

Hoarding of International Reserves:
Mrs Machlup's Wardrobe and the Joneses

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Abstract

Motivated by the observed reserve hoarding behavior in the post-1997 crisis period, we explore the Mrs Machlup's wardrobe hypothesis and the related keeping up with the Joneses argument. It is conceived that, in addition to psychological reasons, holding a relatively high level of international reserves reduces the vulnerable to speculative attacks and promotes growth. A stylized model is constructed to illustrate these effects on reserve accumulation behavior. The relevance of the keeping up with the Joneses effect is examined with data from 10 East Asian economies. Both linear and panel-based regression results are suggestive of the presence of the Joneses effect; especially in the post-1997 crisis period. Individual economy estimation results, however, show that the Joneses effect varies across economies.

JEL Classifications: F3, F4

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1. Introduction

The 1997 financial crisis in East Asia underscores the importance of capital account variability and the role of flow reversal on triggering off a crisis. Economies in the crisis-inflicted region appear to have adjusted their policy behavior and have sharply boosted their international reserves in the aftermath of the crisis. For instance, China, Japan, Korea, Malaysia and Taiwan; the economies that are commonly mentioned in the recent discussion/debate of the extraordinary and puzzling reserve accumulation in the new millennium, see their international reserves increased by, respectively, 388%, 135%, 119%, 138% and 137% between 2000 and 2005.¹

The steep increase in international reserves definitely helps these economies to deter speculative attacks. Nonetheless, the dramatic jumps in reserve holdings raise concerns in both policy and academic circles. In general, it is perceived that some of these economies are holding international reserves at a level that is difficult to be rationalized by conventional factors. For instance, one traditional indicator of reserve adequacy is the reserves-to-imports ratio and the rule of thumb is to maintain international reserves worth, say, three months of imports.

Again, consider China, Japan, Korea, Malaysia and Taiwan – their holdings of reserves are much higher than the three-months benchmark. Specifically, at the end of 2005, the international reserves held by these economies cover, respectively, 14.93, 19.33, 9.66, 7.36, and 16.65 months of imports. While excessive international reserves offer some benefits, they carry substantial negative implications for both domestic economies and global imbalances, and thus, can be a serious threat to the stability of the global economy.

¹ Based on information from the April 2006 IFS data CD.

Existing theories offer a few reasons for holding international reserves. One common explanation is the precautionary demand motivated by trade financing considerations.² The recent literature has extended the precautionary motive and considers reserve accumulation a policy to avoid crisis-induced costs of output and investment contractions.³ Conditions in the financial market are also deemed important determinants of the level of international reserve holding. For instance, the popular Greenspan-Guidotti rule recommends that developing economies should hold international reserves to cover short-term external debts. In general, it is advisable to cover the one year amortized value of various types of liabilities over a wide range of possible outcome.⁴ Apparently, these factors do not fully explain the surge in international reserves witnessed in the new millennium.

In a series of articles Dooley, Folkerts-Landau and Garber (2005) argue that the large hoarding of international reserves by East Asian economies is a natural consequence of the presence of a revived Bretton Woods system in the region. In essence, these economies adopt the mercantilist approach, pursue the export-led growth strategy followed by the post-war Europe and Japan, and, hence, accumulate reserves. According to their view, reserve accumulation is a by-product of the development strategy that promotes exports with an undervalued currency. Aizenman and Lee (2005), however, find that even the mercantilist motive is confirmed by the data, it has little economic significance in explaining the reserve buildup in the post-crisis era.

² See, for example, Grubel (1971) for a survey of the pre-1970 studies. Flood and Marion (2002) review the theory and provide some recent empirical evidence.

³ See, for example, Aizenman *et al.* (2004) and Lee (2004).

⁴ The rule follows from the former Federal Reserve Chairman Alan Greenspan's comments on Pablo Guidotti's insight on the role of external debts in 1999. See Greenspan (1999). Guidotti is a former Deputy Minister of Finance of Argentina. de Beaufort Wijnholds and Kapteyn (2001), on the other hand, argue that the domestic liability represented by money supply should also be considered.

In the current study, we explore an idea advanced by Machlup (1966) and assess the extent to which his idea is relevant for explaining the international reserve accumulation behavior of some East Asian economies. Fritz Machlup, after examining some measures of international reserves, argued that the observed holding patterns could not be explained by reasons offered “by either theorists or practitioners.” Instead, he suggested monetary authorities’ hoarding of international reserves can be driven by non-fundamental factors. Specifically, he used his wife’s need for dresses as a metaphor to exemplify the monetary authorities’ desire for more and more international reserves.

Apparently, the recent ascent in international reserve holding and some related official remarks lend credibility to the Mrs Machlup’s Wardrobe analogy. For instance, an official in the Korea’s central bank said “(T)here is no such thing as too much foreign reserves.” On China’s international reserve holding, a Chinese official argued that there is “no unified benchmark on the appropriate amount of forex reserve a country should hold in both theory and practice” and “it could not be said to be “excessive” or “deficient.”⁵ The official statements usually point to the need of building up international reserves to fend off external shocks and speculative attacks but do not offer a target level based on fundamental considerations. Even with the anecdotal evidence, is it reasonable to assert that the insatiable appetite of central banks for international reserves is the sole reason for the recent building up of reserves?

We postulate that the reserve accumulation process pertaining to the Mrs Machlup’s Wardrobe metaphor may serve some relevant economic purposes. It is quite non-controversial to state that, on the other things being equal basis, international reserves help absorb unexpected (external) shocks and smooth current and capital account imbalances. The crisis experience and

⁵ Day and Choi (2004) and Xinhua News Agency (2004).

the development after the crisis appear to be consistent with the notion of accumulating international reserves to forestall future speculative attacks. The question, of course, is how high the level of the international reserve an economy has to hold?

On his wife's dress need, Machlup (1966, p. 26) suggests that it depends "on the Joneses with whom she wishes to keep up." That is, besides some fundamental considerations, the international reserve buildup depends on the behavior of neighboring economies. Ignoring the question of why Mrs Machlup has to keep up with the Joneses for a moment, the (implicit) rivalry among economies represents a mechanism that can push the hoarding of international reserves to a level that is difficult to explain using only traditional considerations.

Besides the pure psychological desire to feel good and not to be perceived as inferior, there are a few reasons why economies would like to keep up others. A remark by Feldstein (1999) and Fischer (1999) offer some insight on the keeping up with the Joneses motivation. After the crisis, these two noted economists observed that economies with a higher level of international reserves survived the East Asia financial crisis better than those with a lower level. Thus, a level of international reserves that is relatively higher than your neighbors may diffuse the speculative pressure on your own economy and divert it to the neighboring economies and, hence, reduce the chance of bearing the full cost of an attack. In other words, when a financial crisis is brewing in the region, if two economies have similar economic fundamentals, the one with a higher level of international reserves is less likely to be attacked and is more likely to survive the crisis.

Another reason for keeping up with the Joneses is that international reserves can have a positive impact on an economy's output prospect. If the level of international reserve holding is a barometer of financial health, an economy has an additional incentive to keeping up with the

Joneses to position itself to compete for international capital and foreign direct investment, which tend to have a level of productivity proficiency higher than the domestic capital. For developing economies, the output effect of international reserves also arises from their ability to reduce costs of borrowing in the international capital market and provide need liquidity when there is a reversal of capital flight. A relatively high level of international reserves will, thus, provide a catalyst for economic growth and enhance output prospect, which in turn will improve the market sentiment of an economy and, hence, reduce its vulnerability to attack.

In the remaining part of the paper, we use a stylized model to illustrate the demand for international reserves when Mrs Machlup takes the Joneses into her consideration. Specifically, we assume that an economy's vulnerability to speculative attacks depends on, among other things, international reserves held by other economies. The exercise also underscores the effects of the Joneses and the international reserve's feedback on output potential. Further, we take the idea to the data from a group of East Asian economies and investigate whether these economies display the keeping up with the Joneses behavior.

2. Reserve Hoarding and Keeping up with the Joneses

In this section, we present a sequence of models to illustrate the demand for international reserves in the presence of a) keeping up with the Joneses and b) the feedback of international reserves on output. The first model serves as a benchmark, the second one incorporates the notion of keeping up with the Joneses, and the third one allows for a positive output effect of international reserves.

2.1 The Benchmark Model

In this subsection, we derive the baseline demand for international reserves. The basic structure is essentially the model used by Aizenman *et al.* (2005). A few simplifications were introduced to reduce the complexity of the model and highlight the issue we would like to analyze. For this reason, we refer interested readers to Aizenman *et al.* (2005) for a more detailed description.

We consider a two-period model. In period one the economy has an output endowment Y_1 . Without loss of generality, the initial endowment is normalized to 1; that is $Y_1 = 1$. The output in the second period Y_2 is a random variable given by

$$Y_2 = \begin{cases} 1 + \delta & \text{with probability } 1 - p \\ 1 - \varepsilon & \text{with probability } p \end{cases}; \quad \delta, \varepsilon > 0 \text{ and } 0 < p < 1. \quad (1)$$

The random output shocks δ and ε are not necessarily the same. The probability that the economy suffers from output losses from a speculative attack is p . For simplicity, we ignore attacks that do not have any output implications.⁶ For the benchmark model, we assume p is given by

$$p = \phi + \alpha \frac{B}{R}, \quad \alpha > 0, \quad (2)$$

where R and B are, respectively, the level of reserve holding and the amount of foreign borrowing in period 1. In essence, (2) assumes the probability of suffering an attack that leads to an output loss is inversely related to the level of international reserve holding and directly proportional to the level of indebtedness. α is a scale parameter to ensure that the output loss probability p stays within the legitimate region. ϕ is a catch-all parameter representing other

⁶ It means the probability $(1 - p)$ includes these events: 1) no speculative attack; 2) the speculative attack has been sterilized or defended without output loss; 3) a successful speculative attack that does not induce an output drop. Also, we ignore output losses due to factors other than speculative attacks.

factors affecting the attack probability. We label the occurrence of $1 + \delta$ a good state and that of $1 - \varepsilon$ a bad state.

During the first period, given the output Y_1 , the economy makes decisions regarding consumption (C_1), reserve accumulation (R) and borrowing in the international capital market (B), and is subject to the budget constraint

$$C_1 = 1 + B - R. \quad (3)$$

The international borrowing carries a contractual interest rate r and, thus, the required repayment in period 2 is $(1+r)B$.

