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International Financial Crisis: Expectation Transmission and Policy Synchronisation

SUN Guofeng[1], LI Wenzhe, LIU Qiong, ZHANG Chunyi, SONG Jingxuan

Abstract: In recent years, the economic and financial linkages of major economies have become intertwined, and the cross-market contagion effect of the global financial crisis has become more apparent. This paper mainly studies the expectation transmission and policy synchronisation in international financial crisis, netting out influence of fundamental-based factors. Contributions of this paper are two folds. First, we innovatively calculate and utilize expectation gap and policy gap. We apply Taylor Rule regression to different expectation and monetary policy stance variables, and uses respective residuals as expectation gap and policy gap. We measure expectation transmission and policy synchronisation by correlation of expectation gap/policy gap between originating economy and affected economies. Second, we innovatively propose financial accelerator in open economy and Taylor Rule augmented by international factors as respective theoretical basis of expectation transmission and policy synchronisation. Our empirical study covers four international financial crises and 24 economies, and finds that expectation transmission and policy synchronisation are generally significant in the four crises. Transmission efficiency varies because of financial openness, financial stability and regional integration. Economic weight of the originating economy also exerts influences. These results convincingly support the theoretical analysis in this paper. Based on above results, this paper proposes relevant policy recommendations, such as to strengthen expectation management, to strike

[1] SUN Guofeng (corresponding author), Ph.D. in Economics, Research Fellow, Monetary Policy Department of The People's Bank of China, Visiting Professor of Economics Department at Princeton University, sguofeng@pbc.gov.cn. LI Wenzhe, Ph.D. in Economics, Monetary Policy Department of The People's Bank of China, lwenzhe@pbc.gov.cn. LIU Qiong, Ph.D. in Economics, Monetary Policy Department of The People's Bank of China, and Post-doc of Financial Research Institute of The People's Bank of China, lqiong@pbc.gov.cn. Zhang Chunyi, Ph.D. in Economics, Monetary Policy Department of The People's Bank of China, zchunyi@pbc.gov.cn. SONG Jingxuan, Monetary Policy Department of The People's Bank of China, sjingxuan@pbc.gov.cn. We appreciate support from The People's Bank of China 2019 Youth Research Projects. The views expressed in this paper are those of the authors and do not represent the PBC.

balance between domestic and international equilibrium, and to strengthen international macroeconomic policy coordination.

Keywords: International Financial Crisis Shock; Expectation Transmission; Policy Synchronisation; Taylor Rule; Financial Accelerator

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1. Introduction

In recent years, the cross-market contagion effect of the international financial crisis has become more apparent. In September 2008, the U.S. investment banking firm, Lehman Brothers, went bankrupt. Global Financial Crisis (GFC) stemming from the subprime mortgage crisis erupted in full force, resulting in huge shock wave across global economy and financial markets. According to World Bank, global economic growth in 2007, 2008, and 2009 were 4.22%, 1.85%, and -1.69%[2], respectively. Global financial market oscillated sharply, and stock markets in some developing economies fell even more than that in the United States, where the crisis originated.

The more apparent cross-market contagion effect of the international financial crisis is inevitable result of globalization. The first reason is the economic globalization. Multinational corporations distribute supply chain globally. Trade linkage among major economies and international corporate operations continue to increase. The second reason is financial globalization. Cross-border operation, investment and financing activities of financial institutions are more frequent, which deepen global financial integration and more closely connect financial markets. At the same time, after 2008 GFC, Advanced Economies (AEs) implemented several rounds of quantitative easing (QE) policy, bringing large wave of liquidity, which further increased the scale of cross-border capital flow and magnified cross-market contagion of financial crisis.

The shock of international financial crisis (i.e. Financial Contagion) has attracted broad attention from academia and governments. However, previous research has mainly focused on traditional transmission channels, such as trade and capital flow. In recent years, academia has gradually realized that expectation transmission and policy synchronisation are also important channels for financial contagion. For example, empirical research has shown that expectation transmission, measured by investor confidence indices and based on investor behavior, plays an important role in financial contagion (Dées and Güntner, 2014; Kannan and Köhler-Geib, 2009). As another example, current literature analyzes monetary policy independence in the framework

[2] Data source: https://data.worldbank.org.cn/indicator/NY.GDP.MKTP.KD.ZG?end=2018&start=1961&view=chart

of “Impossible Trinity”, confirming the spillover effect of monetary policy and the necessity of international monetary policy cooperation (Obstfeld, Shambaugh and Taylor, 2005; Bruno and Shin, 2015a, 2015b; Sun, Yin and Chai, 2017). However, current research hasn’t included expectation transmission and policy synchronisation into the research framework of financial crisis as independent contagion channels. Especially, in the empirical research, expectation transmission and policy synchronisation aren’t distinguished from economic and financial fundamental-based factors. Expectation transmission and policy synchronisation as studied in current research are actually results of synchronisation and transmission of fundamental-based factors.

This paper mainly studies the expectation transmission and policy synchronisation in international financial crisis, netting out influence of fundamental-based factors. Contributions of this paper are two folds. First, we innovatively calculate and utilize expectation gap and policy gap. We apply Taylor Rule regression to different expectation and monetary policy stance variables, and uses respective residuals as expectation gap and policy gap. We measure expectation transmission and policy synchronisation by correlation of expectation gap/policy gap between originating economy and affected economies. Second, we innovatively propose financial accelerator in open economy and Taylor Rule augmented by international factors as respective theoretical basis of expectation transmission and policy synchronisation. In expectation transmission, we consider not only financial markets expectation, but also macroeconomic expectation. Our empirical study on expectation transmission and policy synchronisation covers 24 economies, and four international financial crises, i.e. 2001 Internet-bubble crisis originating from the U.S., 2008 global financial crisis originating from the U.S., 2011 European debt crisis originated from France and other Euro Area countries, 2013 emerging market crisis originating from Russia and other Emerging Market Economies (EMEs). Empirical results show that expectation transmission and policy synchronisation are broadly significant in all 4 crises, after netting out influence of fundamental-based factors. During the same crisis, transmission efficiency varies because of financial openness, financial stability and regional

integration. Economic weight of the originating economy also contributes to efficiency variation. These empirical results convincingly support the theoretical analysis in this paper.

Structure of this paper is as follows. Section 2 is literature review. Section 3 is theoretical analysis on contagion of international financial crisis through channels of expectation transmission and policy synchronisation. We innovatively propose financial accelerator in open economy and Taylor Rule augmented by international factors. Section 4 is empirical analysis. In this section, we conduct quantitative analysis of expectation transmission and policy synchronisation effect of four international financial crises in 24 economies. Section 5 is conclusion and policy recommendations.

2. Literature Review

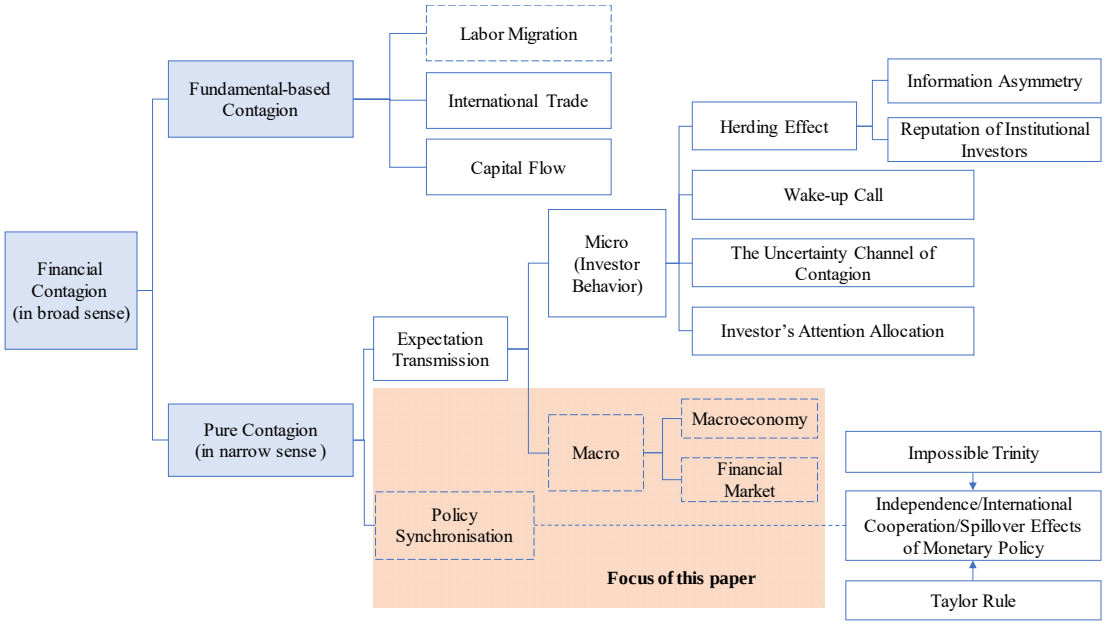


Figure 1 Theoretical framework of current literature and focus of this paper

2.1 Definition and Classification of Financial Contagion

Current research on the impact of the international financial crisis (financial contagion) includes two levels: broad-based and narrow-based. In broad sense, *"contagion occurs when a shock to one or a group of markets, countries, or institutions, spread to other markets, or countries, or institutions"* (Pritsker, 2001), including fundamental-based contagion and pure contagion. Narrow financial contagion, also known as "pure contagion", or "net contagion", refers to the cross-market contagion of the international

financial crisis caused by sudden change of investor confidence and expectation, netting out influence of fundamental-based factors (Masson, 1999; Dornbusch, Park and Claessens, 2000). Figure 1 lists the theoretical structure of current literature. Research focus of this paper, which has been mentioned less often in current literature, is shown in the shaded area.

