News Shocks and Business Cycle in Emerging Markets

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A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Finance
Department of Banking and Finance
FACULTY OF COMMERCE AND ACCOUNTANCY
Chulalongkorn University
Academic Year 2020

ช็อคจากข่าวและวัฏจักรธุรกิจในกลุ่มประเทศตลาดเกิดใหม่

นายจักรพันธ์ กังวานวิบุล

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
สาขาวิชาการเงิน ภาควิชาการธนาคารและการเงิน
คณะพาณิชยศาสตร์และการบัญชี จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2563

Thesis Title	News Shocks and Business Cycle in Emerging Markets
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Field of Study	Finance
Thesis Advisor	Associate Professor VIMUT VANITCHAREARNTHUM, Ph.D.

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จักรพันธ์ กังวานวิบุล : ช็อคจากข่าวและวัฏจักรธุรกิจในกลุ่มประเทศตลาดเกิดใหม่. (News Shocks and Business Cycle in Emerging Markets) อ.ที่ปรึกษาหลัก : รศ. ดร. วิมุต วานิชเจริญธรรม

งานวิจัยฉบับนี้ศึกษาช็อคจากข่าวในแบบจำลองทางทฤษฎีของวัฏจักรธุรกิจจริงโดยศึกษาเน้นในแง่ของระบบเศรษฐกิจของกลุ่มประเทศตลาดเกิดใหม่ ลักษณะเฉพาะหลายๆอย่าง เช่น ความผันผวนของการบริโภคที่ มากกว่าความผันผวนของรายได้ การไหลออกอย่างกระทันหันของเงินทุน และดุลบัญชีเดินสะพัดที่มีวัฏจักรตรงกันข้ามกับรายได้ โดยลักษณะเฉพาะเหล่านี้ทำให้เราสามารถแยกให้เห็นถึงความแตกต่างของระบบเศรษฐกิจพัฒนาแล้วแบบเปิดขนาดเล็กและระบบเศรษฐกิจของตลาดเกิดใหม่ ซึ่งความแตกต่างนี้ทำให้เกิดเป็นแนวคิด ต่อยอดในการศึกษาต่อจากงานวิจัยก่อนๆที่ได้ศึกษาแค่ในระบบเศรษฐกิจพัฒนาแล้วแบบเปิดขนาดเล็ก งานวิจัยชิ้นนี้ใช้วิธีการจำลองระบบเศรษฐกิจของกลุ่มประเทศตลาดเกิดใหม่ โดยตั้งอยู่บนพื้นฐานของทฤษฎีวัฏจักรธุรกิจจริง ตัวระบบเศรษฐกิจจำลองนี้สามารถใช้จำลองค่าความผันผวน ค่าสหสมพันธ์ และผลตอบสนองอิมพัลส์ ของวัฏจักรธุรกิจในระบบเศรษฐกิจจำลองเพื่อใช้ในการเปรียบเทียบกับข้อมูลจริงได้ ผลของงานวิจัยชี้ให้เห็นว่าช็อคจากข่าวเป็นตัวแปรสำคัญที่ทำให้แบบจำลองมีการพัฒนาเพิ่มขึ้นและอธิบายลักษณะเฉพาะของระบบเศรษฐกิจของตลาดเกิดใหม่ได้ สำหรับค่าโมเมนต์จากแบบจำลองทางทฤษฎีของวัฏจักรธุรกิจจริงที่ถึงแม้จะยังไม่สามารถผลิตค่าให้ใกล้เคียงกับข้อมูลจริง แต่ก็ได้เห็นแบบจำลองมีการพัฒนาที่ดีขึ้นจากการเพิ่มตัวแปรของช็อคจากข่าวในกรอบของระบบเศรษฐกิจของตลาดเกิดใหม่ สำหรับผลตอบสนองอิมพัลส์ที่มีแรงเสียดทานในตลาดแรงงานและช็อคจากความเสี่ยงของผลตอบแทนได้แสดงลักษณะที่คล้ายคลึงกับข้อมูลจริงและสามารถอธิบายวัฏจักรธุรกิจของระบบเศรษฐกิจตลาดเกิดใหม่ได้

สาขาวิชา	การเงิน	ลายมือชื่อนิสิต ....
ปีการศึกษา	2563	ลายมือชื่อ อ.ที่ปรึกษาหลัก ....

6082986026 : MAJOR FINANCE

KEYWORD: News Shocks, Business Cycles, Emerging Markets

Jakkraphan Kangwanvibul : News Shocks and Business Cycle in Emerging Markets. Advisor: Assoc. Prof. VIMUT VANITCHAREARNTHUM, Ph.D.

This study examines news shocks in theoretical real-business-cycle model in the aspect of emerging-market economy. Many features in emerging-market business cycles, such as consumption volatility that exceeds income volatility, sudden stop pattern in capital flows and strongly countercyclical current account to income, distinguish itself from a developed small opened economy, and in this study, it also differentiates itself from previous works in the literature by studying in the aspect of business cycles in emerging markets. The study uses simulation method, developing on real-business-cycle theory to generate artificial business cycle moments and impulse response function. For the result, it considers news shocks is one of the candidates to improve real-business-cycle model. Although the business cycle moments still cannot exactly match the real data, there are the signs of improvement in the model from employing the news shocks within the aspect of emerging-market economy. The impulse response function exhibits in line with real data. It can explain the business cycle during crisis with search and matching friction.

Field of Study:	Finance	Student's Signature ....
Academic Year:	2020	Advisor's Signature ....

ACKNOWLEDGEMENTS

I am deeply grateful to my thesis advisor, Associate Professor Vimut Vanitcharearnthum, Ph.D. for giving me the great opportunities and for the valuable advice and guidance. His support is wholeheartedly appreciated. I also would like to extend my sincere gratitude to the thesis committees, Associate Professor Kanis Saengchote, Ph.D., Narapong Srivisal, Ph.D. and Archawa Paweenawat, Ph.D. for their helpful comments and suggestions.

I would like to dedicate this study to my parents who always support and believe in me. Furthermore, I am thankful to my classmate and staff in MSF Program for their support and encouragement during the period of studying. Lastly, I would like to express my gratitude to everyone who contributes colors into my life during the time of my colorless period. Without them, I might have forgotten what the color of blooming flowers is like. Thank you for making my life to be colorful during this time.

Jakkraphan Kangwanvibul

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Chapter 1

Introduction

Since the emergence of real-business-cycle (RBC) model from Kydland and Prescott (1982), many researchers have tested the validity of standard RBC model that whether the standard RBC model can perform the result, such as correlation and volatility of the variables in the model, that similar to the characteristic of the studying economy. There are many previous attempts that try to do that (See for instance, Rouwenhorst (1991); Simkins (1994); Cogley and Nason (1995) and King and Rebelo (1999)). The main goal of this study is in line with these previous works. This thesis attempts to study the role of news shock for explaining the fluctuations of the business cycle in emerging markets. Thus, the source of fluctuations in this thesis focuses on news shocks or the sudden arriving of today's information about future development of the economy. I do not only intend to study news shocks as source of fluctuations in the business cycle from emerging markets but I also try to investigate trend growth shock in Aguiar and Gopinath (2007) to see if news shock can be a substitution in explaining the business cycle from emerging markets. Hence, the research question is whether news shocks can explain the fluctuation in emerging market's business cycle.

The fundamental of expectation driven business cycle appears in the long tradition of macroeconomics since Pigou (1927) suggests the change in today's expectation about the future economic situations could become a source of fluctuations and one of the drivers in economy. This becomes the early concept about news shocks in the literature. The thought of expectation driven business cycle is revived again when Beaudry and Portier (2006) study the time series data from the index of stock market value and total factor productivity and show that one of the important drivers in business cycle may come from the news about future productivity. Their work contributes to the literature and supports the concept of business cycle fluctuation affected by news. Furthermore, the study itself leads to the growing of news shocks studies. In response of the growing, the microeconomic foundation models that rely on fundamental, such as household's preference or technology, include news shock into the models. It is a bit different compared to the first generation of these models that only rely on productivity shock. This only source of fluctuation can be plainly interpreted that if the shock is positive, it will increase output as a result of increasing from consumption and investment. This shock, again, still has limitation for explaining other economic phenomena. Hence, the adapting of news shocks into the business cycle models may be the light at the end of tunnel. In the previous attempts, many researches study empirically and theoretically based on general small open economy. Only a handful of research that focus on the shock that serving today's information about future growth based on emerging markets. Thus, it becomes the challenging to explore news shocks in the business cycle of emerging markets.

There are many features that distinguish emerging-market economy itself from developed open economy. Consumption volatility that exceeds income volatility, sudden stop pattern in capital flows and strongly countercyclical current accounts, these features are usual in the emerging market business cycle. In the Table 1, for the volatility of consumption in emerging-market economies, it is more volatile than income by about 40 percent. On the other hands, the developed small open economies have the average ratio that is slightly below one. From the data in the table, it implies about the consumption smoothness in developed small open economies compared to those in emerging-market cluster that experience relatively volatile consumption. For Table 2, it represents the correlation of income with consumption, investment and next exports. One striking feature in emerging-market cluster that shows in this table is the negative correlation of net exports and output. The degree is quite large with an average about -0.51 compared to weakly countercyclical current accounts in developed small open economy cluster that about -0.17 on average. These features are the characteristic found in the emerging-markets business cycle and they are one of the main themes studying in emerging markets literature.

Table 1. Relative volatility of consumption, investment and net exports

	$\sigma(C/Y)$	$\sigma(I/Y)$	$\sigma(NX/Y)$
Emerging markets:			
Argentina	1.38	2.53	2.56
Brazil	2.01	3.08	2.61
Ecuador	2.39	5.56	5.68
Israel	1.60	3.42	2.12

Korea	1.23	2.50	2.32
Malaysia	1.70	4.82	5.30
Mexico	1.24	4.05	2.19
Peru	0.92	2.37	1.25
Philippines	0.62	4.66	3.21
Slovak Republic	2.04	7.77	4.29
South Africa	1.61	3.87	2.46
Thailand	1.09	3.49	4.58
Turkey	1.09	2.71	3.23
Mean	1.45	3.91	3.22
Develop markets:			
Australia	0.69	3.69	1.08
Austria	0.87	2.75	0.65
Belgium	0.81	3.72	0.91
Canada	0.77	2.63	0.91
Denmark	1.19	3.90	0.88
Finland	0.94	3.26	1.11
Netherlands	1.07	2.92	0.71
New Zealand	0.90	4.38	1.37
Norway	1.32	4.33	1.73
Portugal	1.02	2.88	1.16
Spain	1.11	3.70	0.86
Sweden	0.97	3.66	0.94
Switzerland	0.51	2.56	0.96
Mean	0.94	3.41	1.02

Source: Aguiar and Gopinath (2007)

Table 2. Contemporaneous correlation with output

	$\rho(C,Y)$	$\rho(I,Y)$	$\rho\left(\frac{NX}{Y},Y\right)$
Emerging markets:			
Argentina	0.90	0.96	-0.70
Brazil	0.41	0.62	0.01
Ecuador	0.73	0.89	-0.79
Israel	0.45	0.49	0.12
Korea	0.85	0.78	-0.61
Malaysia	0.76	0.86	-0.74
Mexico	0.92	0.91	-0.74
Peru	0.78	0.85	-0.24
Philippines	0.59	0.76	-0.41
Slovak Republic	0.42	0.46	-0.44
South Africa	0.72	0.75	-0.54
Thailand	0.92	0.91	-0.83
Turkey	0.89	0.83	-0.69
Mean	0.72	0.77	-0.51
Develop markets:			
Australia	0.48	0.80	-0.43
Austria	0.74	0.75	0.10
Belgium	0.67	0.62	-0.04
Canada	0.88	0.77	-0.20
Denmark	0.36	0.51	-0.08
Finland	0.84	0.88	-0.45
Netherlands	0.72	0.70	-0.19
New Zealand	0.76	0.82	-0.26
Norway	0.63	0.00	0.11
Portugal	0.75	0.70	-0.11
Spain	0.83	0.83	-0.60

