ANALYSIS OF THAILAND’S ECONOMIC STRUCTURE ON THE EXTENSIVE MARGIN OF ACTIVITY USING A DYNAMIC STOCHASTIC GENERAL EQUILIBRIUM MODEL

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Abstract—this research provides brief descriptions of Thailand’s economic structure on the extensive margin of activity by developing a dynamic stochastic general equilibrium model with the endogenous determination of the number of business entries on the market. To this aim, the model intended to point out the role of frictions (i.e. monetary and nonmonetary shocks) toward business fluctuations based on the endogenous firms’ entry and the contribution of financial accelerators. In particular, the framework exhibits the role of the banking system and the wage bill as advanced constraints in explaining the overall changes of the Thai economy between 2000Q1 to 2016Q1. The results of this research demonstrate the role of stabilization policy on a model where firm entry responds to several shocks and uncertainty environment. The outcomes of the model support the empirical finding of Poutineau and Vermandel (2015) on several aspects. The estimated model confirms that the effect of frictions on the model economy influence entrepreneurs’ decisions to enter into the goods market, and thus can be used to duplicate actual world data. There are four other main findings.  i) Monetary transmission mechanisms influence on entrepreneurs’ decision which temporarily slowed down investment activities on both existing businesses and new entrants. Besides, the outcome reports the number of entrant are more likely to depend on the bank loans, not the one set by the authorities. ii) The endogenous firm entry implies the countercyclical number of business entry on the goods market toward banks markups and loan spread, hence being in line with the empirical evidence. iii) The end results of the model’s impulse responses, accounting for the frictions, appear to be contradicting the core prediction’s claims since the outcomes are unsound. The end results prove that there is a chance for entrepreneurs to simultaneously invest on both margins of activity. iv) The overall impulse response patterns of the model turns out to be significantly in line with the ones the researcher would have expected using empirical findings, in some cases, appear to be differ from the literature related to these sorts of models. These depend on the contribution of the financial accelerators that amplify the effects of frictions to the model economy.
Keywords — monetary transmission, monetary policy, entry, extensive margin

INTRODUCTION

Recent empirical literature highlights the role of endogenous firm entry as an amplification mechanism of business cycle variations, as in Paretto (1999), Bilbiie et al. (2007) and Bergin and Corsetti (2008). According to Guiso et al. (2004), the concept that a large fraction of the production growth in the economy usually arises at the extensive margin of activity (refers to the number of entrant) rather than on the intensive margin of activity (changes in the production line of existing businesses). For one to enter into the market, especially small-scale businesses and startups that have greater potential and capacity to expand, they need a key to access funds. This is because firms need to be built for a period before the initial production process begins. Beyond personal savings, entrepreneurs rely on their personal credit to set up business. These financial constraints require the banking sector to finance entrepreneurs in the early stages of development. The role of banking system takes a significant part of a firms set up followed by Levine (1997) the level of contention between the banking sector influence on terms of credit to businesses entry as well as the degree to which funds are allocated to the highest-quality projects. Since Bernanke and Gertler (1999), the literature has concentrated on credit channels in the transmission of monetary policy with the endogenous number of business entry on the goods market. Nonetheless, widespread imperfections and asymmetric information toward in the credit market results in friction between entrepreneurs as borrowers and banking sector as lenders between the opportunity costs of funds in the lending process. In facts, the external finance premium depends on each country’s central bank monetary regulation. Monetary policy contraction is not only raising interest rate, but also increasing in the size of external finance premiums through the credit channel. Furthermore, it reduces credit availability and tightens credit qualifications, which diminish entrepreneurial investment and discourages household consumption. In addition, financial accelerator mechanism is used to tie between the economic activities and the banking sector from entrepreneurs’ perspective toward premiums to optimize investment opportunities as in Bernanke and Gertler (1999). Moreover, it accounts for a number of policy decisions. For example, a large drop of interest rate during the sub-prime crisis in 2008 has made it clear that macroeconomic models need to consider on the role of financial sector more to better understand the dynamics of the business cycles.

As most of the business activities rely on the link between the financial market and firms, the purposes of this research are to find out whether financial decisions by the banking sector hold the key to the extensive margin of activity of the Thai economy, and helps to understand the importance of the monetary transmission channels of the financial market (i.e. the interest rate and bank lending channels) to Thailand’s economic structure. Then, it will evaluate the effect of frictions (both monetary and nonmonetary shocks) toward businesses on the goods market, and how the financial accelerator mechanism may influence firms in Thailand. To do so, this research develops a dynamic stochastic general equilibrium (DSGE) model with the endogenous determination of the number of business entries on the goods market that intend to enlighten the role of friction on business fluctuation in Thailand’s goods market. This research documents the key facts underlying the evaluation of Thailand’s economic structure at the extensive margin of activity estimated on quarterly data between 2000Q1 to 2016Q1. Moreover, the model is a synthesis of a number of approaches already in the
literature. As the model demonstrates the role of friction on the model economy, the model exhibits the general framework based on the financial accelerator as in Bernanke et al. (1990), in that the way mechanisms work to propagate and amplify shocks to the economy (i.e. the relationship between the premium and the assets of potential borrowers). Furthermore, the role of the monetary transmission mechanism is included. Additionally, to examine the relative importance of the banking system and firms’ entry constraints on entrepreneurs’ decisions on doing business, this research implement the detailed representative of Poutineau and Vermandel (2015).