Because of the possible default in the second period, the economy faces a credit ceiling that limits the amount it can borrow internationally. The credit ceiling can be determined as follows. In the case of default, we assume the international lender can confiscate a share of Y_2 , denoted by θY_2 ; $0 < \theta < 1$, from the economy. However, the international lender does not have access to the economy's international reserves. If the repayment $(1+r)B$ is larger than the penalty θY_2 , then the economy has an incentive to default. Thus, the international lender would determine the lending amount knowing that the repayment he is going to receive in period 2 is

$$S = \text{MIN}[(1+r)B; \theta Y_2], \quad (4)$$

where $\text{MIN}[.,.]$ is the minimum operator. Let the (international) risk-free interest rate be r^* . It is assumed that $r > r^*$.⁷ Under risk neutrality, the expected repayment is given by

$$E[S] = (1+r^*)B. \quad (5)$$

The credit ceiling, \bar{B} , faced by the economy is the level of debt that will lead to default in both good and bad states. Thus it is given by

⁷ The Appendix shows that the economy has to pay a premium in the international capital market; that is $r > r^*$

$$\bar{B} = \frac{(1-p)\theta(1+\delta) + p \cdot \theta(1-\varepsilon)}{1+r^*} = \frac{\theta(1+\delta) - p\theta(\delta+\varepsilon)}{1+r^*}. \quad (6)$$

The credit ceiling is positively affected by the positive production shock δ , the ability to confiscate θ and is negatively related to the negative production shock ε , the probability of an attack that leads to output losses p , and the risk free rate r^* .

Assuming a) $(1+r)B \leq \theta(1+\delta)$, b) $(1+r)B > \theta(1-\varepsilon)$ with the probability q , and c) the international reserves earn an interest rate of r^* , the budget constraint for the second period is given by⁸

$$C_2 = \begin{cases} C_{2,g} = 1 + \delta - (1+r)B + (1+r^*)R & \text{with probability } 1-p \\ C_{2,b} = 1 - \varepsilon - (1+r)B + (1+r^*)R & \text{with probability } p \cdot (1-q), \\ C_{2,b,d} = (1-\theta)(1-\varepsilon) + (1+r^*)R & \text{with probability } p \cdot q \end{cases} \quad (7)$$

where $C_{2,g}$, $C_{2,b}$, $C_{2,b,d}$ are, respectively, the levels of consumption in period 2 when the country is in the good state, in the bad state with no default, and in the bad state and defaulted.

The economy has to choose the levels of consumption C_1 and C_2 to maximize its representative consumer's expected utility, which is given by

$$U(.) = C_1 + \frac{1}{1+\rho} \left[(1-p)C_{2,g} + p[(1-q)C_{2,b} + qC_{2,b,d}] \right], \quad (8)$$

where ρ is the discount rate and is assumed to be larger than the risk-free interest rate r^* . Taking the output loss probability (2) and the budget constraints (3) and (7) into consideration, the task is to maximize the expected utility $U(.)$ subject to the conditions (2), (3), and (7). In solving the utility maximization problem, we should obtain the optimal levels of borrowing and international reserves along with the optimal consumption path.

⁸ The economy defaults in the bad state if $1 - \varepsilon - (1+r)B < (1-\theta)(1-\varepsilon)$, which can be simplified to the condition $(1+r)B > \theta(1-\varepsilon)$. Thus, q is the probability of $(1+r)B > \theta(1-\varepsilon)$ under the bad state and depends on the output shock ε .

To simplify the presentation, we follow Aizenman *et al.* (2005) and assume that the economy has a discount rate high enough to set the borrowing at the ceiling level \bar{B} . When $B = \bar{B}$, the contractual (not the expected) repayment is

$$B(1+r)|_{B=\bar{B}} = \theta(1+\delta), \quad (9a)$$

and the expected utility $U(\cdot)$ can be written as

$$\begin{aligned} U(\cdot)|_{B=\bar{B}} \\ = (1+\bar{B}-R) + \frac{1}{1+\rho} \{ (1-\theta)(1+\delta) + (1+r^*)R - p(1-\theta)(\delta+\varepsilon) \}. \end{aligned} \quad (9b)$$

Thus, the first order condition with respect to R is

$$1 - \frac{dB}{dR}|_{B=\bar{B}} = \frac{1}{1+\rho} \left[(1+r^*) - (1-\theta)(\delta+\varepsilon) \frac{dp}{dR}|_{B=\bar{B}} \right], \quad (10)$$

which equates the marginal cost of increasing one unit of R in period one to the resulting (discounted) benefit obtained in period two.

Next, we derive $\frac{dB}{dR}|_{B=\bar{B}}$ and $\frac{dp}{dR}|_{B=\bar{B}}$ from (2) and (6) and substitute the results in (10) to obtain

$$\begin{aligned} & \left[(1+r^*)R + \alpha\theta(\delta+\varepsilon) \right]^2 \\ & = \frac{(\delta+\varepsilon)[(1+r^*) + \theta(\rho-r^*)][\alpha\theta(1+\delta) - \alpha\theta\phi(\delta+\varepsilon)]}{(\rho-r^*)}. \end{aligned} \quad (11)$$

Thus, the optimal level of international reserves is

$$\begin{aligned} R_B \\ = \left\{ \frac{(\delta+\varepsilon)[(1+r^*) + \theta(\rho-r^*)][\alpha\theta(1+\delta) - \alpha\theta\phi(\delta+\varepsilon)]}{(1+r^*)^2(\rho-r^*)} \right\}^{1/2} - \frac{\alpha\theta(\delta+\varepsilon)}{1+r^*}. \end{aligned} \quad (12)$$

The subscript “B” indicates that the expression is going to be used as a benchmark for comparison. From (12), it can be verified that the hoarding of international reserves is a) positively related to $(\delta + \varepsilon)$, the benefit of not being attacked and θ , the share of output being confiscated when it defaults, and b) negatively related to $(\rho - r^*)$, the opportunity cost and ϕ , the catch-all parameter that determines the economy’s vulnerability. It is also noted that \bar{B} is positively related to R_B since \bar{B} is negatively related to p (equation (6)) and p is negatively related to R (equation (2)).

2.2 The Joneses

To capture the idea of “keeping up with the Joneses,” we modify the probability that the economy suffers an output-loss-causing attack to

$$p_J = \phi + \alpha \frac{B_J}{R_J} + \beta \frac{\tilde{R}_0}{R_J}, \quad \alpha, \beta > 0, \quad (13)$$

where the subscript “J” indicates the presence of the Joneses effect. \tilde{R}_0 is the average of international reserves held by the other relevant economies (the Joneses) at period 0.⁹

Equation (13) incorporates the effect of other economies’ reserve holdings. It captures the notion that, *ceteris paribus*, speculators tend to attack an economy with a relatively low level of international reserves, which are powerful ammunition against speculative attacks. In addition to its own level of international reserves, an economy has to be aware of its relative position among the group of comparable economies. Attacks can be triggered by self-fulfilling expectations that are not related to fundamentals and speculators will look for a victim that has a

⁹ Strictly speaking, the model is extended to a three-periods model. However, the period 0 is added to accommodate \tilde{R}_0 and it has no implications for other aspects of the model.

relatively (rather than an absolutely) high level of vulnerability. Lagged rather than current reserves in other economies are considered because current information about other economies' international reserves is typically hard to obtain.¹⁰ Indeed, Mrs Machlup's desire for dresses is likely to be instigated by seeing her contemporaries' collection.

With the output loss probability specified by (13) rather than (2), the demand for international reserves in the presence of the Joneses' effect can be derived by maximizing the expected utility $U(.)$ in (8) subject to the conditions (13), (3), and (7). We follow a similar strategy and consider borrowing at the ceiling. In this case, the credit ceiling is given by

$$\bar{B}_J = \frac{\theta(1+\delta) - p_J\theta(\delta+\varepsilon)}{1+r^*}, \quad (14a)$$

and the corresponding first order condition is given by

$$1 - \frac{dB}{dR} \Big|_{B=\bar{B}_J} = \frac{1}{1+\rho} \left[(1+r^*) - (1-\theta)(\delta+\varepsilon) \frac{dp}{dR} \Big|_{B=\bar{B}_J} \right], \quad (14b)$$

where the subscript "J" is used to indicate the presence of the Joneses effect. Thus, it can be shown that

$$\begin{aligned} & \left[(1+r^*)R_J + \alpha\theta(\delta+\varepsilon) \right]^2 \\ &= \frac{(\delta+\varepsilon) \left[(1+r^*) + \theta(\rho-r^*) \right] \left[\alpha\theta(1+\delta) - \alpha\theta\phi(\delta+\varepsilon) + (1+r^*)\beta\tilde{R}_0 \right]}{(\rho-r^*)}, \end{aligned} \quad (15)$$

and the optimal level of international reserves is

$$R_J = \left\{ \frac{(\delta+\varepsilon) \left[(1+r^*) + \theta(\rho-r^*) \right] \left[\alpha\theta(1+\delta) - \alpha\theta\phi(\delta+\varepsilon) + (1+r^*)\beta\tilde{R}_0 \right]}{(1+r^*)^2(\rho-r^*)} \right\}^{1/2}$$

¹⁰ Abel (1990) studies a model in which an individual's current consumption depends on the lagged aggregated consumption. He suggested the use of the phrase "catching up with the Joneses" instead of "keeping up with the Joneses" to reflect the dependence on lagged consumption. Nonetheless, we stay with Machlup's original wording for consistence.

$$- \frac{\alpha\theta(\delta + \varepsilon)}{1 + r^*}. \quad (16)$$

Similar to R_b in (12), the demand for international reserves in the presence of the Joneses increases with $(\delta + \varepsilon)$ and θ and decreases with $(\rho - r^*)$ and ϕ . Through their impact on the probability of output causing attack, the international reserves held by others have a positive implication for an economy's own reserve hoarding. Further, the higher its sensitivity to the Joneses effect as measured by β , the higher will be the level of international reserves held by an economy.

Comparing (12) and (16), it can be seen that the positive term $(1 + r^*)\beta\tilde{R}_0$ is the only difference between R_b and R_j . Thus, R_j is larger than R_b –the demand of international reserves is higher in the presence of the Joneses effect, *ceteris paribus*. An economy's optimal level of international reserves is higher than the one justified by fundamentals alone when its probability of being attacked is adversely affected by international reserves held by other economies. If an economy believes that it is likely to be victimized and suffer output losses from speculative attacks with a relative low level of international reserves, then a rational response is to incorporate others' reserve behavior into its own decision making process.

