Capital Controls, Monetary Policy, and Balance Sheets in a Small Open Economy*

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Abstract

We develop a small open economy, New Keynesian model that incorporates a financial accelerator in combination with liability dollarization. Applying a Ramsey-type analysis, we compare the welfare implications of an optimal monetary policy under flexible exchange rates and an optimal capital control policy under fixed exchange rates. In an economy without the financial accelerator, an optimal monetary policy under flexible exchange rates is superior to an optimal capital control policy under fixed exchange rates. In contrast, in an economy with the financial accelerator, an optimal capital control under fixed exchange rates yields higher welfare than an optimal monetary policy under flexible exchange rates.

Keywords: capital control; monetary policy; balance sheets; Ramsey policy; exchange rate regimes; small open economy; nominal rigidities; New Keynesian; DSGE; welfare comparison; incomplete markets; financial accelerator; financial frictions.
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1 Introduction

Although capital controls are not a new policy instrument, it is not until the recent global financial crisis that the potential effects of capital control policies have been rigorously examined from the theoretical perspective as one of the most important topics in international finance.[1] Given the recent financial crisis, volatile international capital movements in emerging market economies have been the subject of rigorous discussion among concerned policymakers and economists. Volatile capital flows amplify boom-bust cycles and destabilize emerging market economies. The recent global financial crisis led to a reconsideration of the merits of capital account restrictions. An increasing number of policymakers believe that capital controls can effectively stabilize economies against volatile capital flows. In fact, some emerging market countries (Brazil, Taiwan, South Korea, and Thailand) have recently responded to instability by imposing capital controls. Even the IMF, a former critic of capital controls, has been forced to reconsider such measures as an important policy response to volatile capital flows under certain circumstances.[2]

Against this background, there has emerged a rapidly growing body of literature related to capital controls.[3] Jeanne and Korinek (2010) and Bianchi (2011) show that there are pecuniary externalities associated with financial crises and provide a rationale for prudential capital controls to prevent excessive borrowing. Using a two-country model, Brunnermeier and Sannikov (2014) show that

[1] An exception is Kitano (2004). Kitano (2004) shows that capital controls not only stem the capital inflow but also reverse the associated macroeconomic effects, and are effective measures against the capital inflow problem.

[2] For details on the IMF position, see Ostry et al. (2010) and Ostry et al. (2012).

[3] For details, see, for example, Korinek (2011) or Jeanne et al. (2012). For the earlier literature on capital controls, see the introduction in Kitano (2011). Kitano (2011) shows that there exists an optimal degree of capital-account restriction that achieves a higher level of welfare than that under perfect capital mobility, if the economy has costly financial intermediaries.

pecuniary externalities can lead to constrained inefficient outcomes and capital controls can be welfare improving.[4] Developing a disequilibrium model featuring downward rigid wage and peg, Schmitt-Grohé and Uribe (2013) show that capital controls reduce unemployment and can be an effective instrument for macroeconomic stabilization. Among the many recent studies, Farhi and Werning (2012) show that capital controls are effective for addressing some shocks, particularly, country-specific risk-premium shocks. Liu and Spiegel (2013) also examine the effectiveness and welfare implications of capital controls in the face of external shocks. Their findings suggest that under capital controls, stabilizing the real exchange rate is a key factor in weathering external shocks. Using a two-country model, De Paoli and Lipinska (2013) show that restricting international capital flows through capital controls can be beneficial for individual countries, although it would limit international risk sharing. Their findings suggest a possibility of welfare gains from international policy coordination. Davis and Presno (2014) examine welfare gains from capital controls as an additional tool for macroeconomic stabilization under flexible exchange rates. They show that the benefits of capital controls are present even when an optimal monetary policy is employed.

Our paper is most closely related with De Paoli and Lipinska (2013) and Davis and Presno (2014) in that we too apply a Ramsey-type analysis for capital controls. However, we examine optimal capital controls in models that highlight balance sheets effects in the presence of liability dollarization. Therefore, our paper is also rather closely related to Cespedes et al. (2000), Devereux et al. (2006), and Elekdağ and Tchakarov (2007). Building upon the framework developed by

[4]Benigno et al. (2013) consider both ex-ante and ex-post policies in a model with pecuniary externalities. They show that the design of ex-ante policies depends on that of ex-post policies.

Bernanke et al. (1999), Cespedes et al. (2000), Devereux et al. (2006), and Elekdağ and Tchakarov (2007) incorporate a financial accelerator coupled with liability dollarization, in which foreign debt is denominated in foreign currency (not domestic currency). In these models, the financial accelerator works through an endogenous risk premium that is linked to the balance sheets of entrepreneurs. These balance sheets are also vulnerable to exchange rate fluctuations due to the problem of liability dollarization.

Cespedes et al. (2000) and Devereux et al. (2006) find that conventional wisdom, that the flexible exchange rate is preferable to the fixed exchange rate, holds in spite of the financial accelerator effects. Elekdağ and Tchakarov (2007) also confirm that the flexible exchange rate regime has better welfare properties than the fixed exchange rate regime when the country has perfect access to international capital markets. However, when their model incorporates a financial accelerator and the leverage ratio exceeds a threshold, they find that the fixed exchange rate regime could become welfare superior.

We develop a small open economy, New Keynesian model with and without a financial accelerator mechanism, the model structure of which is basically similar to Cespedes et al. (2000), Devereux et al. (2006), and Elekdağ and Tchakarov (2007). We then apply a Ramsey-type analysis and examine the welfare implications of capital control policies.

In the case without the financial accelerator, we compare three cases: optimal monetary policy under flexible exchange rates, optimal capital control policy (on households) under fixed exchange rates, and fixed exchange rates (without capital controls). Our Ramsey-type analysis results indicate that although the optimal capital control policy significantly improves welfare under fixed exchange rates, the optimal monetary policy is the most welfare-maximizing in an economy without the financial accelerator.

In the case with the financial accelerator, we compare the following five cases: an optimal monetary policy under flexible exchange rates, fixed exchange rates (without capital controls), an optimal capital control policy on entrepreneurs, an optimal capital control policy on households, and an optimal capital control policy on both entrepreneurs and households under fixed exchange rates. Our analysis results indicate that the optimal monetary policy still outperforms the optimal capital control policy on households. However, the optimal capital control policy on entrepreneurs outperforms the optimal monetary policy. The most welfare-maximizing is the optimal capital control policy on both entrepreneurs and households.

The intuition underlying our analysis results is straightforward. Entrepreneurs finance investment partly with foreign borrowing, which is subject to financial frictions in the presence of balance sheet vulnerabilities. In an economy with a financial accelerator, the key variable is the foreign interest rate augmented by an external finance premium. Monetary policy works only through domestic interest rates. However, capital controls on entrepreneurs have a direct control on the key variable of interest rates at which entrepreneurs borrow abroad. Therefore, capital controls can be welfare improving in an economy with financial frictions.