Sweden	0.35	0.68	0.01
Switzerland	0.58	0.69	-0.03
Mean	0.66	0.67	-0.17

Source: Aguiar and Gopinath (2007)

I follow the based model in emerging-market economy from Aguiar and Gopinath (2007) and Garcia-Cicco, Pancrazi et al. (2010). Both of their works study on the business cycle in the emerging markets. They both employ productivity shock and shock to trend growth in their model, but there is no news shock included. For this thesis, other than studying the role of news shock in business cycle in emerging markets, I also would like to investigate the news shock as a substitution of shock to trend growth. The reason for this investigating is because Aguiar and Gopinath (2007) suggest that the shock to trend growth can do the remarkable job in explaining the business cycle these markets, compared to the developed markets that have more stable trend. To find the possibility of the substitution, I use news shock that can affect today's expectation of the household from being informed with the future to explain the fluctuations around the trend growth. Thus, instead of including the trend shock into my model, I leave the trend shock aside and include news and other shocks as source of fluctuations to explain the business cycle in emerging markets. For news shock, I also follow the news shock structure from Theodoridis and Zanetti (2014) as another driver of economic fluctuations. Its structure is parsimonious, describing that the technology shock contains today's information about future development. As the shock hit the economy, the information will arrive to household, but the effect of news still does not affect current productivity level. The household can adjust their expenditure according to news in the next period. Furthermore, this study integrates many parts from the literature of emerging markets that is recognized as a workhorse to match with the features of emerging-market economy. Other than news shocks that is the main differentiation, this research set the environment of the emerging-market economy by employing the labor search and matching friction as one of the frictions added in the model. In this model, its role of labor search and matching function is to harmonize the direction of the variables in the model as it is suggested in the literature that search and matching friction helps improving comovement of aggregate variables (Merz (1995) and Andolfatto (1996)), and it help accounting for stylized facts of emerging-market economy (Boz, Durdu et al. 2012). Furthermore, financial friction that appears in Garcia-Cicco, Pancrazi et al. (2010) is included as risk premium shock. It serves as one of the frictions in the model to fluctuate the interest rate of the emerging-market economy. This friction is added in order to match with the instability of interest rate which is one of the features in emerging markets.

Most of the parameters in this study are general and widely used in the literature as standard value from emerging-market economy. Hence, using those values represents a general emerging-market environment. It does not specify into one country's environment. These parameters in the model are calibrated based on emerging-market environment and mostly from the work of Aguiar and Gopinath (2007) and Garcia-Cicco, Pancrazi et al. (2010). For the parameters in matching function, they are calibrated from Boz, Durdu et al. (2012) that study the matching function in emerging market. These parameters are set for determining initial value and steady state of the variables in the model. The simulation is based on MATLAB and Dynare in order to generate business cycle moments and impulse response function through the theoretical model. For the result of this study, it shows the implementing of news shock and risk premium shock in explaining business cycle in emerging-market economy. Firstly, although the model cannot generate the reasonable moments from both shocks, it helps improving some of the business cycle moments in emerging-market economy, such as the volatility of consumption to income ratio that can match with the average of real data from the Table 1 which I use it as the representative of the emerging-market economy, and the sign of improvement in the generated correlation of the model indicates the important of news shocks toward RBC model literature, even though the shock to trend growth is still superior than news shock. For the impulse response function, it exhibits news shocks can explain the period before the economic crisis occurs. At first, news shock leads to economic boom meanwhile it can simultaneously trigger the economic crisis because people reduce their consumption and increase their investment in response of the knowledge about future growth. If the materialization of the information becomes smaller than they expect, the declining in consumption will lead to the decreasing in income. Nevertheless, it still depends on household's expectation and realization toward the news. Another unique characteristic of emerging markets that news shock can match is the countercyclical trade balance. The impulse response function shows the sign of trade deficit during economic boom which is the striking feature in emerging markets.

In explaining the business cycle in emerging markets, as a main contribution, the model that includes news and risk premium shock can explain the fluctuation of business cycle during the economic crisis. The impulse response function depicts the fall in output, private consumption and investment. The trade balance sharply reverses from deficit to be surplus and country's external debt to income ratio suddenly drops. This is similar to the pattern in the real data, described by Akıncı and Chahrour (2018). Furthermore, the model can further explain the empirical evidence found in Gallego and Tessada (2010) in the labor market that in the sectors that the demand external finance leads to the depressing effect of sudden stop event on the job creation. The impulse response function also exhibits the sudden stops that lead to the substantial fall in job creation as suggested in the empirical evidence. Lastly, I surprisingly find out that there is relationship between risk premium shocks and news shocks. Resembling the feature like risk premium shocks in the model reduces economy's response to news shocks. Further investigating this relationship is beyond the scope of this study and the specification of the model. Still, it is considered as the further study in the future. The rest of this thesis looks as follows. Chapter 2 reviews the literature of the news shocks, mainly in theoretical evidence. Chapter 3 is the methodology and the models used in this thesis, including parameters calibration. In the chapter 4, it is about generated business cycle moments, impulse response function and discussing the result. Chapter 5 is the sensitivity analysis based on the parameters of news shocks, and lastly chapter 6 is the conclusion.

Chapter 2

Literature Review

In the first era of studying expectation driven economy, the work starts from Pigou (1927), initiating the concept of the expectation driven business cycle, and since then it becomes the long tradition in macroeconomics. The idea concludes that source of economic fluctuations may come from the changes in expectation of households or agents that perceive the information about future development. Then, in Uhlig (2003a), he searches for the major shock that driven in real GNP based on Vector Autoregressive model and quarterly data from 1964 to 2001. His result shows two shocks that can explain more than 90 percent of variance in GNP. The first shock is a medium-run shock and the impulse responses function from this shock look like the productivity shock as suggested in real business cycle theory. The second shock is a short-run shock that slightly rises GNP and reverts to negative. This shock is harder to interpret compared to the first shock, and it is difficult to separate from the first shock. Accordingly, his result suggests that the medium-shock also contribute in short-run shock path that make it is hard to isolate them. Another evidence in Beaudry and Portier (2006) that support the expectation that driven economy, their work employs Vector Autoregressive model and long run restrictions in order to use shock to learn about economic fluctuations, using stock prices and total factor productivity. The result shows the shock is not standard technology shock because it does not affect productivity in the short run, and it does not look like monetary shock since it affects productivity considerable delay. They suggest the shock to be news about future development opportunities that contain in stock prices. Moreover, it shows the news shock can explain about 50 percent of business cycle. This evidence is in line with the result in Fama (1990) that shows monthly, quarterly and annual stock returns are highly correlated in future growth of production from 1953 to 1987. Fama suggests the relationship of stock returns and future production growth implies the information about future cash flows that implicitly attach in stock prices. For Schmitt-Grohé and Uribe (2012), their result is similar to Beaudry and Portier (2006) that find news shocks can explain about half of predicted business fluctuations, consisting of output, consumption, investment and employment. The empirical evidence found in Beaudry and Portier (2006) leads to the growing of interest in news shock literature from both empirical evidence and theoretical models.

For the studying news shocks in business cycle model, Cochrane (1994) tries to examine the evidence on several shocks; they are productivity shocks, monetary shocks, credit shocks and oil price shocks. He finds that these shocks lack of solid evidence related the source of economic fluctuations. He believes that households who receive the information about future development are likely to adjust their current consumption according to the information they received. Cochrane uses this concept and build the real business cycle model that has the feature of information arriving to households about future development. This theoretical model becomes the first model that combine news shocks into productivity shocks. To dig deeper in the validity of the model with existence of news shocks, Danthine, Donaldson et al. (1998) and Jaimovich and Rebelo (2008) show that the real business cycle model fails to generate the economic boom due to the expectation of the future increases total factor productivity which makes household wealthier, and it causes household to consume more and work less. It, thus, decreases the output, leading to recession instead of the boom. Beaudry and Portier (2007), nevertheless, show that the change of expectation in standard real business cycle model is possible to generate realistic aggregate co-movement amongst consumption, investment and employment at the simple perfect market settings. Furthermore, Jaimovich and Rebelo (2009) study the effects of expectation that driven the small opened economy. Their real-business-cycle model has three more elements exist in the model compared to the simple settings; capital utilization, adjustment cost to investment and a weak short-run wealth effect. The result shows the model can generate aggregate co-movement amongst the variables in the model. However, the generating of the model is held on the condition that short-run wealth effect on the labor supply must be weak.

In the researches that try to study the source of fluctuation in emerging markets, Aguiar and Gopinath (2007) is the first one that try to distinguish the source of fluctuations between developed small open economy and emerging markets. There is a big difference between developed small opened economy and emerging-market economy when come to the sense in the work of

Aguiar and Gopinath (2007) because emerging economy has the specific features, such as the volatility of consumption that exceed the volatility of income, unstable of interest rate and the sudden stop of capital inflow. For Aguiar and Gopinath's model, shock to trend growth does the remarkable job to account for the stylized facts from emerging-market economy. They suggest that fluctuations in the emerging markets mainly come from trend growth rather the stable fluctuation around growth trend in the small open economy. Then, in Garcia-Cicco, Pancrazi et al. (2010), they include financial friction into Aguiar and Gopinath's model, and the result shows that their model with financial friction is more superior than Aguiar and Gopinath's model in explaining Argentina's business cycle. Thus, in order to study emerging-market business cycle, these two works become the core of my model for generating business cycle with emerging-market features. Both of their work discusses on business cycle fluctuations and feature of emerging markets. Their evidences show that the key features of emerging market business cycle are consistent with their standard equilibrium model.

For the news shock that includes into my model, Barsky and Sims (2011) purpose the shock structure that households observe the shock one period in advance. This shock structure is suitable structure as suggested by Barsky, Basu et al. (2015) since the news shock still has no effect on the current productivity level as the shock is recognized. This due to the finding of Beaudry and Portier (2006) from vector error correction models that the shock generates stock price boom but no contemporaneous effect in productivity level. Another component added into my model is search and matching friction. It follows the concept of Mortensen and Pissarides (1994). According to Boz, Durdu et al. (2012), they study the search friction in emerging markets and find that it helps accounting for stylized facts of emerging-market economy. Merz (1995) and Andolfatto (1996) also suggest it can improve comovement amongst aggregate variables. Thus, including frictions in the real-business-cycle model with news shocks is to strengthen the model to explain the fluctuations in emerging markets.

Chapter 3

Methodology

In this study, the emerging markets business cycle model is developed based on the model in Aguiar and Gopinath (2007) and Garcia-Cicco, Pancrazi et al. (2010) as a standard model, and there are the important components added, such as news shock, risk premium shock and search and matching friction to the extended model in order to study the business cycle in emerging markets. The model is a single-good and single-asset small open economy. Household is infinitely lived agents. For the model that included search and match friction, the representative household comprises of a fraction of its members who are employed, and the remaining members are unemployed. All members share the same pool resources and budget constraint. Furthermore, the representative household owns the firm where labor will be hired through search and matching process from both firm and household's members.

3.1 Standard model

Production Function

The production function follows Cobb-Douglas production function with constant return to scale, using capital, K_t, and labor, N_t, as inputs. The parameter α represents capital' share of output where $\alpha \in (0,1)$.

$$Y_t = A_t K_t^{\alpha} N_t^{1-\alpha} \tag{1}$$

The technological shock, A_t, follows AR(1) process with $|\rho_a| < 1$ and ε_t^A is white-noise process. It is the shock that affects the level of productivity or it is equivalent to transitory shock in Aguiar and Gopinath (2007).

$$\ln(A_t) = \rho_A \ln(A_{t-1}) + \varepsilon_t^A \tag{2}$$

Capital's law of motion follows that the capitals used as input are the leftover capitals from depreciation plus the investment for new capital, subtracting the capital adjustment cost.