2.3 *Feedback on Output Outlook*

In this subsection, we modify the model in subsection 2.2 and allow international reserve holdings have effects on output. It is shown that economies will be encouraged to accumulate more international reserves if international reserve holding can improve their output outlook.

Intuitively, holding of international reserves can affect output via a few channels. For instance, international reserves can smooth trade imbalances and, hence consumption. For most

developing economies, a high level of international reserves helps reduce the premium they have to pay for borrowing in the global market. Both a smooth consumption stream and a low borrowing cost are good for economic growth. Further, the level of international reserves can serve as an indicator of financial health and stability of an economy. Thus, a high level of international reserves helps developing economies to attract foreign direct investment, which tends to boost domestic growth. Recently, Aizenman and Lee (2005) adapt a model by Diamond and Dybvig (1983) to show that international reserves enhance output performance by providing the necessary liquidity to avert the damaging output effect of capital flight/sudden stop shocks.

To illustrate the implication for reserve demand in the existing framework, we refine our specification of output in the second period, Y_2 , to

$$Y_2 = \begin{cases} 1 + \delta^* \equiv 1 + \delta + R_{J,F}^2 / 2 & \text{with probability } 1 - p \\ 1 - \varepsilon^* \equiv 1 - \varepsilon + R_{J,F}^2 / 2 & \text{with probability } p \end{cases}; \quad \delta, \varepsilon > 0, 0 < p < 1. \quad (17)$$

To facilitate comparison, we introduce the output effect of international reserves by adding $R_{J,F}^2 / 2$ to the output shocks δ and ε . To simplify the derivation and to facilitate comparison, we assume the reserves' output effects are the same in both the good and bad states.¹¹ The subscript " J,F " signifies both the Joneses effect and the feedback on output are under consideration. If the reserves' output effect outweighs the output loss induced by speculative attack; that is $\varepsilon < R_{J,F}^2 / 2$, we have the result described by Aizenman and Lee (2005).

With the modified output Y_2 given by (17), the budget constraint (7) is modified to

¹¹ In the Appendix, we employ the Aizenman and Lee (2005) apparatus and show that the output levels in both good and bad states are increasing functions of international reserve holding. To simplify the derivation we work with (17).

$$C_2 = \begin{cases} C_{2,g} = 1 + \delta^* - (1+r)B_{J,F} + (1+r^*)R_{J,F} & \text{with probability } 1 - p_{J,F} \\ C_{2,b} = 1 - \varepsilon^* - (1+r)B_{J,F} + (1+r^*)R_{J,F} & \text{with probability } p_{J,F} \cdot (1 - q_{J,F}) \\ C_{2,b,d} = (1 - \theta)(\varepsilon^*) + (1+r^*)R_{J,F} & \text{with probability } p_{J,F} \cdot q_{J,F} \end{cases} \quad (18)$$

We solve the utility maximization problem by maximizing $U(\cdot)$ in (8) subject to the conditions (13), (3), and (18). That is, we incorporate both the keeping up with the Joneses factor and the output effect of international reserves into the utility maximization problem. In this case, the credit ceiling $\bar{B}_{J,F}$ explicitly depends on international reserves;

$$\bar{B}_{J,F} = \frac{\theta R_{J,F} [(1 + \delta) - \theta(\delta + \varepsilon)] - \theta(\delta + \varepsilon)\beta\tilde{R}_0 + \theta R_{J,F}^3 / 2}{(1 + r^*)R_{J,F} + \alpha\theta(\delta + \varepsilon)}.$$

The expression of the optimal demand for international reserves, $R_{J,F}$, incorporating both the Joneses and output effects is given by

$$\begin{aligned} & [(1 + r^*)R_{J,F} + \alpha\theta(\delta + \varepsilon)]^2 \\ & = \frac{(\delta + \varepsilon)[(1 + r^*) + \theta(\rho - r^*)][\alpha\theta(1 + \delta + R_{J,F}^2 / 2) - \alpha\theta\phi(\delta + \varepsilon) + (1 + r^*)\beta\tilde{R}_0]}{(\rho - r^*)} \\ & \quad + \frac{[(1 + r^*) + \theta(\rho - r^*)]R_{J,F}^2}{[(1 + r^*)R_{J,F} + \alpha\theta(\delta + \varepsilon)]}. \end{aligned} \quad (19)$$

The optimal $R_{J,F}$ can be derived from (19), which is a quadratic equation in $R_{J,F}$. Instead of solving for a rather complex expression, we just note that the optimal $R_{J,F}$ is larger than the R_J term given in (16). The result is quite intuitive. For instance, R_J is increasing in the output shocks δ and $-\varepsilon$, which are smaller than their counterparts δ^* and $-\varepsilon^*$.¹² In a word, the beneficial output effect is a factor that effectuates a high level of international reserves. While

¹² Also, it is observed that the coefficient of the squared term in (16) is larger than the one in (19).

most discussions on international reserves focus on its cushioning effect during an attack, it should note that international reserves could indirectly contribute to the economic performance during the non-crisis period. Such output effects can be a significant factor for developing economies in designing their policies.

3. Empirical Evidence

In the previous section, we used a theoretical structure to elaborate Machlup's (1966) contention about reserve demand behavior. Specifically, we outlined a model to interpret the Mrs Machlup's Wardrobe and keeping up with the Joneses argument and to illustrate the dependence of an economy's reserve behavior on other economies' holding of international reserves.

Admittedly, the models in Section 2 are quite stylized. They are meant to demonstrate the keeping up with the Joneses effect, but not necessarily the exact relationship between international reserves held by an economy and its neighboring economies. In the current section, we present some evidence on the relevance of the Mrs Machlup's Wardrobe and keeping up with the Joneses argument.

Annual data from 10 Asian economies, namely China, India, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand are used to assess the keeping up with the Joneses effect. These economies are located in the 1997 crisis-inflicted region. They are either adversely affected by the crisis and/or cited in the recent debate on excessive international reserve accumulation. The sample period is from 1980 to 2004. The behavior of demand for international reserves is investigated using the regression equations

$$Y_{it} = c + X_{it}' \alpha + \varepsilon_{it}, \quad (20)$$

$$Y_{it} = c + X_{it}' \alpha + \delta J_{i,t-1} + \varepsilon_{it}, \text{ and} \quad (21)$$

$$Y_{it} = c + X_{it}' \alpha + \delta J_{i,t-1} + \psi I(t-1 > 97) * J_{i,t-1} + \varepsilon_{it}, \quad (22)$$

where i and t are the economy and time indexes, Y_{it} is the ratio of international reserves to gross domestic product (GDP), X_{it} is the vector containing the traditional economic variables used in the literature to explain reserve behavior, and $J_{i,t-1}$ is the variable capturing the keeping up with the Joneses effect. It is defined a bit later. Henceforth, we label $J_{i,t-1}$ “the Joneses” variable for brevity. $I(\cdot)$ is the indicator function. The interactive Joneses term $I(t-1 > 97) * J_{i,t-1}$ is included to investigate if there is a change in the Joneses effect in the post-1997 crisis period. The joint estimation of δ and ψ helps determine if there is a change in the Joneses effect after the 1997 East Asia financial crisis and if the effect only shows up after the crisis.

Equation (20) is a canonical specification and includes economic variables commonly considered in empirical studies of demand for international reserves.¹³ We normalize international reserves with GDP to facilitate comparison across economies of different sizes. The variables in the X_{it} vector are a) the *per capita* GDP in logarithms, b) the average propensity to imports given by the imports to GDP ratio, c) the exchange rate volatility measured by the standard deviation of monthly exchange rate data, d) the volatility of reserve holding measured by the standard deviation of monthly reserve data, and e) the financial openness variable given by the sum of absolute value of capital inflow and outflow divided by GDP. The Taiwanese data were retrieved from the Central Bank of China (Taiwan) website and all other data were retrieved from the World Bank WDI and the IMF databases.

¹³ Some recent studies on the empirical reserve behavior include Lane and Burke (2001), de Beaufort Wijnholds and Kapteyn (2001), Flood and Marion (2002), Aizenman and Marion (2003). Earlier studies are reviewed in Grubel (1971).

The Joneses effect is assessed using equations (21) and (22). The key issue is how to define the Joneses variable. We do not have a perfect way to handle it because we do not have information on who are the Joneses. As a first attempt, we consider the Joneses variable J_{it} defined by

$$J_{it} = \sum_{k \neq i} Y_{kt}. \quad (23)$$

That is, all the other economies in the sample are the Joneses. Later, we consider an alternative definition of the Joneses variable.

3.1 Panel Data Results

The results of estimating (20) to (22) using the panel data technique are presented in Table 1. Under specification (20), in the absence of the Joneses variables, most of the traditional factors in X_{it} are significant. The *per capital* output is a measure of the level of development and is significantly positive – a result similar to the one reported in Lane and Burke (2001). The import propensity is the average (rather than marginal) propensity. Thus, it is a proxy for trade openness and the degree of vulnerability to external shocks and has the expected positive coefficient (Frenkel, 1974).¹⁴ The effect of financial openness on reserve holdings is similar to the one of trade openness – a high level of openness increases an economy’s vulnerability to external shocks. Even though both openness variables have a positive coefficient estimate, only the financial openness estimate is statistically significant. A similar financial openness effect is reported in, for example, Flood and Marion (2002). Frenkel and Jovanovic (1981) illustrate the

¹⁴ In contrast to Frenkel, Heller (1966) argued that the higher the propensity to import (m) is, the smaller marginal costs of balance of payments adjustment (i.e., $1/m$), and the weaker the demand for international reserves will be, predicting a negative theoretical relation between propensity to import and the level of international reserve accumulation.

effect of reserve volatility in a stochastic inventory control setting.¹⁵ The estimation result is in accordance with the positive impact of reserve volatility on reserve hoarding. Similarly, the reserve holding is found to be negatively impacted by exchange rate volatility. Overall, these five variables explain the reserve behavior quite well – in total they explain 56% of the variation in reserve holdings of these 10 economies.

Estimation results pertaining to specifications (21) and (22) buttress the presence of keeping up with the Joneses effect among these East Asian economies between 1980 and 2004. Under specification (21), the coefficient estimate of the Joneses variable is highly significant with a value of 0.068. The inclusion of the Joneses variable lifts the adjusted r-squares from 56% to 62%. Compared with the results of (20), the coefficient estimates of the traditional explanatory variables are smaller and have a lower level of significance in the presence of the Joneses variable.

