously the reason is the two countries are just symmetric except for their lending cost. The shock increases lending cost, and the effect of the shock outspreads with the channel of firms. At first both countries have a jump GDP and investment but then they fall significantly, below their steady state level. Number of firms, wages, prices, entry cost fall in both countries. For both home and foreign country; number of new entrants and labor supply initially decrease but then increase, consumption initially increases but then decrease, profits and lending rate increase, value of firms first increase but then decrease.

In the case of such an orthogonalized shock to u_t we see different behavior only in international variables. Exchange rate and net exports fluctuate

significantly in the short term. Home country initially experiences a current account deficit then it turns to a surplus. The reverse argument is valid for foreign country. Relating this with latest financial crisis, which is thought to be flared up in the last quarter of 2007 as Taylor (2009) states, one may wonder how current account behaviour differed between high-income and lower/middle income countries. World Bank provides annual current account data for country groups. Even though we do not have an aggregate current account data quarterly, we can look at United Kingdom's and South Africa's current account behaviours. Relevant graphs are provided in Figure 2.2, Figure 2.3. For the financially developed country (high-income country, UK) indeed experiences an increase in current account after the last quarter of 2007, that later decreases again. Looking at the country groups pattern is same; high income countries first have decrease in their current accounts from 2007 to 2008 and then this again turns into an increase. Behaviour of middle and lower income countries is just symmetric.

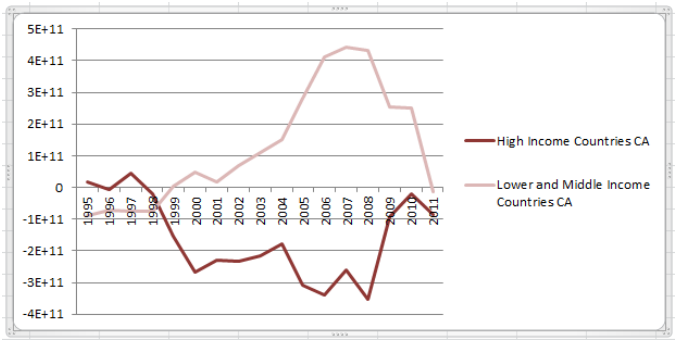


Figure 2.2: Current Account in High Income vs. Middle and Lower Income Countries.
Data: World Bank

So in the existence of global shock, we observe comovement across aggregate real variables of both countries, however in the case of country specific shocks we at most witness contagion. Kalemli-Ozcan et al. (2012) points out that credit shocks enhance comovements across countries, in our model this comovement is only possible with global credit shocks.

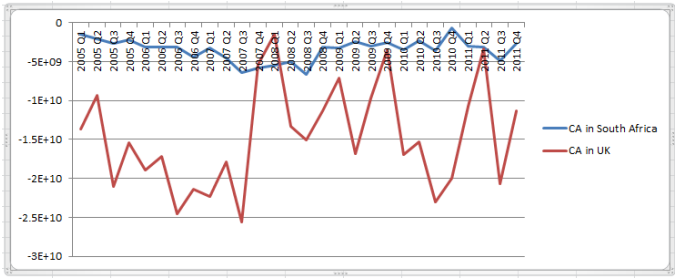


Figure 2.3: Current Account in UK and South Africa.
Data: International Financial Statistics

2.2.4 International Business Cycles and Second Moments:

For comparison, we present both second moments from productivity shocks and credit shocks. To compare the second moments with real data, all variables are in logarithms, detrended with HP fiter, except for net exports and current accounts. Relative standard deviations for productivity shocks and two versions of credit shocks are presented in Table 2.2. We look at relative volatilities, since we are using US parameters, and UK and South Africa lending cost processes, it would not be appropriate to make inferences and comparison with the real data of these countries.

Productivity Shocks

In the case of productivity shocks, both countries' variables have very close standard deviations. Consumption is less volatile than GDP. Investment is more volatile than GDP. Both imports and exports are more volatile than GDP. These are in accordance with what the international business cycle literature suggests (see Auray and Eyquem (2011) and Farhat (2010)). Plus, as the mentioned literature in Section 1 expects, the number of new entrants is more volatile than the number of producing firms in both countries. However in this set-up, contradicting with literature, labor supply is more volatile than GDP, and real exchange rate is less volatile than GDP.

If we look at the cross correlations for the variables, we again would see

same patterns in both countries. The correlations between exports/imports and GDP are positive. Contrary to the data at hand,the correlation between imports and GDP is not higher than the one between exports and GDP and the correlation between net exports and GDP is not negative. Exchange rate is positively correlated with exports and negatively correlated with imports. Cross country correlation of consumptions is higher than cross country correlation of outputs. So the model with productivity shocks does not reflect the so called consumption-output anomaly (the situation seen in the real world data that cross country correlation of consumptions is less than the correlation of outputs).

Aguiar and Gopinath (2007) shows that the correlation between consumption and GDP, and the correlation between investment and GDP are higher in emerging economies compared to developed countries. Putting, financially developed country to developed class, and less financially developed country to emerging class, we can make a comparison in this sense. When cycles are driven by productivity shocks two countries do not differ with respect to this correlations.