In the end, the outcomes of the model support the empirical finding of Poutineau and Vermandel (2015). The estimated model confirms that the effect of frictions on the model economy influence entrepreneurs’ decisions to enter into the good market, and thus can be used to duplicate actual world data. There were four other main findings. First, the monetary transmission mechanisms influence on entrepreneurs’ decisions. The results of the model indicate a negative temporary effect (which slowed down investment decisions). Overtime, the overall consequences would induce larger economic activities on both existing businesses and new entrants. Furthermore, the outcome reports the number of entrant are more likely to depend on the bank loans, not the one set by the authorities. Second, the results of the model are in line with the empirical evidence, as in Cuciniello and Signoretti (2014) and Rossi (2015). The endogenous entry implies the countercyclical number of business entry on the good market toward banks markups and loan spread. Third, the results of the model’s impulse responses, accounting for the both monetary and nonmonetary frictions, appear to be contradicting the core prediction’s claims since the outcomes are unsound. The end results prove that there is a chance for entrepreneurs to simultaneously invest on both margins of activity. Nonetheless, the outcomes of the model economy demonstrate a strong relationship between the entrepreneurs’ wage bill in advance constraint and the lending conditions provided by banks. Forth, the overall impulse response patterns of the model turns out to be significantly in line with the ones the researcher would have expected using empirical findings based on the endogenous firm entry, whereas the amplitude of shocks, in some cases, appear to be differ from the literature related to these sorts of models. These depend on the contribution of the financial accelerators that amplify the effects of frictions to the model economy.

The rest of the research is organized as follows: Section 2 presents a quick summary of the related literature. Section 3 is devoted to the model equilibrium. Section 4 describes the model simulations Section 5 displays the consequence of frictions on the transmission of monetary and nonmonetary shocks to the model equilibrium. Section 6 presents the conclusions.

**Contribution to the Literature**

As this research highlights on the role of banking sector on the variation between existing business and the new entry on Thailand’s good market, this section is devoted to the literatures contribute to the models with endogenous determination of number of businesses operating on the goods market corresponding to the models attribute to monetary transmission and financial accelerator mechanism.

Since analysis of monetary policy and business cycles with endogenous entry and product variety of Bilbiie et al. (2007), most of the literatures contribute to models with endogenous firms’ entry and business cycles significantly relies on their analysis as it is an authoritative instruction towards the analysis of monetary transmission shocks in the dynamic setting. Furthermore, they study the role of monetary policy...
analysis on the endogenous producer entry and the creation of product in a DSGE model as well as in Bergin and Corsetti (2008). The main assumptions of the research mentioned above including imperfect price adjustment (i.e., price rigidity environment), no arbitrary condition, and the financing of product creation. Firm entry symbolizes investment of the extensive margin and as such act in response to economic stimulation. Moreover, it is an important generator in amplifying and propagating monetary policy transmission. As a result, these analyses characterize how the economic expansion results in higher entry rates and thus give more details on how price adjustment distorts the number of firms’ entry on the goods market due to time lagged in firm installment process. Besides, the introduction of new activity is mainly affected by real factors. So far, their solution toward the financial side in the research has interpreted that the number of firm entry and interest rate interchange in the same direction. This was counterintuitive in reality where firms often face with financial constraints. Conversely, Poutineau and Vermandel (2015) as well as Casares (2015) provide the weighty solution to fix the problem founded in the original setting of Bilbiie et al. (2007). They stated that, under monetary contraction, lending conditions offered by the banking system plays an important role as a channel for monetary transmission to reduce the entry rate on the good market. Moreover, entrepreneurs’ decisions toward firm entry depend on interest rate based on the banking sector instead of the monetary authorities. According to Lewis and Poilly (2012), their work on firm entry, markups and the monetary transmission mechanism enclosures the role of firms’ entry for the monetary transmission mechanism by minimizing the distance between the impulses responses to a monetary policy shock generated under sticky price circumstance. In this context, they compare the empirical performance of the two DSGE contexts on aggregate data. They found that the translog model is a perfect match for the data as the strategic interactions model there is no evidence in a completion effect. In this case, competition effect implies that entry lowers desired markups (or markups decrease with the number of new entry) and dampens inflation. The impacts based on the model with endogenous firms’ entry and dynamics on business cycle have been studied in several literatures. As in the study of endogenous firm entry in an estimated model of the U.S. business cycle by Offick et al. (2015), similar to Lewis and Steven (2015), consider a monetary DSGE model and concentrate on the role of firms’ entry for only inflation dynamics. Nonetheless, Offick et al. (2015) research emphasis on role of endogenous firm entry, especially with the medium-scale real business cycle, as an internal amplification mechanism of business cycle fluctuations in the U.S. Likewise, the analysis examines the significance of the amplification mechanism to enumerate the importance and the role of competition and the variety effect. Additionally, this model extends its analysis with several real frictions adopted from Bilbiie et al. (2012), with characterized by flexible prices but in turn fix interest rates so as to investigate endogenous firms’ entry decisions. The contributions of both the intensive and extensive margins of activity change the production of existing commodities and further variant in the range of commodities availability in response to the changes in aggregate productivity. With regards to Croce and Rossi (2014), the model considers a DSGE model with monopolistic competitive banking sector in company with endogenous firms’ entry. The model displays the relationship between the financial market and the economy that are fluctuated in response to businesses entry that funding their activities in receipt of loan condition from banking sector. During financial crisis
the interaction between banking sector and goods market affect both the intensive and extensive margins of activity. In consequent, these imply that it then impacts entrepreneurs’ decision to enter or exit the market. Moreover, there are the existing frameworks on the monetary transmission using DSGE model to analyze the extensive margin, including Christiano et al. (2005) and Cooke (2014). Moreover, vector autoregressions (VARs) methodology in Bean et al. (2002) and Peersman and Smets (2003) show a significant increase toward the firm entry during expansionary monetary policy shocks. These analysis displays wage rigidities and congestion effects of firm entry to reconcile the net entry reaction in the model with its counterpart in the data. Finally, the role of credit market frictions in business fluctuations and financial accelerator mechanism turn out to be important elements to help formulate entry rate. According to Bernanke et al. (1999), they modified dynamic new Keynesian (DNK) framework to allow for financial accelerator effects on investment. This research includes financial accelerator with the intention that endogenous growths in credit markets work to amplify and propagate shocks (i.e. real and nominal shocks) to the economy. In addition, this mechanism involves the link between external finance premium and the net worth of borrowers. As in Bernanke et al. (1999), Gertler et al. (2003), the model extends financial accelerator in describing economic downturns during great financial crisis. Furthermore, Hammersland and Træe (2011) offer a brief description and studies the significant features of a model that allows for co movements between credit, asset prices and real economic activities that in turn often nominated a financial accelerator in the literature. Finally, by enhancing the practical by incorporating a mechanism of macroeconometric data, financial accelerators mechanism seems to come with a couple of values added.