Current research on fundamental-based contagion channel mainly focuses on international trade and capital flows. Wang and Zhang (2011) analyze impacts of Asian financial crisis and the U.S. sub-prime mortgage crisis on China in open economy, and find that international trade channel has become increasingly important in crisis transmission. Kireyev and Leonidov (2015) construct a network model on international contagion, based on the nominal demand shock from trade channel, and decompose the impacts into spillover, spill-back, and spill-in effects among the originating economy, directly-linked economy, and indirectly-linked economy. Adrian and Shin (2008) find that contagion will spread through asset price changes, risk measurement, and market-linked capital of financial intermediation. Jo (2012) links liquidity risk to solvency risk, and builds a network model to measure the contagion risk arising from financial linkages among financial institutions.

2.2 Research on Expectation Transmission based on Investor Behavior

Current research on expectation transmission mainly focuses on micro-level expectation transmission based on investor behavior, and have four interpretation models. Zhang (2013) partially summarize these models. The first is the herding effect caused by information asymmetry and market reputation of institutional investors. Rational herding behavior in financial markets often arises from direct income externalities, principal-agent problems, or information learning (Devenow and Welch, 1996). In the presence of information friction, investors can be divided into informed and uninformed. Information obtained by informed investors includes useful and useless information for uninformed investors. Uninformed investors cannot filter out useless information, and thus can only follow investment strategy of informed ones, which leads to market overreaction (Calvo and Mendoza, 2000). Incentive mechanism and market reputation of institutional investors are also reasons for herding effect. Fund

managers' compensation is generally linked to the performance of their portfolios relative to the benchmark indices, causing them to imitate each other and make similar investment decisions (Gelos, 2011). The second is the wake-up call effect proposed by Goldstein (1998), i.e., after crisis strikes one economy, it will "wake up" investors to reevaluate risk of other economies with similar fundamentals, thus affecting their investment in these economies. The third is transmission mechanism of expectation uncertainty (Kannan and Köhler-Geib, 2009). After the crisis, investors lose confidence on their ability of information collection and analysis, thereby increasing expectation uncertainty of investment in other economies. The endogenous expectation uncertainty increases crisis probability of these economies. The fourth is attention allocation mechanism of investors. Mondria and Quintana-Domeque (2013) suggest that the greater the volatility of a country's financial markets, the more attention investors pay to this market, which results less attention paid to other markets. One possible following action is to withdraw funds from other markets, and thus increase their respective volatility.

Multiple empirical research finds that expectation transmission is an important channel for financial contagion. However, none of this research considers netting out economic and financial fundamental-based factors, and expectation transmission has not been considered as an independent transmission channel. Dées and Güntner (2014) use consumer confidence survey and economic fundamentals of the United States, the United Kingdom, Italy, France, and Germany from 1985 to 2011 to build a single-country VAR model, and find that confidence shock has important and persistent impact on domestic consumption and GDP, which are also significantly correlated among different countries. At the same time, they construct FAVAR model that net out international factors, and find that after controlling international common factors, influence and persistence of confidence shock in different countries are significantly weakened. Kannan and Köhler-Geib (2009) test the uncertainty channel of crisis transmission, using data from 38 countries from December 1993 to September 2005. Results show that uncertainty, which is represented by variance of investor confidence, has significant effect on crisis transmission. Wang and Zhang (2011) use SVAR model

to study the macroeconomic variables of Japan and China during Asian financial crisis from 1995Q1 to 2002Q4, and of the United States and China during the U.S. sub-prime mortgage crisis from 2003Q1 to 2010Q3. They find that Asian financial crisis transmits mainly through financial channel, followed by expectation channel. U.S. sub-prime mortgage crisis transmits mainly through trade channel, while expectation channel is insignificant.

2.3 Research on Policy Transmission based on Impossible Trinity and Taylor Rule

Mundell (1963) and Fleming (1962) propose the classic impossible trinity theory, i.e., one can only choose two among monetary policy independence, free capital flow, and fixed exchange rate. However, with the deepening of global financial integration, multiple empirical research in recent years find that abandoning fixed exchange rate doesn't necessarily guarantee independent monetary policy. Spillover effect of monetary policy becomes more apparent, which challenges the impossible trinity. Obstfeld, Shambaugh and Taylor (2005), and Edwards (2015) have found that a freely floating exchange rate system does not guarantee the independence of monetary policy. Bruno and Shin (2015a, 2015b) conducted theoretical modeling and empirical tests on the banking channel through which the Fed's monetary policy transmits to EMEs. Further, Kearns, Schrimpf and Xia (2018) study the spillover effects of monetary policy. They use high-frequency data to construct monetary policy shock matrix of central banks in 7 AEs, and conduct empirical tests on its impact on 27 AEs and 20 EMEs. They find that spillover effect of monetary policy is relatively significant on long-term interest rates, and that on short-term interest rates is insignificant. Explanatory power of domestic economic condition on spillover intensity is relatively low, while that of exchange rate system and financial openness is relative strong.

Traditionally, monetary authorities in various economies have formulated and implemented monetary policies based primarily on domestic economic and financial conditions. Taylor Rule (Taylor, 1993) links short-term money market rate to output gap and inflation gap. Lubik and Schorfheide (2007) introduce exchange rate change to traditional Taylor Rule, arguing that exchange rate change would affect economic and

financial conditions through trade, financial markets and other channels, thus affecting Taylor Rule. Chatterjee (2016) estimates Taylor Rule for each economy and uses the residuals of Taylor Rules to build a dynamic latent factor model with common factors. He finds that from 1988 to 2003, the common factor is still significant, even after controlling for exchange rate factors. This shows that factors, other than output gap, inflation gap, and exchange rate, have significant impact on monetary policy, and Taylor Rule needs to include other international factors. Our research differs with Chatterjee (2016) at two points. First, Chatterjee (2016) selects five advanced economies, covering the entire time interval from 1980 to 2009, while we select 24 economies, covering major AEs and EMEs, and only focus on crisis period. Second, Chatterjee (2016) focuses on common factor among monetary policy residuals in different economies, which has no clear indicative meaning, while we explicitly study correlation between residuals of different economies, and focus on monetary policy synchronisation during crises, which has clear and operational policy implications.

As spillover effect of monetary policy is more apparent, it's becoming a new trend to strengthen international monetary policy coordination. Sun (2017) proposes that in the post-financial crisis era, global monetary policy decision makers pay more attention to international monetary policy coordination, which is based on consideration of domestic welfare maximization. Sun and Li (2017) suggest that the traditional "Impossible Trinity" has evolved into "Scalene Impossible Trinity", and study the optimal macro-prudential management of cross-border capital flow and optimal international monetary policy coordination, under different exchange rate regimes. They find that even if the exchange rate is freely floating, central bank still needs to conduct macro-prudential management on cross-border capital flow. Theoretically speaking, if monetary authorities formulate monetary policies as fixed rules, and only consider domestic economic condition, the benefits of including international factors are limited. However, with economic and financial globalization deepening, international influence of monetary policy of reserve currency economies is increasing. Including international factors in policy formulation will help increase welfare, which is reflected in international monetary policy coordination. Taylor (2013) explained

reasons behind international coordination. In one scenario, monetary policy of one country deviates from simple Taylor Rule, and the optimal strategy for other economies is also to deviate from Taylor Rule respectively, which is intuitively reflected as international coordination. In another scenario, changes in economic conditions require monetary policy not simply sticking with Taylor Rule (e.g. QE in recent years), and each economy implements similar policies based on similar understanding, which is reflected as international coordination.

Sun, Yin and Chai (2017) stimulate that in current international monetary system, reserve currency economies and non-reserve currency economies have two options in playing the policy game. One is cooperative equilibrium in game theory. The other is that two parties play the game as dominating party and follower respectively. Their research shows that international monetary policy coordination simultaneously enhances welfare of both parties, which is a better choice for either party. For a long time, international coordination takes the form of Stackelberg game by dominating party and followers, but in recent years, characteristics of cooperative equilibrium is more notable.

Before 2008 GFC, the United States barely considered international factors in formulating monetary policy. The more often case is that other economies consider the U.S. factor in one-way coordination. The U.S. has the largest economic weight, and leads in global innovation, while the U.S. dollar is world's most dominant reserve currency. These factors give the United States insufficient motivation to participate in international coordination. Generally speaking, advanced economies' economic cycles incline to move together. With the additional help of freely floating exchange rate, AEs' monetary policy is mostly related to domestic policy targets, while also showing signs of synchronisation. Contrasting with AEs, EMEs' monetary policy tends to coordinate with US monetary policy in a one-way fashion.