The interactive term $I(t-1 > 97) * J_{i,t-1}$ in specification (22) is positively significant along side with the Joneses variable $J_{i,t-1}$. The Joneses effect is not unique to the post crisis period but it is stronger after the Asian financial crisis. The inclusion of the interactive Joneses term nonetheless lowers the impact of the Joneses variable. It also weakens the significance of the traditional explanatory variables with the exception of the *per capita* output. Indeed, with both the Joneses variable and its interactive term, the *per capita* output and the financial openness are the only two traditional explanatory variables that are significant at the 5% level.

The coefficient estimate of the interactive term is only slightly less than that of the Joneses variable – suggesting that the keeping up with the Joneses effect is amplified quite noticeably after the Asian financial crises. The strengthening of the effect, though not necessarily

¹⁵ A similar model, which is the stochastic version of the one developed by Baumol (1952) and Tobin (1956), is used by Frenkel and Jovanovic (1980) to model cash holding.

the magnitude seems in accordance with the anecdotal evidence mentioned in the introduction. Apparently, the dramatic adverse effect of the crisis sways policymaker's attitude towards international reserve hoarding and makes them be more strategic in positioning their levels of reserve holdings among their peers. An interesting observation is the presence of the keeping up with the Joneses effect even before the crisis.

One uncertainty about these estimation results is that we do not know, from these economies' point of view, who are their Joneses. Equation (23) implicitly asserts that all the economies in the sample are the Joneses. To check the robustness of the estimation results, we consider an alternative specification of the Joneses variable. Instead of trying all the possible combinations, we reckon the possibility that an economy may identify just a few representatives in the region as the Joneses. Such a strategy may be justified by monitoring costs and by the belief that the representative economies have timely information and have good assessment of the regional economic conditions.

Thus, to investigate the robustness of the results, we consider the Joneses variable comprises reserve data from only China, Japan, Korea, and Taiwan; that is

$$J_{it} = \sum_{k=\text{China, Japan, Korea, and Taiwan}} Y_{kt} \quad (24)$$

These four are arguably the major economies in the region. For any one of these four economies, the Joneses variable is defined to be the sum of the other three economies' international reserves. The estimation results based on the alternative definition of the Joneses variable are presented in Table 2.

Compared with Table 1, the Joneses effect based on the four-economy specification is stronger. For the whole sample estimation, the Joneses variable coefficient is 0.117 in Table 2 versus 0.068 in Table 1. Apparently, the significance of the four-economy Joneses variable is

mainly driven by its effect in the post-crisis period. The Joneses variable $J_{i,t-1}$ is significant only at the 10% but not at the 5% level in the presence of the significant interaction term $I(t-1 > 97) * J_{i,t-1}$.

In terms of overall explanatory power, the two specifications with a four-economy Joneses variable have adjusted r-squares estimate slightly lower those reported in Table 1. Even though the pattern of the Joneses effect changes as we modify the way to construct the Joneses variable, the change appears to be a matter of magnitude rather than of the nature of the effect. Specifically, both Joneses variables indicate the Joneses effect is stronger in the post-crisis period.

3.2 *Economy-By-Economy Results*

The panel regression technique adopted in Tables 1 and 2 improves estimation efficiency by pooling data across economies. However, the technique restricts the economies to display same responses to the explanatory variables. The restriction may not be appropriate for the current diverse group of economies. An alternative approach is to use the data from individual economies to estimate the international reserve demand equations. Such an approach offers only 24 or less observations per economy but allows us to explore economy-specific behavior and its possible implications for the Joneses effect. Recognizing the small sample size we are working with, we report the estimation results for individual economies in Table 3.

The economy-by-economy results without the Joneses variable are presented in Table 3.a. It is quite evident that the coefficient estimates are heterogeneous across individual economies. There are both similarities and differences between these results and those under the Model (20) column in Table 1. For instance, the *per capita* output, propensity to imports, and reserve

volatility variables are usually positive though not all of them are significant. Compared with the panel regression results, the *per capita* output is less likely to be significant – five out of ten estimates are significantly positive. Taiwan, on the other hand, displays a significant negative output effect on reserve accumulation. The propensity to imports variable is significantly positive in seven of the ten cases. China, interestingly, has a negative propensity to imports effect on reserve hoarding. The effect of financial openness is weaker than that of trade openness and that reported in Table 1. The individual exchange rate volatility effects also appear different from those under the panel specification.

One general observation is that the explanatory power recorded in Table 3.a is higher than the one under the panel specification. The adjusted R-squares estimates in Table 3.a are 80% or higher. The accommodation of economy-specific behavior gives a better fit to the data, even though the small sample size may have “inflated” the goodness of fit measure.

The effects of the Joneses and the interactive Joneses variables are presented in Tables 3.b and 3.c. Apparently, the *per capita* output is affected the most by the presence of the added variables. In Table 3.b, seven of the ten Joneses coefficient estimates are positive and four of them are statistically significant. The Joneses effect seems quite prevalent in the aftermath of the 1997 crisis – the interactive Joneses variable has a positive coefficient estimate in nine of the ten cases reported in Table 3.c and six of these nine positive estimates are significant. It is also noted that the coefficient estimate of the Taiwanese interactive Joneses variable is significantly negative.

In the presence of the interactive variable, the Joneses variable is significantly positive for three economies; namely Japan, Singapore, and Taiwan. In the case of Taiwan, the negative interactive Joneses effect is weaker than the Joneses effect. There is still the Joneses effect in the

post crisis period. However, unlike other economies, the Joneses effect experienced by Taiwan in the post crisis period is weaker, instead of stronger. With Taiwan as the only exception, the results indicate that the Joneses effect is more prominent in the post crisis period.

The Joneses effects based on the alternative definition of the Joneses variable are given in Tables 4.a and 4.b. A comparison of the coefficient estimates of the Joneses and the interactive Joneses variables leads to a similar observation – the Joneses effect is more prevalent and prominent in the post-1997 crisis sample. Specifically, eight of the ten interactive terms are significantly positive and only two Joneses variables are significant.

Although there are discernable differences in Tables 3.b, 3.c, 4.a, and 4.b, the performance of the two alternative specifications of the Joneses variables is quite comparable. The differences include the Joneses variable based on the four-economies specification is only significant in two cases in Table 4.a while it is significant in four cases in Table 3.b. On the other hand, the Joneses effect is stronger in the post crisis period with the four-economies Joneses specification. Similar to the panel data results, the regressions with the four-economies Joneses variable have adjusted R-squares estimates slightly less than those with the Joneses variable defined by all the economies in the sample. Nonetheless, both Joneses variables are indicative the presence of the keeping up with the Joneses effect.

According to these regressions results, especially those allowing for economy-specific behavior, the selected variables – both the traditional macroeconomic variables and the two Joneses variables explain the evolution of the holdings of international reserves quite well. To offer some insights on the debate of excessive reserve hoarding, we examine the estimated residual that is given by the difference between the actual level of reserve holdings and the level

explained by the regressors. Thus, a positive estimated residual suggests that the actual holding level is higher than the one warranted by the model.

According to the argument, the Joneses effect will lead to a level of international reserve holding that is higher than the one implied by fundamentals alone. If the Joneses effect is in operation but it is not accounted for in the regression analysis, the observed international reserves will appear higher than they should be. Thus, under the Joneses effect conjecture, the predicted value of reserve holding should be higher in the presence of Joneses variables than without them.

Figure 1 contains graphs of estimated residuals from the model contains only traditional macroeconomic variables as regressors and from the model that also includes both the Joneses and the interactive Joneses variables. Since the inclusion of the Joneses variables tend to improve the goodness of the fit, it is not surprising to observe that estimated residuals from the model allowing for the Joneses effect are in general smaller than those from the model without the Joneses variable. Another way to interpret the result is that the incorporation of the Joneses effect makes the observed reserve holdings closer to the predicted values. During the 2000 to 2004 period, the presence of the Joneses variables will in general reduce the estimated level of “excessive” holding. Indeed, the Joneses effect reverses the inference from “excessive” holding to “deficient” holding in the case of India, Philippines, and Thailand.

In sum the results from both the panel and economy-by-economy regressions are, in general, supportive of the notion that an economy’s reserve demand behavior is affected by other economies’ action.¹⁶

¹⁶ As a robust check, we added the lagged dependent variable as one of the regressors. The results on the Joneses results are qualitatively the same as those reported in the text.

4. Concluding Remarks

In this exercise, we explore a motive for hoarding international reserves that was advocated by Machlup in the 1960s. Specifically, we consider the Mrs Machlup's wardrobe hypothesis and the related keeping up with the Joneses argument. Motivated by events happened in the post-1997 crisis period, we speculate that, in addition to psychological reasons, there may be economic reasons underlying the keeping up with the Joneses behavior. For instance, if an economy is holding a level of international reserves that is relatively lower than the Joneses, it is more vulnerable to speculative attacks. Further, for developing economies, international reserves can have a positive impact on their growth prospects, which, in turn can reduce their vulnerability to crises. We use a stylized model to illustrate these effects on reserve accumulation behavior.

A canonical empirical reserve demand equation is used to investigate the presence of the Joneses effect in a group of East Asian economies. Both linear and panel-based regression results are suggestive of the presence of the Joneses effect; especially in the post-1997 crisis period. Individual economy estimation results, however, show that the Joneses effect is not uniform across economies.

There are a few caveats. First, the stylized model is used to highlight the Joneses effect. It does not, however, imply that other motivations for holding international reserves are not important. For instance, the increasing capital mobility and growing financial account liberalization around the world will boost the demand for international reserves to smooth out payment imbalances. However, our exercise demonstrates that one seemingly non-economic reason, the so-called Mrs Machlup's wardrobe hypothesis, may help account for part of reserve accumulation that is not explained by standard macroeconomic variables. We realize that the

Joneses effect varies across economies and does not necessarily affect all the economies in the world. However, there is a reason to believe that the Joneses effect is in play for, say, some Asian economies.

Second, our empirical evidence is meant to be illustrative rather than definitive. For one thing, we do not have *a priori* information on “the Joneses” of a given economy. Our choice of economies is based on convenience and the recent discussions in the media. Nonetheless, the empirical evidence is indicative of the presence of the Joneses effect. It is anticipated that a more elaborative framework for investigating demand for international reserves and the Joneses effect may be available in the near future.

