Capital Account Openess and Unemployment
(*Preliminary and Incomplete*)*

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May 3, 2015

Abstract

We investigate how capital account openness affect a country's unemployment in this paper. In theory, using a standard labor search and match model, we find that, in the steady state, a rise in capital account openness will lead to a lower unemployment when the labor market is flexible. However, a rise in capital account openness can yield a higher unemployment when labor market becomes sufficiently rigid. We also provide suggestive empirical evidence to support our theoretical predictions.

*The views expressed in this paper are those of the authors and do not necessarily reflect the views and policies of Monash University, the Federal Reserve Bank of Kansas City, and the Asian Development Bank or its Board of Governors or the governments they represents.

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1 Introduction

Should a country liberalize its capital account or adopt capital control? To our knowledge, the answer has been unclear. In the literature, there exist different views about the wisdom of capital account openness as a policy choice. The first view draws heavily on the predictions of the standard neoclassical growth models. The neoclassical growth theory predicts that, opening the capital account facilitates a more efficient international allocation of resources. Resources can flow from capital-abundant countries (where the return to capital is relatively low) to capital-scarce countries (where the return to capital is relatively high). For those capital-scarce countries, the inflow of resources can generate an increase in investment and growth which in turn raises welfare. Such predictions hold only when there are no distortions to the economy other than barriers to free capital flows. Since there exist a large number of distortions in the real world, especially for developing countries (which can be considered as capital-scarce countries), capital account liberalization may not be effective in boosting investment and economic growth. In one of his well-known papers, "Who Needs Capital Account Convertibility?", Rodrik conducts empirical tests and finds no correlation between the openness of countries' capital accounts and the amount they invest or the rate at which they grow. At the same time, emerging markets suffer from re-current crises, which makes capital control more appealing since it can to some extent reduce the chance of getting into crises.

Few papers in the literature focus on the impact of capital account liberalization on the labor market. We aim at building a theoretical framework to analyze the labor market implications when a country opens its capital account. We extend the standard Diamond-Mortensen-Pissarides (DMP henceforth) framework in a small open economy scenario. Our model predicts that, how capital account liberalization affects unemployment depends on the country's labor market rigidities (more specifically, hiring and firing cost). With a relatively low labor market rigidity, a more open capital account can lead to lower unemployment, while capital account liberalization can result in higher unemployment when the labor market becomes relatively rigid. Our theory essentially is consistent with the first view discussed in the previous analysis. In our model, labor market rigidity is an important factor that determines international capital flow. With a more flexible labor market, firms can hire or fire workers more easily. In this case, more firms will enter the market and produce. On the other hand, with a more rigid labor market, firms need to pay higher cost for hiring/firing workers. Hence, fewer firms will enter the market. As capital is one of the necessary inputs in production, flexible labor markets may yield a higher demand for capital than rigid labor markets. Other factors being equal, this implies that flexible labor markets are more likely to be associated with a net capital inflow while rigid labor markets are more likely to generate a net capital outflow. Then, the standard neoclassical model prediction applies. Capital account liberalization may attract more capital inflows for countries with a net capital inflow, that is, countries with relatively flexible labor markets in our model. The more capital inflow raises the supply of capital stock used in production which reduces firms' capital renting cost. Then more firms will enter the market and hence, employment may rise. On the contrary, capital control can prevent capital escaping from the domestic capital market if a country has a net capital outflow. Based on a similar logic, capital control may be effective in keeping firms to stay in the market. As a result, employment may not fall.

Empirically, we provide suggestive evidence to support the theoretical predictions. Two key variables in our empirical analysis are the capital account openness measure and labor market rigidity index. We adopt three different measures for capital account openness: the Chinn-Ito index $KAOPEN$ and two indices in Quinn (2008). For the labor market rigidity index, we use a newly developed measure in Campos and Nugent (2012). This index is similarly built as in the seminal work of Botero et al. (2004) but covering more countries and more years. On average, countries that have labor regulation embedded in the English common law system have less restrictive labor laws and regulations than those based on French or other civil law systems. In panel data regressions, we find that how capital account liberalization affects unemployment depends on labor market conditions. With a low labor market rigidity, capital account openness is negatively correlated with unemployment, suggesting that a more open capital account lowers unemployment. However, when labor market becomes sufficiently rigid, we obtain the opposite pattern, that is, a more open capital account is associated with higher unemployment.

Our work is related to the capital account liberalization and labor market rigidity literature. Few papers have considered both and analyzed the optimal capital control policy. The most related paper in the literature is Schmitt-Grohe and Uribe (2012). They find that, in a small open economy with downward nominal wage rigidity, a fixed exchange rate regime creates a pecuniary externality. The nature of this externality is that expansions in aggregate demand drive up wages, putting the economy in a vulnerable situation. When adverse shocks hit the economy, downward nominal wage rigidity and a fixed exchange rate prevent real wages from falling to the level consistent with full employment. They show that, a prudential capital control policy should be adopted to improve welfare. If we consider their downward nominal wage rigidity as one of the labor rigidities[1], their result is consistent with our findings in the sense that, capital account liberalization may raise the unemployment when labor market rigidity is high. However, our work differs from Schmitt-Grohe and Uribe (2012) in several aspects. First, the optimal capital control policy in their paper only applies to countries with fixed exchange rate regimes. For countries with flexible exchange rate regimes, their model suggests no effect of changing capital account openness on unemployment. Second, Schmitt-Grohe and Uribe (2012) cannot generate the negative correlation between capital account openness and unemployment when labor market rigidity is low, while we do find this pattern both in theory and data. In sum, our model can be considered a more general case than Schmitt-Grohe and Uribe (2012).

The rest of the paper is organized as follows: In section 2, we present the theoretical model. We first solve the model in the steady state to see how capital account liberalization affects the long run unemployment. Then, we consider the impulse responses of unemployment and other macro variables in a dynamic model under different labor market conditions. Section 3 provides suggestive empirical evidence to support our theoretical predictions. In section 4, we conclude.

[1] In the data, labor market rigidity includes hiring cost, firing cos,t and other employment adjustment cost.

2 Model

There exist two types of agents: households and firms. We consider a small open economy Home. The price of the good is exogenous which equals the world price.

2.1 Households

The optimization problem for a representative consumer is

$$\sum_{t=0}^{\infty} \beta^t u(c_t)$$

subject to the constraint

$$c_t + D_t \leq w_t n_t + b(1 - n_t) - T_t + \Pi_t + (1 + r_{t-1}) D_{t-1} - \frac{\psi}{2}\left(D_t - \bar{D}\right)^2 \tag{1}$$

where c_t is the consumption. D_t is the bond held by the representative household with interest rate r_t. n_t represents employment and w_t is the wage rate for an employee. b and T_t represent the unemployment compensation and the lump-sum taxation, respectively. In this model, we assume that bond holding adjustment is costly, which is represented by a convex cost $\frac{\psi}{2}\left(D_t - \bar{D}\right)^2$, where $\bar{D} > 0$ is a constant. Π_t is the aggregate profit from production. We assume that firms are owned by households, then profit becomes part of household income.

We then can obtain the Euler equation

$$1 + \psi\left(D_t - \bar{D}\right) = \beta(1 + r_{t-1}) E_t\left[\frac{u'(c_{t+1})}{u'(c_t)}\right] \tag{2}$$

2.2 Firms

Firms are established through a matching of a posted vacancy and a worker. Then an existing firm produces output $z_t k_t^{\alpha}$ by inputting capital k_t in period t. z_t represents an economy-wide technology shock. The value of a representative firm is

$$J_t = \max_{k_{t+1}} \left\{ z_t k_t^{\alpha} - w_t - R_t k_t + E_t\left[\beta \frac{u'(c_{t+1})}{u'(c_t)}(1 - \delta_{t+1}) J_{t+1}\right]\right\} \tag{3}$$

where R_t is the capital rental rate. δ_{t+1} is the job separation rate.

Assume that capital stocks are provided by capital good producers. One unit of final good can be transferred into one unit of capital stock. Capital good producers will borrow from households at interest rate r_t to produce. When investing the final good into producing capital stock, it can yield a stochastic rental income R_{t+1} in period $t+1$. At the same time, a fraction $(1 - \delta_K)$ of the capital will be returned to capital stock producers. In this case, one unit of investment can generate revenue $R_{t+1} + 1 - \delta_K$. Assume that capital stock producers are risk neutral and competitive, then the investment decision will be made to satisfy the following condition

$$E_t \left[\beta \frac{u'(c_{t+1})}{u'(c_t)} \left((R_{t+1} + 1 - \delta_K) - (1 + r_t) \right) \right] = 0 \tag{4}$$

The investment can come from both domestic and foreign funds. In this model, if $K_{t+1} > D_t$ capital good producers will borrow from the rest of world to produce capital goods. Then there is a net capital inflow. On the other hand, if $K_{t+1} < D_t$, the country has a net capital outflow. The reason we assume this type of capital supply is that, we would like the model to have the feature that, as the steady state interest rate changes, capital rental cost will be affected. If we directly assume investment in the household budget constraint as in the standard model, we obtain the undesired feature that, the steady state capital rental rate may not depend on the interest rate.

An unemployed worker will always search for a job. We assume the matching function is $m(v_t, u_t)$, where v_t and u_t represent the aggregate vacancies posted and unemployment, respectively. Let $\theta_t \equiv v_t/u_t$ be the market tightness. Assume that, function $m(v_t, u_t)$ is homogenous of degree one in both arguments. Then, the job filling rate f_t is

$$f_t = \frac{m(v_t, u_t)}{v_t} = m\left(1, \frac{1}{\theta_t}\right) \tag{5}$$

and the probability that an unemployed worker finds a job s_t is

$$s_t = \frac{m(v_t, u_t)}{u_t} = m(\theta_t, 1) \tag{6}$$

By (3), the entry condition is

$$\frac{\kappa}{f_t} = E_t \left[\beta \frac{u'(c_{t+1})}{u'(c_t)} (1 - \delta_{t+1}) J_{t+1} \right] \tag{7}$$

As discussed in the previous analysis, all firms make similar investment decisions. Due to the symmetry, they will also set the same wages to workers. The value for an employed worker is

$$W_t = w_t + E_t \left[\beta \frac{u'(c_{t+1})}{u'(c_t)} \left((1 - \delta) W_{t+1} + \delta U_{t+1} \right) \right] \tag{8}$$

where we again use $(1 + r_t)^{-1}$ as discount factor. For an unemployed worker, the value is

$$U_t = b + E_t \left[\beta \frac{u'(c_{t+1})}{u'(c_t)} \left((1 - \delta) s_t W_{t+1} + (1 - (1 - \delta) s_t) U_{t+1} \right) \right] \tag{9}$$

Let $S_t \equiv J_t + W_t - U_t$ be the surplus of a matching. Then,

$$S_t = z_t k_t^{\alpha} - w_t - R_t k_t - b + (1-\delta) E_t \left[\beta \frac{u'(c_{t+1})}{u'(c_t)} \left(J_{t+1} + (1-s_t)(W_{t+1} - U_{t+1}) \right) \right] \tag{10}$$

We assume Nash bargaining on wages. Let η denote the bargaining power of workers,

$$W_t - U_t = \eta S_t,\ J_t = (1-\eta) S_t \tag{11}$$

By (11) and (7), (10) then becomes

$$\frac{\kappa}{f_t} \frac{1}{1-\delta} = E_t \left[\beta \frac{u'(c_{t+1})}{u'(c_t)} \left((1-\eta)(z_t k_t^{\alpha} - R_t k_t - b) + \frac{\kappa}{f_{t+1}} (1 - \eta s_{t+1}) \right) \right] \tag{12}$$

Also by (11) and (10), we have

$$W_t - U_t = \eta \left(z_t k_t^{\alpha} - R_t k_t - b + \frac{\kappa}{f_t} \left(1 + \frac{\eta}{1-\eta} (1 - s_t) \right) \right)$$

Then

$$w_t = \eta (z_t k_t^{\alpha} - R_t k_t + \kappa \theta_t) + (1-\eta) b \tag{13}$$

Substitute (13) into (3), we can obtain the first order condition on k_{t+1} as follows:

$$\alpha z_t k_t^{\alpha - 1} = R_t \tag{14}$$

2.3 Small open economy

We consider a small open economy case. Let r^* denote the world interest rate. We allow international capital flows, which implies that the domestic interest rate will be equal to the world interest rate after adjusting for transaction cost. In a world without any international capital flow cost, $r_t = r^*$. In this paper, we let parameter τ denote an ice-berg cost in international capital flows (a higher value of τ means a more restrictive capital account), then

$$1 + r_t = \begin{cases} (1-\tau)^{-1} (1 + r^*) & \text{if net capital inflow} \\ (1-\tau)(1 + r^*) & \text{if net capital outflow} \end{cases}$$

We will also discuss a case that capital inflow cost and capital outflow cost differ later in this paper.

