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The Korea Institute for International Economic Policy (KIEP) was founded in 1990 as a government-funded economic research institute. It is the world’s leading institute on the international economy and its relationship with Korea. KIEP advises the government on all major international economic policy issues, and also serves as a warehouse of information on Korea’s international economic policies. Further, KIEP carries out research for foreign institutes and governments on all areas of the Korean and international economies.

KIEP has highly knowledgeable economic research staff in Korea. Now numbering over 100, our staff includes research fellows with Ph.D.s in economics from international graduate programs, supported by more than 40 researchers. Our staff’s efforts are augmented by our affiliates, the Korea Economic Institute of America (KEI) in Washington, D.C. and the KIEP Beijing office, which provide crucial and timely information on the local economies. KIEP has been designated by the government as the Northeast Asia Research and Information Center, the National APEC Study Center and the secretariat for the Korea National Committee for the Pacific Economic Cooperation Council (KOPEC). KIEP also maintains a wide network of prominent local and international economists and business people who contribute their expertise on individual projects.

KIEP continually strives to increase its coverage and grasp of world economic events. Expanding cooperative relations has been an important part of these efforts. In addition to many ongoing joint projects, KIEP is also aiming to be a part of a broad and close network of the world’s leading research institutes. Considering the rapidly changing economic landscape of Asia that is leading to a further integration of the world’s economies, we are confident KIEP’s win-win proposal of greater cooperation and sharing of resources and facilities will increasingly become standard practice in the field of economic research.

Choong Yong Ahn
President
Saving, Investment and International Capital Mobility in East Asia

Soyoung Kim
Sunghyun H. Kim
Yunjong Wang
Preface

We have witnessed an unprecedented rise in net private capital flows to emerging market economies in the 1990s. During this period, a number of East Asian countries have liberalized their financial markets to international capital flows by reducing restrictions on inward and outward capital flows. An increase in the degree of international capital mobility through financial market liberalization can provide sizable benefits. With internationally mobile capital, domestic investment can be financed by foreign capital and excess domestic capital or saving can be invested in foreign countries to capture extra gains.

In order to evaluate the series of policies toward international financial market liberalization in East Asia, it is an important task to measure the degree of international capital mobility in East Asia, that is, to investigate whether the East Asian countries have fully utilized increased capital mobility in recent years as a result of international financial market liberalization. However, measuring the degree of international capital mobility is not an easy task since capital flows, saving, and investment are all subject to various structural shocks and different structural shocks would move these variables in different ways. Some past studies investigated the degree of international capital mobility in East Asia based on simple statistical measures, but fail to account for such a complexity in the movements of international capital flows.

In this volume, three authors—Soyoung Kim, Sunghyun H. Kim, and Yunjong Wang—attempt to answer the challenging question with rigorous empirical methods. The authors investigate the degree of capital mobility in East Asia by examining the relationship between saving and investment and accounting for various structural shocks. This study addresses whether the East Asian countries achieved a higher international capital mobility in recent years and compares the current degree of international capital mobility achieved by East Asia with that in major industrial countries.

Extensive empirical results present a number of interesting findings. The degree of international capital mobility in East Asia increased over
time, which suggests that the series of policies toward international financial market liberalization have been effective. On the other hand, the degree of international capital mobility in East Asia is still low, and it is lower than that in industrial countries. The authors conclude by mentioning a possibility that current account targeting may lead to such a result and the importance of capturing the benefits of international financial market liberalization.

The authors would like to thank Seung Kwan Baek, Jung Sik Kim, and Do Yong Yang for their useful comments. The Institute hopes that this book will contribute to building a stronger foundation for international economic policy around the emerging market economies and the world as well.

Choong Yong Ahn  
President  
Korea Institute for International Economic Policy  
December 2004
Executive Summary

This project evaluates the degree of international capital mobility in East Asia. In particular, we investigate whether the East Asian countries have fully utilized increased capital mobility in recent years as intended by the series of policies toward financial market liberalization. Among numerous measures that have been used to evaluate the degree of international capital mobility, we use the relationship between saving and investment, in particular, saving-investment correlation. Saving-investment correlation measures how much national investment is financed by foreign capital. Under perfect capital mobility, national saving and national investment should not be correlated as agents look for worldwide investment and saving opportunities regardless of the nationality of capital. Therefore, a high correlation between national saving and investment would imply a low degree of capital mobility.

However, since both saving and investment are subject to cyclical shocks in domestic and world economy, it is important to control for these cyclical effects in order to correctly capture the implications of the saving-investment correlation on capital mobility. In this paper, we use the empirical methodology used in Kim (2001) to control for business cycle shocks in estimating saving-investment correlation. By using the residuals from the regressions of saving and investment on cyclical shocks (productivity shock, fiscal shock and the terms of trade shock), we can remove cyclical effects from the saving-investment correlation. We apply the maximum likelihood estimation method for 10 Asian countries from 1980 to 2002 and report various estimation results including times-series, cross-section, and panel data analysis. We also investigate if country differences such as the size of GDP and the nontraded sector have any systematic relationship with saving-investment correlation.

We can summarize main findings of the study as follows. First, cross-sectional analysis reveals that the saving-investment correlation steadily decreases over time, 0.76 in the 1980s and 0.53 in the 1990s. This result is consistent with the increase in the capital mobility in the 1990s.

On the other hand, panel data regression with the first differenced data shows that the saving-investment correlation for East Asian
countries (0.88) is higher than that of the OECD countries (0.7), which is consistent with the fact that international capital mobility in East Asian countries is lower than that of the OECD countries. In addition, after controlling for cyclical shocks, the saving-investment correlation decreases, especially when including all three shocks with lags, but the absolute value is still high around 0.4. This suggests that the degree of capital mobility may be still low in Asian countries. Another interpretation on the high saving-investment correlation can be related to the government policies towards current account management; as government target the current account balance as their policy goal, saving and investment may be forced to move together. Such a policy can be costly since the benefits of mobile capital are not fully utilized.

We also found that country differences in terms of size of GDP do not have consistent relationship with saving-investment correlation. Size of nontraded sector is positively related to saving-investment correlation, but this relationship disappears when we control for cyclical shocks. Finally, aggregate regional saving and investment data analysis reveals that the whole region of East Asia is close to self-finance in investment. In other words, investment in the region is largely financed by regional savings. In ASEAN countries, the degree of self-sufficiency in investment is larger than that of Big 3 countries or Greater China.
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I. Introduction

The 1990s witnessed an unprecedented rise in net private capital flows to emerging market economies. During this period, a number of East Asian countries have liberalized their financial markets to foreign capital by reducing restrictions on inward and outward capital flows. As a result, net private capital inflows to East Asia in the mid-1990s were conspicuous in the postwar period in terms of the size of the flow to emerging markets. The inflows to East Asia were driven by a mixture of push and pull factors, including the pursuit of perceived large profit opportunities, the diversion of Japanese overseas direct investment, the expansion of institutional investors and country funds, the development of regional ratings, and the easing of capital account restrictions. In particular, the low world interest rates and yen appreciation were external factors contributing to capital flows into East Asia during 1994-96. Yen appreciation increased Japanese overseas direct investment in East Asia. Low interest rates in the industrial countries including Japan produced the portfolio flows to the East Asian economies.

Increased international capital mobility through financial market liberalization can provide a sizable benefit to the country. A liberalized and integrated international capital market would provide the opportunity to finance domestic investment or to smooth consumption by borrowing and lending internationally (“international intertemporal trade”). As the financial market integration deepens and financial assets of each country become well-diversified, a further benefit can be obtained by insuring country-specific income shocks (“international risksharing”).

This project focuses on the first aspect of international financial market integration, that is, the role of international intertemporal trade (or international lending and borrowing), which is often called “international capital mobility.” This project evaluates the degree of international capital mobility in East Asia. In particular, we investigate whether the East Asian countries have fully utilized increased capital mobility in recent years as intended by the series of policies toward financial market liberalization. This project also compares the current degree of international capital mobility in East Asia with that achieved by major industrial
countries.

A number of measures have been adopted to estimate the degree of international capital mobility or financial integration. Price-based measures include tests on arbitrage conditions such as various types of interest parity conditions (covered, uncovered, real) and tests of international CAPM. Non-price based measures include direct analysis of institutional factors such as capital controls and banking sector regulations, and quantity based measures such as the relationship between saving and investment (e.g. saving-investment correlation), the consumption and income dynamics, and the current account dynamics.

Among numerous measures that have been used to evaluate the degree of international capital mobility, we use the relationship between saving and investment, in particular, saving-investment correlation. Feldstein and Horioka (1980) is the first paper that attempted to relate saving-investment relationship with capital mobility. Saving-investment correlation measures how much national investment is financed by foreign capital. Under perfect capital mobility, national saving and national investment should not be correlated as agents look for worldwide investment and saving opportunities regardless of the nationality of capital. Therefore, a high correlation between national saving and investment would imply a low degree of capital mobility. However, since both saving and investment are subject to cyclical shocks in domestic and world economy, it is important to control for these cyclical effects in order to correctly capture the implications of the saving-investment correlation on capital mobility.

In this paper, we use the empirical methodology used in Kim (2001) to control for business cycle shocks in estimating saving-investment correlation. By using the residuals from the regressions of saving and investment on cyclical shocks, we can remove cyclical effects from the saving-investment correlation. We analyze three shocks; productivity shock, fiscal shock and the terms of trade shock. Kim (2001) used the maximum likelihood estimation method to measure new saving-investment correlation using panel data of the 19 OECD countries from 1960 to 1992. We apply the same method for 10 Asian countries from 1980 to 2002. We

---

1) Saving-investment correlation test is similar to the current account dynamics test because if saving and investment are highly cointegrated, then current account becomes stationary.
also investigate if country differences such as size of GDP and the nontraded sector have any systematic relationship with saving-investment correlation.

