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Korea, Mexico and Hong Kong: Application of
Shibata and Shintani Approach***

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Abstract of "Measurement of International Capital Mobility in Korea, Mexico
and Hong Kong: Application of Shibata and Shintani Approach"

by

Lixing Sun and Makoto Ohta

This paper applies the method of Shibata and Shintani (1998) to measure international capital mobility in Korea, Mexico and Hong Kong, instead of Feldstein and Horioka approach. We found that the capital is much more mobile in these developing countries than in the developed countries of OECD studied by Shibata and Shintani. This is in sharp contrast with Feldstein and Horioka's interpretation that their estimated high correlations between saving and investment imply low capital mobility in OECD countries.

JEL *Classification Number.* D91, F32, P45

1. Introduction: Purpose of the Paper and a cursory Review of the Literature

Many barriers to international capital movement across emerging markets have been dismantled since 1980s. Increasing integration of capital markets promotes foreign lending and borrowing, and thus helps international trades, developments of emerging markets, and foreign investments by developed countries. This paper examines empirically how freely capital moves internationally in Asian developing countries, by using the approach of Shibata and Shintani (1998).¹

There are three main approaches to measure international capital mobility in previous studies. One approach was initiated by the famous paper of Feldstein and Horioka (1980, abbreviated to FH hereafter). They estimated the correlation between saving and investment rates by regressing the latter on the former, to measure the degree of capital mobility. According to them, when the capital mobility is perfect, capital moves freely to seek the maximum return, and so the above correlation will be low. In contrast, the correlation will be high under the low capital mobility, because national saving can not avoid being invested mainly inside the country and the domestic investment can not help being financed mainly by domestic saving under this situation. Low mobility will occur when there are risks of investing abroad and official restrictions on the capital movement, etc.

FH and their followers found statistically significantly positive and large correlations between saving and investment rates for OECD countries. According to their arguments, these findings are strong evidences against the null hypothesis of perfect capital mobility: The mobility is considered to be low by them.

Obstfeld and Rogoff (1996, pp. 162-163) listed several skeptical arguments that had been raised against the validity of interpreting the correlation between saving and investment rates as the measurement of the degree of capital mobility.² FH's approach is not based on a theoretical model, and so the correlation is difficult to interpret. We need a theoretical model to measure the degree of capital mobility.

The second approach for measuring the degree of capital mobility uses the interest parity condition. That condition holds if the mobility is perfect, but it does not hold if the mobility is low. Chinn and Frankel (1994) among others, used covered interest

¹ We developed the same model as Shibata and Shintani (1998) without knowing it in the first version of this paper. Professor Eiji Fujii of Otaru University of Commerce pointed us the above paper of Shibata and Shintani. We thank Professor Eiji Fujii for it.

² Most of these arguments had been given before (Obstfeld 1986 and 1995; Mendoza 1991 and 1994; Montiel 1993).

parity condition. They regressed the domestic interest rate on the foreign interest rate and the depreciation rate of the forward exchange rate of the home currency for the sample of some developed countries. They could not reject the null hypothesis that both the coefficients of the above two explanatory variables are one. This result implies that the covered interest parity is not rejected, and so that we may consider the capital mobility to be high among these developed countries.

Unfortunately, forward exchange markets are either extremely thin or nonexistent for most of the developing countries. So, we can not use the covered interest parity condition, but have to use the uncovered interest parity condition. Edwards and Khan (1985) presented a theoretical model that postulates the domestic market-clearing interest rate to be a weighted average of the hypothetical interest rate under the perfectly open case and the hypothetical interest rate under the financial autarky.³ The weight parameter serves as an index of capital mobility. The hypothetical interest rate under the financial autarky is derived from the money market equilibrium condition under that hypothetical situation. The uncovered interest parity condition is used to derive the hypothetical interest rate under the perfectly open case. They neither considered the risk premium in their theoretical model, nor did an empirical application of their model.

Reisen and Yeches (1993) developed this method of Edwards and Khan (1985) to include risk premium and applied their method to East Asian countries. Sun (2000) followed this method while using SARIMA technique to calculate the expected value of future exchange rates. Their empirical results imply high capital mobility in Asian developing countries.

Capital movement is a dynamic phenomenon. But the above second approach is not based explicitly on the dynamic model which takes the intertemporal optimization of economic agents into consideration. Shibata and Shintani (1998) presented such a dynamic model to measure the degree of capital mobility.

The third approach, which was presented by Shibata and Shintani (1998), considered two hypothetical cases. One is a case of financial autarky (abbreviated to FA), where the representative agent consumes the period's net output of the country in each period. The other is a case of perfect international capital mobility (abbreviated to PM) of a small country, where the representative agent chooses the net foreign asset optimally to maximize his lifetime utility. Actual consumption is assumed to be a

³ For more detailed explanations of interest rate determination identity, see Edwards and Khan(1985), Haque and Montiel(1990).

weighted average of the consumption in these two extreme cases. The weight parameter is the measurement of the degree of capital mobility. Shibata and Shintani (1998) applied their model of measuring capital mobility to eleven developed countries of OECD.