2.4 Equilibrium

We assume the same labor market matching function as in den Haan et al. (2000)

$$m(v_t, u_t) = \frac{v_t u_t}{\left(v_t^l + u_t^l\right)^{1/l}}$$

where unemployment $u_t = 1 - n_t$ in this model. The aggregate capital demand in period t (to be used in period $t+1$) is K_{t+1} while the supply of capital coming from the domestic economy is D_t. If $K_{t+1} > D_t$, there is a net capital inflow. The interest rate r_t is then

$$1 + r_t = \begin{cases} (1-\tau)^{-1}(1+r^*) & \text{if } K_{t+1} > D_t \\ (1-\tau)(1+r^*) & \text{if } K_{t+1} < D_t \end{cases} \tag{15}$$

In equilibrium, employment evovles as follows

$$n_{t+1} = (1-\delta)(n_t + s_t(1-n_t)) \tag{16}$$

and the resource constraint is

$$c_t + D_t = (1-\alpha) n_t z_t \left(\frac{K_t}{n_t}\right)^{\alpha} - \kappa\theta_t (1-n_t) + (R_t + 1 - \delta_K) D_{t-1} - \frac{\psi}{2}\left(D_t - \bar{D}\right)^2 \tag{17}$$

2.4.1 Steady state

We let k_t denote the capital input by each firm, that is, $k_t = K_t/n_t$. Let $\bar{z}$ denote the steady state productivity. By (14), we have

$$\alpha\bar{z}(k^{ss})^{\alpha-1} = R^{ss} \Rightarrow k^{ss} = \left(\frac{\alpha\bar{z}}{R^{ss}}\right)^{\frac{1}{1-\alpha}}$$

In the steady state, (12) becomes

$$\kappa\left(\frac{1-\beta(1-\delta)}{\beta(1-\delta)}\left(1+(\theta^{ss})^l\right)^{1/l} - \eta\theta^{ss}\right) = (1-\eta)\left((1-\alpha)\alpha^{\frac{\alpha}{1-\alpha}}\bar{z}^{\frac{1}{1-\alpha}}(R^{ss})^{-\frac{\alpha}{1-\alpha}} - b\right) \tag{18}$$

Then

$$\frac{d\theta^{ss}}{dr^{ss}} = -\frac{(1-\eta)\alpha^{\frac{1}{1-\alpha}}\bar{z}^{\frac{1}{1-\alpha}}(R^{ss})^{-\frac{1}{1-\alpha}}}{\kappa\left(\frac{1-\beta(1-\delta)}{\beta(1-\delta)}\left(1+(\theta^{ss})^l\right)^{1/l-1}(\theta^{ss})^{l-1} + \eta\right)} < 0 \tag{19}$$

In the benchmark model, κ represents the labor market rigidity (a higher value of κ means a more rigid labor market). We can show the following proposition.

Proposition 1 *Given $\tau \in (0,1)$, under the assumption*

$$\left(\bar{D} + \frac{\beta(1+r^*) + \tau - 1}{\psi(1-\tau)}\right)\left(\frac{\tau + r^*}{1-\tau} + \delta_K\right)^{\frac{1}{1-\alpha}} \leq (1-\delta)(\alpha\bar{z})^{\frac{1}{1-\alpha}} \tag{20}$$

we can show that, there exist thresholds κ_0 and κ_1 ($\kappa_0 \leq \kappa_1$) such that,

- *i) for $\kappa < \kappa_0$, $\frac{du^{ss}}{d\tau} > 0$*
- *ii) for $\kappa > \kappa_1$, $\frac{du^{ss}}{d\tau} < 0$*
- *ii) for $\kappa \in [\kappa_0, \kappa_1]$, $\frac{du^{ss}}{d\tau} = 0$.*

Proof. (see Appendix A). ■

Some remarks are in order. First, if Home's labor market is flexible, firms can more easily enter the market and produce. Then the domestic demand for capital in Home is high which yields a high return on capital. In this case, it is more likely that Home households borrow from the world (capital flows into Home) and invest in capital stocks. A more open capital account means a lower borrowing cost. Thus, Home households borrow more and aggregate capital supply in Home will rise, which encourages more firms to produce. As a result, there will be more vacancies posted and unemployment goes down.

Second, if Home has a rigid labor market, for instance, hiring cost is high or labor market matching efficiency is low, few firms will enter the market to produce. The domestic demand for capital in Home is low in this case, which in turn yields a low return on capital. Home households may be more likely to lend their wealth to the rest of world (capital flows out of the country). A more open capital account leads to a greater volume of capital outflow. The domestic capital supply will decline. Due to the increasing difficulty of acquiring capital, fewer firms will enter the market and produce. As a result, unemployment goes up.

Third, (20) is a sufficient condition that, we can always find a threshold κ_0 below which, capital flows from the rest of the world into Home. As we can see, as $\bar{z}$ goes up, i.e., Home firms are more productive, this immediatly yields a greater demand for capital stock, which raises the possibility of a net capital inflow. Then (20) is more likely to hold. On the other hand, when δ rises, that is, the firm's death rate in Home goes up, this will discourage firms from entering the market. As a result, the demand for capital stock declines which makes capital less likely to flow into Home. Then (20) becomes less likely to hold.

In the dynamic optimization problem, since z_t is a random variable. Even in the case that Home has a very rigid labor market, there might still be capital inflows in certain periods (with very high z_ts). On the other hand, capital may also flow out of Home under very low z_ts no matter how flexible the labor market is. We numerically show in the next section that, similar results as in Proposition 1 still hold when we consider average unemployment.

In our model, labor market rigidity affects a country's net foreign asset position. In the following corollary, we show that an increase in labor market rigidity leads to an increase in the ratio of Home's net foreign asset to GDP (a decline in foreign debt to GDP ratio)

Corollary 1 *Under the same assumptions in Proposition 1, for any non-zero net capital flow, a rise in labor market rigidity κ leads to an increase in the steady state net foreign asset to GDP ratio.*

Proof. (see Appendix B). ■

We will show empirical evidence of this result later in this paper.

2.4.2 Firing cost

Our benchmark model has one underlying assumption, that is, firms are not allowed to fire workers other than through exogenous separations. In other words, we have considered a case with infinite firing cost. We then extend our benchmark model by considering limited firing cost. In this section, we follow den Haan et al. (2000) but assuming an additional firing cost of firms ω if a separation occurs. We will analyze how a change in the firing cost but keeping hiring cost constant will affect unemployment.

For technical reasons, we assume that an existing firm produces output $\varphi_t z_t k_t^{\alpha}$ by inputting capital k_t in period t, where φ_t represents an idiosyncratic shock to each firm. We assume that the relationship between a firm and a worker may be severed for exogenous reasons in any period. We let δ denote the probability of exogenous separation, which is independent of technology shocks. Firms will make capital renting decisions after observing z_t and φ_t. We assume that φ_t is independently and identically drawn from a random distribution $G(\cdot)$ in each period. For firms who receive very low φ_ts, they might choose to separate endogenously. If either exogenous or endogenous separation occurs, there is no output. In this case, workers immediately become unemployed and receive payoff U_t.

Similar to the benchmark model, if a relationship between a worker and a firm remains unseparated in period t, optimal demand on k_t is

$$\alpha\varphi_t z_t k_t^{\alpha-1} = R_t \Rightarrow k_t = \left(\frac{\alpha\varphi_t z_t}{R_t}\right)^{1-\alpha} \tag{21}$$

The output net of capital rental cost is $(1-\alpha)\,\alpha^{\frac{\alpha}{1-\alpha}}\,(\varphi_t z_t)^{\frac{1}{1-\alpha}}\,R_t^{-\frac{\alpha}{1-\alpha}}$. Given the fact that, individual firms' decisions will not affect R_t and z_t, a lower φ_t yields a lower net output in period t. As a result, a separation is more likely to happen. This follows that, there exists a threshold $\bar{\varphi}_t$ such that the partners will opt for separation if $\varphi_t < \bar{\varphi}_t$. In this case, the job separation rate is

$$\delta_t = \delta + (1-\delta)\,G(\bar{\varphi}_t) \tag{22}$$

and employment is

$$n_{t+1} = (1 - \delta_{t+1})(n_t + s_t(1 - n_t)) \tag{23}$$

In this case, the surplus of matching is

$$S(\varphi_t) = (J(\varphi_t) - (-\omega)) + (W(\varphi_t) - U_t) \tag{24}$$

where the term in the first parenthesis on the right hand side of (24) represents the surplus from the firm side (note that the outside option is $-\omega$ if the firm fires the worker), and the term in the second parenthesis represents the surplus from the worker side. Now we consider the decision of separation. The following condition mathematically pins down the threshold value $\bar{\varphi}_t$

$$J(\bar{\varphi}_t) + \omega + W(\bar{\varphi}_t) - U_t = 0 \tag{25}$$

where similar to the benchmark case, $J(\varphi_t)$, $W(\varphi_t)$ and U_t are

$$\begin{aligned} J(\varphi_t) &= (\varphi_t z_t)^{\frac{1}{1-\alpha}} \alpha^{\frac{\alpha}{1-\alpha}} (1-\alpha) R_t^{-\frac{\alpha}{1-\alpha}} - w(\varphi_t) \\ &\quad + E_t\left[\beta \frac{u'(c_{t+1})}{u'(c_t)} \left((1-\delta) \int_{\bar{\varphi}_{t+1}} J(\varphi_{t+1})\, dG(\varphi_{t+1}) - \delta_{t+1}\omega\right)\right] \end{aligned} \tag{26}$$

$$W(\varphi_t) = w(\varphi_t) + E_t\left[\beta \frac{u'(c_{t+1})}{u'(c_t)} \left((1-\delta) \int_{\bar{\varphi}_{t+1}} W(\varphi_{t+1})\, dG(\varphi_{t+1}) + \delta_{t+1} U_{t+1}\right)\right] \tag{27}$$

$$U_t = b + E_t\left[\beta \frac{u'(c_{t+1})}{u'(c_t)} \left(s_t(1-\delta) \int_{\bar{\varphi}_{t+1}} W(\varphi_{t+1})\, dG(\varphi_{t+1}) + (1 - s_t(1-\delta_{t+1})) U_{t+1}\right)\right] \tag{28}$$

and the firms' entry condition is

$$\kappa = f_t E_t\left[\beta \frac{u'(c_{t+1})}{u'(c_t)} \left((1-\delta) \int_{\bar{\varphi}_{t+1}} J(\varphi_{t+1})\, dG(\varphi_{t+1}) - \delta_{t+1}\omega\right)\right] \tag{29}$$

Substituting (26)-(29) into (25), we can obtain

$$(\bar{\varphi}_t z_t)^{\frac{1}{1-\alpha}} \alpha^{\frac{\alpha}{1-\alpha}} (1-\alpha) R_t^{-\frac{\alpha}{1-\alpha}} = b - \frac{1-\eta s_t}{1-\eta} \frac{\kappa}{f_t} - \left(1 + \frac{\eta(1-s_t)}{1-\eta} E_t\left[\beta \frac{u'(c_{t+1})}{u'(c_t)}\right]\right)\omega \tag{30}$$

