# Quantitative Tightening in Advanced Economies and Corporates Vulnerabilities in Emerging Markets

Thierry U. Kame Babilla *
*Euro Area Business Cycle Network*

**Abstract**

I develop a stochastic monetary business cycle model with segmented international collateral constraints tied to public capital and private capital in emerging markets, to assess state-owned corporates and private sector corporates vulnerabilities, in face of quantitative tightening in advanced economies. I found that, due to asset-price effect, private sector corporates in emerging markets, are less vulnerable to monetary policy normalization in advanced economies than state-owned corporates, with high-leverage. Second, international collateral constraints channel accentuates the vulnerabilities of emerging markets corporates balance-sheets to quantitative tightening in advanced economies. Third, the realization of contingent liabilities acts as a powerful channel through which the adverse effects of advanced economies monetary policy normalization on state-owned corporates in emerging markets spill-over to the entire economy.

JEL codes: E13, E32, E44, E52, E58, F34, F44, 016, L32

Keywords: Quantitative Tightening, Corporates Vulnerabilities, Emerging Markets, Stochastic Monetary Business Cycle Model.

*Corresponding Author address: Thierry Urgue Kame Babilla, Euro Area Business Cycle Network (EABCN). Phone: 00237 699 42 92 25, Email: thierrykamebilla@yahoo.fr. All the views expressed in this paper are those of the author. Errors and omissions are also mine.

# Contents


**1 Introduction** **3**

**2 The Stochastic Monetary Business Cycle Model** **6**
2.1 Households . . . . . 6
2.2 Corporates in Emerging Markets . . . . . 7
2.2.1 State-owned Corporate and Contingent Liabilities . . . . . 7
2.2.2 Private Sector Corporate . . . . . 9
2.3 Final Goods Production Sector . . . . . 10
2.4 Capital Producing Sector . . . . . 11
2.5 Banking sector . . . . . 11
2.6 Monetary Policy . . . . . 12
2.6.1 Monetary Policy in Emerging Markets . . . . . 12
2.6.2 Monetary Policy in Advanced Economies . . . . . 12
2.6.2.1 Unconventional Monetary Policy: Quantitative Easing in Advanced Economies . . . . . 12
2.6.2.2 Monetary Policy Normalization : Quantitative Tightening in Advanced Economies . . . . . 13
2.7 Government . . . . . 13

**3 Model Behavior and Calibration** **14**
3.1 Experiment with the economy of Chile . . . . . 14

**4 Dynamic Analysis Results** **16**
4.1 The Case of Unconventional Monetary Policy and Corporates in Emerging Market . . . . . 16
4.2 The Case of Quantitative Tightening and Corporates in Emerging Market . 17

**5 Simulation Results** **19**
5.1 Quantitative Tightening and Corporates Productive Capacities . . . . . 19
5.2 Quantitative Tightening Effects on Corporates Balance-sheets . . . . . 20
5.3 Quantitative Tightening, State-owned Corporates, and Contingent Liabilities 22

**6 Conclusion and Policy Implications** **23**

**7 Reference** **25**

# 1 Introduction

Corporations in emerging markets can suffer severe setbacks when advanced economies move to quantitative tightening. Theoretically, two opposing strand of literature surround the effects of monetary policy in advanced economies on emerging markets. Proponents of ease monetary policy advance that expansionary monetary policy improves borrowers balance sheets in emerging markets. By contrast, advocates of tight monetary policy defends the benefits of contractionary monetary policy on expected inflation in emerging markets (Furman and Stiglitz 1998; Aghion et al. 2000; Cespedes et al. 2000; Gertler et al. 2001; Calvo and Reinhart 2003; Christiano et al. 2004; Caballero and Krishnamurthy 2005; Neumeyer and Perri 2005; Aguiar and Gopinath 2007; Mendoza 2010; Onder and Villamizar-Villegas 2018).

Nevertheless, although there is a significant branch of the literature that has evaluated the virtues of different unconventional monetary policy, the analysis of the quantitative impact of the exit strategy in advanced economies on emerging markets is very scant. This makes it of particular interest to ask, what are the effects of quantitative tightening on emerging markets? While until recently the macroeconomic effects was almost the only case of study, nowadays the aggressive response of many central banks in emerging market aimed at dampening the effects of unconventional monetary policy in advanced economies on their productive sectors, further emphasizes the need for an assessment of monetary policy exit strategy on corporates in emerging markets. Indeed, understanding the mechanism through which monetary policy normalization in advanced economies could typically affect state-owned corporates and private sector corporates in emerging markets could help to adopt a right policy response to this event and prevent their consequences on the entire economy in emerging markets. The main contribution of this paper is to specifically focus on the role of international collateral constraints channel in the relationship between monetary policy normalization in advanced economies and corporates in emerging markets.

The importance of international collateral constraints for emerging markets was first identified by Eaton and Gersovitz (1981), and Bulow and Rogoff (1989), focussing on sovereign debt issues. This is one core respect in which we shall recognize that financial markets can not be frictionless in the sense of Arrow and Debreu in emerging markets, and this is important for the consequences of quantitative titghnening. Basically, much of the recent literature on emerging markets highlights the limited financial development of these economies and the severe financing constraints experienced by local corporates (Bowman et al. 2014; Hamilton and Wu 2015; Medina and Soto 2016; Glick and Leduc 2018). From this structural feature, how international collateral constraints matter for the effects of quantitative tightening in advanced economies on corporates in emerging markets is policy relevant. Empirically, financial frictions are documented by two alternatives approaches, including, the external finance premium version, and the collateral constraints version (Brunnermeier et al. 2012; Brzoza-Brzezina and Kolasa 2013; Hall 2013). Beyond both type of frictions, the collateral constraint version improves in many areas the business cycle

properties than external finance premium version (Chari et al. 2007; Brzoza-Brzezina et al. 2013). In fact, the collateral constraint grounds its micro-foundation from the incomplete markets framework of Hart and Moore (1994), because the amount of credit issuance by lenders to corporates is limited through collaterals constraints. This second version of financial frictions has been introduced by the innovative paper of Kiyotaki and Moore (1997), where a model is constructed to capture how credit constraints interact with aggregate economic activity over the business cycle. Agents are heterogeneous in terms of their rate of time preference, which divides them into lenders and borrowers. The financial sector intermediates between these groups and introduces frictions by requiring that borrowers provide collateral for their loans. The need of collateral is motivated by the absence of contract enforcement in the economy and collateral constraint is set exogenously. Authors highlighted that, the dynamic interaction between financing constraints and assets prices is a powerful transmission mechanism by which the effect of shocks persists, amplify, and spill-over to other sectors. The strand of literature following Kiyotaki and Moore (1997) has stressed the relevance of the link between the value of borrower collateral and their access to funds in amplifying the economy response to shocks within the framework of Dynamic Stochastic General Equilibrium (DSGE) Models (Iacoviello 2005; Iacoviello and Neri 2010; Gerali et al. 2010; Brzoza-Brzezina and Makarsi 2011; Lambertini et al. 2013; Justiniano et al. 2013; Brunnermeier and Sannikov 2011; Jeanne and Korinek 2010; Guerrieri and Iacoviello 2015).

As is stressed in the credit channel literature (Bernanke et al. 1999; Kiyotaki and Moore 1997), increasing the net worth of borrowers is the optimal response to a negative shock, Gertler and Karadi (2011) advances thus this literature by laying the foundation of a DSGE model of unconventional monetary policy. As response, DSGE Models of financial frictions become a fundamental instrument to evaluate effects of unconventional monetary policy both in advanced and in emerging markets (Curdia and Woodford 2011; Garcia-Cicco 2011; Geanakoplos and Zame 2013; Araujo et al. 2015; Yoo 2018).

