Financial Openness, Financial Frictions, and Macroeconomic Fluctuations in Emerging Market Economies

Yong Ma

To cite this article: Yong Ma (2016) Financial Openness, Financial Frictions, and Macroeconomic Fluctuations in Emerging Market Economies, Emerging Markets Finance and Trade, 52:1, 169-187, DOI: 10.1080/1540496X.2014.998549

To link to this article: http://dx.doi.org/10.1080/1540496X.2014.998549

Published online: 11 Jul 2015.

Article views: 790

View related articles

View Crossmark data

Citing articles: 2 View citing articles
Financial Openness, Financial Frictions, and Macroeconomic Fluctuations in Emerging Market Economies

Yong Ma

China Financial Policy Research Center, School of Finance, Renmin University of China, Beijing, China

ABSTRACT: This article develops an open economy dynamic stochastic general equilibrium (DSGE) model which takes into account the effects of financial openness and the associated financial frictions on macroeconomic fluctuations by introducing a modified version of interest parity. Evidence from the Chinese economy shows that the model provides a reasonable description of China’s financial openness and financial frictions during the sample period. Further evidence from comparative analysis shows that in most cases an increase in financial openness, usually accompanied by a decrease in financial frictions, leads to flatter volatility patterns with respect to domestic shocks but sharper volatility patterns in the presence of foreign shocks.

KEY WORDS: financial openness, financial frictions, macroeconomic fluctuations

Introduction

The past two decades have witnessed a dramatic financial opening process in many countries, especially in emerging market economies. As one of the cornerstones of the Washington Consensus, financial liberalization, usually accompanied by an increase in financial openness, is expected to allow developing and emerging market economies to accelerate the development of domestic financial markets and ensure against aggregate shocks, thus improving the efficiency of capital allocation and reducing macroeconomic fluctuations as well. As a result, moving toward a more open financial system is widely recognized as the right policy strategy and actually becomes one of the major pillars of financial reforms in many emerging market economies.

It is worth noting that compared with relatively ample literature on growth effects of financial openness, studies on the effects of financial openness on macroeconomic volatility is still its early stages. According to the standard theory of international economics, an increase in financial openness is expected to lead to a decline in macroeconomic volatility since greater access to international financial markets allows people to smooth consumption better over time by improving risk-sharing possibilities (Obstfeld and Rogoff 2000; Buch et al. 2005). Regarding the effects of financial openness on output volatility, Kalemli-Ozcan et al. (2003) show that financial openness helps to ensure against production risks and thereby reduce output fluctuations. In addition, financial openness may also help promote institutional reforms that can make the financial system more stable, thereby contributing to more macroeconomic stability (Williamson 2003; Mishkin 2009; Gossel and Biekpe 2013). However, financial openness may also make it easier for capital inflows to fuel excessive risk-taking on the part of financial institutions and allows financial shocks to be transmitted more readily across borders (Mishkin 2006). Using a dynamic open economy model with a tradable good produced with capital and a country-specific factor, Aghion et al. (2004) argue that opening domestic markets to foreign capital flows may lead to macroeconomic instability in economies at an intermediate level of financial

Address correspondence to Yong Ma, School of Finance, Renmin University of China, No. 59 Zhong Guan Cun Street, Haidian District, Beijing, 100872 China. E-mail: mayongmail@ruc.edu.cn or mayong19828@hotmail.com
development, where phases of growth with capital inflows are followed by collapse with capital outflows. In Levchenko (2005), when domestic risk sharing is subject to frictions and when risks are idiosyncratic and ascertainable within the domestic economy, opening up to international markets reduces the amount of risk sharing attained at home and raises the volatility of consumption. For emerging market economies, a large strand of literature has focused on the “sudden stop” and “capital flight” problems associated with financial opening. It is argued that capital account liberalization is systematically related to greater instability since capital flows are pro-cyclical in nature, and this exacerbates economic fluctuations (Stiglitz 2000).

Ambiguous conclusions are found not only in theoretical models but also in empirical studies. While some articles show that financial openness tends to be associated with lower consumption volatility (Bekaert et al. 2006; Buch and Yener 2009), others point to the opposite direction (Kose et al. 2003). As for the effects of financial openness on output variability, Loayza and Raddatz (2007) show that financial openness mitigates the consequences of external shocks, while other studies (Bekaert et al. 2006) suggest that financial openness generally has no significant impact on output volatility. In some deeper studies, the relationship between financial openness and macroeconomic volatility is investigated within the context of market imperfections and financial frictions. Tornell et al. (2004) show the existence of a positive link between financial openness and macroeconomic instability by employing a disaggregate model based on the real and financial asymmetries between tradable and nontradable sectors, where the existence of financial frictions is key for the final results. Based on a panel dataset for OECD countries, Buch et al. (2005) finds that the link between financial openness and macroeconomic volatility depends on the nature of the underlying shocks and points out that developing economies are more vulnerable to external shocks due to some structural features, such as small country size, limited foreign trade diversification, and sudden reversal of capital flows.

Overall, the ambiguous conclusions produced by both theoretical models and empirical studies suggest that the relationship between financial openness and macroeconomic fluctuations is still far from being well understood. Moreover, though there are numerous studies that seek to explain macroeconomic fluctuations in emerging market economies, few of them have employed a micro-founded dynamic stochastic general equilibrium (DSGE) model. Therefore, the absence of micro-foundations may be a potential methodological drawback of the existing studies, with the exception of Faia (2011) and Pisani (2011). Faia (2011) uses a small open economy DSGE model where foreign lending to households is constrained by a borrowing limit and shows that an increase in the degree of capital account openness increases consumption volatility as agents are unable to exploit risk-sharing opportunities. In a similar framework where international financial relations are characterized by the presence of a borrowing constraint, Pisani (2011) finds that, in presence of international financial frictions, greater access to international liquidity can cause high short-run macroeconomic instability in emerging market economies. One thing worth noting is that all model parameters in Faia (2011) and Pisani (2011) are obtained by pure calibration. However, according to recent advances in macroeconomics, the Bayesian method would be a better alternative to estimate DSGE models as it provides a rigorous framework for combining prior information with observations to calculate likely values, thus presenting a coherent way to incorporate all available information regarding the unknown parameter and avoiding the potential misspecification problems as well (An and Schorfheide 2007).