We also plug the expressions $J(\varphi_t)$, $W(\varphi_t)$, and U_t into $S(\varphi_t)$, using (30), and we can obtain

$$\begin{aligned} &\frac{\kappa}{(1-\eta)(1-\delta) f_t} + E_t\left[\beta \frac{u'(c_{t+1})}{u'(c_t)}\right] \frac{\omega}{(1-\eta)(1-\delta)} \\ =\; & E_t\left[\beta \frac{u'(c_{t+1})}{u'(c_t)} \int_{\bar{\varphi}_{t+1}} \left(\varphi_{t+1}^{\frac{1}{1-\alpha}} - \bar{\varphi}_{t+1}^{\frac{1}{1-\alpha}}\right) z_{t+1}^{\frac{1}{1-\alpha}} \alpha^{\frac{\alpha}{1-\alpha}} (1-\alpha) R_{t+1}^{-\frac{\alpha}{1-\alpha}} dG(\varphi_{t+1})\right] \end{aligned} \tag{31}$$

We can also compute the wage rate in this case,

$$w(\varphi_t) = \eta\left((\varphi_t z_t)^{\frac{1}{1-\alpha}}\alpha^{\frac{\alpha}{1-\alpha}}(1-\alpha)R_t^{-\frac{\alpha}{1-\alpha}} + \kappa\theta_t + \left(1-(1-s_t)E_t\left[\beta\frac{u'(c_{t+1})}{u'(c_t)}\right]\right)\omega\right) + (1-\eta)b$$

In equilibrium, the aggregate capital input K_t is

$$K_t = n_t \int_{\bar{\varphi}_t} \frac{(\alpha\varphi_t z_t)^{1-\alpha} R_t^{-(1-\alpha)}}{1-G(\bar{\varphi}_t)} dG(\varphi_t) \tag{32}$$

and the resource constraint becomes

$$\begin{aligned} c_t + D_t \quad \leq \quad & \frac{(1-\alpha)n_t \int_{\bar{\varphi}_t}(\varphi_t z_t)^{\frac{1}{1-\alpha}}\alpha^{\frac{\alpha}{1-\alpha}}R_t^{-\frac{\alpha}{1-\alpha}}dG(\varphi_t)}{1-G(\bar{\varphi}_t)} + (R_t + 1 - \delta_K)D_{t-1} - \kappa\theta_t(1-n_t) \\ & -\omega\delta_t\left(n_{t-1} + \frac{\theta_{t-1}(1-n_{t-1})}{\left(1+\theta_{t-1}^l\right)^{1/l}}\right) - \frac{\psi}{2}\left(D_t - \bar{D}\right)^2 \end{aligned} \tag{33}$$

2.5 Numerical steady state solutions

Since it is difficult to solve the model with firing cost analytically, we pursue numerical solutions. We follow the strategy in den Haan et al. (2000) to calibrate parameters in the labor market. For the job separation rate, Hall (1995) concludes that, for the long-term employment relationship of the type we consider, quarterly US job separation rates lie between 8 to 10 percent. Using the Current Population Survey (CPS) data, Davis et al. (1996) compute an annual separation rate of 36.8 percent, which implies a roughly 11 percent quarterly separation rate. We then set $\delta^{ss} = 0.10$ in our model.

Similar to den Haan et al. (2000), to interpret exogenous and endogenous components of the separation rate, we assume that firms experiencing exogenous separations attempt to refill the positions by posting vacancies while those having endogenous separations do not. den Haan et al. (2000) argue that, the assumption makes sense if exogenous separations are considered as being worker-initiated, reflecting changes in the workers' personal circumstances. Endogenous separations, in contrast, may reasonably be viewed as reflecting the firms' circumstances. In this model, we simply assume that the rate at which separations are reposted by firms is equal to the proportion of all exogenous separations, that is δ/δ^{ss}.

Let M^{ss} denote the relationships established by a worker and a firm (which is different from the number of existing firms), the steady state mass of jobs destroyed per period is $\delta^{ss}\left(1-\frac{\delta}{\delta^{ss}}f^{ss}\right)M^{ss}$, where f^{ss} is the steady state job filling rate. The steady state job creation (the mass of firms that have no employees at the beginning but find workers in the matching phase) per period is $f^{ss}(v^{ss} - \delta M^{ss})$. Job destruction must be equal to job creation in the steady state

$$\delta^{ss}\left(1-\frac{\delta}{\delta^{ss}}f^{ss}\right)M^{ss} = f^{ss}(v^{ss} - \delta M^{ss}) \tag{34}$$

Using data from the manufacturing sector, Davis et al. (1996) allow us to pin down directly the job creation rate. As in den Haan et al. (2000), we have the ratio of job creation to total established relationships between a worker and a firm at around 5.2%,

$$\frac{f^{ss}\left(v^{ss}-\delta M^{ss}\right)}{M^{ss}}=0.052 \tag{35}$$

By (34) and (35), we have

$$\delta f^{ss}=\delta^{ss}-0.052 \tag{36}$$

We set $f^{ss}=0.7$ which is consistent with den Haan et al. (2000). Then $\delta=0.069$. In this case,

$$G\left(\bar{\varphi}\right)=\frac{\delta^{ss}-\delta}{1-\delta}=0.034$$

We set the job finding rate s^{ss} to 0.45 in the steady state, which is consistent with den Haan et al. (2000). Given f^{ss} and s^{ss}, we can pin down the steady state market tightness

$$\theta^{ss}=\frac{s^{ss}}{f^{ss}}=0.643$$

and parameter l will satisfy the following condition

$$\frac{1}{\left(1+\left(\theta^{ss}\right)^{l}\right)^{1/l}}=f^{ss} \tag{37}$$

For the economy-wide productivity shocks, we assume an AR(1) process that

$$\log z_t=\rho\log z_{t-1}+\varepsilon_t$$

where we assume that $\rho=0.95$. ε_t is independenly and identically drawn from a normal distribution with zero mean and standard deviation $\sigma_\varepsilon=0.007$, which is consistent with the business cycle literature. Idiosyncratic shocks φ_t are drawn from a log-normal distribution with mean one and standard deviation σ_φ.

For the productivity parameter α, we set $\alpha=0.36$. Consistent with the business cycle literature, we let $\delta_K=0.025$. For parameters in the utility function, we set $\beta=1/\left(1+r^*\right)$. In our benchmark small open economy, we assume that world interest rate $r^*=0.01$ and $\tau=0$ (financially open). We also assume equal bargaining power for workers and firms, that is, $\eta=0.5$. We assume a symmetric distribution of the idiosyncratic shock φ. The mean of φ is one. In our model, we simply assume that φ is drawn from a log-normal distribution with mean zero and standard deviation $\sigma_\varphi=0.2$. The choices of the mean and the standard deviation of φ are within the range of their values in the standard literature.

For parameters l, b, κ, and ω, we calibrate them to solve the equilibrium conditions (30) and (31), the endogenous job separation rate, plus one more moment condition that, the total vacancy post cost is around 1 percent of GDP (as in Krause and Lubik (2010)). We obtain the same values, $l = 1.267$, $b = 2.170$, $\kappa = 0.25$, $\omega = 0.18$.

Finally, we calibrate ψ and $\bar{D}$ in the budget constraint. We first set $\psi = 0.00074$ which is the same as in Schmitt-Grohe and Uribe (2003). We then pin down the value of $\bar{D}$ to match the fact that US net foreign asset to GDP ratio is about -0.005 in the year 2004. Then, we have $\bar{D} = 3.979$. We will change the values of $\bar{D}$ in the robustness checks.

All parameters are summarized in the following table

Parameter	Value	Parameter	Value
β	0.99	η	0.5
α	0.36	δ_K	0.025
l	1.267	ψ	0.00074
κ	0.2499	$\bar{D}$	3.6096
ρ	0.95	ω	0.1784
δ	0.069	σ_φ	0.2
b	2.17	σ_ε	0.007

Figures 1 to 3 report the numerical results. In Figure 1, we let the firing cost be fixed at $\omega = 0.18$. We show how steady state unemployment responds to the change in international capital flow cost τ under various hiring costs. As we can see, when κ takes a lower value such as 0.25, 0.3 and 0.35, as τ goes up, unemployment first rises and then stays constant. When κ takes higher values such as 0.4 or 0.45, we can see that, as τ increases, unemployment first falls and then remains constant. In other words, when hiring cost is low, a rise in international capital flow cost is more likely to yield an increase in unemployment while the opposite pattern occurs when hiring cost becomes sufficiently large. We can also see from Figure 1 that, Corollary 1 holds for κ greater than 0.3, that is, when $\kappa \geq 0.3$, our numerical example shows that a rise in hiring cost leads to an increase in the steady state net foreign asset position (net foreign asset to GDP ratio). $\kappa = 0.25$ is an exception, that is, when κ increases from 0.25 to 0.3, net foreign asset to GDP ratio falls. Finally, we can see that, steady state consumption responses to the change in capital control degree τ is exactly the opposite of the responses of unemployment. This suggests that, a higher unemployment is associated with a lower output which in turn may lead to a lower consumption. Note that our utility function is only based on consumption-led utility, i.e., a lower steady state consumption means a lower welfare.

In Figure 2, we fix hiring cost κ at 0.25 and let firing cost ω vary. We report how steady state unemployment responds to the change in international capital flow cost τ. We find that, when ω takes a lower value (for instance $\omega \leq 0.3$), a rise in capital flow cost τ leads to higher unemployment. However, when ω takes a higher value such as 0.4 or 0.45, a rise in capital flow cost τ yields lower unemployment. Similarly, except for $\omega = 0.18$, a rise in ω yields a higher net foreign asset position on average. For steady state consumption, it falls (rises) when τ rises under a relatively low (high) firing cost.

In Figure 3, we consider how steady state unemployment responds to capital flow cost τ under various combinations of (κ, ω). When κ and ω take relatively low values, a rise in international capital flow cost τ leads to a higher unemployment. However, when κ and ω become sufficiently large, a higher international capital flow cost can yield lower steady state unemployment. For the steady state net foreign asset position, when κ changes from 0.25 to 0.3, and ω changes from 0.18 to 0.25, the change in net foreign asset to GDP ratio is very small. However, when κ and ω keep rising, on average, the steady state net foreign asset goes up. Again, from Figure 3, we see that the steady state consumption moves to the opposite direction compared to unemployment.

In sum, the three figures suggest that, as labor market rigidity is low, a more open capital account (a decline in τ) can lead to a lower unemployment but higher consumption. However, all patterns reverse when labor market rigidity becomes sufficiently high. Quantitatively, the effect is not small. For instance, under our benchmark $\kappa = 0.25$ and $\omega = 0.18$, as τ declines from 0.0001 to 0, unemployment falls by around 0.2 percent. Under a more rigid labor market parameter combination $\kappa = 0.4$ and $\omega = 0.4$, when τ declines from 0.0001 to 0, unemployment rises by around 0.5 percent.

2.6 Dynamic Analysis

The previous section shows the steady-state relationships between the unemployment rate and the capital account openness are consistent with the empirical findings (which are reported in section 3). However, in the steady state which shuts off variations in the aggregate shock, a country either has capital inflows or capital outflows, not both. This section explores the dynamics taking into account both capital inflows and capital outflows. Such dynamic analysis is important to understanding the importance of capital control policies because a temporary increase in capital inflows may not be beneficial to a country if it leads to large capital outflows in the future. Specifically, though a temporary increase in capital inflows may lead to a temporary reduction in unemployment, it could also lead to large increases in unemployment when capital starts to move out of the country. This effect will be amplified if firms are not able to adjust wages quickly enough (i.e., wage rigidity).

