

The role of financial development in economic growth: The experiences of Taiwan, Korea, and Japan

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Abstract

Since the financial crisis broke out in East Asia, the importance of financial development and stability had been noted. This paper tries to examine the relationship between financial development and the source of growth for three Asian economies, namely, Taiwan, Korea, and Japan. Particularly, we wish to emphasize the role of financial development and structure (including banking and stock markets), monetary and financial policies, as well as the degree of international capital mobility in the economic growth processes. Using the generalized method of moments (GMM) and principal component analysis, we find that (1) high investment had accelerated economic growth in Japan, while high investment to GDP ratio did not necessarily lead to better growth performance if investment did not have been allocated efficiently, e.g. in Taiwan and Korea cases; (2) real export growth rate had contributed to Taiwan and Korea; (3) the finance-aggregate had positive effects on Taiwan's economy, but had negative effect on other countries; (4) the stock market development had positive effects on Taiwan's economic growth; (5) Taiwanese economy suffered less from the Asian financial crisis; (6) after foreign exchange deregulation, capital outflows had negative effects on all three economies, while the effect of capital inflows is negative but insignificant.

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1. Introduction

The rapid economic growth of the Asian countries has been a focus of interest for academics and policy makers for the last three decades. Among them, once Taiwan and Korea were colonies

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of Japan, and these three nations exhibited similarities in economic structure and policies. For example, all three economies had followed export oriented development strategy and had accumulated significant foreign reserves from trade surplus and experienced higher rates of domestic investment over the past 30 years. These three nations are also active members in the WTO.² In addition, financial liberalization and financial reform have been undergone in these nations recently. This offers a superb sample to be examined the role of the financial sector development in economic growth processes. That is, it is interesting to investigate the relationship between financial development and the source of growth in Taiwan, Korea, and Japan.

The general idea that economic growth is related to financial development and structure can go back at least to Schumpeter (1911). Schumpeter emphasized the importance of the banking system in economic growth and highlighted circumstances when financial institutions can actively spur innovation and future growth by identifying and funding productive investments. Earlier literature including Goldsmith (1969), McKinnon (1973) and Shaw (1973) had suggested that financial system should have played an important role in economic growth. These models, McKinnon (1973) and Shaw (1973) showed that financial development would raise saving, capital accumulation, and hence economic growth. Recent theoretical papers by Greenwood and Jovanovic (1990), Bencivenga and Smith (1991), Levine (1991), Saint-Paul (1992), King and Levine (1993a), and Bencivenga, Smith, and Starr (1995) have developed various theoretical frameworks that link financial activities or services with steady state growth. However, among them, except Saint-Paul (1992), models also show that financial development can hurt growth. Specifically, financial development by enhancing resource allocation and hence the returns to saving may lower saving rates.

At the empirical studies, King and Levine (1993a, 1993b) used cross-countries data to analyze the relationship between economic growth and the financial development. Their results had shown that a range of financial indicators are robustly positively correlated with economic growth. But, they also found that government intervention in the financial system has a negative effect on the growth rate. Demirgüç-Kunt and Levine (1996b) used 44 cross-countries data from 1986 through 1993 had found that a positive relationship between stock market and financial institutions development. Demetriades and Hussein (1996) employed time series data for each of 16 countries showed that finance is a leading sector in the process of economic development. Also, Odedokun (1996) employed time series data for 71 developing countries and showed that financial intermediation had promoted economic growth, in some 85% of the countries. While the empirical works above focus on only banking sector development, they ignored the effect of stock market development.

Levine and Zervos (1998) investigated whether measures of stock market liquidity, size, volatility, and integration with world capital markets are correlated with economic growth. Their study provided empirical evidence on the theoretical debates regarding the linkages between stock markets and long-run economic growth. However, their study did not utilize time series model to test the growth relation in a particular country. Instead, they used 47 countries data from 1976 through 1993 by taking the standard cross-country growth regression framework like Barro (1991) to test the economic growth hypothesis. Also, Leahy, Schich, Wehinger, and Pelgrin (2001) used OECD countries data and showed that stock market and financial institutions

² Japan and Korea had been a WTO member since 1 January 1995, Taiwan became the member of the WTO on 1 January 2002.

development are correlated with economic growth. Levine, Loayza, and Beck (2000) and Beck, Levine, and Loayza (2000) used both cross-country data and dynamic panel data techniques to assess the role of the financial development in stimulating economic growth. Their results found that financial development had been robustly linked with economic growth and total factor productivity growth.