The estimation results show that the cross-sectional saving-investment correlation steadily decreases over time but it is still high in the absolute measure (around 0.5) even in the 1990s, which is similar to the conclusion in many papers including the original Feldstein and Horioka (1980). Even after controlling for cyclical shocks, the smallest estimate for the saving-investment correlation is still above zero around 0.4. Country differences do not have any significant effects on saving-investment correlation.

Since our measures are directly related to the possible macroeconomic gains of international financial market integration, this study would properly evaluate the effectiveness of the recent policies towards financial market liberalization from the macroeconomic perspective, and shed light on the way to achieve a better integrated financial market if such policies were found to be ineffective.

The remaining chapters of the study consist of the followings. In Chapter II, we review previous theoretical and empirical studies on saving-investment correlation including theoretical models that analyze possible factors that affect saving-investment correlation. Chapter III explains data sources and the empirical methodology that we adopt in this study. In Chapter IV, we report estimation results including cross-sectional regressions and time-series panel regressions. Finally, Chapter V provides conclusion and policy implications.
II. Literature Survey

1. Empirical Overview

In a perfect capital market, there should be no relationship between
domestic saving and domestic investment. Saving in a country responds
to worldwide opportunities for investment while investment in a country
is financed by a worldwide pool of capital. Feldstein and Horioka (1980)
was the first attempt to connect the saving-investment correlation to
international capital mobility. They performed cross-sectional regressions
using the data of sixteen OECD countries from 1960 to 1974:

\[
\begin{pmatrix}
\frac{I}{Y}
\end{pmatrix} = \alpha + \beta \begin{pmatrix}
\frac{S}{Y}
\end{pmatrix}.
\]  

(1)

Their estimated saving-investment correlation ranged from 0.85 to
0.95 according to the selection of instrumental variables (IV). They
concluded that a high saving-investment correlation reflects a low degree
of capital mobility. However, most subsequent empirical papers reveal
that the saving-investment correlation is still high even in the 1980s
when international capital market became rapidly integrated, a phenomena
that remains a puzzle in international finance.

Dooley, Frankel and Mathieson (1987) claimed that the saving-
investment correlation would not be zero even under perfect capital
mobility since financial assets are not perfectly substitutable. They
concluded that the instrumental variable (IV) techniques cannot reduce a
high saving-investment correlation and that population and GNP growth
rates do not have any effect on the saving-investment correlation.
Feldstein and Bacchetta (1991) expanded the previous data set to include
twenty-three countries from 1960 to 1986 and found that the
saving-investment correlation is reduced from 0.914 in the 1960s to 0.607
in the 1980s. They did not use the IV technique, but their results are
similar to those with instrumental variables.

A large number of cross-sectional studies of the saving-investment
correlation followed in the 1980s. Despite a large volume of cross-
sectional studies, there are a smaller number of empirical tests which use the time series analysis because of the econometric problems such as cyclical properties and nonstationarity of the data, and insignificance of coefficients due to the lack of the number of observations. Bayoumi (1989) and Obstfeld (1995) reported country-by-country time series regression results using level data or first differenced data but could not produce significant and consistent estimation results. Recently, there have been several papers dealing with the econometric problems using cointegrating regressions or panel data analysis.  

Most previous papers followed two different theories to interpret this result. One theory accepts the Feldstein and Horioka results and attributes a high saving-investment correlation to a low degree of capital mobility due to capital market friction in the form of high transaction costs, exchange rate risk, and institutional friction.  

Contrary to the Feldstein and Horioka results, the second theory concludes that a high saving-investment correlation does not necessarily reflect a low degree of capital mobility but results from other factors affecting saving and investment even under perfect capital mobility. Recent empirical studies reveal that the second stream is more relevant.

From the late 1980s, there have been an increasing number of simulation studies based on real business cycle (RBC) models that explain a high saving-investment correlation using different kinds of shocks under perfect capital mobility.  

Although many papers suggest several possible shocks and economic structures explaining the high saving-investment correlation, many have been limited to simulation or vector autoregression methods and do not yet have strong empirical support. Moreover, their results depend on the specification of the model, especially the structure of investment and the specification of shocks.

## Box 1. Summary of Empirical Studies on Saving-Investment Correlation

<table>
<thead>
<tr>
<th>Paper</th>
<th>Data</th>
<th>Empirical method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feldstein and Horioka (1980)</td>
<td>16 OECD countries, 1960-1974, S/I as shares of GDP</td>
<td>Cross-section</td>
<td>0.89 (gross measures) 0.94 (net measures)</td>
</tr>
<tr>
<td>Feldstein (1983)</td>
<td>17 OECD countries, 1960-1979</td>
<td>Cross-section</td>
<td>0.80</td>
</tr>
<tr>
<td>Murphy (1984)</td>
<td>17 OECD countries, 1960-80</td>
<td>Cross-section</td>
<td>0.85</td>
</tr>
<tr>
<td>Bayoumi (1989)</td>
<td>10 OECD countries, 1965-86</td>
<td>Cross-section</td>
<td>OLS: 0.97 Two-stage LS: 0.85</td>
</tr>
<tr>
<td>Golub (1990)</td>
<td>16 OECD countries, 1960-88</td>
<td>Cross-section</td>
<td>0.76</td>
</tr>
<tr>
<td>Tesar (1991)</td>
<td>16-23 OECD countries, 1960-1986</td>
<td>Cross-section</td>
<td>1960-86: 0.84 1960-74: 0.89 1975-86: 0.81</td>
</tr>
<tr>
<td>Sinn (1992)</td>
<td>23 OECD countries, 1960-88</td>
<td>Cross-section</td>
<td>1960-69: 0.87 1670-79: 0.82 1980-89: 0.68</td>
</tr>
<tr>
<td>Obstfeld (1994)</td>
<td>20 OECD countries, 1974-1990</td>
<td>Cross-section</td>
<td>1974-90: 0.72 1974-80: 0.87 1981-90: 0.64</td>
</tr>
<tr>
<td>Bayoumi (1989)</td>
<td>1961-86</td>
<td>Time Series</td>
<td>US: 1.00 Japan: 0.84 Germany: 0.87 UK: 0.33 France: 0.80 Canada: 0.83 Finland: 0.98 Norway: -0.21</td>
</tr>
<tr>
<td>Tesar (1993)</td>
<td>1960-88</td>
<td>Time-series OLS, S/I as ratios of GDP</td>
<td>US: 0.752 Canada: 0.848 France: 0.929 Germany: 0.886 Italy: 0.063 UK: 0.592</td>
</tr>
<tr>
<td>Obstfeld (1994)</td>
<td>1974-90</td>
<td>Time-series OLS, S/I as ratios of GDP</td>
<td>US: 0.848, UK: 0.113 Japan: 1.161 Italy: 0.214 France: 0.909 Germany: 0.327</td>
</tr>
<tr>
<td>Kim (2001)</td>
<td>21 OECD countries, 1960-92</td>
<td>Panel (MLE) with first differenced data</td>
<td>0.70</td>
</tr>
<tr>
<td>Mendoza (1991)</td>
<td>Simulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backus, Kehoe and Kydland (1993)</td>
<td>Simulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baxter and Crucini (1993)</td>
<td>Simulation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Glick and Rogoff (1995) developed an analytically tractable empirical model of current account and investment and performed a structural estimation using global and local productivity shocks of seven major countries. They showed that their empirical model with productivity shocks can explain the stable correlation between investment and the current account. Taylor (1994) claimed that the consumption-investment correlation can be explained by the demographic and growth factors and the relative price structure of investment and consumption. He used panel data analysis with five-year averaged data and showed powerful price, demographic, and growth effects on the demand functions for private and public consumption and investment. He showed that the Feldstein-Horioka correlation might be an artifact of omitted variable bias, since a common set of variables does influence national saving and investment rates, and sufficiently so to explain much of the correlation.

Details of all empirical analysis of saving-investment correlation are summarized in the following box.6)

2. Theoretical Overview

In this chapter, we explain the factors claimed to have effects on saving and investment (and consumption as well). Based on this theoretical background, we construct the new saving, investment and consumption data that are controlled for cyclical effects. We also provide a theoretical and empirical background of how these factors can affect domestic saving and investment in order to rationalize the use of these specific factors in explaining the high saving-investment correlation. According to the National Accounting Statistics, aggregate saving is defined as national output minus private and government consumption. Therefore, any factor affecting these macro variables will eventually influence saving. If any of these factors affect investment in the same direction with a similar frequency, then saving and investment will move together and produce a high correlation.

We categorize these factors into two groups. The first group includes the exogenous shocks affecting both saving and investment over time with relatively short frequency. We select three possible exogenous shocks--productivity shocks, fiscal shocks, and terms of trade (TOT)

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6) Refer to Coakley et al. (1998) for the detailed survey on this literature.
shocks.\textsuperscript{7} The second group includes factors due to country differences which affects saving and investment cross-sectionally or with relatively long frequency. This group includes two factors, the size of the GNP and the size of the non-traded sector.

1) Exogenous Shocks Affecting Business Cycles\textsuperscript{8}

A high saving-investment correlation can be explained using an intertemporal approach with shocks to the economy. The exact effects on saving and investment depend on the structure of the model and the specification of shocks, transitory or permanent, and global or local. In this chapter, we introduce a simple intertemporal model of a small open economy and analyze how exogenous shocks can affect saving and investment decisions. For simplicity, we assume that the economic agents have perfect foresight of the future. This assumption will be relaxed later.

Consider a small open economy that produces and consumes a single composite goods and trades freely with the rest of the world. Only riskless bonds are traded internationally at the world interest rate, $r$.\textsuperscript{9} Labor is not mobile across countries. Let $B_t$ denote the economy’s net foreign claims at the end of period $t-1$, $Y_t$ net domestic product in period $t$, $C_t$ private consumption, $G_t$ government consumption, and $I_t$ net investment. Then the current account and saving can be expressed as the following:

$$CA_t = B_{t+1} - B_t = S_t - I_t$$

and

\textsuperscript{7} There are other shocks claimed to have effects on Corr(S,I) such as income distribution shocks in Ghosh and Pesenti (1995), taste shocks in Stockman and Tesar (1995), and intermediate good’s price change—oil price shock—in Svensson (1984). We excluded income distribution shocks and taste shocks since it is hard to construct the exogenous data for these variables. We excluded oil price shock since the import of oil occupies a large portion of the total import in many Asian countries, and the change of general import price and therefore TOT can reflect the change in oil prices.