This paper extends this literature by focussing in two different aspects. On the one hand, beyond the DSGE Models of unconventional monetary policy, our model features quantitative tightening in advanced economies. On the other hand, contrast to the broad macroeconomic effects analysis, the model focuses on corporates analysis by disentangling state-owned corporates from private sector corporates in emerging markets. Specifically, in our model, we advance the distinction made by Caballero and Krishnamurthy (2001) by differentiated collaterals constraints according to the type of corporates. First, private corporates borrow directly to advanced economies lenders using private capital as collateral. So, they may have limited collateral and therefore be constrained in borrowing from foreign lenders. Second, state-owned corporates borrow from foreign lenders indirectly via government guarantee or contingent liabilities using public capital as collateral. Hence, the country as a whole may have limited international collateral, and therefore state-owned corporates are constrained in borrowing from foreign investors. Financial frictions appear thus because state-owned corporates and private sector corporates face a collateral con-

straint when borrowing from foreign banks and financing constraints are affected by the quantity and the value of these collaterals. In turn, the collateral's values can be affected by the size of the financing constraints. Third, households supply labor to both types of corporates and use their wages, as well as dividends from banks, to consume, save and pay government taxes. Fourth, we feature monetary policy stance both in the emerging markets and in the advanced economies before and after the normalization of monetary policy. We start by modeling quantitative easing as the purchase by advanced economies central banks of foreign assets financed by monetary expansion. Subsequently, we model quantitative tightening as the reduction of the size of balance-sheet of central banks in advanced economies. In emerging markets, we model the fact that central bank conducts monetary policy following a Taylor-type rule indexed to the change of balance-sheets of central banks in advanced economies. Fifth, government uses fiscal revenue to fund the realization of contingent liabilities when state-owned corporates default.

The findings indicate that quantitative tightening in advanced economies could have important contractionary effects on productive capacities as well as balance-sheets of both state-owned corporates and private sector corporates in emerging markets. Two channels can be involved in the propagation of this mechanism. First, the international collateral constraint channel, whereby quantitative tightening in advanced economies changes the shadow value of loans and therefore the demands of both type of corporates collapse. Second, the assets-price effect, whereby changes in the value and levels of both public capital and private capital alter their collaterals values when corporates pledge them as a guarantee. Nevertheless, the magnitude of these adverses effects partly depend on the degree of financial vulnerability of each type of corporates.

Indeed, this dynamic interaction between the quantitative tightening, the international collateral constraints channel, and the asset-price channel, therefore would have important repercussions on their activities even in the subsequent periods. State-owned corporates and private sector corporates would earn less revenue, their production would fall even more, and, again because of the tightening of financing constraints, they would further reduce investments. So, by undoing the unconventional monetary policy, the exit strategy in advanced economies may induce a significant slowdown in the activities of corporates in emerging markets, particularly if they are highly leveraged.

The dynamic analysis advances that, because of their different degree of financing constraints, the state-owned corporates would be more affected by the effects of quantitative tightening in advanced economies than private sector corporates. This is explained by the fact that, private sector corporates employ a relatively small portion of the economy's workforce but equips each worker with significantly more capital.

The remainder is as follows: in section 2 we present the stochastic monetary business cycle model. Section 3 describes the model solution and calibration. In section 4 we conduct a dynamic analysis of both exceptional events. In Section 5 we turn to the effects of monetary policy normalization in advanced economies for state-owned and private sectors corporates in emerging markets. Section 6 draws conclusions and policy implications.

# 2 The Stochastic Monetary Business Cycle Model

This research develops a stochastic monetary business cycle model which features international collateral constraints to assess the effects of quantitative tightening on state-owned corporates and private sector corporates vulnerabilities in emerging markets.

## 2.1 Households

Households allocate their labor to the two corporates sectors of the economy: the composite labor index, $n_t$, thus consists of hours worked in the state-owned corporate, $n_t^g$, and in the private sector corporate, $n_t^p$, following the CES aggregator:

$$n_t = [(1-\theta_H)^{1/\tau}(n_t^g)^{\tau-1/\tau} + (\theta_H)^{1/\tau}(n_t^p)^{\tau-1/\tau}]^{\tau/\tau-1}, \tag{1}$$

where $\theta_H$ stands for the share of labor in the private sector corporate over total labor and $1-\theta_H$ the share of labor in the state-owned corporate over total labor. In addition, $\tau$ is the elasticity of substitution between the two corporate sectors for labor supply. [1]

A continuum of infinitely-lived households obtain thus utility from consumption $c_t^H$ and labor supply $n_t$. Their intertemporal optimization problem is to maximize lifetime utility:

$$U_0 = E_0 \sum_{t=0}^{\infty} \beta_H^t (\varpi_t log c_t^H + \vartheta_t log(1-n_t)). \tag{2}$$

Here $\varpi_t$ stands for a preference shock affecting the marginal utility of household, $\beta_H$ denotes the household's discount factor and $\vartheta_t$ represents a preference shock affecting the marginal utility of the labor supply.[2]

The representative household maximizes (2) subject to the intertemporal budget constraint:

$$c_t^H + D_t = w_t^g n_t^g + w_t^p n_t^p + R_{D,t-1} D_{t-1} + \Xi_t - T_t, \tag{3}$$

The right hand side of (3) describes the household's resources and the left hand side represents the uses of these resources. The household financial resources come from real wages received from state-owned corporate, $w_t^g n_t^g$, and the private sector corporate,$w_t^p n_t^p$,

[1] This form of labor market specification is justified by the way we capture the concept of representative agent in the model. The assumption of representative agent does not literally means that one unique household divides its work time in both sectors; rather it is meant to represent a situation where a continuum of agents coexist but these different agents are sufficiently similar that treating them as one introduce no first-order problems. In such a context, equation (1) is simply interpreted as reflecting the presence of heterogeneity, mainly related to skills or education in the case of emerging markets, that makes the substitution of labor from one sector to another imperfect. As result, skilled or educated households mostly supply labor hours to private sector corporate, by contrast, unskilled or uneducated households mostly supply their labor hours to state-owned corporates.

[2] Households have a discount factor $\beta_H$ higher than both types of coporates. They are therefore more patient and are the model's economy natural lenders.

interest on deposits at the bank, $R_{D,t-1}D_{t-1}$, and profit from bank shares, $\Xi_t$. The household financial resources are used for consumption, $c_t^H$, deposits at the banks, $D_t$, and lump sum taxes paid to government, $T_t$.[3]

## 2.2 Corporates in Emerging Markets

There is a continuum of infinitely lived corporates involved in the production process. Some are state-owned corporates and some are private sector corporates. Both state-owned and private sector corporates produce intermediate goods, consume final goods, accumulate physical capital and pay wages to their workers, which are the households whose optimization problems have just been discussed. State-owned and private sector corporates are both financially constrained but evolve in two parallel production sectors that produce two imperfectly substitutable intermediate goods.

### 2.2.1 State-owned Corporate and Contingent Liabilities

The state-owned corporates begin period t with public capital holdings, $k_{t-1}^g$, which they purchased in the preceding period using bank loans. During period t they use that public capital, alongside hired labor, to produce intermediate goods; with the proceeds, they will pay labor, consume, pay back bank loans, and buy new public capital for tomorrow subject to a financing constraint. Since state-owned corporates are credit constrained, they discount the future more heavily than the households and the private sector corporate and this behavior guarantees that the credit constraints will bind in the neighborhood of the steady state we analyze.

In that context, the representative state-owned corporate maximizes expected utility as follows:

$$U_0 = E_0 \sum_{t=0}^{\infty} (\beta_g)^t log c_t^g, \tag{4}$$

where $\beta_g$ stands for the state-owned corporate's inter-temporal discount factor and $c_t^g$ is his individual consumption.

This state-owned corporate maximizes (4) subject to the budget constraint:

$$c_t^g + w_t^g n_t^g + R_{L,t-1}^g L_{t-1}^g + q_t k_t^g = p_t^g y_t^g + L_t^g + q_t(1-\delta^g)k_{t-1}^g. \tag{5}$$

The right hand side of (5) describes the state-owned corporate's resources and the left hand side the uses of these resources. Financial resources come from sales of intermediated goods produced, $p_t^g y_t^g$, new bank loans, $L_t^g$, and the value of undepreciated physical public capital he owns, $q_t(1-\delta^g)k_{t-1}^g$. These resources are used to consume, $c_t^g$, to pay wage

[3]The Lagrangian and the first-order conditions of this household optimization problem can be found at the Technical Appendix upon request.

to workers, $w_t^g n_t^g$, pay back bank loans from last period, $R_{L,t-1}^g L_{t-1}^g$, and buy new public capital for tomorrow, $q_t k_t^g$.

Each state-owned corporate has access to the following production function that takes labor and public capital inputs and turns them into goods:

$$y_t^g = a_t^g (n_t^g)^{1-\alpha^g} (k_{t-1}^g)^{\alpha^g}, \tag{6}$$

where $\alpha^g$ represents the labor share in the production sector and $a_t^g$ measures the total productivity factor (TPF) specific to the sector.

The law of motion for the stock of physical public capital owned by the representative state-owned corporate is given by:

$$k_t^g = (1-\delta^g) k_{t-1}^g + i_t^g, \tag{7}$$

where $i_t^g$ represents investment in physical public capital and $\delta^g$ is the depreciation rate of public capital.