The remainder of the paper is organized as follows. In Section 2, we present a sticky price, small open economy model with and without a financial accelerator in combination with liability dollarization. In Section 3, we perform a comparative analysis of welfare for alternative policy regimes in this economy. For the economy without the financial accelerator, we compare (i) the flexible exchange rate regime accompanied by an optimal monetary policy, (ii) the fixed exchange rate regime accompanied by optimal capital controls on households, and (iii) the fixed exchange rate regime (without capital controls). For the economy with the financial accelerator, we compare (i) the fixed exchange rate regime accompanied by optimal capital controls on households and entrepreneurs, (ii) the fixed exchange rate regime accompanied by optimal capital controls on entrepreneurs, (iii) the flexible exchange rate regime accompanied by an optimal monetary policy, (iv) the fixed exchange rate regime accompanied by optimal capital controls on households, and (v) the fixed exchange rate regime (without capital controls). Conclusions are presented in Section 4.

2 Model

We employ the small open economy structure developed by Galí and Monacelli (2005) and Faia and Monacelli (2008). The small open economy model incorporates a financial accelerator a la Bernanke et al. (1999) in combination with liability dollarization. Our model is close to those in Cespedes et al. (2000), Devereux et al. (2006), and Elekdağ and Tchakarov (2007). The small open economy consists of households, production firms, entrepreneurs, and the government.

2.1 Households

A representative household maximizes its expected lifetime utility:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{C_t^{1-\sigma}}{1-\sigma} - \frac{L_t^{1+\phi}}{1+\phi} \right\}, \tag{1}$$

where E_t denotes the mathematical expectations operator conditional on information available at time t, $\beta \in (0,1)$ is the discount factor, C_t signifies a composite consumption index, and L_t represents labor effort. Households consume differentiated goods (produced by both domestic and foreign firms). The composite consumption index C_t is given by

$$C_t \equiv \left[(1-\gamma)^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + \gamma^{\frac{1}{\eta}} C_{F,t}^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}. \tag{2}$$

$\eta(>0)$ is the elasticity of substitution between domestic and foreign goods, and $\gamma \in (0,1)$ represents the measure of openness. $C_{H,t}$ and $C_{F,t}$ are, respectively, the indices for consumption of domestic and foreign goods, expressed by

$$C_{H,t} \equiv \left[\int_0^1 C_{H,t}(j)^{\frac{\varepsilon-1}{\varepsilon}}\, dj\right]^{\frac{\varepsilon}{\varepsilon-1}}; \quad C_{F,t} \equiv \left[\int_0^1 C_{F,t}(j)^{\frac{\varepsilon-1}{\varepsilon}}\, dj\right]^{\frac{\varepsilon}{\varepsilon-1}}, \tag{3}$$

where $\varepsilon(>1)$ is the parameter for the elasticity of substitution among differentiated goods. A household's optimal expenditure allocation in each goods category yields the demand functions for domestic and foreign differentiated goods:

$$C_{H,t}(j) = \left(\frac{P_{H,t}(j)}{P_{H,t}}\right)^{-\varepsilon} C_{H,t}\,; \quad C_{F,t}(j) = \left(\frac{P_{F,t}(j)}{P_{F,t}}\right)^{-\varepsilon} C_{F,t}, \tag{4}$$

where $P_{H,t}(j)$ and $P_{F,t}(j)$ denote the domestic-currency-denominated prices of differentiated goods j produced by domestic and foreign firms, respectively. $P_{H,t}$ and $P_{F,t}$ are the domestic and import price indices, respectively:

$$P_{H,t} \equiv \left[\int_0^1 P_{H,t}(j)^{1-\varepsilon}\, dj\right]^{\frac{1}{1-\varepsilon}}; \quad P_{F,t} \equiv \left[\int_0^1 P_{F,t}(j)^{1-\varepsilon}\, dj\right]^{\frac{1}{1-\varepsilon}}. \tag{5}$$

From Eq. (5), we obtain

$$\int_0^1 P_{H,t}(j)\, C_{H,t}(j)\, dj = P_{H,t}\, C_{H,t}\,; \qquad \int_0^1 P_{F,t}(j)\, C_{F,t}(j)\, dj = P_{F,t}\, C_{F,t}. \tag{6}$$

The optimal expenditure allocation between domestic and imported goods gives

$$C_{H,t} = (1-\gamma)\left(\frac{P_{H,t}}{P_t}\right)^{-\eta} C_t\,; \qquad C_{F,t} = \gamma\left(\frac{P_{F,t}}{P_t}\right)^{-\eta} C_t, \tag{7}$$

where P_t represents the consumer price index (CPI):

$$P_t \equiv \left[(1-\gamma)P_{H,t}^{1-\eta} + \gamma P_{F,t}^{1-\eta}\right]^{\frac{1}{1-\eta}}. \tag{8}$$

From Eqs. (7) and (8), we obtain

$$P_{H,t}\, C_{H,t} + P_{F,t}\, C_{F,t} = P_t\, C_t. \tag{9}$$

Households have access to domestic and foreign asset markets. A household's budget constraint in period t is given as

$$P_t\, C_t + (1+i_{t-1})A_{t-1} + (1+\tau_{h,t-1})(1+i^*_{t-1})\mathcal{E}_t B_{t-1} + P_t \frac{\psi_B}{2}(B_t - B)^2 = A_t + \mathcal{E}_t B_t + W_t L_t + T_{h,t} + \Pi^F_t, \tag{10}$$

where i_t is the interest rate of domestic currency assets, A_t is the domestic currency debt position, $\tau_{h,t}$ is the tax on the foreign currency debt of households, i^*_t is the interest rate of foreign currency assets, $\mathcal{E}_t$ represents the nominal exchange rate (in terms of the domestic currency), B_t is the households' foreign currency debt position, W_t is the nominal wage, $T_{h,t}$ is the lump-sum transfer, and Π^F_t

denotes dividends from firms. $P_t\psi_B(B_t - B)^2/2$ denotes the portfolio adjustment costs, which yield the stationarity of the equilibrium dynamics in the small open economy.