As monetary policy spillover effect becomes more apparent, global economies take changes in global monetary and financial conditions into consideration when formulating respective monetary policies. For example, G20 platform established after GFC is the most important multilateral policy coordination platform, including not only

AEs but also EMEs. Global economies frequently communicate through platforms such as G20, to better understand policy of other economies, and maintain maximum policy coordination. Policy coordination among global economies has also become the focus of relevant parties. By strengthening policy coordination, global economies have alleviated the impact of financial crisis, and better anchored investors' expectations of economic growth, which further help fend off recession.

Practice of Federal Reserve to value international factors began around 2015-2016, direct reason of which is that China's influence became apparent. First, economic weight gap shrank. The United States has a shrinking share of the global economy, while China's share has risen. Second, the two countries have closer linkages in economy, finance, and trade. Third, competitiveness gap shrank. Moreover, two countries have different economic cycles. All these factors give China more influence on the U.S. As a result, Federal Reserve has to consider China factor in monetary policy formulation.

After 2015, global economies more often adopt "Taylor Rule augmented by international factors" in formulating and implementing monetary policy. In December 2015, the Federal Reserve carried out its first rate hike after GFC. At press conference after the rate decision, Chairwoman of Federal Reserve, Janet L. Yellen told the press, "*the performance of the U.S. economy has important spillovers onto emerging markets and vice versa…we would do our best to communicate as clearly as we could about our policy intentions to avoid spillovers that might result from abrupt or unanticipated policy moves*" (Yellen, 2015). According to the Fed's initial plan, it would raise interest rates four times in 2016 (Federal Reserve Board, 2015). However, in 2016, China faced substantial economic downward pressure, with annual GDP growth rate at 6.7%, a record low since 2008. China's PPI year-on-year growth rate was negative for 54 consecutive months. Value of RMB decreased by nearly 1 *yuan* from its 2014 peak, and China's foreign exchange reserves decreased by nearly 1 trillion U.S. dollars during the same period. Affected by international development, especially China's economic conditions, Federal Reserve kept interest rate unchanged after the rate hike in December 2015, and waited until end of 2016 to raise interest rate again. Yellen admitted in an

interview in February 2019 that "*…the drags from abroad…we concluded that these spill backs were significant enough that we really couldn't go through with what looked like a plan or an expectation in December of 2015 that we should raise interest rates four times*" (Yellen, 2019).

3. Mechanism of Expectation Transmission and Policy Synchronisation in International Financial Crisis

3.1 Financial Accelerator in Open Economy and Expectation Transmission of International Financial Crisis

Bernanke, Gertler and Gilchrist (1996) propose financial accelerator theory, i.e., information asymmetry in the credit market makes the external financing cost of corporations higher than the internal financing cost, resulting in an external financing premium. In the context of globalization, multinational corporations operate worldwide, and the traditional financial accelerator upgrades to financial accelerator in open economy. Compared with non-multinational corporations facing only the local financial accelerator, multinational corporations need to struggle against multiple financial accelerators in different economies involved in their business. Hence financial accelerator in open economy is essentially "multiple financial accelerators" connected by global layout of multinational corporations and reveals itself in a network structure. When financial accelerator at any node in this network is activated, it would trigger other financial accelerators at other nodes in the network structure, through balance sheet of multinational corporations, resulting in expectation transmission during international financial crisis.

Balance sheets are closely related to cash flow statements. The net cash flow of a general corporation NCF consists of operating net cash flow NCF_O, investing net cash flow NCF_I and financing net cash flow NCF_F, as shown in equation (1). In open economy, we refer the economy where the parent company of the multinational corporation is located as economy B, and the economy where the subsidiary corporation is located as economy A. The corporate NCF is affected by two markets of economy A and B, as shown in equation (2). First, the operating net cash flow depends not only on

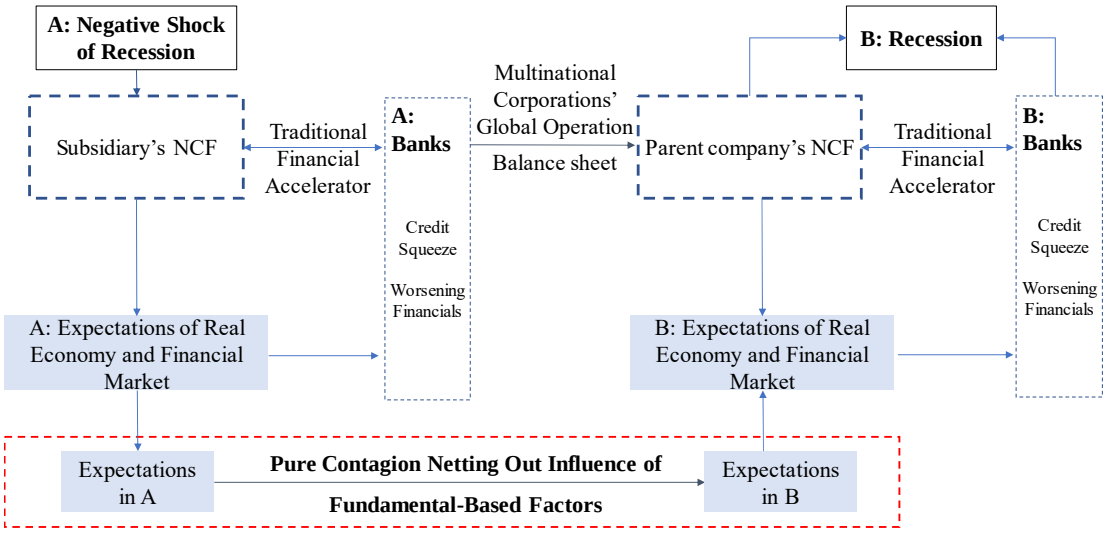
demand in Economy B, d_B, but also on demand in economy A, d_A. Second, investing net cash flow depends not only on investment return in economy B, r_B, but also on investment return in economy A, r_A. Third, financing net cash flow not only depends on risk premium in economy B's credit market f_B, but also on risk premium in cross-border financing f_A.

$$NCF = NCF_O + NCF_I + NCF_F \quad (1)$$

$$NCF = NCF_O(d_A, d_B) + NCF_I(r_A, r_B) + NCF_F(f_A, f_B) \quad (2)$$

Financial accelerator in open economy not only amplifies "tangible" trade and capital channels, but also amplifies "intangible" expectation channels. As shown in figure 2, when economy of subsidiary enters recession, the local financial accelerator is activated. Banks, corporations, investors, and all kinds of market entities expect operating NCF of subsidiary corporation to deteriorate, which is reflected as worsening macroeconomic expectation. They also expect investing and financing NCF of subsidiary corporation to be further tightened, which is reflected as weakening financial markets expectation. In the presence of financial accelerator, expectation on the tightness of subsidiary's operating, investment and financing NCF reinforce each other, and transmit through multinational corporations' balance sheet to parent company. Then financial accelerator in B is activated, and consequently influence expectation of banks, corporations, investors, and all kinds of market entities in B on future NCF of parent company, as reflected in macroeconomic and financial markets expectations of market entities. Macroeconomic expectation and financial market expectation will also interact with and amplify each other through functioning of financial accelerator. Of course, expectation transmission could also happen in opposite direction as well.

Based on above analysis, due to influence of financial accelerator in open economy, expectation variation in economy of subsidiary will influence expectation in economy of parent company. Even if fundamental-based factors have not been affected yet, expectation transmission still will happen, which shows as "pure contagion" of expectation, netting out economic and financial fundamental-based factors.



Note: This figure is drawn and expanded based on Sun (2014).

Figure 2 Financial accelerator in open economy and expectation transmission

3.2 Taylor Rule Augmented by International Factors and Policy Synchronisation of International Financial Crisis

Traditional Taylor Rule is shown in equation (3). Short-term money market rate is denoted by I, Y refers to the natural logarithm of realized output, Y^* refers to the natural logarithm of potential output, π refers to realized inflation, and π^* refers to target inflation.

$$I_{it} = a_i + b_i(Y_{it} - Y_{it}^*) + c_i(\pi_{it} - \pi_{it}^*) + u_{it} \quad (3)$$

After the 2008 GFC, with the changes in global financial conditions, financial spillovers became more apparent for three reasons. First, the degree of global financial integration has greatly deepened over the past three decades. Cross-border operation and investment of financial institutions among major economies have increased significantly. Financial investments and banks' risk exposure among different economies have grown exponentially. Second, the scale of cross-border capital flows has increased significantly. The quantitative easing policy of monetary authorities in some AEs injected large amount of liquidity. Arbitrage money in global financial markets has grown rapidly. Directions of capital flow change frequently and drastically. Third, with rapid IT development, the speed, depth and breadth of information dissemination have increased as never before, and the impact of monetary policy on expectations of market participants through information is continuously growing.