Motivated by the above considerations, this article develops an open economy New Keynesian DSGE model which takes into account the effects of financial openness on macroeconomic fluctuations by introducing a modified version of interest parity. We also include a financial friction parameter in our model since financial openness and financial frictions are closely related with each other and the combination of the two may provide us with a more complete picture of the financial markets in emerging market economies. Comparing with previous studies, our article contributes to the literature in the following three aspects. First, in contrast with the large body of work relying on macroeconometric models, this article provides a newly developed micro-founded DSGE model featuring an explicit specification of financial openness and financial frictions for
analyzing the links between financial openness and macroeconomic fluctuations. Second, the model is estimated using the Bayesian method, which is system-based and allows us to account for important effects of financial openness on macroeconomic volatility by combining prior information available in existing literature with actual observations. Third, the model is estimated and analyzed for the Chinese economy, which is the largest emerging economy in the world, thus adding new and important evidence to establish the relationship between financial openness and macroeconomic fluctuations in emerging market economies.

The rest of the article is organized as follows: the next section presents the structure of the model, followed by a discussion of the estimation methodology and a presentation of the empirical results. The following section provides further analysis of the relationship between financial openness, financial frictions, and macroeconomic fluctuations; and the final section contains concluding remarks.

The Model

Households

The domestic economy consists of a continuum of identical infinitely-lived households. The representative agent maximizes his lifetime welfare represented by a utility function:

\[
\max_{C, N} E_0 \sum_{t=0}^{\infty} \beta^t \xi_t \left( \frac{C_t - h C_{t-1}}{1 - \sigma} + \frac{1}{1 - \sigma} \left( \frac{M_t}{P_t} \right)^{1 - \sigma_M} - \frac{N_t^{1+\varphi}}{1 + \varphi} \right)
\]

where \( \beta \) is the intertemporal preferences discount factor, \( C_t \) denotes household consumption, \( N_t \) denotes hours worked, \( M_t/P_t \) denotes the real cash balance, \( \sigma \) is the inverse intertemporal elasticity of substitution between the present and future consumption, \( \varphi \) is the inverse Frisch elasticity of labor supply, and \( \sigma_M \) is the elasticity of money demand. The parameter \( h \) captures exogenous habit in consumption and \( \xi_t \) is a preference shock that follows an AR(1) process.

The consumption basket consists of domestic goods \( C_H \) and foreign goods \( C_F \) aggregated by Dixit-Stiglitz aggregator:

\[
C_t = \left[ (1 - \omega)^{\frac{1}{\eta}} C_{H,t}^{\frac{1}{\omega}} + \omega C_{F,t}^{\frac{1}{\omega}} \right]^{\frac{1}{\eta}}
\]

where \( \eta \) denotes the elasticity of substitution between domestic and foreign goods and \( \omega \) is the weight of imports in the production of final consumption goods.

The household’s problem is completed given the following budget constraint:

\[
P_t C_t + M_t + Q_{t,t+1} B_{t+1} = W_t N_t + B_t + M_{t-1} - T_t
\]

where \( W_t \) denotes the nominal wage, \( B_t \) is the government bonds, \( T_t \) denotes lump-sum taxes, \( P_t \) is a price of the consumption basket. \( Q_{t,t+1} \) is the stochastic discount factor, \( E_t Q_{t,t+1} = \frac{1}{R_t} \), where \( R_t \) is the (gross) nominal interest rate.

The FOCs (in log-linear form) of this problem are summarized by the labor supply

\[
w_t - p_t = \varphi n_t + \frac{\sigma}{1 - h} (c_t - h c_{t-1})
\]

the Euler equation

\[
c_t - h c_{t-1} = E_t (c_{t+1} - h c_t) - \frac{1 - h}{\sigma} (r_t - E_t \sigma_{t+1}) + \frac{1 - h}{\sigma} \left( \xi_t^p - E_t \xi_{t+1}^p \right)
\]
and the money demand equation

\[ m_t = \frac{\sigma}{(1 - h)\sigma_M} c_t - \frac{\sigma h}{(1 - h)\sigma_M} c_{t-1} - \frac{1}{\sigma_M} r_t \quad (6) \]

where lower case letters denote log deviations of a variable from its steady state value, e.g., \( x_t = \log X_t - \log X \).

**Producers**

It is assumed that the domestic sector is populated by a \((0, 1)\) continuum of monopolistically competitive producers. They share the same production technology: \( Y_t(j) = A_tN_t(j) \), where \( N_t(j) \) is the labor employed by firm \( j \). \( A_t \) is an exogenous technology shock that follows an AR(1) process, which is given by (in logarithms):

\[ a_t = \rho a_{t-1} + \epsilon_a, \quad \epsilon_a \sim i.i.d. N(0, \sigma_a^2). \]