Aguiar and Gopinath (2007) also document business cycle differences between emerging economies and developed countries. They present the fact that relative volatilities of real variables are significantly higher for emerging countries compared to developed ones. In accordance with Aguiar and Gopinath (2007), Buch et al. (2005) points out empirically that countries with more developed financial systems have lower business cycle volatility.

With productivity shocks, foreign country's GDP is slightly more volatile. However consumption, investment and lending rate in foreign country (financially less developed country) are not more volatile than the consumption, investment and lending rate in home country (financially developed country). The standard deviations of new entrants are nearly same in both countries,

σ_F/σ_H	Productivity Shocks	Credit Shocks*	Credit Shocks**
$\sigma_{GDP^*}/\sigma_{GDP}$	1.006	1.125	1.628
$\sigma_{INV^*}/\sigma_{INV}$	0.997	1.178	1.714
$\sigma_{\rho_D^*}/\sigma_{\rho_D}$	1.006	1.204	1.688
$\sigma_{EX^*}/\sigma_{EX}$	1.042	1.004	1.184
$\sigma_{IM^*}/\sigma_{IM}$	0.954	0.994	0.801
$\sigma_{NX^*}/\sigma_{NX}$	1.002	1.002	1.002
σ_{N^*}/σ_N	0.997	1.195	1.782
σ_{v^*}/σ_v	1.000	1.035	1.422
σ_{q^*}/σ_q	0.769	1.208	1.838
σ_{H^*}/σ_H	1.000	1.204	1.688
$\sigma_{N_E^*}/\sigma_{N_E}$	1.000	0.996	1.444
σ_{d^*}/σ_d	1.002	1.086	1.507
σ_{C^*}/σ_C	0.997	1.010	1.383
σ_{L^*}/σ_L	0.992	0.974	1.379
σ_{r^*}/σ_r	1.001	0.856	1.138
σ_{w^*}/σ_w	1.006	1.204	1.688

Note: Credit Shocks* denotes the set-up where we made country-specific error term variances same; for Credir Shock**, it is the real variance-covariance matrix.

Table 2.2: Relative Standard Deviations

while the model estimates the volatility of producing firms in home country is higher than the one in foreign country.

Credit Shocks

To compare second moments, with credit shocks, we make two experiments. First we impose exactly what the covariance matrix implies. Second we will change the variance of ε_t^* and put the restriction of both country specific error terms have the same variance. We do second experiment to see what would happen if the two countries experience exactly same credit shocks plus a global shock, preserving covariances. This is to eliminate the fact that historically, lending cost in South Africa has indeed very large variance; which can effect resulting moments significantly.

When there are credit shocks, either with same variances or with the real covariance matrix, we see the same patterns in terms of individual variables' volatilities, as productivity shocks. With credit shocks however, the differences in the mentioned variables' moments are much more apparent, more

close what the data suggests. For the correlations again we match the same set of business cycle facts. One difference is in the real covariance version for the foreign country imports and GDP are not positively correlated. When we impose same variances, this correlation becomes negative for home country too. With credit shocks, in both versions, correlation between consumption and GDP, and the correlation between investment and GDP are higher in foreign country.

Credit shocks also reflect better the fact that less financially developed country has more volatile business cycle. Not only the GDP but also consumption, investment and lending rate in foreign country are now more volatile compared to home country. This is compatible what Garcia-Cicco et al. (2010) suggest; with productivity shocks real business cycle models fail to show high volatility of financially less developed (emerging) countries. However, in the case of credit shocks (or shocks coming from financial frictions like country premium shocks in their paper) reveal mentioned higher volatility.

The version that has real covariance matrix estimates the volatility of producing firms and new entrants to be higher in the foreign country. When we make the variance of two country specific components' error terms same, volatility of new entrants is now lower in foreign country, whereas volatility of producing firms higher in foreign country. So this version is the most close one to the pattern we witness in the financial crisis. If we give only global shock and cancel out the country-specific shocks, both the producing firms and new entrants in home country become more volatile than those in foreign country.

In accordance with arguments of Aguiar and Gopinath (2007) and Buch et al. (2005); in our all three versions volatility of business cycle of foreign country is higher. However when there is productivity shocks, the volatility

of variables in foreign country are just slightly higher compared to those in home country. In the existence of credit shocks the difference is more apparent. When we make same the variances of country specific shocks, we further cover the fact of different volatilities of new entrants.

CHAPTER 3

CONCLUSION

To conclude, this paper has built a DSGE model embracing certain empirical facts about finance differences in new entrants and older firms. Solving the model both with productivity and credit shocks we show that both shocks are able to match a set of business cycle statistics. Different than productivity shocks, credit shocks also reveals the fact that financially less developed countries have more volatile business cycles compared to financially developed ones. Plus, when business cycles are driven by credit shocks, the model also exhibits the empirical fact that financially less developed countries have more correlated consumption and GDP and also more correlated investment and GDP compared to the financially developed ones. If we restrict the model to work with only global shocks, or specify equal country-specific shocks, the model also matches higher volatility of firm entry in high-income (financially) developed countries. However we doubt that this is a long-term business cycle fact; because imposing the shocks as the real data suggests the volatility of new entrants also seem to be higher in less financially developed countries. This is mainly because of the fact that, historically these countries face credit shocks that have larger variances.