The international financial frictions arise as follows. We assume that the amount of loans one corporate can obtain is constrained by the value of the collateral he can pledge. Collateral is materialized by public physical capital holdings and loans are provided by foreign advanced economies banks. The process implies that how much physical capital a state-owned corporate can accumulate depends on the minimum loan return required by banks, which in turn depends on three mains components: the LTV ratio, the contingent liabilities $[E_t q_{t+1}^g]$, and the real interest rate $R_{L,t}^g$ on loans. The contingent liabilities is directed linked to the expected future price on public capital pledge as collateral.[4] If the expected future price on public capital pledge as collateral exceeds the real interest rate $[E_t q_{t+1}^g] > R_{L,t}^g$ on loans, state-owned corporates fulfill their financial engagement via-vis the lenders. By contrast, if the expected future price on public capital pledge as collateral is less than the real interest rate $[E_t q_{t+1}^g] < R_{L,t}^g$ on loans, there is a realization of contingent liabilities and the entire economy bears the cost of financing. Consequently, variations in the quantity and in the value of collateral modify the transmission of shocks and can amplify their effects.

Written in equation term, this friction reads like:

$$R_{L,t}^g L_t^g \leq V_t^g ((1-\delta^g) k_t^g) E_t[q_{t+1}], \tag{8}$$

given the following conditions:

$$\begin{cases} \text{State-owned corporate Repayment} & \text{if } [E_t q_{t+1}^g] > R_{L,t}^g, \\ \text{Default, contingent liabilities realization} & \text{if } [E_t q_{t+1}^g] < R_{L,t}^g, \end{cases}$$

[4]Contingent liabilities are government guarantee of financial repayment in the case the state-owned corporate would be insolvable.This type of government provisions are recurrent in emerging markets.

where $V_t^g$ stands for the maximum loan to value (LTV) ratio available to a given state-owned corporate.[5]

### 2.2.2 Private Sector Corporate

The private sector corporate's problem is very similar to that of the state-owned one (the major difference is that in this case there is no government guarantee), so this sub-section will be written in a more concise manner. Within this production sector, the representative private sector corporate maximizes its expected utility described as follows:

$$U_0 = E_0 \sum_{t=0}^{\infty} (\beta_p)^t log c_t^p, \tag{9}$$

where $\beta_p$ stands for the private sector corporate's discount factor and $c_t^p$ his consumption. Since private sector corporate are also credit constrained (but less so than state-owned corporate) they also discount the future more heavily than households ($\beta_p < \beta_H$).

The representative private sector corporate solves (9) subject to the intertemporal budget constraint:

$$c_t^p + w_t^p n_t^p + R_{L,t-1}^p L_{t-1}^p + q_t k_t^p = p_t^p y_t^p + L_t^p + q_t(1-\delta^p)k_{t-1}^p, \tag{10}$$

He also has access to a production function that takes labor and private capital inputs and turns them into goods:

$$y_t^p = a_t^p (n_t^p)^{1-\alpha^p} (k_{t-1}^p)^{\alpha^p}, \tag{11}$$

The law of motion for the stock of physical private capital $k_{t-1}^p$ is given by:

$$k_t^p = (1-\delta^p)k_{t-1}^p + i_t^p, \tag{12}$$

Contrast to their state-owned corporates counterpart, government is not involved in private sector corporates financial agreement. The international financial frictions are thus quite different in this case. Collateral is materialized by private physical capital holdings and loans are provided by foreign advanced banks.We assume that the amount of loans one private sector corporate can obtain is constrained by the value of the collateral he can pledge. As in this model, collateral is materialized by physical capital holdings, the process implies that how much physical private capital a private sector corporate can accumulate depends on the minimum loan return required by banks, which in turn depends on three mains components: the LTV ratio, the expected future price $[E_t q_{t+1}^p]$ of private capital pledged as collateral and the real interest rate $R_{L,t}^p$ on loans. Consequently, variations in the quantity and in the value of collateral modify the transmission of shocks and can amplify their effects.

[5]The Lagrangian and the first-order conditions of this state-owned corporate optimization problem can be found at the Technical Appendix upon request.

while the equation for the financial friction reads like:

$$R^p_{L,t} L^p_t \leq V^p_t((1-\delta^p)k^p_t)E_t[q^p_{t+1}], \tag{13}$$

The borrowing constraint (13) shows that private sector corporates cannot borrow more than a fraction $V^p_t$ of the expected future value of the stock of private capital they pledged.[6]

The takeaways from this sub-section are the two key differences between state-owned and private sector corporates. First, the discount factor of state-owned corporate $\beta_g$ is lower than its counterpart private sector corporate $\beta_p$. This feature implies that the ability of state-owned corporate to save pledgeable capital is reduced. Second, the state-owned corporates ' maximal LTV ratio in their borrowing constraint $V^g_t$ is lower than its counterpart for private sector corporates $V^p_t$. This second feature means that state-owned corporate can not pledge their accumulated capital as efficiently as private sector corporates. This may explain the reason why government is always involved in state-owned corporate financial contract.[7]

### 2.3 Final Goods Production Sector

Firms producing the economy's final good use the intermediate goods supplied by state-owned corporates $y^g_t$ and private sector corporates $y^p_t$, using the following CES production function:

$$y_t = [(1-\theta_y)^{1/\mu}(y^g_t)^{\mu-1/\mu} + (\theta_y)^{1/\mu}(y^p_t)^{\mu-1/\mu}]^{\mu/\mu-1}, \tag{14}$$

Final good producers choose $y^g_t$ and $y^p_t$ to maximize profits, given the production function (14) and input prices $p^g_t$ and $p^p_t$:

$$Max_{y^g_t, y^p_t}[y_t - (p^g_t y^g_t + p^p_t y^p_t)], \tag{15}$$

The first order conditions for this problem imply the following demand for the output of state-owned corporates:

$$y^g_t = (1-\theta_y)(p^g_t)^{-\mu} y_t, \tag{16}$$

and its counterpart for the private sector corporates:

$$y^p_t = (\theta_y)(p^p_t)^{-\mu} y_t, \tag{17}$$

Because final goods producing firms operate under perfect competition, profits are zero. Further, inserting the demand functions, (16) and (17), into the profit function and

[6] This type of collateral constraints is used in several contributions to the literature on financial frictions. See Iacovello (2005) for instance. The Lagrangian and the first-order conditions of this private sector corporate optimization problem can be found at the Technical Appendix upon request.

[7] One should not need to make a literally interpretation here.

imposing the zero profit condition reveal that the only price $P_t$ that is consistent with this requirement is given by:

$$P_t = 1 = [(1-\theta_y)(p_t^g)^{(1-\mu)} + \theta_y(p_t^p)^{(1-\mu)}]. \tag{18}$$

We shall recall that our model is based on an real business cycle (RBC) approach and one of its key assumptions is the flexibility of price. Hence, $P_t$ the price of final goods serves to set inputs price $p_t^g$ of state-owned corporates intermediate goods, and $p_t^p$ price of private sector corporates intermediate goods. Since the final good is the economy's numeraire, we set its price $P_t$ equal to 1.

### 2.4 Capital Producing Sector

Capital producers purchase final goods as investment goods $I_t$ and transform them into physical capital that they sell to both state-owned corporates and private sector corporates. These producers choose the quantity of investment to maximize profits as follows:

$$Max_{I_t} E_t[q_t I_t - I_t - \Psi/2(I_t/k_t - \delta)^2 k_t]. \tag{19}$$

The first order condition (relative to investment $I_t$) is given by:

$$E_t[q_t - 1 - \Psi(I_t/k_t - \delta)] = 0. \tag{20}$$

Since capital producers face an adjustment cost $(\Psi/2(I_t/k_t - \delta)^2 k_t)$ relation (20) highlights the relationship between the price of physical capital $q_t$ and the marginal cost of adjustment. Note however that, at the stationary state, those adjustment costs are not active and the price of capital therefore equals one.

### 2.5 Banking sector

The representative of foreign bank intervenes in the model as supplier of loans to both state-owned corporates and private sector corporates. It solves the following problem:

$$MaxE_0 \sum_{t=0}^{\infty} (\lambda_t/\lambda_{t-1})\beta_H^t DIV_t, \tag{21}$$

where $DIV_t$ represents the dividends paid to households, which are the ultimate owners of bank shares. Note that as a result, the discount factor in problem (21) is the same as in the household program and $\lambda_t$ therefore represents the marginal utility of wealth for households. Banks optimize subject to the flow of funds constraint

$$DIV_t + R_{D,t-1}D_{t-1} + L_t^g + L_t^p = D_t + R_{L,t-1}^g L_{t-1}^g + R_{L,t-1}^p L_{t-1}^p, \tag{22}$$

and the balance sheet identity:

$$D_t = L_t^g + L_t^p. \tag{23}$$

Here $D_t$ represents households' deposits collected by the banking sector, while $L_t^g$ and $L_t^p$ are loans to state-owned corporates and private sector corporates, respectively.[8]

## 2.6 Monetary Policy

This section examines the conduct of monetary policy in emerging markets and in advanced economies, before and after the exit strategy, so as to clarify the role of quantitative tightening in advanced economies on various corporates in emerging markets.