Firms are assumed to set prices à la Calvo such that in every period a fraction \( 1 - \theta_H \) of domestic producers is able to reset their price optimally. Thus, the maximization problem of firm \( j \) is given by:

\[ E_t \sum_{T=t}^{\infty} \theta_H^{T-t} Q_{i,T} y_{H,T}(j) \left[ P_{H,t}(j) - P_{H,t}MC_T \right] = 0. \quad (7) \]

where \( y_{H,T}(j) \) is the demand for the production of the \( j \)-th producer, \( P_{H,t}(j) \) is the optimal price set by the \( j \)-th producer in period \( t \) and \( MC_T \) are marginal costs given as a derivative of the total costs. Differentiating with respect to \( P_{H,t}(j) \), the following optimality condition is obtained:

\[ E_t \sum_{T=t}^{\infty} \theta_H^{T-t} Q_{i,T} y_{H,T}(j) \left[ \frac{\partial H}{\partial H} - 1 P_{H,t}MC_T \right] = 0. \quad (8) \]

The log-linearized FOC of this problem is the well-known Phillips curve for the domestic goods inflation:

\[ \pi_{H,t} = (1 - \theta_H) \frac{(1 - \beta\theta_H)}{\theta_H} mc_t + \beta E_t \pi_{H,t+1} \quad (9) \]

where the gap of marginal costs is given by:

\[ mc_t = \varphi y_t + \frac{\sigma}{1 - h} (c_t - hc_{t-1}) + \omega s_t - (1 + \varphi) a_t. \quad (10) \]

**Importers and Overall Inflation**

Similar to the model setting of domestic producers, we assume that there is a \((0, 1)\) continuum of monopolistically competitive importers in the domestic economy. Each importer imports a unique good \( i \) bought for the price “at the docks,” for example, \( EX_t P_{F,i}(i) \), where \( EX_t \) is the nominal exchange rate.

Firms are also assumed to set prices à la Calvo such that in every period a fraction \( 1 - \theta_F \) of importers is able to reset their price optimally. Given the demand for their goods \( C_{F,T}(i) \), the problem of the importers is to maximize:

\[ E_t \sum_{T=t}^{\infty} Q_{i,T} \theta_F^{T-t} C_{F,T}(i) [P_{F,t}(i) - EX_t P_{F,i}^*(i)]. \quad (11) \]
The first order condition to the above problem is given by:

\[
E_t \sum_{T=t}^{\infty} Q_{i,T} \theta_F^{T-t} C_{F,T}(i) |P_{F,i}(i) - \frac{\theta_F}{\theta_F - 1} EX_i P_{F,i}(i)| = 0
\] (12)

which leads to the following Phillips curve of the imported goods inflation:

\[
\pi_{F,t} = (1 - \theta_F) \left(1 - \theta_F \right) \psi_t + \beta E_t \pi_{F,t+1}
\] (13)

where \( \psi_t = e_t + p_t^* - p_{F,t} \) is the log of the law of one price gap. Using (9) and (13) the overall inflation is defined as:

\[
\pi_t = (1 - \omega) \pi_{H,t} + \omega \pi_{F,t}.
\] (14)

**Modified Interest Parity With Financial Openness and Financial Frictions**

Following Monacelli (2005), the real exchange rate is defined in log terms by:

\[
q_t = e_t + p_t^* - p_t = e_t + p_t^* - p_{F,t} + (1 - \omega) s_t = \psi_t + (1 - \omega) s_t
\] (15)

where \( q_t \) is the log of the real exchange rate, \( e_t \) is the log of the nominal exchange rate, \( p_t^* \) is the log of the foreign CPI, \( s_t = p_{F,t} - p_{H,t} \) are log terms of trade. In addition, equating the intertemporal optimality conditions for the domestic and foreign households’ optimization problem gives the following international risk sharing condition:

\[
c_t - hc_{t-1} = y_t^* - hy_{t-1}^* + \frac{1-h}{\sigma} q_t + \xi_t^p
\] (16)

where \( y_t^* \) is the log of foreign output, \( \xi_t^p \) is a preference shock that follows an AR(1) process:

\[
\xi_t^p = \rho \xi_{t-1}^p + \epsilon_t^p, \epsilon_t^p \sim i.i.d. N(0, \sigma_p^2).
\]

The uncovered interest parity condition requires that \( r_t - r_t^* = E_t e_{t+1} - e_t \). After plugging for \( e_t \) and defining inflation as \( \pi_t = p_t - p_{t-1} \), we obtain:

\[
r_t = r_t^* - E_t \pi_{t+1} + E_t \pi_{t+1} + E_t q_{t+1} - q_t.
\] (17)

Note that Equation (17) represents the uncovered interest arbitrage relation in a world with no financial frictions, which is commonly used in the DSGE models. By assuming free capital mobility, perfect substitutability between domestic and foreign assets, and no information problem or other sources of frictions in international financial markets, domestic and foreign assets should yield the same return at all times, that is, the uncovered interest parity (UIP) given by Equation (17) always holds.

However, as emphasized by Edwards and Khan (1985) and Chang et al. (2014), in most emerging market economies, because of financial frictions arising from transaction costs, information lags, government-imposed regulations, and the like, domestic interest rates respond with delay to any changes in the foreign rate of interest or in exchange rate expectations. In such an environment, the uncovered interest parity condition can be modeled with a lagged response in a partial adjustment framework:

\[
r_t = \gamma (r_t^* - E_t \pi_{t+1} + E_t \pi_{t+1} + E_t q_{t+1} - q_t) + (1 - \gamma) r_{t-1}
\] (18)
where the adjustment parameter $\gamma (0 \leq \gamma \leq 1)$ is a measure of financial frictions as discussed above. It can be easily seen from Equation (18) that a smaller $\gamma$ means a more sluggish adjustment of domestic interest rate toward UIP, thus implying more frictions in the financial market. Conversely, in a frictionless financial market where domestic interest rate adjusts rapidly, $\gamma$ will tend toward unity.