\textsuperscript{8} This chapter is based on Obstfeld and Rogoff (1996).

\textsuperscript{9} This assumption excludes the trade of risks in insurance markets so that country specific shocks cannot be diversified away.
\[ S_t = rB_t + Y_t - C_t - G_t \]  \hfill (3)

The representative agent chooses her path of consumption to maximize

\[ \sum_{s=0}^{\infty} \beta^s U(C_{t+s}) \]  \hfill (4)

subject to the intertemporal budget constraint

\[ B_{t+1} = (1 + r)B_t + Y_t - G_t - C_t - I_t. \]  \hfill (5)

The first order condition produces the intertemporal Euler equation

\[ U'(C_t) = \beta(1 + r)U'(C_{t+1}) \]  \hfill (6)

To simplify, assume \( \beta=1/(1+r) \) and utility follows a quadratic specification

\[ U(C_t) = C_t - \frac{h}{2} C_t^2. \]  \hfill (7)

The optimal consumption will be a constant fraction of wealth which is the discounted sum of current and future incomes plus initial stock of foreign assets.

\[ C_t = \frac{r}{1+r} \left[ (1 + r)B_t + \sum_{s=0}^{\infty} \left( \frac{1}{1+r} \right)^s (Y_{t+s} - I_{t+s} - G_{t+s}) \right]. \]  \hfill (8)

Define the permanent value of a variable \( X_t \) on date \( t \) by

\[ \overline{X}_t = \frac{r}{1+r} \sum_{s=0}^{\infty} \left( \frac{1}{1+r} \right)^s X_{t+s}. \]  \hfill (9)

Plug (8) into (2) and (3) using the expression in (9), then \( CA_t \) and \( S_t \) can be expressed as

\[ CA_t = (Y_t - \overline{Y}_t) - (G_t - \overline{G}_t) - I_t - \overline{I}_t \]  \hfill (10)

and
\[ S_t = (Y_t - \bar{Y}_t) - (G_t - \bar{G}_t) + \bar{I}_t. \]  

(11)

In this basic setup with a riskless bond and constant world interest rate, saving depends on the specification of investment, and investment is determined by elements that are independent of consumption preferences. Investment decisions are made to maximize the present discount value of the country’s output evaluated at the world interest rate. However, introducing a risk premium or nontradable goods allows investment to also depend on consumption decision.\(^{10}\) Based on this basic setup, we illustrate various models with different specifications to examine the effect of exogenous shocks on saving and investment in the following sub-sections.

**Productivity Shocks**

In order to obtain a closed form solution of saving and investment in terms of productivity shocks, we adopt an empirically tractable model developed by Razin (1993) and Glick and Rogoff (1995). They simplify the expected permanent value of each variable to first differences in order to directly apply empirical regressions. Since productivity shocks follow a stochastic process, we introduce expectations in the model assuming that individual agents have rational expectations of the future.

The aggregate output, \( Y_t \), is produced using capital stock with adjustment costs.

\[ Y_t = A_t K_t^\rho \left[ 1 - \frac{\theta}{2} \left( \frac{K^*}{K_t} \right) \right]. \]  

(12)

where \( l_t = K_{t+1} - K_t \) and \( A_t \) is the time-\( t \) productivity factor which follows a first-order autoregressive process:

\[ A_t \rho A_{t-1} \varepsilon_t, \quad 0 \leq \rho \leq 1 \]  

(13)

The solution of this problem using a linear approximation to the first order conditions yields

\[ Y_t \approx \alpha_t I_t + \alpha_K K_t + \alpha_A A_t \]  

(14)

\(^{10}\) See Obstfeld and Rogoff (1994).
and

\[ I_t \approx \beta_1 I_{t-1} + \eta \sum_{s=0}^{\infty} \lambda^2 (E_t A_{t+s} - E_{t-1} A_{t+s-1}), \quad (15) \]

where \( \alpha_1 < 0, \alpha_A, \alpha_K > 0, 0 < \beta_1 < 1, \eta > 0, \) and \( 0 < \lambda < 1 \)

If the shocks are permanent, \( \rho = 1 \), then the first difference of investment will follow

\[ \Delta I_t = (\beta_1 - 1) I_{t-1} + \beta_2 \Delta A_t, \quad \text{where} \quad \beta_2 = \eta \lambda / (1 - \lambda). \quad (16) \]

Thus, current investment is positively correlated with permanent productivity shocks. If the shocks are global, then the effects will be weakened since the world interest rate changes. If the shocks are only transitory, \( \rho = 0 \), then the equation (16) will be

\[ \Delta I_t = (\beta_1 - 1) I_{t-1}. \quad (17) \]

The transitory productivity shocks have no effect on current investment.

Now, the representative agent maximizes the conditional expectation of life time utility in (4) subject to the same budget constraint. Then, the intertemporal Euler equation in (6) holds in expectation. Using the same utility function as in (7), the optimal consumption follows a random walk process, \( E_t C_{t+1} = C_t \), and the certainty-equivalence consumption function will be

\[ C_t \frac{r}{1 + r} \left[ (1 + r) B_t + E_t \sum_{s=0}^{\infty} \left( \frac{1}{1 + r} \right)^s (Y_{t+s} - I_{t+s} - G_{t+s}) \right]. \quad (18) \]

Take the first difference of (14) and use (16), then \( \Delta Y_t \) can be expressed as

\[ \Delta Y_t = [\alpha_1 (\beta_1 - 1) + \alpha_K] I_{t-1} + [\alpha_1 \beta_2 + \alpha_A] \Delta A_t. \quad (19) \]

Assuming \( G = 0 \), take the first difference of (18) and plug (16) and (19), then

\[ \Delta C_t = \left( \frac{\beta_2 (\alpha_1 - 1) r + \alpha_K}{1 + r - \beta_1} + \alpha_A \right) \Delta A_t. \quad (20) \]
The first difference of saving can be expressed as the following:

\[
\Delta S_t = \left[ a_1 (\beta - 1) + a_K \right] I_{t-1} + \beta_2 \left\{ \frac{a_1 (1 - \beta_1) + r - a_K}{1 + r - \beta_1} \right\}
\]

(21)

The sign of coefficients shows that a permanent rise in productivity increases both investment and saving on the condition that \( a_K - r < a_1 (1 - \beta_1) \), which yields a positive correlation between saving and investment. The same analysis can be applied to the case where the productivity shocks are temporary, \( \rho = 0 \). In this case, current income would rise more than permanent income which would increase saving but have no effect on investment.

Glick and Rogoff (1995) distinguished local and global productivity shocks and showed that investment responds positively and significantly to both local and global productivity shocks and that current account responds negatively and somewhat significantly to local shocks but that there is little or no response to global shocks. This implies that global productivity shocks increase both saving and investment which produces a high saving-investment correlation, while country-specific shocks result in an increase of saving which is less than the amount of an increase of investment or even a decrease of saving. However, the specific effects of productivity shocks depend on the structure of the model, especially the structure of the adjustment costs of investment and the specification of shocks.

There are some RBC models which explain the effect of productivity shocks on saving and investment. In an overlapping generation model of a small open economy, Finn (1990) showed that positively autocorrelated shocks can generate patterns of saving and investment that replicate the observed high saving-investment correlation. Baxter and Crucini (1993) showed that global productivity shocks can produce a positive saving-investment correlation. If the shocks are positively correlated across countries, individual countries cannot rely on international capital markets to smooth their levels of consumption, and savings and investment for individual countries as well as for the system as a whole would be positively correlated.

**Fiscal Shocks**

The traditional Ricardian view suggests that forward-looking agents
will internalize the government’s budget constraints and adjust their own behavior to offset changes in government policy. The specific effects, however, depend on whether the government policy is persistent or temporary and global or local.

Glick and Rogoff (1995) simplified the government spending shocks as pure aggregate demand shocks shown in equation (11). Assume that the government increases its expenditure financed by a lump-sum tax, then investment will be independent from the change in government spending and saving will follow

$$\Delta S_t = [\alpha_t(\beta_1 - 1) + \alpha_k] I_{t-1} + \beta_2 \left[ \frac{\alpha_t(1-\beta_1) + r - \alpha_k}{1 + r - \beta_1} \right] \Delta \alpha_t + (\bar{G}_t - E_{t+i}, \bar{G}_t - \Delta G_t)$$  \hspace{1cm} (22)$$

A temporary rise in government spending decreases saving since the permanent after-tax income and therefore consumption declines less than the rise in \( G \). A permanent fiscal shock, however, will be offset fully by the change of consumption. Investment is unaffected unless there is a change in the future marginal product. However, the global government spending shocks can affect investment through the change of the world interest rate.

In a two-goods infinite horizon model, Turnovsky and Sen (1991) showed the effects of permanent and temporary changes in government expenditures on various macroeconomic variables. A permanent increase in government spending directed towards the domestic good increase employment and output both in the short run and over time. Despite the transitional rise in the domestic real interest rate, investment is stimulated by the increase in \( q \), leading to a higher equilibrium capital stock. Along the transitional adjustment path, consumption and leisure are both below their respective initial starting levels. If a permanent increase in government spending is directed towards the import good, then the effects can be reversed—a reduction in output and employment, a capital decumulation, and lower interest rates.

Sen (1994) illustrated in a simple two-goods two-period model that an expected future fiscal expansion directed towards a domestic good can cause investment to rise. If taxes are levied in the future, consumers will save today, which yields a positive saving-investment correlation. He showed another simple example of a positive saving-investment correlation. Suppose the government plans to pay the subsidy on the
capital in place in period 1 and lump-sum taxes will be imposed on households to pay for this. Then, the household will save in period 0 in a bid to smooth consumption and the firm will undertake the investment in period 0.