### 2.6.1 Monetary Policy in Emerging Markets

The central bank in emerging markets makes lump sum transfers of money to the real sector consistent with quantitative easing in advanced economies by following a Taylor-type interest rate rule which takes the form

$$R_t = (1 - r_R)((1 + r_\pi)\pi_{t-1} + r_Y Y_{t-1}) + r_R R_{t-1} + \epsilon_{R,t}, \tag{24}$$

where $rr$ and $Y$ are steady-state real rate and output, respectively. Here, monetary policy responds systematically to past inflation $r_\pi$ and past output $r_Y$. A backward-looking Taylor rule has the advantage of isolating the exogenous component of monetary policy from its endogenous counterpart and fit for exit strategies. If $r_R > 0$, the rule allows for interest rate inertia. $\epsilon_{R,t}$ is a white noise shock process with zero mean and variance $\sigma_e^2$.

The central bank in emerging markets may depart from this unconventional monetary policy when advanced economies central banks move towards the normalization of their monetary policy.

### 2.6.2 Monetary Policy in Advanced Economies

This section describes the process of quantitative tightening of monetary policy in advanced economies. We start by discussing the unconventional monetary policy adopted during the global financial crisis. We then depart from this policy to discuss the exit strategy or the normalization of monetary policy.

#### 2.6.2.1 Unconventional Monetary Policy: Quantitative Easing in Advanced Economies

Central banks in advanced economies conducts quantitative easing as a measure of unconventional monetary policy. Quantitative easing is materialized by the purchase, by central

[8]The Lagrangian and the first-order conditions for this banking sector optimization problem is available in the Technical Appendix upon request.

banks, of foreign assets, financed by a monetary expansion. In line with the core objective of our research, we assume that those foreign assets are essentially claims to state-owned corporates and private sector corporates in emerging markets.

In each period, t, central banks in advanced economies decide on three types of assets: base money ($M_t$), claims to private sector corporates in emerging markets $L_t^{p*}$, and claims to state-owned corporates in emerging markets $L_t^{g*}$.

The advanced economies central bank resource constraint in any given period is given by :

$$(M_t - M_{t-1}) = \left(L_t^{p*} - L_{t-1}^{p*}\right) + \left(L_t^{g*} - L_{t-1}^{g*}\right) \tag{25}$$

Following Reynard and Schabert (2009), Garcia-Cicco (2011), this quantitative easing formulation implies that the central bank changes the position of an asset in its balance sheet, compensated by a change in another asset such that the bank total net worth is kept constant in nominal term.

#### 2.6.2.2 Monetary Policy Normalization : Quantitative Tightening in Advanced Economies

The normalization of monetary policy in advanced economies proceeds by the undoing of unconventional monetary policy initially implemented. The exit strategy adopted thus in this paper is the quantitative tightening policy. The central banks in advanced economies conduct quantitative tightening by reducing the size of their balance sheets. Practically, they will run quantitative tightening by selling the same amount of foreign assets (purchased under unconventional monetary policy) against the domestic currency. The central banks in advanced economies aim would be to increase their stock ($M_t$) of money by refunding their holdings of both, claims to private sector corporates in emerging markets $L_t^{p*}$, and claims to state-owned corporates in emerging markets $L_t^{g*}$. By diminishing central bank stock of foreign financial assets holding, the quantitative tightening in advanced economies would in turn shrink liquidity in foreign financial markets, including emerging markets.[9]

### 2.7 Government

The government intervenes in the economy by following a policy of public spending represented by the process ($g_t$). We assumed that government expenses are essentially linked to the realization of contingent liabilities when the state-owned corporates default from their financial engagement. This spending is financed via lump sum taxes ($T_t$) paid by households to the government. The government budget always binds, so that:

$$g_t = T_t. \tag{26}$$

[9]The calibration of parameter of the model help to emphasize these monetary policy measures.

# 3 Model Behavior and Calibration

## 3.1 Experiment with the economy of Chile

Table 1 presents the numerical values of the model's key parameters who are calibrated based on the features of the Chilean economy. We choose Chile because she is one of emerging markets countries that have driven the policy rate down to its lower bound during the 2008–09 crisis following advanced economies unconventional monetary policy.

The labor market parameters are calibrated to reflect the presence of heterogeneity in emerging markets labor markets, mainly related to skills or education, that makes the substitution of labor from one type of corporate to another imperfect. Private sector corporates labor share over total labor index $\theta_H$ is calibrated to 40 percent to capture the fact that, the private sector corporates hired more skilled households rather than more labor in general (Labor efficiency). The elasticity of substitution among different labor varieties is set to 1.14, which is close to the value found by Garcia-Cicco (2011). The depreciation rate for physical capital is calibrated to feature that private capital is more easily collateralizable than public capital. In line with Medina and Soto (2016), the depreciation rate of public capital $\delta^g$ is calibrated to 5.8 percent whereas the depreciation rate of private calibrated $\delta^p$ is set to 5.5 percent. These value are lower than the 10 percent value found by Christiano and Eichenbaum (1992) for the United States.

The household discount factor is calibrated to 0.999 in order to get an annual nominal interest rate around 6.5% in the steady state consistent with Medina and Soto (2016) findings. We calibrate corporates discount factors according to the degree of patience of economic agents. Due to public investment inefficiency feature in emerging markets, state-owned corporates producers are impatient and their discount factor $\beta_g$ is calibrated to 0.94, which is in accord with the range suggested by Iacoviello (2005) and Iacoviello and Neri (2008) for impatient agents. Private sector corporates producers are more patient than state-owned corporates, but less so than households; hence, we calibrate their discount factor $\beta_p$ to 0.98. The lower value of discount factor for state-owned corporates producers is meant to reflect aspects of the emerging markets where in contrast to their private sector counterparts, state-owned corporates producers may face difficulties, institutionally, projecting themselves in the future; as a result they save less, thus accumulating less pledgeable collateral.[10]

The labor share in the production function of intermediate goods of state-owned corporates $\alpha^g$ is calibrated to 0.66. By contrast, the labor share in the production function of intermediate goods of private sector corporates $\alpha^p$ is calibrated to 0.60. The calibration of the Loan to Value ratio (LTV) of state-owned corporates deserves some attention. Christensen et al. (2007), estimate a lower value of the LTV (0.32), in a model for Canada where corporates can borrow against business capital. Iacoviello (2005) estimates a value of 0.89, but, in his model, only commercial real estate can be collateralized. In contrast to those

[10] One should not need to make a literally interpretation here.

previous studies in our model corporates borrow against physical capital and we feature heterogeneity among corporates, with state-owned corporates being more constrained than their private sector counterparts because they can not pledge their accumulated capital as efficiently as private sector corporates. As result, we calibrate a lower value of the LTV for state corporates $V^g$, at 0.5, and a higher value of LTV of private sector corporate $V^p$, at 0.8. Due to high degree of preference of private corporate intermediate goods rather than state-owned corporates intermediate goods, the share of intermediate goods produced by private sector corporate in final goods $\theta_y$ is set to 65 percent. Consistent with Li (2011), to feature the high degree of flexibility of prices over wages in emerging markets, the elasticity of substitution between of different goods varieties $\mu$ is calibrated at 1.12.