In this paper, we estimate it for three developing countries, Korea, Mexico and Hong Kong. These countries have either experienced a severe currency crisis, or suffered a ripple effect from the crisis. A high degree of capital mobility can be found in all the sample countries, and international capital movement in Hong Kong is higher than that in the other sample countries.

This paper is organized as follows. Section 2 shows the estimation equation developed by Shibata and Shintani (1998). Section 3 describes the data briefly. Section 4 explains the design of econometric method and reports the estimation results. Section 5 presents conclusions.

2. Shibata and Shintani Model for Measuring the Degree of Capital Mobility

As pointed out in section 1, Shibata and Shintani (1998) considered two hypothetical cases, that is, perfect international capital mobility and financial autarky of a small country. In the extreme case of perfect international capital mobility, they considered that the representative agent maximizes the lifetime utility function with respect to net foreign asset, subject to the country's budget constraint in a small open economy. The optimal consumption behavior of representative agent follows the permanent income model. In the other extreme case of financial autarky, they considered that the representative agent's consumption is restricted by national current net output.

Then, they considered that the actual situation is somewhere between the above two extreme cases of the hypothetical perfect capital mobility and the hypothetical financial autarky. In other words, capital is mobile but not perfectly so across countries. Then, the actual consumption of the representative agent of this mixed case is shown as follows.

$$C_t = (1 - \lambda)C_t^p + \lambda C_t^a = (1 - \lambda)C_t^p + \lambda X_t \quad (1)$$

where C_t^p , C_t^a , X_t are consumption under perfect capital mobility, consumption

under financial autarky and the country's net output in period t , respectively. X_t is defined as $X_t = Y_t - I_t - G_t$. λ is considered to represent the degree of international capital immobility ($0 \leq \lambda \leq 1$).

In the extreme case of $\lambda = 0$, C_t coincides with C_t^p so that the consumption behavior of the representative agent becomes that of the PM agent. In the other extreme case of $\lambda = 1$, C_t^a coincides with X_t , so that the consumption behavior of the representative agent becomes that of the PA agent. Thus, the more freely the capital moves internationally, the smaller is the value of λ . This is why we call λ "the degree of capital immobility".

In order to eliminate an unobservable term, C_t^p , in (1), they derived the following equation describing the change in aggregate consumption.

$$\Delta C_t = (1 - \lambda)\varepsilon_t + \lambda\Delta X_t \quad (2)$$

This is the estimation equation (10) in Shibata and Shintani (1998). In this paper, we also apply it to our three developing countries in the following section.

3. Sample Countries and Data

We choose three countries, Korea, Mexico and Hong Kong to represent developing countries in East Asia and Middle-Southern America. We are interested in these countries, because Korea and Mexico have experienced severe currency crises, while Hong Kong has suffered a ripple effect from the crisis. We use quarterly time-series data, which are obtained from the IMF's *International Financial Statistics*, Dec. 1998. The sample period for each country differs, depending on the availability of the data, as shown in Table 1.

4. Estimation Methods and Empirical Findings

Besides using OLS, we use the generalized method of moments (GMM) to estimate the measurement of the degree of capital immobility, λ , in equation (2). The reason for using GMM is that the error term, ε_t , may be correlated with the change of net output, ΔX_t , as follows. A positive value of ε_t means that C_t^p is larger than

$E_{t-1}(C_t^p)$. Since the level of C_t^p depends on the permanent income in period t as mentioned before, so the permanent income of period t is larger than that expected in period $t-1$. This will happen usually in the case that the increase of net output from period $t-1$ to t , ΔX_t , is large.

The alternative sets of instrumental variables (IV) used in our GMM estimation are $\{\Delta X_2, \dots, \Delta X_4\}$ for IV=1; $\{\Delta X_2, \dots, \Delta X_6\}$ for IV=2; $\{\Delta C_2, \dots, \Delta C_6\}$ for IV=3 and $\{\Delta X_2, \dots, \Delta X_4, \Delta C_2, \dots, \Delta C_4, CA_{t-2}\}$ for IV=4. The point estimate of λ will depend on the choice of instrumental variables to some extent.

Before we estimate Shibata and Shintani model, we should perform unit root tests to the variables used in the estimation of (2), in order to make it sure that these variables are stationary over time. We use two different types of unit root tests which are originally proposed by Dickey and Fuller (1979) and by Phillips and Perron (1988), respectively. The results of tests are shown in Table 1. We can safely say that these results reject the null hypothesis of a unit root for all the variables. So we can assume that these variables are stationary, and thus we can use GMM and J test.

First, we show the estimation results by OLS. The results are presented in the first column of Table 2. The estimated values of λ for all the three developing countries are small. This means that these countries are highly open.

Next, we turn to the estimation results by GMM in Table 2. The small p-values of the J statistics mean that the null hypotheses of the overidentifying restrictions are rejected so that the estimates of λ by GMM are not reliable in these sets of instrumental variables, and so we do not have to consider these cases anymore. These sets of instrumental variables are IV=2, 3 and 4 for Korea, IV=3 for Mexico, and IV=1 and 3 for Hong Kong.