In our set-up responses to productivity shocks are not symmetric. When there is positive shock to either country, both countries increase their consumption.When the source of the productivity shock is home country, aggregate variables' in foreign country behave exactly same as corresponding aggregate variables in home country. However when the source of the productivity shock is foreign country this is not the case. In such a case, the GDP of home country decreases! Investment, number of producing firms, number of new entrants and labour first fall below their steady state level but then increase. Responses to country-specific credit shocks, on the other hand, are symmetric and we see the contagion of country-specific crisis after some periods, in variables, consumption, investment, labour supply, number of producing firms and new entrants. If the credit shock is not country-specific but instead global then we observe a synchronized recession. While both countries have decline in their consumption and output, financially developed country initially experiences a current account deficit which later turns to a surplus. For the less financially developed country the reverse argument is valid.

One important point is that, we modelled the lending costs of both countries as if both of them absorbs all of the global shock. Another way to model lending cost would be to constrain global components' effect with financial openness of the country. We may change monitoring cost of home country as $m_t = e^{s_t} - \lambda e^{-g_t}$ where, λ indicates the country's vulnerability to global shocks. Or modelling monitoring cost in a different functional form may let more interaction between global and country-specific terms.

We estimated credit shock processes using representative countries for high income and middle income country groups. However correct approach may require a detailed econometric work on mentioned groups and estimating a multivariate process using all available countries' information. This applications are left as future works.

An important drawback is we restricted firms' borrowing decisions; did not let them making their own finance choice. Because of this reason stock market finance and bank finance are not substitutes in our set-up. Solving this problem, probably with the enforcement constraint formulation that Jermann and Quadrini (2009) suggest, may improve the model and also make it able to explain the behaviour of financial variables.

Nevertheless, the model has set-up a frame of business cycle model where shocks manage the cycle via the channel of firm finance. Model's comparison between productivity shocks and credit shocks provides a different perspective on international business cycles.

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APPENDIX

A. Model Summary

Table 3.1: Model Summary

Equation	
Pricing	$\rho_{D,t} = \frac{\theta}{\theta-1}\frac{w_t}{Z_t}$
	$\rho^*_{D,t} = \frac{\theta}{\theta-1}\frac{w^*_t}{Z^*_t}$
	$\rho_{X,t} = Q_t^{-1}\tau_t\rho_{D,t}$
	$\rho^*_{X,t} = Q_t\tau^*_t\rho^*_{D,t}$
Price Indexes	$\left(\nu N_t(\rho_{D,t})^{1-\theta} + (1-\nu)N^*_t(\rho_{X,t})^{1-\theta}\right) = 1$
	$\left(\nu N^*_t(\rho^*_{D,t})^{1-\theta} + (1-\nu)N_t(\rho_{X,t})^{1-\theta}\right) = 1$
Profits	$d_t = d_t = \nu C_t\frac{1}{\theta}\rho_{D,t}^{1-\theta} + \frac{Q_t}{\theta}(1-\nu)C^*_t\rho_{X,t}^{1-\theta}$
	$d^*_t = \nu C^*_t\frac{1}{\theta}\rho_{D,t}^{*1-\theta} + \frac{1}{Q_t\theta}(1-\nu)C_t\rho_{X,t}^{*1-\theta}$
Free entry	$E_t(d_{t+1} + v_{t+1}) = (1+q_t)H_t$
	$E_t(d^*_{t+1} + v^*_{t+1}) = (1+q^*_t)H^*_t$
Number of Firms	$N_t = (N_{t-1} + N_{E,t-1})(1-\delta)$
	$N^*_t = (N^*_{t-1} + N^*_{E,t-1})(1-\delta)$
Intratemporal Optimality	$\chi L_t^{1/\varphi} = \frac{w_t}{C_t}$
	$\chi L_t^{*1/\varphi} = \frac{w^*_t}{C^*_t}$
Euler Eqn (domestic deposits)	$C_t^{-1}(1+\eta B_{t+1}) =$
	$\beta(1+r_{t+1})E_t\left[C_{t+1}^{-1}\right]$
	$(C^*_t)^{-1}(1+\eta B^*_{*,t+1}) =$