Arestis, Demetriades, and Luintel (2001) used quarterly data and applied time series model to five developed economies and showed that while both banking sector and stock market development could explain subsequent growth, the effect of banking sector development had been substantially larger than that of stock market development. Hsu and Lin (2000) had investigated the relationship between long-run economic growth and financial development to see whether stock market and financial institutions promote economic growth using Taiwan's data from 1964 through 1996. The empirical method utilized is the vector autoregressive error-correction model proposed by Johansen and Juselius (1992). They found that both banking and stock market development are positively related with short-run and long-term economic growth. In particular, the financial depth measured by the ratio of the broad monetary aggregate (M2) and GDP had strong effect on the output growth. In addition, they also found that Granger causality exists between financial development measures and economic development in both directions occurred during the study period (i.e. from 1964 through 1996).

However, most of the empirical studies on economic growth had neglected the effect of international capital mobility on economic growth. High degree of capital mobility not only affects independence of domestic monetary and fiscal policies, but also adds to complexity of managing saving and investment problems in a country.

Hanson (1994) suggested that a stable macroeconomy and domestic financial liberalization to a significant degree are preconditions to international financial liberalization. Johnston, Darbar, and Echeverria (1997) examined issues in sequencing and pacing capital account liberalization and draws lessons from experience in Chile, Indonesia, Korea, and Thailand. Their results suggested that capital account liberalization should be approached as an integrated part of comprehensive reform strategies and should be paced with the implementation of appropriate macroeconomic and exchange rate policies. However, Kim and Suh (1998) suggested that capital account liberalization will enhance the competitiveness and efficiency of financial transactions for Korean corporations. Hence, it cannot further delay the opening of domestic capital market to foreigners as well as the foreign capital markets to domestic residents.

In this paper we will focus on those factors such as financial development and structure (including banking and stock markets), monetary and financial policies, as well as the degree of international capital mobility in the economic growth processes of Taiwan, Korea, and Japan. In contrast to the recent empirical literature, this study uses a longer period quarterly data (1981:1–2001:3) and utilizes the generalized method of moments (GMM) and principal component analysis to estimate. The paper proceeds as follows. Section 2 briefly discusses the experiences with financial liberalization in these countries. Section 3 describes an econometric model and the data used in this study. Section 4 presents the main results. Section 5 is the concluding remarks.

2. Selected country experiences with financial liberalization

This section discusses the three countries' experience of financial liberalization during the last two decades. World Bank (1993) showed that Taiwan, Korea, and Japan have achieved high

economic growth since the post-World War II is due to the guide of government policies. However, the government policies of financial liberalization process implemented by these countries were different during the last two decades. In order to explore cross-sectional differences in financial liberalization processes, we will focus on four key elements: (1) interest rate deregulation, (2) deregulation of foreign exchange rate, (3) enlargement of the business scope of financial institutions, and (4) liberalization of capital movement.³

2.1. Interest rate deregulation

The three economies' interest rate deregulation proceeded slowly and gradually. Among them, Taiwan had pushed on liberalization of interest rates fastest and Korean interest rate full deregulation occurred latest. Before 1975, Taiwanese interest rate was determined by the central bank. The amendment of the Banking Law promulgated in 1975, and Taiwanese government started to relax its controls on bank lending rates. In 1976, the money market was established and stressed the interest rates should be decided by market. Deregulation of the interest rate ceiling on the money market was effective in November 1980, when the Guidelines Governing the Adjustment of Interest Rates of Banks promulgated. And from March 1985 banks were allowed to price their own interest rates. In 1986, banks were accorded more freedom to decide interest rates of bank deposits, and deregulation of interest rate was finally completed in July 1989 Revised Banking Law. Therefore, it took 14 years for the liberalization of Taiwanese interest rates to be complete.

In Korea, the partial interest rate deregulation on commercial paper (CP) started in June 1981. The abolition of preferential interest rates in 1982 and extensive deregulation of interest rates of banks and non-banking financial intermediaries in 1988 resulted in the liberalization of most of the lending rates, interest rates in money and capital markets, and partial liberalization of the interest rates on deposits (see Kim & Suh, 1998). However, as the prospect of becoming an OECD member country was instrumental in the move towards liberalizing its financial market, Korean government accelerated its interest rates liberalization and announced a plan to implement a four phase interest rate deregulation from August 1991. The restrictions on interest rates of bank loans and deposits were totally abolished in July 1997. Therefore, Korean interest rates liberalization took about 16 years, longer than Taiwan and Japan.