The Model Equilibrium
This section provides a detailed description of the model as displays in fig.1. There are six types of agents interacting in the model economy: households, banks, productive sectors (namely extensive and intensive margin of activity), entrepreneurs, capital suppliers, and the fiscal and monetary authority (refers to bank of Thailand). Each of the first three agents maximizes an objective function subject to a given set of constraints (i.e. households maximizes their utility subject to a set of budget constraint and firms maximize their profits subject to production functions). For this model, entrepreneurs play a significant role in introducing financial frictions. This agent is a key determination of financing business for both perspectives and thus purchasing capitals supplied from the capital producers. Moreover, banks take deposits form households and offer to entrepreneurs whose required lending condition.

A. Entrepreneurs
In what follows describes the role of entrepreneurs, denoted e. For this model, entrepreneurs play a significant role in financing capitals for the intensive margin of activity with tradeoff in financing the initial labor wage bills to the extensive margin of activity.
Beyond their personal saving $TA_{et}$, entrepreneurs rely on the $BL_{et}$ loan condition offered by banking sector. Thus, the representative equation for entrepreneurs can be written as:

$$BL_{et+1} + TA_{et+1} = (P_{kt}K_{et+1}) + (\propto W_tH_{et})$$  \(1\)

In the balance sheet (1), the term $P_{kt}K_{et+1}$ refers to the intensive margin of activity which depends on prices and quantities of capital, $P_{kt}$ and $K_{et}$ respectively. Likewise, the term $\propto W_tH_{et}$ represents the extensive margin of activity that includes the labor income $W_t$ for the given hours worked $H_{et}$ and a $\propto$ fraction of input costs that is utilized during the initial production process of firm entry.

According to Bernanke and Gertler (1989), in the absence of frictions, entrepreneurs do not face with the external finance premium and hence financial status will not affect decisions in any projects. When financial friction was introduced, it leads to fluctuations within the economy even if the shocks appear to have no intrinsic persistence. Since raising fund from external lenders (refers to banks) are more expensive than internal finance, the external finance premium is more likely to be positive ($X_E > 0$). Therefore, the representative equation for external finance premium can be written as follow:

$$X_E = \phi^{e_{p}-1}\left(\frac{BL_{et+1}}{P_{kt}K_{et+1}}\right)^{e_{p}}$$  \(2\)

For equation (2), the size of premium depends on its elasticity $e_{p}$ and entrepreneurs’ total asset, and hence a positive function of the leverage ratio $\left(\frac{BL_{et+1}}{P_{kt}K_{et+1}}\right)$. Additionally, Bernanke and Gertler (1989) demonstrate that there are negative relationship between the external finance premium and the strength of entrepreneurs’ financial status (refers to assets, liquidity and current to future expected circulates). These are because they tend to have greater potential to make proper choices and ensure good and stable financial outcomes. Consequently, entrepreneurs in healthy financial condition face a lower premium cost for external finance. The total assets of entrepreneurs can be defined as:

$$TA_{et+1} = (1 - \delta)(1 - \theta)D_{et} + T_e$$  \(3\)

Where $D_{et}$ is entrepreneurs’ profit (in term of dividend), $T_e$ is the amount of entrepreneurs assets transmit to the next generations when $T_{e}^{ss} = (1 - \delta)(1 - \theta)D_{et}^{ss} - TA_{et}^{ss}$. The symbol $\delta$ stands for the exogenous exit shock and $\theta$ is the entrepreneurs’ dividends policy. Following Poutineau and Vermandel (2015), the representative equation for entrepreneur’s dividend can be written as:

$$D_{et} = \rho_{et}(\sigma_{et} - \omega^{e}_{et})(1 + R^{L}_{t})P_{kt-1}K_{et+1} e^{eN}$$  \(4\)

With regard to entrepreneur’s dividend (4), the critical value that distinguishes profitable project form non-profitable project is the term $\omega^{e}_{et}$. $R^{L}_{t}$ is bank lending rate, and $e^{eN}$ is an exogenous collateral shock estimated in the model.