Because of changing financial environment, the traditional Taylor Rule should be amended, i.e. when central banks consider monetary policy stance, i.e. short-term money market rate I_{it}, it should consider output gap $(Y - Y^*)$, inflation gap $(\pi - \pi^*)$, as well as international factor $(\gamma - \gamma^*)$, as shown in equation (4). γ refers to those indicators of other economies and global financial markets which have major effect on domestic economy. One good example is monetary policy of reserve currency economies (such as the United States) and originating economy of financial crisis. γ^* refers to monetary policy indicators, in accordance with Taylor Rule, of reserve currency economies (such as the United States) and originating economy of financial crisis (e.g. Federal Funds Rate in the United States) , and $(\gamma - \gamma^*)$ refers to monetary policy gaps of these foreign economies, i.e. international factor.

$$I_{it} = a_i + b_i(Y_{it} - Y_{it}^*) + c_i(\pi_{it} - \pi_{it}^*) + d_i(\gamma_{it} - \gamma_{it}^*) + u_{it} \quad (4)$$

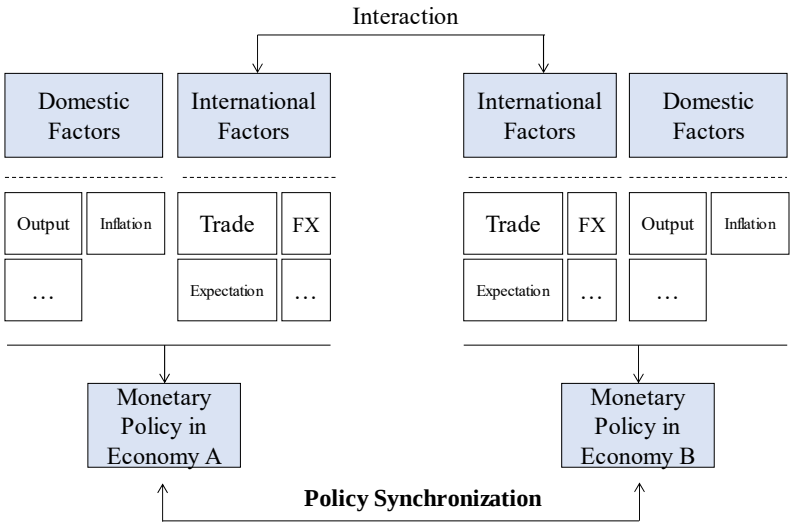


Figure 3 Taylor Rule augmented by international factors and policy synchronisation

If every economy considers international factors when formulating monetary policy, the international factors will simultaneously affect monetary policy of different economies, which is reflected in same direction movement of monetary policy, i.e. policy synchronisation, as shown in Figure 3.

4. Empirical Analysis

4.1 Empirical Strategy

This section focuses on two issues. The first is "pure contagion" of expectation, netting

out influence of economic and financial fundamental-based factors. Thus, we need to control economic growth, inflation, financial markets variables in measuring expectation, in order to obtain "expectation gap". In the presence of financial accelerator in open economy, through balance sheet of multinational corporations, if the "expectation gap" shows positive correlation, it proves after shock of international financial crisis, macroeconomic expectation and financial markets expectation transmit among economies. The second is the policy synchronisation, netting out influence of fundamental-based factors. According to Taylor Rule augmented by international factors, if the "policy gap" obtained by netting influence of fundamental-based factors out of monetary policy stance indicators shows positive correlation, it means that global central banks take international factors into consideration while formulating monetary policy, which is further reflected as policy rate synchronisation.

The empirical analysis of this paper is divided into two steps.

The first step is to calculate the expectation gap and policy gap. We apply Taylor Rule regression to different expectation and monetary policy stance variables, and use respective residuals as expectation gap and policy gap, as shown in equation (5). u_{it} is the expectation gap and policy gap. In this step, Taylor Rule is the way how we control fundamental-based factors, such as economic growth, inflation, financial markets. Compared with alternative rules, Taylor Rule is more widely recognized and accepted, and is widely used as monetary policy rule of central banks in Dynamic Stochastic General Equilibrium (DSGE) modelling. As a matter of fact, it is adopted by considerable number of central banks in practice. Based on above consideration, we adopt Taylor Rule regression in the first step calculation. It should be observed that, "gap" in this paper could also be interpreted as "shock", i.e. in economics modelling, monetary policy gap is usually called monetary policy shock.

$$X_{it} = a_i + b_i \text{Economic and financial fundamentals} + u_{it} \quad (5)$$

The second step is to test the expectation transmission and policy synchronisation. The expectation transmission and policy synchronisation of the financial crisis are measured by the correlation of expectation gap/policy gap between originating

economies and affected economies, as shown in equation (6). If the coefficient $b_{i,j}$ is significantly positive, it proves significance of expectation transmission and policy synchronisation between originating economy j and the affected economy i.

$$u_{it} = a_{i,j} + b_{i,j}u_{jt} + c_{i,j}\text{Control economy gaps} + v_{i,j,t} \quad (6)$$

Considering that the United States may have greater influence on other economies, when the originating economy is not the United States, we also introduce respective gaps of the United States into the regression equation as control variable to accurately identify expectation transmission and policy resonances between originating economies other than the U.S. and affected economies.

In the first step, we use Ordinary Least Square method. In the second step, we use Generalized Method of Moments (GMM). For time series regression, there are always the issue of heteroscedasticity and autocorrelation, which invalidate the usual t-test and F-test. This paper uses the heteroscedastic autocorrelation consistent (HAC) standard error in the second step of regression. Specifically, the Newey-West method is employed. As we don't concern with coefficient estimation and respective significance of the first step regression, we don't deal with error term additionally.

4.2 Samples and Indicators

4.2.1 Choice of Crises

We have selected four international financial crises since 2000, as shown in Table 1, including 2001 Internet-bubble crisis originating from the U.S., 2008 global financial crisis originating from the U.S., 2011 European debt crisis originated from France and other Euro Area countries, 2013 emerging market crisis originating from Russia and other EMEs. The data range is 24 or 30 months around each crisis.

Table 1 Description of the four financial crises in empirical analysis

Year	Crisis name	Crisis Code	Originating Economy	Sample Period	Control Economy
2001	Internet-Bubble Crisis	1	U.S.	2000/1-2002/6	None
2008	Global Financial Crisis	2	U.S.	2008/1-2010/6	None
2011	European Debt Crisis	3	France/Euro Area	2011/1-2012/12	U.S.
2013	Emerging Market Crisis	4	Russia	2013/1-2014/12	U.S.

According to the World Economic Outlook database released by the IMF in April 2019, we select the top 30 economies in terms of GDP in 2018, and three representative

emerging economies (South Africa, Malaysia and Vietnam), with a total of 33 economies. We exclude Saudi Arabia, Iran, Norway, the United Arab Emirates, whose quarterly GDP year-on-year growth data isn't found in Wind Database, and Netherlands, Poland, Sweden, Belgium, Austria due to data availability[3], i.e. 10 economies excluded. In addition, since countries in Euro Area do not have independent monetary policy, when analyzing the policy synchronisation, we regard Euro Area as one economy. There are total of 24 economies in this section. Due to data availability, the number of economies corresponding to each type of indicator may vary slightly, see Appendix A.

4.2.2 Expectation Indicators and Policy Indicators

The variables selected in the empirical analysis section and their measurement are shown in Table 2. Details of specific indicators of stock market indices, bond market yield, term spread of government bond, short-term money market rate for each economy could be found in table in Appendix B. Data source is Wind Database.

Table 2 Variables in empirical analysis

Factors	Variable Symbol	Variable Name	Measurement Method
Economic fundamentals	GDP	Year-on-year GDP growth[1]	Quarterly data is replicated within each quarter to obtain monthly data
Economic fundamentals	GDP*	Trend value of year-on-year GDP growth	Apply HP filter to quarterly data, and the filtered quarterly trend data is replicated with each quarter to obtain monthly data
Economic fundamentals	CPI	Year-on-year CPI growth[2]	-
Economic fundamentals	CPI*	Trend value of year-on-year CPI growth	Apply HP filter to monthly year-on-year CPI growth
Financial fundamentals	S	Stock market index yield	Monthly return of representative stock indices (end-month to end-month)
Financial fundamentals	I	Bond market yield[3]	Short-term government bond yields (monthly average when applicable)[4]
Macroeconomic expectation	PMI	PMI of manufacture industry[5]	-
Stock market expectation	VIX	Volatility of stock market indices	Standard deviation of daily returns of representative stock indices (calculated with the same month)

[3] This refers to that 3 or more out of 5 continuous time series data in PMI, short-term government bond interest rate, long-term government bond interest rate, stock market index, and short-term money market rate aren't found in Wind Database. For short-term government bond interest rate, we generally choose one-year term, and "missing" is defined as no 1-year government bond interest rate data, and no government bond interest rate data below 2 years for substitution. For long-term government bond interest rates, we generally choose 10-year term, and "missing" is defined as no 10-year government bond interest rate data, and no government bond interest rate data above 5 years for substitution.