For the remaining cases of reliable estimates, the estimates of λ are rather stable for each country even if we use different sets of instrumental variables. They are small (around 0.2) in all the three countries. Our results imply high capital mobility even in these developing countries.

Further, we know from our estimates of λ that Hong Kong is the most open among our three developing countries, and the openness of Korea and that of Mexico are almost the same.

5. Conclusion

This paper applied Shibata and Shintani approach to measure international capital mobility in Korea, Mexico, and Hong Kong. We found significant evidences on the high capital mobility in all the sample countries.

Shibata and Shintani (1998) estimated the degree of capital mobility in eleven developed countries of OECD. The main result of their empirical analyses suggested that their sample countries can be divided into two groups. In one group, including six developed countries (Australia, Belgium, Denmark, Germany, Italy and Netherlands), the degree of capital mobility was found to be high. In the other group, including five developed countries (Canada, France, Japan, the United Kingdom and the United States), the degree of capital mobility was shown to be low. But the estimation values of λ were generally around 0.5. Thus, it is difficult to evaluate whether the capital is mobile or immobile in these developed countries. The possible reason why relatively low degree of capital mobility was found in the second group was pointed out by Shibata and Shintani as follows. Since their model is based on the small-country assumption, the violation of this assumption may have caused the correlation between consumption and net output even in the case of perfect capital mobility.

Our findings show that the capital is much more mobile in the three developing countries of our paper than in the developed countries of OECD studied by Shibata and Shintani. Furthermore, our findings support the empirical results in Reisen and Yeches (1993), and Sun (2000), and contradict the FH's interpretation of their regression results stated in section 1.

The approach of Shibata and Shintani (1998) that we used in this paper, that of Reisen and Yeches, and Sun, and that of FH are all different. On the whole, the former two approaches imply much higher capital mobility than the FH's own interpretation of their results that the capital mobility is low. The former two approaches build theoretical models to measure the degree of capital mobility directly, while FH does not do so. Thus, the result of the FH's regression allows several possible alternative interpretations other than the one given by FH.⁴ From these points, we consider that the FH's interpretation of their results is somewhat dubious.

⁴ As we wrote in section 1, Obstfeld and Rogoff (1996, pp.162-163) listed several interpretations for the significantly positive and large correlation between saving and investment rates in the FH's regression. In point 4 of page 163, they referred to the theoretical model of section 3.4 of their book, which implies positive correlation between the above two rates in the steady state even under perfect capital mobility. In point 2 of the same page, they mentioned the possibility that the capital mobility might be relatively low in developed countries that are near steady states, while it might be relatively high in developing countries that are distant from steady states. This reasoning of low mobility in developed countries without any barriers is quite different from that of FH.

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Table1: Tests for a unit root

Countries	Sample Period	Augmented Dickey-Fuller Test		Phillips-Perron Test [†]	
		ΔX	ΔC	ΔX	ΔC
Korea	1980:1 1997:4	-9.09550 (0.0000)**	-10.30228 (0.0000)**	-93.43606	-74.66929
Mexico	1982:2 1996:3	-4.72166 (0.0006)**	-1.86964 (0.0670)	-76.37280	-63.34086
HongKong	1986:1 1997:4	-14.4443 (0.0000)**	-7.07643 (0.0000)**	-46.43070	-61.28391

[†] 5% and 1% critical values are -3.60 and -4.38, respectively, for the unit root test (Fuller 1996, p.642).

** Significant at the 1% level for a one sided test. *p*-values in parentheses.

Table2: Estimates of the degree of capital mobility[†]

	OLS estimates	GMM estimates			
		IV=1	IV=2	IV=3	IV=4
(1)Korea					
λ measure	0.1651 (0.007)	0.2468 (0.000)	0.2780 ^Δ (0.000)	0.5490 ^Δ (0.001)	0.5531 ^Δ (0.000)
J statistic		3.0852 (0.2138)	9.7671 (0.0445) ^Δ	8.6589 (0.0702) ^Δ	12.3530 (0.0545) ^Δ
(2) Mexico					
λ measure	0.1959 (0.036)	0.2472 (0.009)	0.2665 (0.006)	0.4266 ^Δ (0.039)	0.2266 (0.025)
J statistic		2.1113 (0.3480)	7.1714 (0.1271)	9.7891 (0.0441) ^Δ	10.0993 (0.1205)
(3)HongKong					
λ measure	0.1711 (0.001)	0.2093 ^Δ (0.000)	0.1873 (0.000)	0.2015 ^Δ (0.000)	0.1845 (0.000)
J statistic		5.0619 (0.0796) ^Δ	6.1262 (0.1899)	8.3211 (0.0805) ^Δ	9.7545 (0.1354)

[†] Estimates of λ and *J* statistics are shown with *p*-values in parentheses.

^Δ The *p*-values of the *J* statistics are small so that the estimates by GMM in these cases are not reliable, and so we do not have to consider these estimates in our discussions.