**Banks**

Consider the source of funds for the economy, denoted $b$. The purpose of introducing this agent in the model is to enable monetary transmission channel (i.e. the bank lending channel) to transmit throughout the mode economy, as in Atta-Mensah and Dib (2008). Banks take deposits from households and lend to entrepreneurs, which face a financial constraint in financing wage bills as advanced. In consequence, supply of loanable fund equal to the entire household deposit.

$$BL_{bt+1} = \left[\frac{V_t}{(1+\gamma)(1-\delta)}\right] D_t$$  \(5\)

where $D_t$ is households deposit, whereas the loan-to-deposit ratio $\left(\frac{V_t}{1+\gamma}(1-\delta)\right)$ depends on the growth rate of the economy relative to its steady-state growth rate and $\gamma$ is the elasticity of the willingness to lend with respect to the growth rate of the economy.

With reference to Poutineau and Vermandel (2015), the differences between bank loan supply activity and the
cost of fund deposit from the monetary authority can be defined as:

$$E_t \pi_{t+1} = E_t [\rho_{t+1} + (1 - \mu_B)(1 - \rho_{t+1})] (1 + R^L_t)BL_{t+1} - (1 + R_t)BL_t$$

(6)

As mentioned in equation (6), the marginal cost of credit maximizes the expected profit with respect to $BL_{t+1}$ can be written as:

$$1 + MC_{BL} = \frac{(1 + R_t)}{E_t[\rho_{t+1} + (1 - \mu_B)(1 - \rho_{t+1})]}$$

(7)

Given nominal rigidity, the representative equation for adjustment cost for banking sector can be written as:

$$AC_{BL} = \frac{\eta_t R_{BL}}{\mu_{BL} - 1} (1 - R_t)^2$$

(8)

In consequence, banking sector representative equation for the interest rate is defined as:

$$R^L_t = \mu_t MC_{BL} - (\mu_t - 1) R_t \left( \beta E_t \left[ \frac{\lambda_t \sigma_{AC_{BL}}^t}{\beta R_t BL_{t+1}} \right] \right)$$

(9)

### Households

There is a continuum of households, denoted $h$, optimizing their utility by taking a variety of decisions on consumption and investment, labor and capital supplied to firms, and saving (in term of assets holding).

Algebraically, the representative household maximizes:

$$E_t \sum_{t=0}^{\infty} \beta^t \left[ \frac{(C_{ht} - C_{ht-1})^{1-\sigma_c}}{1-\sigma_c} - \omega^L_t \frac{1^{1-\sigma_c}}{1+\sigma_c} \right]$$

(10)

Subject to

$$W_t L_{ht} + e^{\beta R_{ht}}(1 + R_{ht} - 1) R_t \left( D_t + \tau_t + 0 \right) (V_{ht} + e^{\sigma N}(AC_{ht-1}) n_{t-1}) = C_{ht} + \frac{BL_{t+1}}{\mu_t} + \tau_h v_{ht+1} + n_t f_{t+1} MC_t + T_{GT} - \eta_{ft}$$

(11)

In the utility function (10), $C_t$ is household consumption index, whereas $P_t$ is household price consumption index.

As in Bernanke et al. (1990),

$$C_t = \left( \int_0^{n_t} \frac{\gamma_{ht} \gamma - 1}{\gamma} d\mu \right) \frac{1}{\gamma} \text{ and } P_t = \left( \int_0^{n_t} \frac{\gamma - 1}{\gamma} \frac{1}{\gamma} \right)$$

where $\gamma$ is the elasticity of substitution between varieties of products produced (assuming that $\gamma$ is greater than one). $\beta$ is the discount factor, $L_{ht}$ is labor services supplied to firms with $\sigma_l$ the inverse Frisch elasticity of labor supply and $\omega^L$ is the scaling parameter for the disutility of supplying labor. $B_{ht}$ is household riskless deposit, $v_{ht}$ is household shareholding, $D_t$ is household deposits, $f_{t+1}$ is the sunk fixed cost occurring when entering the market, and $n_t$ is the number of firm on the good market both entering and existing firms. Following Bilbiie et al. (2007), the law of motion of the number of business on the good market can be defined as:

$$n_t = (1 - \delta)(n_{t-1} + e^{\sigma N}(1 - AC_{ht-1}) n_{t-1})$$

(12)

when

$$AC_t = \left( \frac{n_t}{n_t - 1} \right)$$

The Euler equation condition on deposit is:

$$\beta E_t \left[ \frac{\lambda_t \sigma_{AC_{ht}}}{\beta R_t \mu_t} \right] = 1$$

(13)

The Euler equation condition on shareholding is

$$\tau_{ht} = (1 - \delta) \beta E_t \left[ \frac{\lambda_t \sigma_{AC_{ht}}}{\beta R_t} \right] (D_t + \theta D_t)$$

(14)

With regards to equation (13) - (14), $\lambda_t$ is lagrange multiplier associated to household budget constraint in equation 11 when $\lambda_t = (C_{ht} - C_{ht-1})^{-\sigma_c}$

### Authorities

This section has been divided into two agents: fiscal and monetary authorities. For fiscal authority, government takes charge in managing government spending. Therefore, the representative equation for the fiscal rule is defined as:

$$P_t G_t = \phi_G (P_{t-1} G_{t-1}) + (1 - \phi_G) (\Psi Y_t)$$

(15)

where $\phi_G$ is the degree of persistence and $\Psi$ is a fraction of nominal GDP, denoted $Y_t$.