Factors	Variable Symbol	Variable Name	Measurement Method
Bond market expectation	TS	Term spread of government bond	Long-term and short-term government bond yields' difference[6] (monthly average when applicable)
Monetary policy stance	IR	Short-term money market rate[7]	(monthly average when applicable)

Note 1: As HP filter requires data continuity in the studied interval, and Argentina's year-on-year GDP growth data in 2004 isn't included in Wind, we exclude Argentina's year-on-year GDP growth before 2004 in the research.
Note 2: As HP filter requires data continuity in the studied interval, and Argentina's year-on-year CPI growth data during November 2015 to March 2017 isn't included in Wind, we exclude Argentina's year-on-year CPI growth data after November 2015 in the research. For the same reason, we find supplemental data of Brazil's year-on-year CPI growth data from http://www.inflation.eu, and calculate Vietnam's year-on-year CPI growth of April 2005 by averaging those of March and May 2005.
Note 3: Due to data availability, for most economies, we use 1-year government bond yield as bond market yield, with the exception of Australia using 2-year government bond.
Note 4: "monthly average when applicable" means that if the source data is daily, we calculate simple arithmetic average by month; if the source data is monthly, we directly use source data, same as follows.
Note 5: For macroeconomic expectations, we use comprehensive PMI for Switzerland, and manufacturing PMI for all other economies.
Note 6: Due to data availability, for most economies, we calculate term spread as difference between 10-year government bond and 1-year government bond, with the exception of Australia using difference between 10-year government bond and 2-year government bond.
Note 7: Due to data availability, when choosing short-term money market rate, for most economies, we adopt overnight (O/N) lending or repo rate, and there are also several exceptions. For example, for China, we adopt depositary institutions 7-day pledged repo rate (DR007), and for Mexico, we adopt interbank interest rate: 1 month.

Macroeconomic expectation is represented by Purchasing Managers' Index (PMI) of manufacture industry. This indicator comprehensively describes the expectations of manufacture corporations for expansion and contraction of economic activities.

Stock market expectation is represented by volatility of stock market indices (VIX). More volatility in the stock market means that investors have divergent expectation regarding market movement, which reflects more uncertainty.

Bond market expectation is represented by term spread (TS) of government bond. Larger term spread means that investors expect acceleration in economic growth, and short-term interest rate could go upward. Shrinking term spread means that investors expect possible recession, and short-term interest rate could go downwards.

Monetary policy stance is represented by short-term money market rate (IR). This indicator is highly influenced by monetary policy operations of central banks.

Time interval in this section is from January 2000 to December 2018, and the data frequency is monthly.

4.3 Empirical Results

4.3.1. Calculation of Expectation Gap and Policy Gap

4.3.1.1 Macroeconomic Expectation Gap

The error term $u_{PMI,it}$ in equation (7) is the macroeconomic expectation gap, which is used to gauge macroeconomic expectation netting out influence of fundamental-based factors. As shown in Figure 4, macroeconomic expectation gaps of studied economies show sign of co-movement (synchronisation). Research in this sub-section involves 19 economies. As inclusion of all economies in one figure makes it over-crowded, we include only 10 largest economies in Figure 4 to 7 for illustration purposes.

$$PMI_{it} = a_i + b_i(GDP_{it} - GDP^*_{it}) + c_i(CPI_{it} - CPI^*_{it}) + u_{PMI,it} \quad (7)$$

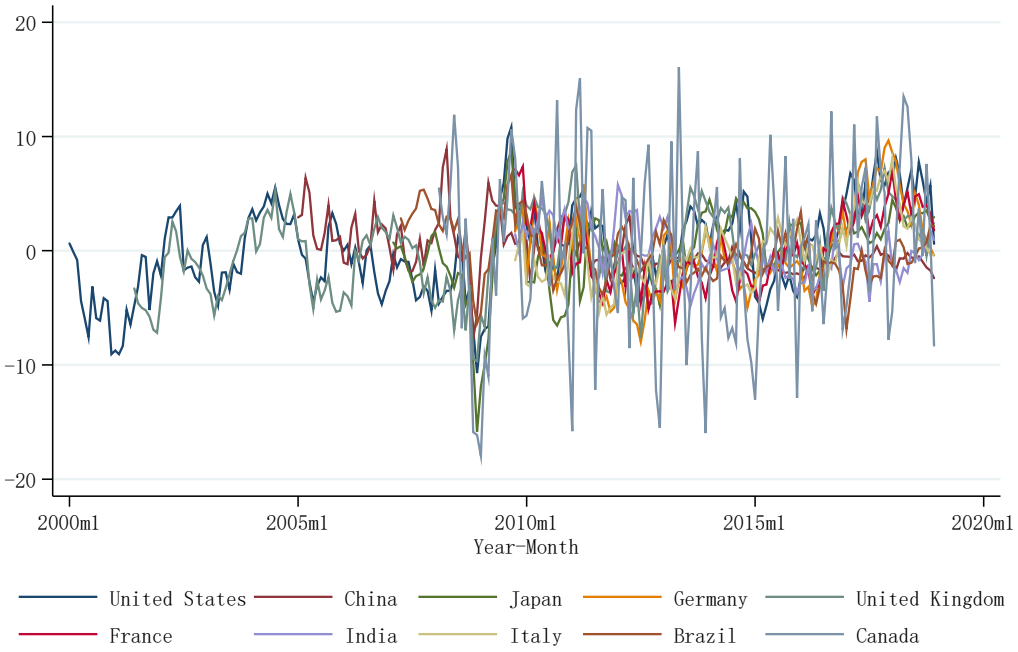


Figure 4 Macroeconomic expectation, netting out influence of fundamental-based factors.

4.3.1.2 Financial Markets Expectation Gap

The error term $u_{VIX,it}$ in equation (8) is the stock market expectation gap, which is used to gauge stock market expectation, netting out influence of fundamental-based factors. In calculation of gaps, besides netting economic-fundamental factors, such as economic growth and inflation, we also net out stock market fundamental factor by including monthly return of stock indices. As shown in Figure 5, stock market expectation gaps of studied economies show sign of co-movement (synchronisation). Research in this sub-section involves 23 economies.

$$VIX_{it} = a_i + b_i(GDP_{it} - GDP^*_{it}) + c_i(CPI_{it} - CPI^*_{it}) + d_iS_{it} + u_{VIX,it} \quad (8)$$

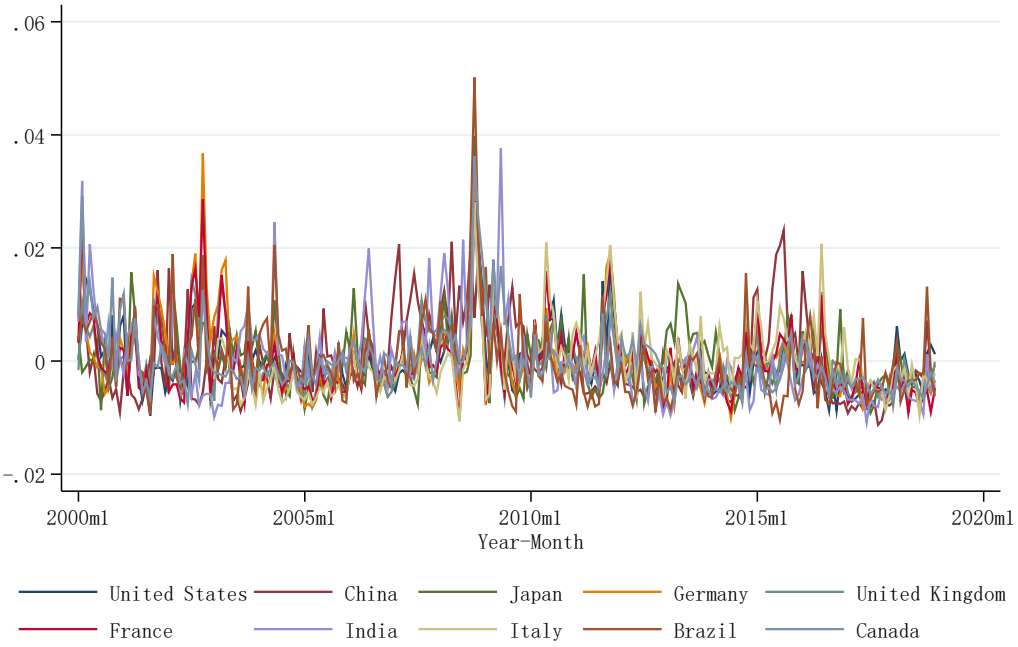


Figure 5 Stock market expectation, netting out influence of fundamental-based factors.