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Appendix

A. *The risk premium*

Because of the default risk, the home economy has to pay a risk premium to borrow in the global capital market. This leads the foreign debt interest rate that home country has to pay to be higher than the world interest rate. To illustrate the point, suppose the home economy defaults only in the bad state of nature. The expected debt service is

$$E[S] = (1-p)(1+r)B + p \cdot [(1-q)(1+r)B + q \cdot \theta \cdot (1-\varepsilon)] \quad (\text{A1})$$

With (5) in the text,

$$(1+r^*)B = (1-p)(1+r)B + p \cdot [(1-q)(1+r)B + q \cdot \theta \cdot (1-\varepsilon)] \quad (\text{A2})$$

Re-arranging, we obtain

$$(1+r)(1-pq)B = (1+r^*)B - pq\theta(1-\varepsilon) \quad (\text{A3})$$

Since the default occurs when $(1+r)B > \theta(1-\varepsilon)$, (A3) can be rewritten as

$$(1+r)(1-pq)B > (1+r^*)B - pq(1+r)B,$$

which can be simplified to $(1+r)B > (1+r^*)B$, and, thus, for a positive borrowing B

$$r > r^*. \quad (\text{A4})$$

B. *The Output effect of International Reserves Holding*

The Aizenman and Lee (2005) model, which is based on the work of Diamond and Dybvig (1983), is used to illustrate the output effect of international reserve holding. In this setting, international reserves help cushion the output effect of liquidity shocks. Consider an economy that finances a long term project via bank loans. The representative agent is both the entrepreneur and the banker who does the financing and investment.

In period 1, the risk neutral central planner borrows B in the global capital market and makes deposit in the bank. The deposit B has two components – one component is reserve holding, R that does not go into the production process and the other component $(B-R)$ is used to finance the long term investment. The long term investment is undertaken prior to the realization of a liquidity shock. Note that it is the central planner who decides on the allocation of B between reserves R and productive capital $(B-R)$. The representative agent only does the financing and investment.

At the beginning of period 2, a stochastic liquidity (sudden stop) shock is realized with the aggregate value of Z . The shock, say, is affected by a speculative attack. If the realization Z is less than the reserve holding, R , the economy uses the reserve holding R to fill in the sudden drop in liquidity and produces with capital $(B-R)$. Thus, the economy does not suffer from output losses.

On the other hand, if Z is greater than R , then it triggers a premature liquidation of amount $(Z-R)$. The liquidation is accompanied by an adjustment cost that is proportional to $(Z-R)$, say $\lambda(Z-R)$, $0 < \lambda < 1$. Therefore, when the level of reserves is not large enough to cover the amount of sudden drop in liquidity, the economy suffers an output loss. The net capital for the production in period 2 is,

$$K_2 = \begin{cases} (B-R) - (1+\lambda)(Z-R) & \text{if } Z > R \\ B-R & \text{if } Z \leq R \end{cases} \quad (\text{B1})$$

The production technology of the long-term project in period 2 is given by

$$Y_2 = \begin{cases} A[(B-R) - (1+\lambda)(Z-R)] & \text{with probability } p \\ A[B-R] & \text{with probability } 1-p \end{cases}, \quad (\text{B2})$$

where A is the productivity parameter.¹⁷ $A > 1+r$, allows the economy at least to pay off the debt that carries an interest rate r . The probability of having an speculative attack that leads to output losses is p and, in this case, $p = \text{prob}(Z > R)$.

We express the liquidity shock in term of B using $Z = zB$ and assume z follows a uniform distribution in $[0, 1]$. The expected output in period 2 is

$$E(Y_2) = pA[(B-R) - (1+\lambda)(Z-R)] + (1-p)A[B-R]. \quad (\text{B3})$$

Following the argument in Section 2.1, the deposit ceiling \bar{B} is given by

$$(1+r^*)\bar{B} = \theta \cdot pA[(\bar{B}-R) - (1+\lambda)(Z-R)] + \theta \cdot (1-p)A[\bar{B}-R] \quad (\text{B4})$$

and $E(Y_2)$ is

$$E(Y_2) = (1+r^*)\bar{B} / \theta. \quad (\text{B5})$$

The economy defaults if

$$(1+r)B > \theta \cdot A[(B-R) - (1+\lambda)(Z-R)]. \quad (\text{B6})$$

Therefore, the probability of default q is

¹⁷ (B2) is a A-K model Cobb-Douglas function $Y = AK^\alpha$ with $\alpha = 1$.

$$\begin{aligned}
q &= \text{prob}\left\{(1+r)B > \theta \cdot A[(B-R) - (1+\lambda)(Z-R)]\right\} \\
&= \text{prob}\{z > [\theta - (1+r) + \theta\lambda R/B] / \theta(1+\lambda)\}.
\end{aligned} \tag{B7}$$

Since, z is uniformly distributed at $[0, 1]$, we obtain

$$q = 1 - [\theta - (1+r) + \theta\lambda R/B] / \theta(1+\lambda). \tag{B8}$$

Recall that, at the borrowing ceiling, the country default at all states of nature. This means that $q=1$ at the borrowing ceiling. Also, recall that the contractual repayment equals the default penalty in the best state of nature; that is $\bar{B}(1+r) = \theta \cdot A(\bar{B} - R)$. Thus (B8) implies

$$\bar{B} = (\theta\lambda + A)R / A - 1 \tag{B9}$$

and

$$E(Y_2) = (\theta\lambda + A)(1+r^*)R / [\theta(A-1)]. \tag{B10}$$

(B10) shows that the expected output is positively influenced by the level of reserves holding. Further it can be shown that a higher level of international reserves increases output when $Z > R$ or $Z \leq R$. Thus, international reserves have a positive impact on output in both the crisis and non-crisis periods. As stated in the text, the specification (17) for Y_2 with the effect of international reserves is used to facilitate comparison with models in Sections 2.1 and 2.2.

Table 1: Demand for International Reserves and the Joneses Effect

	Model (20)	Model (21)	Model (22)
lngdppc	0.1437*** (9.65)	0.0605*** (3.10)	0.0682*** (3.63)
mp	0.4374 (1.08)	0.0015 (0.04)	-0.0164 (-0.41)
F_open	0.2105*** (4.86)	0.1704*** (4.20)	0.1564*** (4.01)
E_vol	0.0000** (2.00)	0.0000** (2.22)	0.0000 (1.49)
R_vol	0.0025*** (3.72)	0.0014** (2.14)	0.0010 (1.60)
Joneses		0.0681*** (6.27)	0.0298** (2.21)
I>97*Joneses			0.0242*** (4.45)
constant	-0.9794*** (-8.73)	-0.4236*** (-3.03)	-0.4206*** (-3.14)
Adj. R-squares	0.5561	0.6211	0.6535
Observations	235	228	228

Note: The table reports the results of estimating models (20) to (22) in the text using the panel data technique. “lngdppc” is log per capita GDP, “mp” is propensity to imports, “F_open” is financial openness, “E_Vol” is exchange volatility, and “R_vol” is reserve volatility. “Joneses” is the Joneses variable defined by equation (23) in the text. “I>97*Joneses” is the interactive Joneses variable $I(t-1>97) * J_{i,t-1}$. T-statistics are in parentheses. “***”, “**”, and “*” denote significance at the 1%, 5% and 10% level, respectively.

Table 2: Demand for International Reserves with an Alternative Definition of the Joneses Variable

	Model (21)	Model (22)
lngdppc	0.1107*** (6.72)	0.0905*** (5.82)
mp	0.0474 (1.15)	0.0068 (0.18)
F_open	0.0846** (2.57)	0.0598* (1.95)
E_vol	0.0000** (2.13)	0.0000 (1.36)
R_vol	0.0016** (2.40)	0.0009 (1.40)
Joneses_4	0.1173*** (6.10)	0.0372* (1.70)
I>97*Joneses_4		0.0946*** (6.25)
constant	-0.7671*** (-6.27)	-0.5593*** (-4.75)
Adj. R-squares	0.5867	0.6498
Observations	228	228

Note: The table reports the panel regression results of models (21) to (22) in the text. “lngdppc” is log per capita GDP, “mp” is propensity to imports, “F_open” is financial openness, “E_Vol” is exchange volatility, and “R_vol” is reserve volatility. “Joneses_4” is the Joneses variable defined by equation (24) in the text. “I>97*Joneses_4” is the interactive Joneses variable $I(t-1>97) \cdot J_{i,t-1}$. t-statistics are in parentheses. “***”, “**”, and “*” denote significance at the 1%, 5% and 10% level, respectively.

Table 3.a: Results from individual economies without the Joneses effect

	China	India	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand
Ingdppc	0.1151*** (3.69)	0.0161 (0.65)	0.0309 (1.02)	0.1344*** (3.00)	0.1184*** (5.15)	0.1246 (1.07)	-0.0515 (-0.65)	0.2902** (2.63)	-0.4402*** (-3.36)	0.1468*** (4.12)
mp	-0.5428* (-1.97)	0.9984*** (3.42)	0.5418* (1.94)	0.9556*** (3.78)	0.9602*** (4.32)	0.0685 (0.43)	0.4353*** (6.97)	-0.1026 (-0.99)	1.7498*** (3.74)	0.3930*** (3.94)
F_open	-0.1363 (-0.41)	-0.1487 (-0.53)	-1.3096*** (-2.90)	0.0803 (0.62)	-0.3103 (-1.65)	-0.1262 (-0.64)	0.1400*** (3.56)	-0.0764 (-1.10)	0.3525 (0.83)	0.2376** (1.97)
E_vol	-0.0253 (-0.35)	-0.0053 (-1.48)	0.0001** (2.78)	-0.0008 (-0.74)	-0.0004*** (-3.92)	-0.2740*** (-3.18)	-0.0093** (-2.51)	-0.5536 (-0.75)	-0.0136 (-0.45)	-0.0023 (-0.60)
R_vol	0.0046*** (5.43)	0.0106*** (6.22)	-0.0023 (-0.13)	0.0017*** (4.39)	0.0117*** (4.66)	0.0431*** (3.73)	-0.0110 (-0.63)	0.0338* (1.81)	0.0165** (2.97)	-0.0130** (-1.98)
constant	-0.5492*** (-3.43)	-0.1399 (-1.16)	-0.1707 (-0.99)	-1.4426*** (-3.01)	-1.2295*** (-5.04)	-0.8032 (-0.97)	0.2928 (0.55)	-1.8721 (-1.64)	3.7644*** (3.33)	-1.0589*** (-4.81)
Adj R-squares	0.9152	0.9176	0.8244	0.8008	0.9192	0.7958	0.8893	0.8346	0.8432	0.9465
Observations	23	24	24	25	25	24	25	25	15	25

Note: The table reports the results of estimating model (20) economy by economy. “Ingdppc” is log per capita GDP, “mp” is propensity to imports, “F_open” is financial openness, “E_Vol” is exchange volatility, and “R_vol” is reserve volatility. t-statistics are in parentheses. “****”, “***”, and “**” denote significance at the 1%, 5% and 10% level, respectively.