Continued on next page

Table 3.1 – continued

Equation	
	$\beta(1+r^*_{t+1})E_t\left[C^{*-1}_{t+1}\right]$
Euler Eqn (foreign deposits)	$C_t^{-1}(1+\eta B_{*,t+1}) = \beta(1+r^*_{t+1})$
	$E_t\left[\frac{Q_{t+1}}{Q_t}C^{-1}_{t+1}\right]$
	$(C^*_t)^{-1}(1+\eta B^*_{t+1}) = \beta(1+r_{t+1})$
	$E_t\left[\frac{Q_t}{Q_{t+1}}C^{*-1}_{t+1}\right]$
Euler Equation (shares)	$v_t = E_t(\beta(1-\delta)(\frac{C_{t+1}}{C_t})^{-1}(d_{t+1}+v_{t+1}-$
	$\psi(\theta-1)(1+q_t)d_t))$
	$v^*_t = E_t(\beta(1-\delta)(\frac{C^*_{t+1}}{C^*_t})^{-1}\left(d^*_{t+1}+v^*_{t+1}-\right.$
	$\psi(\theta-1)(1+q^*_t)d^*_t))$
Sunk Entry Cost	$H_t = f_{E,t}\frac{w_t}{Z_t}$
	$H^*_t = f_{E,t}\frac{w^*_t}{Z^*_t}$
Bank's interest on entry loans	$1+q_t = \frac{(1+r_{t+1})(1+m_t)}{1-\delta}$
	$1+q^*_t = \frac{(1+r^*_{t+1})(1+m^*_t)}{1-\delta}$
Labor market equilibrium	$L = \frac{N_t}{w_t}(\theta-1)(\nu\frac{1}{\theta}(\rho_D^{1-\theta})C_t+$
	$(1-\nu)\frac{1}{\theta}(\rho_{X,t}^{1-\theta})C^*_tQ_t) + N_{E,t}\frac{f_e}{Z}$
	$L^* = \frac{N^*_t}{w^*_t}(\theta-1)(\nu\frac{1}{\theta}(\rho_D^{*1-\theta})C^*_t+$
	$(1-\nu)\frac{1}{\theta}(\rho_{X,t}^{*1-\theta})C_t\frac{1}{Q_t}) + N^*_{E,t}\frac{f_e}{Z}$
Bond market equilibrium	$B_{t+1}+B^*_{t+1} = (1+m_t)(H_tN_{E,t}$
	$+\psi(\theta-1)d_tN_t)$
	$B_{*,t+1}+B^*_{*,t+1} = (1+m^*_t)(H^*_tN^*_{E,t}$
	$+\psi(\theta-1)d^*_tN^*_t)$
Law of net foreign assets .	$Q_tB_{*,t+1}-B^*_{t+1} = Q_t(1+r^*_t)B_{*,t}-$
	$(1+r_t)B^*_t-(1/2)((1+m_t)(H_tN_{E,t}$
	$+\psi(\theta-1)N_td_t)-Q_t(1+m^*_t)$
	$(H^*_tN^*_{E,t}+\psi(\theta-1)N^*_td^*_t))$

Continued on next page

Table 3.1 – continued

Equation	
.	$-(1/2)(v_t N_t - Q_t v_t^* N_t^*))$
	$-(1/2)(C_t - Q_t C_t^*$
	$+(1/2)((1+r_t)(1+m_{t-1})(H_{t-1}N_{E,t-1}$
.	$+\psi(\theta-1)N_{t-1}d_{t-1}) - Q_t(1+r_t^*)$
	$(1+m_{t-1}^*)(H_{t-1}^* N_{E,t-1}^* + \psi(\theta-1)N_{t-1}^*$
.	$d_{t-1}^*)) + (1/2)(w_t L_t - Q_t w_t^* L_t^*)$
	$+(1/2)(N_{t-1}(1-\delta)(d_t + v_t - \psi(\theta-1)$
.	$(1+q_{t-1})d_{t-1}) - Q_t N_{t-1}^*(1-\delta)(d_t^*$
.	$+v_t^* - \psi(\theta-1)(1+q_{t-1}^*)d_{t-1}^*))$
Monitoring Cost	$m_t = (e^{s_t} - e^{-g_t})$
	$m_t^* = (e^{s_t^*} - e^{-g_t})$
Country-Specific Component	$s_t = s_d + \kappa s_{t-1} + \varepsilon_t$
	$s_t^* = s_d^* + \kappa^* s_{t-1}^* + \varepsilon_t^*$
Global Component	$g_t = g_d + \gamma g_{t-1} + u_t$

B. Steady State

Steady state risk free interest rate and lending rate;

$r = \frac{1-\beta}{\beta}$

$(1+q) = \frac{(1+r)(1+m)}{(1-\delta)}$

Now, define κ and Φ as follows;

$\kappa = \frac{(1+q)(r+\delta)}{z((r+\delta)+(1-\delta)(1-\psi(\theta-1)(1+q)))}$

$\Phi = \kappa \left[\frac{\theta(\nu+(1-\nu)\tau^{1-\theta})}{\nu+(1-\nu)\tau} - \frac{(1-\delta)(1-\psi(1+q)(\theta-1))r}{r+\delta} - \frac{r(1+m)(f_E\delta+\psi(\theta-1)z(1-\delta))}{z(1-\delta)} \right]$

Number of producing firms at steady state;

$N = \left[\frac{(\nu+(1-\nu)\tau)}{(\nu+(1-\nu)\tau^{1-\theta})\Phi^{\varphi}\,\kappa\,\theta\,\chi} \right]^{\frac{\varphi}{1+\varphi}}$

Number of new entrants;

$N_{E,t} = \frac{\delta}{1-\delta} N$

Labor supply;

$L = \Phi\, N$

Real wages;

$w = \frac{(\theta-1)zN^{\frac{1}{\theta-1}}}{\theta(\nu+(1+\nu)\tau^{1-\theta})^{\frac{1}{1-\theta}}}$

Prices;

$\rho_D = \left(N\ \left(\nu + \tau^{1-\theta}\ (1-\nu) \right) \right)^{\frac{1}{\theta-1}}$

$\rho_X = \tau \rho_D$

Deposit Holdings;

$B = (1+m)Nw(\frac{f_E\delta}{z(1-\delta)} + \psi(\theta-1)\kappa)$

Consumption;

$C = \frac{\kappa\theta w}{(\nu+(1+\nu)\tau)\rho_D^{1-\theta}}$

Dividends (Profits);

$\mathrm{d} = \kappa w$

Value of a firm;