In this section, we show how unemployment and other macro variables response to a change in the economy-wide productivity. We first consider a country with a rigid labor market ($\kappa = 0.4$ and $\omega = 0.4$) (Figure 4). Initially, this country has a net capital outflow. But when productivity goes up, demand for capital rises which lead the country to a net capital inflow case. The dynamics of capital flows are shown in Figure 5. We compare the impulse responses under three τs ($\tau = 0.00005$, $\tau = 0.0005$, $\tau = 0.005$). In all cases, unemployment falls after the shock, and when τ takes a higher value, unemployment falls less in the beginning. This is because a higher τ prevents capital flowing into the country right after the productivity shock. As the shock fades away, unemployment gradually rises. During this transition, a higher τ leads to lower unemployment. This is mainly due to the reason that, the economy will go back to its long run equilibrium which is associated with a net capital outflow. A higher τ then prevents capital flowing out and hence yields lower unemployment. Hence, in this case, some degree of capital control may be helpful in reducing the average unemployment rate. The current simulation does not assume wage rigidity. If wages are rigid (especially when it is downward rigid), a control on capital inflows may be more effective in reducing overall unemployment rates. This is because, with downward wage rigidity, firms have fire workers when positive shocks are fading away and their profits decline.

When the country experiences a negative productivity shock, it will always has a net capital outflow in this case. As a result, a higher capital flow cost always leads to lower unemployment.

We also show another example, a country with a flexible labor market ($\kappa = 0.25$ and $\omega = 0.18$), in Figure 6. When the country experiences a transitory negative productivity shock, it may fall into a net capital outflow scenario (Figure 7). Figure 6 shows that, in the short run, a higher capital flow cost τ may result in lower unemployment. However, in the long run, when the economy goes back to the initial steady state, a higher τ yields higher unemployment. When the country experiences a positive productivity shock, it will always have a net capital inflow in this case. As a result, a higher capital flow cost always leads to higher unemployment. Overall, whether the average unemployment rate will increase or decrease after increasing the degree of the capital control is a quantitative question. (More discussions will be added here.)

2.7 A model with real wage rigidity

In all previous analysis, a higher capital flow cost τ can effectively reduce unemployment when there is a net capital outflow, while it raises unemployment when a country is associated with a net capital inflow. Such results may change if we allow capital inflow and outflow costs are separate. In fact, countries in the real world can choose different degrees of controls on capital inflow and outflow independently. In this section, we show an example that, even capital inflow and outflow cost can be independently affected by a country's policy, for a country with a rigid labor market, capital control on inflows may also effective in reducing unemployment during some economic transitions.

We consider a model with real wage rigidity in this section. We similarly adopt the notion of a wage norm as in Hall (2005). A wage norm may arise from social convention that constrains wage adjustment for existing and newly hired workers. We model the real wage paid is the weighted average of a notional wage $w^n(\varphi_t)$ and a wage norm $\bar{w}_t$

$$w(\varphi_t) = (1-\gamma)\, w^n(\varphi_t) + \gamma \bar{w}_t \tag{38}$$

where parameter γ denotes the degree of real wage rigidity. The notional wage $w^n(\varphi_t)$ is the wage obtained from Nash Bargaining in our previous model (with endogenous separations and firing cost). $\bar{w}_t$ is set independently of idiosyncratic conditions.

We first derive $w^n(\varphi_t)$. By (26), (**??**) and (28),

$$w^n(\varphi_t) = \eta\left((\varphi_t z_t)^{\frac{1}{1-\alpha}}\alpha^{\frac{\alpha}{1-\alpha}}(1-\alpha)R_t^{-\frac{\alpha}{1-\alpha}} + \kappa\theta_t - E_t\left[\beta\frac{u'(c_{t+1})}{u'(c_t)}\delta_{t+1}\right]\omega\right) + (1-\eta)b \tag{39}$$

We simply let $\bar{w}_t = w_{t-1}^n$ denote the economy-wide average notional wage rate in the past period, then

$$\bar{w}_t = \eta\left(z_{t-1}^{\frac{1}{1-\alpha}}\alpha^{\frac{\alpha}{1-\alpha}}(1-\alpha)R_{t-1}^{-\frac{\alpha}{1-\alpha}}\frac{\int_{\bar{\varphi}_{t-1}}\varphi_{t-1}^{\frac{1}{1-\alpha}}dG(\varphi_{t-1})}{1-G(\bar{\varphi}_{t-1})} + \kappa\theta_{t-1} - E_{t-1}\left[\beta\frac{u'(c_t)}{u'(c_{t-1})}\delta_t\right]\omega\right) + (1-\eta)b \tag{40}$$

where variable $Z^{ss,n}$ denote the steady state value of Z in our previous model (with endogenous separation and firing cost). Now the value of a φ_t-firm is

$$\begin{aligned} J(\varphi_t) &= (\varphi_t z_t)^{\frac{1}{1-\alpha}}\alpha^{\frac{\alpha}{1-\alpha}}(1-\alpha)R_t^{-\frac{\alpha}{1-\alpha}} - w(\varphi_t) \\ &\quad + E_t\left[\beta\frac{u'(c_{t+1})}{u'(c_t)}\left((1-\delta)\int_{\bar{\varphi}_{t+1}}J(\varphi_{t+1})\,dG(\varphi_{t+1}) - \delta_{t+1}\omega\right)\right] \end{aligned} \tag{41}$$

Now we can re-compute the dynamics of unemployment in responsing to productivity shocks. **(results to be added...).** For a country with a rigid labor market, when a transitory positive shock occurs, unemployment falls and wage goes up in the short run. As the shock fades away, unemployment gradually rises. However, when there is a real wage rigidity in the model, firms cannot lower workers' wages freely as productivity falls over time, which discourages firms from entering and producing during this transition. In this case, if the country adopts some degree of capital control on inflows, it may be effective in reducing unemployment during the transition period. Here is the intuition. If a control on inflows was adopted, in the very short run when the shock occurs, less capital flows into the economy which leads to a lower average wage rate compared to the case when there is no controls on capital inflows. Although unemployment is also higher under a capital inflow control, during the transition that the economy goes back to its initial steady state, firms are facing lower cost on wage payment, and hence, the number of firms in the economy does not decline that much compared to the free capital account case (more firms than that in the scenario when there is no control on inflows will enter and produce). As a result, during the whole process the economy goes back to its initial steady state, unemployment is lower when the country adopts some degree of capital control on inflows. **(more discussions to be added...)**

3 Suggestive empirical evidence

3.1 Data and methodology

We provide some suggestive empirical evidence. Our theory predicts that, how financial openness affects unemployment depends on the labor market rigidity in the country. We use data to test the following specification

$$\begin{aligned} u_{it} &= \alpha + \beta_1 \cdot \text{financial openness}_{it} + \beta_2 \cdot (\text{financial openness}_{it} \times \text{labor market rigidity}_{it}) \\ &\quad + \beta_3 \cdot \text{labor market rigidity}_{it} + \gamma Z_{it} + f_i + f_t + \varepsilon_{it} \end{aligned} \tag{42}$$

where u_{it} is the unemployment rate of country i in period t, which is obtained from the World Bank database. The two key regressors are financial openness and labor market rigidity. For the measure of financial openness, we use the well known Chinn-Ito measure ($KAOPEN$) in the benchmark regression. $KAOPEN$ was initially introduced in Chinn and Ito (2006), which is based on binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). It covers 182 countries in the world since year 1970. One of the merits of the $KAOPEN$ index is that it attempts to measure the intensity of capital controls. We also consider two alternative measures (Fin current and Capital openness) in Quinn (2008) in the robustness checks. Quinn (2008) constructs the measures by coding the text in the AREAER describing the type of restrictions affecting international transactions. A ranking of the importance of these restrictions gives rise to a measure of the intensity of capital controls. Fin current is an indicator from 0 to 8 that shows how compliant a government is with its obligations under the IMF's Article VIII to free from government restriction the proceeds from international trade of goods and services. A higher value means greater compliance. We transformed each measure into a 0–100 scale. Capital openness is scored 0–4, in half integer units, with 4 representing an economy fully open to capital flows. Table 2 shows the correlations between the three financial openness measures.

For labor market rigidity, we adopt the index by Campos and Nugent (2012). In the labor market rigidity literature, seminal work by Botero et al. (2004) constructs an index of labor market legislation rigidity based on the provisions of the labor laws for about 85 countries around the year 1997. Campos and Nugent (2012) extend their work by covering more countries and more years, which allows us to run panel data regressions. This index (as well as Botero et al. (2004)) shows that, on average, countries that have labor regulations embedded in the English common law system have less restrictive labor laws and regulations than those based on French or other civil law systems. The intuition is that the main difference between the English common law and French or other civil law systems is that the latter are associated with more rigid, more detailed, more complicated, all-encompassing labor laws which are more difficult to change (i.e., less flexible).

Z_{it} is a set of other control variables in the regressions such as log GDP per capita, financial market development, log inflation, trade openness, crisis dummy, and exchange rate regimes. GDP per capita and inflation data are obtained from the World Bank database. Trade openness is defined as the sum of export and import to GDP ratio. Crisis dummy is a dummy variable that takes value the one if a country has a systemic financial crisis. We compute this dummy by using data from Kaminsky and Reinhart (1998), and Gosh, Gulde, and Wolf (2000). For exchange rate regimes, we consider three *de facto* classifications: IMF classification, Reinhart and Rogoff classification, and Levy-Yeyati and Sturzenegger classification. Data can be obtained from Reinhart and Rogoff (2004) and Levy-Yeyati and Sturzenegger (2004).

We take five years as one period in this paper due to two reasons. First, the labor market rigidity measure is an index for every five years. Second, our analytical work mainly focuses on the steady state of the model. The corresponding empirical work should then consider long run average impact of financial openness on unemployment. We consider five periods here: 1980-1984, 1985-1989, 1990-1994, 1995-1999, and 2000-2004. We compute the five year average for each variable in each period. We also control for country and time fixed effects in the regressions. Our theory suggests a negative β_1 and a positive β_2. In other words, when labor market rigidity is low (close to zero in our paper), β_1 shows the impact of raising financial openness on unemployment. As in our previous analysis, the effect is negative. However, as labor market rigidity becomes higher, the impact of raising financial openness on unemployment is $\beta_1 + \beta_2 \cdot$labor market rigidity$_{it}$. Our theory implies $\beta_2 > 0$ such that when labor market rigidity is sufficiently large, the previous effect (β_1) will be weakened or even reversed.

3.2 Results

Table 3 reports the benchmark regression results using the well-known Chinn-Ito capital account openness index ($KAOPEN$). To prevent outliers from affecting our regression results, we drop those observations with unemployment rate greater than 30 percent. In each odd numbered column, we do not include the interaction term between financial openness and labor market rigidity. After controlling for various sets of variables, none of the coefficients on $KAOPEN$ is significant. However, as we include the interaction term, we obtain the results as predicted by theory (in even numbered columns), $\beta_1 < 0$ and $\beta_2 > 0$. They are all significant. We consider the regression in Column (2). For countries such as the US with low labor market rigidity, a rise in $KAOPEN$ will yield a decline in unemployment. Note that, labor market rigidity measure ranges from 0.11 to 3.5. For countries with labor market rigidity around 1.8, $\beta_1 + \beta_2 \cdot$labor market rigidity$_{it}$ is close to zero. A change in financial openness does not affect unemployment. When labor market rigidity keeps rising, for instance, labor market rigidity is close to 3.5, we can easily obtain $\beta_1 + \beta_2 \cdot$labor market rigidity$_{it} > 0$. In fact, t test shows that the effect is also statistically significant. This implies that, a rise in financial openness can result in higher unemployment. We then use the two alternative measures of financial openness from Quinn (2008). Tables 4 and 5 show the regression results. They are very similar to the results in Table 3.

We also provide scatter plots to show the relationship between financial openness and unemployment (Figure 6). In this case, we divide observations into three groups: low labor market rigidity group, median level labor market rigidity group, and high labor market rigidity group. Using three financial openness measures, conditional on log GDP per capita, country and time fixed effects, we can clearly see that, in the low labor market rigidity group, unemployment is negatively correlated with financial openness. In fact, the slopes are all statistically significant. In the median level labor market rigidity group, the fitted lines are still negatively sloped, but they are not statistically significant. This implies that, financial openness does not affect unemployment when labor market rigidity becomes moderately large. In the last group, the high labor market rigidity group, those fitted lines are all positively sloped. Using Quinn (2008) measures, those slopes are also statistically significant. This suggests that the impact of financial openness on unemployment may be reversed when labor market rigidity is high.