With capital adjustment costs from Hayashi (1982)

$$-\frac{\theta}{2}\left(\frac{I_t}{K_t}-\delta_K\right)^2 K_t$$

The capital's law of motion becomes

$$K_{t+1} = (1-\delta_K)K_t + I_t - \frac{\theta}{2}\left(\frac{I_t}{K_t}-\delta_K\right)^2 K_t \tag{3}$$

Utility function

$$E_0\sum_{t=0}^{\infty}\beta^t\left[\ln(C_t-\gamma C_{t-1})-\psi\frac{N_t}{1+\chi}^{1+\chi}\right] \tag{4}$$

The stream of the utility is log function with habit formation, γ, subjected to the resource constraint that household choose to maximize their consumption investment in capital and paying debt, given the resource available: the income, the amount of capital leftover from depreciation, capital adjustment cost, profit from firm, government transfer, and amount of money from borrowing, discounted by international interest rate. Last term is the posted job vacancy fees.

$$C_t + I_t + B_t = r_tK_t + w_tN_t + (1-\delta_K)K_t - \frac{\theta}{2}\left(\frac{I_t}{K_t}-\delta_K\right)^2 K_t$$
$$+\pi_t + g_t + \frac{B_{t+1}}{(1+r_t)} - \kappa v_t \tag{5}$$

The international interest rate takes the functional form used in Schmitt-Grohé and Uribe (2003) and Aguiar and Gopinath (2007) where the interest rate is affected by the level of debt.

$$r_t = r^* + \Delta[exp^{B_{t+1}-b}-1] \tag{6}$$

The equation above describes the borrowing rate in domestic country, where r^*stands for world interest rate, Δ is the elasticity of the interest rate to change in indebtedness and b is the steady state level of debt in domestic country. Additionally, the second term on the right-hand side can be interpreted as risk premium.

Households maximize the discounted expected future flow of the utility,

$$\max_{\{C_t, I_t, K_{t+1}, N_t, B_{t+1}\}} E_0 \left[\sum_{t=0}^{\infty} \beta^t \left(\ln(C_t - \gamma C_{t-1}) - \psi \frac{N_t^{1+\chi}}{1+\chi} \right) \right] \tag{7}$$

Subject to constraints

$$C_t + I_t + B_t = r_t K_t + w_t N_t - \frac{\theta}{2} \left(\frac{I_t}{K_t} - \delta_K \right)^2 K_t + \pi_t + g_t + \frac{B_{t+1}}{(1+r_t)} - \kappa v_t \tag{8}$$

$$K_{t+1} = (1 - \delta_K) K_t + I_t \tag{9}$$

Rewrite it in Lagrangian

$$Max\ E_0 \left[\sum_{t=0}^{\infty} \beta^t \left(\ln(C_t - \gamma C_{t-1}) - \psi \frac{N_t^{1+\chi}}{1+\chi} \right) \right] + E_0 \sum_{t=0}^{\infty} \lambda_t \left(r_t K_t + w_t N_t - \frac{\theta}{2} \left(\frac{I_t}{K_t} - \delta_K \right)^2 K_t + \pi_t + g_t + \frac{B_{t+1}}{(1+r_t)} - \kappa v_t - C_t - I_t - B_t \right) + E_0 \sum_{t=0}^{\infty} \phi_t \left((1 - \delta_K) K_t + I_t - K_{t+1} \right)$$

First order conditions with respect to $\{C_t, K_{t+1}, I_t, B_{t+1}, N_t\}$ are given by

$$\frac{1}{C_t - \gamma C_{t-1}} - E\beta \left[\frac{\gamma}{C_{t+1} - \gamma C_t} \right] = \lambda_t \tag{10}$$

$$\phi_t = E_t \beta \left[\lambda_{t+1} \left(r_{t+1} - \left(\frac{\theta}{2} \right) \left(\frac{I_{t+1}}{K_{t+1}} - \delta_K \right)^2 + \theta \left(\frac{I_{t+1}}{K_{t+1}} - \delta_K \right) \left(\frac{I_{t+1}}{K_{t+1}} \right) \right) \right] + E_t[\phi_{t+1}(1 - \delta_K)] \tag{11}$$

$$\phi_t = \lambda_t \left(1 + \theta \left(\frac{I_t}{K_t} - \delta_K \right) \right) \tag{12}$$

$$\lambda_t \frac{1}{(1+r_t)} = E_t \beta [\lambda_{t+1}] \tag{13}$$

$$\lambda_t w_t = \psi N_t^{\chi} \tag{14}$$

In this context, Euler equation is given by

$$\lambda_t \left(1 + \theta \left(\frac{I_t}{K_t} - \delta_K\right)\right) =$$

$$E_t \beta^t \lambda_{t+1} \left[\begin{array}{c} \left(r_{t+1} - \left(\frac{\theta}{2}\right)\left(\frac{I_{t+1}}{K_{t+1}} - \delta_K\right)^2 + \theta \left(\frac{I_{t+1}}{K_{t+1}} - \delta_K\right)\left(\frac{I_{t+1}}{K_{t+1}}\right) \right) \\ + \left(1 + \theta\left(\frac{I_{t+1}}{K_{t+1}} - \delta_K\right)\right)(1 - \delta_K) \end{array} \right] \tag{15}$$

3.2 Augmented Real business cycle model

I extend the standard model in the previous subsection to test the effect of news shock or an arriving of information about future development to the household before it can be materialized. Furthermore, I employ more settings for emerging-market economy; for instance, the model includes risk premium shock which is the feature of emerging-market economy that has unstable interest rate. Another feature in the model is search and matching friction that play an important role in enhancing the co-movement among macroeconomic variables.

News shock

News shock, z_t, represents today's information that arrive to household in order to inform them about future development of economy or the positive news shock. The information affect household about future expectation, and they make household to adjust itself according to the shock. In the model, at current period, household has the knowledge about future development, but household adjusts itself in the next period as the shock become materialized. The news shock structure follows AR (1) process with $|\rho_z| < 1$ and ε_t^z is white-noise process. The parameter ρ_z is the rate of news diffusion as described in Barky and Sims (2011), whereas ε_t^z represent the innovation that will be materialized in $t+1$ period, and since it is the information about the future development that affect household's expectation, it doesn't have contemporaneous effect on the current level of technology.

$$z_t = \rho_z z_{t-1} + \varepsilon_t^z \tag{16}$$

This arriving of about future development is contained in the productivity shock that act as unanticipated shock. Thus, autoregressive of news shock is embedded in the productivity shock as follow.

$$\ln(A_t) = \rho_A \ln(A_{t-1}) + z_{t-1} + \varepsilon_t^A \tag{17}$$

Risk premium shock

One of the main features of emerging-market country is the unstable of interest rate. In the subsection, I use risk premium shocks to fluctuate the interest rate of the economy that is used in international transactions, following the work of Garcia-Cicco, Pancrazi et al. (2010) that study on emerging market and found this shock is important for emerging-market economy. Thus, the risk premium shocks of the country are added in the form

$$r_t = r^* + \Delta[exp^{B_{t+1}-b} - 1] + exp^{d_t - 1} - 1 \tag{18}$$

Where d_t represents the exogenous stochastic country-premium shock following the AR (1) process and ε_t^d is white-noise process.

$$\ln(d_t) = \rho_d \ln(d_{t-1}) + \varepsilon_t^d \tag{19}$$

Search and matching friction

In labor market, there are people who unemployed, u_t, and firms who post the vacancies, v_t, to the labor market. Both unemployed people and firms can meet and be matched for getting a job or getting a labor in matching function, $m_t(v_t, u_t)$. The matching function has a constant return to scale where $\varphi \in (0,1)$.

$$m_t = \mu u_t^{\varphi} v_t^{1-\varphi} \tag{20}$$

Where μ is the scaling factor and φ is the elasticity of matching respect to unemployment. The number of labor force is normalized equal to unity, so that the number of unemployed people is equal to $u_t = 1 - N_t$. The market tightness, x_t, represent how crowded of jobs posted from several firms to unemployed people.

$$x_t = \frac{v_t}{u_t} \tag{21}$$

The probability for unemployed people is the number of people who get matched to the total unemployed people.

$$p_t = \frac{m_t}{u_t} \tag{22}$$

The probability for vacancies to be filled is the number of people who get matched to the total amount of vacancies posted from the firm.

$$q_t = \frac{m_t}{v_t} \tag{23}$$

Lastly, the labor's law of motion describes the dynamics of the input labor that total labor is the sum of the labors that survive job separation or job destruction plus the new labors that just get matched in this period.

$$N_t = (1 - \delta_N)N_{t-1} + q_t v_t \tag{24}$$

Finding the profit maximization of the firm under search and matching friction that subject to the labor's law of motion. The stream of firm's profit maximization is

$$E_0 \sum_{t=0}^{\infty} \beta^t \lambda_t [Y_t - w_t N_t - r_t K_t - \kappa v_t] \tag{25}$$

Rewriting in Lagrange form as

$$\mathcal{L} = \max_{\{N_t, v_t\}} \{[Y_t - w_t N_t - r_t K_t - \kappa v_t]\} + \zeta_t \big((1 - \delta_N)N_{t-1} + q_t v_t - N_t\big)$$

The Lagrangian shows the profit maximization of the firm. The profits are the residual after firms sell all of output, subtracting wage paid, rental fee and job vacancy posting cost, κ. Firm's profit maximization is subjected to the labor's law of motion that determines the number of the labor in the firm where ζ_t is a Lagrange multiplier.

Finding the first order condition respect to N_t, K_t and v_t, it yields

$$w_t = (1-\alpha)\frac{Y_t}{N_t} - \zeta_t + (1-\delta_N)\beta E_t\left[\left(\frac{\lambda_{t+1}}{\lambda_t}\right)\zeta_{t+1}\right] \tag{26}$$

$$r_t = \alpha\frac{Y_t}{K_t} \tag{27}$$

$$\kappa = q_t\zeta_t \tag{28}$$

The rental rate is set to be equal to domestic interest rate of the economy. I combine equations (27) and (29), creating the job creation condition same as in the search and matching literature.

$$\frac{\kappa}{q_t} = (1-\alpha)\frac{Y_t}{N_t} - w_t + (1-\delta_N)\beta E_t\left[\left(\frac{\lambda_{t+1}}{\lambda_t}\right)\frac{\kappa}{q_{t+1}}\right] \tag{29}$$

The meaning of this equation describes the firm's behavior in offering the vacancy to the labor market. The left-hand side is the marginal cost of the firm or the marginal cost of vacancy posting. For the right-hand side of equation, it shows the marginal benefit of the firm from getting one more labor. Thus, firm will keep offering the jobs until the marginal cost is equal to marginal benefit.

Bargaining Wage Solution

In the search and matching framework, there will be the surplus that occurs from both labor side and firm side, and some of the total surplus will be distributed to household as a bargaining wage, depending on the bargaining power of the household that can negotiate to the firm. Generally, labor can receive the wage that is determined by the fraction of the total surplus that occurs in the economy. The households will have people who are employed and unemployed through search and matching. An agent who is employed will have following value function.

$$V_t^N = \lambda_t w_t - \psi {N_t}^{\chi} + \beta\left[(1-\delta_n)E[V_{t+1}^N] + \delta_n E[V_{t+1}^u]\right] \tag{30}$$

While agent who is unemployed

$$V_t^U = \beta\left[p_t E[V_{t+1}^N] + (1-p_t)E[V_{t+1}^U]\right] \tag{31}$$

The worker surplus comes from people who have a job and those who do not get hired to work

$$\begin{aligned} V_t^N - V_t^U = {} & \lambda_t w_t - \psi {N_t}^{\chi} + \beta\left[(1-\delta_n)E[V_{t+1}^N] + \delta_n E[V_{t+1}^U]\right] \\ & - \beta\left[p_t E[V_{t+1}^N] + (1-p_t)E[V_{t+1}^U]\right] \end{aligned} \tag{32}$$

Rearrange the equation will yield

$$V_t^N - V_t^U = \lambda_t w_t - \psi {N_t}^{\chi} + \beta\left[(1-\delta_n - p_t)E[V_{t+1}^N] - E[(1-\delta_n - p_t)V_{t+1}^U]\right] \quad (33)$$

In term of goods

$$S_t^h = w_t - \bar{w}_t + \beta(1-\delta_n + p_t)E\left[\frac{\lambda_{t+1}}{\lambda_t} S_{t+1}^h\right] \quad (34)$$

The equation above tells us that the household surplus, S_t^h, is equal to the bargaining wage, w_t, given by the firm, subtracting the opportunity cost of holding a job, $\bar{w}_t$, or the disutility from working, and the last term is the expected surplus in the next period if this worker can survive job separation or job destruction.