Equation (18) describes the interest parity with financial frictions in a fully open economy. By comparison, nominal interest rates in a closed economy will be given by the classic Fisher equation:

$$r_t = rr_t + \pi_t$$  \hspace{1cm} (19)$$

where $rr_t$ is the real rate of interest. Following Edwards and Khan (1985) and Ahn (1994), in emerging market economies where exist controls on capital movements, the equation for the nominal interest rate can be specified as a weighted average of the open and closed economy expressions represented by Equations (18) and (19). Denoting the weight by $\Gamma$, adding exchange rate shock $\xi_t^q$ and combining Equations (18) and (19) gives the following specification for nominal interest rate:

$$r_t = \Gamma (r_t^* - E_t \pi_{t+1} + E_t \pi_{t-1} + E_t q_{t+1} - q_t) + (1 - \Gamma) (rr_t + \pi_t) + \xi_t^q$$  \hspace{1cm} (20)$$

where the parameter $\Gamma$ can be interpreted as an index measuring the degree of financial openness. Theoretically, the parameter $\Gamma$ lies between zero and unity for economies that exert controls on capital movements, and the closer it is to unity, the more open the economy will be. Note that full interest parity would require the condition $\Gamma = \gamma = 1$; when $\Gamma = 0$, the capital account is closed, and Equation (20) collapses into the Fisher closed economy Equation (19). The exchange rate shock $\xi_t^q$ is introduced as an exogenous AR(1) process: $\xi_t^q = \rho^q \xi_{t-1}^q + \varepsilon_t^q$, $\varepsilon_t^q \sim i.i.d.N(0, \sigma^q_\varepsilon)$.

Finally, we assume that the real rate of interest $rr_t$ is linked to monetary disequilibrium by taking into account the "liquidity effect" in the literature (Mundell, 1963). In this case, excess (inadequate) growth rate of money supply will yield a temporarily lower (higher) real interest rate. Thus, the real rate of interest $rr_t$ can be modeled as

$$rr_t = \rho_{rr} rr_{t-1} - (1 - \rho_{rr}) (\zeta_m \kappa_t) + \varepsilon_t^{rr}$$  \hspace{1cm} (21)$$

where $\rho_{rr}$ denotes the persistence of the real interest rate, $\kappa_t = \log M_t - \log M_{t-1}$ is the money growth rate, $\zeta_m$ measures the sensitivity of the real interest rate to the money growth rate, and $\varepsilon_t^{rr} \sim i.i.d.N(0, \sigma^2_{rr})$ is an exogenous real interest rate shock.

**Equilibrium**

The market clearing requires that domestic output is equal to the sum of domestic consumption and foreign consumption of home produced goods:

$$y_t = \omega c^H_t + (1 - \omega) c^*_t$$  \hspace{1cm} (22)$$

where $c^*_t$ is the overall foreign consumption and $c^*_t$ is the foreign consumption of domestic goods. Acknowledging that the domestic consumption demand is given by:

$$c_t = c_t - \eta (p_H - p_t) = c_t + \eta s_t$$  \hspace{1cm} (23)$$

and the foreign demand for domestic goods is given by:

$$c^{*}_t = c^*_t - \eta (p_H - p^*_t) = c^*_t + \eta (s_t + \xi_t^q).$$  \hspace{1cm} (24)$$
Therefore, the final form of the goods-market clearing condition can be written as:

\[
y_t = (1 - \omega) c_t + \omega [\eta (2 - \omega) s_t + \eta \psi_t + y^*_t]
\]

where \( y^*_t \) is the foreign output. For simplicity, all foreign variables are introduced as exogenous stochastic AR(1) processes:

\[
y^*_t = \rho^*_y y^*_{t-1} + \epsilon^*_y
\]

\[
\pi^*_t = \rho^*_\pi \pi^*_{t-1} + \epsilon^*_\pi
\]

\[
r^*_t = \rho^*_r r^*_{t-1} + \epsilon^*_r
\]

where \( \rho^*_y, \rho^*_\pi \) and \( \rho^*_r \) denote the persistence parameters of the foreign output, inflation and interest rate respectively, and the innovations \( \epsilon^*_y, \epsilon^*_\pi \) and \( \epsilon^*_r \) are assumed to follow \( i.i.d. N(0, \sigma^2_y) \), \( i.i.d. N(0, \sigma^2_\pi) \) and \( i.i.d. N(0, \sigma^2_r) \) respectively.

### Monetary Policy

Following Taylor (2001) and Fan et al. (2011), a three-factor augmented Taylor-type rule is used in our article:

\[
r_t = \rho r_{t-1} + (1 - \rho) [\phi_y y_t + \phi_\pi \pi_t + \phi_q q_t] + \epsilon^*_r
\]

where \( \rho \) is parameter of interest rates smoothing, \( \phi_y, \phi_\pi \) and \( \phi_q \) donate the reaction coefficients of the monetary authority to the gaps of output, inflation, and exchange rate respectively. \( \epsilon^*_r \sim i.i.d. N(0, \sigma^2_r) \) is an exogenous monetary policy shock.

### Estimation Methodology and Results

#### Econometric Method

Following the recent literature (Smets and Wouters 2003; An and Schorfheide 2007), we use the Bayesian estimation technique to estimate the log-linearized version of the model presented in the previous section. It overcomes the potential misspecification problem in the comparison of DSGE models and outperforms GMM and maximum likelihood estimation for small data samples (Fernández-Villaverde and Rubio-Ramirez 2004). To understand the estimation procedure, one may refer to An and Schorfheide (2007) and Mancini-Griffoli (2007) for further details.

#### Data and Prior Distributions

The model is estimated for the Chinese economy over the period from 1992:Q1 to 2013:Q3 due to data availability. The model features eight exogenous stochastic shocks: the technology shock, the preference shock, the monetary policy shock, the interest rate shock, the exchange rate shock, the foreign output shock, the foreign inflation shock, and the foreign interest rate shock.