In Japan, the liberalization of interest rates on large-denomination CDs (certificates of deposit) began in May 1979. After several years of no further deregulation measures, the Japanese government started to decontrol interest rates step by step from 1984, due to the requests of the United States and consideration of the internationalization of the yen. The interest rate deregulation proceeded slowly and full deregulation occurred much later than other major industrialized economies. By 1993 almost all bank deposit rates except for small-denominated and demand deposits had been liberalized. The deregulation of deposit interest rate was completed in 1994. The liberalization of interest rates took 15 years.

2.2. Deregulation of foreign exchange rate

In foreign exchange deregulation the three cases were also differed significantly. The Taiwanese foreign exchange system was converted from a fixed rate system to a managed flexible

³ The details of financial liberalization in Taiwan, Korea, and Japan can be found in Ministry of Finance (1996), Bank of Korea (2002), Kim and Suh (1998), Tsuruta (1999), Takahashi and Kobayakawa (2003) and Honda (2003).

rate system and started operation in February 1979, when the foreign exchange market was established.⁴ Due to the continuous and huge trade surplus during the 1980s, Taiwanese government amended the Statute Governing the Foreign Exchange in 1986. And the foreign exchange control was remarkably deregulated accordingly in July 1987.⁵ Although the exchange rate of the NT dollar against the U.S. dollar has been allowed to fluctuate since then, it is controlled occasionally by the central bank. Until now, the foreign exchange market is still only partially liberalized. To guide financial system moving toward internationalization, the foreign exchange control on the current account was totally abolished, and restrictions on the capital movement had also relaxed significantly since 2004.

In Korea, a foreign currency call market was set up in December 1989, and a completely revised Foreign Exchange Management Act was passed in December 1991. The exchange rate regime in Korea was from the multi-currency basket system to the market average foreign exchange rate system in March 1990. Under the new exchange rate regime, the fluctuate limitation of foreign exchange transactions were based on daily exchange rate fluctuations, and because of this their movements failed to fully reflect the pressures for exchange rate change. As a result, there were frequent cases of foreign exchange rate misalignment and Korea fell victim to speculative attacks, which was what finally led to the crisis. To make the exchange rate better reflected the economic fundamentals and to stave off the speculative attack on currency and the financial market, the Korean government completely abolished the limit on daily fluctuations and adopted a free-floating exchange rate system in December 1997, allowing the won exchange rate to be determined by market supply and demand (see Kim, 2003, p. 5).

The Japanese government formally adopted a floating exchange rate system in 1973. Foreign exchange transactions were liberalized in 1980 when New Foreign Exchange and Foreign Trade Control Law was implemented, although there are some restrictions still remained. The yen was internationalized through the establishment of an off-shore market and the deregulation of the Euro-yen in December 1986.

2.3. Enlargement of the business scope of financial institutions

The three economies display significant differences in their approaches to liberalizing the deregulation of the scope of financial institutions. In Taiwan, the government had strictly restricted on new entry to the financial business and expanded the business scope of financial institutions until the early 1990s, and all banks were either owned or partly owned by the government. In July 1989, the Taiwanese government accounting to the Banking Law amendment began to allow new applications for the establishment of financial institutions and permitted them to diversify their business scope. In addition, it also allowed foreign banks to engage in more financial operations, such as savings and trust business, but denied non-banking financial institutions (NBFIs) the same privilege. Furthermore, to improve the efficiency of government banks, in May 1991, the Taiwanese government started privatization of banks by

⁴ The central exchange rate system was adopted. Banks and their customers were able to trade foreign based on the weighted-average of the exchange rates on transactions among banks on the previous business day. In April 1989, the central exchange rate system was replaced by the negotiation exchange rate system. Banks were allowed to negotiate the foreign exchange rates with their customers on all transactions except for small transactions between the banks and individual customers. By 1990, all remaining restrictions on exchange rate movements were removed. Every Bank is entirely free to set its own rates for foreign currencies.

⁵ In 1987, all foreign exchange controls on trade-related current account transactions were abolished.

selling part of shares in major commercial banks. After opening domestic banking market, Taiwanese interest rate and foreign exchange rate had been completely determined by market forces.

However, since 16 private commercial banks was established in 1991, the number of domestic banks had increased from 24 in 1990 to 47 in 1997 and 53 in 2001. The average rate of return on the net worth (ROE) for the banks dropped tremendously from 20.79% in 1990 to 3.61% and –7.35% in 2001 and 2002, respectively. The non-performing loans (NPL) rose from 0.93% of total loans in 1990 to 5.34% and 7.48% in 2000 and 2001, respectively (see Table 1). Over banking phenomenon came out.