On the other hands, the firm has the value function where the residual from paying wage to worker and getting expected cost that will be save if the worker survives job destruction because firm does not need to advertise its job vacancy. For the household side, the labor surplus is equal to the bargaining wage, w_t, given by the firm, subtracting the opportunity cost of holding a job, $\bar{w}_t$, or the disutility from working, and the last term is the expected surplus in the next period if this worker can survive job separation or job destruction.

$$V_t^f = \lambda_t\left((1-\alpha)\frac{Y_t}{N_t} - w_t\right) + \beta\left[(1-\delta_n)E[V_{t+1}^F]\right] \quad (35)$$

In term of goods

$$S_t^f = (1-\alpha)\frac{Y_t}{N_t} - w_t + \beta(1-\delta_n)E\left[\frac{\lambda_{t+1}}{\lambda_t} S_{t+1}^f\right] \quad (36)$$

For the firm surplus, S_t^f, it comes from the net of output per labor, subtracting the wage that pays to labor, and plus the expected surplus in the next period if the job in the firm survives job separation or job destruction. Specifically, the expected surplus in the next period is the same as the cost that firm can save from posting a vacancy because labor survived the job separation or job destruction.

Now the surplus from both worker side and firm side can derive the bargaining wage by using the fact that labor can receive the wage that is determined by some fraction of the total surplus that occurs in the economy. The Greek letter η determines the bargaining power of the household.

$$S_t^h = \eta\left(S_t^h + S_t^f\right) \tag{37}$$

The equilibrium wage for household is

$$S_t^h = \frac{\eta}{1-\eta} S_t^f \tag{38}$$

Substitute both S_t^h and S_t^f

$$(1-\eta)\left(w_t - \overline{w}_t + \beta(1-\delta_n + p_t)E\left[\frac{\lambda_{t+1}}{\lambda_t}\frac{\eta}{1-\eta}S_{t+1}^f\right]\right)$$
$$= (\eta)\left((1-\alpha)\frac{Y_t}{N_t} - w_t + \beta(1-\delta_n)E\left[\frac{\lambda_{t+1}}{\lambda_t}S_{t+1}^f\right]\right) \tag{39}$$

After doing the algebra, the equation that determine the real wage for worker will be

$$w_t = \eta\left[(1-\alpha)\frac{Y_t}{N_t} + \beta p_t E\left[\frac{\lambda_{t+1}}{\lambda_t}S_{t+1}^f\right]\right] + (1-\eta)[\overline{w}_t] \tag{40}$$

Equation (29) can also represent as the firm surplus when there is no need for hiring one additional worker. By using the fact that $S_t^f = \zeta_t$, It yields the following wage bargaining solution equation.

$$w_t = \eta\left[(1-\alpha)\frac{Y_t}{N_t} + \beta p_t E\left[\frac{\lambda_{t+1}}{\lambda_t}\frac{\kappa}{q_{t+1}}\right]\right] + (1-\eta)[\overline{w}_t] \tag{41}$$

This equation can be thought that labor's wage is paid from 2 parts: the first one is paid from some amounts in the surplus of the firm that labor can create the value for the firm, and the second one is kind of some amounts of the labor's opportunity cost from unemployment for being employed.

Trade Balance

Lastly, closing the model with aggregate constraint and defining trade balance.

$$TB_t = Y_t - C_t - I_t - \kappa v_t - \frac{\theta}{2}\left(\frac{I_t}{K_t} - \delta_K\right)^2 K_t \tag{42}$$

Trade balance or current account is determined by the aggregate output which subtract by domestic consumption, domestic investment, job vacancy posted fees and capital adjustment cost. In the other words, the trade balance is the net export. Furthermore, the trade balance can be viewed in another aspect as financial account. It can be illustrated in another form as

$$TB_t = \frac{B_{t+1}}{(1 + r_t)} - B_t \tag{43}$$

The equation (43) represents the definition of balance of payment that shows net capital flow of the economy. For instance, as trade balance become deficit then household must borrow money from international transaction to pay the deficit. Thus, the amount of money borrowed become the capital inflows into the economy; it is vice versa for opposite case.

To proceed with this study, these constructed models are calibrated with the real data from emerging markets. I use the benchmark parameters in emerging-market literature. They are standard values and widely used among the literature. Furthermore, this research does not specify to one country or concern to specific characteristic in one country, thus using the standard parameters from the literature as the representative of emerging markets seem to be applicable.

3.3 Parameters Calibration

The structure of these models is based on small opened economy. I calibrate the parameters in the model using standard values from the emerging-markets literature. A period in the model represent a quarter. There are totally 21 parameters in the models $\{\beta, \psi, \chi, \alpha, r^{*}, \Delta, b, \theta, \delta_K, \delta_N, \mu, \varphi, \kappa, \eta, \gamma, \rho_a, \rho_z, \rho_d, \sigma_a, \sigma_z, \sigma_d\}$ and 3 persistent autoregressive processes of the exogenous shocks $\{\varepsilon_t^a, \varepsilon_t^z, \varepsilon_t^d\}$. These are detailed in the Table 3.

Table 3: Calibration of the emerging-markets economy

Discount factor	β	0.98
Scaling parameter for disutility of supplying labor	ψ	1
Inverse of the Frisch elasticity of labor supply	χ	3.0303
Capital share in production	α	0.32
Risk-free world interest rate	r^{*}	0.030029
Coefficient on interest rate premium	Δ	0.001
Steady-state normalized debt	b	10%
Capital adjustment cost	θ	4
Capital depreciation rate	δ_K	0.05

Job destruction rate	δ_N	0.06
Matching efficiency	μ	0.687
Elasticity of the matching function with respect to aggregate unemployment	φ	0.5
Unit cost of posting vacancy	κ	0.1276
Bargaining power	η	0.5
Habit formation	γ	0.85
Autoregressive coefficient in productivity shocks	ρ_a	0.94
Autoregressive coefficient in news shocks	ρ_z	0.90
Autoregressive coefficient in country premium shocks	ρ_d	0.91
Standard deviation of productivity shocks	σ_a	0.0046
Standard deviation of news shocks	σ_z	$\sigma_a = \sigma_z/(1-\rho_z)$

Standard deviation of country premium shocks	σ_d	0.000111

The quarterly discount factor, β, is set to be equal to 0.98. The inverse of the Frisch elasticity of labor supply, χ, is 3.0303, according to the OLS estimation from Bank of Thailand and implying that wage elasticity of labor supply is set at 0.33 which is relative to the value in the literature within the ranges of 0.25-0.4 and 0-0.35. I set scaling parameter for disutility of supplying labor, ψ, to 1, meaning that no scaling for the disutility. The capital exponent or capital share, α, in production function is 0.32, corresponding to emerging-market literature. For risk-free world interest rate, this one is set to satisfy the condition in Aguiar and Gopinath (2007) that $\beta(1+r^*) = e^{\mu_g(1-\tau(1-\sigma))}$, given time devoted to laboring, τ, is 0.36 and risk aversion, σ, is equal to 2. The coefficient on interest rate premium is set at 0.001 which is the value that used in Schmitt-Grohe and Uribe (2003) and Neumeyer and Perri (2005). The steady-state level of normalized debt is set at 0.1. In capital accumulation process, capital adjustment cost, θ, is set to be equal to 4 while the depreciation rate in capital is 5%. Both values are the same value used in Aguiar and Gopinath (2007) for small open economy models. For the parameters in matching friction part, the job destruction rate per quarter is 6% and the efficiency of matching in matching function is set at 0.687. The unit cost of posting vacancy is set according to the assumption that the aggregate cost of recruiting to GDP ratio is 10%, thus unit cost of posting a job is $\kappa v^* = 0.1$ and in this case it becomes 0.1276. For the bargaining power in the negotiation of wage, it is set at 0.5 which is the number used in the literature. These values are used for search and matching friction in Boz, Durdu et al. (2012). The habit formation parameter is set according to Bank of Thailand which is 0.85. Lastly, the autoregressive processes both persistency of the productivity shock, ρ_a, and news shock, ρ_z, are set at 0.94 and 0.90, respectively. According to Garcia-Cicco, Pancrazi et al. (2010), the persistency of the risk premium shock is set at 0.91. For the standard deviation of productivity shock, Aguiar and Gopinath (2007) set it equal to 0.0046 while the standard deviation of news shock is set with condition that $\sigma_a = \sigma_z/(1-\rho_z)$ sine it would be difficult to extract it from productivity shock. The values in the autoregressive process section comes from Aguiar and Gopinath (2007) and Barsky and Sims (2011). The standard deviation of risk premium shocks is set according to the calibration to be 0.000111.

Chapter 4

Results

Business cycle moments

In this subsection, I provide the result from simulation for theoretical moments using the parameters in the previous section. For the comparison, I construct 3 models, comprising of the standard model (1) that based on the idea of Aguiar and Gopinath (2007). The model excludes trend shock which is one of the two main shocks in their original work. The reason is because I would like to find the substitution of the trend shock whether the shock like news or risk premium shocks can play the same role as trend shock in the emerging markets. For the second model (2), I include news shock and the search friction into the standard model. The third model (3) is integrated with risk premium shock into the second model. The average of the real data in emerging markets are from Aguiar and Gopinath (2007). For the result as shown in the Table 4, it shows that the shocks and friction can improve some of theoretical moments and correlation from theoretical models. Even though they underperform the real data, there is a significance of improvement.

Table 4: Empirical and Simulated Moments

Quantity	Data	Models			
	Average of Emerging Markets[1]	Aguiar and Gopinath (2007): Mexico	Standard Model (1)	News Shock (2)	News Shock and Risk Premium Shock (3)
$\sigma(C)/\sigma(Y)$	1.45	1.26	0.66	1.16	1.45
$\sigma(I)/\sigma(Y)$	3.91	2.60	2.57	1.44	1.64
$\rho(C,Y)$	0.72	0.94	0.87	0.52	0.36
$\rho(I,Y)$	0.77	0.92	0.10	0.32	0.17
$\rho\left(\frac{TB}{Y},Y\right)$	-0.51	-	0.01	-0.08	0.03

[1] Source: Aguiar and Gopinath (2007)

For the performance of volatility, the third model (3) with both news shock and risk premium shock can generate a moment that match with average of the real data. The volatility of consumption to the volatility of income ratio from the third model (3) can match with the real data surprisingly, implying that this model can match with one of the unique characteristics in emerging markets. Adding the risk premium shock yields the slight enhancement of the performance in the model as it shows in the improvement in term of the volatility in third model (3). On the other hands, the generated volatility of investment to the volatility of income ratio from both second (2) and third model (3) still underperform from the real data in emerging markets.

For the correlation between variables in each model, the standard model can generate a reasonable correlation between consumption and income that in line with the real data. In the second models, adding frictions strengthens the correlation between investment and income, and another pair is between trade balance to income ratio and trade balance. There are some penalties in adding news shock, and the risk premium shock as a feature of emerging-market economy. Including those shocks lower the correlation between consumption and income. For the risk premium shock, moreover, the penalty is a bit severe in the correlation between investment and income. Nonetheless, including risk premium shocks into the model seem to be a trade-off. Although it helps improving the volatility of those ratios, it yields the bad performance and weakens some correlation in the model. Ultimately, the result concludes that even though news shock or risk premium shock cannot substitute the shock to trend growth in Aguiar and Gopinath (2007), they help improving the performance of the model in term of the volatility and correlation instead.