Another channel through which government can affect saving and investment is the current account targeting policy, either through capital controls or changing government saving. Governments can affect the current account by imposing constraints on cross-border capital flows or by adjusting saving and investment of the public sector whenever the deficit (or surplus) in the current account exceeds a predetermined level. However, it is difficult to judge how well these policies succeed, and it is also possible that other government policies have effects similar to current account targeting.\textsuperscript{11)}

**Terms of Trade Shocks**

The effect of changes in terms of trade on saving and current account has been an issue since Harberger, Laursen, and Metzler (H-L-M) in the 1950s. H-L-M postulated that real income falls with a terms of trade deterioration since deterioration in the terms of trade means that with the same quantity of exports, a country is able to import a reduced amount of goods and services from abroad. However, this argument depends on a static theory and has been reconsidered by many papers following the intertemporal approach with forward looking savings behavior. The effect of terms of trade can be incorporated in the stochastic intertemporal model as the following:\textsuperscript{12)} Consider an economy with two goods—export goods(X) and import goods(M). The economy produces and exports $X$, but consumes both goods. Consumption is a composite index of the individual’s consumption of exports and imports, $C_X$ and $C_M$, and has the CES form:

$$C = \left[ a^{\frac{1}{\theta}} C_M^\theta + (1-a) \frac{1}{\rho} C_X^{\frac{\theta-1}{\rho}} \right]^{\frac{\rho}{\rho-1}}, \quad (23)$$

\textsuperscript{11)} The fragility of the econometric evidence is illustrated by Feldstein and Bacchetta (1991) reinterpretation of the regressions Summers (1988) offers as evidence of current account targeting.

\textsuperscript{12)} See Obstfeld and Rogoff (1994) for details.
where \( \rho \) is the intratemporal elasticity of substitution between exports and imports.

Let \( p \) denote the price of exports in terms of imports, which is determined exogenously in the world market. The CPI (consumer price index) in terms of imports can be calculated as

\[
P = \left[ a + (1 - a)p^{1 - \rho} \right]^{\frac{1}{1 - \rho}}.
\]

In this case, the consumption function reduces to:

\[
C_t - \frac{r}{1 + r} \left[ (1 + r)B_t + E_t \sum_{s=0}^{\infty} \left( \frac{1}{(1 + r)} \right)^s \left( \frac{Y_{t+s} - I_{t+s}}{P_{t+s}} \right) \right].
\]

In this model, a drop in terms of trade will lower \( p \) relative to \( P \). If \( Y \) is constant, then current consumption decreases and saving increases. Thus, the fluctuation in terms of trade will affect consumption and saving. However, the exact effects on consumption depend on the specification of utility function, the movement of output and investment, and the degree of persistence of shocks.

Obstfeld (1982) showed that the deterioration of the terms of trade can increase saving by adopting a Uzawa-type utility function with the rate of time preference being an increasing function of utility. In this economy, there is a target level of real wealth and the deterioration of the terms of trade lowers real wealth. To converge to the target level, the economy must accumulate foreign wealth and hence, save.

Sen (1994) summarized the effect of terms of trade on saving and investment in a simplified two-period model.\(^{13}\) The domestic firm produces only export goods and investment must be carried out one period in advance. Then, investment is carried to the point where marginal productivity of capital equals \( p_0(1+r)p_{1}^{-1} \). In this case, a fall in \( p_0 \) or a rise in \( p_1 \) lowers the discount factor and, therefore, increases current investment \( I_0 \) and the output in the next period, \( Y_1 \). However, a permanent worsening of the terms of trade has an ambiguous effect on future production and \( I_0 \). For a consumption decision, the interest factor

\(^{13}\) For the detailed discussion, see Svensson and Razin (1983) and Persson and Svensson (1985).
will be $P_0(1+r)P_t^{-1}$. A change in $p$ enters the consumer’s problem through the wealth effect and the intertemporal substitution effect. A decrease in $p_0$ lowers the real value of domestic output in terms of import goods ($p_0Y_0/P_0$) through wealth effect and lowers the real interest rate (via a fall in $P_0$). The former channel lowers current consumption but the latter channel has an ambiguous effect on consumption.

2) **Country Differences**

**Country Size**

Harberger (1980) argues that the possible divergence of saving and investment in a block of a city may disappear as the level of aggregation rises to city, state and national levels. Bayoumi and Rose (1993) support the size effect using U.K. regional saving and investment data arguing that the correlation coefficients are near zero using local data but the aggregation of data tends to converge saving and investment.

Thus, a country with a large share of the world output is likely to have a relatively large share of the world’s total saving and investment. Small countries take the world interest rate as given, while changes in the investment and savings behavior of large countries will have an impact on the world interest rate. For example, an increase in the national saving of a large country lowers the world interest rate, which increases the investment of all countries. Therefore the saving-investment correlation of a large country tends to be high. Murphy (1984) and Dooley, Frankel, & Mathieson (1987) confirm that the inclusion of small countries lowers the saving-investment correlation.

**Size of the Non-traded Sector**

Wong (1990) argues that as long as domestic residents consume traded as well as non-traded goods, an increase in saving leads to an increase in wealth and future consumption path, but consumption in non-traded goods can increase only if production of non-traded goods increases, and this necessitates an increase in investment in the

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14) Other possible country specific factors affecting the saving-investment correlation are the degree of risk averse in Feldstein and Bacchetta (1991) and human capital or educational factor relating to growth variable in Ghosh and Pesenti (1995).
non-traded goods sector. Therefore, as long as non-traded goods exist, we should expect to find a correlation between saving and investment, even if capital is perfectly mobile across countries. He showed that the saving-investment correlation is relatively higher in countries with larger non-traded sectors.

Tesar (1993) showed that the saving-investment correlation can be high when agents face stochastic fluctuations in the output of non-traded goods even under complete financial markets. She used a two-country two-sector production model, where non-traded goods make up a significant share of total output, and showed that preferences over consumption of traded and non-traded goods and over the intertemporal allocation of consumption may result in an optimal portfolio biased towards claims on domestic output. In a dynamic setting, such preferences are consistent with relatively low correlations among consumptions across countries and a high correlation between saving and investment.
III. Data and Empirical Methodology

In this chapter, we explain how we construct the data and estimate the saving-investment correlation. We use aggregate saving and investment data calculated from National Accounting Statistics since the sectoral data of saving and investment are not available in many countries and the ex post relationship between saving and investment is more relevant for this analysis. Most data are from the International Financial Statistics (IFS) dataset by the IMF. Some data are taken from the Asian Development Bank, Bank of Korea, Ministry of Finance in Japan and Taiwan.

Ten Asian countries are used in this study: Japan, China, Korea, Indonesia, Malaysia, the Philippines, Thailand, Taiwan, Singapore and Hong Kong. We use the annual data from 1980 to 2002. Saving is defined as the GDP minus government consumption and private consumption. Investment is gross fixed capital formation plus change in stocks. Since we use the level data instead of the rate, it is necessary to convert the data in different currency units to a common currency unit. We convert the data to U.S. dollar using period average exchange rate. We convert the data into real values using GDP deflator.

Productivity shocks are defined as the annual percentage change of productivity.\(^{15}\) For productivity measure, we use Solow residuals which are derived from Cobb-Douglas production function of the form \( Y = AL^\alpha K^{(1-\alpha)} \). In this study, we use \( A = \frac{Y}{L^\alpha} \) where we control only for changes in labor, not for changes in capital stock.\(^{16}\) The value of \( \alpha \), the share of labor in manufacturing output, is assumed to be 0.6. We use the

\(^{15}\) Shocks are defined as percentage change of each factor instead of first differences to overcome the differences in units for comparing the coefficients of different shocks in the regression.

\(^{16}\) Glick and Rogoff (1995) argue that adjusting for capital inputs should not produce radically different results since, if one explores US data, short-term movements in capital are small relative to short-term movements in labor. One might argue that the problems in constructing comparable capital stock measures in cross-country data are so severe that attempts to adjust for capital inputs are not that reliable.
Industrial Production index for $Y$ and the employment data taken from IFS for $L$.

Fiscal shocks are defined as the percentage change of unexpected government spending since using government spending as fiscal shocks may cause an endogeneity problem with other macro variables. To construct data for the unexpected change of government spending, we assume that policymakers determine the growth rate of government spending at the start of a fiscal year considering the predicted annual GDP growth rate and the net government debt at the start of the year. The data for government debt is constructed using net government surplus/deficit in national currencies from IFS (line 80). Assuming that policymakers have perfect foresight, we run the country-by-country OLS regression of the growth rate of real government spending at time $t$ on the real GDP growth rates and the real net government debt at the start of the year. We use the residuals as data for unexpected government spending.

The results which we do not report in the table are the following. GNP growth rates have positive and significant effects on government spending in most countries, which shows that governments increase their spending when the economy is expected to grow. The net government debt has negative effects on government spending in many countries but they are insignificant. A negative coefficient can be rationalized by arguing that governments reduce their spending when the initial level of debt is large. However, since it is hard to determine the desired long-run level of government debt and the actual divergence of current government debt from the desired level, this variable affects government spending only marginally.

TOT shocks are defined as the percentage change of TOT--export price/import price. Export and import prices are unit values of exports and imports from IFS (line 74, 75), respectively.17

The time series data of saving and investment consists of two factors with different characteristics. One is low-frequency data that reflects long-term movement and the other is high-frequency data that reflects short-term fluctuations. Most previous empirical papers used a cross-

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17) For Indonesia and Malaysia, import price index is not available. For Malaysia, export price index is constructed by taking the weighted average of three main export goods’ prices, Rubber, Tin and Palm.
sectional analysis with time-averaged low-frequency data and tried to relate the saving-investment correlation to the long-term capital movement. In this case, high-frequency fluctuations in the data are averaged out. On the other hand, the saving-investment correlation using a time series analysis with annual data or data with shorter periods can reflect short-term capital movement over time.