The optimality conditions associated with households' maximization problem are given by

$$\lambda_t = C_t^{-\sigma}, \tag{11}$$

$$\lambda_t = \frac{L_t^{\phi}}{W_t/P_t}, \tag{12}$$

$$1 = \beta(1+i_t)E_t\left\{\frac{\lambda_{t+1}}{\lambda_t}\frac{P_t}{P_{t+1}}\right\}, \tag{13}$$

and

$$1 = \beta(1+\tau_{h,t})(1+i_t^*)\left[1 - \frac{\psi_B P_t(B_t - B)}{\mathcal{E}_t}\right]^{-1} E_t\left\{\frac{\lambda_{t+1}}{\lambda_t}\frac{P_t}{P_{t+1}}\frac{\mathcal{E}_{t+1}}{\mathcal{E}_t}\right\}. \tag{14}$$

Combining (13) and (14), we obtain the interest parity condition:

$$(1+i_t)E_t\left\{\frac{\lambda_{t+1}}{\lambda_t}\frac{P_t}{P_{t+1}}\right\} = (1+\tau_{h,t})(1+i_t^*)\left[1-\frac{\psi_B P_t(B_t - B)}{\mathcal{E}_t}\right]^{-1} E_t\left\{\frac{\lambda_{t+1}}{\lambda_t}\frac{P_t}{P_{t+1}}\frac{\mathcal{E}_{t+1}}{\mathcal{E}_t}\right\}. \tag{15}$$

We assume that the law of one price holds for individual goods. The terms of trade are therefore given as

$$S_t \equiv \frac{P_{F,t}}{P_{H,t}} = \frac{\mathcal{E}_t P_t^*}{P_{H,t}}, \tag{16}$$

where P_t^* denotes the CPI in the foreign country (in terms of foreign currency).[5]

[5]Without loss of generality, we assume that P_t^* is exogenous and constant ($= 1$) for all t.

From (16), we obtain

$$\frac{S_t}{S_{t-1}} = \frac{\Delta\mathcal{E}_t}{\Pi_{H,t}}, \tag{17}$$

where $\Pi_{H,t}\left(\equiv \frac{P_{H,t}}{P_{H,t-1}}\right)$ and $\Delta\mathcal{E}_t\left(\equiv \frac{\mathcal{E}_t}{\mathcal{E}_{t-1}}\right)$ represent the rate of domestic inflation and the depreciation rate of the nominal exchange rate, respectively. From CPI (8) and (16), we obtain

$$\frac{P_t}{P_{H,t}} = [(1-\gamma)+\gamma S_t^{1-\eta}]^{\frac{1}{1-\eta}} \equiv g(S_t). \tag{18}$$

From (18), CPI inflation $\Pi_t\left(\equiv \frac{P_t}{P_{t-1}}\right)$ is given by

$$\Pi_t = \Pi_{H,t}\frac{g(S_t)}{g(S_{t-1})}. \tag{19}$$

From (16) and (18), the real exchange rate Q_t is given by

$$Q_t \equiv \frac{\mathcal{E}_t P_t^*}{P_t} = \frac{S_t}{g(S_t)} \equiv q(S_t). \tag{20}$$

2.2 Production firms

Monopolistically competitive firms produce differentiated goods by using capital and labor. Each monopolistic firm j in the home economy produces a differentiated good with the following production function:

$$Y_t(j) = Z_t K_t(j)^{\alpha} L_t(j)^{1-\alpha}, \tag{21}$$

where $Y_t(j)$, $K_t(j)$, $L_t(j)$, and Z_t denote the firm's output level, its capital and labor inputs, and a stochastic productivity shock, respectively.

The firm's cost minimization implies that the firm's real marginal cost is given by

$$MC_t(j) = MC_t = \frac{(R_t/P_{H,t})^{\alpha}(W_t/P_{H,t})^{1-\alpha}}{Z_t\alpha^{\alpha}(1-\alpha)^{1-\alpha}}. \tag{22}$$

The capital accumulation process in the economy is given as

$$K_{t+1} = \left[\frac{I_t}{K_t} - \frac{\phi_I}{2}\left(\frac{I_t}{K_t} - \delta\right)^2\right]K_t + (1-\delta)K_t, \tag{23}$$

where I_t is aggregate investment and δ is the depreciation rate of capital. $\frac{\phi_I}{2}\big(\frac{I_t}{K_t} - \delta\big)^2$ denotes the adjustment costs of capital, and ϕ_I is it's parameter value. I_t is composed of domestic and imported goods:

$$I_t \equiv \left[(1-\gamma)^{\frac{1}{\eta}} I_{H,t}^{\frac{\eta-1}{\eta}} + \gamma^{\frac{1}{\eta}} I_{F,t}^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}, \tag{24}$$

where $I_{H,t}$ and $I_{F,t}$ are represented by

$$I_{H,t} \equiv \left[\int_0^1 I_{H,t}(j)^{\frac{\varepsilon-1}{\varepsilon}}\, dj\right]^{\frac{\varepsilon}{\varepsilon-1}}; \qquad I_{F,t} \equiv \left[\int_0^1 I_{F,t}(j)^{\frac{\varepsilon-1}{\varepsilon}}\, dj\right]^{\frac{\varepsilon}{\varepsilon-1}}. \tag{25}$$

The optimal allocation of expenditure in each goods category yields the following demand functions:

$$I_{H,t}(j) = \left(\frac{P_{H,t}(j)}{P_{H,t}}\right)^{-\varepsilon} I_{H,t}\,; \qquad I_{F,t}(j) = \left(\frac{P_{F,t}(j)}{P_{F,t}}\right)^{-\varepsilon} I_{F,t}. \tag{26}$$

The optimal allocation of expenditures between domestic and imported goods gives

$$I_{H,t} = (1-\gamma)\left(\frac{P_{H,t}}{P_t}\right)^{-\eta} I_t\,; \qquad I_{F,t} = \gamma\left(\frac{P_{F,t}}{P_t}\right)^{-\eta} I_t. \tag{27}$$

From the profit-maximization problem of capital producers, we can obtain the price of capital Q_t:

$$Q_{K,t} = \left[1 - \phi_I\left(\frac{I_t}{K_t} - \delta\right)\right]^{-1}, \tag{28}$$

where $Q_{K,t} \equiv \frac{Q_t}{P_t}$.

2.3 Price setting

Following Calvo (1983), we assume that in each period, a fraction $1 - \zeta$ of monopolistically competitive firms reset their prices, while a fraction ζ keep their prices unchanged. This implies that the domestic price index can be expressed as

$$P_{H,t} \equiv \left[\zeta P_{H,t-1}^{1-\varepsilon} + (1-\zeta)\bar{P}_{H,t}^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}, \tag{29}$$

where $\bar{P}_{H,t}$ represents the price reset in period t. Transforming (29) yields

$$1 = \zeta \Pi_{H,t}^{-1+\varepsilon} + (1-\zeta)\tilde{P}_{H,t}^{1-\varepsilon}, \tag{30}$$

where $\tilde{P}_{H,t} \equiv \frac{\bar{P}_{H,t}}{P_{H,t}}$.