Impulse response function

There are 3 types of the shock simulated in this study; the first one is productivity shock, the second one is news shock and the last one is risk premium shock, and in this subsection, I emphasize on the third model that contains all shock. As stimulating, all shock happens at the same time, but the result of impulse response function from each shock is separated. Hence, the following results represent the economy and the behavior of household at the same starting point and time length.

In responding of productivity shock, output, consumption and investment increase as predicted by theory while the unemployment rate rises after the shock hit the economy. To explain this phenomenon, firstly, the household side is richer due to the shock, and it triggers the wealth effect from the household side. After having been hit by the shock, households are richer due to increase in income, thus they opt to shift from participating in finding a job to consumption. Hence, the sharp increase in consumption causes the rising in the unemployment rate. On the firm side, the amount of vacancy posting to labor market also decline drastically since the increasing in bargaining wage leads to the declining in marginal revenue of the firm. According to job vacancy posting condition which profit maximization condition is where marginal benefit must be equal to marginal cost, firm, thus, decreases amount of job vacancy posting until marginal benefit is equal to marginal cost. This phenomenon exhibits in the rising of bargaining wage and declining of job vacancy posted. The amount of matching between job vacancy and people who are unemployed fall at first because of wealth effect and firm decision. It then reverses back to be rising as bargaining wage declines.

For the news shock, it tells us that people are suddenly informed about future productivity development of the economy. There is no guarantee that the development will surely occur. Thus, the role of this shock is to affect the expectation of the household. In case the households believe that the development will occur, they will adjust themselves in accordance with the news they are informed. The shock to expectation causes output and investment rise as usual while consumption declines drastically below the trend because of news. The phenomenon is opposite to the dynamic of the consumption in the productivity shock that the consumption increases and then moves back to equilibrium. This happens in the same manner as suggested in Akinci and Chahrour (2018) that the budget constraint hit by news shock induces consumption to fall substantially. Den Haan and Kaltenbrunner (2009) also explain this phenomenon as the persistence of investment from news shock. To elaborate more about this phenomenon, household choose to reduce their consumption and invest more on capital, leading to the persistence in the dynamic of capital accumulation which is the same as suggested by Den Haan and Kaltenbrunner (2009). In the other words, the news shock leads to the fall of consumption, shifting to the investing in capital. Hence, it shows that this shock contracts the consumption of the economy. In search and matching friction, the unemployment rate substantially falls from the equilibrium and gradually reverse back while the job matching become spiked at the same time of decreasing in unemployment rate. The bargaining wage behaves like a humped shape because of growing output that agents keep investing in capital instead of consuming and the rising in employment. Since the wage rate is negotiated based on output, increasing in output always leads to rising of the wage rate.

In the effect of risk premium shock, a sudden increasing of the interest rate makes investment and bond issue plummet. The declining of investment reduces the accumulation of capital which affect to the sudden drop of output in the next period, leading to the declining of consumption as output decreases. For the trade balance, it sharply increases, and according to the definition of balance of payment, meaning that it causes the sudden stop in capital flows, namely sudden stop phenomenon. To pay attention to this phenomenon in the labor market, the bargaining wage significantly decline due to the decrease of output. Simultaneously, the decline in output leads to falling in marginal productivity of labor. As output per labor decreases, it encourages firm to reduce the creating of job vacancy from firm. This evidence found can explain the empirical evidence from Gallego and Tessada (2010) that sudden stop lower job creation.

Summary of the Results and Discussion

Positive news shock shows the sign of improvement in the model in the aspect of volatility and correlation. Yet, the artificial data generated by the model still underperform to match with the real data. In the simulation of impulse response function, the model generates the business cycle that in line with the real data. The news shock or shock to the expectation of household generates the contraction in consumption. This phenomenon is likely to become the economic crisis if only materialization from news is smaller than household's expectation. For example, the amount of consumption that household gives up to investment yields less benefits than they expect. The arriving of news affects expectation and realization rather than the fundamentals; thus, it could trigger the economic crisis if household fails to realize the news. For instance, in the recession of 2001 and 2008 crisis, Barsky, Basu et al. (2015) explain that news is a casual explanation of the crisis at the time. Since people are excessively optimistic toward the expected high-growth rate, they expect the growth of economy will carry on. It finally causes the economic crisis. Hence, it depends on the realization of the household that determine the situation whether it leads to economic crisis.

Furthermore, including risk premium shock into the model can explain the emerging-market business cycle during the crisis. The impulse response function exhibits the fall in output, private consumption and investment. The trade balance to income ratio sharply reverse and country's external debt to income ratio suddenly drops. In the labor market, the model can theoretically explain the effect of sudden stop toward the labor market. As suggested by Gallego and Tessada (2010), the economy that demand external finance leads to the depressing effect from sudden stop event toward the job creation. The model explains this phenomenon as the sudden increase of interest rate that occur from risk premium shock causes the fall in country's external debt, investment and consumption in the first period. Accordingly, output falls but the trade balance increases because of declining in consumption and investment. This causes the sudden stop in capital flows since the economy does not need to issue debt to pay for the trade balance that is usually deficit as the emerging-market feature. In the labor market, in the consequence of falling in output, it makes the marginal productivity or output per labor drop. This causes marginal benefit of the firm decline, and it also affects the job creation that condition on marginal benefit of the firm. Lastly, firm reduces their job vacancy in order to maintain job creation condition.

Figure 1.1: Impulse response of the economy in response to productivity shocks.

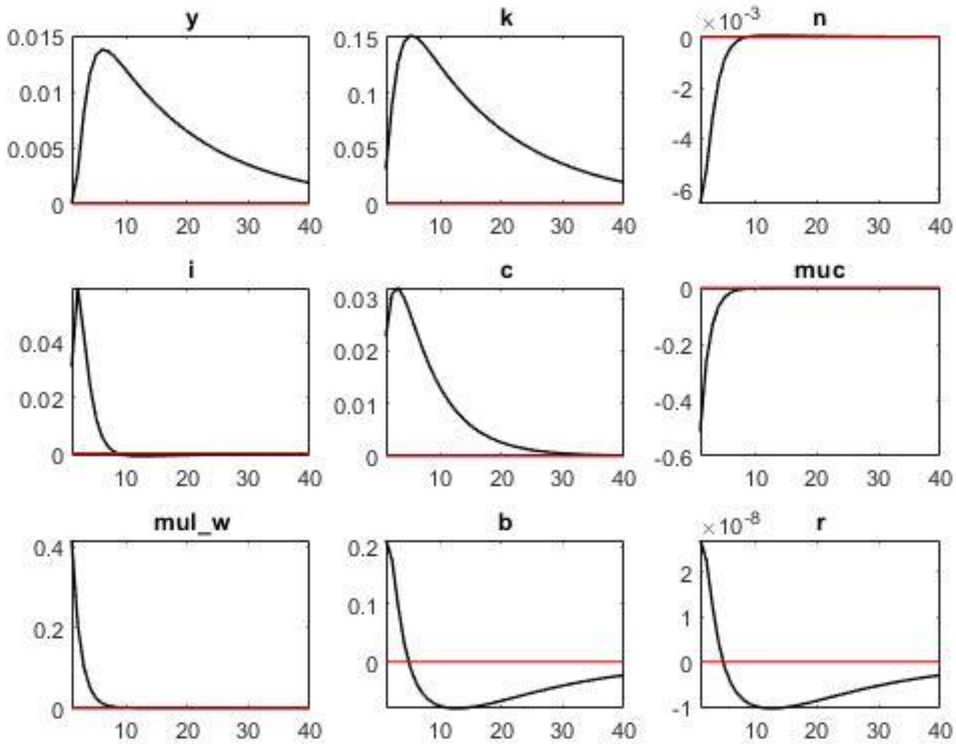


Figure 1.2: Impulse response of the economy in response to productivity shocks.

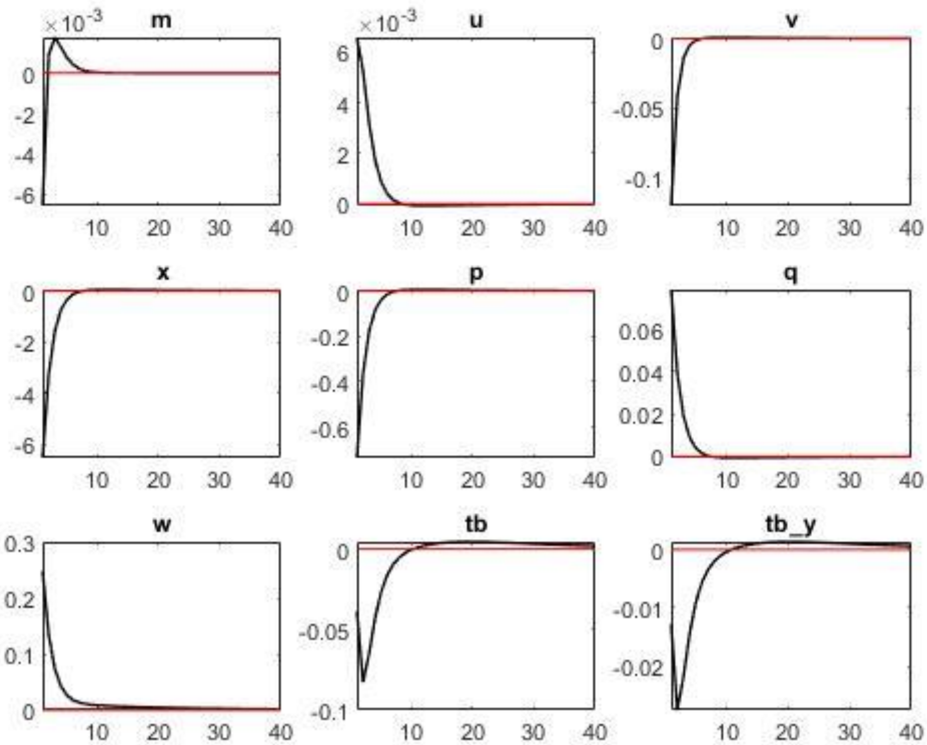


Figure 1.3: Impulse response of the economy in response to productivity shocks.

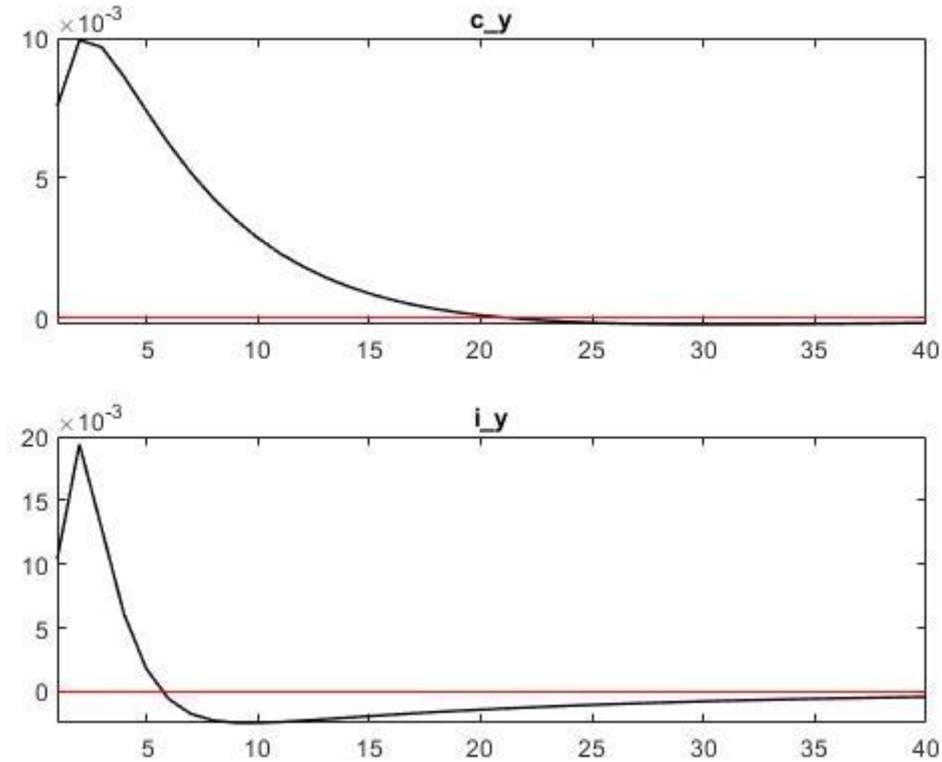


Figure 2.1: Impulse response of the economy in response to news shocks.