**Table 3: Value of the Calibrated Parameters in the Benchmark**

| Parameter | Meaning | value | Source |
|---|---|---|---|
| $\theta_H$ | Private corporates labor share in labor index | 40% | Labor efficiency |
| $\tau$ | Elasticity substitution labor varieties | 1.14 | Imperfect substitution |
| $\beta_H$ | Households discount factor | 0.999 | Match interest rate |
| $\beta_g$ | Public corporates discount factor | 0.94 | Less patient |
| $\beta_p$ | Private corporates discount factor | 0.98 | More patient |
| $\delta^g$ | Depreciation rate of public capital | 5.8% | Less collateralizable |
| $\delta^p$ | Depreciation rate of private capital | 5.5% | More collateralizable |
| $\alpha^g$ | Labor share in public corporate production | 0.66 | Labor-intensive |
| $\alpha^p$ | Labor share in private corporate production | 0.60 | Less labor-intensive |
| $V^g$ | Public corporate LTV ratio | 0.5 | More constrained |
| $V^p$ | Private corporate LTV ratio | 0.8 | Less constrained |
| $\theta_Y$ | Share of private corporate good in final good | 0.65 | High preference |
| $\mu$ | Elasticity substitution goods varieties | 1.12 | Match price flexibility |
| $\bar{\pi}$ | Long-run inflation | 3% | Central Bank of Chile |
| $r_R$ | Monetary shock persistence | 0.74 | Persistent MP |
| $r_\pi$ | Responses to inflation deviation | 1.67 | More agressive |
| $r_Y$ | Responses to output gap deviation | 0.39 | Less agressive |

The long-run annual inflation rate $\bar{\pi}$ is set to 3 percent, which is consistent with the Central bank of Chile inflation objective. The parameter explaining monetary policy shock persistence $r_R$ is calibrated to 0.74 to reflect the persistence of the monetary shock in emerging markets as advanced by Coleman (2010). Following Garcia-Cicco (2011), we postulate that, the coefficient of the inflation $r_\pi$ enters the central bank reaction function with the size of 1.67, above the Taylor Rule standard value of 1.5, while the policy response to output growth $r_Y$, is less than the response to inflation and calibrated to 0.39 below the standard value of 0.5. These values suggest that, monetary authority in Chile is very aggressive in fighting increases in the prices level as described in Clarida et al. (2000).

# 4 Dynamic Analysis Results

Tables 2-3 present the steady state of the model for two versions of emerging markets depending of the monetary policy stance in advanced economies.[11]

## 4.1 The Case of Unconventional Monetary Policy and Corporates in Emerging Market

The baseline case in Table 2 represents the emerging markets steady state when both state-owned corporates and private sector corporates face unconventional monetary policy from advanced economies. The results of Table 2 indicate that when advanced economies conduct unconventional monetary policy, financing constraints are loosened in emerging markets. As state-owned corporates are becoming less financial constrained, they become more capital intensive. The public capital-labor ratio of the state-owned corporates records a double digit of 10.53. However, state-owned corporates are relatively less capital intensive than their private sector counterpart. The private capital-labor ratio of private sector corporate is 12.23.

**Table 2: Features of the Emerging Market' Steady State when Corporates face Unconventional Monetary Policy in Advanced Economies.**

| Variables | Both Corporates UMP Effects |
|---|---|
| Public capital-Labor ratio in state-owned corporate | 10.53 |
| Private capital-Labor ratio in private sector corporate | 12.23 |
| State-owned corporate proportion of value-added | 0.50 |
| Private sector corporate proportion of value-added | 0.49 |
| Household consumption to GDP | 0.739 |
| State-owned corporate consumption over GDP | 0.023 |
| Private sector corporate consumption over GDP | 0.017 |
| Total consumption over GDP | 0.78 |
| State-owned corporate investment to GDP | 0.10 |
| Private sector corporate investment to GDP | 0.11 |
| State-owned corporate hours over total hours | 0.52 |
| Private sector corporate hours over total hours | 0.47 |

Moreover, the table shows that state-owned corporates are saving more. The state-owned corporates consumption-output ratio is 0.023 very lower than the total consumption over total output ratio (0.78). Nonetheless, the level of state-owned corporates savings is relatively lower than that of private sector corporates. The consumption-output ratio of private

[11] All the model's equation leading to the steady states are available in the Technical Appendix upon request.

sector corporates is 0.017, which is the lowest among the three. Further, the loosening of the financial constraint affecting state-owned corporates increases their investment capabilities. Investment of state-owned corporates , as a proportion of output, is 10 percent and now comes close to the investment of private sector corporates, which is 11 percent. Hence, as state-owned corporates become less financial constrained, their investment level increases towards the levels of their private sector counterparts.

The easier availability of resources facilitates the production of intermediates goods of the state-owned corporates. As the demand of those goods remains relatively unchanged and their supply is increasing, their price declines and their value added of 0.50 becomes close to that of their private sector counterpart. Private sector meanwhile begin to lose market share and the relative supply of their good is decreasing. As result, the price of their goods increase and this induces the sector's value added of 0.49. Moreover, the private sector corporates are becoming labor intensive. The labor hours of private sector corporates over total labor hours is 0.47. But, the state-owned corporates are the most labor-intensive market in emerging markets, even when financing constraint is loosed. The labor hours of private sector corporates over total labor hours is greater than that of their private sector counterpart and is 0.52.

## 4.2 The Case of Quantitative Tightening and Corporates in Emerging Market

The counterfactual scenario case in Table 3 represents the emerging markets steady state when both state-owned corporates and private sector corporates face quantitative tightening from advanced economies. The findings reveal that quantitative tightening in advanced economies leads to tighter financing constraint in emerging markets. Indeed, following the quantitative tightening in advanced economies, state-owned corporates becomes more financing constrained. By contrast, financing constraint is less severe in private sector corporates. Private sector corporates become thus highly capital intensive, with a capital-labor ratio equal to 13.03, in contrast to the much lower value of 6.31 in state-owned corporates. As a counterpart, the table shows that state-owned corporates becomes highly labor intensive: the labor input of state-owned corporates is 60 percent of total hours, against 40 percent for the private sector corporate. Private sector corporates thus employ a relatively small portion of the economy's workforce but equips each worker with significantly more capital.

Because they face tight financing conditions, the table goes on to show that state-owned corporates save less. Private sector corporates by contrast, save more, because they are less affected relatively to their counterpart. Hence, the consumption of state-owned corporates over aggregate GDP is 4.7 percent, against 3.1percent for the private sector corporates. Private sector corporates therefore accumulate more pledgeable collateral, and can undertake more investment projects than state-owned corporates. The proportion of aggregate investment generated by private sector corporates over aggregate GDP is 0.10,

in contrast to 0.08 for state-owned corporates.

**Table 3: Features of the Emerging Market's When Corporates face Quantitative Tightening in Advanced Economies**

| Variables | Both Corporates QT Effects |
|---|---|
| Public capital-Labor ratio in state-owned corporate | 6.31 |
| Private capital-Labor ratio in private sector corporate | 13.03 |
| State-owned corporate proportion of value-added | 0.52 |
| Private sector corporate proportion of value-added | 0.47 |
| Household consumption to GDP | 0.73 |
| State-owned corporate consumption over GDP | 0.047 |
| Private sector corporate consumption over GDP | 0.031 |
| Total consumption over GDP | 0.81 |
| State-owned corporate investment to GDP | 0.080 |
| Private sector corporate investment to GDP | 0.10 |
| State-owned corporate hours over total hours | 0.60 |
| Private sector corporate hours over total hours | 0.39 |

Furthermore, because state-owned corporates are the most financially constrained, their costs are higher and it is relatively expensive to produce in this sector; goods in this sector thus become scarce. As the demand of those goods remains unchanged, this shift in supply implies that their prices rise, leading to an increase in the valued added of state-owned corporates. For private sector corporates by contrast, it is easier to produce, because the financial constraints are less severe; goods from this sector thus become abundant. This increase of private sector corporates supply leads to a price decrease, and the value added of the sector therefore declines. Hence, the proportion of value added for state-owned corporates (0.52) is greater than the proportion for the private sector corporates (0.47).

Overall the dynamic analysis reveals that the quantitative tightening worsens the balance sheets and the productive capacities of both state-owned corporates and the private sector corporates. But because of their different degree of financing constraints, the state-owned corporates seem more affected by the quantitative tightening than private sector corporates. As response, private sector corporates seem to accumulate pledgeable private capital collateral more efficiently than state-owned corporates with pledgeable public capital collateral. Hence, private sector corporates are thus capital-intensive, whereas, state-owned corporates are labor-intensive. The quantitative tightening would ruined the progress realized by state-owned corporates during years of unconventional monetary policy, ( which made them more economically close to their private sector counterpart due to loose financing constraint), and leads them to a situation worst than their state before the implementation of unconventional monetary policy.

# 5 Simulation Results

The benchmark case is an era of relaxed financing constraints in emerging markets due to persistent unconventional monetary policy in advanced economies. Scenarios analysis depart from this baseline to simulate the situation where monetary authorities exit from ease monetary policy in advanced economies by implementing quantitative tightening.

