
**Financial Market Integration
in Singapore: The Narrow and the
Broad Views**

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**FINANCIAL MARKET INTEGRATION IN SINGAPORE:
THE NARROW AND THE BROAD VIEWS**

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EXECUTIVE SUMMARY

1 As an integral part of its development strategy, Singapore has maintained an open capital (as well as current) account, in which there is virtually no restriction on movements of portfolio capital and direct investment. The paper is concerned with evaluating the extent to which the liberal exchange control regime has led to, from an economic stand point, a perfect integration of the Singapore financial market with the rest of the world.

2 The study employs three macroeconomic benchmarks for evaluating the degree of financial market integration, namely:

- (i) the international parity conditions which is concerned with the equality of nominal and real expected returns on financial assets denominated in different currencies as a result of arbitrage activities in the financial and the goods markets;
- (ii) the degree to which domestic saving is correlated with investment and the extent to which capital movements allow a country to smoothen its consumption over time;
- (iii) the closeness of a country's consumption growth with the consumption growth of the rest of the world as a consequence of consumption risk diversification.

3 The empirical results indicate that movement of funds between the domestic and the ACU interbank markets has resulted in the covered and uncovered interest parity relationship holding for the short term nominal Singapore Dollar and the US Dollar interest rates. The fact that uncovered interest parity holds indicates not only the absence of regulatory barriers to capital mobility but also the absence of aversion to exchange rate risk, which is one of the major sources of portfolio 'home bias'. However, the analysis indicates that real interest parity condition for the short-term interest rate does not hold, mainly on account of the failure of the purchasing power

parity relationship. The departure from PPP relationship is a result of the imperfect integration of the goods market, rather than the absence of integration among the money markets.

4 Focusing on a broader definition of capital mobility that includes both short-term and long-term funds, the analysis shows that there is no correlation between the country's saving and its investment, as would be the case if there is perfect international capital mobility. With an open capital account, any excess domestic saving over investment would tend to move out of the home country. Likewise, an increase in domestic investment will tend to be financed by external sources, and not necessarily by domestic saving. A complementary analysis also indicates that capital movement freely offset the difference between domestic saving and investment in a manner that allows the country to smoothen its consumption profile in response to shocks.

5 Finally, the paper tests the most stringent criteria for financial integration which requires not only complete capital mobility but also the existence of state-contingent financial markets so that individuals in different countries can fully hedge their country-specific risks. On the assumption that the preferences are identical across different countries, the criteria implies that consumption growth across countries are perfectly correlated. Given the onerous assumptions underlying the test of financial integration, it is not surprising that the empirical results reject the hypothesis of perfectly correlated consumption growth across countries, even though capital is fully mobile across borders.

6 Overall, the empirical findings support the notion that Singapore's financial market is integrated with the rest of the world. The recent financial sector reform measures can be expected to further increase the integration of the country's financial market by encouraging greater mobility of capital and by reducing various sources of 'home bias' among foreign investors with respect to Singapore-issued securities and the local investors' bias towards foreign securities.

I INTRODUCTION

1.1 It has been long established that an open and well-integrated financial market enables a country to maximise the benefits of an increasing globalised economy. A financial market that is well integrated with the rest of the world allows a country to smoothen its consumption and attract productivity-enhancing investment from abroad. Financial integration adds depth and liquidity to the domestic capital market and permits it to perform its intermediation and risk diversification roles more efficiently. While the recent East Asian financial crisis has highlighted the dangers of capital flows reversal, it also provides a policy lesson on the need to put in place a robust financial system regulatory framework before a country can maximise the benefits of an open financial market.

1.2 For Singapore, the openness of the capital account has been one of the pillars of its development strategy aimed at developing the country into an international financial centre and at promoting an export-oriented manufacturing sector. The recent measures to further liberalise the financial sector are expected to increase further the capital flows between Singapore and the rest of the world.

1.3 The paper analyses how the liberal exchange control regime and the scale of capital flows have led to the integration of the Singapore financial market compared to the economists' benchmark of perfect capital market integration. A country's financial market is said to be fully integrated with the rest of the world when capital flows are able to move freely across its border in response to changes in expected relative returns on assets. A fully integrated financial market, therefore implies (i) the absence of barriers to capital movement, in the form of high transaction costs, taxes, official regulations and controls, which allow arbitrage activities to equalise expected yields on asset denominated in different currencies, (ii) the absence of aversion to exchange rate risk and other form of "home bias" that lead investors to view the domestic and foreign currency assets of identical characteristics as imperfect substitutes. Imperfect asset

substitutability may segment the capital market even if there is no institutional and regulatory barriers to mobility of capital. The empirical tests on integration of financial market focus on the implications of perfect capital mobility and asset substitutability on differential returns on assets, the relationship between domestic saving and investment, and correlation of consumption across countries.

1.4 Section II of the paper outlines the major features of the country's saving-investment balance and the trend in two-way capital flows. Section III focuses on the tests of financial market integration that are based on the "law of one price" comparison of the short-term money market yields. Section IV takes a broader view of capital flows and evaluates the degree of market integration on the basis of the correlation between aggregate saving and investment and the extent to which capital flows allow consumption smoothing to take place. The criteria employed in Section V to test for capital market integration requires not only that capital be freely mobile but also the asset market be complete in order to allow individual agents to fully diversify their consumption risk. Section VI concludes and discusses the implications of the recent financial sector reform measures on the integration of the capital market.

II OPENNESS OF THE ECONOMY AND CAPITAL FLOWS

2.1 Singapore is one of the most open economy in the world with its goods and financial markets closely linked with the rest of the world. The average share of import and exports to GNP during the period 1980 to 1999 was 290 percent while the share of capital inflows and outflows as the percentage of GNP was 41 percent.

2.2 Underpinning the outward capital movement is the high saving rate of the country which rose from 33 percent of GDP in 1980 to 54 percent by 1998. Since 1988 the amount of domestic saving has been more than sufficient to finance the level of gross domestic investment, giving rise to a surplus in the current account of the balance of payments. The surplus in the current account increased from 7.7 percent of GDP in 1988 to 21 percent of GDP (Figure 1). The outflows of direct and portfolio investment abroad has risen substantially in line with the rising current account surplus (Figure 2a). As a result, the stock of Singapore-owned assets held abroad increased from S\$5 billion (17% of GDP) in 1980 to S\$147 billion by 1997 (103% of GDP)¹. Direct investment constituted the largest component of the foreign assets held, accounting for an average share of 35 percent. In recent years, deposit placements and property-ownership have become more prominent components of overseas asset holding, besides investment in shares and debt securities.

2.3 At the same time that excess domestic savings were being invested abroad, the country has been a recipient of continuous large foreign direct and portfolio investment (Figure 2b). The export-oriented industrialisation programme that was launched during the early 1960s, which aimed at attracting the multinational corporations to locate their manufacturing facilities in Singapore, has led to large direct investment inflows. The increase in private portfolio capital inflows, largely for investment in the local stocks and shares, was part of the global private

¹ Department of Statistics, Singapore Investment Abroad, various issues.

equity flows to emerging market capital markets². The stock of foreign equity investment, i.e. direct, indirect³, and portfolio, had risen from S\$13 billion in 1980 (52% of GDP) to S\$147 billion in 1997⁴ (103% of GDP). The manufacturing sector, on an average, absorbed around 36 percent of the total foreign equity investment while the finance and insurance services accounted for another 40 percent and the transport, storage, and communication took up another 10 percent. The flow of inward direct investment represented, on an average, 36 percent of the annual gross private investment between 1980 to 1999.

2.4 The flows recorded under "other investment" are foreign currency lending and borrowing activities of the domestic banking institutions and non-bank residents. Some of these foreign currency transactions are conducted through the Asian Currency Units (ACUs).⁵

2.5 The magnitude of the domestic banking system transactions with the ACUs and foreign banks outside of Singapore can be seen from Figure 3. Lending by the domestic banking system to the ACUs and banks outside of Singapore, as a percentage of the banking system assets, rose from an average of 12 percent during the early 1980s to an average of 24 percent in recent years. Likewise, borrowing by the domestic banking system from these entities increased from 20 percent of its total liabilities during the early 1980s to 30 percent in the late 1990s. In recent years, the net interbank borrowing by the domestic banking system from these sources

² See World Bank (1997) for an analysis on the magnitude and the determinants of private portfolio flows to emerging markets.

³ Foreign indirect investment refers to investment in a local company by existing foreign company operating out of Singapore.

⁴ Department of Statistics, Foreign Equity Investment in Singapore, various issues.

⁵ An ACU is a separate accounting unit established within a banking institution that has been approved by the Monetary Authority of Singapore to operate in the Asian Dollar Market. It is licensed to transact only in foreign currency business and is prohibited to acquire any asset or to incur any liabilities denominated in Singapore Dollar. Notwithstanding these restrictions, the ACUs are permitted to conduct a wide range of banking business with non-residents as well as residents.

had increased substantially in order to fund the increase in domestic loans and advances.

2.6 Underpinning the openness of the economy to international trade and capital is the absence of formal trade barriers and exchange controls. With the exception of a few items, no import duties are levied and there is no import licensing. Export licences are required only for a handful of items and there is no restrictions on the utilisation of export proceeds. Residents are allowed to borrow, lend and invest freely in foreign currencies and they may also freely deal in spot and forward foreign exchange transactions. Non-residents are freely allowed to make direct and portfolio investments in the country⁶. The liberal exchange control regime provides the necessary environment for the development of Singapore as an international financial centre that has attracted large number of financial institutions from the region and globally.