$v = \frac{(1-\delta)(1-\psi(1+q)(\theta-1))}{r+\delta} d$

The Amount that new entrants should borrow from banks;

$H = \frac{f_E\, w}{z}$

C. Impulse Responses

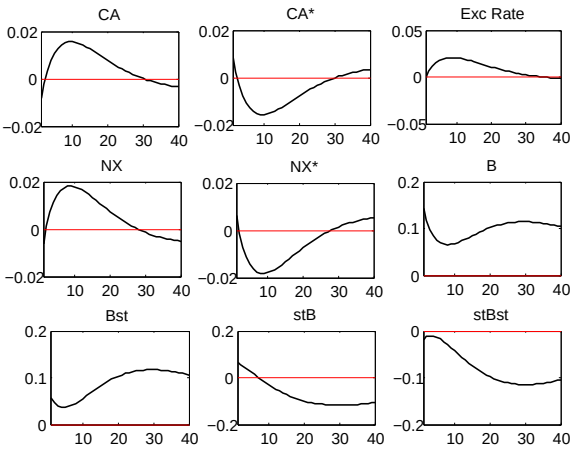

Figure 3.1: Responses to an orthogonalized productivity shock in ς_t

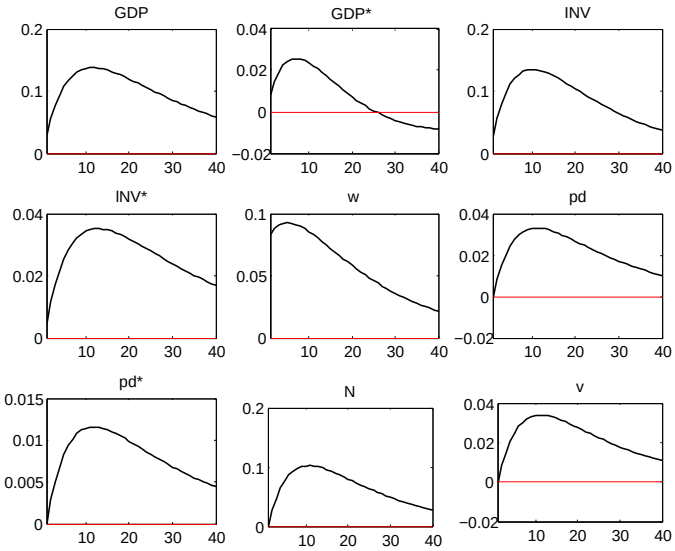

Figure 3.2: Responses to an orthogonalized productivity shock in ς_t

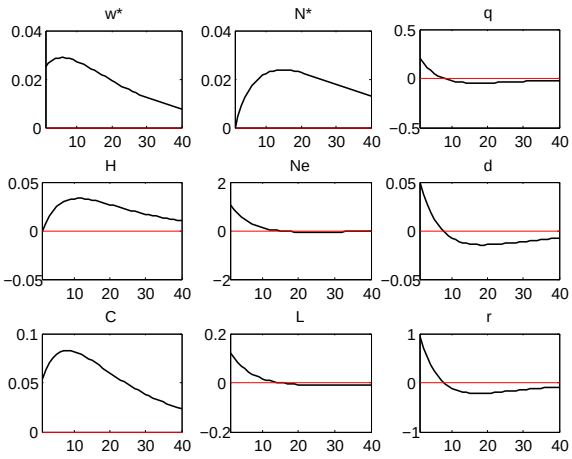

Figure 3.3: Responses to an orthogonalized productivity shock in ς_t

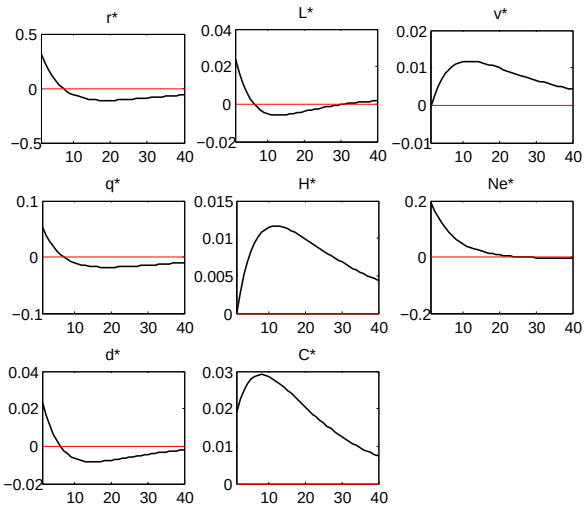

Figure 3.4: Responses to an orthogonalized productivity shock in ς_t

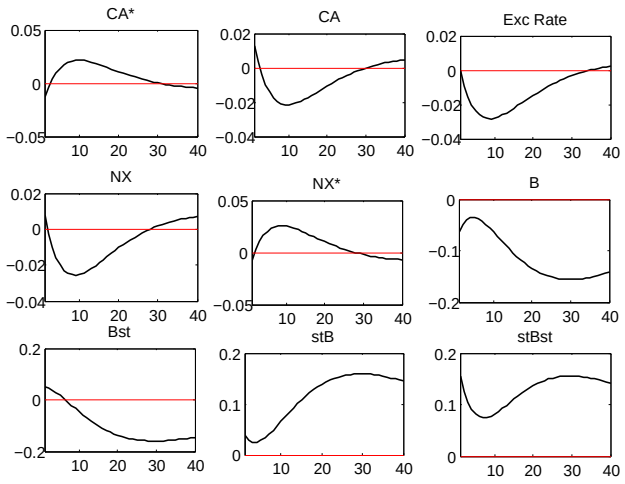