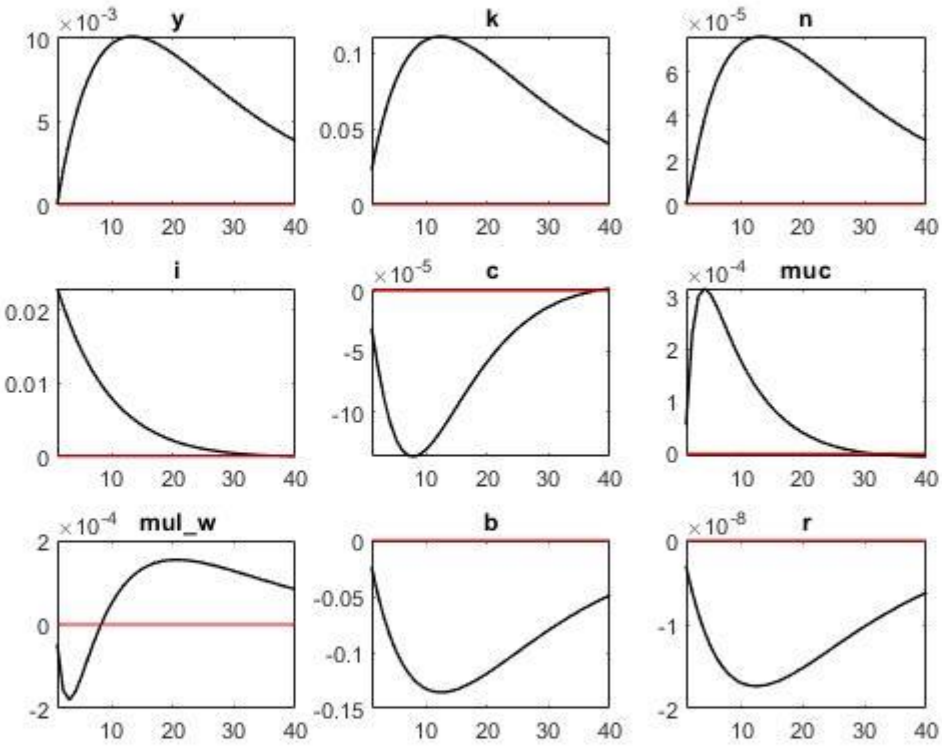


Figure 2.2: Impulse response of the economy in response to news shocks.

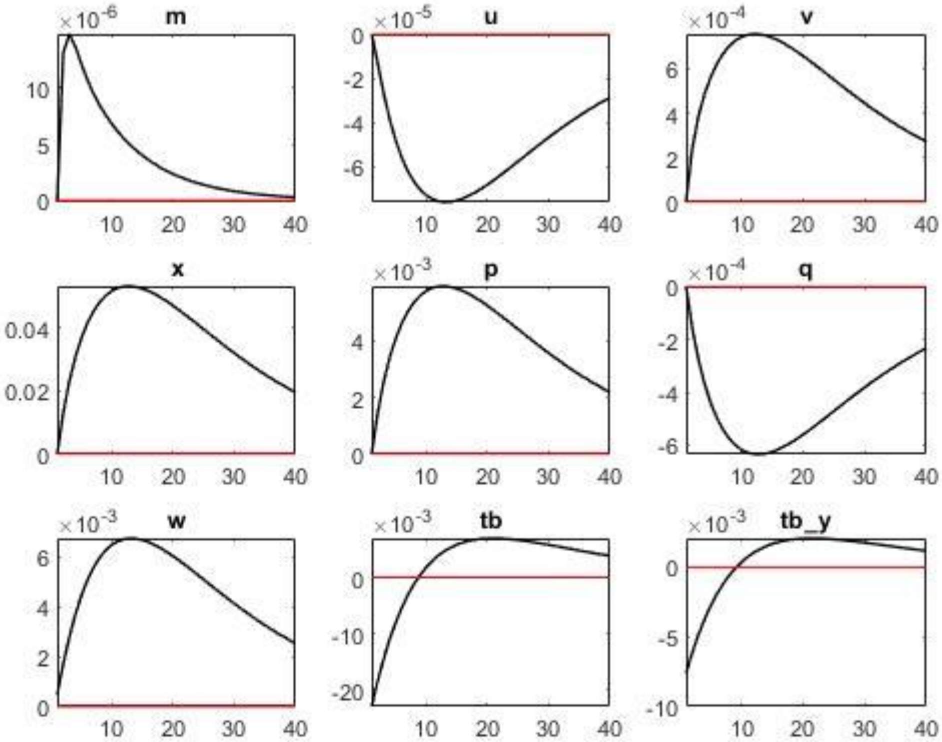


Figure 2.3: Impulse response of the economy in response to news shocks.

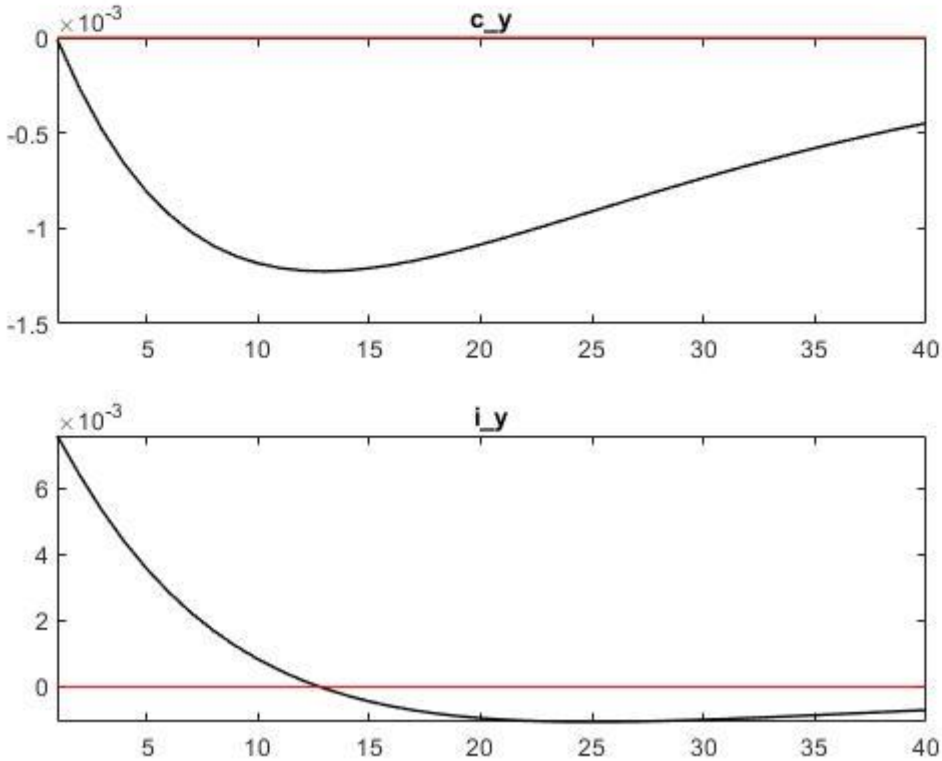


Figure 3.1: Impulse response of the economy in response to risk premium shocks.

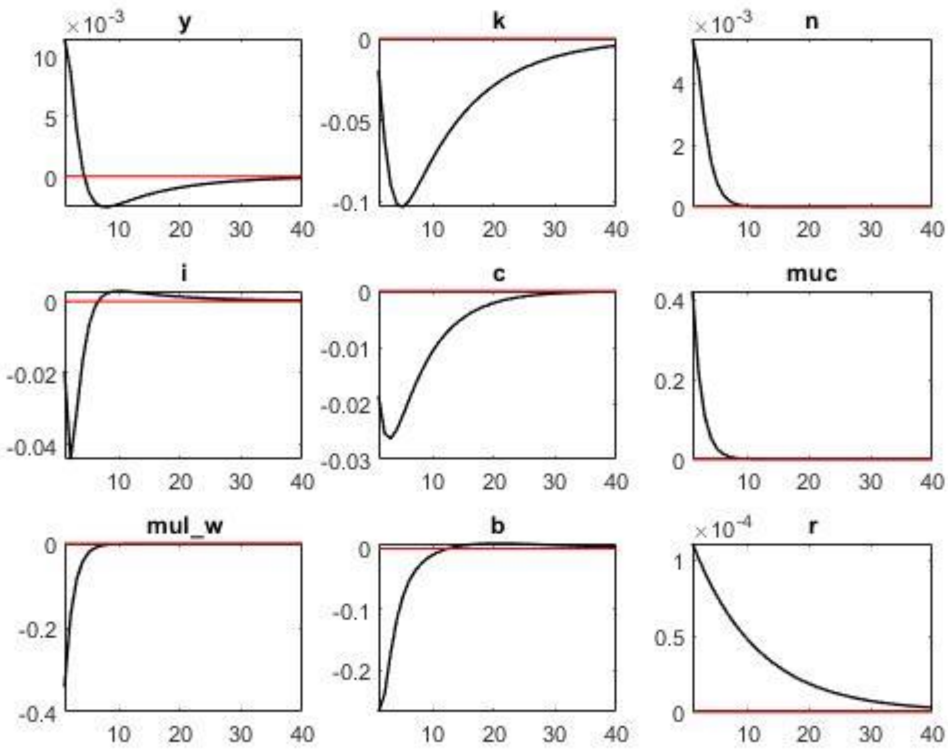


Figure 3.2: Impulse response of the economy in response to risk premium shocks.