In order to relate the saving-investment correlation to business cycles and capital mobility over time, it is more appropriate to include the analysis of short-term properties of saving and investment as well as long-term properties. Therefore, the econometric method in this study is based on the time-series cross-sectional analysis of the annual data.

However, the time series analysis has some econometric problems. First, the saving-investment correlations from country-by-country time series regressions are insignificant in many cases and too different across countries to specify any systematic relationship with capital mobility. Second, time series data of saving and investment are usually nonstationary which results in a spurious regression. Third, the usual time series regressions do not represent the correct saving-investment correlation since both saving and investment have cyclical properties. Most previous empirical papers have used cross-sectional analysis with time-averaged data to avoid these problems. Some papers attempted to circumvent these problems by detrending the data or expressing saving and investment as a fraction of GDP. However, detrending the data is inappropriate and may result in incorrect inferences in cases where the data are really stationary in first differences.\(^\text{18}\) Using rate data may cause a spurious regression in cases where the orders of integration of GDP, saving, and investment data are not the same. It also neglects the supply-side channel of the business cycles. Therefore, in order to apply the time series analysis, one must solve the econometric problems caused by nonstationarities and cyclical properties of the data, and insignificant coefficients.

In this study, we overcome these problems by adopting a panel data analysis based on the results of unit root test and controlling business cycles caused by exogenous shocks.\(^\text{19}\) First, using a panel data set can

\(^{18}\) See Ghosh (1995) for detailed explanation.

\(^{19}\) See Korl (1996) and Jansen (2000) for the example of the use of panel data in the analysis of international capital mobility.
increase the significance of the saving-investment correlation coefficients and make it possible to explicitly incorporate country-specific effects. Second, for the nonstationary problem, we perform unit root tests to decide which type of data, level or first difference, is appropriate for the regression. If the data is \( I(1) \) process, then it is appropriate to use the least squares estimation with first differenced data.\(^{20}\) However, if two nonstationary data have a cointegrating relation, then it is more appropriate to use a cointegrating regression to incorporate the long-term relationship of the data. Third, in order to remove the cyclical properties of the data caused by exogenous shocks, we run the regressions of aggregate supply and demand on exogenous time-series shocks and derive the saving-investment correlation using the residuals of saving and investment from the regression. With this method, we can use the level data of saving and investment which makes it possible to consider the short-term movements of aggregate variables and the effects of exogenous shocks through the supply side.

For estimating regressions with pooled time-series cross-sectional data, we use the Seemingly Unrelated Regression (SUR) with equality restrictions across the equations excluding a constant term.\(^{21}\) By using this method, we can capture the country specific effects and correct the cross-country heteroscedasticity and correlation in the error term.

In particular, to measure the saving-investment correlation, we run the following regressions.

\[
\Delta l_{it} = \alpha_i + \beta \Delta s_{it} + \epsilon_{it} \tag{26}
\]

where \( \alpha_i \) denotes the country specific intercept, \( \beta \) is assumed to be the

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20) \( I(1) \) process is the time series process in which the level data is nonstationary but first differenced data is stationary. A cointegration test is used to find out whether there is a long-term relationship between two nonstationary variables.

21) The usual regression method with panel data is developed in empirical micro-economic analysis. The usual method is to run the simple OLS regression with stacked data assuming fixed or random effects. However, this method is valid only when the number of cross-sectional units is relatively large and the data are independent over cross-sectional units. Since the data used in this study have relatively large number of time series observations and there exist cross-country correlation as well as heterogeneity in the data set, it is more efficient to use the SUR method with restrictions on coefficients.
same across countries, $I$ is investment, $S$ is saving.

In order to control for shocks, we use the residuals from the following regressions for $\Delta S$ and $\Delta I$:

$$\Delta Z = \text{constant} + \beta_0 \text{ shock}_t + \beta_1 \text{ shock}_{t-1} + \beta_2 \text{ shock}_{t-2} + \text{ residuals}_t,$$  \hspace{1cm} (27)

where $\Delta Z = \Delta S$ and $\Delta I$. We set the lag length at 2 because the coefficients from the lag length 3 and on are insignificant in most cases.

For panel regressions above, we use the maximum likelihood estimation (MLE) calculated by iterating the seemingly unrelated regression (SUR) with equality restrictions using newly computed covariances and system equation estimates from the GLS estimation. We set a maximum of 20 iterations, but all the results converge before reaching this limit. Since the number of time-series observations in the regression is not large enough for the asymptotic efficiency of the GLS estimation, we use the MLE throughout the study.
IV. Empirical Results

1. Stylized Facts

In this chapter, we analyze the data of consumption, saving, investment, and current account for the 10 Asian countries to establish some stylized facts. First, we report time series graphs as well as basic statistical properties of these variables for each country. Then, we perform unit root and cointegration tests to determine the appropriate data type and regression method.

1) Main Statistical Properties

Table 1 reports main statistical properties of saving and investment (as a ratio of GDP). The first column reports the statistics of the whole time period (1980-2002). Average savings and investment rates of the ten countries are 33% and 30%, respectively. Singapore shows the highest savings rate (about 45%) among the ten countries, while China shows the highest investment rate of 37%. The Philippines have the lowest savings and investment rates; 19% and 22%, respectively. Average savings rate is higher than the average investment rate in all countries except for the Philippines and Thailand.

We divide the whole sample period into 1980-89 and 1990-2002. Four countries exhibit that both savings and investment rate increase significantly in the second period. They are China, Korea, Malaysia and Thailand. In particular, the savings rate in China, Malaysia and Thailand increased by 6-7% over this period. Investment rate goes up by 3-4% maximum. For other countries, both savings and investment rates decreases in the second period.

We also report statistics of sub-group countries: big three (China, Japan and Korea), ASEAN (Indonesia, Thailand, the Philippines, Malaysia, and Singapore), and Greater China (Hong Kong, Taiwan and China). Both savings and investment rates of the big three are the largest among the three sub-groups. In particular, the investment rate of the big three is about 33%, while it is around 30% in the other two groups.

Figure 1 reports time-series graphs of saving, investment and the
Table 1. Properties of saving and investment in Asia

<table>
<thead>
<tr>
<th>Country</th>
<th>1980-02</th>
<th>1980-89</th>
<th>1990-02</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S/Y</td>
<td>I/Y</td>
<td>S/Y</td>
</tr>
<tr>
<td>China</td>
<td>37.9%</td>
<td>37.2%</td>
<td>34.8%</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>32.3%</td>
<td>28.6%</td>
<td>33.5%</td>
</tr>
<tr>
<td>Indonesia</td>
<td>30.2%</td>
<td>27.2%</td>
<td>31.0%</td>
</tr>
<tr>
<td>Japan</td>
<td>30.6%</td>
<td>29.0%</td>
<td>31.7%</td>
</tr>
<tr>
<td>Korea</td>
<td>33.5%</td>
<td>32.4%</td>
<td>31.0%</td>
</tr>
<tr>
<td>Malaysia</td>
<td>37.8%</td>
<td>32.4%</td>
<td>33.2%</td>
</tr>
<tr>
<td>Philippines</td>
<td>18.9%</td>
<td>22.0%</td>
<td>23.0%</td>
</tr>
<tr>
<td>Singapore</td>
<td>44.9%</td>
<td>37.1%</td>
<td>41.6%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>30.3%</td>
<td>23.1%</td>
<td>34.1%</td>
</tr>
<tr>
<td>Thailand</td>
<td>30.8%</td>
<td>31.6%</td>
<td>26.0%</td>
</tr>
<tr>
<td>Total</td>
<td>32.7%</td>
<td>30.1%</td>
<td>32.0%</td>
</tr>
<tr>
<td>Big 3</td>
<td>34.0%</td>
<td>32.9%</td>
<td>32.5%</td>
</tr>
<tr>
<td>ASEAN</td>
<td>32.5%</td>
<td>30.1%</td>
<td>31.0%</td>
</tr>
<tr>
<td>Greater China</td>
<td>33.5%</td>
<td>29.6%</td>
<td>34.1%</td>
</tr>
</tbody>
</table>

Current account (as ratio of GDP) of the ten countries. Five Asian crisis countries show similar paths of the current account (therefore, saving and investment) until after the crisis in 1997. These countries show CA balance or slight surplus in early 1990s, deficits in the mid 1990s, and huge surplus after the crisis. Improvement in CA during the crisis period is mostly due to the drop in investment. Savings arte during the crisis period increased in Malaysia and Korea, while Indonesia shows large decrease in both savings and investment after the crisis.

Singapore exhibits a quite unique pattern of movements. Investment continuously decreases since mid 1980s, while savings continuously increase. Therefore, the current account steadily goes up over time and the surplus now is around 20% of GDP. Taiwan and Japan have continuous surplus of CA throughout the whole period, which means
that their savings exceed investment. On the other hand, Hong Kong shows steady CA deficits in the 1990s. China’s current account surplus started to decrease since late 1990s as investment picks up.

**Figure 1. Saving, investment and current account**
2) Unit-root Test

In this chapter, we check the order of integration of the data that we use. In particular, we perform unit root tests of saving, investment and three exogenous shocks. If a variable is proved to be stationary, then we can apply stationary time series analysis. If a variable is nonstationary, then we should use first differences of the data (or detrended data depending on the existence of the drift term). However, using the differenced data has the disadvantage of not capturing the long-term relationship of the variables. If two nonstationary data have a cointegrating relation, then it is better to use the cointegrating regression to incorporate the long-term properties of the data. However, the cointegrating regression method with panel data has not been fully studied in Econometrics\(^{22}\).
In Appendix Table 1, we report unit root test results of saving, investment and three exogenous shocks. We use Augmented Dickey-Fuller unit root test where the null hypothesis is that a variable is nonstationary. For saving and investment data, we test both level and first differenced data. If the level data is nonstationary but the first differenced data become stationary (I(1) process), then we can use the first differenced data for stationary time series regressions. We run country-by-country unit root test instead of panel unit root test (which method is available but not well established).