Figure 3.5: Responses to an orthogonalized productivity shock in ς_t^*

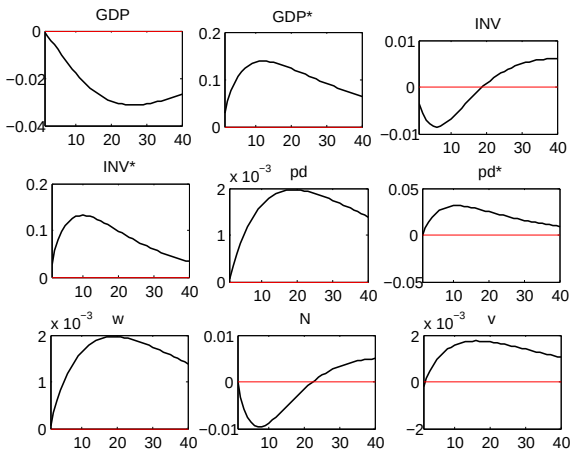

Figure 3.6: Responses to an orthogonalized productivity shock in ς_t^*

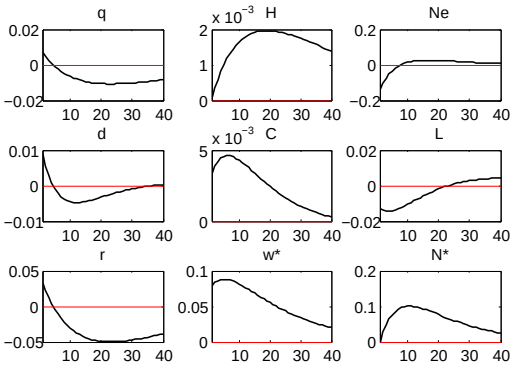

Figure 3.7: Responses to an orthogonalized productivity shock in ς_t^*

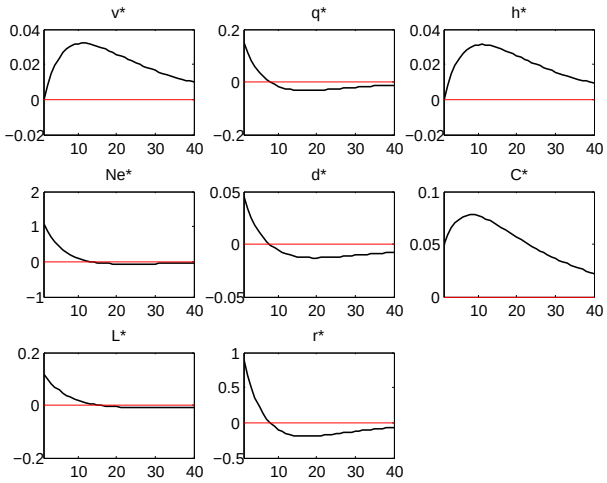

Figure 3.8: Responses to an orthogonalized productivity shock in ς_t^*

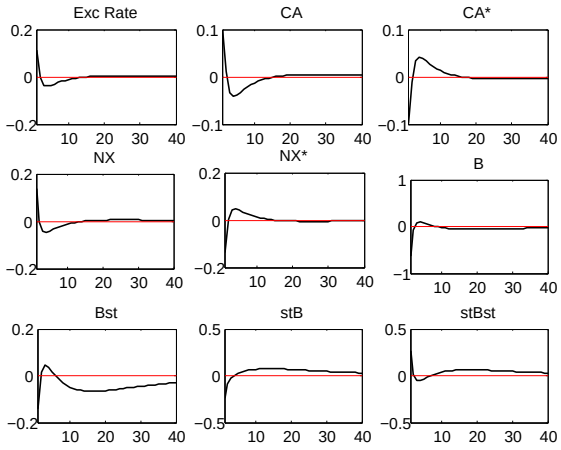

Figure 3.9: Responses to an orthogonalized credit shock in ε_t

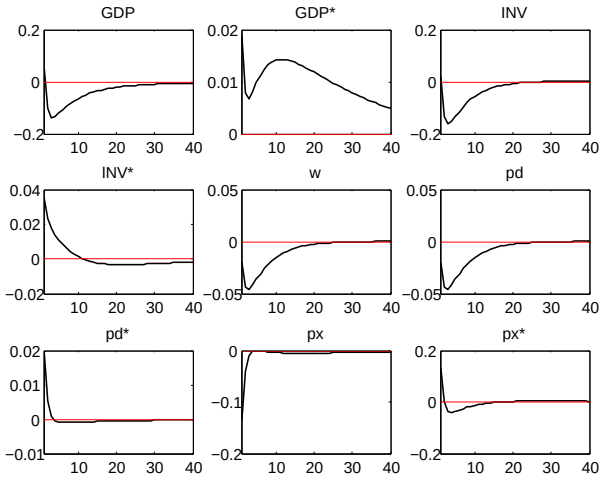

Figure 3.10: Responses to an orthogonalized credit shock in ε_t