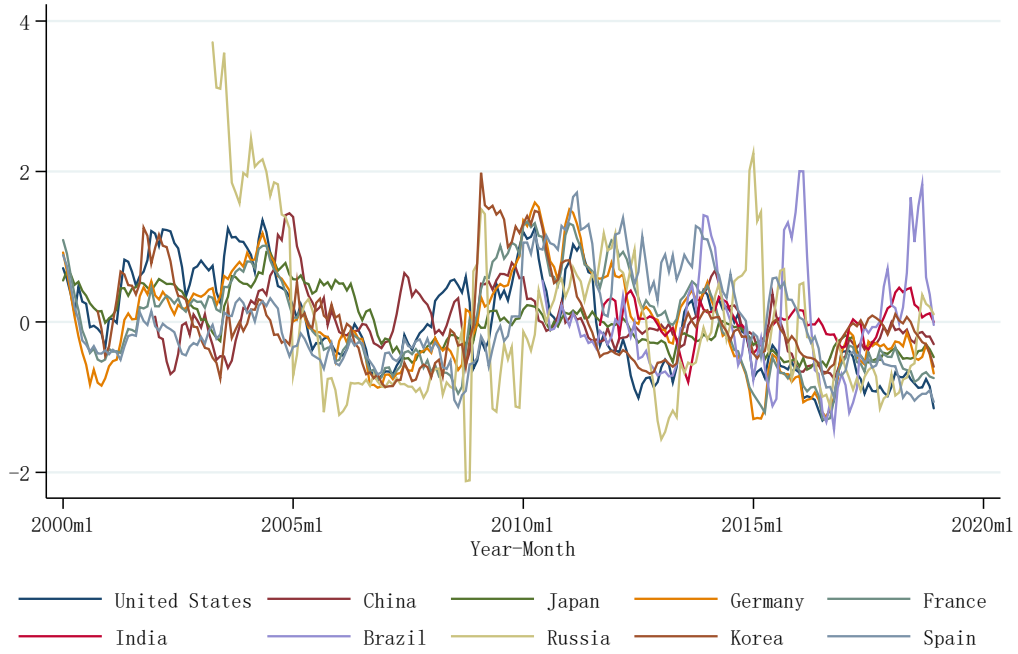


Figure 6 Bond market expectation, netting out influence of fundamental-based factors.

The error term $u_{TS,it}$ in equation (9) is the bond market expectation gap, which is used to gauge bond market expectation netting out influence of fundamental-based factors. In calculation of gaps, besides netting economic-fundamental factors, such as economic growth and inflation, we also net out bond market fundamental factor by including yield of short-tern government bond. As shown in Figure 6, bond market expectation gaps of studied economies show sign of co-movement (synchronisation). Research in this sub-section involves 16 economies.

$$TS_{it} = a_i + b_i(GDP_{it} - GDP^*_{it}) + c_i(CPI_{it} - CPI^*_{it}) + d_i I_{it} + u_{TS,it} \quad (9)$$

4.3.1.3 Policy Gap

The error term $u_{IR,it}$ in equation (10) is the policy gap, which is used to gauge monetary policy stance netting out influence of fundamental-based factors, such as economic growth and inflation. As shown in Figure 7, policy gaps of studied economies show sign of co-movement (synchronisation). Research in this sub-section involves 17 economies.

$$IR_{it} = a_i + b_i(GDP_{it} - GDP^*_{it}) + c_i(CPI_{it} - CPI^*_{it}) + u_{IR,it} \quad (10)$$

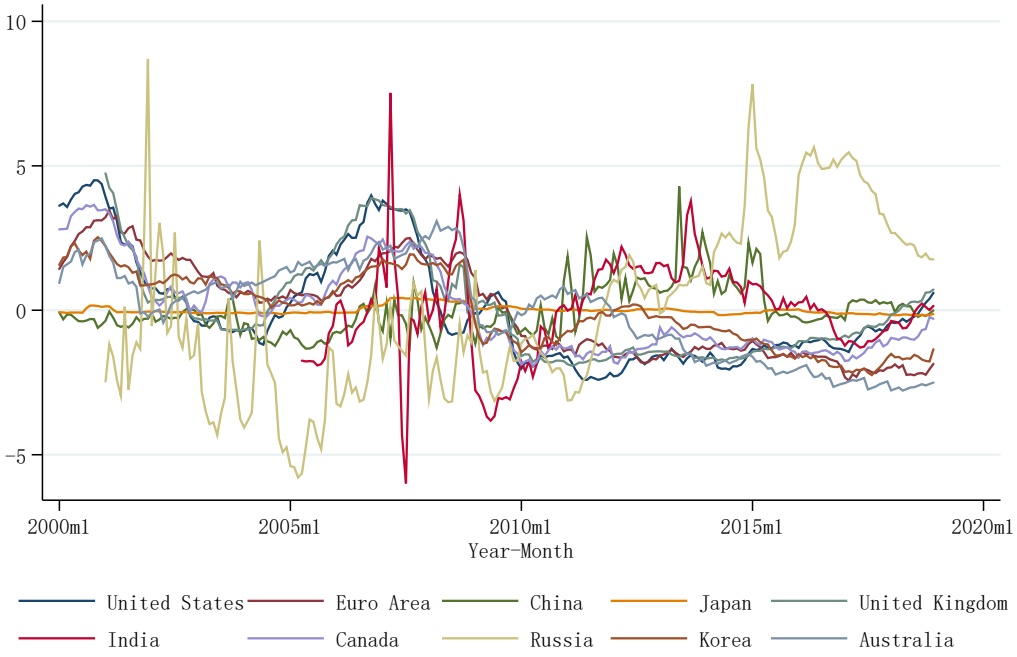


Figure 7 Policy gap, netting out influence of fundamental-based factors.

4.3.2 Empirical Tests of Expectation Transmission and Policy Synchronisation

We report results of second step regression in this sub-section. $b_{i,j}$ in equation (6) and respective significance levels are reported in Table 3 – Table 6. Every column stands for an affected economy. The originating economy of each crisis is listed in Table 1. To be specific, originating economy of crisis 3 (i.e. European debt crisis) is France in Table 3 - Table 5, and is Euro Area in Table 6.

4.3.2.1 Macroeconomic Expectation Transmission

Empirical results show that there are significant macroeconomic expectation transmission effects in international financial crises, as shown in Table 3. In the four crises, macroeconomic expectation transmission of most economies is significantly

positive. When macroeconomic expectation of the originating economy deteriorates, even if economic growth and inflation of other economies haven't been affected yet, macroeconomic expectations of other economies may still deteriorate. For example, in 2008 global financial crisis, changes in Switzerland and Japan's macroeconomic expectation gap are 105% and 97% of that in macroeconomic expectation gap of the United States respectively, i.e., macroeconomic expectation transmission efficiency from the U.S. to Switzerland and Japan are 105% and 97% respectively.

Table 3 Empirical results of macroeconomic expectation transmission

Crisis	China	Japan	Germany	United Kingdom	France	India	Italy	Brazil	Canada
1									
2	0.074	0.968***		0.753***				0.485***	
	(0.73)	(8.18)		(9.88)				(7.19)	
3	0.316***	-0.257	0.808**	0.565***		0.905***	0.529**	0.453**	0.310
	(4.82)	(-1.23)	(2.40)	(2.62)		(5.68)	(1.98)	(2.40)	(0.68)
4	0.066	-0.395*	-0.392	-1.465***	-0.597**	0.524**	-0.662***	0.652***	1.359***
	(0.92)	(-1.73)	(-1.03)	(-13.92)	(-2.47)	(2.11)	(-3.12)	(4.12)	(2.89)

Crisis	Russia	Korea	Spain	Australia	Mexico	Indonesia	Turkey	Switzerland	Vietnam
1								-0.124	
								(-0.59)	
2				0.749***				1.051***	
				(4.66)				(17.98)	
3	0.037	0.538***		0.551***			-0.043	0.524***	
	(0.18)	(3.24)		(2.71)			(-0.15)	(5.48)	
4		0.437***	-0.360***	-0.078	0.300	-0.285**	-0.070	-0.598*	-0.449**
		(5.16)	(-3.25)	(-0.26)	(1.31)	(-2.38)	(-0.35)	(-1.77)	(-1.99)

Note: In each cell per crisis and per economy, the upper value is the regressed coefficient, while the lower value is HAC t statistics, with ***, **, * representing passing significance tests at 1%, 5%, 10% significance levels.

Impact of expectation gap of originating economy of each crisis has more influence on those economies which are more closely integrated with originating economy. Take Australia as an example. In 2008 global financial crisis, changes in U.S. macroeconomic expectation gap caused Australia's macroeconomic expectations to change in the same direction, the transmission efficiency being 75%. In European debt crisis, France's macroeconomic expectation transmission efficiency to Australia is only 55%. In emerging market crisis, the changes in Russia's macroeconomic expectations

impacted Australia insignificantly. The U.S. has far more economic weight than other economies, which partially explains why it has far more influence on macroeconomic expectations than other originating economies. Besides, the dependence of international trade on U.S. dollar is higher than other currencies, resulting in more acute response of economic variables of other economies to macroeconomic fluctuation in the U.S.

4.3.2.2 Financial Markets Expectation Transmission

Empirical results show that there are significant financial markets expectation transmission in international financial crises, as shown in Table 4. In the first three crises, stock market expectation transmission of most economies is significantly positive. When there are large stock market fluctuation and unfavorable stock expectations in originating economies, even if economic and stock market fundamentals haven't been affected yet, it may still trigger reversal of stock market expectations in other economies.