For monetary authority, this research applied an equation for the central bank behavior from Poutineau and Vermandel (2015) by assuming that the monetary authority sets policy rate $R_t$, given by:

$$R_t - R^{es} = \rho (R_{t-1} - R^{es}) + (1 - \phi_p) [\pi_t (\pi_t - 1) + \pi_y (Y_t - Y^{es})] + \pi_{\delta y} (Y_t - Y_{t-1}) + e^{\rho R}$$

(16)
where $e^R$ is an exogenous monetary policy shock, $\pi$ is inflation target rate, $\pi_y$ is output gap, and $\pi_\Delta y$ is output growth.

**Productive Sector**

The supply side of the economy is composed by two groups of agents: intermediate goods-producing sector and final good sector that aggregates the differentiated intermediate goods under monopolistic competition. For this setting, an intermediate goods-producing sector denoted i. This agent combines the two types of inputs: labor and capital, denoted $K_t$ and $L_t$ respectively, that later used to produce the homogenous final good by final good producers. These final good producers are assumed to be perfectly competitive and maximize profit value of:

$$P_t Y_t^d - P_t Y_t^d$$

Subject to

$$Y_t^d = \int_0^{P_t} \left( \frac{P_t}{Y_t^d} \right)^{\frac{\alpha - 1}{\alpha}} \left( \frac{P_t}{Y_t^d} \right)$$

The representative intermediate goods-producing production function can be written as:

$$Y_t = e_t A_t K_{it+1} (1 - \alpha)$$

Where the productive output is $Y_t$ by combining labor $L_{it}$ and capital $K_t$ ($K_{it+1} = u_{it} K_{it}$ when $u_{it}$ is the rate of capital utilization). $A_t$ is the aggregate productivity, $\log(A_t) = A = \rho \log(A_{t-1}) + e_t$, and $e^A$ is an exogenous technology shock.

The marginal cost of this production function so given the price of labor and capital, $W_t$ and $P_I$ respectively, can be written as:

$$mc_t = \frac{1}{e_t} \left( \frac{P_I}{\alpha} \right)^{\alpha} \left( \frac{A_t W_t}{1 - \alpha} \right)^{1 - \alpha}$$

Thus,

$$A_t L_{it} W_t = (1 - \alpha) K_{it+1} P_I$$

The representative equation for intermediate goods-producing price adjustment costs can be written as

$$AC_{it} = \frac{\pi_i}{2} - (\alpha_p \left( \frac{P_{it-1}}{P_t} \right) + (1 - \alpha_p)) \frac{P_{it}}{P_t}$$

Where $\pi_i$ is the price adjustment cost and $\alpha_p$ is coefficient of the past rate inflation.

Following Poutineau and Vermandel (2015), endogenous price mark-up can be written as:

$$\pi_{it} = e_{it}^p \left( \frac{\pi_{it-1}}{\pi_{it}} \right)^{\frac{\epsilon_p}{(\pi_{it-1})(1 - \pi_{it} A_{it}) + \chi p A_{it}}$$

where $e^p$ is an exogenous price mark-up shock.

Finally, the real term profit of the intermediate firm can be written as:

$$\pi_{it} = (P_{it} - AC_{it} - mc_{it}) Y_{it}$$

To compute the steady state level of the firm entry with financial friction, this research borrow Poutineau and Vermandel (2015),

$$\bar{\pi} = \left[ \frac{(1 - (1 - \delta) f \epsilon_t (1 - \alpha)(1 + \gamma))}{(1 - \delta) \beta (1 - \delta)} \right]^{-1}$$

**Capital Suppliers**

The next agent is capital suppliers, denoted k. This research follow Poutineau and Vermandel (2015) by assuming that these suppliers are homogenous and distributed over a continuum normalized to 1 where $k \in [0, 1]$. This agent takes charge in manufacturing new capital stock $K_{kt+1}$ in order to supply to the intermediate firms by purchasing capital and investment goods. Hence, the representative equation for capital suppliers can be written as:

$$K_{kt+1} = e_k (1 - AC_{kt}) I_{kt} + (1 - \delta) K_{kt}$$

Where $AC_{kt}$ is capital adjustment cost when $AC_{kt} = \eta_k (\frac{I_{kt}}{K_{kt-1} - 1})^2$. $\eta_k$ is cost for capital adjustment and $e^I_k$ is an exogenous investment adjustment cost shock.