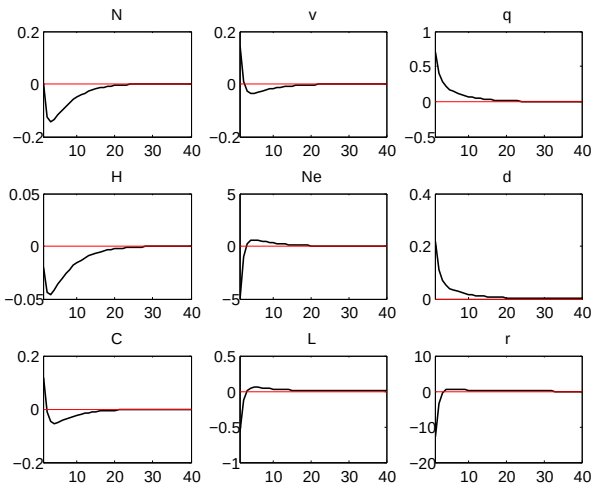

Figure 3.11: Responses to an orthogonalized credit shock in ε_t

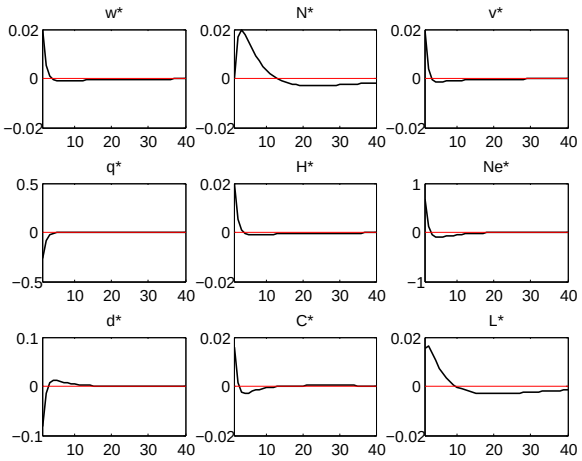

Figure 3.12: Responses to an orthogonalized credit shock in ε_t

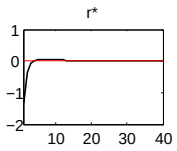

Figure 3.13: Responses to an orthogonalized credit shock in ε_t

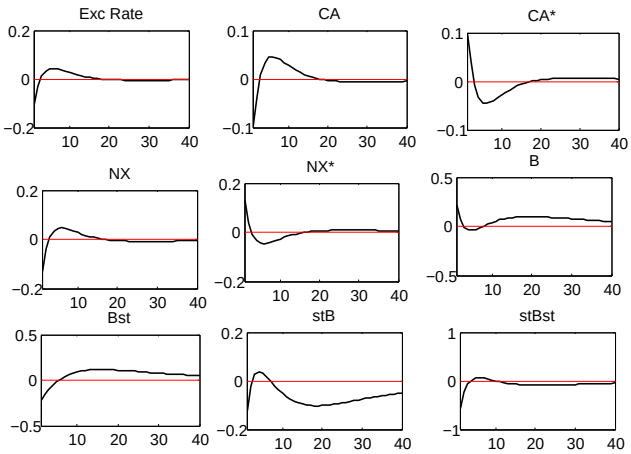

Figure 3.14: Responses to an orthogonalized credit shock in ε_t^*

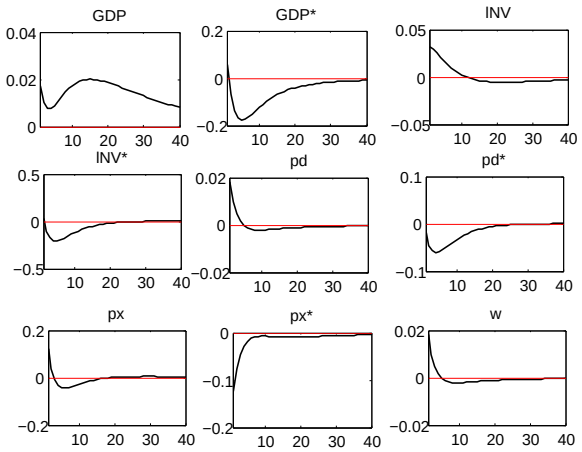

Figure 3.15: Responses to an orthogonalized credit shock in ε_t^*

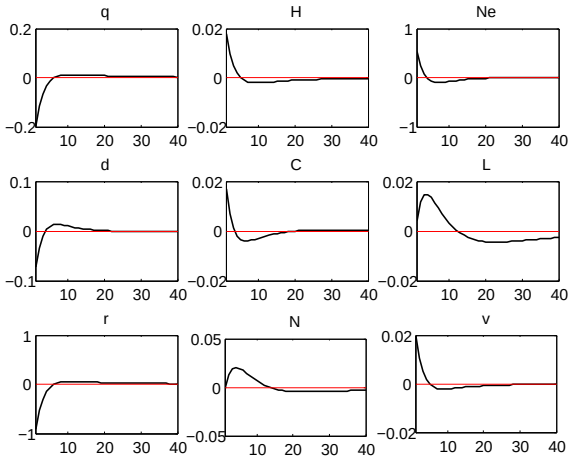

Figure 3.16: Responses to an orthogonalized credit shock in ε_t^*