All the regression results and scatter plots directly support our theory on the relationship between unemployment and financial openness. We also provide some indirect evidence in this section. One of our model implications, Corollary 1 suggests that, a higher labor market rigidity is associated with a higher net foreign asset to GDP ratio. We then use data to test this hypothesis. Table 6 provides the regression results and clearly, we find the coefficients on labor market rigidity are all positive and statistically significant.

There exist some weaknesses of our empirical work. First, the labor market rigidity index is a *de jure* measure which may not reflect a country's situation. This may yield measurement errors in our regressions. Second, although we tried our best to show the correlations between unemployment and financial openness, we have not found a good instrument to deal with the potential endogeneity problems. Due to these limitations, we only consider our empirical evidence as suggestive support to our theory.

4 Concluding remarks

We investigate how capital account openness affects a country's unemployment in this paper. In theory, using a standard labor search and match model, we find that, in the steady state, a rise in capital account openness will lead to lower unemployment when the labor market is flexible. However, a rise in capital account openness can yield higher unemployment when the labor market becomes sufficiently rigid. We also provide suggestive empirical evidence to support our theoretical predictions.

There exist several extensions to our framework. For instance, we can discuss the optimal capital control policy. We leave those works to our future research.

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A Proof of Proposition 1

Proof. By (18), we have

$$1-\beta(1-\delta)<1-\beta(1-\delta)\left(1-\eta\frac{\theta^{ss}}{\left(1+(\theta^{ss})^{l}\right)^{1/l}}\right)<1-\beta(1-\delta)(1-\eta)$$

and then,

$$\frac{1}{\kappa}\frac{(1-\eta)(1-\delta)(a_L-b)}{1-\beta(1-\delta)(1-\eta)}<\left(1+(\theta^{ss})^{l}\right)^{1/l}<\frac{1}{\kappa}\frac{(1-\eta)(1-\delta)(a_H-b)}{1-\beta(1-\delta)} \tag{43}$$

where

$$\begin{aligned} a_L &= (1-\alpha)\alpha^{\frac{\alpha}{1-\alpha}}\bar{z}^{\frac{1}{1-\alpha}}\left(\frac{1+r^*}{1-\tau}\right)^{-\frac{\alpha}{1-\alpha}} \\ a_H &= (1-\alpha)\alpha^{\frac{\alpha}{1-\alpha}}\bar{z}^{\frac{1}{1-\alpha}}\left((1-\tau)(1+r^*)\right)^{-\frac{\alpha}{1-\alpha}} \end{aligned}$$

By (43), as $\kappa\to 0$, $\theta^{ss}\to\infty$. On the other hand, we can always find a sufficiently large κ such that $\theta^{ss}\to 0$. For instance, when

$$\kappa\to\frac{(1-\eta)(1-\delta)(a_H-b)}{1-\beta(1-\delta)}<\infty$$

we have $\theta^{ss}\to 0$.

In the labor market, we have

$$\delta(1-u^{ss})=\frac{(1-\delta)\theta^{ss}}{\left(1+(\theta^{ss})^{l}\right)^{1/l}}u^{ss}\Rightarrow u^{ss}=\frac{\delta}{\delta+\frac{(1-\delta)\theta^{ss}}{\left(1+(\theta^{ss})^{l}\right)^{1/l}}} \tag{44}$$

In this case,

$$c^{ss}=\bar{z}n^{ss}(k^{ss})^{\alpha}-\kappa\theta^{ss}(1-n^{ss})+r^{ss}D^{ss}-\frac{\psi}{2}\left(D^{ss}-\bar{D}\right)^2$$

Since $c^{ss}>0$, we must have

$$r^{ss}D^{ss}>\frac{\psi}{2}\left(D^{ss}-\bar{D}\right)^2-\bar{z}n^{ss}(k^{ss})^{\alpha}-\kappa\theta^{ss}(1-n^{ss}) \tag{45}$$

When

$$\kappa\to\frac{(1-\eta)(1-\delta)(a_H-b)}{1-\beta(1-\delta)}$$

we have $\theta^{ss}\to 0$ and $n^{ss}\to 0$, and (45) becomes

$$r^{ss}D^{ss}>\frac{\psi}{2}\left(D^{ss}-\bar{D}\right)^2$$

Then $D^{ss} > 0$. In this case, $D^{ss} > n^{ss}k^{ss}$. There will be a net capital outflow. Due to the continuity, there always exists a threshold κ_1 above which, capital flows out of Home. In this case, a rise in τ leads to a decline in the interest rate. By (19), $\frac{d\theta^{ss}}{d\tau} > 0$ in this case. By (44), this implies that

$$\frac{du^{ss}}{d\tau} < 0$$

When the capital account becomes more open (τ declines), unemployment rises.

We can also show that, when κ is sufficiently low, there will be a net capital inflow when $\tau < 1$. For $\kappa \to 0$, we have $\theta^{ss} \to \infty$. Then

$$n_a^{ss} = 1 - \frac{\delta}{\delta + \frac{(1-\delta)\theta_a^{ss}}{\left(1+(\theta_a^{ss})^l\right)^{1/l}}} \to 1 - \delta$$

By (2), we have

$$D_a^{ss} = \bar{D} + \frac{\beta\left(1 + r_a^{ss}\right) - 1}{\psi}$$

In financial autarky, $n_a^{ss}k_a^{ss} = D_a^{ss}$, which implies that

$$(1-\delta)\left(\frac{\alpha\bar{z}}{r_a^{ss} + \delta_K}\right)^{\frac{1}{1-\alpha}} = \bar{D} + \frac{\beta\left(1 + r_a^{ss}\right) - 1}{\psi}$$

Under the assumption

$$\left(\bar{D} + \frac{\beta\left(1 + r^*\right) + \tau - 1}{\psi\left(1 - \tau\right)}\right)\left(\frac{\tau + r^*}{1 - \tau} + \delta_K\right)^{\frac{1}{1-\alpha}} \leq (1-\delta)\left(\alpha\bar{z}\right)^{\frac{1}{1-\alpha}}$$

we can show that

$$1 + r_a^{ss} \geq \frac{1 + r^*}{1 - \tau}$$

Then there will be a net capital inflow. Due to the continuity, there always exists a threshold κ_0 below which, capital flows into Home. In this case, a rise in τ leads to a rise in the interest rate. By (19), $\frac{d\theta^{ss}}{d\tau} < 0$ in this case. By (44), this implies that

$$\frac{du^{ss}}{d\tau} > 0$$

When the capital account becomes more open (τ declines), unemployment falls.

By (44), we can show that unemployment is decreasing in θ^{ss}. This means that n^{ss} is increasing in θ^{ss}. Also by (18), once r^{ss} stays constant, θ^{ss} is decreasing in κ. We then show by contradiction that, for $\kappa \in [\kappa_0, \kappa_1]$, Home is at financial autarky and $\frac{du^{ss}}{d\tau} = 0$.

Suppose not, then there are two possibilities: i) we can find a point κ_2, such that within a neighbourhood of $\kappa < \kappa_2$, $\frac{du^{ss}}{d\tau} < 0$ and at $\kappa = \kappa_2$, $D^{ss} = n^{ss}k^{ss}$, and/or, ii) we can find a point κ_3, such that within a neighbourhood of $\kappa > \kappa_3$, $\frac{du^{ss}}{d\tau} > 0$ and at $\kappa = \kappa_3$, $D^{ss} = n^{ss}k^{ss}$.

We first show that scenario i) is not possible. Within the small neighbourhood of $\kappa < \kappa_2$, $\frac{du^{ss}}{d\tau} < 0$ corresponds to the case that capital flows out of Home. At $\kappa = \kappa_2$, $D^{ss} = n^{ss}k^{ss}$, this means that, $1 + r^{ss} = (1 - \tau)(1 + r^*)$ when $\kappa = \kappa_2$. However, within a small neighbourhood $\kappa < \kappa_2$, given the interest rate constant at $1 + r^{ss} = (1 - \tau)(1 + r^*)$, when κ falls, as we showed above, θ^{ss} will rise, which in turn leads to a rise in n^{ss}. Then, for $\kappa < \kappa_2$, we obtain

$$n^{ss}|_{\kappa<\kappa_2} > n^{ss}|_{\kappa=\kappa_2} = D^{ss}|_{\kappa=\kappa_2} = D^{ss}|_{\kappa<\kappa_2}$$

where the last equality holds because the interest rate does not change and hence B^{ss} stays the same value. This contradicts the conjecture that $\kappa < \kappa_2$, capital flows out of Home.

As for scenario ii), we can similarly show that

$$n^{ss}|_{\kappa>\kappa_3} < n^{ss}|_{\kappa=\kappa_3} = D^{ss}|_{\kappa=\kappa_3} = D^{ss}|_{\kappa<\kappa_3}$$

This contradicts the conjecture that, within the small neighbourhood of $\kappa > \kappa_3$, capital flows into Home.

Therefore, for any $\kappa \in [\kappa_0, \kappa_1]$, Home is at its financial autarky and $\frac{du^{ss}}{d\tau} = 0$. ■

B Proof of Corollary 1

Proof. We can show that net foreign asset to GDP ratio is

$$\frac{D^{ss} - n^{ss}k^{ss}}{GDP^{ss}} = \frac{1}{r^{ss}} \left(\frac{1}{\psi} \frac{\beta(1 + r^{ss}) - 1 + \psi\bar{D}}{\alpha^{\frac{\alpha}{1-\alpha}} \bar{z}^{\frac{1}{1-\alpha}} (R^{ss})^{-\frac{\alpha}{1-\alpha}} n^{ss}} - \frac{\alpha}{R^{ss}} \right)$$

When there is a net capital flow, r^{ss} and R^{ss} are constant. Also, by (18), we can show that

$$\frac{d\theta^{ss}}{d\kappa} < 0$$

which implies that, as κ increases, n^{ss} falls. Then,

$$\frac{d\left(\frac{D^{ss} - n^{ss}k^{ss}}{GDP^{ss}}\right)}{d\kappa} = -\frac{1}{r^{ss}} \frac{1}{\psi} \frac{\beta(1 + r^{ss}) - 1 + \psi\bar{D}}{\alpha^{\frac{\alpha}{1-\alpha}} \bar{z}^{\frac{1}{1-\alpha}} (R^{ss})^{-\frac{\alpha}{1-\alpha}} (n^{ss})^2} \frac{dn^{ss}}{d\kappa} > 0$$

Therefore, a rise in κ leads to a decline in debt-to-GDP ratio. In other words, a more rigid labor market yields an increase in net foreign asset to GDP ratio. ■