## 5.1 Quantitative Tightening and Corporates Productive Capacities

Figure 1 (in Appendix ) depicts the response of corporates in emerging markets following a quantitative tightening in advanced economies. At first view, the quantitative tightening leads to a contraction of activities in both state-owned corporates and private sector corporates, more so for the former. This negative effect is accentuated by the presence of the international financial frictions in the model and two channels are involved in the propagation of this mechanism. First, the international collateral constraint channel, whereby quantitative tightening in advanced economies changes the shadow value of loans and therefore demands of both type of corporates collapses. Second, the assets-price effect, whereby changes in the value and levels of both public capital and private capital alter their collaterals values when corporates pledge them as a guarantee. Hence, the decline in accumulation of both public capital and private capital pushes down the price of those physical capital, so that corporates also loss from the wider financing tightening that lower collateral values induce. As a result, investment in state-owned corporates and investment in private sector corporates are reduced by the tighter access to credit, so that respective labor demands and output of each type of corporates all feature a common decrease.

Secondly, in comparison to the benchmark case, results reveal that, when the financial constraint is tightened, the contractionary effect of monetary policy normalization becomes larger than in the case where the financial constraint is relatively relaxed (benchmark). The asset-price effect leads to a decrease of corporates investments more than the benchmark case. In addition, the international collateral constraint channel induces a decrease of consumption demands than under the benchmark case. Both channels lead to a decreases in corporates output below what was the case under the relatively loose financial constraints. However, the magnitude of the adverse effects is different between both type of corporates, with the tightening financing constraint being more severe in the state-owned corporates relatively o private sector corporates.

Basically, as financing conditions of the state-owned corporates tighten even more, relative prices in the sector decrease below the benchmark level. The state-owned corporates respond to the quantitative tightening by increasing their demand for unskilled workers more than under the benchmark level, and decreasing in turn their demand for public capital less than under the benchmark level. The acquisition by state-owned corporates of less physical capital relative to unskilled labor leads to a reduction of their investment level below the benchmark level. In addition, the decline in accumulation of public physical

capital pushes the price of physical capital down, and induces lower collateral valuations, which amplify the initial effect. The negative effect of lower collateral valuation decreases the productivity of state-owned corporates below the benchmark level. Furthermore, because state-owned corporates are less competitive, they will reduce their wages below the benchmark level in order to afford more workers.

By contrast, the private sector sector corporates remains more relatively competitive due to less financial vulnerability. In presence of quantitative tightening in advanced economies, private sector corporates will also face a decrease of their relative prices below the benchmark level. They react to monetary policy normalization in advanced economies by hiring less workers than under the benchmark case. All this leads private sector corporates to keep going in demanding and accumulating private capital, so as to sustain their productive capacities. Due to the lack of additional funding, private sector corporates invest less than under the benchmark, and their investment level remains slightly below the benchmark level. To sustain their investment decisions, private sector corporates will reduce their wage below the benchmark level. As the sector adjusts to the new financing condition, the low labor cost and resilience of physical capital demand and accumulation, raise the output of of private sector corporates above the state-owned corporate level.

Hence, the quantitative tightening in advanced economies deteriorates the productive capacities of corporates in emerging markets, more so for state-owned corporates than private sector corporates. This is justified by the fact that, while state-owned corporates increase demand for labor to insulate against the effects of quantitative tightening on their productive capacities, private sector corporates continue to increase demand for private capital because they are less financially constrained than their state-owned corporates counterpart.

### 5.2 Quantitative Tightening Effects on Corporates Balance-sheets

Figure 2 (in Appendix ) reflects the effects of quantitative tightening in advanced economies on corporates balance-sheets in emerging markets. The monetary policy normalization adversely affects the loan-to-value ratio of both corporates in emerging markets. Indeed, the quantitative tightening leads to a reduction in loan-to-value ratio of both corporates in emerging markets below the benchmark level. A decline of the loan-to-value ratio tightens the financial constraint and allows a decrease in the availability of loans below the benchmark level . The resulting fall in investment induces a decrease in labor hiring and public capital as well as private capital demands. Lower demand for both private capital (relatively to the benchmark amount) and public capital sharply decreases their respective values, tightening the collateral constraint further. Thus, a tightening of the borrowing constraint due quantitative tightening has a worsening effects on the balance-sheets of corporates.

For the state-owned corporates, the negative effects on balance-sheet shock is more accentuated. Since the state-owned corporates know that the normalization of monetary

policy in advanced economy would be permanent and that they would not be able to make the reimbursement of their loans under those circumstances in the long run, they initially mostly decrease the accumulation of public capital and slightly decrease the demand for loans below the benchmark level. Subsequently, the tightening of the collateral constraints induced by the quantitative tightening further amplifies the effect by leading to a decrease in labor demand by the state-owned corporates. The initially stronger decrease of demand induces an even stronger reduction of loans due to asset-price effect. This deterioration in financing conditions contracts activity in state-owned corporates and pushes them to reduce investment further, which in turn induces a lower price of public capital and hence lower collateral valuations, reinforcing the initial effect. As response, in the state-owned corporates sector, the decrease in accumulation of public capital and the quantity of loans induces a persistent deterioration of the state-owned corporates balance-sheet.

By contrast, the balance sheet of private sector corporates shows a sign of resilience following a quantitative tightening. The tightening of financing constraints of the state-owned corporates implicitly raises the quantity of loans available for the private sector corporates. The private sector corporates react by raising slightly their investment, but which remains below the benchmark level. This leads afterward to smooth investment level towards steady state over time. Luckily, the increase in consumption offsets the level of investment and induces an increase of the productivity of the private sector corporate. As productivity of the private sector corporates increases, their return also increases and push them to increase, on the one hand their demand for private capital (since the relative price of private capital is now lower than under the benchmark case), on the other hand their accumulation of their private capital, so as to dampen the adverse effects of quantitative tightening on their balance-sheet. Hence, because private sector corporates accumulate pledgeable collaterals more efficiently than state-owned corporates, rising productivity and consumption limit the negative effects of quantitative easing on their balance-sheet.

Overall, quantitative tightening in advanced economies, on the one hand, leads to the reduction of the quantities of loans supplied to both state-owned corporates and private sector corporates, on the other hand, induces the collapse of the value of public capital and private capital as collateral. Both effects worsen the respective balance-sheets of corporates in emerging market. The adverse effects are more accentuated on the balance-sheet of state-owned corporates, because, private sector corporates accumulate pledgeable collateral more efficiently than state-owned corporates.

### 5.3 Quantitative Tightening, State-owned Corporates, and Contingent Liabilities

Figure 3 (in Appendix ) illustrates the effect of quantitative tightening on the dynamic between contingent liabilities and state-owned corporates. The severity of quantitative easing triggers default of state-owned corporates and in turn the realization of contingent liabilities. Since government intermediates between state-owned corporates and the foreign banks, the realization of contingent liabilities raises public spending. An increase of public expenses financed by taxes paid by household increases the transfer from households to the government. The increase of taxes paid by households leads to a decrease in the disposable revenue of households. As result, the demand for deposits in the banking sector will be negatively affected. The fall of deposits induces the decline of banking sector assets. To re-balance its balance sheet, the banking sector will seek to reduce loans and increase deposits. Subsequently, the deposit rate as well as the lending rates will rise above the benchmark level. Loans volumes decline for both state-owned corporates and private sector corporates below the benchmark level (more so for state-owned corporates than private sector corporates as describe below), and thus lead to the reduction of funds available for them.

This process is intensified by the international collateral constraint channel, as the banking sector could increase the requirements for banks to supply loans, including collateral. Since state-owned corporates are directly concerned by contingent liabilities, its realization will further accentuate their shortage in the credit market. State-owned corporates will cut their wage substantially because of the fall of their relative prices. At the same time they will decrease labor demand and savings due to the negative effect of the policy, which will decrease investment, leading to a decrease in their output below the benchmark level.

In contrast, the private sector corporates are not concerned by the contingent liabilities and will easily overcome the adverse effect of its realization via the international collateral channel. The level of loans granted to the sector will be at least identical to level before the realization of contingent liabilities. The private sector corporates will thus increase their investment and consumption demand. Also, to compensate for the high cost of private capital, the private sector corporates will increase its demand for skilled labor. The rise on investment and consumption lead to an increase in the output of the private sector corporate.

All in all, the sharp decline of savings of the state-owned corporate offsets the increase of consumption of the private sector corporates and induces a sharp decrease in aggregate savings below the benchmark level. The decrease in aggregate investment and savings limits the effect of the collateral channel on the private sector corporates and leads to a decrease in aggregate output and job creation in the entire economy. Hence, the realization of contingent liabilities acts as a powerful channel through which the adverse effects of advanced economies monetary policy normalization on state-owned corporates in emerging markets spill-over to the entire economy.