Each firm chooses its price to maximize the present discounted value of its profit stream:

$$\max_{\bar{P}_{H,t}} \quad \sum_{k=0}^{\infty} \zeta^k E_t\{\Lambda_{t,t+k}[Y_{t+k|t}(\bar{P}_{H,t} - MC_{t+k|t}^n)]\}, \tag{31}$$

subject to

$$Y_{t+k|t} = \left(\frac{\bar{P}_{H,t}}{P_{H,t+k}}\right)^{-\varepsilon} Y_{t+k}, \tag{32}$$

where $Y_{t+k|t}$ and $MC_{t+k|t}^n$ denote the output level and the nominal marginal cost, respectively, in $t + k$ for a firm that last reset its price in period t. $\Lambda_{t,t+k} \equiv \beta^k \frac{\lambda_{t+k}}{\lambda_t} \frac{P_t}{P_{t+k}}$ is the discount factor. Y_{t+k} is the aggregate output level in period $t + k$. From the first-order condition associated with the above problem, the optimal price is determined as

$$\tilde{P}_{H,t} = \frac{\varepsilon}{\varepsilon - 1} \frac{\sum_{k=0}^{\infty} \zeta^k E_t \Big\{ \Lambda_{t,t+k} \Big(\frac{P_{H,t}}{P_{H,t+k}} \Big)^{-\varepsilon-1} Y_{t+k} MC_{t+k|t} \Big\}}{\sum_{k=0}^{\infty} \zeta^k E_t \Big\{ \Lambda_{t,t+k} \Big(\frac{P_{H,t}}{P_{H,t+k}} \Big)^{-\varepsilon} Y_{t+k} \Big\}}. \tag{33}$$

2.4 Entrepreneurs

Entrepreneurs have available net worth N_t denominated in domestic currency. To finance the difference between their expenditures on capital goods and their net worth, entrepreneurs borrow from foreign lenders. That is, the entrepreneur finances investment partly with foreign currency denominated debt. The entrepreneur's balance sheet is therefore given by

$$P_{H,t} N_t = Q_t K_{t+1} - \mathcal{E}_t D_t, \tag{34}$$

where D_t is the entrepreneur's foreign currency debt position. Note that an unanticipated depreciation reduces net worth in the balance sheet (34), which reflects the problem of liability dollarization in emerging market economies.

Following Bernanke et al. (1999), we assume that foreign lenders charge an external finance premium to entrepreneurs due to asymmetric information. Entrepreneurs choose D_t and K_{t+1} so that the expected return on capital (R^K) equals the cost on foreign borrowing:

$$R_{t+1}^K = (1+\tau_{e,t})(1+i_t^*)\left(\frac{\mathcal{E}_{t+1}}{\mathcal{E}_t}\right)F_t, \tag{35}$$

where F_t is the external finance premium and $\tau_{e,t}$ is a tax on the entrepreneur's foreign borrowing. Following Cespedes et al. (2000), we assume that the external finance premium is an increasing function of the value of capital relative to net worth:

$$F_t = \Psi\left(\frac{Q_t K_{t+1}}{P_{H,t}N_t}\right), \quad \Psi(1)=1, \quad \Psi'(.)>1, \tag{36}$$

where the functional form for Ψ is given by $\Psi(g) = g^\mu$ ($\mu > 0$).

At the beginning of each period, entrepreneurs collect returns from capital and repay their foreign debt. Following Cespedes et al. (2000) and Elekdağ and Tchakarov (2007), we assume that entrepreneurs consume a fraction $1-\omega$ of the remainder on imports. The evolution of net worth is thus given as

$$P_{H,t}N_t = \omega[R_t^K Q_{t-1}K_t - (1+\tau_{e,t-1})(1+i_{t-1}^*)F_{t-1}\mathcal{E}_t D_{t-1} + T_{e,t}], \tag{37}$$

where $T_{e,t}$ denotes a lump-sum transfer from the government.

Finally, the return on capital for entrepreneurs R_t^K is expressed by the sum of the nominal rental rate on capital earned from production firms R_t and the value of non-depreciated capital stock, divided by the original price of capital Q_t:

$$R_{t+1}^K = \frac{R_{t+1}}{Q_t} + \frac{Q_{t+1}}{Q_t}\left[(1-\delta) + \phi_I\left(\frac{I_{t+1}}{K_{t+1}} - \delta\right)\frac{I_{t+1}}{K_{t+1}} - \frac{\phi_I}{2}\left(\frac{I_{t+1}}{K_{t+1}} - \delta\right)^2\right]. \tag{38}$$

2.5 Government

We assume that the government transfers the collected tax on foreign debt to households and entrepreneurs in a lump-sum manner. The government's budget constraints are thus given by

$$\tau_{h,t-1}(1+i^*_{t-1})\mathcal{E}_t B_{t-1} = T_{h,t} \tag{39}$$

and

$$\tau_{e,t-1}(1+i^*_{t-1})F_{t-1}\mathcal{E}_t D_{t-1} = T_{e,t}. \tag{40}$$

We consider optimal Ramsey monetary and capital control policies. We obtain the Ramsey optimal policy by setting up a Lagrangian problem in which the social planner maximizes the conditional lifetime utility of the representative household subject to the first-order conditions of the private agents and the market-clearing conditions of the economy. We compute this numerically using the Matlab procedures developed by Levin et al. (2006).[6]

2.6 Equilibrium and exogenous shocks

The market clearing for domestic goods must satisfy

$$P_{H,t}Y_t = P_{H,t}C_{H,t} + P_{H,t}I_{H,t} + \mathcal{E}_t EX_t, \tag{41}$$

where the domestic good is also exported to the foreign country, demand for which is assumed to be an exogenous stochastic process, EX_t. Dividing both sides of

[6] Levin et al. (2006)'s program reads a Dynare model file and generates the first-order conditions of a Ramsey policymaker. See Adjemian et al. (2011) for details on Dynare.

(41) by $P_{H,t}$ yields

$$Y_t = C_{H,t} + I_{H,t} + S_t EX_t \tag{42}$$

$$= (1-\gamma) g(S_t)^{\eta} (C_t + I_t) + S_t EX_t, \tag{43}$$

where the second equality is derived by considering the demand functions (7), (27), and (18).

(21) and the production function that is homogeneous with degree 1, imply that

$$\int_0^1 Y_t(j) dj = Z_t K_t^{\alpha} L_t^{1-\alpha}, \tag{44}$$

where $K_t = \int_0^1 K_t(j)dj$ and $L_t = \int_0^1 L_t(j)dj$. From the demand function for differentiated goods, it follows that

$$\int_0^1 \left(\frac{P_{H,t}(j)}{P_{H,t}} \right)^{-\varepsilon} Y_t \, dj = Z_t K_t^{\alpha} L_t^{1-\alpha}. \tag{45}$$

We define $\theta_t \equiv \int_0^1 \left(\frac{P_{H,t}(j)}{P_{H,t}} \right)^{-\varepsilon} dj$, which can be expressed as[7]

$$\theta_t = (1-\zeta) \tilde{P}_{H,t}^{-\varepsilon} + \zeta \Pi_{H,t}^{\varepsilon} \theta_{t-1}. \tag{46}$$

Then, we can rewrite (45) as

$$Y_t = \theta_t^{-1} Z_t K_t^{\alpha} L_t^{1-\alpha}, \tag{47}$$

where θ_t measures the resource costs induced by price dispersion in the Calvo

[7]For the derivation of (46), see Schmitt-Grohé and Uribe (2006).

model.