Table 3.b: Results from individual economies with the Joneses effect

	China	India	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand
Ingdppc	0.1226*** (2.91)	0.0448 (0.69)	-0.0378 (-1.02)	-0.0150 (-0.37)	0.1379*** (3.07)	-0.0112 (-0.07)	-0.0647 (-0.74)	-0.0112 (-0.10)	-0.5494** (-2.78)	0.0994** (2.64)
mp	-0.4901 (-1.44)	0.7831* (1.74)	0.4269* (1.73)	0.8716*** (4.97)	0.9513*** (4.12)	0.1228 (0.73)	0.4054*** (3.52)	-0.2803*** (-2.95)	1.5215** (2.69)	0.1891 (1.71)
F_open	-0.1901 (-0.48)	-0.2066 (-0.61)	-0.6230 (-1.32)	0.0067 (0.08)	-0.4761** (-2.21)	-0.0081 (-0.04)	0.1348*** (3.44)	-0.0581 (-1.11)	0.1661 (0.33)	0.4562*** (3.61)
E_vol	-0.0336 (-0.42)	-0.0054 (-1.45)	0.0001*** (3.17)	0.0006 (0.76)	-0.0004*** (-3.6)	-0.1813* (-1.77)	-0.0075* (-1.74)	-0.1226 (-0.21)	-0.0095 (-0.30)	-0.0037 (-1.13)
R_vol	0.0046*** (5.14)	0.0110*** (5.39)	-0.0058 (-0.37)	0.0005 (1.44)	0.0114*** (4.26)	0.0401*** (3.49)	-0.0063 (-0.33)	0.0349** (2.49)	0.0146** (2.36)	-0.0128** (-2.27)
Joneses	-0.0101 (-0.28)	-0.0055 (-0.32)	0.0410** (2.63)	0.0619*** (5.21)	-0.0049 (-0.17)	0.0647 (1.63)	0.0073 (0.52)	0.1538*** (3.97)	0.0808 (0.75)	0.0576*** (3.15)
constant	-0.5820** (-2.87)	-0.2766 (-0.9)	0.1907 (0.94)	0.0035 (0.01)	-1.3804*** (-3.54)	0.1150 (0.11)	0.3743 (0.64)	1.0855 (0.97)	4.7485** (2.72)	-0.7645*** (-3.27)
Adj R-squares	0.9103	0.9142	0.8678	0.9193	0.9265	0.8094	0.8957	0.902	0.8353	0.9612
Observations	23	23	24	24	24	23	24	24	15	24

Note: The table reports the results of estimating model (21) economy by economy. “Ingdppc” is log per capita GDP, “mp” is propensity to imports, “F_open” is financial openness, “E-Vol” is exchange volatility, and “R_vol” is reserve volatility. “Joneses” is the Joneses variable defined by equation (23) in the text. t-statistics are in parentheses. “***”, “**”, and “*” denote significance at the 1%, 5% and 10% level, respectively.

Table 3.c: Results for individual economies with Period-Specified Joneses effects

	China	India	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand
lngdppc	0.0902** (2.53)	-0.0198 (-0.37)	0.0389 (1.12)	-0.0176 (-0.42)	0.0437 (1.35)	-0.0756 (-0.5)	-0.1240* (-1.75)	-0.0050 (-0.04)	-0.8913*** (-3.96)	0.1692*** (6.25)
mp	-0.2494 (-0.87)	0.6319* (1.79)	0.2958 (1.57)	0.7775*** (3.56)	0.2596 (1.37)	0.1877 (1.15)	0.3196*** (3.40)	-0.2686** (-2.71)	1.3437** (2.84)	0.0408 (0.54)
F_open	-0.0822 (-0.26)	0.3899 (1.24)	-0.1483 (-0.39)	-0.0044 (-0.05)	-0.1095 (-0.74)	-0.1070 (-0.53)	0.0776** (2.21)	-0.0566 (-1.05)	0.1978 (0.48)	0.2949*** (3.47)
E_vol	-0.0369 (-0.57)	-0.0023 (-0.75)	0.0000** (2.32)	0.0004 (0.53)	-0.0002** (-2.49)	-0.1575 (-1.61)	-0.0062* (-1.81)	-0.1682 (-0.28)	0.1055 (1.81)	-0.0085*** (-3.75)
R_vol	0.0040*** (5.29)	0.0098*** (6.05)	-0.0133 (-1.10)	0.0005 (1.33)	0.0045** (2.19)	0.0472*** (4.06)	0.0226 (1.32)	0.0374** (2.49)	0.0127** (2.46)	-0.0007 (-0.18)
Joneses	-0.0343 (-1.12)	-0.0019 (-0.14)	-0.0155 (-0.81)	0.0556*** (3.76)	0.0104 (0.60)	0.0274 (0.63)	-0.0104 (-0.84)	0.1292** (2.16)	0.4535** (2.37)	-0.0063 (-0.37)
I>97*Joneses	0.0212*** (3.07)	0.0130*** (3.39)	0.0278*** (3.73)	0.0038 (0.74)	0.0387*** (5.46)	0.0244 (1.71)	0.0222*** (3.39)	0.0128 (0.55)	-0.1242* (-2.2)	0.0290*** (5.23)
constant	-0.3878** (-2.21)	0.0808 (0.31)	-0.2013 (-1.08)	0.0494 (0.12)	-0.4172 (-1.41)	0.6339 (0.59)	0.8179 (1.71)	1.0279 (0.90)	7.3576*** (3.95)	-1.1135*** (-6.91)
Adj. R-squares	0.9413	0.9482	0.9249	0.9171	0.9727	0.8299	0.9355	0.8978	0.8886	0.9848
Observations	23	23	24	24	24	23	24	24	15	24

Note: The table reports the results of estimating model (22) economy by economy. “lngdppc” is the log per capita GDP, “mp” is the import propensity, “F_open” is financial openness, “E_Vol” is exchange volatility, and “R_vol” is reserve volatility. “Joneses” is the Joneses variable defined by equation (23) in the text. “I>97*Joneses” is the interactive Joneses variable $I(t-1>97) * J_{i,t-1}$. t-statistics are in parentheses. “***”, “**”, and “*” denote significance at the 1%, 5% and 10% level, respectively.

Table 4.a: Results from individual economies with the an Alternative Definition of the Joneses effect

	China	India	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand
lngdppc	0.1206*** (3.6)	0.0458 (0.86)	0.0099 (0.30)	0.0954*** (3.20)	0.1414*** (5.85)	0.0952 (0.68)	-0.0795 (-0.92)	0.1547 (1.53)	-0.4842*** (-3.46)	0.1363*** (3.23)
mp	-0.4710 (-1.51)	0.6770 (1.19)	0.5163* (1.90)	1.1368*** (6.55)	0.9141*** (4.38)	0.0851 (0.49)	0.4507*** (4.61)	-0.2172** (-2.15)	1.1941 (1.59)	0.3219** (2.64)
F_open	-0.2622 (-0.63)	-0.1935 (-0.36)	-0.9746* (-1.95)	-0.0042 (-0.05)	-0.5639** (-2.66)	-0.0205 (-0.09)	0.1351*** (3.32)	-0.0540 (-0.92)	0.1026 (0.21)	0.3339** (2.26)
E_vol	-0.0317 (-0.42)	-0.0054 (-1.46)	0.0001** (2.78)	0.0001 (0.19)	-0.0004*** (-4.37)	-0.2356** (-2.37)	-0.0085* (-2.00)	-0.3432 (-0.54)	-0.0235 (-0.74)	-0.0026 (-0.66)
R_vol	0.0046*** (5.28)	0.0113*** (4.87)	-0.0048 (-0.27)	0.0010*** (3.47)	0.0125*** (4.80)	0.0406*** (3.35)	-0.0097 (-0.49)	0.0301* (1.92)	0.0126 (1.81)	-0.0135* (-2.00)
Joneses_4	-0.0278 (-0.54)	-0.0122 (-0.44)	0.0379 (1.41)	0.0886*** (5.24)	-0.0388 (-1.15)	0.0536 (0.89)	0.0014 (0.06)	0.1686*** (3.09)	0.3376 (0.95)	0.0400 (1.28)
constant	-0.5737*** (-3.38)	-0.2777 (-1.11)	-0.0654 (-0.36)	-1.0950*** (-3.47)	-1.3863*** (-5.81)	-0.6238 (-0.63)	0.4765 (0.82)	-0.5079 (-0.49)	4.3506*** (3.37)	-0.9898*** (-3.76)
Adj. R-squares	0.9115	0.9146	0.8337	0.9198	0.9317	0.7883	0.8941	0.8791	0.8415	0.9439
Observations	23	23	24	24	24	23	24	24	15	24