2.7 While Singapore has maintained a liberal exchange control regime, there are certain restrictions placed on the provision of Singapore-Dollar credit facilities to non-residents. Before August 1998, banking institutions were required to consult with the Monetary Authority of Singapore (MAS) before granting Singapore-Dollar credit facilities in excess of S\$5 million to non-residents for the purpose of financing investment in Singapore and they are not allowed to provide credit facilities to non-residents for use outside of Singapore⁷. Even in the case of resident borrowers, the banks need to secure the MAS approval if the credit facilities are to be used for financing activities off-shore.

⁶ Government approval is required, however, for foreign investment in residential and other properties that has been zoned or approved for industrial and commercial use. Foreigners may freely purchase residential units in buildings of six or more stories and in approved condominium developments.

⁷ The MAS's policy on the internationalisation of the Singapore Dollar was previously set out in a MAS notice to banks, MAS 621. MAS 621 was replaced by MAS 757 in August 1998 which sets the first phase of liberalisation on the use of Singapore Dollar for business transactions.

2.8 Since August 1998, as a result of several liberalisation measures, banks are allowed to provide Singapore-Dollar credit facilities to residents for use outside of Singapore and to grant such facilities to non-residents to finance designated economic activities in Singapore. No prior approval was required if the credit facilities to the non-residents was for the purpose of acquisition of shares, bonds, deposits and commercial properties in which the amount is less than S\$5 million. With effect from November 1999, non-residents can freely borrow to finance any transactions in Singapore if the borrowing limit is maintained at S\$5 million⁸. Banking institutions are allowed, without prior consultation with the MAS to arrange for the Singapore Dollar equity listings or bond issues for non-residents if the proceeds from the issuance are for financing designated economic activities in Singapore. Where the proceeds are to be used offshore, the banks need to consult the MAS before arranging the issue of these securities. The proceeds from such issues are required to be converted or swapped into foreign currencies for repatriation offshore.

2.9 The following sections of the paper are concerned with testing the extent to which the open regulatory regime in Singapore and the observed two way flows of funds in the past have brought about a close integration of the Singapore financial market with the rest of the world using various benchmarks of perfect capital mobility that have been developed in the literature.

⁸ This was effected through the new MAS 757 which further relaxed the rules relating to the internationalisation of the Singapore Dollar.

III INTERNATIONAL PARITY CONDITIONS

3.1 The international parity conditions refer to the equality of nominal and real expected returns on financial assets denominated in different currencies (when measured in a common currency) as a result of arbitrage activities in the financial and goods markets. The first parity condition which focuses exclusively on the mobility of capital in facilitating arbitrage activities is the covered interest parity (CIP) condition. Under CIP, arbitrage activities are fully covered against exchange rate risk and the only barriers that prevent free movement of capital to equalise nominal returns on assets of different currency denominations are capital controls and other institutional barriers. As such the CIP is often viewed as the most unalloyed criterion for capital mobility [Frankel (1992)].

3.2 CIP states that funds flow so as to equalise the forward premium (discount) to the difference between interest rates on the domestic and foreign currency denominated assets:

$$i_{t+k} - i_{t+k}^f = f_{t+k} - s_t \quad (1)$$

where i_{t+k} is the nominal interest rate of the domestic currency asset purchased at time t and maturing at time $t+k$, i_{t+k}^f is the corresponding interest rate on a foreign currency denominated asset of identical default risk, s_t is the logarithm of the spot exchange rate and f_{t+k} is the logarithm of the forward rate transacted at t for settlement at $t+k$.

3.3 Equation (1) indicates that when the domestic interest rate is higher (lower) than the foreign interest rate, the lower (higher) foreign interest rate is compensated by a forward premium (discount) on the foreign currency. The arbitrage transaction is fully covered for the exchange rate risk as the investors simultaneously make a forward purchase (sales) of the

domestic currency when they sell (purchase) it down in the spot market.⁹ Deviations from CIP would therefore reflect mainly barriers to free capital movement such as capital controls, discriminatory tax regulations, and transaction costs.

3.4 Predicated on the assumption that capital is able to move freely across borders to engage in covered arbitrage activities, the next parity condition that is commonly employed to evaluate the degree of financial integration is the uncovered interest parity condition (UIP). Under the UIP, investors seek to engage in the uncovered arbitrage activities in the hope of reaping larger speculative profit from future exchange rate movement. The UIP condition is stated as:

$$i_{t+k} - i_{t+k}^f = s_{t+k}^e - s_t \quad (2)$$

where s_{t+k}^e is the market's expectation of the logarithm of the spot exchange rate at $t+k$ formed at t .

3.5 UIP condition holds only if the investors are risk neutral in that they do not seek any exchange rate risk premium to undertake the unhedged arbitrage transactions. If investors are risk averse and therefore regard assets denominated in different currencies as imperfect substitutes in their portfolio, then a persistent deviation to UIP attributable to the exchange risk premium would arise even if capital is freely mobile. Given our definition of financial integration in terms of the absence of barriers to capital mobility and risk neutral preference of the investors, the UIP condition would be a more appropriate benchmark for evaluating any departure from a situation of complete integration of financial markets. When UIP holds, it implies that not only capital is able to move freely in search of the highest expected return

⁹ In practice, the covered arbitrage transactions are carried out through the forex swap transactions, in which in a single transaction the equivalent of a spot sale (purchase) and a forward purchase (sale) is accomplished. There is no separate interbank market for outright forward exchange rate. Outright forward transaction is carried out using an outright spot transaction and a forward swap of a desired maturity.

but also investors are willing to allocate their international portfolio without regard to the exchange rate risk.

3.6 The final parity condition that can be used to evaluate the simultaneous integration of the financial and goods markets is the real interest rate parity condition (RIP):

$$R_{t+k}^e = R_{t+k}^{ef} \quad (3)$$

where R_{t+k}^e and R_{t+k}^{ef} are the *ex ante* real interests on k -period domestic and foreign securities respectively. The RIP condition is the outcome of simultaneous arbitrage activities in the financial and goods markets which lead to equality of expected nominal returns on financial assets and equality of expected inflation rates between countries. In other words, RIP holds only if uncovered interest parity and *ex ante* purchasing power parity (PPP) conditions hold simultaneously. The *ex ante* PPP is defined as:

$$p_{t+k}^e - p_{t+k}^{ef} = s_{t+k}^e - s_t \quad (4)$$

where p_{t+k}^e and p_{t+k}^{ef} are the expected domestic and foreign inflation rates from period t to $t+k$ respectively. The *ex ante* PPP states that the expected differential in the domestic and foreign inflation rates equals the anticipated rate of depreciation of the spot exchange rate. According to Roll (1979) and Alder and Lehmann (1983), in an efficient market, the expected return from speculating in storable commodities in different markets would be zero. This implies that the expected changes in the real exchange rate would be equal to zero. The *ex ante* PPP, therefore, like UIP, is the outcome of efficient speculation where, instead of arbitraging in interest-bearing securities, the speculator invests in commodities.

3.7 Subtracting (4) from (2) yields the *ex ante* RIP condition:

$$\begin{aligned} 0 &= i_{t+k} - p_{t+k}^e - (i_{t+k}^f - p_{t+k}^{ef}) \\ &= R_{t+k}^e - R_{t+k}^{ef} \end{aligned} \quad (5)$$

3.8 The deviation from RIP therefore reflects either the exchange rate risk premium that is required to undertake uncovered arbitrage among financial assets denominated in different currencies or the purchasing power parity risk where the expected exchange rate movement does not reflect adequately the expected changes in the relative purchasing power.

3.9 We test the international parity conditions using short-term interbank data to evaluate the extent to which the unrestricted flow of funds between the domestic and the ACU money markets has driven away any excess returns from covered and uncovered arbitrage activities.

3.10 We define the deviation from CIP relationship as $i_{t+1} - i_{t+1}^f - f_{t+1} - s_t$ and test whether it is significantly different from zero using monthly (end of month) observations of one-month Singapore Dollar domestic interbank interest rate and the corresponding ACU interbank US Dollar SIBOR rate. The sample is from January 1989 to February 2000. The sample mean of the (annualised) deviation from CIP is -0.9603 of a percent with a standard deviation of 2.4758. The null hypothesis of zero mean is therefore rejected at the marginal significance level of 0.00. We next estimate the following equation:

$$f_{t+1} - S_t = a + b(i_{t+1} - i_{t+1}^f) + u_{t+1} \quad (6)$$

and test the null hypothesis that $\hat{a}=0$ and $\hat{a}=1$. Equation (6) was estimated by OLS using the Newey-West (1987) procedure to obtain consistent estimates of the standard error in the presence of serial correlations in the residuals:

$$f_{t+1} - s_t = 1.2655 + 1.1482 (i_{t+1} - i_{t+1}^f)$$

(4.1406) (12.4741)

The null hypothesis that $\hat{a}=0$ and $\hat{a}=1$ is rejected at the marginal significance level of 0.00. The significance of the positive constant term can be attributed to the differences in the statutory reserves requirement and tax treatment of earnings between the DBU and the ACU units. The DBU units are required to hold a minimum cash balance (required reserve) with the MAS and must also maintain liquid assets at or above the minimum liquidity ratio¹⁰. On the other hand, an ACU is exempted from holding the required reserves as well as to maintain the minimum liquidity ratio. Further interest income derived from an ACU lending to non-residents attracts only a concessionary tax of 10 percent while interest income derived from a DBU lending to residents is subject to the prevailing corporate income tax rate.

3.11 Allowing for the effects of these factors on the regression intercept, the null hypothesis that the coefficient of the interest rate differential is not significantly differently from one cannot be rejected at the five percent marginal significance level.