The test results show that both saving and investment are I(1) processes for most countries. All level data are nonstationary, while the first differenced data are stationary in 7 out of 10 countries. For China, Japan and Thailand, first differenced data are still nonstationary. For exogenous shocks, all shocks are stationary except for two cases; productivity shock in Thailand and fiscal shock in Taiwan. However, even these two data show near unit root property. Since we define shocks as percentage differences, it is natural to observe that shocks are stationary.

2. Estimation Results

This chapter reports the estimation results of the saving-investment correlation before and after controlling the relevant factors described in the previous chapter. First, we estimate the saving-investment correlation using panel data. We use SUR and MLE to analyze the panel data. We first estimate the basic saving-investment correlation without controlling any shocks. Then, we construct new saving and investment data by controlling for cyclical shocks. For the regression of aggregate supply and demand variables on exogenous time-series shocks, we do not specify any prior structure of the estimation model to regress. By using panel data, we can analyze the effects of country differences on saving-investment correlation. We run the separate regressions with sub-country data sorted by each category instead of including these variables directly in the regression since these variables affect the saving-investment correlation cross-sectionally or over relatively long horizon.

22) Some estimation methods are available for estimating long-term relationship of nonstationary panel data. However, estimation of short-term relationship using panel data (such as panel error correction model) is not yet developed.
1) Cross-Sectional and Panel Data Estimation

We first report the estimation results of cross-sectional regressions of the saving-investment correlation using OLS estimation method. Cross-sectional data are constructed by taking averages of saving and investment rates over different periods of time. In the first panel of Table 2, we report the regression coefficients of investment (ratio of GDP) on saving (ratio of GDP). That is, the coefficient $\beta$ is from the regression $I/Y = a + \beta(S/Y)$. From the regression of the whole period data, the saving-investment correlation is 0.65, while in the 1980s it is 0.85 and decreases to 0.51 in the period of 1990-2002. This is exactly what is done in the seminal Feldstein-Horioka paper. We also calculate rolling saving-investment correlation with 15 year window. The results show that the saving-investment correlation consistently decreases over time; from 0.76 in the 1980-1994 period to 0.53 in the 1988-2002 period. All these results confirm that the saving-investment correlation decreased significantly over time in Asia.

The second panel reports time-series cross-sectional regression results. We report coefficients from three regressions, pooled OLS, SUR and MLE calculated by FGLS. Pooled OLS estimation result is from the pooled regression model with stacked data of saving and investment: $\Delta I_i = a + \beta \Delta S_i$, where $a_i$ denotes the country specific intercept and $\beta$ is assumed to be the same across countries. However, the OLS estimation is not efficient if the error term is not well specified. We test whether there exist cross-country heteroscedasticity, cross-country correlation, and within-country autocorrelation in the error term. We find that there exist both cross-country heteroscedasticity and correlation but not autocorrelation.

The second method is based on the Seemingly Unrelated Regression (SUR) with equality restrictions across the equations excluding a constant term. In order to correct the cross-country heteroscedasticity and correlation in the error term, we use the estimates of cross-country covariances based on the residuals from individual country OLS regressions. Finally, the third method is the Maximum Likelihood Estimation (MLE) derived by iterating the SUR with equality restrictions using newly computed covariances and system equation estimates from the GLS estimation. Since the number of time-series observations in the regression is not large enough for the asymptotic efficiency of the GLS estimation, the MLE would provide the most efficient estimation results among the three methods.
### Table 2. Saving-investment correlation

<table>
<thead>
<tr>
<th>Cross-sectional regression (OLS)</th>
<th>Pooled OLS</th>
<th>SUR</th>
<th>MLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I/Y=α+β(S/Y)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>whole period</td>
<td>0.65</td>
<td></td>
<td>(0.14)</td>
</tr>
<tr>
<td>1980-89</td>
<td>0.85</td>
<td></td>
<td>(0.26)</td>
</tr>
<tr>
<td>1990-2002</td>
<td>0.51</td>
<td></td>
<td>(0.12)</td>
</tr>
<tr>
<td>1980-94</td>
<td>0.76</td>
<td></td>
<td>(0.21)</td>
</tr>
<tr>
<td>1981-95</td>
<td>0.75</td>
<td></td>
<td>(0.20)</td>
</tr>
<tr>
<td>1982-96</td>
<td>0.72</td>
<td></td>
<td>(0.19)</td>
</tr>
<tr>
<td>1983-97</td>
<td>0.70</td>
<td></td>
<td>(0.18)</td>
</tr>
<tr>
<td>1984-98</td>
<td>0.67</td>
<td></td>
<td>(0.15)</td>
</tr>
<tr>
<td>1985-99</td>
<td>0.63</td>
<td></td>
<td>(0.14)</td>
</tr>
<tr>
<td>1986-2000</td>
<td>0.58</td>
<td></td>
<td>(0.13)</td>
</tr>
<tr>
<td>1987-2001</td>
<td>0.55</td>
<td></td>
<td>(0.12)</td>
</tr>
<tr>
<td>1988-2002</td>
<td>0.53</td>
<td></td>
<td>(0.13)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel regression</th>
<th>Pooled OLS</th>
<th>SUR</th>
<th>MLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First differences</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔI=α+βΔS</td>
<td>(0.05)</td>
<td></td>
<td>(0.04)</td>
</tr>
<tr>
<td><strong>Ratios</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.35</td>
<td>0.54</td>
<td>0.49</td>
</tr>
<tr>
<td><strong>I/Y=α+β(S/Y)</strong></td>
<td>(0.09)</td>
<td></td>
<td>(0.03)</td>
</tr>
<tr>
<td><strong>First differences of the ratios</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.38</td>
<td>0.51</td>
<td>0.66</td>
</tr>
<tr>
<td>Δ(I/Y)=α+βΔ(S/Y)</td>
<td>(0.11)</td>
<td></td>
<td>(0.06)</td>
</tr>
<tr>
<td><strong>OECD (ΔI=α+βΔS)</strong></td>
<td>0.91</td>
<td>0.87</td>
<td>0.70</td>
</tr>
<tr>
<td>(1960-92)</td>
<td>(0.04)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
</tbody>
</table>
Using first differenced data of saving and investment, all three regressions show high, positive coefficients. Estimation results with MLE indicate that the saving-investment correlation is around 0.88 in the whole sample period. However, if we use ratio data (or first differences of the ratios), the coefficients decrease (to around 0.5-0.6 from the MLE estimation). Compared to the results from the OECD countries, the saving-investment correlation in Asia is larger. Average OECD countries (19 countries in fact, for details see Kim, 2002) saving-investment correlation is around 0.7 from the MLE method, while our data set shows that it is around 0.88.

Throughout this study, we set the benchmark value for the saving-investment correlation at 0.88 derived from the MLE. Is this value an adequate number for the current degree of international capital mobility? Is there any other factor affect saving and investment to produce the correlation of 0.88? The next chapter examines the possible factors which can explain this high saving-investment correlation.

**Country specific coefficients**

Table 3 presents the saving-investment correlation estimated without equality restrictions on the coefficient. Although the saving-investment correlation differs across countries, they are significant in most cases. Results with first differenced data show that China and Thailand exhibit high correlation, around 1.6, while other countries show correlation between 0.4 and 1 except for Korea and Taiwan. For Korea, saving-investment correlation is near zero, while it is around 0.2 for Taiwan. When using ratio data, saving-investment correlation generally decreases.

2) **The Saving-Investment Correlation and Exogenous Shocks**

This chapter analyzes the effects of three time-series shocks--productivity, fiscal, and TOT shocks--on the saving-investment correlation. In order to identify the characteristics of exogenous shocks, we check the exogeneity and correlations among these shocks. Based on these results, we report the regression results of macroeconomic variables, Y, C, G, I, and S on exogenous shocks with various lags. By running the regression of the residuals of saving and investment unexplained by exogenous shocks, we derive the saving-investment correlation after controlling cyclical properties over different horizons.
### Table 3. Saving-investment correlation (country specific coefficient)

<table>
<thead>
<tr>
<th>Country</th>
<th>ΔI, ΔS</th>
<th>I/Y, S/Y</th>
<th>Δ(I/Y), Δ(S/Y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>1.66   (0.12)</td>
<td>0.68 (0.08)</td>
<td>0.37 (0.18)</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>0.73 (0.07)</td>
<td>0.22 (0.09)</td>
<td>0.44 (0.13)</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.73 (0.05)</td>
<td>0.95 (0.06)</td>
<td>0.89 (0.06)</td>
</tr>
<tr>
<td>Japan</td>
<td>1.00 (0.07)</td>
<td>0.74 (0.04)</td>
<td>0.83 (0.11)</td>
</tr>
<tr>
<td>Korea</td>
<td>-0.02 (0.20)</td>
<td>0.22 (0.08)</td>
<td>-0.29 (0.07)</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.45 (0.16)</td>
<td>-0.46 (0.07)</td>
<td>-0.45 (0.20)</td>
</tr>
<tr>
<td>Philippines</td>
<td>1.02 (0.13)</td>
<td>0.53 (0.08)</td>
<td>0.72 (0.16)</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.45 (0.11)</td>
<td>-1.34 (0.23)</td>
<td>0.55 (0.16)</td>
</tr>
<tr>
<td>Taiwan</td>
<td>0.22 (0.10)</td>
<td>0.22 (0.06)</td>
<td>0.08 (0.13)</td>
</tr>
<tr>
<td>Thailand</td>
<td>1.63 (0.15)</td>
<td>0.36 (0.10)</td>
<td>-0.68 (0.16)</td>
</tr>
</tbody>
</table>

**Properties of Exogenous Shocks**

In order to avoid multicollinearity problem, we check if the three shocks that we use are systematically correlated. If they are not significantly correlated, then we can use different shocks in the same regression without worrying about the multicollinearity problem. The results show that the average correlation (pairwise) of the three shocks are -0.13 (prod/fiscal), -0.07 (prod/TOT) and -0.04 (Fiscal/TOT) with standard deviation of 0.19, 0.25, and 0.36, respectively. These numbers confirm that the correlation is not significantly high and we can use different shocks in the same regression.
Effects of Exogenous Shocks on Saving and Investment

In Table 4, we report the coefficients from the panel data regressions of $\Delta Y$, $\Delta C$, $\Delta G$, $\Delta S$, and $\Delta I$ on each shock with a lag structure. Numbers in the parenthesis are standard errors.