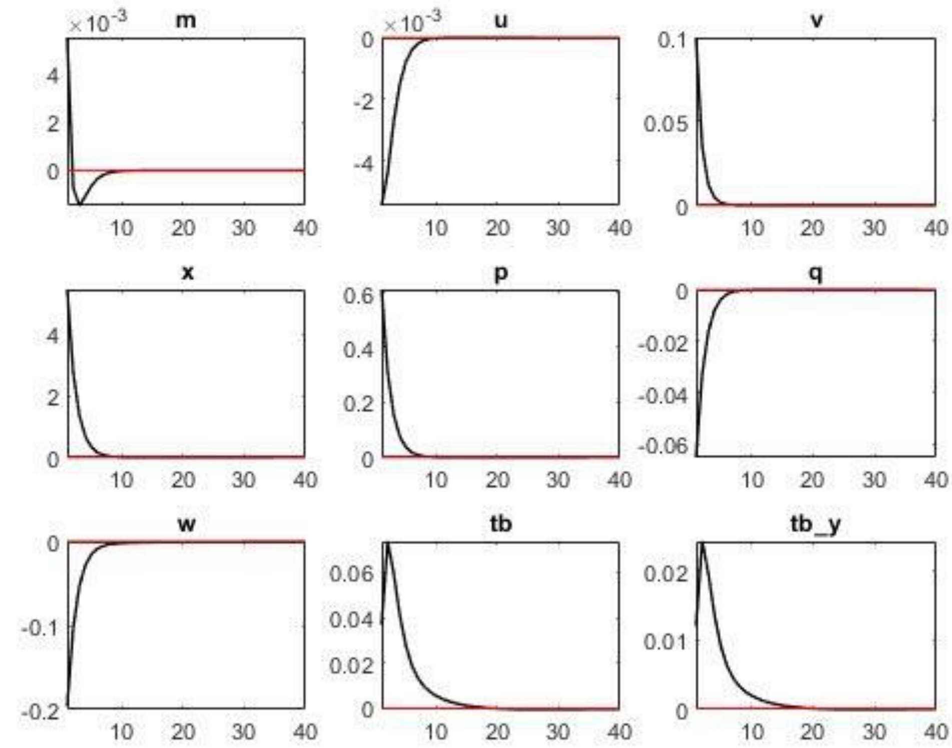
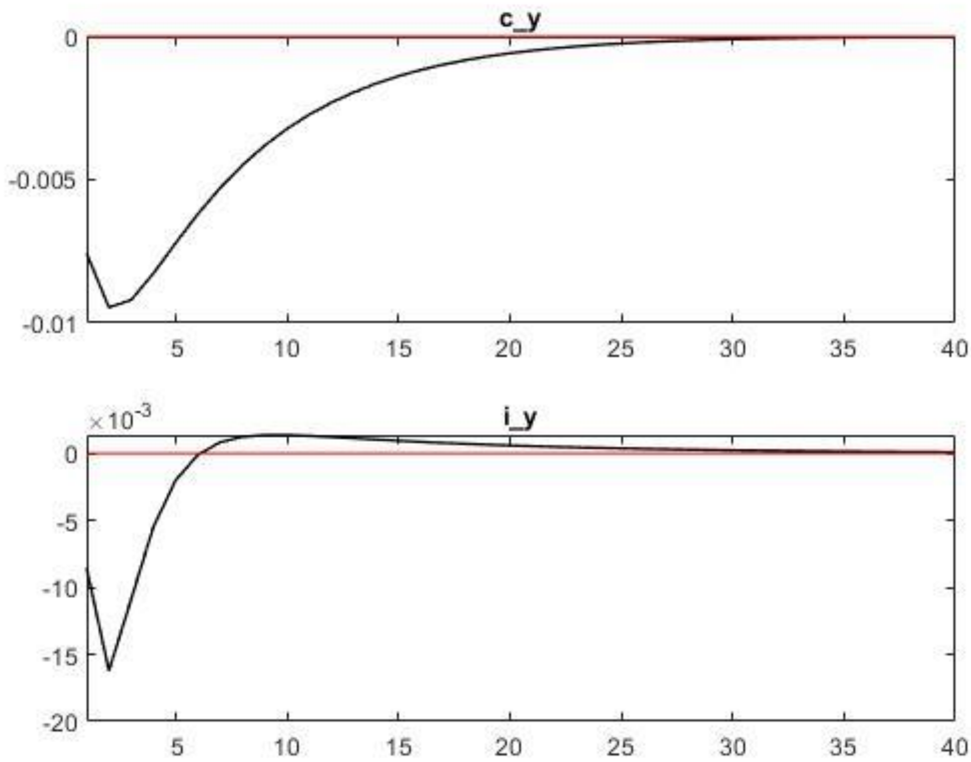


Figure 3.3: Impulse response of the economy in response to risk premium shocks.



Chapter 5

Sensitivity Analysis

For this section, I show the results of sensitivity analysis from varying the parameters ρ_z and σ_z from the model with both news and risk premium shocks, representing how diffusion rate of news shocks affects toward the emerging markets business cycle, given everything is constant. I tabulate the results of parameter ρ_z varying from 0.30 to 0.90, and parameter σ_z varying according to the condition that $\sigma_z = \sigma_a(1 - \rho_z)$ as described in the parameter section.

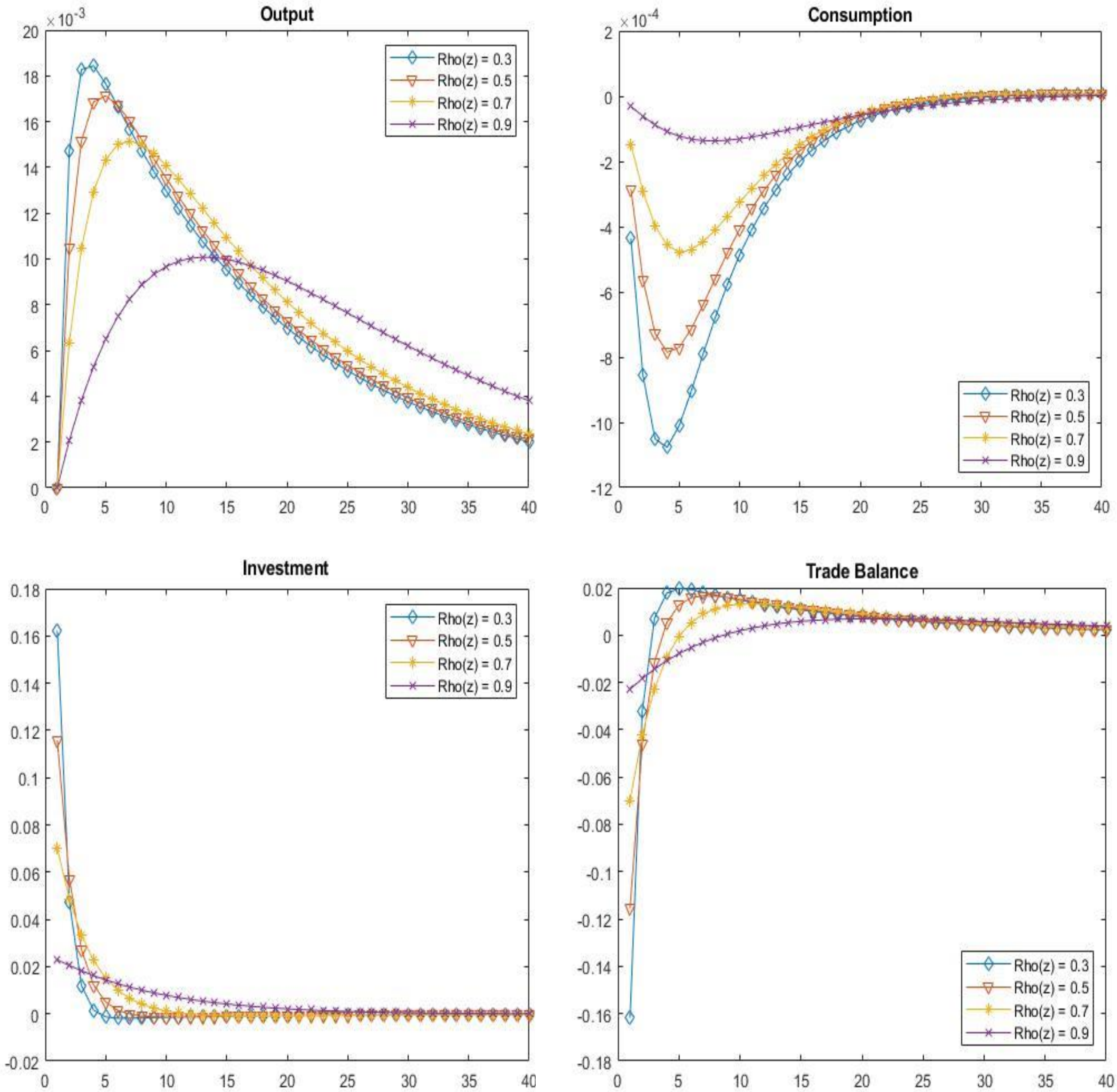
Table 5: Sensitivity Analysis of The Parameters ρ_d and σ_d.

ρ_z	σ_z	$\sigma(C)$ $/\sigma(Y)$	$\sigma(I)$ $/\sigma(Y)$	$\rho(C,Y)$	$\rho(I,Y)$	$\rho\left(\frac{TB}{Y},Y\right)$
0.3	0.0032	1.30	2.54	0.30	0.05	0.11
0.5	0.0023	1.31	2.17	0.31	0.10	0.10
0.7	0.0014	1.34	1.85	0.32	0.15	0.07
0.9	0.00046	1.45	1.64	0.36	0.17	0.03

According to the Table 5, it shows the news shocks that have effect toward the movement of aggregate variable in emerging-market economy. As the diffusion rate increasing, the volatility of consumption rises more than the volatility of income, but it is vice versa in case of investment to income ratio and trade balance to income ratio. In case of correlation, nevertheless, the diffusion rate of news shocks enhances the performance of the generated correlations. It helps adjusting the artificial data to move in the same direction as the data in emerging market countries.

For the Figure 4, it exhibits the result of varying the parameter in impulse response function. The result shows that as the diffusion rate of news become higher or the news become more persist, the effects toward the economy become smoother and less volatile. In the vice versa, as a few households realize the news, it can cause the recession. This figure shows the same result as the Table 5 that as news become more pervasive people adjust themselves less due to the condition that extracts volatility of news shock from the productivity shock. Nevertheless, the improvement in correlation shows how important of news shock in explaining business cycle in the model of emerging markets.

Figure 4: The results of varying the parameter ρ_z from 0.3 to 0.9 in impulse response function



Chapter 6

Conclusion

In this study, I document the characteristics of news shocks in the emerging market business cycle model. Including the news shocks into the real business cycle model can enhance the theoretical model's performance, especially in the term of correlation. The news shocks help improve co-movement of the variables in the model through the expectation of the household toward the future and their adjustment in consumption. Furthermore, the news shocks do the remarkable job in creating the countercyclical in trade balance which is the unique feature in emerging markets as it is shown in the impulse response function. For the model that include risk premium shock, it can explain the business cycle during the crisis and can generate sudden stop event from this model. Ultimately, the model can theoretically explain the phenomenon found in Gallego and Tessada (2010) that sudden stop affects job creation in labor market.

In the substitution of shock to trend growth, news shock and risk premium shock in the model perform quite well in term of the impulse response function, but they perform poorly in term of simulating business cycle moments compared to trend growth shock. It appears that both shocks still cannot be a substitute of shock to trend growth in Aguiar and Gopinath (2007). Nevertheless, those shocks show a sign of improvement of the model to match with the real data when shock to trend growth is absent in the model.

The evidence also indicates that, in the situation with unstable of the interest rate, news shock is dominated by the volatility of the interest rate. Thus, it cannot explain well in term of the correlation when there is the unstable of interest rate. This is similar to Gambetti, Görtz et al. (2017) that also report the similar result in the sharp changes in the conduct of monetary policy have an impact on the different responses of impulse function to news shock. Moreover, Lorenzoni (2007) shows the manipulating in real interest rate can reduce the economy's response to news shocks. In my model, this phenomenon happens through real interest rate. By happening of risk premium shocks, it causes the impact on domestic interest rate which leads to change in expectation and the adjustment of household through the Euler consumption equation. This relationship of risk premium shock and news shock is now beyond the specific model used in this thesis. It is considered as the further study by taking the step from this study.

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Appendix A: Solution for steady state

In this subsection, I provide the solution of initial values in the steady state. The values yielded from these equations are the results of the stationary equilibrium of the model.