In order to solve the over banking problem, the government had undergone significant changes in financial reforms. Firstly, in order to raise the competitiveness of financial institutions, the Financial Institutions Merger Law was promulgated in December 2000. Secondly, to effectively handle unhealthy financial institutions, the financial restructuring fund was set up in July 2001. Thirdly, to raise the overall operational efficiency of financial system and promote the soundly development of the financial market, the Financial Holding Company Act was enacted and formally implemented in November 2001. The Act provides banks, securities firms and insurance companies with a mechanism for cross-industry operations. As of August 2003, the government has approved the application of 14 financial institutions to set up financial holding companies.

In Korea, the government had removed entry barriers and eased restriction on business scope of financial institutions earlier than Taiwan and Japan. The privatization of commercial banks started in 1982 and was completed by 1983, the commercial banks began to enjoy more freedom over both interest rates and credit allocation. However continued government control of interest rates at all banks in the period, along with high proportion of non-performing bank loans and heavy dependence on the Bank of Korea for low-cost funds to support their outstanding loans, had left the privately owned commercial banks very vulnerable. A substantial of their outstanding loans had been still policy-related. The banks could not afford to ignore the government's suggestions, despite their shift to private ownership (see Smith, 2000).

In contrast with the restriction on the operations of commercial banks, unlike Taiwan, Korean government had permitted established various NBFIs, such as investment and finance companies

Table 1
Non-performing loans ratio (%) at banking sectors of Taiwan, Korea, and Japan

	Taiwan	Korea	Japan ^a
1980	4.68		
1990	0.93	2.1	
1995	2.85	0.9	3.5
1996	3.68	3.9	6.0
1997	3.70	14.9	
1998	4.36	16.8	5.38
1999	4.88	12.9	6.16
2000	5.34	8.0	5.93
2001	7.48	3.4	6.26
2002	6.12	2.3	8.44

Source. The data for Taiwan are from Financial Statistics Monthly, Central Bank of China. For Korea, the data of 1996–1997, figures are from Ji and Park (1999, p. 32), and other figures are from He (2004, Table 1). For Japan, the figures in 1995 and 1996 are from Taniuchi (1997, Table 1), and other figures are from Japanese Bankers Association, analysis of financial statements of all banks, various issues.

^a Data are for 31 March of year shown, which is the fiscal year-end.

and mutual savings and finance companies, and allowed them to diversify their business scope between 1982 and 1992. As NBFIs had always been privately owned and had been both less controlled and less protected by the government, the amount of NBFIs increased significantly. As a result, the number of domestic banks increased slowly from 15 in 1981 to 21 in 1990 and 26 in 1997, then decreased to 15 in 2001. The banking sector's share of deposits decreased from 43.3% in 1980 to 20.4% in 1997 (see Ji & Park, 1999, Table 2). The share of NBFIs, in contrast, increased from 35.6% in 1980 to 63% in 1997. The NBFIs occupied significant proportion in the financial market.

However, due to the fact that Korean chaebols owned most of the non-bank financial sector, they relied increasingly on non-bank financial institutions for their investment needs. Particularly, chaebols were largely dependent on short-term debt for financing their investment, which rapidly increased their short-term liability. The results of overexpansion led firms to deteriorate their financial structure. Poor financial structure and high interest payment as well as domestic economic recession had resulted in a chain of chaebol bankruptcies in early 1997.

After the crisis, in April 1998, the Korean government announced the basic framework of financial sector restructuring. Korean government had taken a series of measures to improve the financial situation, including lowering the debt ratio of chaebols, eliminating cross-debt guarantee, concentrating on core business, and purchase of non-performing loans, etc. (Chopra et al., 2001). Also, to facilitate the financial sector reform, several financial supervisory authorities were created or modified. For example, the Financial Supervisory Commission (FSC) was created and the Korea Asset Management Corporation (KAMC) and the Korea Deposit Insurance Corporation (KDIC) were modified. To help financial institutions dispose of their non-performing assets, the Non-performing Loans Management Fund was set up under the umbrella of the KAMC. The Financial Holding Company Act was also passed to promote universal banking in October 2000. As of the end of September 2001, three financial holding companies had been established.⁶

Since 1948, Japan had followed the U.S. policy of separating securities activities from banking activities. Banks were prohibited from underwriting, trading equities and corporate bonds except public sector bonds such as government bonds, and security companies were prohibited from conducting banking business including foreign exchange transactions.