The signs of the coefficients are as expected in most cases. First, an increase in productivity initially has positive and significant effects on output, consumption, and investment but these effects diminish over time. Saving is also increased since productivity shocks increase output more than they increase consumption. Since productivity shocks are constructed to contain more of the temporary movements, the permanent income and therefore consumption are not fully increased to the level of the increase of output. This crowding out effect of consumption can also explain the result that investment increases more than saving. Government spending is not affected by a change in productivity. This result confirms some of the theoretical predictions in chapter 4 that productivity shocks have a positive effect on saving and investment.

Second, an increase in government spending has a positive impact on output but ambiguous effects on consumption. Saving decreases initially because of an initial increase in government spending at time $t$ ($S=Y-C-G$). However, effects on savings become positive over time as output goes up. Investment increases initially but the positive effects rapidly diminishes. It can be interpreted that the crowding out effects between investment and government spending is weak and government spending successfully boosts up investment in these countries. However, the fact that this positive effect diminishes rapidly suggests that private sector quickly adjusts their expectations on economic environments and the crowding out effects occur. In theoretical models, the effects of fiscal shocks on saving and investment are ambiguous since the effects depend on the specification of the shocks. The empirical results in this chapter also show ambiguous effect of fiscal shocks, especially on investment.

Third, an increase in the relative price of export goods has a positive effect on output with a time lag, an initial decrease followed by a

23) We use the MLE derived by iterating the SUR with equality restrictions imposed across equations excluding a constant term. All the shocks are multiplied by the mean of each country's real GNP over the estimation period. We can interpret, therefore, that the coefficients are the change of left-hand-side variable as a percent of average GNP in response to one percent increase in each shock.
### Table 4. Effects of shocks on aggregate variables

<table>
<thead>
<tr>
<th>Lag</th>
<th>Productivity shock</th>
<th>Fiscal shock</th>
<th>TOT shock</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.164 (0.015)</td>
<td>0.024 (0.016)</td>
<td>-0.024 (0.011)</td>
</tr>
<tr>
<td>Output</td>
<td>1.004 (0.015)</td>
<td>0.184 (0.016)</td>
<td>0.03 (0.011)</td>
</tr>
<tr>
<td></td>
<td>0.019 (0.014)</td>
<td>0.194 (0.016)</td>
<td>0.04 (0.011)</td>
</tr>
<tr>
<td></td>
<td>0.015 (0.007)</td>
<td>0.01 (0.015)</td>
<td>-0.01 (0.007)</td>
</tr>
<tr>
<td>Consumption</td>
<td>0.017 (0.007)</td>
<td>-0.046 (0.015)</td>
<td>0.014 (0.007)</td>
</tr>
<tr>
<td></td>
<td>0.001 (0.007)</td>
<td>0.031 (0.015)</td>
<td>0.019 (0.007)</td>
</tr>
<tr>
<td></td>
<td>-0.008 (0.002)</td>
<td>0.075 (0.003)</td>
<td>0.001 (0.001)</td>
</tr>
<tr>
<td>G spending</td>
<td>-0.012 (0.002)</td>
<td>0.009 (0.003)</td>
<td>0.003 (0.001)</td>
</tr>
<tr>
<td></td>
<td>-0.011 (0.002)</td>
<td>0.001 (0.002)</td>
<td>0.009 (0.001)</td>
</tr>
<tr>
<td></td>
<td>0.026 (0.010)</td>
<td>-0.096 (0.018)</td>
<td>0.016 (0.009)</td>
</tr>
<tr>
<td>Saving</td>
<td>0.013 (0.010)</td>
<td>0.038 (0.019)</td>
<td>0.005 (0.009)</td>
</tr>
<tr>
<td></td>
<td>0.001 (0.010)</td>
<td>0.073 (0.018)</td>
<td>0.005 (0.009)</td>
</tr>
<tr>
<td></td>
<td>0.066 (0.016)</td>
<td>0.099 (0.028)</td>
<td>-0.004 (0.010)</td>
</tr>
<tr>
<td>Investment</td>
<td>0.022 (0.016)</td>
<td>0.05 (0.028)</td>
<td>-0.027 (0.010)</td>
</tr>
<tr>
<td></td>
<td>-0.004 (0.015)</td>
<td>0.006 (0.027)</td>
<td>0.066 (0.010)</td>
</tr>
</tbody>
</table>
significant increase over time. This observation is consistent with the well-known J-curve effects of the terms of trade. It takes time for the production sector to reflect the benefit from an improvement in TOT. For example, amount of exports and imports does not adjust quickly to price changes in prices because prices are set in advance (3-6 months) in most trade contracts. Consumption increases over time with an initial downturn. Government spending is not affected by a change in TOT. Saving increases initially but decreases over time. Investment decreases for the first two years but finally increases in three years showing a strong J-curve effect. The results in the theoretical example given in Chapter IV depend on the specification of TOT shocks, temporary or persistent. The empirical results show that both saving and investment increase but only with a time lag.

This analysis provides additional findings. First, the effects of productivity shocks are larger than the effects of the other two shocks on all the aggregate variables in the economy. Therefore, productivity shocks are the most important factor explaining the business cycles in the economy. Second, the effects of lagged shocks are very weak in the case of productivity shocks but fiscal and TOT shocks have prolonged effects, especially on investment. Third, in most cases, the effects on consumption are less than the effects on output, which supports the permanent income hypothesis. Fourth, the effects of productivity and TOT shocks on government spending are significantly weak compared to the effects on other variables, Y, C, and I. This suggests that the government spending responds not to the current shocks to the economy but to other targets such as income, inflation, current account, or government debt of current and previous periods.

In Table 5, we report the saving-investment correlations after controlling the cyclical properties caused by exogenous shocks in the economy. The correlation coefficients are derived from the regression of the residuals of investment on the residuals of saving where the residuals are derived from the regressions on exogenous shocks with different number of lags. In the first row, we report the saving-investment correlations after controlling each shock setting the number of lags at 0, 1 and 2. Compared to the benchmark value of 0.88, the correlations decrease only by small number. However, when taking all three shocks together, the saving-investment correlation decreases to 0.83, 0.61 and 0.4 as the number of lags increases.
Table 5. S-I correlation after controlling for shocks

<table>
<thead>
<tr>
<th>lag</th>
<th>Productivity shock</th>
<th>Fiscal shock</th>
<th>TOT shock</th>
<th>all shocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.82</td>
<td>0.86</td>
<td>0.92</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.05)</td>
<td>(0.04)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>1</td>
<td>0.82</td>
<td>0.87</td>
<td>0.9</td>
<td>0.61</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.05)</td>
<td>(0.04)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>2</td>
<td>0.82</td>
<td>0.83</td>
<td>0.85</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.05)</td>
<td>(0.04)</td>
<td>(0.03)</td>
</tr>
</tbody>
</table>

OECD
Benchmark value: 0.70

<table>
<thead>
<tr>
<th>lag</th>
<th>Productivity shock</th>
<th>Fiscal shock</th>
<th>TOT shock</th>
<th>all shocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.75</td>
<td>0.7</td>
<td>0.68</td>
<td>0.64</td>
</tr>
<tr>
<td>1</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.58</td>
</tr>
<tr>
<td>2</td>
<td>0.64</td>
<td>0.65</td>
<td>0.6</td>
<td>0.42</td>
</tr>
</tbody>
</table>

All the regressions are estimated by the MLE driven by iterating the SUR. All the correlation coefficients are significant with the 1 percent level in the OECD case.

Table 5 also reports the saving-investment correlation of OECD countries after controlling for cyclical shocks (Kim, 2001). Patterns of changes in the coefficient are quite similar to the case of Asia: correlation decreases only by small number when controlling individual shocks (from benchmark of 0.7 to 0.6) but when including all three shocks together, correlation decreases to 0.42 with two lag periods. Absolute numbers of correlation for OECD countries are smaller than those of Asian countries, which is also consistent with the case before controlling shocks.

Another observation is that the effects of the terms of trade shock on saving-investment correlation are weak in Asian countries, while this effect is rather significant in the OECD countries. On the other hand, the effects of productivity shocks on saving-investment correlation are
stronger in the Asian country sample, compared to the case of the OECD countries. This may indirectly suggest that the Asian countries suffer from cyclical shocks from productivity changes because these countries do not use business cycle stabilizing monetary and fiscal policies effectively, compared to the OECD countries.

**Country Specific Coefficient**

Table 6 presents the saving-investment correlation estimated without equality restrictions on the coefficient after controlling for all shocks. As before, the saving-investment correlation significantly differs across countries. Among the ten countries, saving-investment correlation decreases after controlling for all shocks except for two countries: Korea and Taiwan.

<table>
<thead>
<tr>
<th>Country</th>
<th>no control (table 3)</th>
<th>control for all shocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>1.66 (0.12)</td>
<td>0.03 (0.10)</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>0.73 (0.07)</td>
<td>0.27 (0.05)</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.73 (0.05)</td>
<td>0.24 (0.03)</td>
</tr>
<tr>
<td>Japan</td>
<td>1.00 (0.07)</td>
<td>0.72 (0.07)</td>
</tr>
<tr>
<td>Korea</td>
<td>-0.04 (0.20)</td>
<td>0.43 (0.19)</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.45 (0.16)</td>
<td>0.10 (0.05)</td>
</tr>
<tr>
<td>Philippines</td>
<td>1.02 (0.13)</td>
<td>1.02 (0.11)</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.45 (0.11)</td>
<td>0.01 (0.09)</td>
</tr>
<tr>
<td>Taiwan</td>
<td>0.22 (0.10)</td>
<td>0.41 (0.08)</td>
</tr>
<tr>
<td>Thailand</td>
<td>1.63 (0.15)</td>
<td>0.61 (0.19)</td>
</tr>
</tbody>
</table>

**Table 6. S-I correlation after controlling for shocks (country specific coefficient)**
Note that these two countries show the lowest saving-investment correlation before controlling for shocks. These differences in coefficients are mainly due to the lack of data points. In individual country analysis, the number of observation is only 20.