From FOCs w.r.t. K and I

$$\lambda_t\left(1+\theta\left(\frac{I_t}{K_t}-\delta_K\right)\right)$$

$$= E_t\left[\lambda_{t+1}\left(r_{t+1}-\left(\frac{\theta}{2}\right)\left(\frac{I_{t+1}}{K_{t+1}}-\delta_K\right)^2+\theta\left(\frac{I_{t+1}}{K_{t+1}}-\delta_K\right)\left(\frac{I_{t+1}}{K_{t+1}}\right)\right)\right]$$

$$+ E_t\left[\lambda_{t+1}\left(1+\theta\left(\frac{I_t}{K_t}-\delta_K\right)\right)(1-\delta_K)\right]$$

At the steady state, $I = \delta_K K$

$$\lambda\left(1+\theta\left(\frac{\delta_K K}{K}-\delta_K\right)\right)$$

$$= E_t\beta\left[\lambda\left(r-\left(\frac{\theta}{2}\right)\left(\frac{\delta_K K}{K}-\delta_K\right)^2+\theta\left(\frac{\delta_K K}{K}-\delta_K\right)\left(\frac{\delta_K K}{K}\right)\right)\right]$$

$$+ E_t\beta\left[\lambda\left(1+\theta\left(\frac{\delta_K K}{K}-\delta_K\right)\right)(1-\delta_K)\right]$$

$$\lambda = E_t\beta[\lambda(r)] + E_t\beta[\lambda(1-\delta_K)]$$

$$\lambda = E_t\beta[\lambda(1-\delta_K+r)]$$

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

$$r = \frac{1}{0.98} - 1 + 0.05$$

$$r = \frac{1}{0.98} - 1 + 0.05$$

$$r = 0.0704$$

Assume at equilibrium that household keep investing in physical capital until marginal product of capital equals to domestic interest rate.

$$r = \alpha \frac{Y}{K}$$

$$0.0704 = 0.32 \frac{Y}{K}$$

$$K = 4.5455Y$$

Unemployment rate is given by an average from Mexico as representative equals to 0.0821, thus N = 1-U

$$N = 0.9179$$

$$Y = 4.5455Y^{0.32}0.9179^{0.68}$$

$$Y^{1-0.32} = 4.5455^{0.32}0.9179^{0.68}$$

$$Y = 4.5455^{\frac{0.32}{0.68}}(0.9179)$$

$$Y = 1.8717$$

$$K = 4.5455Y$$

$$K = 4.5455(1.8717)$$

$$K = 8.5078$$

$$I = \delta_K K$$

$$I = 0.05(8.5078)$$

$$I = 0.4254$$

Debt per capita at steady state from Aguiar and Gopinath (2004) is equal to 10 percent of GDP. In each period households must pay their debt and issue new debt. Thus, capital flow in trade financial account will be

$$tb = \frac{b}{(1 + 0.0704)} - b$$

$$tb = \frac{0.1}{(1 + 0.0704)} - 0.1$$

$$tb = -0.0066$$

Solve for the initial values in matching function

$$m = \delta_N N$$

$$m = 0.06(0.9179)$$

$$m = 0.0551$$

$$v = \left(\frac{m}{mu * u^{phi}}\right)^{\frac{1}{1-phi}}$$

$$v = \left(\frac{0.0551}{0.687 * 0.0821^{0.5}}\right)^{\frac{1}{1-0.5}}$$

$$v = 0.0784$$

$$p = \frac{m}{u}$$

$$p = \frac{0.0551}{0.0821}$$

$$p = 0.6711$$

$$q = \frac{m}{v}$$

$$q = \frac{0.0551}{0.0783}$$

$$q = 0.7028$$

$$x = \frac{v}{u}$$

$$x = \frac{0.0783}{0.0821}$$

$$x = 0.9549$$

Domestic consumption

$$TB = Y - C - I - kappa * v - \left(\frac{\theta}{2}\right)\left(\frac{I}{K} - \delta_K\right)^2 K$$

$$-0.0066 = 1.8717 - C - 0.4254 - 0.0187 * 0.0784 - 2\left(\frac{0.4254}{8.5078} - 0.05\right)^2 8.5078$$

$$C = 1.8717 - 0.4254 - 0.0015 + 0.0066 - 0$$

$$C = 1.4514$$

$$muc = \frac{1}{C - \gamma C} - \frac{\beta\gamma}{C - \gamma C}$$

$$muc = \frac{1}{1.4514 - (0.85)(1.4514)} - \frac{(0.98)(0.85)}{1.4514 - (0.85)(1.4514)}$$

$$muc = 0.7671$$

$$mul\_w = \frac{\psi N^{\chi}}{muc}$$

$$mul\_w = \frac{0.9179^{3.0303}}{0.6890}$$

$$mul\_w = 1.1195$$

Solve for bargaining wage

$$w_t = \eta\left[(1-\alpha)\frac{Y_t}{N_t} + \beta p_t E\left[\frac{\lambda_{t+1}}{\lambda_t}\frac{\kappa}{q_{t+1}}\right]\right] + (1-\eta)\left[\frac{mul\_w}{muc}\right]$$

$$w = 0.5\left[(0.68)\frac{1.8717}{0.9179} + (0.98)(0.6711)E\left[\frac{0.0187}{0.7028}\right]\right] + 0.5\left[\frac{1.1195}{0.7671}\right]$$

$$w = 0.5[1.3866 + 0.0175] + 7297$$

$$w = 0.7020 + 7297$$

$$w = 1.4317$$

$$\phi = muc * \left(1 + \theta\left(\frac{I}{K} - \delta_K\right)\right)$$

$$\phi = 0.7671 * \left(1 + 4\left(\frac{0.4254}{8.5078} - 0.05\right)\right)$$

$$\phi = 0.7671$$

Appendix B: Code in Dynare and MATLAB

This section contains the code of the models used. These codes are written on Dynare which is based on MATLAB.

Standard model

```
var y, a, k, n, i, c, muc, mul_w, b, r, tb, s_phi, tb_y, c_y, cc_y,
i_y;
varexo e_a;

parameters alpha, rho_z, rho_a, theta, delta_k, beta, psi, chi,
r_star, delta, b_ss, sigma_a, gramma;
alpha = 0.32;
rho_a = 0.94;
theta = 4;
delta_k = 0.05;
beta = 0.98;
psi = 1;
chi = 3.0303;
r_star = 0.030029;
delta = 0.001;
b_ss = 0.1;
sigma_a = 0.0046;
gramma = 0.85;

model;
y = a*(k(-1)^alpha)*(n^(1-alpha));
log(a) = rho_a*log(a(-1))+e_a;
k = (1-delta_k)*k(-1)+i-(theta/2)*(((i/k(-1))-delta_k)^2)*k(-1);
r = r_star+delta*(exp(b-b_ss)-1);
r = alpha*y/k(-1);
muc = (1/(c-gramma*c(-1)))-beta*gramma*(1/(c(+1)-gramma*c));
s_phi = muc*(1+theta*((i/k(-1))-delta_k));
s_phi = beta*muc(+1)*(r(+1)-(theta/2)*(((i(+1)/k)-
delta_k)^2)+theta*((i(+1)/k)-delta_k)*(i(+1)/k)+s_phi(+1)*(1-
delta_k));
mul_w = (psi*n^chi)/muc;
tb = y-c-i-(theta/2)*(((i/k(-1))-delta_k)^2)*k(-1);
(b(+1)/(1+r))-b = tb;
tb_y = tb/y;
c_y = c/y;
cc_y = (c-gramma*c(-1))/y;
i_y = i/y;
c+i+b = mul_w*n-(theta/2)*(((i/k(-1))-delta_k)^2)*k(-1)+r*k(-
1)+b(+1)/(1+r);
end;

initval;
y       =    2.03944;
a       =    1;
k       =    9.40372;
n       =    0.993433;
i       =    0.470186;
```

```
c       =    0.99894;
muc     =    1.00106;
mul_w   =    0.979193;
b       =    -8.74563;
r       =    0.0694001;
tb      =    0.567559;
s_phi   =    1.00106;
tb_y = tb/y;
c_y = c/y;
cc_y = (c-gramma*c)/y;
i_y = i/y;
end;

shocks;
var e_a; stderr sigma_a;
end;

steady;

stoch_simul (order=1);
```

Augmented model with the shocks and the friction

```
var y, a, k, n, z, i, c, muc, mul_w, b, r, m, u, v, x, p, q, w, tb,
s_phi, tb_y, c_y, cc_y, i_y, d;
varexo e_a, e_z, e_d;

parameters alpha, rho_z, rho_a, theta, delta_k, beta, psi, chi,
r_star, delta, b_ss, mu, phi, delta_n, kappa, eta, sigma_a, gramma,
rho_d;
alpha = 0.32;
rho_z = 0.90;
rho_a = 0.94;
theta = 4;
delta_k = 0.05;
beta = 0.98;
psi = 1;
chi = 3.0303;
r_star = 0.030029;
delta = 0.001;
b_ss = 0.1;
mu = 0.687;
phi = 0.5;
delta_n = 0.06;
kappa = 0.1276;
eta = 0.5;
sigma_a = 0.0046;
gramma = 0.85;
rho_d = 0.91;

model;
y = a*(k(-1)^alpha)*(n^(1-alpha));
z = rho_z*z(-1)+e_z;
log(d) = rho_d*log(d(-1))+e_d;
log(a) = rho_a*log(a(-1))+z(-1)+e_a;
```

```
k = (1-delta_k)*k(-1)+i-(theta/2)*(((i/k(-1))-delta_k)^2)*k(-1);
r = r_star+delta*(exp(b-b_ss)-1)+exp(d-1)-1;
r = alpha*y/k(-1);
muc = (1/(c-gramma*c(-1)))-beta*gramma*(1/(c(+1)-gramma*c));
s_phi = muc*(1+theta*((i/k(-1))-delta_k));
s_phi = beta*muc(+1)*(r(+1)-(theta/2)*(((i(+1)/k)-
delta_k)^2)+theta*((i(+1)/k)-delta_k)*(i(+1)/k)+s_phi(+1)*(1-
delta_k));
mul_w = (psi*n^chi)/muc;
m = mu*(u^phi)*(v^(1-phi));
u = 1-n;
x = v/u;
p = m/u;
q = m/v;
n = (1-delta_n)*n(-1)+q*v;
kappa/q = (1-alpha)*(y/n)-w+(1-
delta_n)*beta*(muc(+1)/muc)*(kappa/q(+1));
w = eta*((1-alpha)*(y/n)+beta*p*(muc(+1)/muc)*kappa/q(+1))+(1-
eta)*(mul_w/muc);
tb = y-c-i-kappa*v-(theta/2)*(((i/k(-1))-delta_k)^2)*k(-1);
(b(+1)/(1+r))-b = tb;
tb_y = tb/y;
c_y = c/y;
cc_y = (c-gramma*c(-1))/y;
i_y = i/y;
end;

initval;
y       =    2.03944;
a       =    1;
k       =    9.40372;
n       =    0.993433;
z       =    0;
i       =    0.470186;
c       =    0.99894;
muc     =    1.00106;
mul_w   =    0.979193;
b       =    -8.74563;
r       =    0.0694001;
m       =    0.059606;
u       =    0.00656699;
v       =    1.1463;
x       =    174.556;
p       =    9.07661;
q       =    0.0519984;
w       =    1.39235;
tb      =    0.567559;
s_phi   =    1.00106;
tb_y = tb/y;
c_y = c/y;
cc_y = (c-gramma*c)/y;
i_y = i/y;
d = 1.0396;
end;

shocks;
var e_a; stderr sigma_a;
var e_z; stderr sigma_a*(1-rho_z);
```

```
var e_d; stderr 0.000111;
end;

steady;

stoch_simul(order = 1);
```

Appendix C: Summary of all variables

This section provides the summary of the variables in the models. All variable is represented in term of the quarter. The descriptions of the variables are shown in Table5 below.

Table 6: Summary of the variables in the model

Variables	Descriptions
A	Technology shock
B	Domestic debt per capita
C	Consumption per capita
d	Risk premium shock
g	Unproductive government transfer per capita
I	Investment per capita
K	Capital per capita
m	Amount of job matched
N	A fraction of the members in the household who are employed
p	Probability of the unemployed to get the job
q	Probability of the job vacancy to be filled
r	Interest rate
S^f	Firm surplus per capita
S^h	Household surplus per capita
TB	Trade balance per capita
u	A fraction of the members in the household who are unemployed
v	Amount of job vacancy that firm creates in each period
w	Wage rate per capita

x	Ratio of job vacancies to unemployment
Y	Income per capita
z	News shock

VITA

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