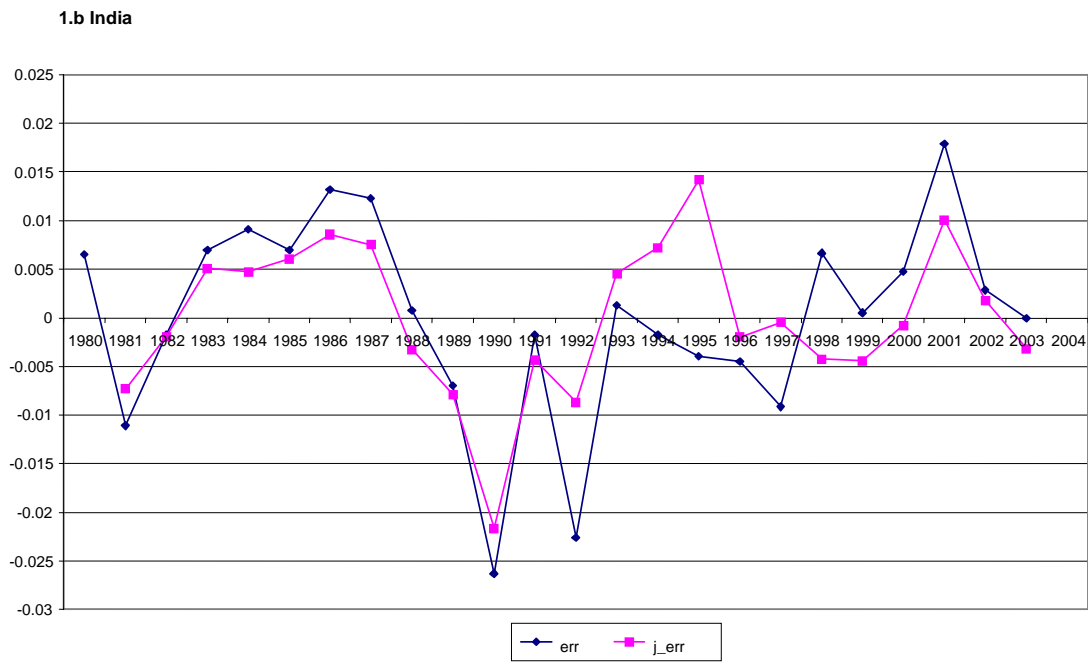
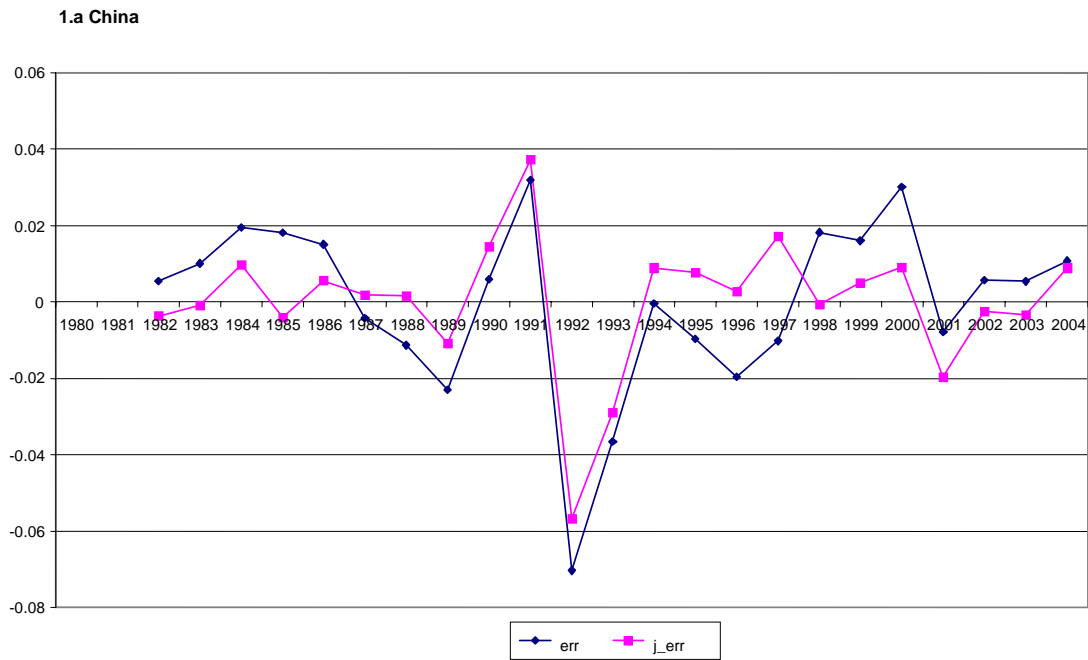
Note: The table reports the results of estimating model (22) economy by economy. “lngdppc” is log per capita GDP, “mp” is propensity to imports, “F_open” is financial openness, “E-Vol” is exchange volatility, and “R_vol” is reserve volatility. “Joneses_4” is the Joneses variable defined by equation (24) in the text. t-statistics are in parentheses. “***”, “**”, and “*” denote significance at the 1%, 5% and 10% level, respectively.

Table 4.b: Results for individual economies with an Alternative Definition of Period-Specified Joneses effects

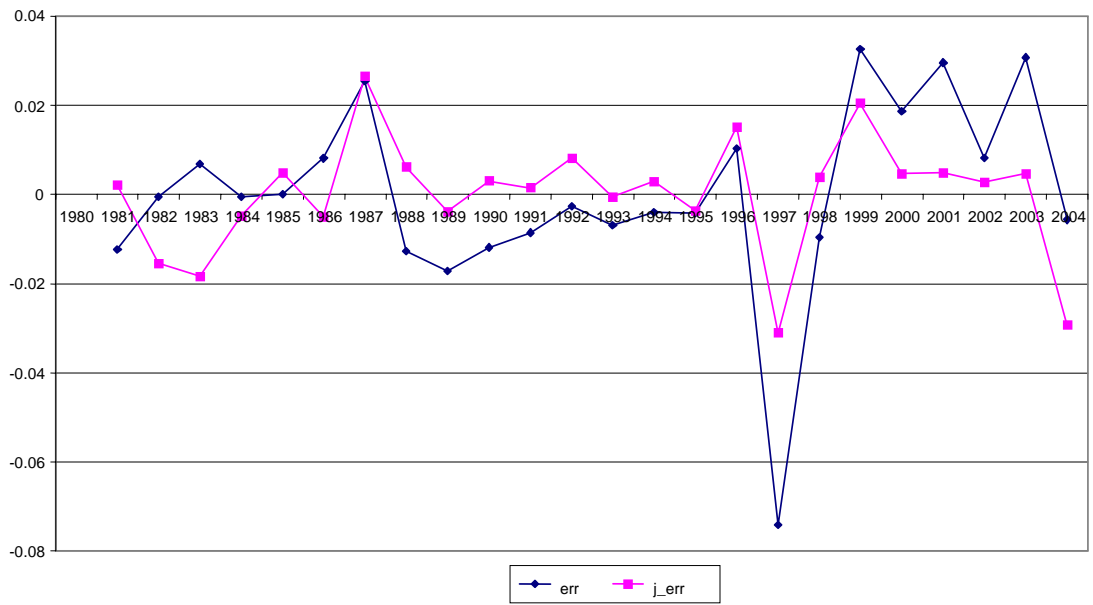
	China	India	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand
lngdppc	0.0784** (2.54)	0.0272 (0.69)	0.0207 (0.79)	0.0462 (1.70)	0.0521** (2.56)	-0.0346 (-0.23)	-0.1780** (-2.74)	0.1180 (1.20)	-0.4856** (-3.21)	0.1656*** (6.66)
mp	-0.3807 (-1.48)	0.1423 (0.33)	0.3919* (1.79)	0.6730*** (3.54)	0.0991 (0.55)	0.1851 (1.08)	0.3281*** (4.39)	-0.2167** (-2.26)	1.1875 (1.47)	0.0447 (0.53)
F_open	-0.0385 (-0.11)	0.3174 (1.23)	-0.3400 (-0.78)	-0.0407 (-0.61)	-0.1015 (-0.70)	-0.1010 (-0.47)	0.0879** (2.85)	-0.0566 (-1.02)	0.1075 (0.20)	0.3684*** (4.30)
E_vol	-0.0164 (-0.27)	-0.0028 (-1.01)	0.0000*** (2.49)	-0.0001 (-0.20)	-0.0001 (-1.60)	-0.1765* (-1.80)	-0.0060* (-1.95)	-0.3209 (-0.53)	-0.0220 (-0.51)	-0.0080*** (-3.28)
R_vol	0.0037*** (4.71)	0.0098*** (5.62)	-0.0148 (-1.03)	0.0006** (2.31)	-0.0007 (-0.26)	0.0462*** (3.95)	0.0192 (1.23)	0.0336** (2.24)	0.0125 (1.69)	-0.0042 (-1.00)
Joneses_4	-0.0323 (-0.77)	-0.0328 (-1.57)	-0.0166 (-0.62)	0.0606*** (3.92)	-0.0075 (-0.37)	0.0180 (0.30)	-0.0447** (-2.23)	0.1089* (1.74)	0.3678 (0.59)	-0.0089 (-0.45)
I>97*Joneses_4	0.0816*** (2.97)	0.0480*** (3.87)	0.0624*** (3.35)	0.0461*** (3.47)	0.1978*** (5.98)	0.0717* (1.85)	0.0760*** (4.26)	0.0660 (1.70)	-0.0214 (-0.06)	0.0771*** (5.92)
constant	-0.3433** (-2.16)	-0.1332 (-0.72)	-0.1090 (-0.75)	-0.5321* (-1.81)	-0.4210* (-1.99)	0.3471 (0.33)	1.1900** (2.70)	-0.1402 (-0.14)	4.3600** (3.14)	-1.0978*** (-7.17)
Adj R-squares	0.9406	0.9545	0.8961	0.9514	0.9776	0.8161	0.9474	0.8912	0.8189	0.9813
Observations	23	23	24	24	24	23	24	24	15	24

Note: The table reports the results of estimating model (22) economy by economy. “lngdppc” is log per capita GDP, “mp” is propensity to imports, “F_open” is financial openness, “E_Vol” is exchange volatility, and “R_vol” is reserve volatility. “Joneses_4” is the Joneses variable defined by equation (24) in the text. “I>97*Joneses_4” is the interactive Joneses variable $I(t-1>97) * J_{i,t-1}$. t-statistics are in parentheses. “***”, “**”, and “*” denote significance at the 1%, 5% and 10% level, respectively.