Figure 1: Fixing omega = 0.18, changing kappa

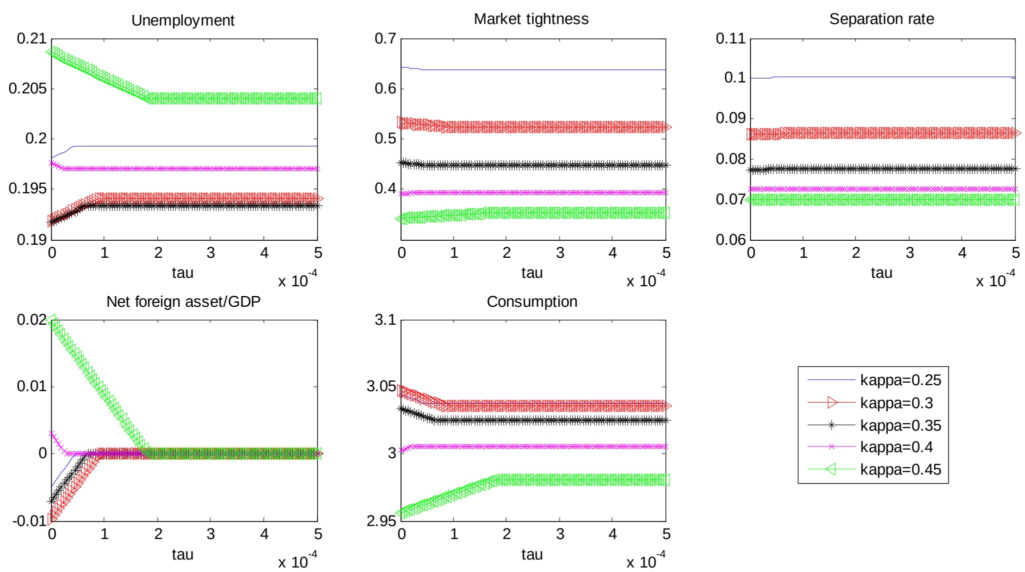


Figure 2: Fixing kappa = 0.25, changing omega

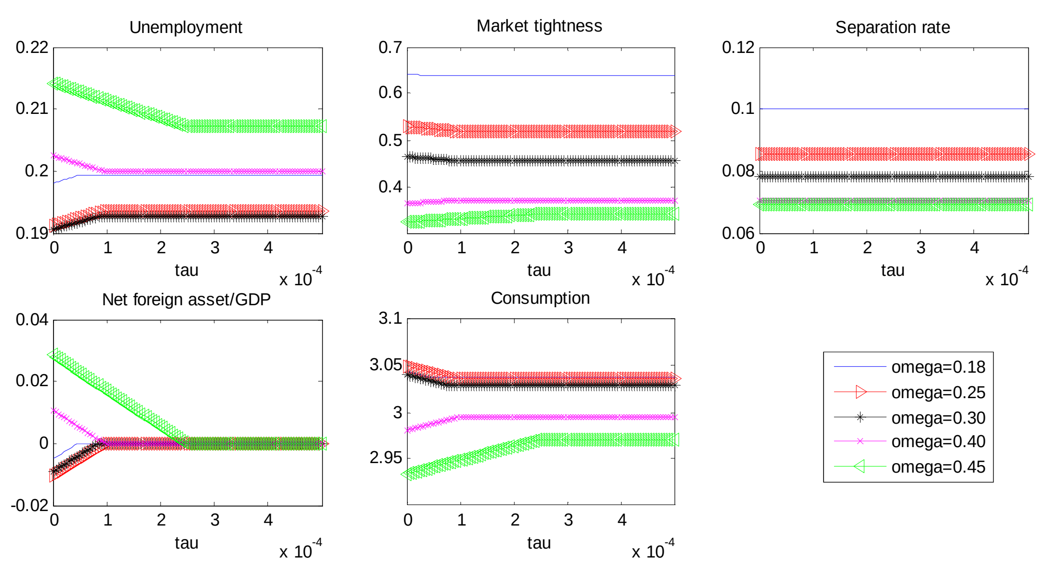


Figure 3: Changing kappa and omega

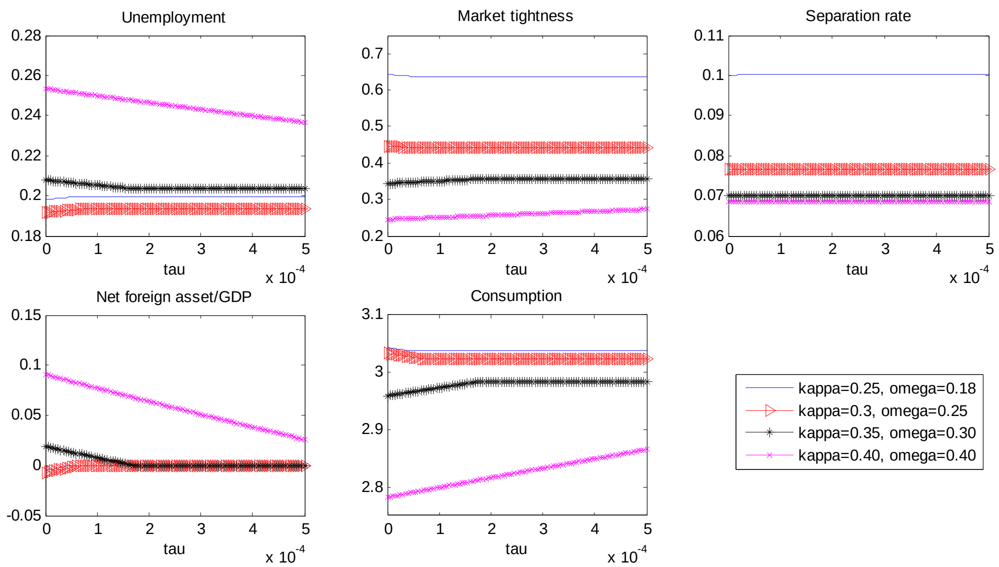


Figure 4: Impulse responses to positive productivity shocks, kappa=0.4, omega=0.4

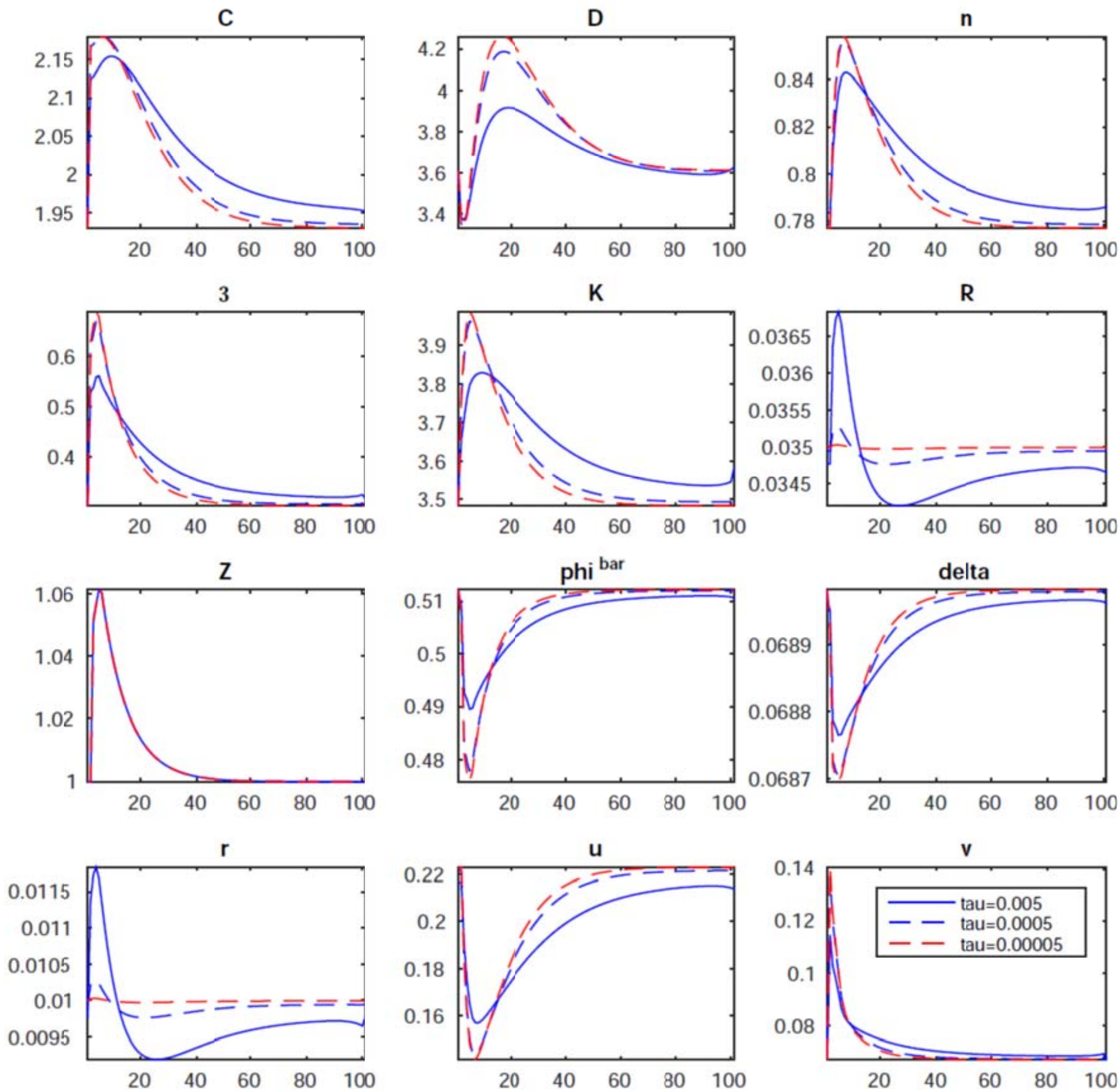


Figure 5: Dynamics of Capital Flows, kappa=0.4, omega=0.4

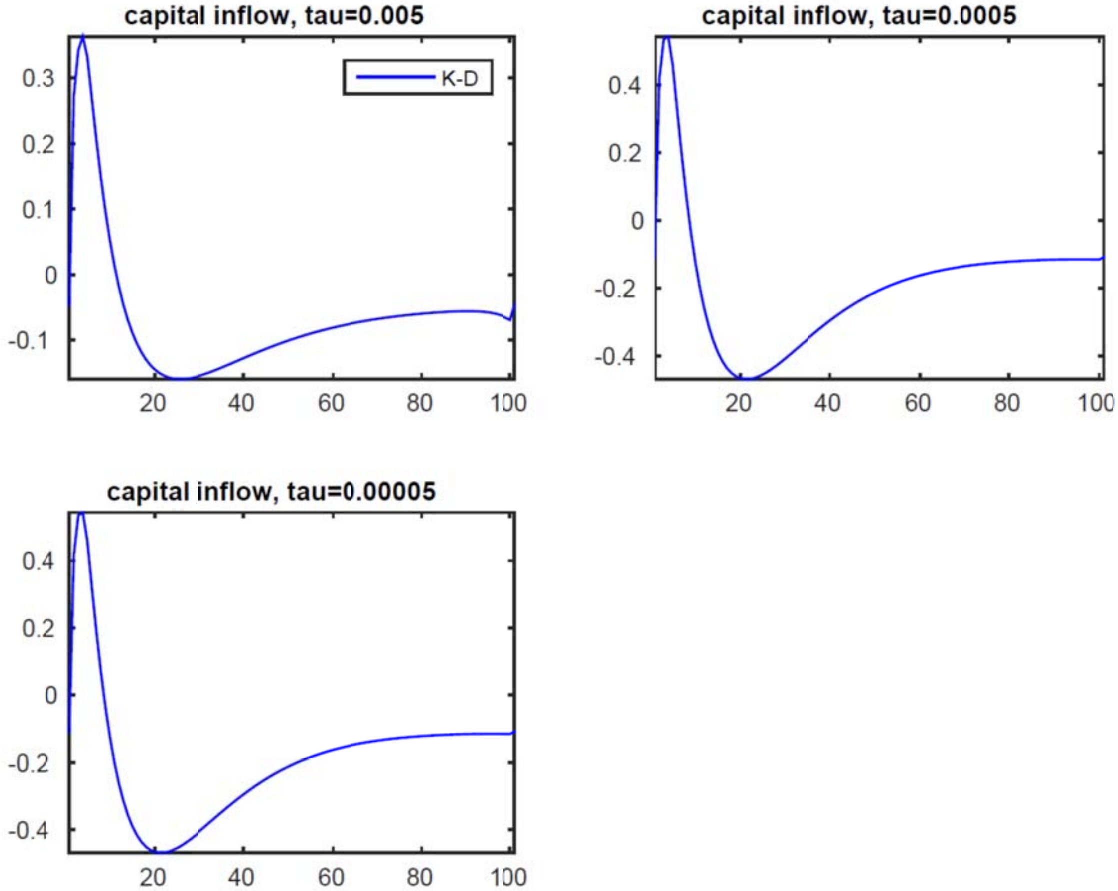


Figure 6: Impulse responses to a negative productivity shock, kappa=0.25, omega=0.18