The productivity shock Z_t, export shock EX_t, and foreign (nominal) interest-rate shock i_t^* are exogenously evolving according to the following processes:

$$\log Z_t = (1-\rho_z)\log Z + \rho_z \log Z_{t-1} + \varepsilon_{z,t}, \quad \varepsilon_{z,t} \sim i.i.d.\ N(0,\sigma_z^2), \tag{48}$$

$$\log EX_t = (1-\rho_{ex})\log EX + \rho_{ex} \log EX_{t-1} + \varepsilon_{ex,t}, \quad \varepsilon_{ex,t} \sim i.i.d.\ N(0,\sigma_{ex}^2), \tag{49}$$

and

$$i_t^* = (1-\rho_i)i^* + \rho_i i_{t-1}^* + \varepsilon_{i,t}, \quad \varepsilon_{i,t} \sim i.i.d.\ N(0,\sigma_i^2). \tag{50}$$

2.7 Parameterization

We choose standard parameter values in the related literature for calibration, which are summarized in Table 1. Following many previous studies, we set the quarterly discount factor β to 0.99. Following Elekdağ and Tchakarov (2007) and Devereux et al. (2006), we set the inverse of intertemporal elasticity of substitution σ, elasticity of labor supply ϕ, and capital adjustment cost parameter ψ^K to 2, 1, and 12, respectively. We set capital share in production α to 0.32 as in Schmitt-Grohé and Uribe (2003). Following Kollmann (2002) and Devereux et al. (2006), we set the quarterly depreciation rate δ to 0.025. Following Galí and Monacelli (2005), we set the elasticity of substitution among differentiated goods ϵ and fraction of firms that do not reset their prices ζ to 6 and 0.75, respectively. Following Ravenna and Natalucci (2008), we set the elasticity of substitution between domestic and foreign goods η to 1.5. With respect to the degree of openness γ, we follow Cook (2004) and set it to 0.28. The parameter for bond adjustment cost ψ^B and steady state debt ratio to GDP $\frac{B}{Y}$ are set to 0.0007 and 0.4, respectively, as in Devereux et al. (2006). We set the steady state level of leverage ratio $\frac{Q_K K}{MW}$ at 2.2, which is higher than in Bernanke et al. (1999) who use 2, but not as high as in Devereux et al. (2006) who use 3. Following Cespedes et al. (2000) and Merola (2010), we set the elasticity of external finance premium to leverage ratio μ to 0.02. We use the same values as in Elekdağ and Tchakarov (2007) for the exogenous shocks. The persistence and the standard deviation of the productivity shock (ρ_z and σ_z) are set to 0.8 and 0.02, respectively. The persistence and the standard deviation of the export shock (ρ_{ex} and σ_{ex}) are set to 0.5 and 0.06, respectively. The persistence and the standard deviation of the foreign interest shock (ρ_i and σ_i) are set to 0.8 and 0.003, respectively.

2.8 Welfare evaluation

We calculate and compare welfare levels under alternative policy regimes. We let V_0^a denote the conditional welfare level associated with case (a) (a=i, ii, iii...):

$$\begin{aligned} V_0^a &\equiv E_0 \sum_{t=0}^{\infty} \beta^t U(C_t^a, L_t^a), \\ &= E_0 \sum_{t=0}^{\infty} \beta^t U((1-\lambda^a)C, L). \end{aligned} \tag{51}$$

Here, λ^a is the welfare cost of adopting policy (a) on the condition of the calibrated steady state. The conditional welfare measure is obtained using the second-order perturbation methods as described in Schmitt-Grohé and Uribe (2004) and Schmitt-Grohé and Uribe (2007).[8] We let the most welfare-maximizing case be

[8]Kim and Kim (2003) reveal that second-order solutions are necessary because conventional linearization may generate spurious welfare reversals.

Table 1: Parameterization.

Parameters	Value	
β	0.99	Discount factor
σ	2	Inverse of intertemporal elasticity of substitution
ϕ	1	Elasticity of labor supply
ψ^K	12	Capital adjustment cost parameter
α	0.32	Share of capital in output
δ	0.025	Depreciation rate of capital
ϵ	6	Elasticity of substitution among differentiated goods
ζ	0.75	Fraction of firms that do not reset their prices
η	1.5	Elasticity of substitution between domestic and foreign goods
γ	0.28	Degree of openness
ψ^B	0.0007	Parameter for bond adjustment cost
$\frac{B}{Y}$	0.4	Steady-state ratio of debt to GDP
$\frac{Q_K K}{MW}$	2.2	Steady-state ratio of capital to net worth
μ	0.02	Elasticity of external finance premium
ρ_Z	0.8	Persistence: productivity shock
σ_Z	0.02	Standard deviation: productivity shock
ρ_{ex}	0.5	Persistence: export shock
σ_{ex}	0.06	Standard deviation: export shock
ρ_i	0.8	Persistence: foreign interest rate shock
σ_i	0.003	Standard deviation: foreign interest rate shock

the reference case (ref). Therefore, $\lambda^a - \lambda^{ref}$ denotes the welfare loss in each case, which is the fraction of consumption that compensates a household to a level that is considered as well off under policy (a) as in the reference case (ref).

3 Results

This section presents the main results of our analysis. We evaluate the welfare implications of alternative policy and exchange rate regimes with and without the financial accelerator. In Section 3.1, we consider an economy without the financial accelerator and compare the welfare consequences of an optimal monetary policy under flexible exchange rates, an optimal capital control policy on households under fixed exchange rates, and a peg regime without an optimal capital control policy. In Section 3.2, we analyze an economy with the financial accelerator and compare the welfare consequences of an optimal monetary policy under flexible exchange rates, an optimal capital control policy on households under fixed exchange rates, an optimal capital control policy on entrepreneurs, optimal capital control policies on households and entrepreneurs, and a peg regime without optimal capital control policy.

3.1 No financial accelerator

We first compare welfare levels in an economy without the financial accelerator in the following cases: (i) an optimal monetary policy under flexible exchange rates, (ii) an optimal capital control policy under fixed exchange rates, and (iii) a fixed exchange rate regime (without capital controls). Since the optimal monetary policy case under flexible exchange rates (i) turns out to be the most welfare-maximizing,

Table 2: Conditional welfare costs: No financial accelerator

	(i) Mon.	(ii) Cap. Con.	(iii) Fixed ER
Welfare Cost:			
$(\lambda^a - \lambda^{ref}) \times 100$	0	0.106	0.306

Note) The conditional welfare costs in (ii) and (iii) are measured with the most welfare-maximizing case (i) being the reference case.

we let (i) to be the reference case (ref).