3.12 Predicated on the CIP holding, the next step is to evaluate the uncovered interest parity and real interest parity hypotheses. Since evaluating RIP involves testing the joint hypothesis of UIP and PPP, Marston (1997) has suggested that the power of the test can be enhanced if the three parity conditions are tested jointly in order to exploit the fact that common factors are responsible for the deviations from more than one of the parity conditions. Previously the standard test to evaluate whether each of these conditions holds has to resort to using observable *ex post* deviations from the parity conditions. The *ex post* deviation from UIP consists of the

¹⁰ From 1976 to 1998, the minimum cash balance was kept at 6 percent of deposit liabilities. It was reduced to 3 percent in 1998. Since 1987, the liquid asset ratio has been set at 18 percent.

exchange rate risk premium r_{t+k} , and the exchange rate forecast error,

$$\mathbf{e}_{t+k} = S_{t+k}^e - S_{t+k} :$$

$$i_{t+k} - i_{t+k}^f - \Delta S_{t+k} = \mathbf{r}_{t+k} + \mathbf{e}_{t+k} \quad (7)$$

3.13 Similarly, the deviation from *ex post* PPP is attributed to both the exchange rate forecast error and the inflation differential forecast error,

\mathbf{m}_{t+k} :

$$\mathbf{p}_{t+k} - \mathbf{p}_{t+k}^f - \Delta S_{t+k} = \mathbf{m}_{t+k} + \mathbf{e}_{t+k} \quad (8)$$

3.14 Given (7) and (8), the *ex post* real interest rate differential is attributed to the presence of a risk premium and errors in forecasting inflation:

$$R_{t+k} - R_{t+k}^f = \mathbf{r}_{t+k} + \mathbf{m}_{t+k} \quad (9)$$

3.15 The standard procedure for testing the hypothesis that the parity conditions holds is to determine whether the deviations from the parity conditions are systematically related to variables that are in the information set. The test is essentially a joint test of the rationality of forecasts and the parity condition. If the parity condition holds and the forecast is rational, then the *ex post* deviation from the parity condition should not be systematically correlated with the variables in the information set.

3.16 Consider now a system of three equations, with each equation relating the *ex post* deviations from a given parity condition to a common set of variables, Z_t , in an information set:

$$i_{t+k} - i_{t+k}^f - \Delta S_{t+k} = \mathbf{f}_0 + \mathbf{f}_1 Z_t + u_{t+k} \quad (10a)$$

$$\mathbf{p}_{t+k} - \mathbf{p}_{t+k}^f - \Delta S_{t+k} = \mathbf{l}_0 + \mathbf{l}_1 Z_t + v_{t+k} \quad (10b)$$

$$R_{t+k} - R_{t+k}^f = \mathbf{g}_0 + \mathbf{g}_1 Z_t + w_{t+k} \quad (10c)$$

3.17 The conventional single-equation test of UIP would involve estimation of equation (10a) and testing the null hypothesis that $f_t = 0$ [Giovannini and Jorion (1987), Cumby (1988), Bekaert and Hodrick (1992)]. The rejection of the null hypothesis would imply that the deviations from UIP can be due to the presence of risk premia and/or the presence of systematic forecast errors. In the single equation test, however, it is not possible to pinpoint the exact source of the departure from the UIP.

3.18 However, if additional information is available from equation (10c), a more definitive inference can be made. A rejection of the null hypothesis that $g_t = 0$ and $f_t = 0$ would imply that risk premium, r_{t+k} , is responsible for the deviation in UIP and RIP. This is because the exchange risk premium is the only variable that is common to both equations (7) and (9).

3.19 Similarly, a rejection of the null hypotheses that $f_t = 0$ and $I_t = 0$ would imply that the systematic exchange rate forecast error, ε_{t+k} , is responsible for the deviations from UIP and *ex ante* PPP.

3.20 The presence of the r_{t+k} term in both equations (7) and (9) can be tested by the cross-equation restriction $f_t = g_t$. This restriction, however, is equivalent to the restriction $I_t = 0$ in equation (10b). The presence of ε_{t+k} in both equations (7) and (8) is tested by the cross-equation restriction $f_t = I_t$, which implies an equivalent restriction $g_t = 0$ in equation (10c).

3.21 Figure 4 plots the monthly *ex post* deviations from UIP, PPP, and RIP for the sample period January 1990 to February 1999. The Singapore interest rate is the 3-month domestic interbank rate while the foreign interest rate is the 3-month US Dollar SIBOR rate. The inflation rates for Singapore and US are measured as the percentage change in the consumer price index. Table 1 presents the unconditional means and variances of the *ex post* departures from the three parity conditions. As can be expected, the deviations from both UIP and PPP are much more volatile

than the deviations from RIP as the former is driven by exchange rate forecast errors.

3.22 In Table 2 we report the test of the three parity conditions based on estimates of equations (10a), (10b), and (10c). The variables that we include in the information set Z_t are one-month lagged changes in the Singapore Dollar SIBOR rate and the US Dollar SIBOR rate, and two-month lagged Singapore and US inflation rates. All these variables are known when projections are made at each period t . The table shows the χ^2 statistics for the tests of the null hypothesis for each equation: $f_t = 0$ in the UIP equation, $I_t = 0$ in the PPP equation and $\gamma_1 = 0$ in the RIP equation. The test statistics reject the null hypothesis that each of the parity conditions hold. The rejection of $I_t = 0$ implies that the presence of a time-varying exchange rate risk premium is partly responsible for the deviation from UIP. The rejection of $g_t = 0$ indicates that systematic exchange rate forecast errors also account for the rejection of the UIP hypothesis.

3.23 Given that the deviations from the three parity conditions appear to be unusually large during the period following the outbreak of the Asia currency crisis (Figure 4), we estimated equations (10a) to (10c) and performed the orthogonality tests on a sub-sample that covers only the period 1990Q1 to 1997Q2, before the crisis. When the observations from the currency crisis period are excluded, the sample mean of the *ex post* deviations from UIP is -0.38 percent (as opposed to the mean of -1.17 percent when the entire sample is considered) and it is statistically not significant from zero (Table 1). The average deviations from PPP and RIP computed over the restricted sample are larger than the average deviations over the larger sample.

3.24 The chi-square tests of the three parity conditions based on the restricted sample are reported in Table 2. The test statistic indicates the restriction $f_t = 0$ underlying the UIP cannot now be rejected. The finding indicates that once the period of extreme market turbulence is excluded,

there is little systematic exchange rate forecast error or exchange rate risk premium that causes persistent deviations from UIP.

3.25 The chi-square statistics reaffirm the rejection of the restriction $I_I = 0$ in equation (9b) and $g_I = 0$ in equation (9c). The test results therefore confirm the rejection of RIP and this can be attributed to the presence of systematic inflation forecast errors.

3.26 Thus on the basis of the covered interest parity and the uncovered interest parity criteria, the Singapore financial market appears to be well integrated. Real interest parity, however, does not hold and this is attributed to the less than perfect integration of the goods markets (rather than the capital markets) which gives rise to significant deviation from the *ex ante* purchasing power parity. Existing evidence has shown that PPP can be expected to hold only over very long time periods [Frankel and Rose (1995), Froot and Rogoff (1995)].

IV SAVING-INVESTMENT CORRELATION AND INTER-TEMPORAL CURRENT ACCOUNT BEHAVIOUR

4.1 Feldstein and Horioka (1980) have pointed out that one can infer from the correlation between the national saving rate and the national investment rate the degree to which financial capital flows across countries in response to differences in the real rate of returns on capital. According to the authors, changes in national saving or domestic investment would generate movement in a country's current account balance. In a well integrated financial market, a current account deficit (surplus) will be offset by a corresponding capital inflow (outflow) and a country's savings decisions will be separated from its investment decisions. Feldstein and Horioka emphasised that the capital flows they refer to are the long-term flows that respond to the real yield differences among the relatively illiquid physical assets invested in different countries and not to the short-term liquid portfolio flows that seek to arbitrage differences in the interest rates as in the case of the international parity conditions. Since the test involves evaluating the flow of saving relative to the requirement of domestic investment, the underlying concept of capital mobility is much broader involving both the short-term and long-term funds that are intermediated from a country's aggregate saving.

4.2 The Feldstein-Horioka criterion rests on the argument that when capital moves in response to cross-country differences in the real rate of return, the location of a country's investment in fixed capital would be independent of its domestic saving. As Feldstein and Horioka states "With perfect world capital mobility, there should be no relation between domestic saving and domestic investment: Saving in each country responds to the worldwide opportunities for investment while investment in that country is financed by the worldwide pool of capital." (p. 317).

4.3 The Feldstein-Horioka test of perfect capital mobility can be evaluated by estimating the following regression:

$$\left(\frac{I}{Y}\right)_t = a + b \left(\frac{S}{Y}\right)_t + e_t \quad (11)$$

and testing the null hypothesis that $b=0$. I_t is the gross domestic fixed investment, S_t is the gross domestic saving, and Y_t is the gross domestic product.

4.4 Feldstein and Horioka estimated equation (11) for a cross-section sample of fifteen industrial countries using the average saving and investment rates for the period 1960-1974. They estimated a value of $b=0.88$ and concluded that for the industrial economies, a relatively high fraction of the gross fixed investment was financed by domestic saving. A later study by Feldstein and Bacchetta (1990) found that the value of b had declined from 0.91 in the 1960s to 0.61 over the period 1980-1986. The inference was that while capital remain relatively immobile, the degree of financial integration among OECD countries had increased overtime. A study by Obstfeld (1989) has confirmed that the estimates of the parameter b have fallen after 1973.