Figure 1: Estimated Residuals from Models With and Without the Joneses Effect



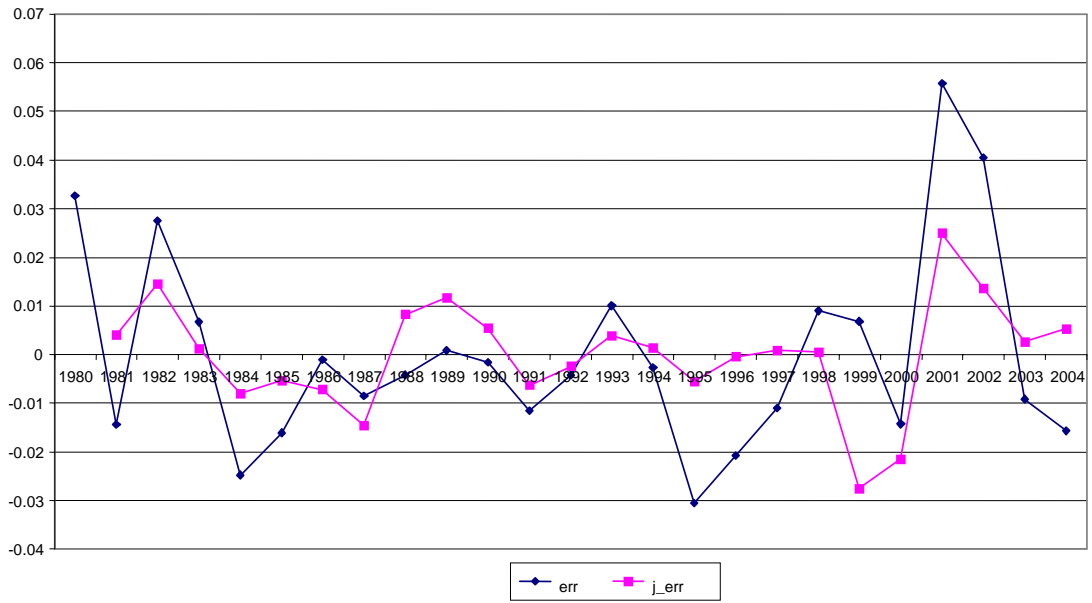
1.c Indonesia



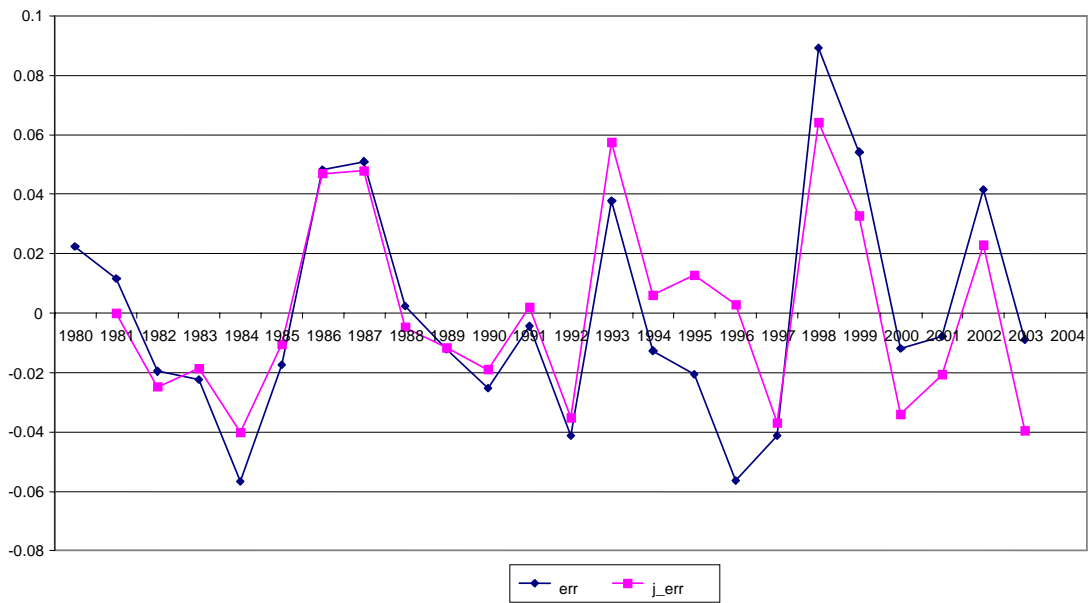
1.d Japan



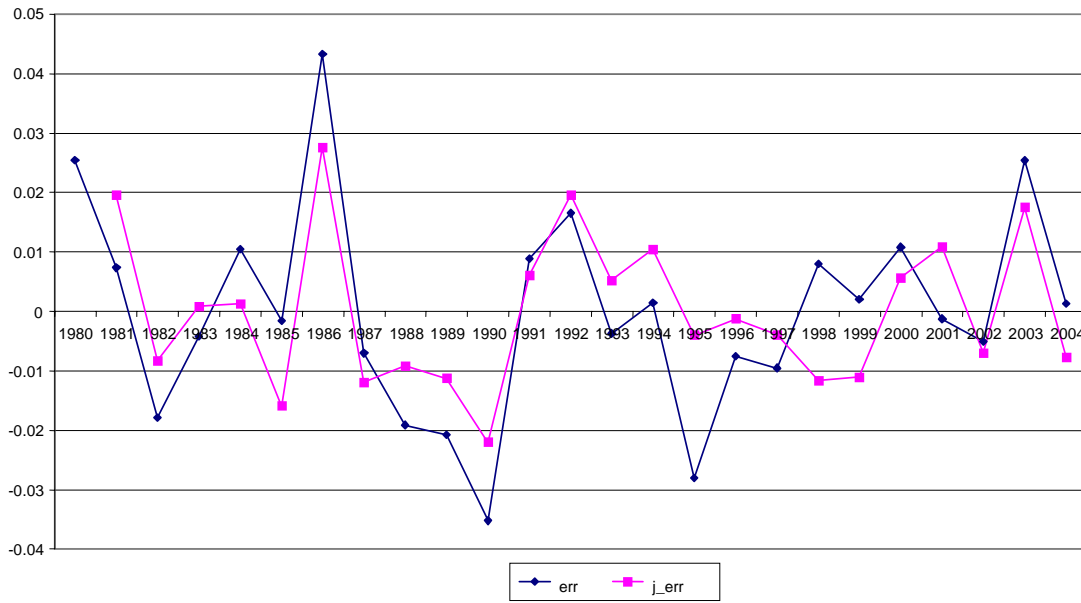
1.e Korea



1.f Malaysia



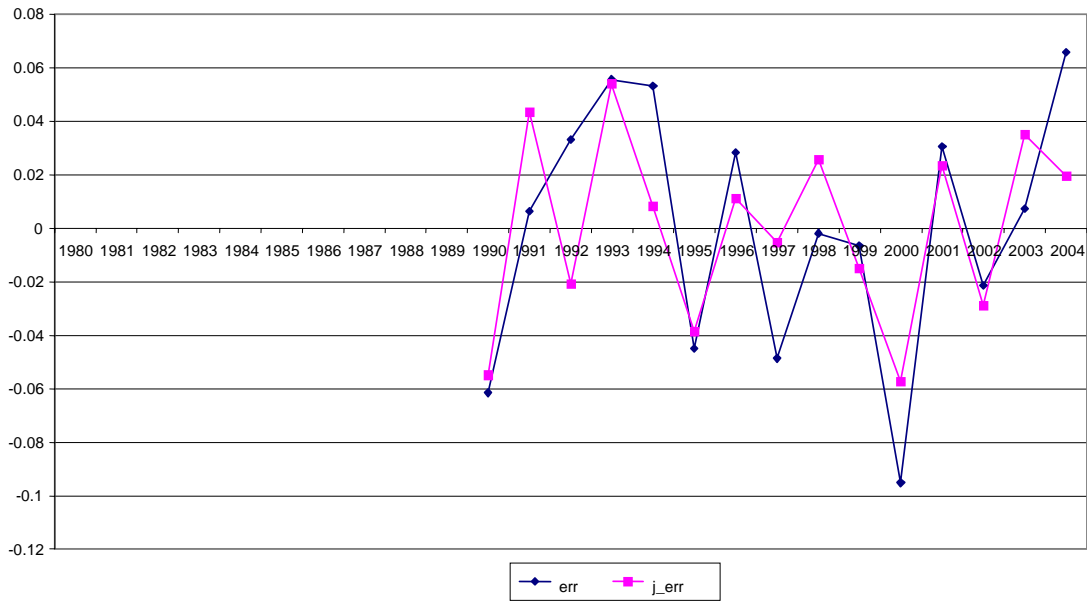
1.g Philippines



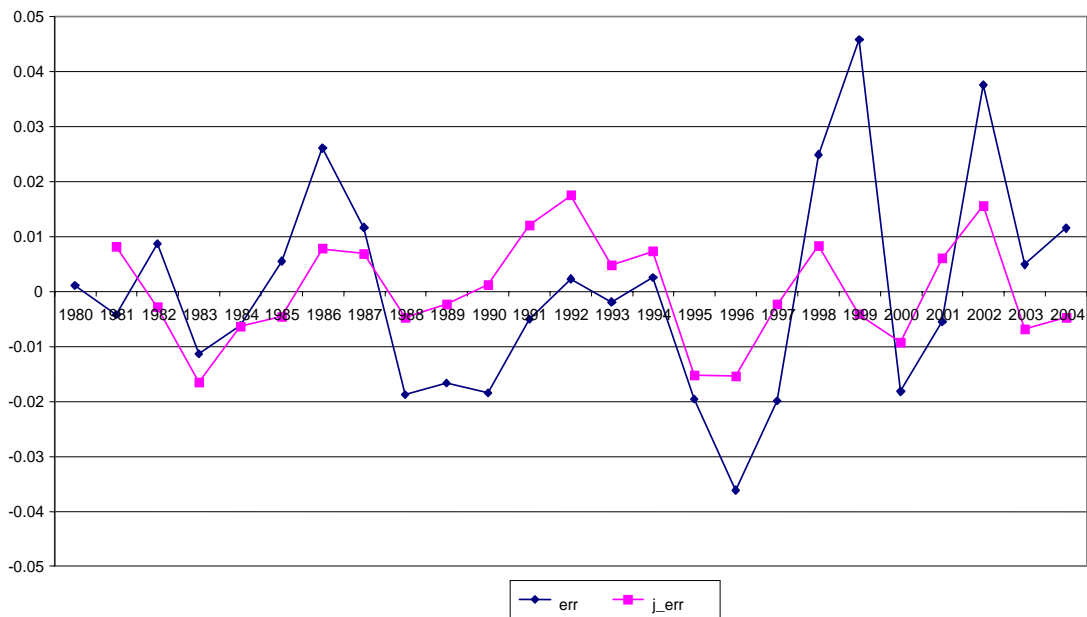
1.h Singapore



1.i Taiwan



1.j Thailand



Notes: The line graph labeled “err” gives the estimated residuals from fitting individual economy data to the equation (20) in the text. Equation (20) includes only traditional macroeconomic variables as regressors. The line graph labeled “j_err” gives the estimated residuals from fitting individual economy data to the equation (22), which includes both the Joneses and the interactive Joneses variables.