The conditional welfare costs in each case (i, ii, and iii) compared with the reference case (ref) are shown in Table 2. The welfare cost in the case of an optimal capital control policy under fixed exchange rates (ii) is 0.106%, whereas the welfare cost in the fixed exchange rate regime (iii) is 0.306%. Hence, we can say that the optimal capital control policy more than halves the welfare gap between the flexible exchange rate case (i) and the fixed exchange rate case (iii). However, it is obvious that the optimal monetary policy under flexible exchange rates (i) outperforms the optimal capital control policy under fixed exchange rates (ii) in an economy without the financial accelerator.

Tables 3 and 4 show the means and standard deviations of the main variables in the case without the financial accelerator. Since the capital control policy is adopted only in case (ii), by definition, the means and standard deviations of τ_h in cases (i) and (iii) are zero in Tables 3 and 4. Since the fixed exchange rate eliminates the volatility of the nominal exchange rate, by definition, the standard deviation of $\Delta\mathcal{E}$ in cases (ii) and (iii) is zero in Table 4. Further, note that since the optimal monetary policy under flexible exchange rates (i) is an "inward looking" policy, it has the lowest domestic price inflation (Π_H) volatility among the three regimes in Table 4. In contrast, since the optimal capital control policy under

Table 3: Means: No financial accelerator

	(i) Mon.	(ii) Cap. Con.	(iii) Fixed ER
Y	1.8042	1.8042	1.7987
C	1.4571	1.4565	1.4535
I	0.3426	0.3422	0.3420
L	0.6943	0.6944	0.6944
$\Delta\mathcal{E}$	1.0000	1.0000	1.0000
S	0.9968	0.9967	0.9945
Π	1.0000	1.0000	1.0000
Π_H	1.0000	1.0000	1.0000
i_d	0.0099	0.0099	0.0100
τ_h	0.0000	-0.0001	0.0000

fixed exchange rates (ii) and the fixed exchange rate regime (iii) are "outward looking" policies, the terms of trade (S) in (ii) and (iii) are more stabilized (i.e., the standard deviations of S in (ii) and (iii) are smaller) compared to that in case (i) in Table 4.

3.2 With financial accelerator

We next consider alternative policies in an economy with the financial accelerator. We compare the welfare levels in the following cases: (i) optimal capital controls on both households and entrepreneurs under fixed exchange rates, (ii) optimal capital controls on entrepreneurs under fixed exchange rates, (iii) an optimal monetary policy under flexible exchange rates, (iv) optimal capital controls on households under fixed exchange rates, and (v) a fixed exchange rate regime (without capital controls). Since optimal capital controls on both households and entrepreneurs under fixed exchange rates (i) is the most welfare-maximizing, we let (i) be the reference case (ref).

Table 4: Standard Deviations (%): No financial accelerator

	(i) Mon.	(ii) Cap. Con.	(iii) Peg
Y	3.55	3.21	2.97
C	1.67	2.06	1.40
I	7.60	10.13	6.17
L	0.86	1.93	3.62
$\Delta\mathcal{E}$	2.75	0.00	0.00
S	4.06	2.14	2.63
Π	0.79	0.19	0.59
Π_H	0.05	0.27	0.81
i_d	1.00	0.96	0.50
τ_h	0.00	1.05	0.00

We show the welfare ranking for the alternative regimes in Table 5. It should be noted that the optimal monetary policy under flexible exchange rates (iii), which was the most welfare-maximizing in the previous subsection 3.1 for the economy without the financial accelerator, is now ranked third. As argued above, the most welfare-maximizing is optimal capital controls on both households and entrepreneurs under fixed exchange rates (i). Optimal capital controls on households (iv) improves the welfare level of the economy under fixed exchange rates (v). However, the welfare-improving effect of optimal capital controls on households (iv) is limited. Optimal capital controls on households (iv) is inferior to the optimal monetary policy under flexible exchange rates (iii). In contrast, optimal capital controls on entrepreneurs (ii) outperforms the optimal monetary policy (iii). Further, optimal capital controls on entrepreneurs (ii) is second only to the most welfare-maximizing case (i).

Tables 6 and 7 show the means and standard deviations of the main variables in the case with the financial accelerator. Comparing column (v) in Table 7 to

Table 5: Conditional welfare costs: With financial accelerator

	(i) Cap. Con. ent. & hous.	(ii) Cap. Con. ent.	(iii) Mon.	(iv) Cap. Con. hous.	(v) Peg
Welfare Cost: $(\lambda^a - \lambda^{ref}) \times 100$	0	0.215	1.606	1.900	2.385

Note) The conditional welfare costs in (ii) to (v) are measured with the most welfare-maximizing case (i) being the reference case.

column (iii) in Table 4, we can see that the standard deviations of Y, C, I, L, S, Π, and Π_H in column (v) are larger, which implies that the introduction of a financial accelerator mechanism into an economy increases the volatilities of the economy to the same shocks. Figure 1 represents the impulse responses of Y, C, I, L, S, Π, and Π_H to a foreign interest rate shock in the peg case with and without the financial accelerator. From Figure 1, we can also confirm that the financial accelerator makes the economy more volatile. It should be noted that in Table 6, the mean of the external finance premium F is the lowest in case (i) and second-lowest in case (ii). We can say that capital controls on entrepreneurs curtail the external finance premium level more significantly than a monetary policy or capital controls on households.

The intuition underlying our analysis results is as follows. Entrepreneurs finance investment partly with foreign borrowing, which is subject to financial frictions. Entrepreneurs borrow abroad at an interest rate, which is equal to the foreign interest rate, adjusted for expected exchange rate fluctuations, and augmented by an external finance premium. Although it affects the economy through domestic interest rates, a monetary policy does not directly affect the interest

Table 6: Means: With financial accelerator

	(i) Cap. Con. ent. & hous.	(ii) Cap. Con. ent.	(iii) Mon.	(iv) Cap. Con. hous.	(v) Peg
Y	1.7328	1.7295	1.7344	1.7065	1.6948
C	1.2672	1.2647	1.2684	1.2495	1.2409
I	0.2348	0.2341	0.2353	0.2204	0.2163
L	0.7819	0.7825	0.7819	0.7874	0.7894
$\Delta\mathcal{E}$	1.0000	1.0000	1.0000	1.0000	1.0000
S	0.9966	0.9957	0.9961	0.9935	0.9915
Π	1.0000	1.0000	1.0000	1.0000	1.0000
Π_H	1.0000	1.0000	1.0000	1.0000	1.0000
i_d	0.0098	0.0100	0.0098	0.0096	0.0100
F	1.0098	1.0107	1.0136	1.0164	1.0173
τ_h	-0.0002	0.0000	0.0000	-0.0002	0.0000
τ_e	0.0031	0.0034	0.0000	0.0000	0.0000