4.5 While many studies have established conclusive evidence that saving rates were closely correlated with the investment rates for different set of countries and for different time period, there was considerable divergence of views as to what the estimated correlations imply. Summers (1988) and others have viewed the observed high correlation between saving and investment rates as evidence of successful balance of payments policy designed at controlling the excessive current account imbalance. Over the long run, however, saving and investment will be correlated closely because of the inter-temporal budget constraint [Coakley et al (1996)].

4.6 Murphy (1984) has argued that the close saving and investment correlation was attributed to the inclusion of the large industrialised countries in the sample of the researchers. Small countries take the world interest rate as given, while changes in the savings and investment in the large countries would have significant impact on world interest rates. Shocks to national savings in large countries could thus affect world interest rates and through them domestic investment. Saving and investment would be correlated even if financial markets are integrated

because both these variables are endogenous in nature and respond to movements in common factors. Tesar (1991), for example, argued that capital indeed was mobile, but shocks to the productivity of domestic capital stock and labour in a particular country tend to affect both desired saving and investment, leading to a positive correlation between these variables. The outcome of all these criticisms is to raise doubt whether a high correlation between the saving and investment rates can be interpreted as evidence of low cross-border capital mobility.

4.7 Figure 5 shows the scatter plots of the annual domestic saving and investment rates for the Singapore economy for the period 1975 to 1999. The lack of correlation between the saving rate and investment rate, especially after 1988, is evident from the deviations of the observations from the 45° diagonal. While the country exported its excess saving abroad, it was at the same time receiving foreign capital inflows to finance part of the domestic capital formation.

4.8 An estimate of equation (11), in the first difference form¹¹, using a quarterly sample from 1985:1 to 1993:3 yields the following results:

$$\Delta(I/Y) = -0.0018 + 0.0571 \Delta(S/Y)_t$$

(-0.5767) (1.1439)

$$R^2 = 0.015 \quad DW = 2.7076$$

Figures in parentheses are *t*-values. The coefficient of the change in the saving rate is not statistically significant from zero.

4.9 A more useful measure of international capital mobility while retaining the focus on the saving-investment relationship, is to analyse how

¹¹ The Augmented Dickey-Fuller test indicates that the null hypothesis of unit root cannot be rejected for both the saving and investment ratios. The ADF test statistics for the saving and investment ratios respectively are -3.2993 and -3.4171 compared to the 5 percent critical value of -3.4889. The ADF autoregressive equations for performing the unit root tests include a deterministic linear time trend and a constant.

far capital flows allow an individual country to smooth its consumption profile over time in response to transitory shocks in income. To the extent capital flows allow agents of a country to fully smooth their consumption inter-temporally, then the financial market of the country is considered to be well integrated with the world.

4.10 The theoretical framework of the inter-temporal approach to current account can be drawn from the discrete time version of Sach's (1982) model, which is essentially an extension of the rational expectations permanent income hypothesis of private consumption [Campbell (1987)] to an open economy setting.

4.11 Consider a small open economy represented by a single infinite lived agent who can borrow and lend freely in the international capital markets at a constant world real interest rate r . Suppose the preferences of the representative agent are given by:

$$\sum_{j=0}^{\infty} \mathbf{b}^j E_t[U(C_j)] \quad (12)$$

where \mathbf{b} is the subjective rate of discount, $U(\cdot)$ is the instantaneous utility function, and E_t is the expectation operator.

4.12 The consumer faces an inter-temporal budget constraint of the form:

$$\sum_{j=0}^{\infty} \left(\frac{1}{1+r}\right)^{j+1} C_{t+j} = \sum_{j=0}^{\infty} \left(\frac{1}{1+r}\right)^{j+1} (q_{t+j} - i_{t+j} - g_{t+j}) + b_t \quad (13)$$

where q_t is the output or gross domestic product in period t , C_t is the private consumption expenditure, i_t is the total public and private investment, g_t is the government consumption expenditure, and b_t is the stock of net foreign assets at the end of period t .

4.13 Maximising (12) subject to (13), the optimal consumption path C_t^* can be written as:

$$C_t^* = \frac{r}{g} \left\{ b_t + (1+r)^{-1} E_t \left[\sum_{j=0}^{\infty} (1+r)^{-j} Cfn_{t+j} \right] \right\} \quad (14)$$

where $Cfn_t = q_t - i_t - g_t$ is the economy net national cash flow, g is a proportionality parameter reflecting the consumption tilting propensity of the economy [Sachs (1982) and Ghosh (1995)]. If $g > 1$, the country consumes less than its permanent cash flow and therefore tilts its consumption towards the future. If $g < 1$, the opposite holds true and for $g = 1$, consumption equals the economy's permanent cash flows. Equation (14) constitutes the permanent income hypothesis consumption function in an open economy in which planned consumption is proportional to the permanent national cash flows.

4.14 Ghosh (1995) defines the optimal consumption smoothing current account, i.e. the level of capital flows that is consistent with the joint hypothesis of consumption smoothing behaviour of the agent and the satisfaction of the inter-temporal budget constraint as:

$$Ca_t^* = Cfn_t - gC_t^* \quad (15)$$

4.15 Substituting (14) into (15) and solving for Ca_t^* yields:

$$Ca_t^* = -E_t \left[\sum_{j=1}^{\infty} (1+r)^{-j} \Delta Cfn_{t+j} \right] \quad (16)$$

where Δ is the first-difference operator. Expression (16) indicates that the optimal or the consumption-smoothing path of the current account is negatively related to the discounted value of the stream of future net national cash flow. It represents a direct extension of Campbell (1987)'s "saving for a

rainy day" hypothesis since it indicates that a country's saving will rise (fall), thereby resulting in a current account surplus (deficit) whenever it expects a temporary decrease (increase) in the net national cash flow in the future. On the other hand, an anticipated permanent change in the national cash flow, say due to an increase in the output, would cause a one-for-one change in consumption, leaving the current account unaltered.¹²

4.16 There are several testable implications of the consumption-smoothing behaviour as represented by equation (16). First, the position of the current account should allow one to forecast the subsequent changes in the national cash flow. In other words, the consumption-smoothing component of the current account should Granger - cause changes in the national cash flow. Second, if the change in the national cash flow is a stationary process, then equation (16) suggests that the optimal consumption-smoothing current account Ca^* will be an $I(0)$ variable in levels because it is defined as an infinite discounted sum of the stationary variables. Moreover, under the null hypothesis that the present value model is true, the actual consumption-smoothing current account, $Ca_t = Cfn_t - gC_t$, will also be a stationary $I(0)$ variable. The stationarity of the current account implies that C_t and Cfn_t will be cointegrated with the cointegrating parameter g .

4.17 We follow the procedure of Campbell (1987) and Campbell and Shiller (1987) in calculating the expected present discounted value of changes in the national cash flow, conditioned on the information set known to the agent. The agent is assumed to form expectations about the future value of ΔCfn_t by estimating a bivariate VAR of order p that involve Ca_t and ΔCfn_t :

¹² Gan and Soon (1994) have tested the Campbell (1987) saving for a rainy day hypothesis in Singapore and had found that current saving correctly anticipated future changes in income.

$$\begin{bmatrix} \Delta Cfn_t \\ Ca_t \end{bmatrix} = \begin{bmatrix} a(L) & b(L) \\ c(L) & d(L) \end{bmatrix} \begin{bmatrix} \Delta Cfn_{t-1} \\ Ca_{t-1} \end{bmatrix} + \begin{bmatrix} U_{1t} \\ U_{2t} \end{bmatrix} \quad (17)$$

where $a(L)$, $b(L)$, $c(L)$ and $d(L)$ are polynomials in lag operator of order p . Letting $Z_t = [\Delta Cfn_t \dots \Delta Cfn_{t-p} \quad Ca_t \dots Ca_{t-p}]'$, the system in (17) can be written more compactly as $Z_t = AZ_{t-1} + U_t$. Taking into account that expectations are formed rationally, it follows that $E_t(Z_{t+i} / H_t) = A^i Z_t$ for all i , where H_t is the limited information set containing lagged values of Z . Substituting this expression into the right hand side of (16) yields:

$$Ca_t^* = -h'(1+r)^{-1} A [I - (1+r)^{-1} A]^{-1} Z_t = BZ_t \quad (18)$$

where $B = -h'(1+r)^{-1} A [I - (1+r)^{-1} A]^{-1}$. Expression (18) indicates that the optimal consumption-smoothing current account is given as the VAR forecast of the present value of future changes in the national cash flow.

4.18 Once the optimal consumption-smoothing current account is constructed, one can then calculate the variance of Ca_t^* to serve as a benchmark against which the variance of the actual consumption-smoothing current account can be compared in order to test the joint hypothesis of perfect capital mobility and consumption-smoothing behaviour. Under the null hypothesis, the variance of Ca_t^* should be equal to the variance of Ca_t . If the variance of actual Ca_t deviates significantly from the variance of the optimal Ca_t^* , this would imply that the economy has not fully exploited the opportunity available from the international capital market to smoothen consumption in response to changes in the national cash flows.

4.19 We employ the augmented Dickey-Fuller test to test for the presence of unit roots in Cfn_t and C_t using a quarterly sample from 1985:I to 1999:III. The ADF statistic for Cfn_t and C_t are -3.1206 and -3.3155 respectively. These values are less than the Mackinnon 5 percent critical

value of -3.4889 . Hence the null hypothesis that these two variables contain unit root cannot be rejected. We then use the Johansen maximum likelihood cointegration procedure to test for the cointegration between Cfn_t and C_t and to obtain a consistent estimate of the parameter g .