**Model Parameterization**

The purpose of this section is to solve for the equilibrium given the structure of the model described above and given model parameters to be described in this section. There are two broad methods for parameterizing DSGE models: calibration and estimation. For the calibration, the parameters are based on empirical findings that are suitable to the characteristics of Thailand economy.
structure. These parameters are classified into two groups:

**Parameters Governing the Steady State**

**TABLE I**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Household:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \beta )</td>
<td>0.9926</td>
<td>Discount factor</td>
</tr>
<tr>
<td>( \delta )</td>
<td>0.0105</td>
<td>Depreciate rate</td>
</tr>
<tr>
<td>( \sigma_L )</td>
<td>0.33</td>
<td>Labor elasticity</td>
</tr>
<tr>
<td>( \mu^W )</td>
<td>1.05</td>
<td>Wage markup</td>
</tr>
<tr>
<td><strong>Firms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \mu^P )</td>
<td>1.2</td>
<td>Price markup</td>
</tr>
<tr>
<td><strong>Authorities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( g )</td>
<td>0.2</td>
<td>Government expenditure to GDP</td>
</tr>
<tr>
<td>( \pi )</td>
<td>0.0074</td>
<td>Inflation</td>
</tr>
</tbody>
</table>


For this model, the steady-state parameters consist of those of households \( (\beta, \delta, \sigma_L, \mu^W) \), firms \( (\mu^P) \), and also fiscal and monetary authorities \( (g, \pi) \), as in Tanboon (2008). Details on the representative steady state parameters are represented in table 1. The quarterly discount factor equal to 0.9926, which pins down to an annual riskless rate of 3 percent. The depreciation rate of capital \( \delta \), i.e. the size of the exogenous firm exit rate, is assigned the value of 0.0105. This parameter corresponds to the average annual exit rate between 1970 and 2006 of 4.2 percent per year. The Inverse of Frisch elasticity refers to elasticity of substitution between different labor varieties \( \sigma_L \), obtained from an OLS estimation of the first- order condition with respect to labor, equals to \( \sigma_L = 0.33 \). This value is relative the other empirical findings (i.e. range within 0.25 to 0.45), as in McCurdy (1981) and Altonji (1986). The model fixes the wage markup price \( \mu^W \), at 1.05, as calculated by using the data from the National Statistical Office and the National Economic and Social Development Board. By setting the ratio of government expenditure to nominal GDP to 20%, the value is set at \( g = 0.2 \), which is close to mean and median over the period 1993Q1-2008Q2. As in Sutthasri (2007), the parameter \( \mu^P \) stands for price markup for firms. The parameter is set to \( \mu^P = 1.2 \), calculated by the ratio of the total value of production to the total cost of production. Moreover, inflation rate target is set to \( \pi = \frac{1}{4} \times \log (1.03) = 3 \) percent per year. Then using the \( \pi^P = 0.0074 \). 

B. Parameters Governing the Transition Dynamics

**TABLE II**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Households</strong></td>
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<tr>
<td>( \eta_c )</td>
<td>0.85</td>
<td>Consumption habit persistence</td>
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<tr>
<td>( \chi_t )</td>
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<td>Investment adjustment cost</td>
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<td><strong>Firms</strong></td>
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<td></td>
</tr>
<tr>
<td>( \kappa_P )</td>
<td>10</td>
<td>Degree of price rigidities</td>
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<tr>
<td>( \alpha )</td>
<td>0.4</td>
<td>Capital share</td>
</tr>
<tr>
<td><strong>Banks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \tau )</td>
<td>0.5</td>
<td>Elasticity of willingness to lend with respect to output growth</td>
</tr>
<tr>
<td>( \chi_E )</td>
<td>0.5</td>
<td>External finance premium</td>
</tr>
</tbody>
</table>

**Authorities**
Interest rate smoothing parameter

Output growth


The following section includes the transition dynamic parameters based on empirical findings of Tanboon (2008), Atta-Mensha and Dib’s (2008), and Poutineau and Vermandel (2015). For this model, the transition dynamic parameters consist of those of households ($\eta_{c}, \chi_{t}$), firms ($\kappa_{p}, \alpha$), banks ($\tau, \chi_{E}$), and fiscal and monetary authorities ($\rho, \pi_{\Delta y}$). According to table 2, the parameter governing the consumption habit persistence is set to $\eta_{c} = 0.85$, deliberates from GMM estimation of the Euler equation using data during 1994Q1—2006Q4. The parameter stands for investment adjustment cost is set to $\chi_{t} = 1$, whereas the interest rate smoothing parameter is set to $\rho = 0.961$. The degree of price rigidities is set to $\kappa_{p} = 10$ in order to get the closest value to the research anticipation. With regards to Atta-Mensha and Dib’s (2008), $\tau = 0.5$, is used to explain Thai data on the interest rate spread between the effective lending rate and the effective deposit rate. As in Poutineau and Vermandel (2015), the value of capital share equal to $\alpha = 0.4$ with the sunk cost of 5 so that they can obtain a steady state investment-to-GDP ratio close to 16%. Moreover, the external finance premium $\chi_{E} = 0.5$. Following the Bank of Thailand monetary reports, the expected output growth of 2016 is 3.2 percent per year. Additionally, the committee decided to maintain the growth forecast at 3.2 percent in 2017.

To estimate the impulse responses of Thailand’s economic structure on the extensive margin of activity, the model includes seven structural shock processes: productivity, price and wage markup, fiscal spending, monetary policy, credit rate markup, and collateral shocks respectively. These structure shock processes of the exogenous variables characterized by $\xi_{t}^{E} = \phi_{E}\xi_{t-1}^{E} + \sigma_{E}^{t}$. $E = \{A, P, W, G, R, L, N\}$ where $\phi_{E}$ are autoregressive roots and $\sigma_{E}^{t}$ are standard errors, $\sigma_{E}^{t} \sim N(0, \sigma_{E}^{2})$. With reference to the transformation of the model, the model data set includes ten stationary time series data including quarterly data on Thailand total production $\Delta Y^p_{t}$, consumption $\Delta C^r_{t}$, investment $\Delta I^F_{t}$, amount of hour work $\Delta H^t_{t}$, inflation $\Delta \pi^r_{t}$, real wage $M^t_{t}$, policy rate $R^t_{t}$, firm value $\bar{L}_{t}$, loans $\Delta \bar{B}_{t}$, and lastly the share entry $n_{t}$. To get accurate data, this model focuses on stationary data. However, some data may consist of trend or unit root. The model intended to fix this problem by transform it into real variable, per capita or log term, using the symbol of $\chi_{t}, \chi_{t}^{p}, \chi_{t}^{r}, \chi_{t}^{l}$ respectively. Thus, the model data set can be defined as:

$$\chi_{t}^{obs} = [\Delta Y^p_{t}, \Delta C^r_{t}, \Delta I^F_{t}, \Delta H^t_{t}, \Delta \pi^r_{t}, \Delta M^t_{t}, R^t_{t}, \Delta \bar{B}_{t}, \Delta \bar{L}_{t}, n_{t}]'$$

V. Empirical Results

In what follows, the model focuses on all monetary transmission channels operate. First, evaluates how Thailand economy responds to exogenous monetary and nonmonetary shocks on variables based on the literatures contributed to the extensive margin of activity.
A. The Consequence of Financial Frictions on the Transmission of Nonmonetary Shocks

1) Productivity Shock
The following section contributes to the impulse responses of the productivity shocks. In general, productivity shock involves with sudden changes in firms’ production so as to improve product efficiency or its value. Given nominal rigidities, positive productivity shock amplifies the level of output for a given set of inputs (e.g. labor and capital). Because of positive productivity shock, firms are able to hire a lesser amount of labor and hence reduce firms’ marginal cost (equation 20). When the marginal cost of businesses has been abridged, it enlarges businesses’ profitability as well as the growth of the business’s value (equation 24). Assuming that entrepreneurs face tradeoff between financing in both margins of activity, the reduction in the entry cost as well rising in firms’ value and profitability impact on entrepreneurs’ decisions on doing business. As a result, it attracts more investor to invest on the extensive margin rather than the intensive margin of activity. However, the effect of positive productivity seems to increase the level of output of the economy only for the short time period. The result of this model appears to contradict to the theory’s claims since positive productivity is believed to boost the level of investment on the good market. Correspond to the price level of goods on the good market increase; it results in a large impact on entrepreneurs’ decision and consequently creates negative impact on the level of investment on both margins of activity as the firms’ value is now declined. Overall, the effect of positive productivity only helps increasing the country GDP for a short time period. After ten quarters, the combines’ dynamic of positive productivity reduces both consumption and investment level. In consequence, it weighs on the country’s growth as shown in fig. 3.

2) Price Markup Shock
Consider a shock to the price level set by firm. The positive price markup shock causes a temporary rise in inflation. When the price level goes up, it will immediately impact on the investment levels on the good market, especially the extensive margin of activity. The movement of the price of all goods sold in the economy induces greater number of firm entry. Therefore, firms’ value and profitability are more likely to be less negative (equation 24). Nonetheless, price levels seem to have negative relationship to some macroeconomic indicators. It simultaneously slow down consumption growth and discourage investment, especially the intensive margin of activity due to high cost of factors of production. In the meantime, inflation level lessens the pre-shock level. The investment level turn out to be positive from a long period of depressing. This could potentially impact on entrepreneurs’ decision as they lean toward additional spending on the intensive margin rather than extensive margin of activity. Therefore, the dynamic adjustment both from consumption and investment increase the country’s growth and thus moves closer to the steady state level as displays in fig. 4.
3) Wage Markup Shock
This section evaluates the responses of a temporary increase in the wage rate, as shown in fig. 5. Generally, a rise in wage rate causes inflation. However, this research has shown that it is possible for wages to rise without causing inflation. In this case workers will be better off because wage raises are directly impact on household disposable income as there will be a rise in household revenue. Thus, it translates into higher household consumption after five quarters. Overtime, there will be positive impact on entrepreneurs’ decision on doing business. For the extensive margin of activity, firms have to finance a fraction of their wage bill through loan offered by banking sector (equation 1). The wage bill in advance constraint automatically pushes the cost of the firms ‘production as entrepreneurs have to pay additional compensation on the workers wage bills. These results in higher price of goods on the good market and hence impact on the firms’ sales. As now household gain higher purchasing power, it turns out to boost up firms’ profitability (rising in selling price makes firm becomes more profitable). Since the cost of firm entry requires labor (which related to the cost of wage bill in advance), the expected returns of these firms will be less than investing in the new production line. It in turn persuades entrepreneurs to finance more in existing firms (which now becomes positive).

4) Fiscal Spending Shock
This section analyzes the effects of shocks on government spending. The research focus on the conditions under which an exogenous increase in government expenditure has a positive effect that are significantly amplify the fiscal policy shocks on the level of output and firm entry during the fiscal expansion. Fiscal expansion is generally as increasing in government spending-boosted in order to provide short-term stimulus to help end a recession. Nonetheless, relationship between government expenses and the country growth may depend on factors that can be changed over time. According to fig. 6, by injecting purchasing power into the economy, this shock results in a significant change of inflation level during the five quarters after the shocks period. Moreover, negative relationship between nominal credit rate and loan quantity influences entrepreneurs’ decision on doing business. Thus, it results in a drop in the rate of firm entry in the beginning of shock period. Since inflation level is sharply drop, which is corresponded to a decline in price level on the good market. As observed in the previous section, the price reduction leads to lower entry cost, and increases the firm value. Thus, the extensive margin of activity moves up closer to the steady state level and becomes positive.