3) The Saving-Investment Correlation and Country Differences

In Table 7, we analyze the effects of country size on the saving-investment correlation. We sort ten Asian countries into three groups according to the size of the real GDP denominated in US dollar (at 2002) and run the separate regression with each country sample.\(^{24}\) Large countries are China, Japan and Korea. Medium countries are Thailand, Taiwan, Singapore and Hong Kong, while small countries include Indonesia, Malaysia and the Philippines. The theory predicts that the saving-investment correlation increases with country size. However, in both

<table>
<thead>
<tr>
<th>Size of GDP</th>
<th>no control</th>
<th>control for all shocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>0.98</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.09)</td>
</tr>
<tr>
<td>Medium</td>
<td>1.01</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>(0.13)</td>
<td>(0.13)</td>
</tr>
<tr>
<td>Small</td>
<td>0.83</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.09)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size of Nontraded sector</th>
<th>no control</th>
<th>control for all shocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>1.08</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>Medium</td>
<td>0.76</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(0.13)</td>
</tr>
<tr>
<td>Small</td>
<td>0.58</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>(0.16)</td>
<td>(0.15)</td>
</tr>
</tbody>
</table>

24) We use the same estimation method as before, the MLE derived by iterating the SUR.
models, with and without controlling for cyclical effects, the saving-investment correlation does not have a positive relationship with country size.

Next, we estimate the effects of nontraded sector on saving-investment correlation. We sort ten Asian countries into three groups using the ratio of -\((\text{import}/\text{GNP})\) in the year 2002 as the proxy of the size of the non-traded sector.\(^{25}\) We assume that the smaller the relative size of the import sector, the larger the non-traded sector. Countries with large nontraded sector (small share of import) are China, Japan and Indonesia. Medium countries are Thailand, Taiwan, Korea and the Philippines, while small countries include Singapore, Hong Kong and Malaysia. The regression results before controlling for shocks are consistent with the theoretical predictions. The larger the nontraded sector is, the higher the saving-investment correlation. However, after controlling for cyclical effects, this positive relationship disappears.

4) Aggregate Saving-Investment Correlation

Table 8 reports the saving-investment correlation using aggregate saving and investment data of Asia. Aggregate data are constructed by taking sum of each country’s data (adjusted for currency unit and inflation). This regression based on the aggregate data may indicate how much investment of a certain region is financed by regional savings,

<table>
<thead>
<tr>
<th></th>
<th>ΔI, ΔS</th>
<th>I/Y, S/Y</th>
<th>Δ(I/Y), Δ(S/Y)</th>
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<td>All</td>
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<td>0.92</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>(0.20)</td>
<td>(0.19)</td>
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<td>0.83</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>(0.20)</td>
<td>(0.15)</td>
<td>(0.27)</td>
</tr>
<tr>
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<td>0.76</td>
<td>1.03</td>
</tr>
<tr>
<td></td>
<td>(0.26)</td>
<td>(0.44)</td>
<td>(0.43)</td>
</tr>
<tr>
<td>Greater China</td>
<td>1.11</td>
<td>0.88</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>(0.21)</td>
<td>(0.14)</td>
<td>(0.32)</td>
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\(^{25}\) We used the same proxy which Wong (1990) used for estimating the size of the non-traded sector.
instead of country-by-country analysis. We use the same three data conversion methods and all estimation is done by the MLE. Regressions with Asian aggregate savings and investment show high coefficients, suggesting that the Asian investment is largely financed by savings within the region. Regressions with all three data types (first differences, rations and first differences of the ratios) suggest that saving-investment correlation is larger in ASEAN compared to those in big three or greater China. This suggests that investment in ASEAN is more likely to be financed by regional savings, while investment in big three countries are relatively more financed by savings outside of the region.

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26) That is, we treat the whole Asian region as one country and examine the saving-investment correlation for the whole Asian region. Note that this aggregate level correlation may not reflect the true degree of international capital mobility if one country in a region borrows internationally but another country lends internationally.
V. Conclusion and Policy Implications

In this study, we analyzed saving-investment correlation for the East Asian countries. We report various estimation results including times-series, cross-section, and panel data analysis with different estimation methods including OLS and MLE. We can summarize main findings of the study as follows.

First, cross-sectional analysis reveals that the saving-investment correlation steadily decreases over time, 0.76 in the 1980s and 0.53 in the 1990s. However, the absolute magnitude of the coefficient is still large even in the 1990s. Second, panel data regression with the first differenced data shows that the saving-investment correlation for East Asian countries (0.88) is higher than that of the OECD countries (0.7) in Kim (2001), which is consistent with the fact that international capital mobility in East Asian countries is lower than that of the OECD countries. Third, panel data analysis with country specific coefficients suggests that the saving-investment correlation widely varies across countries: for example, 1.66 in China and -0.02 in Korea. This point was also made in many previous studies with time-series analysis with OECD data.

Fourth, regression of aggregate national income accounting variables on exogenous shocks shows that the estimated coefficients are in general consistent with theoretical predictions. Fifth, after controlling for cyclical shocks, the saving-investment correlation decreases, especially when including all three shocks with lags, but the absolute value is still high around 0.4. This suggests that the degree of capital mobility is still low in Asian countries. However, there might be other factors that can explain low saving-investment correlation other than cyclical shocks, which may have been omitted in this study. Sixth, country differences in terms of size of GDP do not have consistent relationship with saving-investment correlation. Size of nontraded sector is positively related to saving-investment correlation; the larger the size of the nontraded sector, the higher the saving-investment correlation. However, this relationship disappears when we control for cyclical shocks. Finally, aggregate regional saving and investment data analysis reveals that the whole region of East Asia is close to self-finance in investment. In other words,
investment in the region is largely financed by regional savings. In ASEAN countries, the degree of self-sufficiency in investment is the largest compared to big 3 or Greater China.

From these results, we can safely argue that in general the direction of changes in saving-investment correlation over time is consistent with the changes in the degree of capital mobility; the saving-investment correlation decreases as capital mobility increases over time. On the other hand, the saving-investment correlation, even after controlling cyclical shocks, is still positive, which may imply that the absolute degree of capital mobility is still low. However, it would be hard to directly infer the degree of capital mobility of specific countries because the saving-investment correlation is too much different across countries in country specific analysis. This cross-country difference of the saving-investment correlation may reflect either the presence of other country-specific factors (some of them are possibly not considered in this study) or the small degree of freedom given the short sample size.

Another interpretation on the high saving-investment correlation can be related to the government policies towards current account management. Saving-investment correlation is directly related to the characteristics of current account. If countries can freely borrow and lend with the rest of the world and obtain full degree of intertemporal consumption smoothing, then current account should fluctuate in a close relation with business cycles. This movement should be directly reflected by saving-investment correlation because the current account can be expressed as saving minus investment. A low correlation of saving and investment implies that current account freely adjusts for intertemporal consumption smoothing purpose. However, if government maintains current account targeting policy, then current account would not fluctuate to the optimal level and saving and investment would be highly correlated even in the world of perfect capital mobility. Therefore, saving-investment correlation may provide indirect evidence of the government’s stance on the current account policy, whether governments target the current account balance as their policy goal or simply take the current account as residuals of economic activities.

The above explanations may explain the current status for East Asian countries. East Asian countries have liberalized the capital market in recent years, and the degree of international capital mobility in these countries may be comparable to industrial countries. In our empirical
results, the saving-investment correlation of East Asian countries in recent years decreases, which is consistent with higher capital mobility in recent years, but the saving-investment correlation of East Asian countries is still higher than that of industrial countries. The reasons for the relatively high correlation, compared to industrial countries, may be found due to the current account targeting in the East Asian countries. Many East Asian countries have intervened in foreign exchange market to intentionally undervalue their currencies to maintain current account surplus and accumulate foreign reserves regardless of their economic conditions. Since the Asian crisis, these countries more eagerly try to maintain current account surplus and accumulate foreign exchange reserves in order to provide the safety net against future recurrence of currency crisis. Such policy behaviors may result the high saving-investment correlation, despite of the capital market liberalization in these countries.

However, this policy cannot be continued forever because of the nature of business cycles. As the economy moves from boom to bust cycles (or the other way), current account should move accordingly if a country wants to maximize welfare through international intertemporal trade. Current policies (that maintain current account surplus and accumulate foreign exchange reserves) are against this welfare-maximizing scheme; even with high degree of international capital mobility achieved by capital market liberalization, the benefits of mobile capital are not fully utilized. As economic conditions change, exchange rate should adjust to stabilize domestic economy, so as current account, saving and investment. As such, the welfare gains from high degree of capital mobility can be maximized through international intertemporal trade. A correct measurement of saving-investment correlation in relation with business cycles can provide us valuable studies on welfare gains of intertemporal trade.
<table>
<thead>
<tr>
<th>Country</th>
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<th>Saving</th>
<th>Inv</th>
<th>Prod sh</th>
<th>Fiscal sh</th>
<th>TOT sh</th>
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</table>

Note: We use the Augmented Dickey-Fuller Unit root test. The Null hypothesis is that the variables is nonstationary. I include a constant and the time trend term in the regression. The critical values are -3.24 with a 10% critical level, -3.6 with a 5% critical level and -4.38 with a 1% critical level. If the test statistic is less than the critical value, then one can reject the null hypothesis of nonstationarity. The Italic numbers denote that the Null hypothesis is rejected at the 10% significance level.
References


Kim, Sunghyun. 2001. ”The Saving-Investment Correlation Puzzle is Still a Puzzle.“ *Journal of International Money and Finance* 20, pp. 1017-34.


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