4.20 The I trace statistic for testing the null hypothesis that there is no cointegrating relationship between Cfn_t and C_t was 24.3595 which exceeded the 5 percent critical value of 15.41 [Osterwald – Lenum (1992)]¹³. The following cointegrating vector was estimated:

$$Cfn_t = -2676.481 + 1.5759 C_t \\ (0.0418)$$

The number in the parentheses is the asymptotic standard error. The estimated consumption tilting parameter is 1.6 which indicates that the country consumes less than its permanent cash flow and thus tilts its consumption towards the future. Ghosh (1995) had also found that for countries that had experienced persistent current account surplus like Japan and Germany, the estimates of g were in excess of unity.

4.21 Once the consumption-smoothing current account is constructed, we then test the first implication to the joint hypothesis of capital mobility and optimal consumption behaviour, i.e. the consumption-smoothing current account helps to forecast subsequent changes in the national cash flow. The results of the estimated VAR model are presented in Table 3. The lag length of four was determined on the basis of the Akaike Information Criterion and the Schwarz criterion. The coefficient of the third lag of the current account in the Cfn equation is negative as suggested by the theoretical model and is statistically significant from zero. The null

¹³ In estimating the VAR, we have allowed for a linear deterministic trend and a lag length of four was chosen on the basis of the Akaike Information criterion and the Schwarz Criterion and the chosen lag structure was sufficient to ensure there was no serial correlation in the residuals of the VAR.

hypothesis that the current account does not Granger - cause changes in the national cash flow is rejected at 5 percent.

4.22 We next compare the actual Ca_t with the optimal Ca_t^* formed from the unrestricted VAR forecast of the discounted present value of future changes in net national cash flow. To generate the optimal VAR forecast from equation (18), we express the current account and the change in net national cash flow variables as deviations from their sample means and then we estimated a fourth-order VAR consisting of these variables. We assume a real world interest rate of 4 percent for discounting purposes¹⁴.

4.23 Figure 6 plots the time series of Ca_t and the generated Ca_t^* . The degree of the co-movement of these variables allows one to assess informally the extent to which capital mobility has allowed the economy to smoothen its consumption. Any significant deviations of the current account from the optimal current account would suggest departures from the hypothesis of capital mobility and consumption-smoothing behaviour. With the exception of the observations for years 1992 to 1995, the estimated Ca_t^* is able to track closely the quarterly fluctuations in the country's actual consumption-smoothing current account.

4.24 In Table 4, we present the sample variance of the actual and optimal consumption-smoothing current account. The sample variance of Ca_t^* is slightly smaller than the sample variance of Ca_t . We tested the null hypothesis that the variance of Ca_t^* equals the variance of Ca_t . The F-test and the Siegel-Tukey test failed to reject the null hypothesis that the two sample variances are equal. Hence the inter-temporal current account model suggests that the variability of the capital flows to and from Singapore had been sufficient to allow the economy to smoothen its aggregate private consumption according to the country's expectation of the future cash flows.

¹⁴ The use of 2 percent and 6 percent for the real interest rate does not result in any quantitative differences in the results.

4.25 Overall, the analysis of the saving-investment relationship and the inter-temporal current account behaviour confirms the notion of free mobility of capital in and out of Singapore such that investment is not constrained by domestic saving and the aggregate consumption path is sufficiently smoothed by capital flows.

V CROSS-COUNTRY CONSUMPTION CORRELATION

5.1 This section deals with the final test of financial integration that is based on the correlation of aggregate private consumption growth between Singapore and the rest of the world. Obstfeld (1994a, 1994b) has emphasised that in the presence of a complete state-contingent international finance market, individuals of different countries can insure their consumption risks against all anticipated contingencies, thereby enabling them to smooth their consumption plan over time. The presence of an international Arrow-Debreu type of asset market allows agents from different countries to buy and sell securities with each other in order to insure their desired consumption plan against any country-specific shocks to income and wealth. If such a market for internationally traded state-contingent assets exists, then the expected marginal rates of substitution in consumption between the home country and the rest of the world would equalise. The present test of financial integration is much broader than the tests conducted in the previous section since it requires not only the absence of institutional and regulatory barriers to cross-border capital movement but also the existence of complete state-contingent financial markets which allows consumers to diversify away any country-specific consumption risks.

5.2 Assume there are J countries indexed by $j=1,2,\dots,J$. Each country is inhabited by a representative agent who seeks to maximise his expected utility for different states of nature. The first-order condition implies the following inter-temporal Euler Equation which characterises the optimal consumption plan for country i 's agent:

$$p(S_{t+1}) \cdot U'[C_i(S_t)] = \hat{a} E_t \{ U'[C_i(S_{t+1})] \} p(S_{t+1}) \quad (19)$$

where $C_i(S_t)$ is the country i per capita consumption level contingent on state of nature S at time t , $p(S_{t+1})$ is the probability that state S_{t+1} would occur at time $t+1$, \hat{a} is the subjective discount factor, E_t is the expectation operator conditional on information known on time t , $p(\cdot)$ is the price of the Arrow-

Debreu security that pays a certain sum to buy one unit of consumption in the event state S_{t+1} occurs.

5.3 Equation (19) implies that the marginal rate of substitution of state S_{t+1} consumption for state S_t consumption equals the relative price of state t in terms of state $t+1$ consumption. If agents in all countries face a perfectly integrated international financial market which allows them to trade freely securities across borders, then consumers in countries i and j would be able to equate their marginal rate of substitution between the current consumption and the state-contingent future consumption to the same state contingent security prices. This implies:

$$E_t \left\{ \frac{\mathbf{b}_i U'[C_i(S_{t+1})]}{U'[C_i(S_t)]} \right\} = E_t \left\{ \frac{\mathbf{b}_j U'[C_j(S_{t+1})]}{U'[C_j(S_t)]} \right\} \quad (20)$$

5.4 The empirical implication of equation (20) is that the marginal rate of substitution in consumption will be equalised across time and across states of nature and the *ex post* differences in the inter-temporal substitution between two countries will be uncorrelated with any variables known at time t .

5.5 Assuming the utility function is isoelastic, $U(C_t) = \frac{(C_t)^{1-\ell}}{1-\ell}$, and substituting the actual for the expected consumption growth, the Euler equation can be rewritten as:

$$\Delta C_{t+1}^i = \Delta C_{t+1}^j + \log \left(\frac{\mathbf{b}_i}{\mathbf{b}_j} \right) \frac{1}{\ell} + \mathbf{e}_{t+1}^{ij} \quad (21)$$

where \mathbf{e}_{t+1}^{ij} is the composite forecast error for consumption growth in both countries. If the national time preferences are identical ($\mathbf{b}_i = \mathbf{b}_j$), then consumption growth between countries i and j would be perfectly correlated or the difference in the consumption growth between the two countries would

follow a random walk and would be orthogonal to any variable that is in the information set at time t :

$$\Delta C_{t+1}^i - \Delta C_{t+1}^j = \mathbf{e}_{t+1}^{ij} \quad (22)$$

5.6 The hypothesis of perfect integration of financial markets across countries can be tested by estimating the following regression:

$$\Delta C_{t+1}^i - \Delta C_{t+1}^j = \mathbf{q}X_t + \mathbf{e}_{t+1}^{ij} \quad (23)$$

and evaluating that $\mathbf{q} = 0$. X_t is a matrix of variables known at time t .

5.7 A "weak form" test of the null hypothesis would only employ past observations of the dependent variable in the matrix X_t . A "semi-strong form" test would use any publicly available data known at time t .

5.8 Equation (23) is estimated using quarterly per capita private consumption data for Singapore from 1985:I to 1999:III. The OECD per capita aggregate private consumption as well as the United States per capita private consumption are used to represent the international consumption level. The second and third lagged values of the difference in consumption growth are employed to conduct the weak form test. Since the consumption data are measured as quarterly averages rather than at a given point in time, the change in consumption will be correlated with its first lag. Hence a two-period time gap would be required, at least, between the change in consumption and its predictors. In addition, the time averaging of the consumption data would induce a first-order moving average process in the error term \mathbf{e}_{t+1}^{ij} . Consequently, equation (23) is estimated using the Newey-West generalised covariance matrix estimator. For the semi-strong test, we included the second and third lags of the difference in the growth rate of the per capita GDP in addition to the lagged difference in consumption growth.

5.9 Table 5 presents the results of the weak and semi-strong tests. The results indicate that the difference in the per capita consumption growth between Singapore and the United States are systematically correlated with the information variables, leading us to reject the hypothesis that the financial market of Singapore is perfectly integrated with the rest of the world. However, it should be noted that the Euler equation test is strictly a joint test of capital mobility and the existence of complete state contingent financial market. As Obstfeld (1994b) has pointed out, it is possible to reject the null hypothesis because of incompleteness of financial market even when there is no restrictions on the cross-border movement of capital. In addition, the null hypothesis of perfect correlation of consumption growth across countries is premised on the specific form of the underlying utility function and the assumption that preferences are identical. The stringency of this form of Euler equation test of financial market integration can be seen from the findings by Obstfeld (1994a) on the basis of a sample of seven OECD economies and by Lewis (1996) using a pooled cross-section time series sample of seventy-two countries. These studies rejected the hypothesis that consumption growth across countries are perfectly correlated. In a more recent study, Lewis (1998) also found that consumption growth among seven OECD countries can be predicted from cross country income growth.