Eight key macroeconomic quarterly time series, including domestic output (real GDP), domestic inflation, domestic consumption, domestic interest rate, real exchange rate, foreign output, foreign inflation, and foreign interest rate, are used as observable variables. Domestic time series data are obtained from the National Bureau of Statistics of China. Following Haider and Khan (2008), the foreign economy is approximated by the world’s largest economy (e.g., United Sates) and the corresponding time series data are obtained from the Federal Reserve Economic Data (FRED). In order to guarantee the stationarity of the variables, all the data are logged and then detrended with HP Filter.
In the Bayesian estimation, identification problems will emerge if all the structural parameters are estimated using the Bayesian method (Mancini-Griffoli 2007). Thus, some parameters are fixed in the estimation procedure. As usual in the literature, the discount factor $\beta$ is set at 0.99 to produce an annual steady-state interest rate of 4 percent. The parameter of import to GDP ratio $\omega$ is set at 0.21 by taking into the average value in the sample period. All other parameters are estimated using the Bayesian method. According to Schorfheide (2000), priors can be gleaned from personal introspection to reflect strongly held beliefs about the validity of economic theories. When deciding on prior means and standard deviations, we take into account that choosing a wide (concentrated) prior distribution for a parameter shows that we have low (great) confidence in prior information about that parameter.

Since most of the priors we use are standard in the literature (e.g., Smets and Wouters 2003; An and Schorfheide 2007; Ozdemir 2013), here we only focus on the specification of prior distributions for parameters in the modified interest parity, which is the main interest of the study. Since the theoretical values of the financial openness parameter $\Gamma$ and the financial friction parameter $\gamma$ lie between zero and unity, a beta distribution with prior mean 0.5 and standard error 0.2 is used. By centering the prior mean of $\Gamma$ around 0.5, it is easy to allow the data to tell us the actual degree of an economy’s financial openness: if $\Gamma$ is less than 0.5, a relatively low degree of financial openness is found; on the contrary, if $\Gamma$ turns out to be larger than 0.5, a relatively high degree of financial openness is found. Similar logic can be applied to understand the prior specification of $\gamma$, where a high degree of financial frictions is found when $\gamma<0.5$ while the reverse is true when $\gamma>0.5$. For parameters that describe the evolution of the real rate of interest, the sensitivity parameter of the real interest rate to the money growth rate $\zeta_m$ is assumed to follow gamma distribution with prior mean 1 and standard error 0.2, while the persistence of the real interest rate $\rho_{rr}$ is assumed to follow beta distribution with prior mean 0.5 and standard error 0.2. The specification of prior distributions for other parameters of the model is reported in Table 1.

**Parameter Estimates**

Table 1 reports Bayesian estimates of the model parameters with 95 percent confidence intervals based on 100,000 draws. As displayed in Table 1, all parameters are estimated to be significantly different from zero.

For the estimates of the behavioral parameters, it turns out that the inverse elasticity of intertemporal substitution in consumption $\sigma$ and labor supply $\varphi$ are estimated to be 1.440 and 1.025 respectively, both of which are higher than their prior means and theoretically valid. The elasticity of money demand $\sigma_M$ is estimated to be 2.859, which is close to its prior mean. The posterior means of Calvo parameters for domestic producers and importers, e.g., $\theta_H$ and $\theta_F$, are estimated to be 0.823 and 0.535 respectively, implying that in any period $t$, the probability of optimal price setting in domestic producers is lower than that of importers. The elasticity of trade substitution $\eta$ is estimated to be 0.565, which is lower than its prior mean and largely consistent with the results previously found in the literature (see Justiniano and Preston 2010). The habit parameter $h$ is estimated to be 0.542, suggesting that the degree of habit persistence in Chinese consumption is lower than that of advanced economies (e.g., Smets and Wouters 2003). Overall, the posterior estimates of the behavioral parameters seem to be quite consistent with China’s economic conditions as an emerging market economy (Li and Tsai 2013; Ma 2014).

Turning to the estimates of the monetary policy parameters, a considerable degree of interest rate smoothing is found as the posterior mean of the coefficient on the lagged interest rate $\rho_r$ and is estimated to be 0.770. The posterior mean of inflation coefficient $\phi_\pi$ is estimated to be 1.132, which is not only lower than its prior mean but also much lower than that found in advance economies, implying that the Chinese monetary authority does not show a strong anti-inflation stance in its monetary policy practice. By comparison, the posterior estimate of output gap coefficient $\phi_y$ turns out to be 0.749, which is higher than its prior mean and implies a relatively
strong preference for output stabilization. In addition, the posterior mean of exchange rate coefficient $\phi_q$ is estimated to be 0.349, which is lower than its prior mean but statistically significant, indicating that exchange rate stabilization might be an important motive in the conduct of China’s monetary policy.

Now we turn to the posterior estimates of the modified interest parity, where there are two key parameters that need special attention: the financial openness parameter $\Gamma$ and the financial friction parameter $\gamma$. As illustrated in Table 1, the posterior mean of the financial openness parameter $\Gamma$ is estimated to be 0.526, indicating a medium level of financial openness for the Chinese economy. This value is quite reasonable as it is largely consistent with the actual conditions of China’s financial openness during the sample period. According to the statistical data from the IMF, as early as in 2001, within the total of forty-three capital account items, China completely opened twelve items, partially opened sixteen items, with fifteen items prohibited. Currently, of the forty-three capital account items, more than 50 percent have no or little control in China, most of which are associated with transactions of nonresident selling or issuing money market instruments and derivatives inside China, or transactions of residents and nonresidents to provide personal loans. All these facts tend to suggest that China’s financial openness is generally at a medium level.