Table 4 Empirical results of stock market expectation transmission

Crisis	China	Japan	Germany	United Kingdom	France	India	Italy	Brazil	Canada	Russia	Korea
1	0.001	0.128	0.366***	0.440***	0.651***	0.616***		0.554***	0.976***		0.658***
	(0.01)	(1.01)	(5.20)	(6.54)	(11.60)	(4.07)		(4.61)	(15.80)		(6.94)
2	0.133	0.993***	0.946***	0.807***	0.903***	0.491***	0.930***	1.176***	0.946***	1.496***	0.739***
	(1.42)	(6.72)	(17.56)	(15.18)	(14.30)	(5.89)	(11.85)	(6.39)	(6.62)	(5.65)	(6.01)
3	-0.118	-0.173	1.106***	0.571***		0.236**	0.977***	-0.182	-0.268***	-0.028	0.519***
	(-0.61)	(-0.97)	(4.25)	(13.67)		(2.39)	(15.52)	(-1.33)	(-2.93)	(-0.16)	(3.81)
4	0.209	-0.164**	0.105***	0.033	0.034	0.057	0.118*	0.149*	0.063		-0.020
	(1.22)	(-2.04)	(2.75)	(1.02)	(1.09)	(0.60)	(1.73)	(1.71)	(1.25)		(-0.93)

Crisis	Spain	Australia	Mexico	Indonesia	Turkey	Switzerland	Argentina	Thailand	South Africa	Malaysia	Vietnam
1	0.313***	0.241***	0.644***		0.692**	0.102		0.345***	0.383***		
	(2.72)	(4.20)	(6.18)		(2.53)	(0.47)		(4.58)	(7.01)		
2	0.893***	0.484***	0.953***	0.561***	0.620***	0.785***	0.965***	0.373***	1.354***	0.158***	0.349***
	(10.41)	(5.24)	(6.35)	(14.82)	(5.62)	(22.91)	(12.79)	(4.77)	(14.63)	(3.54)	(2.96)
3	0.785***	0.167*	0.166	0.661***	-0.143	0.533***	-0.263	0.048	0.474***	0.271*	0.098
	(3.69)	(1.76)	(1.31)	(3.85)	(-0.39)	(8.04)	(-1.50)	(0.59)	(2.59)	(1.87)	(0.40)
4	0.037	0.018	0.166***	-0.013	0.158*	-0.010	0.052	-0.089*	0.153***	0.081*	0.086
	(1.15)	(0.32)	(12.44)	(-0.22)	(1.89)	(-0.20)	(0.37)	(-1.69)	(3.52)	(1.79)	(0.95)

Note: In each cell per crisis and per economy, the upper value is the regressed coefficient, while the lower value is HAC t statistics, with ***, **, * representing passing significance tests at 1%, 5%, 10% significance levels.

During the same crisis, stock market transmission is more apparent in those

economies which have more open financial markets, fragile financial system, and more closely integrated with other regional economies. To be specific, first, expectation transmission effect in more open economies is more pronounced. For example, in 2008 global financial crisis, stock market transmission efficiency from the U.S. to Japan and Germany are 99% and 95% respectively, while transmission to China is insignificant. Second, in several emerging economies, such as Turkey, financial systems are relatively fragile, and endured larger expectation shocks in crises. Transmission efficiency to Turkey in the first two crises is both higher than 60%. Third, in highly integrated regions, expectation transmission is more pronounced. For example, in 2011 European debt crisis, stock market transmission efficiency from France to Euro Area economies, such as Germany and Italy, is higher than that to economies in other regions.

Table 5 Empirical results of bond market expectation transmission

Crisis	China	Japan	Germany	France	India	Brazil	Russia	Korea
1		0.274***	0.835***	0.545***				
		(3.82)	(6.21)	(5.83)				
2	0.096	0.154**	0.819***	0.605**			-0.655	0.269
	(1.50)	(2.06)	(3.04)	(2.30)			(-1.29)	(0.73)
3	-0.050	0.165**	0.577***			0.625***	1.448***	0.266
	(-0.41)	(2.52)	(3.44)			(4.23)	(2.86)	(1.35)
4	0.014	0.059***	-0.368***	-0.415***	0.059	-0.089*		0.033**
	(0.24)	(3.17)	(-11.09)	(-11.71)	(0.60)	(-1.73)		(2.53)

Crisis	Spain	Australia	Indonesia	Turkey	Thailand	Malaysia	Vietnam
1	0.267***	0.656***					
	(3.19)	(7.89)					
2	0.805***	-0.031			0.613***	0.473***	
	(3.42)	(-0.17)			(5.88)	(3.60)	
3	0.255	0.392***	1.304***		-0.212	0.030	
	(1.30)	(5.02)	(3.96)		(-0.84)	(0.52)	
4	-0.412***	-0.132***	-0.181**	-0.206***	-0.102***	0.125***	0.070
	(-17.79)	(-8.46)	(-2.09)	(-16.87)	(-4.37)	(9.73)	(0.54)

Note: In each cell per crisis and per economy, the upper value is the regressed coefficient, while the lower value is HAC t statistics, with ***, **, * representing passing significance tests at 1%, 5%, 10% significance levels.

When term-spread of government bond in originating economies narrows, or even reverses, and there are unfavorable bond market expectation changes, even if economic and bond market fundamentals haven't been affected yet, it may still induce same-

direction change of term-spread of government bond in other economies, i.e. change in bond market expectations, as shown in Table 5. Compared with stock market expectation transmission, expectation transmission in bond market is more moderate and milder. For example, in 2008 global financial crisis, bond market expectation transmission from the U.S. to France is 61%, lower than that of stock market during the same crisis.

In a nut shell, analysis regards financial markets expectation transmission shows that, with deepening of globalization and financial development, information asymmetry in financial markets has intensified. When prices fluctuate drastically, it is more difficult for investors to extract information from prices, resulting in decision making based on market expectations, which further induces sentimental trading behavior in the financial markets, and more significant financial market expectation transmission during crises.

4.3.2.3 Policy Synchronisation

Empirical results show that during the first two crises, U.S. policy gaps will significantly affect policy gaps of some of other economies, as shown in Table 6. For example, during the Internet-bubble crisis, 81% of U.S. policy gap variation is transmitted to Canada, and 61% to Australia. This reflects the monetary policy synchronisation between the U.S. and other economies.

We could observe two interesting phenomena from Table 6. One is that policy synchronisation in crises originating from the U.S. is more apparent. During the last two crises, policy synchronisation effects are more moderate. This is mainly because of that originating economies in the last two crises aren't the United States. They had different economic cycles compared with the United States, while monetary policy in most economies is more synchronized with the United States. The other one is that policy synchronisation is mostly insignificant in these economies, which either face ZLB (Zero Lower Bound) or have capital flow management measures in place. Since 2008, several advanced economies have been facing ZLB. Nominal interest rate remained unchanged for a substantial period. Price-based indicators, such as interbank market lending rate, cannot fully capture monetary policy stance of these economies.

Besides, economies with capital flow management measures have more monetary policy independence, resulting in limited impacts from other economies.

Table 6 Empirical results of policy synchronisation

Crisis	China	Japan	United Kingdom	India	Canada	Russia	Korea	Australia
1	-0.011	0.029**			0.808***		0.343***	0.607***
	(-0.99)	(2.30)			(20.92)		(16.60)	(23.11)
2	0.015	0.053	0.787***	-0.269	0.734**	-0.453***	0.490	0.122
	(0.15)	(1.64)	(7.35)	(-0.49)	(2.41)	(-6.51)	(1.52)	(0.28)
3	0.290	-0.004	-0.410***	-1.956***	0.248	-4.905***	-0.600**	1.427***
	(0.34)	(-0.25)	(-2.73)	(-3.15)	(1.36)	(-2.95)	(-2.37)	(3.45)
4	0.063	-0.026***	-0.022	-0.183***	-0.076***		-0.129***	-0.088*
	(0.81)	(-3.37)	(-1.32)	(-3.91)	(-4.44)		(-9.05)	(-1.76)

Crisis	Mexico	Indonesia	Switzerland	Argentina	Thailand	Malaysia	Vietnam	Euro Area
1	1.569***		0.280***					0.241***
	(8.49)		(5.18)					(3.74)
2	0.734*	-0.044	0.685***	0.246	0.517***	0.326***		0.744***
	(1.67)	(-0.27)	(4.35)	(0.69)	(4.93)	(3.10)		(3.40)
3	2.015***	2.577***	-0.484**	0.129	-0.723*	-0.397***	-2.527	
	(4.81)	(5.59)	(-1.98)	(0.20)	(-1.74)	(-3.86)	(-0.56)	
4	-0.424***	0.143*	-0.052**	1.191***	-0.116***	0.017	-0.081	0.058***
	(-3.02)	(1.86)	(-2.42)	(7.23)	(-3.07)	(1.00)	(-0.86)	(3.13)

Note: In each cell per crisis and per economy, the upper value is the regressed coefficient, while the lower value is HAC t statistics, with ***, **, * representing passing significance tests at 1%, 5%, 10% significance levels.

5. Conclusion and Policy Recommendations

This paper innovatively proposes financial accelerator in an open economy and Taylor Rule augmented by international factors as theoretical basis of expectation transmission and policy synchronisation, respectively. Our empirical study on expectation transmission and policy synchronisation covers 24 economies, and four international financial crises, i.e. 2001 Internet-bubble crisis originating from the U.S., 2008 global financial crisis originating from the U.S., 2011 European debt crisis originated from France and other Euro Area countries, 2013 emerging market crisis originating from Russia and other EMEs.