5.10 Lewis (1998) has provided a complementary interpretation on the imperfect cross-country correlation of consumption growth as evidence of "home bias" in portfolio holdings. Home bias in portfolio allocation refers to the domestic investors holding a substantially smaller fraction of their wealth portfolio in foreign securities than the standard mean variance portfolio theory would suggest. Home bias implies that domestic investors, despite of the absence of regulatory barriers to offshore investment, choose to forego the benefits of international portfolio diversification¹⁵.

¹⁵ See French and Poterba (1991), Tesar and Werner (1995), Kang and Stulz (1997) for evidence of home bias in equity holdings.

Consequently home bias tends to lead to segmentation of the international capital market.

5.11 As Lewis (1998) has shown, portfolio home bias could prevent individuals from diversifying their risks across countries so that their consumption would be more closely correlated. Individuals in countries that bias their portfolio away from foreign bonds and equities will not be able to diversify away all the risks associated with the fluctuations in home country's income. In the case of Singapore, despite progressive diversification of foreign asset holdings over the years as documented in Section II, the imperfect correlation of the country's consumption with world consumption growth would imply the existence of certain degree of home bias in the domestic investors' portfolio. However, some degree of home bias is inevitable to the extent that national borders exist. What is important is the extent to which the rising two-way capital flows have given rise to integration of the financial system that approximate the ideal of free international capital mobility.

VI SUMMARY AND IMPLICATIONS

6.1 This paper assessed the extent to which the openness of the Singapore financial market to capital flows has led to the international integration of the market on the basis of several criteria on perfect capital mobility and substitutability. The empirical analysis has found that CIP and UIP hold at the short-end of the financial asset maturity spectrum. While the short-term capital movement is able to arbitrage away excess return in the money market, the failure of the *ex ante* PPP to hold has resulted in the real interest rate in Singapore to diverge from its parity relationship with the real interest rate in the US. This source of deviation from RIP is more of a goods market phenomena rather than evidence of imperfect mobility and substitutability of capital.

6.2 Given that Singapore simultaneously exports its surplus saving abroad and receives foreign capital into the various sector of its economy, it is hardly surprising that the two-way capital movement satisfies the Feldstein-Horioka criterion of capital mobility. A more formal test of capital mobility supports the notion of that the country's capital market is well-integrated as capital flows allow consumption smoothing to take place freely. In addition, we tested the notion of capital market integration that is based on the existence of a complete state-contingent asset market and the absence of home bias in portfolio holdings. Here we reject the hypothesis that the capital market is sufficiently complete as to enable individuals to diversify away all the country-specific risk.

6.3 The liberalisation on the rules relating to the internationalisation of the Singapore Dollar together with the financial market reforms undertaken during the past two years can be expected to increase further the integration of the country's financial market by encouraging greater mobility of capital and by reducing various sources of 'home bias' among foreign investors with respect to Singapore issued securities and the domestic investors' bias towards foreign securities.

6.4 The sources of home bias which tend to segment the international financial market are asymmetric information, illiquidity, and the high transaction costs that could offset the benefits of international portfolio diversification. These impediments lead to demand for higher required return or risk premium by foreigners in order to induce them to hold these securities.

6.5 Information asymmetries arise because non-resident investors are less familiar with the local regulatory and corporate governance environment as well as accounting standards than resident investors. Chuhan (1994) in her survey of market participants from Canada, Germany, Japan, the US and the UK found the fund managers viewed the limited information on the emerging markets as one of the key obstacles to investing in these markets. Markets can be segmented if the non-resident investors perceived the domestic markets to be relatively illiquid. In an illiquid market, investors are not able to liquidate their position quickly without incurring substantial cost.

6.6 The adoption of the predominantly disclosure-based system of regulating the securities industry in Singapore together with the enhanced disclosure standards required of banking institutions would have the effect of mitigating information asymmetries¹⁶.

6.7 The transaction costs of trading shares in the Singapore Exchange (SGX) would be further reduced with the progressive deregulation of the commission rates. By January 2001, commissions on trades of all sizes will be fully negotiable. Liquidity in the local exchange will be further enhanced by allowing complete access to the International Members¹⁷ of the

¹⁶ Improvement in the bank disclosure standards came about through discontinuation of the practice of maintaining hidden reserves, disclosure of details on loan loss provisions, disclosure of off-balance sheet items in notes to accounts.

¹⁷ International members are foreign securities houses which are allowed to trade on the Exchange mainly for the non-resident clients. Their dealings with resident clients were limited, prior to January 2000, to trades in excess of S\$5 million.

Exchange to participate in transaction of all sizes by January 2001. Already, the allowable size of trades in which the International Members are permitted to participate had been reduced from S\$5 million to S\$500,000 with effect from January 2000. From July 2000, new members to the Exchange will be freely admitted and the minimum size limit on their trades with the local investors will be progressively lowered and then removed completely by January 2002.

6.8 The removal of barriers to entry to new stockbrokers together with the easing of the listing conditions for foreign companies to list in Singapore Dollar on the Exchange¹⁸ will enhance its network externalities. Network externalities arise when larger customers using the network lead to greater utility for everyone [Economides (1996)]. Companies will have incentive to list in an exchange where many other firms are already listed (the direct-network effect) and where many intermediaries and brokers trade (the cross-network effect), as more liquidity is in the market [Domowitz (1995), DiNoia (1998)]. Brokers, in turn, would want to be present in an exchange where companies and other intermediaries are present as they will enhance the brokers' attractiveness to their clients. Evidence on the evolution of stock markets has shown that rising liquidity provision has led to decline in the equity risk premium on stocks traded on these markets [Jorion and Goetzman (1999)].

6.9 The change in the governance structure of the merged Singapore Exchange from a mutual organisation to a for-profit company would make it more conducive for the SGX to adopt more progressive technology and enhance its product quality in order to stay competitive. A study by Cybo-Ottone et al (1999) has shown the exchanges that are

¹⁸ The liberalisation of the listing criteria took effect on September 1999. Foreign-incorporated companies can list S\$ denominated shares without having to satisfy the requirement that at least 20 percent of their revenue, profits, or expenses are attributable to Singapore. These companies are now subject to the same listing criteria as the Singapore-incorporated companies. Some aspects of the listing requirement liberalisation are the removal of minimum paid-up capital requirement, relaxation of shareholding spread, and modification of the chain-listing rule.

governed as mutual entities are less likely to adopt electronic trading system as automation is perceived to be against the members' interest.

6.10 For the domestic investors, foreign listing in Singapore Dollar on the SGX reduces the cost of investing in the overseas stock market and minimises the exchange rate risk of holding foreign equity. Local investors buying foreign stocks in off-shore stock exchange would have to go through several layers of intermediation. Besides lower transaction costs, international dual listing in the domestic exchange has been found to reduce the risk premium demanded by the local investors for holding foreign securities and thereby reducing the home bias of the local investors [Foerster and Karolyi (1999), Miller (1999)]. Foreign listings on the local exchange therefore allow domestic investors to diversify their portfolio without ever transacting in a foreign market.

6.11 In a similar vein, the government's effort to encourage foreign entities to issue Singapore Dollar bonds would provide the local investors an additional avenue for international diversification of their portfolio. Efforts made to promote a deep bond market would minimise the liquidity risk of holding bonds¹⁹. Through several measures the MAS has provided the impetus for the development of the currency swap market and repurchase agreement (repo) which would allow foreign issuers of bonds and traders to

¹⁹ Measures to deepen the bond market and to encourage secondary trading activities include the regular issuance of 10-year Singapore Government Securities for the purpose of extending the benchmark yield curve on which private debt securities can be priced, subjecting the income earned by financial institutions from trading in debt instruments and interest earned by corporations and financial institutions from bonds to only a 10 percent concessionary tax rate, exempting totally from tax fee income earned by arrangers of debt securities and interest earned by non-residents from debt securities arranged in Singapore.

hedge their Singapore Dollar exchange rate risk when dealing with the debt securities²⁰.

6.12 Another aspect of the enabling environment which facilitates the domestic investors' attempt to diversify their portfolio is the growth of the asset management industry. Revision has been made to the Central Provident Fund (CPF) Investment Schemes rules to encourage CPF members to invest their funds in unit trusts. New selection criteria for CPF-approved fund managers was introduced to improve the quality of fund managers and a liberalised set of guidelines for non-CPF unit trusts was announced in order to provide a wider range of products at more competitive prices to investors.

²⁰ Since October 1998 banks are not required to hold the minimum cash balance and minimum liquid assets against Singapore Dollar funds received from their customers via currency swaps related to the Singapore Dollar bond issuance. As part of the banking sector liberalisation measure announced in May 1999, off-shore banks which have arranged for the Singapore Dollar bond issues for their foreign customers are also allowed to perform the currency swaps with their clients. Since January 2000 banks are allowed to transact Singapore Dollar denominated bonds and Singapore Government Securities repo with non-residents without limit.

Table 1
Unconditional Means and Standard Deviation
of Deviations from UIP, PPP and RIP

	Deviation From UIP	Deviation From PPP	Deviation From RIP
1990Q1 – 1999Q2			
Mean	-1.1754 (0.0429)	-0.5963 (0.2915)	-0.5648 (0.0269)
Standard Deviation	6.0192	5.9006	2.6386
1990Q1 – 1997Q2			
Mean	-0.3800 (0.1682)	-0.6066 (0.000)	-0.9866 (0.000)
Standard Deviation	4.2313	4.0202	2.31639

Note: Figures in parentheses are p-values for the null hypothesis that the mean is zero.