Table 7: Standard Deviations (%): With financial accelerator

	(i) Cap. Con. ent. & hous.	(ii) Cap. Con. ent.	(iii) Mon.	(iv) Cap. Con. hous.	(v) Peg
Y	2.83	3.13	3.64	2.88	3.52
C	2.69	1.69	1.97	3.17	2.04
I	7.12	10.23	8.70	8.73	11.02
L	3.35	3.48	1.99	3.90	4.50
$\Delta\mathcal{E}$	0.00	0.00	4.14	0.00	0.00
S	1.75	2.81	4.89	1.91	2.85
Π	0.21	0.57	1.29	0.19	0.65
Π_H	0.30	0.79	0.22	0.26	0.91
i_d	1.31	0.50	1.74	1.68	0.50
F	0.10	0.17	0.16	0.15	0.34
τ_h	1.40	0.00	0.00	1.85	0.00
τ_e	0.83	1.31	0.00	0.00	0.00

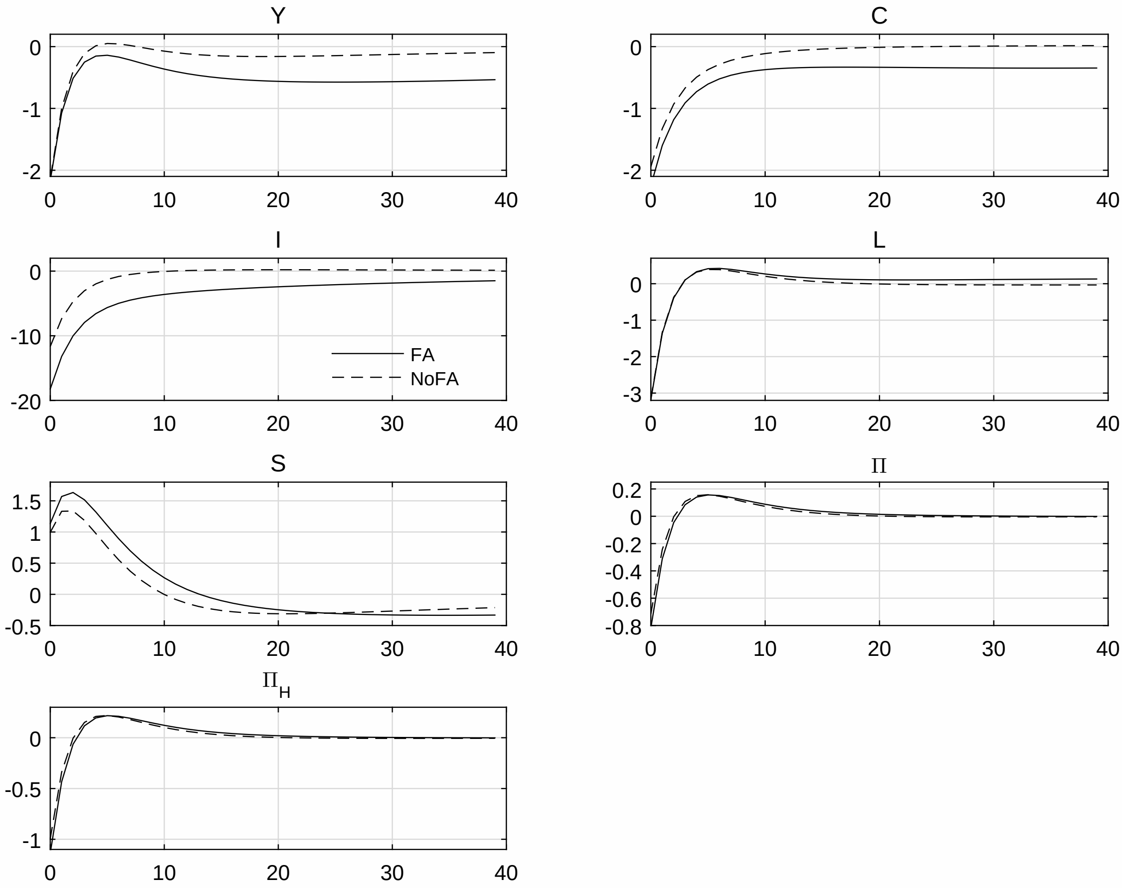

Figure 1: Model with (−) and without (−−) the financial accelerator; Peg case: Impulse responses to a foreign interest rate shock

rate at which entrepreneurs borrow from abroad. In contrast, capital controls on entrepreneurs have a direct control on the interest rate at which entrepreneurs borrow from foreign lenders, and may yield higher welfare in an economy with the financial accelerator.

4 Conclusion

We have developed a small open economy, New Keynesian model that highlights the vulnerability of balance sheets to exchange rate fluctuations. We then apply a Ramsey-type analysis and examine the welfare implications of optimal monetary and capital control policies. To our knowledge, our paper is the first that examines the welfare implications of optimal capital control policies in a small open economy, New Keynesian model that incorporates a financial accelerator coupled with liability dollarization.

In the case without the financial accelerator, we have compared three cases: an optimal monetary policy under flexible exchange rates, an optimal capital control policy (on households) under fixed exchange rates, and fixed exchange rates (without capital controls). Our Ramsey-type analysis results have shown that although the optimal capital control policy significantly improves welfare under fixed exchange rates, the optimal monetary policy is the most welfare-maximizing in an economy without the financial accelerator.

In the case with the financial accelerator, we compared five cases: an optimal monetary policy under flexible exchange rates, fixed exchange rates (without capital controls), an optimal capital control policy on entrepreneurs, an optimal capital control policy on households, and an optimal capital control policy on both entrepreneurs and households under fixed exchange rates. Our results have shown that the optimal monetary policy still outperforms the optimal capital control policy on households. However, the optimal capital control policy on entrepreneurs outperforms the optimal monetary policy. The most welfare-maximizing is the optimal capital control policy on both entrepreneurs and households.

The intuition underlying our analysis results is straightforward. Entrepreneurs finance investment partly with foreign borrowing, which is subject to financial frictions. In an economy with a financial accelerator, the key variable is the foreign interest rate augmented by an external finance premium. Whereas monetary policy works through domestic interest rates, capital controls on entrepreneurs have a direct control on the interest rate at which entrepreneurs borrow from abroad. Hence, capital controls under fixed exchange rates can yield higher welfare in an economy with a financial accelerator coupled with liability dollarization.

References

Adjemian, Stéphane, Houtan Bastani, Michel Juillard, Frédéric Karamé, Ferhat Mihoubi, George Perendia, Johannes Pfeifer, Marco Ratto, and Sébastien Villemot (2011) "Dynare: Reference Manual, Version 4," Dynare Working Papers 1, CEPREMAP.