# 6 Conclusion and Policy Implications

This paper examines the effects on the vulnerabilities of state-owned corporates and private sector corporates in emerging markets, of the ongoing quantitative tightening in advanced economies central banks.

This research adds three important dimensions to the literature on emerging markets and monetary policy: (*i*) Corporates analysis by disentangling the state-owned corporates from the private sector corporates in emerging markets: (*ii*) International financial market segmentation in which we draw a distinction between public capital backed collateral and private capital backed collateral. (*ii*) Quantitative tightening effects assessment.

Specifically, we develop a stochastic monetary business cycle model to conduct this topical experiment. The model is quite successful in reflecting the conduct of monetary policy both in the emerging markets and in the advanced economies before and after the normalization of monetary policy. We start by modeling quantitative easing as the purchase by advanced economies central banks of foreign assets financed with monetary expansion. Subsequently, we model quantitative tightening as the reduction of the size of balance-sheet of central banks in advanced economies. In emerging markets, we model the fact that central bank conducts monetary policy following a Taylor-type rule indexed to the change of balance-sheets of central banks in advanced economies. We introduce the realization of contingent liabilities as government unique expenses when state-owned corporates default.

Our analysis illustrates how differentiated types of corporates in emerging markets may segment financial markets and create international financial frictions. It demonstrates how monetary policy normalization in advanced economies affects these differentiated types of corporates vulnerabilities. It emphasizes how international financial frictions emphasizes the dynamic between exit strategies in advanced economies and corporates activities in emerging markets. The analysis reveals how the contingent liabilities can transmit the adverse effects of quantitative tightening from the state-owned corporates sector to an entire economy in emerging markets.

More granularly, findings reveal that the quantitative tightening in advanced economies deteriorates the productive capacities of corporates in emerging markets, more so for the state-owned corporates relative to the private sector corporates. These negative effects are accentuated by the presence of the international financial frictions in the model and two channels are involved in the propagation of this mechanism. First, the international collateral constraint channel, whereby the quantitative tightening in advanced economies changes the shadow value of loans and therefore demands of both state-owned and private sector corporates collapses. Second, the assets-price effect, whereby changes in the value and levels of both public capital and private capital alter their collaterals values when corporates pledge them as a guarantee.

Furthermore, we found that, quantitative tightening in advanced economies, on the one hand, leads to the reduction of the quantities of loans supplied to both state-owned corpo-

rates and private sector corporates, on the other hand, induces the collapse of the value of public capital and private capital as collateral. Both effects worsen the respective balance-sheets of corporates in emerging markets. The adverse effects are more accentuated on the balance-sheet of state-owned corporates, because, private sector corporates accumulate pledgeable collateral more efficiently than state-owned corporates. Moreover, results reveal that, the realization of contingent liabilities acts as a powerful channel through which the adverse effects of advanced economies monetary policy normalization on state-owned corporates in emerging markets spill-over to the entire economy.

The dynamic analysis confirms that, the quantitative tightening worsens the balance sheets and the productive capacities of both state-owned corporates and the private sector corporates. But because of their different degree of financing constraints, the state-owned corporates seem more affected by the quantitative tightening than private sector corporates. This is explained by the fact that, following quantitative tightening in advanced economies, private sector corporates in emerging markets employ a relatively small portion of the economy's workforce but equips each worker with significantly more capital.

Subsequently, the following policy implications come out from this research:

($i$) Policymakers in emerging markets should be aware of potential negative effects of quantitative easing in advanced economies on various corporates in their economies, namely those who are highly vulnerable to foreign loans reversals.

($ii$) Monetary Policy normalization in advanced economies should be overwhelming communicated and well-sequenced.

($iii$) Monetary authorities in emerging markets should anticipate and factor-in the inevitable normalization of monetary policy in advanced economy in their monetary policy stance.

($iv$) Corporates in emerging markets should clean up their balance-sheet under current environment of relaxed financing constraints, in order to limit the consequences on their balance-sheets and productive capacities of the upcoming normalization of monetary policy in advanced economies.

($v$) To avoid the quantitative tightening in advanced economies to ruin the progress made by the state-owned corporates during years of unconventional monetary policy in advanced economies, policymakers in emerging markets should try to avoid, or phase-out the realization of contingents liabilities, for instance by limiting the size of government in the state-owned corporates.

While this research focuses essentially on quantitative tightening, further extensions could explore other dimensions of exit from unconventional monetary policy. Also, this analysis intentionally abstracted from the effects of exchange rates, further analysis could add this strand of reflexion. Note that the model captures the government in a very simple form so as to put emphasize on the dynamic between foreign monetary policy and corporates in emerging markets. This part of the model could be further developed with more features for the government in future extensions of our analysis.

# 7 Reference


Agenor, Pierre-Richard, Koray Alper, and Luiz Pereira da Silva (2013). "Capital Regulation, Monetary Policy, and Financial Stability". *International Journal of Central Banking* 9(3):198–243.

Angeloni, Ignazio and Ester Faia (2013). "Capital Regulation and Monetary Policy with Fragile Banks". J*ournal of Monetary Economics* 60(3):311–24.

Aghion, Philippe, Philippe Bacchetta, and Abhijit Banerjee (2000) "Currency Crises and Monetary Policy with Credit Constraints." *Mimeo*, Harvard University.

Aguiar, M., and Gita Gopinath (2007). "Emerging Market Business Cycles: The Cycle is the Trend." *Journal of Political Economy* 115 (1): 69–102.

Alvarez, R. and J. De Gregorio (2014). "Understanding Differences in Growth Performance in Latin America and Developing Countries between the Asian and the Global Financial Crises." *IMF Economic Review* 62:494–525 .

Araujo, Aloisio, Susan, Schommer, and Michael Woodford (2015) "Conventional and Unconventional Monetary Policy with Endogenous Collateral Constraints." *American Economic Journal: Macroeconomics*, 7(1):1–43

Bernanke Ben and Mark Gertler (1989). "Agency Costs, Net Worth, and Business Fluctuations". *American Economic Review* 79(1):14–31.

Bernanke, Ben, Mark Gertler, and Simon Gilchrist (1999). "The financial accelerator in a quantitative business cycle framework". In John Taylor and Michael Woodford, eds., *Handbook of macroeconomics*, Vol. 1C, Amsterdam: Elsevier Science, North-Holland: 1341–1393.

Bowman, David, Etienne Gagnon, and Mike Leahy (2010). "Interest on Excess Reserves as a Monetary Policy Instrument: The Experience of Foreign Central Banks." *Manuscript.*

Bowman, David, J. M. Londono, and H. Sapriza (2014). "U.S. Unconventional Monetary Policy and Transmission to Emerging Market Economies." *International Finance Discussion Paper Series* No. 1109, Board of Governors of the Federal Reserve System.

Brunnermeier, Markus and Yuliy Sannikov (2014). "A Macroeconomics Model with a Financial Sector". *American Economic Review* 106(7):379–421.

Brzoza-Brzezina, Michal, Marcin Kolasa, and M. Makarski (2013). "The Anatomy of Standard DSGE Models with Financial Frictions". *Journal of Economic Dynamic and Control* 37(1):32–51.

Bulow, Jeremy, and Kenneth Rogoff. (1989). "A Constant Recontracting Model of Sovereign Debt." *Journal of Political Economy* 97 (1): 155–78.

Carlstrom, Charles and Timothy Fuerst (1997). "Agency costs, net worth, and business fluctuations: A computable general equilibrium analysis". *The American Economic Review*, 87:893–910.

Carlstrom, Charles, Timothy Fuerst, and M. Paustian (2010). "Optimal Monetary Policy in a Model with Agency Costs". *Journal of Money, Credit and Banking* 42(s1):37–70.

Caballero, Ricardo J., and Arvind Krishnamurthy (2001). "International and Domestic Collateral Constraints in a Model of Emerging Market Crises." *Journal of Monetary Economics* 48:513– 48.

Caballero, Ricardo J., and Arvind Krishnamurthy (2005). "Exchange Rate Volatility and the Credit Channel in Emerging Markets: A Vertical Perspective." *International Journal of Central Banking* 1(1):207–245.

Calvo, Guillermo A., and Carmen M. Reinhart (2003). "Fear of Floating." *Quarterly Journal of Economics* 117 (2): 379–408.

Cespedes, Luis F., Robert Chang, and Andres Velasco. (2000). "Balance Sheets and Exchange Rate Policy." *NBER Working Paper* No. W7840 (August).