Table 2
Testing for Systematic Deviations from UIP, PPP and RIP

	$f_l = 0$	$l_l = 0$ ($f_l = g_l$)	$g_l = 0$ ($f_l = l_l$)
1990Q1 – 1999Q2	21.822 (0.0002)	11.434 (0.022)	15.592 (0.004)
1990Q1 – 1997Q2	6.999 (0.1359)	14.251 (0.006)	21.121 (0.0003)

Note: The figures in the first row are $\chi^2(4)$ tests of coefficient restrictions.
 Figures in parentheses are p-values.

Table 3
Estimates of VAR Model and Granger Causality Tests

	Ca_t	Cfn_t
Ca_{t-1}	1.7469 (4.6867)	0.7067 (2.0942)
Ca_{t-2}	0.1707 (0.2881)	0.1697 (0.3163)
Ca_{t-3}	-1.1831 (-2.0301)	-1.2596 (-2.3876)
Ca_{t-4}	0.0133 (0.0253)	0.0879 (0.1837)
ΔCfn_{t-1}	-1.2056 (-2.8554)	-1.1658 (-3.0498)
ΔCfn_{t-2}	-1.1899 (-2.3074)	-1.1183 (-2.3947)
ΔCfn_{t-3}	-0.0477 (-0.0899)	0.1072 (0.2229)
ΔCfn_{t-4}	-0.2637 (-1.8357)	-0.0937 (-0.7209)
R^2	0.4530	0.3521
AIC	16.4029	16.2049
SC	16.6976	16.4991
F	2.2591	6.7859
F -test p -value	0.0775	0.0002

Note: Figures in parentheses are t -values. AIC is the Akaike AIC . SC is the Schwarz Criterion. F is the Granger causality test statistic.

Table 4
Standard Deviations of Ca^* and Ca

$SD(Ca)$	$SD(Ca^*)$	Ratio	F -test	Siegel-Tukey
995.845	812.093	0.8154	1.5037 (0.1284)	0.8271 (0.3651)

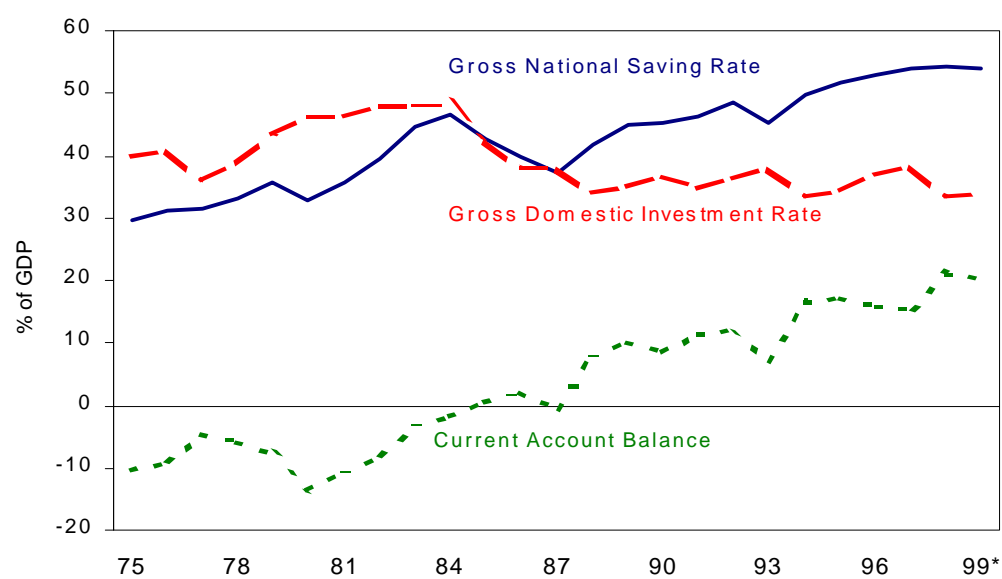
Notes: Ratio = $SD(Ca^*) / SD(Ca)$. Figures in parentheses are p -value for tests of the null hypothesis that the variance of Ca^* is equal to the variance of Ca .

Table 5
Tests for Predictable Components in Consumption Growth Differences

	OECD		United States	
Constant	0.0062 (1.0126)	0.0054 (0.9004)	0.0051 (0.9418)	0.0047 (0.8796)
Difference in Consumption growth (-2)	0.1899 (1.6030)	0.13001 (1.1598)	0.1576 (1.3331)	-0.1411 (-0.6810)
Difference in Consumption growth (-3)	0.2833 (1.7739)	0.2089 (1.1667)	0.3212 (2.308)	0.3862 (1.6304)
Difference in GDP growth (-2)		0.988 (1.3659)		0.3700 (1.5103)
Difference in GDP growth (-3)		0.0988 (0.8750)		-0.1382 (-0.6029)
R^2	0.1324	0.1459	0.1549	0.1937
Chi-square	7.1031	7.8860	9.260	11.8445
Chi-square test p -value	0.0286	0.0956	0.0097	0.0185

Notes: Figures in parentheses are t -values. The Chi-square statistic refers to the test of the joint significance of the information variables.

Figure 1
Saving, Investment and Current Account



* Refers to first 9 mths

Figure 2a
Components of Capital Outflow

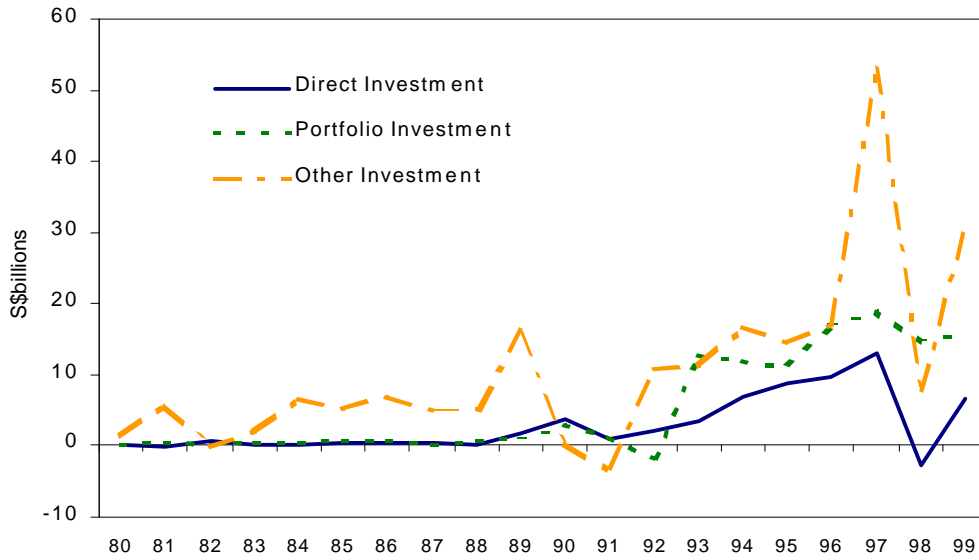


Figure 2b
Components of Capital Inflow

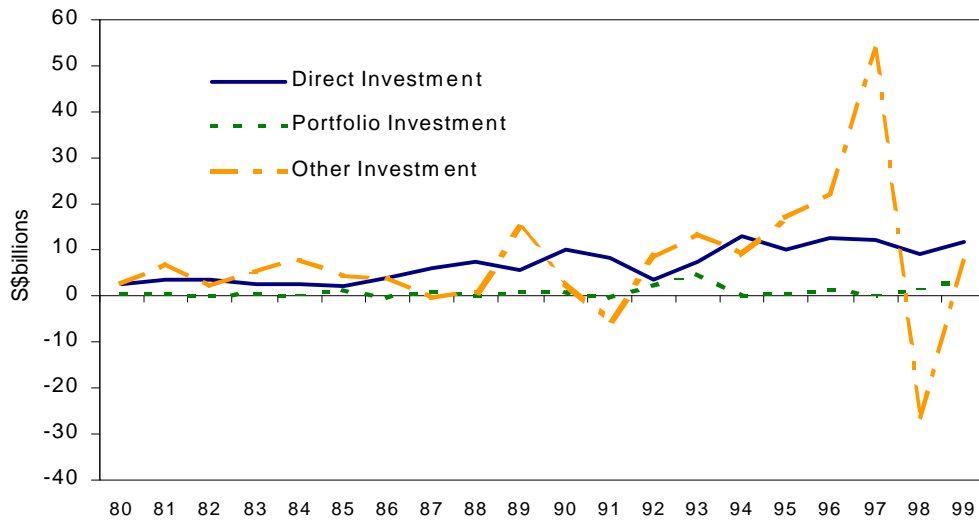


Figure 3
Domestic Banking System Interbank Borrowing and Lending with the ACUs and Banks Outside of Singapore