Benigno, Gianluca, Huigang Chen, Christopher Otrok, Alessandro Rebucci, and Eric R. Young (2013) "Financial Crises and Macro-prudential Policies," *Journal of International Economics*, Vol. 89, No. 2, pp. 453 - 470.

Bernanke, Ben S., Mark Gertler, and Simon Gilchrist (1999) "The Financial Accelerator in a Ouantitative Business Cycle Framework," in Taylor, J. B. and M. Woodford eds. *Handbook of Macroeconomics*, Vol. 1 of Handbook of Macroeconomics: Elsevier, Chap. 21, pp. 1341-1393.

Bianchi, Javier (2011) "Overborrowing and Systemic Externalities in the Business Cycle," *American Economic Review*, Vol. 101, No. 7, pp. 3400-3426.

Brunnermeier, Markus K. and Yuliy Sannikov (2014) "International Credit Flows and Pecuniary Externalities," Working Paper 20803, National Bureau of Economic Research.

Calvo, Guillermo A. (1983) "Staggered Prices in a Utility-Maximizing Framework," *Journal of Monetary Economics*, Vol. 12, No. 3, pp. 383-398.

Cespedes, Luis Felipe, Roberto Chang, and Andres Velasco (2000) "Balance Sheets and Exchange Rate Policy," Working Paper 7840, National Bureau of Economic Research.

Cook, David (2004) "Monetary Policy in Emerging Markets: Can Liability Dollarization Explain Contractionary Devaluations?" *Journal of Monetary Economics*, Vol. 51, No. 6, pp. 1155-1181.

Davis, Scott and Ignacio Presno (2014) "Capital Controls as an Instrument of Monetary Policy," Working Paper 171, Globalization and Monetary Policy Institute, Federal Reserve Bank of Dallas.

De Paoli, Bianca and Anna Lipinska (2013) "Capital Controls: A Normative Analysis," Staff Reports 600, Federal Reserve Bank of New York.

Devereux, Michael B., Philip R. Lane, and Juanyi Xu (2006) "Exchange Rates and Monetary Policy in Emerging Market Economies," *The Economic Journal*, Vol. 116, No. 511, pp. 478-506.

Elekdağ, Selim and Ivan Tchakarov (2007) "Balance Sheets, Exchange Rate Policy, and Welfare," *Journal of Economic Dynamics and Control*, Vol. 31, No. 12, pp. 3986-4015.

Faia, Ester and Tommaso Monacelli (2008) "Optimal Monetary Policy in a Small Open Economy with Home Bias," *Journal of Money, Credit and Banking*, Vol. 40, No. 4, pp. 721-750.

Farhi, Emmanuel and Ivan Werning (2012) "Dealing with the Trilemma: Optimal Capital Controls with Fixed Exchange Rates," Working Paper 18199, National Bureau of Economic Research.

Galí, Jordi and Tommaso Monacelli (2005) "Monetary Policy and Exchange Rate Volatility in a Small Open Economy," *The Review of Economic Studies*, Vol. 72, No. 3, pp. 707-734.

Jeanne, Olivier, Arvind Subramanian, and John Williamson (2012) *Who Needs to Open the Capital Account?*: Peterson Institute for International Economics.

Jeanne, Olivier and Anton Korinek (2010) "Excessive Volatility in Capital Flows: A Pigouvian Taxation Approach," *American Economic Review*, Vol. 100, No. 2, pp. 403-407.

Kim, Jinill and Sunghyun Henry Kim (2003) "Spurious Welfare Reversals in International Business Cycle Models," *Journal of International Economics*, Vol. 60, No. 2, pp. 471-500.

Kitano, Shigeto (2004) "Macroeconomic Effect of Capital Controls as a Safeguard Against the Capital Inflow Problem," *Journal of International Trade & Economic Development*, Vol. 13, No. 3, pp. 233-263.

——— (2011) "Capital Controls and Welfare," *Journal of Macroeconomics*, Vol. 33, No. 4, pp. 700-710.

Kollmann, Robert (2002) "Monetary Policy Rules in the Open Economy: Effects on Welfare and Business Cycles," *Journal of Monetary Economics*, Vol. 49, No. 5, pp. 989-1015.

Korinek, Anton (2011) "The New Economics of Prudential Capital Controls: A Research Agenda," *IMF Economic Review*, Vol. 59, No. 3, pp. 523-561.

Levin, Andrew T., Alexei Onatski, John Williams, and Noah M. Williams (2006) "Monetary Policy under Uncertainty in Micro-Founded Macroeconometric Models," in Gertler, Mark and Kenneth Rogoff eds. *NBER Macroeconomics Annual 2005, Volume 20*: MIT Press, pp. 229-312.

Liu, Zheng and Mark M. Spiegel (2013) "Monetary Policy Regimes and Capital Account Restrictions in a Small Open Economy," Working Paper Series 2013-33, Federal Reserve Bank of San Francisco.

Merola, Rossana (2010) "Optimal Monetary Policy in a Small Open Economy with Financial Frictions," Discussion Paper Series 1: Economic Studies 01/2010, Deutsche Bundesbank, Research Centre.

Ostry, Jonathan David, Mahvash Saeed Qureshi, Karl Habermeier, Dennis Bernhard Sebastian Reinhardt, Marcos Chamon, and Atish Ghosh (2010) "Capital Inflows: The Role of Controls," IMF Staff Position Notes 2010/04, International Monetary Fund.

Ostry, Jonathan, Atish Ghosh, and Anton Korinek (2012) "Multilateral Aspects of Managing the Capital Account," IMF Staff Discussion Notes 12/10, International Monetary Fund.

Ravenna, Federico and Fabio M. Natalucci (2008) "Monetary Policy Choices in Emerging Market Economies: The Case of High Productivity Growth," *Journal of Money, Credit and Banking*, Vol. 40, No. 2-3, pp. 243-271.

Schmitt-Grohé, Stephanie and Martin Uribe (2003) "Closing Small Open Economy Models," *Journal of International Economics*, Vol. 61, No. 1, pp. 163-185.

——— (2004) "Solving Dynamic General Equilibrium Models Using a Second-Order Approximation to the Policy Function," *Journal of Economic Dynamics and Control*, Vol. 28, No. 4, pp. 755-775.

——— "Optimal Simple and Implementable Monetary and Fiscal Rules: Expanded Version," Working Paper 12402, National Bureau of Economic Research.

——— (2007) "Optimal Simple and Implementable Monetary and Fiscal Rules," *Journal of Monetary Economics*, Vol. 54, No. 6, pp. 1702-1725.

——— (2013) "Downward Nominal Wage Rigidity, Currency Pegs, and Involuntary Unemployment," Unpublished.