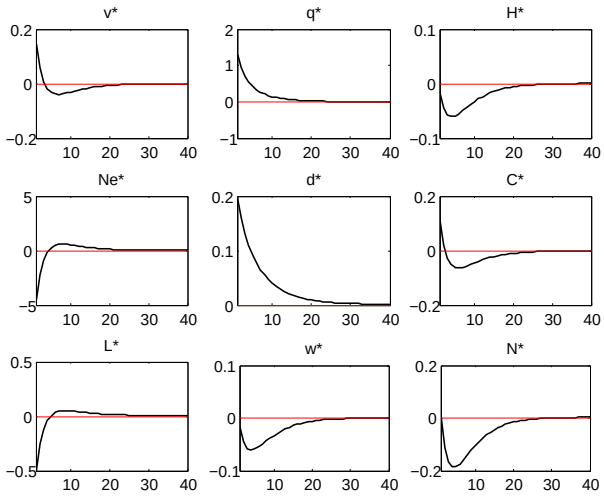

Figure 3.17: Responses to an orthogonalized credit shock in ε_t^*

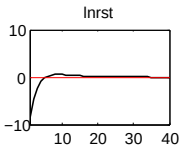

Figure 3.18: Responses to an orthogonalized credit shock in ε_t^*

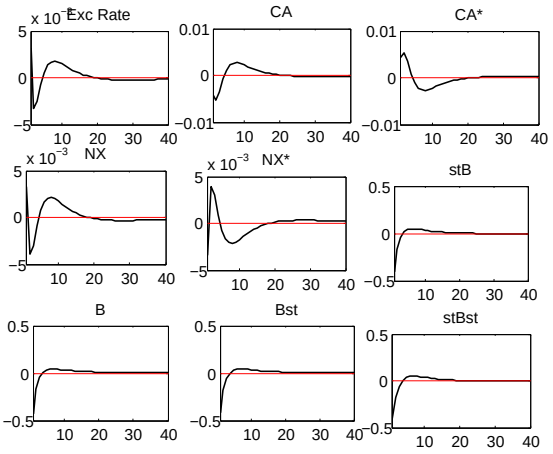

Figure 3.19: Responses to an orthogonalized credit shock in u_t

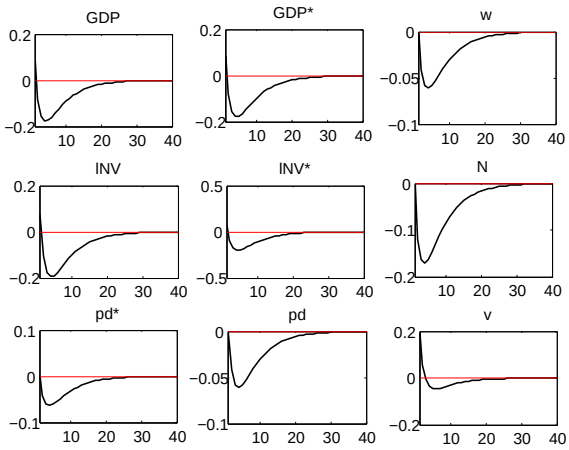

Figure 3.20: Responses to an orthogonalized credit shock in u_t

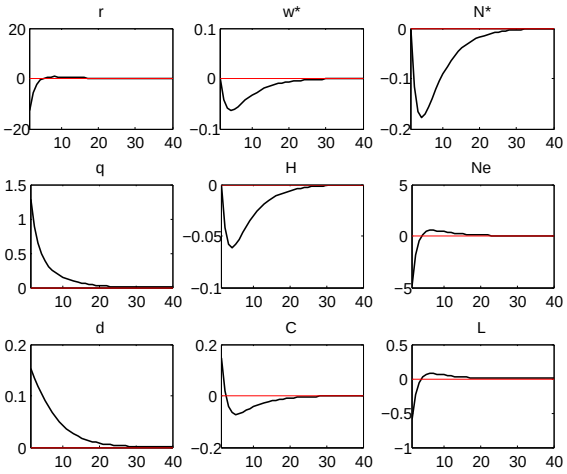

Figure 3.21: Responses to an orthogonalized credit shock in u_t

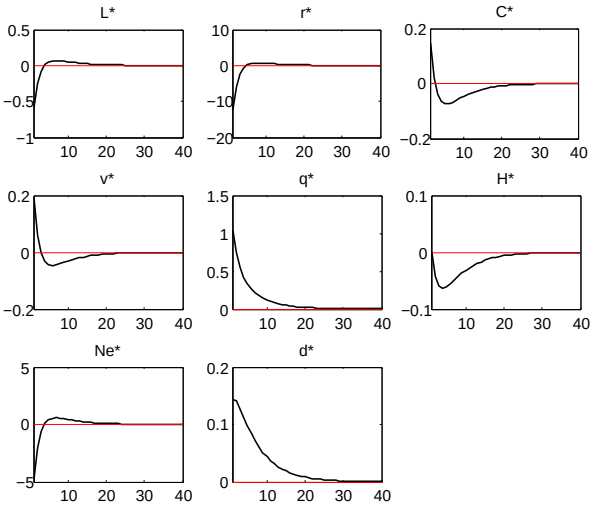

Figure 3.22: Responses to an orthogonalized credit shock in u_t