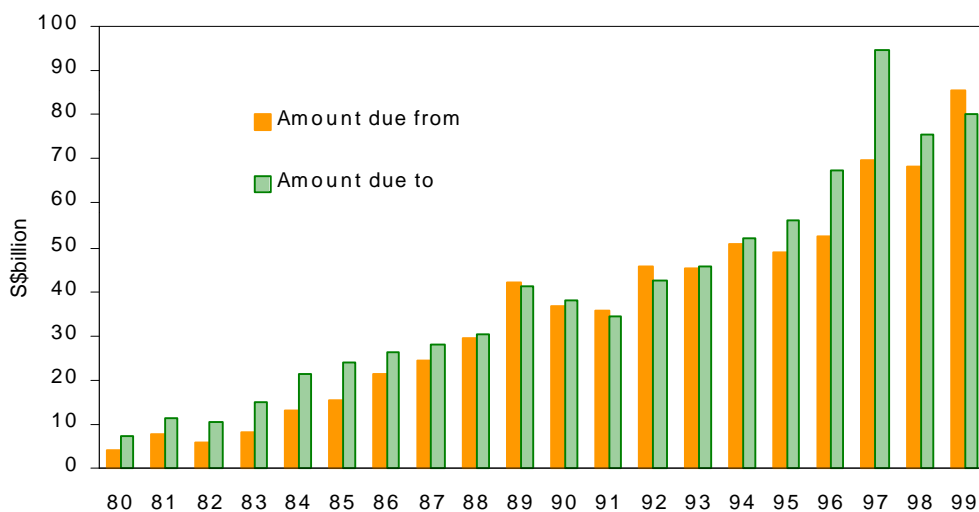
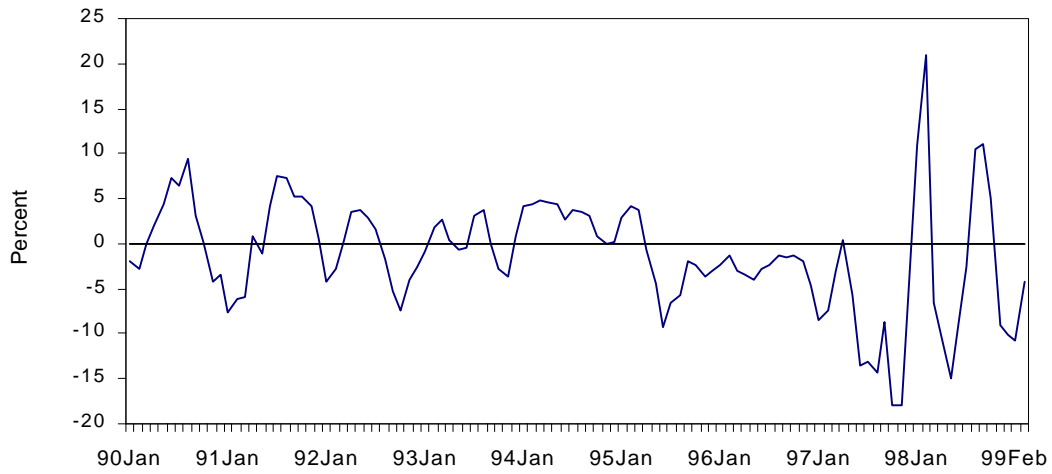
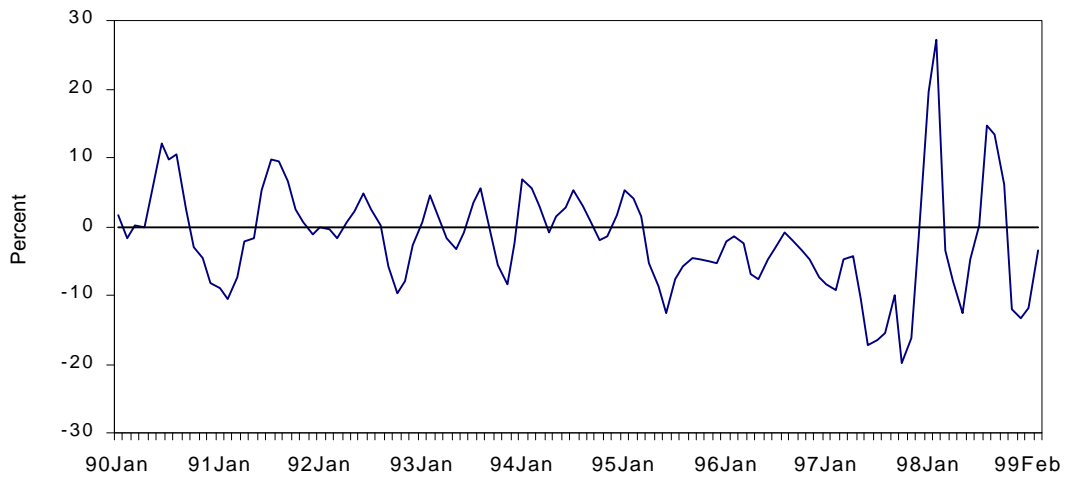


Figure 4

Ex post Deviations from UIP



Ex post Deviations from PPP



Ex post Deviations from RIP

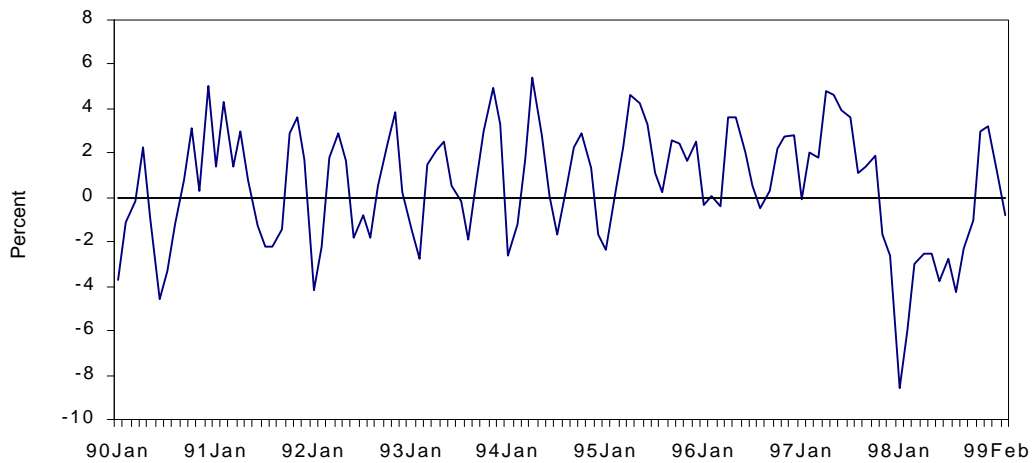


Figure 5
Scatter Plots of Saving and Investment Rates, 1975-99

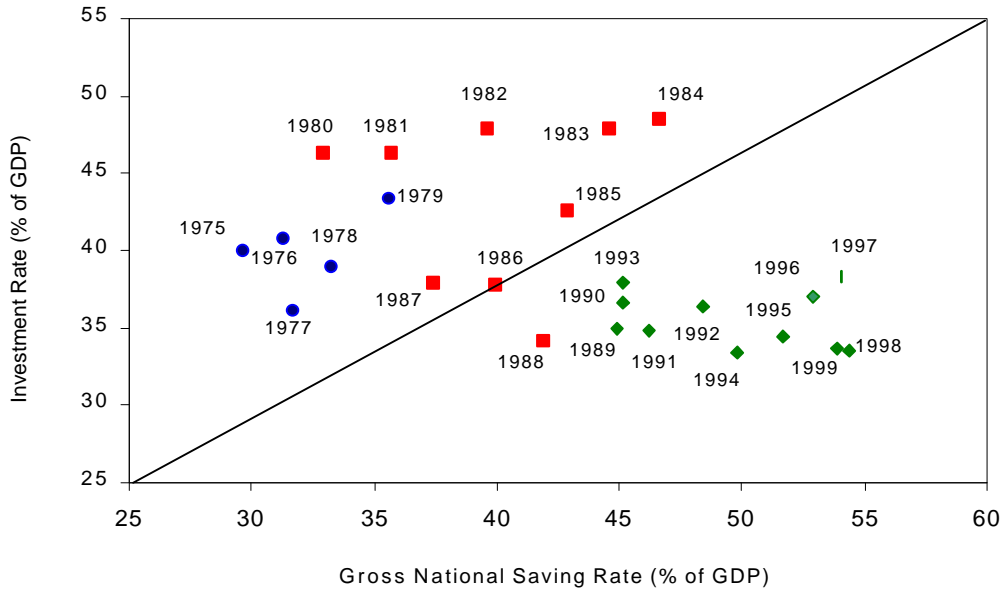
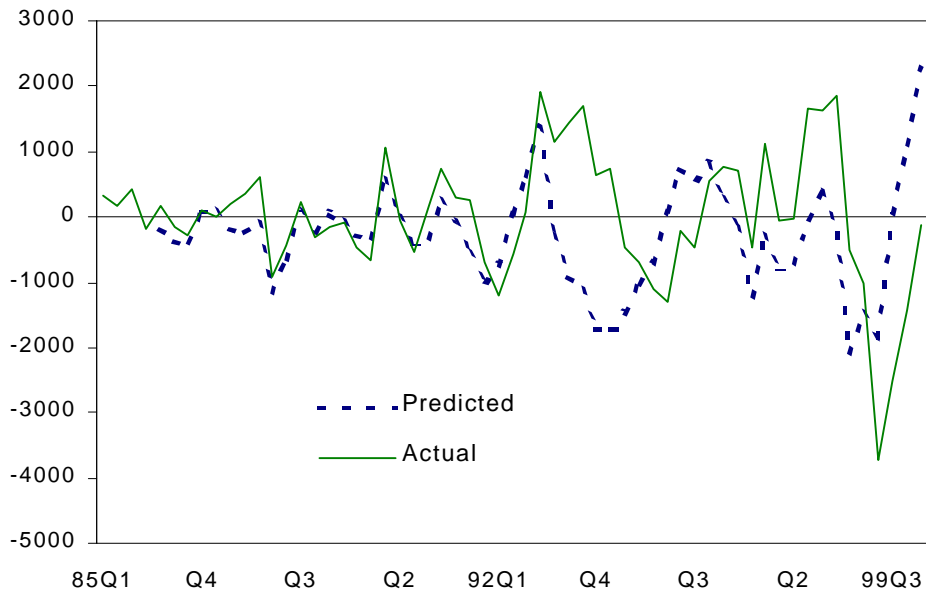


Figure 6
De-Mean Actual and Predicted Consumption Smoothing Current Account



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