Chari, Varadarajan, Patrick Kehoe, and Ellen Mc Grattan (2007). "Business Cycle Accounting". *Econometrica* 75(3):781–836.

Christensen, Ian and Ali Dib (2008). "The financial accelerator in an estimated new-Keynesian model". *Review of Economic Dynamics*11 (1): 155–178.

Christiano, Lawrence, Roberto Motto, and Massimo Rostagno (2003). "The Great Depression and the Friedman-Schwartz Hypothesis". *Journal of Money, Credit and Banking* 35(6):1119–1197.

Christiano, Lawrence, Massimo Rostagno, and Roberto Motto (2010). "Financial factors in economic fluctuations". *Working Paper Series*, ECB, No. 1192.

Cooley, Thomas (1995). *Frontiers of Business Cycle Research.* Princeton, NJ: Princeton University Press.

Cooley, Thomas and Gary Hansen (1989). "The Inflation Tax in a Real Business Cycle Model". *American Economic Review* 79(4):733–748.

Curdia, Vasco and Michael Woodford (2010). "Credit Spreads and Monetary Policy". *Journal of Money, Credit and Banking* 42(s1):3–35.

Darracq-Paries, Matthieu, Christoffer Kok Sorensen, and Diego Rodriguez-Palenquela (2011). "Macroeconomic Propagation under Different Regulations Regimes: Evidence from an estimated DSGE Model for the Euro Area". *International Journal of Central Banking* 7(4):49-113.

De Fiore, Fiorella and Oreste Tristani (2013)."Optimal Monetary Policy in a Model with Credit Channel". *Economic Journal* 123(57106–31.

Demirel, Ufuk (2009). "Optimal Monetary Policy in a Financially Fragile Economy". *B.E. Journal of Macroeconomics* 9(1).

De Greave, Ferre (2008). "The External Finance Premium and the Macroeconomy: U.S. Post-WWI Evidence". *Journal of Economic Dynamic and Control* 32(11):3415–3440.

Eaton, Jonathan, and Mark Gersovitz. (1981). "Debt with Potential Repudiation: Theory and Estimation." *Review of Economic Studies* 48:289–309.

Fernandez-Villaverde, Jesus (2010). "Fiscal Policy in a Model with Financial Frictions". *American Economic Review* 100(2):35–40.

Furman, Jason, and Joseph E. Stiglitz (1998) "Economic Crises: Ev- idence and Insights from East Asia." *Brookings Papers of Economic Activity* 2.

Gagnon, J., M. Raskin, J. Remache, and B. Sack. (2011). "The Financial Market Effects of the Federal Reserve's Large-Scale Asset Purchases." *International Journal of Central Banking* 7 (1): 3–43.

Garcia-Cicco, Javier, (2011) "On the Quantitative Effects of Unconventional Monetary Policies in Small Open Economies." *International Journal of Central Banking* 7(1):53–115.

Gali, Jordi (2008). *Monetary Policy, Inflation and the Business Cycle: An introduction to the New Keynesian Framework*. Princeton University Press.

Geanakoplos, John, and William R. Zame (2013) "Collateral Equilibrium: A Basic Framework." *Manuscript.*

Gertler, Mark, and Peter Karadi (2011) "A Model of Unconventional Monetary Policy." *Journal of Monetary Economics* 58 (1): 17–34.

Gertler, Mark and Nobuhiro Kiyotaki (2011). "Financial intermediation and credit policy in business cycle analysis". In Benjamin Friedman and Michael Woodford, eds., *Handbook of Monetary Economics*, vol. 3A, Amsterdam: Elsevier Press.

Gertler, Mark, Simon Gilchrist, and Fabio M. Natalucci (2001) "External Constraints on Monetary Policy and the Financial Accelerator." *New York University Working Paper* (February).

Gilchrist, Simon and John Leahy (2002). "Monetary Policy and Assets Prices". *Journal of Monetary Economics* 48(2):415–36.

Gilchrist, Simon and Egon Zakrajcek (2012). "Credit Supply Shocks and Economic Activity in a Financial Accelerator Mofdel". In *Rethinking the Financial Crisis*, ed. Alan Blinder, Andrew Lo, and Robert Solow, 37-72(chapter 3). Russel Sage Foundation.

Goodfriend, Marvin and Bennett McCallum (2007). "Banking and Interest Rate in Monetary Policy Analysis: A Quantitative Exploration". *Journal of Monetary Economics* 54:1480–1507.

Guerrieri, Luca and Mateo Iacoviello (2015). "OccBin: Toolkit for Solving Dynamic Models with Occasionally Binding Constraint Easily". *Journal of Monetary Economics* 70: 22–38.

Hall, Robert (2013). "Financial Frictions". *International Journal of Central Banking* 9(2):155–163.

Hamilton, J., and J. C. Wu. (2015). "Effects of Index-Fund Investing on Commodity Futures Prices." *International Economic Review* 56 (1): 187–205.

Hart, Oliver and John Moore (1994). "A theory of Debt Based on the Inalienability of Human Capital". *Quarterly Journal of Economics.* 109(4):841–879.

Iacoviello, Mateo (2015). "Financial Business Cycles". *Review of Economic Dynamics* 18(1): 140–64.

Iacoviello, Mateo (2005). "House Prices, Borrowing Constraints and Monetary Policy in a Business Cycle". *American Economic Review* 95(3):739–64.

Iacoviello, Matteo and Stefano Neri (2010). "Housing Market Spillovers: Evidence from an Estimated DSGE Model". *American Economic Journal: Macroeconomics* 2(2):125-64.

Jeanne, Olivier and Anton Korinek (2010). "Managing Credit Booms and Busts: A Pigouvian Taxation Approach". *NBER Working Paper* No. 16377.

Jorda, Oscar, Moritz Schularick, and Alan Taylor (2013). "When Credit Bites Back". *Journal of Money, Credit and Banking* 45(S2):3-28.

King, Robert, Charles Plosser, and Sergio Rebelo (1998). "Production, Growth and Business Cycles I. The Basic Neoclassical Model". *Journal of Monetary Economics* 21:195–232.

Kiyotaki, Nobuhiro and JohnMoore (1997). "Credit Cycles". *Journal of Political Economy* 105(2):211–248.

Kydland, Finn and Edward Prescott (1982). "Time-to-build and Aggregate Fluctuations". *Econometrica* 50:1345?1370.

Medina, Juan Pablo and Claudio Soto (2016) "Commodity Prices and Fiscal Policy in a Commodity Exporting Economy." *Economic Modelling* 59(December):33-51.

Mendoza, Enrique (2010). "Sudden Stops, Financial Crises, and Leverage". *American Economic Review* 100(4):1941–1966.

Onder , Yasin Kursat and Mauricio Villamizar-Villegas (2018)"The Effects of Monetary and Exchange Rate Policy Shocks: Evidence from an Emerging Market Economy." *International Journal of Central banking* 14 (1):159-199.

Quadrini, Vicenzo (2013). "Financial Frictions in Macroeconomic Fluctuations". *Economic Quarterly, Federal Reserve Bank of Richmond, issue* 3Q:209–254.

Quint, Dominic and Pau Rabanal (2014). "Monetary and Macroprudential Policy in an estimated DSGE Model of the Euro Area". *International Journal of Central Banking* 2(2):169–236.

Ravenna, Federico and Carl Walsh (2006). "Optimal Monetary Policy with the Cost Channel". *Journal of Monetary Economics* 53(2):199–216.

Reynard, S., and A. Schabert (2009) "Modeling Monetary Policy.? *Manuscript*, Swiss National Bank.

Smets, Frank and Raf Wouters (2007) "Shocks and Frictions in U.S. Business Cycles: A Bayesian DSGE Model Approach". *American Economic Review* 97(3):586–606.

Stadler, George(1994) "Real Business Cycles". *Journal of Economic Literature* 32(4):1750—1783.

Stiglitz, Joseph and Andrew Weiss (1981). "Credit Rationing in Markets with Imperfect Information". *The American Economic Review* (71):393–410.

Townsend, Robert (1979). "Optimal Contracts and Competitive Markets with Costly State Verification". J*ournal of Economic Theory* 21(2):265–293.

Walsh, Carl (2003). *Monetary Theory and Policy.* 2nd ed. Cambridge, MA: MIT Press.

Woodford, Michael. (2003). *Interest and Prices: Foundations of a Theory of Monetary Policy.* Princeton, NJ: Princeton University Press.

Yoo, Jinhyuk (2018). "Capital Injection to Banks versus Debt Relief to Households". *International Journal of Central Banking* 13(3):213–266.