Table 1. Prior and posterior distributions of parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Prior distribution*</th>
<th>Prior mean</th>
<th>Posterior mean</th>
<th>95% Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma$</td>
<td>Gamma[1, 0.2]</td>
<td>1</td>
<td>1.440</td>
<td>[1.061, 1.833]</td>
</tr>
<tr>
<td>$\phi$</td>
<td>Gamma[1, 0.2]</td>
<td>1</td>
<td>1.025</td>
<td>[0.701, 1.348]</td>
</tr>
<tr>
<td>$\sigma_M$</td>
<td>Gamma[3, 1]</td>
<td>3</td>
<td>2.859</td>
<td>[2.036, 3.647]</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Gamma[0.8, 0.2]</td>
<td>0.8</td>
<td>0.565</td>
<td>[0.443, 0.667]</td>
</tr>
<tr>
<td>$h$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.542</td>
<td>[0.364, 0.743]</td>
</tr>
<tr>
<td>$\theta_H$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.823</td>
<td>[0.768, 0.879]</td>
</tr>
<tr>
<td>$\delta_F$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.535</td>
<td>[0.392, 0.677]</td>
</tr>
<tr>
<td>$\rho_s$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.770</td>
<td>[0.684, 0.858]</td>
</tr>
<tr>
<td>$\phi_s$</td>
<td>Gamma[1.5, 0.25]</td>
<td>1.5</td>
<td>1.132</td>
<td>[0.794, 1.470]</td>
</tr>
<tr>
<td>$\phi_y$</td>
<td>Gamma[0.5, 0.2]</td>
<td>0.5</td>
<td>0.749</td>
<td>[0.442, 1.042]</td>
</tr>
<tr>
<td>$\phi_q$</td>
<td>Gamma[0.5, 0.2]</td>
<td>0.5</td>
<td>0.349</td>
<td>[0.217, 0.479]</td>
</tr>
<tr>
<td>$\Gamma$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.526</td>
<td>[0.362, 0.696]</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.369</td>
<td>[0.125, 0.619]</td>
</tr>
<tr>
<td>$\rho_r$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.493</td>
<td>[0.323, 0.675]</td>
</tr>
<tr>
<td>$\eta_M$</td>
<td>Gamma[1, 0.2]</td>
<td>1.0</td>
<td>1.172</td>
<td>[0.923, 1.431]</td>
</tr>
<tr>
<td>$\rho_o$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.843</td>
<td>[0.759, 0.936]</td>
</tr>
<tr>
<td>$\rho_p$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.771</td>
<td>[0.603, 0.842]</td>
</tr>
<tr>
<td>$\rho_q$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.489</td>
<td>[0.268, 0.712]</td>
</tr>
<tr>
<td>$\rho_y$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.875</td>
<td>[0.803, 0.949]</td>
</tr>
<tr>
<td>$\rho_r$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.657</td>
<td>[0.541, 0.777]</td>
</tr>
<tr>
<td>$\rho_r$</td>
<td>Beta[0.5, 0.2]</td>
<td>0.5</td>
<td>0.892</td>
<td>[0.829, 0.951]</td>
</tr>
<tr>
<td>$\sigma_a$</td>
<td>Inv gamma[1, $\infty$]</td>
<td>1</td>
<td>1.523</td>
<td>[1.016, 2.035]</td>
</tr>
<tr>
<td>$\sigma_p$</td>
<td>Inv gamma[1, $\infty$]</td>
<td>1</td>
<td>1.658</td>
<td>[1.123, 2.196]</td>
</tr>
<tr>
<td>$\sigma_r$</td>
<td>Inv gamma[1, $\infty$]</td>
<td>1</td>
<td>0.299</td>
<td>[0.262, 0.336]</td>
</tr>
<tr>
<td>$\sigma_r$</td>
<td>Inv gamma[1, $\infty$]</td>
<td>1</td>
<td>0.302</td>
<td>[0.265, 0.337]</td>
</tr>
<tr>
<td>$\sigma_q$</td>
<td>Inv gamma[1, $\infty$]</td>
<td>1</td>
<td>0.219</td>
<td>[0.191, 0.238]</td>
</tr>
<tr>
<td>$\sigma_r$</td>
<td>Inv gamma[1, $\infty$]</td>
<td>1</td>
<td>0.245</td>
<td>[0.215, 0.276]</td>
</tr>
<tr>
<td>$\sigma_r$</td>
<td>Inv gamma[1, $\infty$]</td>
<td>1</td>
<td>0.303</td>
<td>[0.264, 0.339]</td>
</tr>
<tr>
<td>$\sigma_r$</td>
<td>Inv gamma[1, $\infty$]</td>
<td>1</td>
<td>0.184</td>
<td>[0.162, 0.206]</td>
</tr>
</tbody>
</table>

Note: *Numbers in the square brackets are prior means and standard deviations.
Another parameter worthy of special attention is the financial friction parameter $\gamma$. As shown in Table 1, the posterior mean of the financial friction parameter $\gamma$ is estimated to be 0.369, which is lower than its prior mean and numerically suggests a relatively large degree of financial frictions in China’s financial market. Theoretically, there might be some relations between the financial friction parameter $\gamma$ and the financial openness parameter $\Gamma$ in that a more open financial market is generally associated with less financial frictions. However, many other factors, especially the degree of market freedom or various policy restrictions, may also have notable impacts on the financial friction parameter $\gamma$. In the past two decades, though the Chinese economy has witnessed a remarkable process moving toward a free market economy, government interventions via foreign exchange regulation and interest rate control still play a nonnegligible role in the financial system, which might be an important source of financial frictions in the economy. This can partially explain the existence of a medium level of financial openness with a higher degree of financial friction in the Chinese economy. In fact, in many emerging market economies, due to market imperfections and government interventions, the degree of financial frictions may decrease at a slower pace as compared with the financial opening process.