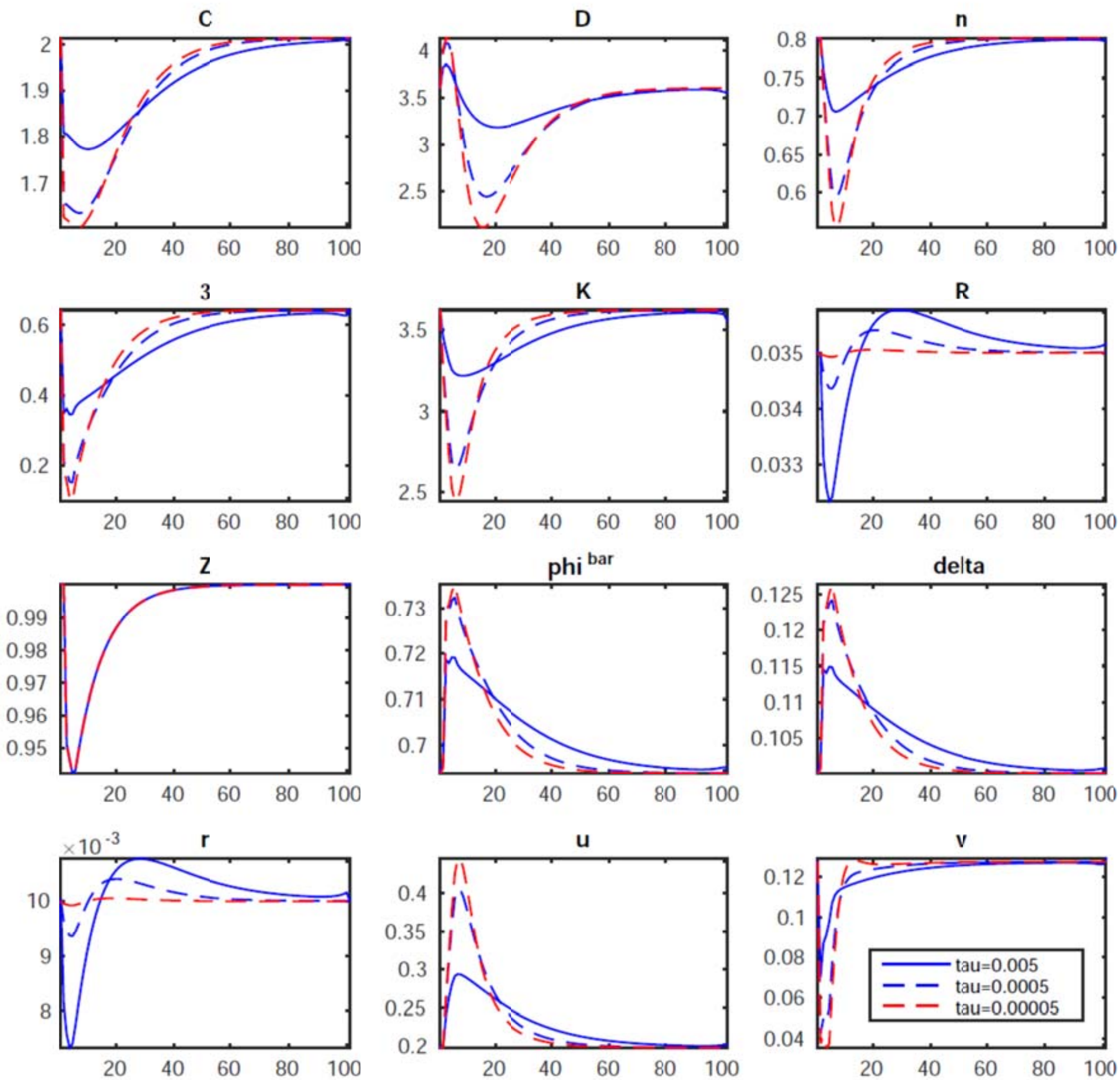


Figure 7: Dynamics of Capital Flows, kappa=0.25, omega=0.18

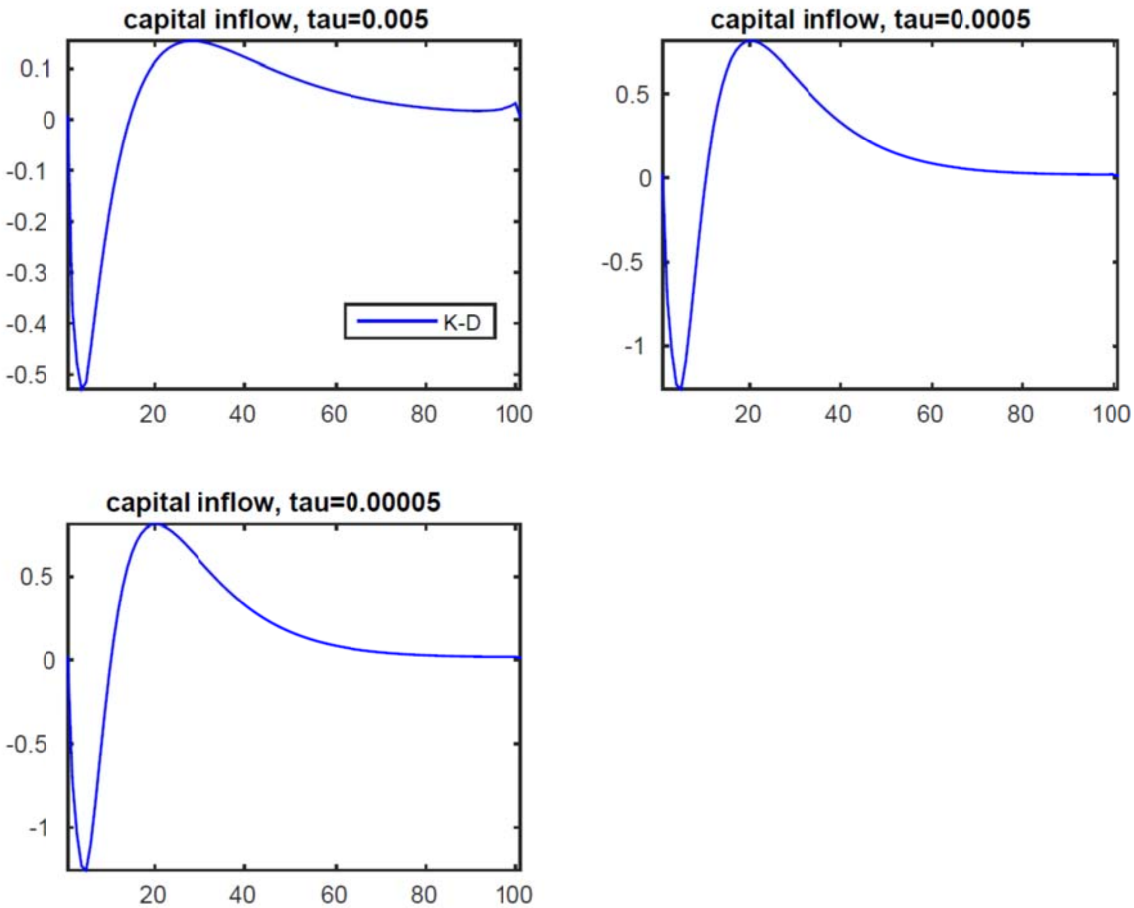
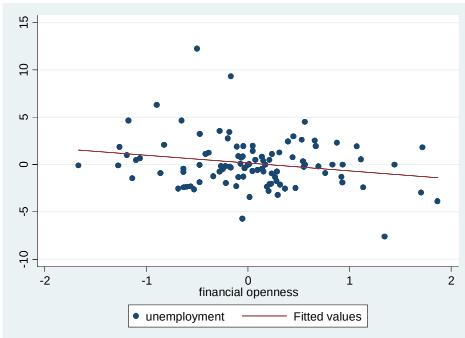
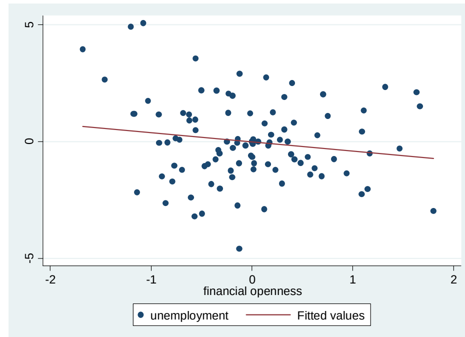


Figure 8: Unemployment vs Capital Account Openness

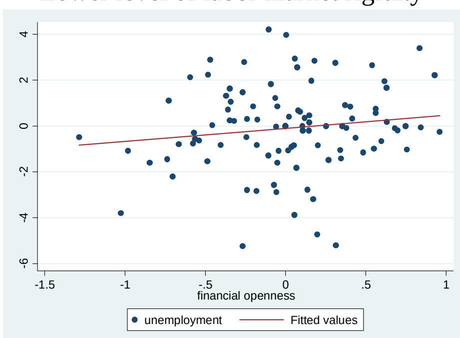
Chinn-Ito measure



Lower level of labor market rigidity

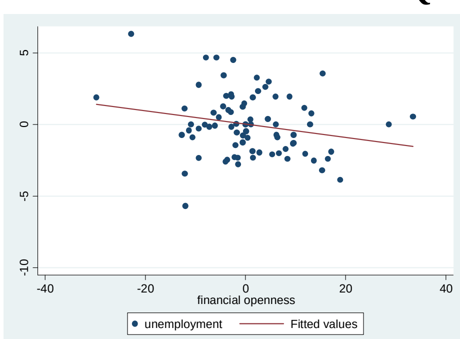


Median level of labor market rigidity

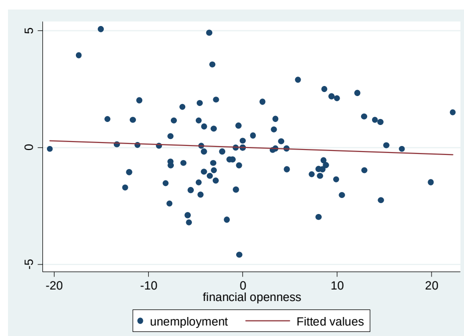


Higher level of labor market rigidity

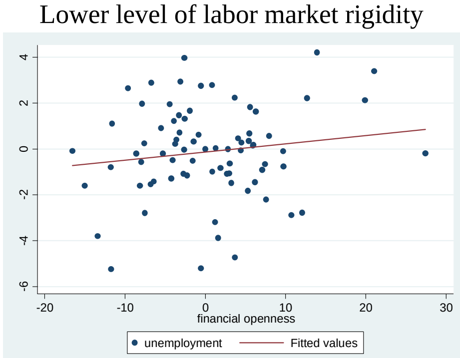
Quinn measure 1



Lower level of labor market rigidity

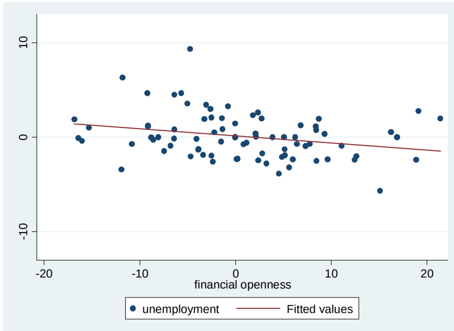


Median level of labor market rigidity

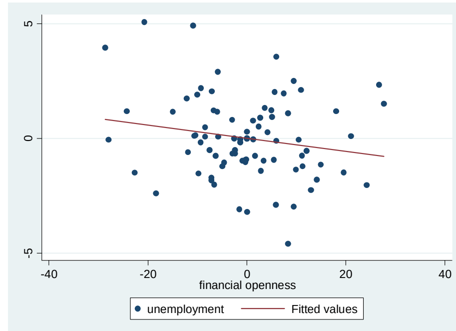


Higher level of labor market rigidity

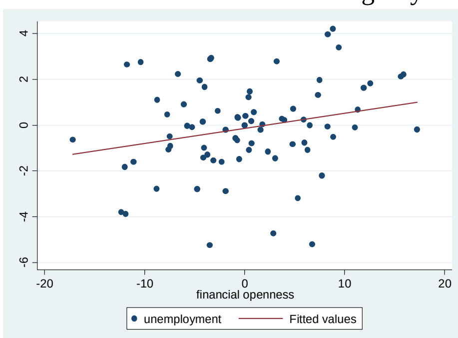
Quinn measure 2



Lower level of labor market rigidity



Median level of labor market rigidity



Higher level of labor market rigidity

- The scatter plots are conditional on log(GDP per capita), country- and year-fixed-effects.
- We exclude obvious outliers in the scatter plots.