B. The Consequence of Financial Frictions on the Transmission of Monetary Shocks
This section devoted to the simulation of the economy dynamics responses over time, be subject to stochastic monetary shocks, and are based on the general equilibrium principle following the literatures related to the extensive margin of activity. The shocks of monetary policy transmission estimated in the model including shock on interest rate channel and bank lending channel (namely credit rate markup and collateral shock).

1) Interest Rate Shock
This shock displays the role of interest rate channel on monetary transmission mechanism in the economy. By theory, the movement of nominal interest rate directly impact on entrepreneurs’ decision on doing business. Expansionary monetary policy is another tool for the authorities that believe to help boosting up the economy through lower interest rates (equation 16). As interest rates decrease, entrepreneurs can take advantage of cheaper loans and easy credit that in turn weight on businesses into expanding. Once the temporary effects of change in the relative input price decline, the price levels on the good market decrease. Consequently, it induces deflation. Overtime, the overall effect would increase the economic activities from greater business projects on investment from both margins of activity, and household purchases. As in fig. 7, a decline the nominal interest rate and credit rate encourages more incentive for lending and investment on both margins of activity. This shock mainly weighs on the extensive margins of activity which become positive after five quarters. This is because lower rate on interest loan result in lower entry cost since entrepreneurs can now pay a lesser amount of wage bills and installment cost in advance during the early stage of installment (equation 1).

Following the monetary policy shocks, the dynamics of both margins of activity lead to further expand in the country GDP.

2) Credit Markup Shock

This shock exhibits the role of bank lending channel on monetary transmission mechanism in the economy. Fig. 8 demonstrates the forecast of the positive credit markup shock. The positive shock in the markup of banking system related to an increasing of exogenous borrowing constraint provided to entrepreneurs (assuming that entrepreneurs depend on interest rate set by the banking system instead of policy rate set by authority). After the interest loan increase, consumption and investment decrease. With regard to investment, this shock negatively impacts on entrepreneurs’ decision on doing business. When the costs of loan to entrepreneurs rise, it reinforces investment during the initial shock period. It immediately leads to higher total wage bills owning to intermediation costs and thus impact on the extensive margin of activity. Rising in the markup of banking activity is not only affected on investment level but also household consumption. It further decline the price of goods sold on the good market and hence induces deflation. As a result, the declines in activities combine a drop in both investments on the two margins of activity. As time goes, the nominal credit rate adjusts and moves closer toward the pre-shock level after ten quarters. In consequence, the term of credit becomes more reasonable together with low price of goods attract the investors to come back on the good market on both margins of activity. However, financing for the new entry are more costly than in existing firm. Consequently, this leads to a larger impact on the intensive margin (which becomes positive).

3) Collateral Shock

With reference to credit markup shock, the collateral shock also related to lending condition provided by banking sector. As collateral is something that helps secure a loan for businesses, a positive collateral shock makes it possible for entrepreneur to get larger loans at a good rate. Fig. 9 depicts the responses of the activities
based on positive collateral shock. For the early quarters, a rise in collateral affects the transformation of consumption into investment. Additionally, it positively impacts on the financing of the new production line rather than the new entry. Due to the shock, the inflation level seem to go up, which contrast to a drop in price of goods sold on the good market, make the extensive margin of activity become less desirable. After about twenty quarters, the number of firm entry becomes positive in respond to the higher firm value (as the selling price of goods tends to be higher).

### VI. Conclusions

To this end, this research formulates and estimates a dynamic stochastic general equilibrium model that incorporates the feature of the extensive margin of activity (i.e. the endogenous number of business entry on Thailand’s goods market). The purpose of the model is to investigate the literature contributed to the combination of frictions (both monetary and nonmonetary shocks), that account for Thailand’s economic fluctuation for the time period of 2000Q1 to 2016Q1. To capture the effects of financial frictions, the researcher took the general assumptions of Poutineau and Vermandel (2015) by adding in wage bill as advanced constraints and the banking sector into the model. As a result, this research finds the evidence supporting their empirical findings in which financial frictions play a key role in determining the number of firms on the good market (i.e. financial circumstances affects the entrepreneurs’ decision to enter into the goods market and hence can be used to replicate real world data). For this research, the monetary transmission channels, both the interest rate and credit channels, can be used to express the dynamic of monetary shocks on both financial and macroeconomic variables of the model. It then creates domino effects on the entrepreneurs’ choice of doing business at both the intensive and extensive margin of activity. Furthermore, the endogenous firm entry implies the countercyclical number of business entry on the goods market toward banks markups and loan spread, hence being in line with the empirical evidence. Likewise, the results of the model impulse responses, accounting for the both monetary and nonmonetary frictions, appear to contradict the core prediction’s claims (i.e. entrepreneurs face a tradeoff in either financing the wage bill for the new entry or renting capital to existing firms). However, the end results of this model confirm a strong relationship between the initial wage bill in advance constraint and the lending conditions of the banking system. Finally, the overall impulse response patterns of the model turns out to be significantly in line with the ones the researcher would have expected using empirical findings based on endogenous firm entry, despite the fact that the amplitude of shocks in some cases appear to differ from the literature related to these sorts of models. This depends on the contribution of financial accelerators that amplify the effects of frictions to the model economy.

### References