As for the parameters in the real interest rate function, a high degree of persistence in the evolution of real interest rate is found as the autoregressive coefficient $\rho_{rr}$ is estimated to be 0.493. The sensitivity parameter of the real interest rate to money growth rate $\zeta_m$ is estimated to be 1.172, implying that real interest rate in the short run is sensitive to the changes in money supply as one percent growth of money supply will lead to more than one percent decrease in the real interest rate.

Finally, regarding the estimated processes for the exogenous shock variables, all shocks display a considerable degree of persistence, especially the productivity, foreign output, and foreign interest rate shocks. In addition, the large standard deviations of the productivity shock and the preference shock imply that at long horizons most of the forecast error variance of the model variables will be attributed to the two domestic shocks. A detailed discussion of the shock decompositions will be provided in a later section.

**Macroeconomic Implications**

**Impulse Response Analysis**

The empirical results of the previous section suggest that the status quo of China’s financial openness is generally at a medium level. According to the “Twelfth Five-Year Program” of the Chinese government, financial reforms leading toward a liberalized capital account remain a long-term goal for China. Therefore, it is widely anticipated that the degree of China’s financial openness will gradually increase in the next five to ten years. In this context, a more liberalized financial system is expected to have less financial frictions as well.

In order to investigate the impacts of financial openness (financial frictions) on macroeconomic fluctuations, different values are assigned to $\Gamma$ and $\gamma$ to indicate different degrees of financial openness (financial frictions) and the volatility of output and inflation is used to represent macroeconomic fluctuations. Then, impulse response functions are employed to analyze the relationship between financial openness (financial frictions) and macroeconomic fluctuations.

First, we illustrate what happens to the key macroeconomic variables (e.g., output and inflation) as the degree of financial openness increases. In order to do so, a data set of $\{0, 0.2, 0.526, 0.8, 1\}$ is given to $\Gamma$ while keeping other parameters of the model unchanged. As mentioned in section 2, higher values of $\Gamma$ denote higher degrees of financial openness. Note that $\Gamma = 0$ means the capital account is closed while $\Gamma = 1$ indicates a fully liberalized capital account. Note also that $\Gamma = 0.526$ is the value obtained from the Bayesian estimation in section 3, and thus can be referred to as the baseline scenario that describes the status quo of China’s financial openness. The impulse responses of output and inflation to various exogenous shocks are plotted in Figures 1–8, with different types of lines representing different degrees of financial openness.
Figure 1. Impulse responses to technology shocks for different values of $\Gamma$.

Figure 2. Impulse responses to preference shocks for different values of $\Gamma$.

Figure 3. Impulse responses to interest rate shocks for different values of $\Gamma$. 
Figure 4. Impulse responses to real interest rate shocks for different values of $\Gamma$.

Figure 5. Impulse responses to exchange rate shocks for different values of $\Gamma$.

Figure 6. Impulse responses to foreign output shocks for different values of $\Gamma$. 
As shown in Figures 1–8, the relationship between financial openness and macroeconomic volatility generally depends on the nature of the underlying shocks. To be more specific, following a technology shock, as the degree of financial openness increases, output volatility becomes less volatile while inflation volatility becomes more volatile. But following a preference shock, both output and inflation volatility become more volatile due to households’ consumption shift from future to present, which increases the present demand. As for the three price shocks (e.g., interest rate shock, real interest rate shock, and exchange rate shock), both output and inflation volatility become less volatile with higher degrees of financial openness, as the increase in financial openness typically leads to a more integrated domestic financial market with the world and thus dampens the effects of domestic price shocks via the interest parity function. However, if the economy is hit by shocks that originate from the foreign economy (e.g., foreign output shock, foreign inflation shock, and foreign interest rate shock), a consistent positive link is found between financial openness and macroeconomic volatility: both output and inflation become more volatile as the degree of financial openness increases. This is not surprising since an economy with higher financial openness is naturally more prone to foreign shocks.

Now we turn to different degrees of financial frictions and their impacts on macroeconomic volatility. Similarly, keeping other parameters unchanged, a data set of \{0, 0.369, 0.5, 0.8, 1\} is
assigned to $\gamma$, where higher values of $\gamma$ denote lower degrees of financial frictions and $\gamma = 0.369$ is the estimated value obtained in section 3.3 which can be referred to as a baseline scenario for the Chinese economy. The impulse response functions of output and inflation to various shocks for different degrees of financial frictions are illustrated in Figures 9–16.

One can see in Figures 9–16 that the relationship between financial frictions and macroeconomic volatility is very similar to that of financial openness and macroeconomic volatility. This similarity is mainly due to the underlying theoretical relations between the financial openness parameter $\Gamma$ and the financial friction parameter $\gamma$. For example, if the domestic financial market is fully integrated with the international capital markets (where a high degree of financial openness is found), it is also likely that domestic interest rates would adjust quite rapidly (where a low degree of financial frictions is found). This relationship can also be identified in the modified interest parity specified in section 2, where the financial openness parameter $\Gamma$ and the financial friction parameter $\gamma$ generally perform a similar function in that either a larger value of $\Gamma$ or $\gamma$ will cause the nominal interest rate to be more tightly related to international financial markets.

In sum, despite differences in magnitude, financial openness and financial frictions generally produce similar effects on macroeconomic fluctuations. The logic is that higher financial openness, usually associated with lower financial frictions, causes the domestic financial market to be more

---

**Figure 9.** Impulse responses to technology shocks for different values of $\gamma$.

**Figure 10.** Impulse responses to preference shocks for different values of $\gamma$. 
Figure 11. Impulse responses to interest rate shocks for different values of $\gamma$.

Figure 12. Impulse responses to real interest rate shocks for different values of $\gamma$.

Figure 13. Impulse responses to exchange rate shocks for different values of $\gamma$. 
Figure 14. Impulse responses to foreign output shocks for different values of $\gamma$.