In the context of globalization, multinational corporations operate worldwide, and the traditional financial accelerator upgrades to financial accelerator in open economy.

Compared with non-multinational corporations facing only the local financial accelerator, multinational corporations need to struggle against multiple financial accelerators in different economies involved in their business. Hence financial accelerator in open economy is essentially "multiple financial accelerators" connected by global layout of multinational corporations and reveals itself in a network structure, which not only amplifies "tangible" trade and capital channels, but also amplifies "intangible" expectation channels. Global layout of multinational corporations and their balance sheets are connections among multiple financial accelerators.

After 2008 global financial crisis, with changes in global financial conditions, financial spillover effect became more apparent and deemed revision to the traditional Taylor Rule necessary. Monetary policy should also take international factors into consideration, in addition to the traditional output and inflation gaps. Previous research shows that if international factors are taken into consideration, it will improve welfare of all relevant economies simultaneously, which proves to be a better choice for all parties. When each economy formulates monetary policy with international factors in mind, the common international factors will cause same direction change of monetary policy in different economies, reflected as policy synchronisation. In recent years, various economies have gradually realized the necessity of considering international factors in monetary policy making, and international monetary policy coordination is increasingly characterized by two-way coordination.

This paper applies Taylor Rule regression to different expectation and policy variables, and uses respective residuals as expectation gap and policy gap, whose correlation between originating economies and impacted economies is further used to measure expectation transmission and policy synchronisation in financial crises. This paper focuses on two types of expectations, i.e. macroeconomic expectation and financial markets expectation, the latter further subdivided into stock market expectation and bond market expectation. We focus on monetary policy as research subjects of policy synchronisation, and use short-term money market rate as proxy variable of monetary policy stance.

In the presence of financial accelerator in open economy, through balance sheet of

multinational corporations, if the “expectation gap” shows positive correlation, it proves after shock of international financial crisis, there are “pure contagion” of macroeconomic expectation and financial markets expectation among economies. According to Taylor Rule augmented by international factors, if the “policy gap” shows positive correlation, it means that global central banks take international factors into consideration while formulating monetary policy, which is further reflected as policy rate synchronisation.

Empirical results show that there are significant macroeconomic expectation transmission effects in international financial crises. International operation and global specialization are reasons behind macroeconomic expectation co-movement of different economies during crises. In addition, as the originating economy, United States has far more influence on macroeconomic expectations than other originating economies. The following reasons could cause the efficiency difference. First, studied economies have more profound economic connections with the U.S. economy, compared with other originating economies. Second, the dependence of international trade on U.S. dollar is higher than on other currencies, resulting in more acute response of economic variables of other economies to macroeconomic fluctuation in the U.S.

Empirical results show that there are significant financial markets expectation transmission in international financial crises. Expectation transmission of both stock market and bond market in most economies are significantly positive in four crises, while compared with stock market expectation transmission, expectation transmission in bond market is more moderate and milder. These results show that, with deepening of globalization and financial development, information asymmetry in financial markets has intensified. Sentimental trading behavior increases in the financial markets, and induces more significant financial market expectation transmission during crises. We also find that during the same crisis, stock market transmission efficiency varies because of financial openness, financial stability and regional integration.

Empirical results show that during the first two crises, U.S. policy gaps significantly affect policy gaps of some other economies (especially those economies located in Europe and America). During the last two crises, policy synchronisation

effects are more moderate. We provide 2 possible explanations. First, originating economies in the last two crises aren't the United States. Respective originating economies had different economic cycles compared with the United States. Second, several economies have been facing ZLB. Nominal interest rate remained unchanged for quite a period. Price-based indicators, such as interbank market lending rate, cannot fully capture monetary policy stance of these economies. Besides, economies with capital flow management measures have more monetary policy independence, resulting in limited impacts from other economies.

Based on above analysis, this paper proposes following policy recommendations:

First, strengthen expectation management. Pay more attention to maintain stable expectation, and strengthen communication with market entities, to timely respond to concerns, to eliminate market confusion, and to avoid excessive market volatility. Accelerate reforms in key areas relevant to expectation management and improve business environment, to further enhance confidence of entrepreneurs, and provide necessary institutional environment for stabilizing expectations.

Second, strengthen international macroeconomic policy coordination. Actively conduct international cooperation, and maintain close communication with major international financial organizations and central banks of major economies. Understand the latest trends of economic and financial development in other economies, as well as policy intentions and considerations of policy makers, to fully assess the impact on domestic economic development and monetary policy, and also explain domestic economic and financial development and monetary policy consideration, to promote other central banks' understanding of domestic economy, which should help other central banks to include domestic factor into their respective decision functions.

Third, maintain better coordination between domestic financial policy and international financial policy, and also strike balance between domestic and international equilibrium. Focus on domestic economy, while taking international equilibrium into consideration. Maintain three-fold balance well among maintaining the flexibility of the RMB exchange rate, perfecting macro-prudential policy regarding cross-border capital flow, and strengthening international macroeconomic policy

coordination.

Fourth, further push forward monetary policy framework transmission to price-based framework. The major central banks mostly adopt price-based policy frameworks, and to push forward transformation to price-based framework is conducive to strengthening communication and coordination with major central banks, and improving international macroeconomic policy coordination efficiency.

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Appendix A: Economies selected in "Empirical Tests of Expectation Transmission and Policy Synchronisation"

Variables	Economy
Macroeconomic expectation	USA, China, Japan, Germany, UK, France, India, Italy, Brazil, Canada, Russia, Korea, Spain, Australia, Mexico, Indonesia, Turkey, Switzerland, Vietnam
Bond market expectation	USA, China, Japan, Germany, France, India, Brazil, Russia, Korea, Spain, Australia, Indonesia, Turkey, Thailand, Malaysia, Vietnam
Stock market expectation	USA, China, Japan, Germany, UK, France, India, Italy, Brazil, Canada, Russia, Korea, Spain, Australia, Mexico, Indonesia, Turkey, Switzerland, Argentina, Thailand, South Africa, Malaysia, Vietnam
Monetary policy stance	USA, China, Japan, UK, India, Canada, Russia, Korea, Australia, Mexico, Indonesia, Switzerland, Argentina, Thailand, Malaysia, Vietnam, Euro Area

Note: South Africa and Malaysia have continuous time series data of manufacturing PMI, but their respective time intervals do not cover any of the four crises studied in this paper. As a result, they are excluded in the empirical test of expectation transmission.

Appendix B: Details of Variable Selection in Empirical Analysis

Economy	Stock Market Index Yield	Bond Market Yield (Maturity)	Term Spread	Short Term Money Market Rate
United States	Standard & Poor 500 Index	1-year	10 year-1 year	Federal funds rate
China	Shanghai Composite Index	1-year	10 year-1 year	Depositary institutions 7-day pledged repo rate (DR007)
Japan	Nikkei 225 Stock Index	1-year	10 year-1 year	O/N unsecured lending rate
Germany	Germany DAX Index	1-year	10 year-1 year	—
United Kingdom	FTSE 100 Index	—	—	LIBOR O/N rate
France	French CAC40 Index	1-year	10 year-1 year	—
India	Mumbai's SENSEX30 Index	1-year	10 year-1 year	Short-term weighted average interbank lending rate
Italy	Italian Index	—	—	—
Brazil	Sao Paulo IBOVESPA Index	1-year	10 year-1 year	—
Canada	Toronto 300 Index	—	—	Overnight repo rate
Russia	Russia RTS Index	1-year	10 year-1 year	O/N interbank lending rate
Korea	Korea Composite Index	1-year	10 year-1 year	Unsecured lending rate
Spain	Spain IBEX35 Index	1-year	10 year-1 year	—
Australia	Australian Standard & Poor 200 Index	2-year	10 year-2 year	O/N interbank money market rate
Mexico	Mexico MXX Index	—	—	Interbank interest rate: 1 month
Indonesia	Jakarta Composite Index	1-year	10 year-1 year	O/N Jakarta interbank lending rate
Turkey	Istanbul ISE100 Index	1-year	10 year-1 year	O/N lending rate
Switzerland	Swiss SMI Index	—	—	Swiss Franc 3-month LIBOR rate
Argentina	Argentina MERV Index	—	—	Private bank interbank lending rate

Economy	Stock Market Index Yield	Bond Market Yield (Maturity)	Term Spread	Short Term Money Market Rate
Thailand	Thailand Composite Index	1-year	10 year-1 year	Interbank lending rate
South Africa	South Africa MSCI Index	—	—	—
Malaysia	FTSE Kuala Lumpur Composite Index	1-year	10 year-1 year	O/N weighted average interbank lending rate
Vietnam	Ho Chi Minh Stock Index	1-year	10 year-1 year	O/N weighted average interbank lending rate
Euro Area	—	—	—	O/N EURIBOR rate

Note: Depositary institutions 7-day pledged repo rate (DR007) before December 2014 is replaced by Interbank 7-day pledged repo rate (R007).