Table 1: Summary statistics of key variables

	mean	median	std dev	min	max
Unemployment	8.68	7.7	5.97	0.2	36.4
KAOPEN (Chinn-Ito)	0.18	-0.1	1.47	-1.84	2.48
Fin current (Quinn measure 1)	71	75	25	12.5	100
Capital openness (Quinn measure 2)	65	65	26	12.5	100
Labor market rigidity	1.56	1.6	0.51	0.11	3.5
GDP per capita	10336	4902	11856	304	67351
Credit to private sector/GDP	43	29	38	2.03	214
Real interest rate	8.27	6.96	11	-49	94
Trade openness	77	65	49	13	378

Table 2: Correlations between three capital account openness measure

KA openness Ito-Chinn measure	1	-	-
Financial current openness	0.82	1	-
Capital account openess	0.79	0.85	1

Table 3: Unemployment, Capital Account Openness and Labor Market Rigidity, Chinn-Ito measure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
KAOPEN	-0.19	-1.81***	-0.26	-2.03***	-0.13	-1.82**	-0.22	-1.98***	-0.27	-2.04***
	(0.26)	(0.69)	(0.27)	(0.73)	(0.25)	(0.74)	(0.29)	(0.76)	(0.27)	(0.76)
Labor market rigidity		1.04**		1.15***		1.08***		1.16**		1.16**
* KAOPEN		(0.42)		(0.44)		(0.44)		(0.46)		(0.47)
Labor market rigidity	-2.18*	-1.93	-1.14	-1.05	-0.13	-0.19	-0.93	-0.97	-1.13	-1.06
	(1.23)	(1.22)	(1.26)	(1.24)	(1.15)	(1.14)	(1.29)	(1.27)	(1.27)	(1.25)
Log(GDP per capita)			-2.92	-3.27*	-1.37	-2.06	-3.05	-3.31*	-3.08*	-3.28*
			(1.83)	(1.81)	(1.74)	(1.74)	(1.85)	(1.82)	(1.86)	(1.83)
Credit to private			-0.03**	-0.03**	-0.02*	-0.02*	-0.03**	-0.03**	-0.03**	-0.03**
sector/GDP			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
log(100 + inflation)			0.67	0.88	1.00	1.12	0.69	1.01	0.88	0.92
			(1.39)	(1.37)	(1.26)	(1.24)	(1.42)	(1.40)	(1.47)	(1.44)
Trade openness			-0.02	-0.02	-0.03	-0.03	-0.02	-0.02	-0.02	-0.02
			(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Crisis			0.06	0.37	-0.34	-0.12	0.18	0.43	0.16	0.46
			(0.88)	(0.88)	(0.80)	(0.80)	(0.89)	(0.89)	(0.91)	(0.90)
Crawling peg					2.28***	2.48***				
(IMF)					(0.90)	(0.89)				
Managed floating					0.20	0.81				
(IMF)					(0.69)	(0.72)				
Free floating					1.95**	2.38***				
(IMF)					(0.81)	(0.82)				
Crawling peg							-0.44	0.03		
(RR)							(0.80)	(0.81)		
Managed floating							0.34	0.65		
(RR)							(0.90)	(0.89)		
Free floating							-0.64	0.75		
(RR)							(2.50)	(2.53)		
Crawling peg									0.16	-0.36
(LYS)									(0.90)	(1.04)
Dirty float									-0.83	0.08
(LYS)									(1.04)	(1.51)
Float									-0.33	0.22
(LYS)									(0.90)	(0.92)
Country fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	315	315	290	290	278	278	290	290	290	290
# of countries	100	100	94	94	92	92	94	94	94	94
R-squared	0.04	0.06	0.10	0.13	0.15	0.18	0.11	0.14	0.10	0.13

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

- We exclude the observations with unemployment rate greater than 30 percent from the sample.

Table 4: Unemployment, Capital Account Openness and Labor Market Rigidity, Quinn measure 1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Fin current	0.00	-0.09*	-0.01	-0.13***	-0.02	-0.14***	0.00	-0.12**	-0.00	-0.14***
	(0.02)	(0.05)	(0.02)	(0.05)	(0.02)	(0.05)	(0.02)	(0.05)	(0.02)	(0.05)
Labor market rigidity		0.05**		0.07***		0.07***		0.07***		0.08***
*Fin current		(0.02)		(0.03)		(0.03)		(0.03)		(0.03)
Labor market rigidity	-1.51	-4.78**	-0.44	-5.08***	-0.83	-5.45***	0.03	-4.54**	-0.37	-5.55***
	(1.17)	(1.94)	(1.17)	(1.95)	(1.15)	(2.03)	(1.20)	(2.03)	(1.19)	(2.02)
Log(GDP per capita)			-3.09	-3.52	-2.94	-3.88	-3.52	-3.82*	-3.03	-3.30
			(2.18)	(2.13)	(2.29)	(2.26)	(2.19)	(2.15)	(2.22)	(2.16)
Credit to private			-0.03**	-0.04***	-0.02	-0.02*	-0.03**	-0.04**	-0.03**	-0.03*
sector/GDP			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
log(100 + inflation)			1.91	2.23	2.17	2.46*	1.83	2.20	1.73	2.04
			(1.41)	(1.38)	(1.40)	(1.37)	(1.42)	(1.40)	(1.47)	(1.43)
Trade openness			-0.01	-0.01	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01
			(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Crisis			0.09	0.67	-0.02	0.45	0.29	0.79	0.20	0.81
			(0.86)	(0.86)	(0.85)	(0.85)	(0.87)	(0.87)	(0.88)	(0.88)
Crawling peg					2.63***	2.46***				
(IMF)					(0.98)	(0.96)				
Managed floating					0.32	1.01				
(IMF)					(0.76)	(0.78)				
Free floating					1.93**	2.32***				
(IMF)					(0.89)	(0.89)				
Crawling peg							-0.68	-0.37		
(RR)							(0.78)	(0.77)		
Managed floating							0.57	0.75		
(RR)							(0.87)	(0.85)		
Free floating							-1.22	-0.28		
(RR)							(2.33)	(2.31)		
Crawling peg									-0.40	0.02
(LYS)									(1.04)	(1.02)
Dirty float									0.71	1.19
(LYS)									(1.41)	(1.38)
Float									0.28	0.99
(LYS)									(0.89)	(0.90)
Country fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	245	245	226	226	217	217	226	226	226	226
# of countries	68	68	64	64	62	62	64	64	64	64
R-squared	0.03	0.06	0.09	0.14	0.16	0.20	0.11	0.16	0.10	0.15

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

- We exclude the observations with unemployment rate greater than 30 percent from the sample.

Table 5: Unemployment, Capital Account Openness and Labor Market Rigidity, Quinn measure 2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Capital openness	-0.01	-0.09**	-0.01	-0.10**	-0.02	-0.11**	0.00	-0.09*	-0.01	-0.11**
	(0.02)	(0.04)	(0.02)	(0.04)	(0.02)	(0.05)	(0.02)	(0.05)	(0.02)	(0.05)
Labor market rigidity		0.05**		0.05**		0.06**		0.05**		0.06**
*capital openness		(0.02)		(0.03)		(0.03)		(0.03)		(0.03)
Labor market rigidity	-1.59	-4.65**	-0.41	-3.94**	-0.71	-4.57**	0.06	-3.57*	-0.35	-4.51**
	(1.15)	(1.86)	(1.15)	(1.98)	(1.13)	(2.03)	(1.18)	(2.11)	(1.16)	(2.06)
Log(GDP per capita)			-3.10	-3.56	-2.96	-3.85	-3.50	-3.86*	-3.06	-3.42
			(2.18)	(2.16)	(2.29)	(2.29)	(2.19)	(2.18)	(2.21)	(2.19)
Credit to private			-0.03**	-0.03**	-0.02	-0.02	-0.03**	-0.03**	-0.03**	-0.03*
sector/GDP			(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
log(100 + inflation)			1.85	2.11	2.03	2.33*	1.85	2.19	1.68	1.90
			(1.42)	(1.40)	(1.41)	(1.40)	(1.43)	(1.42)	(1.47)	(1.45)
Trade openness			-0.01	-0.02	-0.02	-0.03	-0.01	-0.02	-0.01	-0.02
			(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Crisis			0.13	0.37	0.10	0.27	0.28	0.48	0.24	0.51
			(0.86)	(0.86)	(0.85)	(0.85)	(0.87)	(0.86)	(0.88)	(0.88)
Crawling peg					2.66***	2.77***				
(IMF)					(0.98)	(0.97)				
Managed floating					0.32	0.88				
(IMF)					(0.76)	(0.79)				
Free floating					1.94**	2.32***				
(IMF)					(0.90)	(0.90)				
Crawling peg							-0.67	-0.38		
(RR)							(0.78)	(0.78)		
Managed floating							0.62	0.90		
(RR)							(0.90)	(0.90)		
Free floating							-1.24	0.14		
(RR)							(2.34)	(2.41)		
Crawling peg									-0.42	-0.12
(LYS)									(1.04)	(1.03)
Dirty float									-0.71	1.30
(LYS)									(1.41)	(1.41)
Float									-0.27	0.90
(LYS)									(0.89)	(0.91)
Country fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	245	245	226	226	217	217	226	226	226	226
# of countries	68	68	64	64	62	62	64	64	64	64
R-squared	0.03	0.06	0.10	0.12	0.16	0.19	0.11	0.14	0.10	0.13

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

- We exclude the observations with unemployment rate greater than 30 percent from the sample.

Table 6: Net Foreign Asset positions vs Labor Market Rigidity

	(1)	(2)	(3)	(4)	(5)
Labor market rigidity	0.074*	0.090**	0.098**	0.076*	0.087**
	(0.044)	(0.040)	(0.041)	(0.041)	(0.039)
kaopen	0.027***	0.035***	0.039***	0.033***	0.037***
	(0.008)	(0.008)	(0.009)	(0.009)	(0.008)
Log(GDP per capita)		0.110**	0.072	0.116**	0.110**
		(0.051)	(0.054)	(0.051)	(0.050)
Credit to private sector/GDP		-0.002***	-0.002***	-0.002***	-0.002***
		(0.000)	(0.000)	(0.000)	(0.000)
Real interest rate		0.000	0.000	-0.000	0.000
		(0.001)	(0.001)	(0.001)	(0.001)
Trade openness		0.003***	0.003***	0.003***	0.003***
		(0.001)	(0.001)	(0.001)	(0.001)
Crisis		-0.013	-0.016	-0.011	-0.011
		(0.028)	(0.028)	(0.028)	(0.028)
Crawling peg (IMF)			0.003		
			(0.037)		
Managed floating (IMF)			0.000		
			(0.023)		
Free floating (IMF)			0.015		
			(0.028)		
Crawling peg (RR)				0.051**	
				(0.025)	
Managed floating (RR)				-0.004	
				(0.028)	
Free floating (RR) rr4				-0.017	
				(0.052)	
Crawling peg (LYS)					0.077**
					(0.030)
Dirty float (LYS)					0.119***
					(0.045)
Float (LYS)					0.071***
					(0.027)
Country fixed effect	Y	Y	Y	Y	Y
Year fixed effect	Y	Y	Y	Y	Y
Observations	408	335	323	335	335
Number of countries	106	99	99	99	99
R-squared	0.21	0.40	0.41	0.42	0.44

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

- We exclude the observations with the absolute value of net foreign asset to GDP ratio greater than 4. In Columns (2) to (5), we also exclude observations with the absolute real interest rate values greater than 40 percentage points from the sample.