Figure 15. Impulse responses to foreign inflation shocks for different values of $\gamma$.

Figure 16. Impulse responses to foreign interest rate shocks for different values of $\gamma$. 
integrated with the world financial market, thus leading to flatter volatility patterns with respect to
domestic shocks but sharper volatility patterns in the presence of foreign shocks.

**Variance Decomposition**

Variance decomposition measures the contribution of each type of shock to the forecast error variance. This section employs infinite horizon variance decomposition to show how the contributions of each shock to variations in output and inflation are related to different degrees of financial openness and financial frictions.

As shown in Table 2, domestic shocks, especially the technology shock and preference shock, account for a major portion of the variations in output and inflation. However, as the degree of financial openness increases, the relative importance of foreign shocks is also increasing. One striking feature of the output decomposition in Table 2 is that in contrast with significant declines in the contributions of technology shock, interest rate shock and real interest rate shock as the degree of financial openness increases from 0 to 1, the contribution of the preference shock has increased by about 40 percent correspondingly. By comparison, the contributions of various shocks to inflation variance seem to be less sensitive to changes in financial openness: as the degree of financial openness increases from 0 to 1, the contributions of technology shock increase by about 7 percent, while the contributions of preference shock, interest rate shock, and real interest shock decrease by about 4 percent, 2 percent, and 1 percent, respectively.

Similar results are obtained for variance decompositions under different degrees of financial frictions, as shown in Table 3. The major difference is that variance decompositions in Table 3 generally show smaller marginal changes as compared with the results in Table 2, indicating that variations in the contributions of various external shocks exhibit relatively large sensitivities to changes in financial openness but less sensitivity to changes in financial frictions.

**Concluding Remarks**

In the era of financial integration, financial openness has become one of the most important factors that affect macroeconomic fluctuations in emerging market economies. This article develops an open economy DSGE model which takes into account the effects of financial openness and the associated financial frictions on macroeconomic fluctuations by introducing a modified version of interest rate

| Table 2. Variance decompositions for different degrees of financial openness |
|--------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Structural shocks (%)        |                  |                  |                  |                  |                  |                  |                  |                  |
| Variable                     | Financial openness | $\varepsilon_a$  | $\varepsilon_p$  | $\varepsilon_r$  | $\varepsilon_{rr}$ | $\varepsilon_q$  | $\varepsilon_y$  | $\varepsilon_\pi$ | $\varepsilon_r$  |
| Output                       | $\Gamma = 0$     | 27.15            | 50.41            | 8.89             | 8.24             | 4.32            | 0.98            | 0.00            | 0.00            |
|                             | $\Gamma = 0.2$   | 25.99            | 55.28            | 8.48             | 4.96             | 4.05            | 1.17            | 0.02            | 0.03            |
|                             | $\Gamma = 0.526$ | 18.36            | 68.87            | 6.08             | 1.41             | 3.29            | 1.55            | 0.16            | 0.29            |
|                             | $\Gamma = 0.8$   | 8.83             | 81.65            | 3.70             | 0.20             | 2.65            | 1.75            | 0.33            | 0.89            |
|                             | $\Gamma = 1$     | 1.84             | 89.52            | 2.09             | 0.00             | 2.17            | 1.82            | 0.49            | 2.07            |
| Inflation                   | $\Gamma = 0$     | 58.01            | 36.78            | 2.43             | 1.57             | 0.82            | 0.37            | 0.00            | 0.00            |
|                             | $\Gamma = 0.2$   | 61.66            | 34.44            | 2.04             | 0.83             | 0.68            | 0.32            | 0.00            | 0.02            |
|                             | $\Gamma = 0.526$ | 64.57            | 32.87            | 1.31             | 0.22             | 0.50            | 0.32            | 0.03            | 0.18            |
|                             | $\Gamma = 0.8$   | 65.06            | 32.67            | 0.71             | 0.03             | 0.38            | 0.36            | 0.06            | 0.72            |
|                             | $\Gamma = 1$     | 65.42            | 32.41            | 0.32             | 0.00             | 0.29            | 0.45            | 0.09            | 2.02            |

**Notes:** $\varepsilon_a$, $\varepsilon_p$, $\varepsilon_r$, $\varepsilon_{rr}$, $\varepsilon_q$, $\varepsilon_y$, $\varepsilon_\pi$, $\varepsilon_r$ denote technology shock, preference shock, interest rate shock, real interest rate shock, exchange rate shock, foreign output shock, foreign inflation shock, and foreign interest rate shock, respectively.
Evidence from the Chinese economy shows that the model provides a reasonable description of China’s financial openness and financial frictions during the sample period.

Further evidence from comparative analysis shows that though the relationship between financial openness (financial frictions) and macroeconomic fluctuations depends on the nature of the underlying shocks, in most cases an increase in financial openness, usually accompanied by a decrease in financial frictions, will lead to larger macroeconomic fluctuations in the presence of foreign shocks but less fluctuation with respect to domestic shocks. The logic is that higher financial openness, which is generally associated with lower financial frictions, causes the domestic financial market to be more integrated with the world financial market, thus leading to flatter volatility patterns with respect to domestic shocks but sharper volatility patterns in the presence of foreign shocks.

### Notes

1. In a framework similar to Edwards and Khan (1985), Ahn (1994) presents a model of the determination of the interest rate and exchange rate for a small economy with different degrees of capital mobility.

2. A sample of 100,000 draws is sufficient to ensure convergence of the Metropolis-Hastings sampling algorithm according to multivariate and univariate diagnostics.

### Acknowledgments

The author would like to thank the editors and the anonymous referees for their helpful comments and suggestions.

### Funding

The research is supported by the National Natural Science Foundation of China (Grant No. 71403277) and National Social Science Foundation of China (Grant No. 12&ZD089).

### References