After 1975, to offset fiscal deficits, Japanese government began to issue large scale revenue-financing bonds and forced banks to raise the share of bonds in their portfolios. The increase in the supply of government bonds also encouraged the development of money market.⁷ This made it difficult for the Japanese government to maintain deposit rate ceilings and therefore allowed banks to issue CDs in May 1979. The Japanese government gradually deregulated financial system in 1980s. For example, private banks and postal savings were allowed to sell government bonds in 1983 and 1988, respectively. Bank dealings of all types of bonds and the participation of foreign institutions in government bond syndicates were allowed in 1984. Foreign banks were able to participate in domestic trust business in 1985. And from August 1987 the U.S. banks could do securities business. However, due to the fact that firms could choose more freely among alternative fund sources, many Japanese companies had financed their funding needs in the capital markets rather than through bank lending in the late 1980s.⁸ Thus, there existed

⁶ See Bank of Korea (2002, p. 23).

⁷ The Ministry of Finance of Japan was compelled to open a secondary market for government bonds in 1977, and to start issuing bonds through public auctions in 1978 (see Hoshi & Kashyap, 1999, pp. 134–135).

⁸ By 1987, the Japanese domestic commercial paper market was created, giving firms another non-bank source of funding (see Hoshi & Kashyap, 1999, p. 137).

Table 2
Sequence of financial liberalization (1973–2001)

	1973	1975	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Domestic																										
Interest rate deregulation																										
Taiwan		⊙											←													
Korea					⊙																	←				
Japan			⊙															←								
Banking system development																										
Taiwan													⊙									⊙			⊙	
Korea						⊙	⊙															⊙				
Japan							⊙								⊙							⊙				
Capital market development																										
Taiwan												⊙														
Korea										⊙																
Japan		⊙																		⊙						
External																										
Foreign exchange rate deregulation																										
Taiwan			⊙								⊙	⊙	⊙													
Korea														⊙								←				
Japan	←																									
Removal of trade barriers																										
Taiwan											⊙															
Korea							⊙																			
Japan				⊙																						
Removal of capital control																										
Taiwan											⊙			⊙												
Korea					⊙										⊙	⊙										
Japan	⊙																					←				←

Note. An “⊙” represents major measures undertaken that year and “←” represents the liberalization to be complete in that year.

competition of firms' borrowing in financial markets. To survive, banks tried to maintain loan outstanding. This caused banks to look for new borrowers, such as construction companies, real estate developers and non-banking finance companies on which they had not learned enough credit information. This is one of the reasons why Japanese banks have accumulated huge bad loans (see Honda, 2003, p. 137).

As the bubble's collapsed, the Japanese economy slumped into the long stagnation in the 1990s. To solve this stagnation, the government began to encourage financial reform. In 1992, the Financial Reform Law was approved and financial institutions were allowed to enter into other kinds of financial business by establishing subsidiaries. For example, banks were allowed to engage in securities business through their subsidiaries. Banks also could conduct trust businesses either through trust-bank subsidiaries or by themselves. The government allowed securities companies to set up trust-bank subsidiaries from 1993. And the pension fund market was opened in 1995. Finally in 1996 all rules regarding bond issues were lifted.

In late 1996, the government revealed a plan to reform financial markets and institutions, and to create a free, fair and global financial system. The financial system reform is so-called Japanese Big Bang. Under the Big Bang reform, Japanese banks had established bank holding companies that own a securities subsidiary since March 1998. Furthermore, banks had been allowed to sell investment trusts at their counters since December 1998. There were also limits on the scope of businesses permitted bank's securities and trust subsidiaries. But these restrictions were totally abolished from October 1999. Also, banks conducted insurance business through subsidiaries from October 2000. Furthermore, revision to the Insurance Businesses Law in 2000 made possible for banks to engage in retail sales of certain kinds of insurance products from April 2001.

Although the Japanese government began to engage financial reform earlier than Taiwan and Korea, however, the reform still went slowly. The quick rising in non-performing loans led to Japan's banking crisis burst in late 1997 and early 1998. The banking sector NPL ratio in Japan increased from 3.5% in March 1995 to 5.38% and 6.26% in March 1998 and March 2001, respectively. The disposal of non-performing loans is lagging behind Korea (see Table 1).

2.4. Liberalization of capital movement

In capital movement liberalization the three countries also differed significantly. In Taiwan, to promote the liberalization policy and capital market expansion, the liberalization of the securities market started in January 1988, when the Securities and Exchange Law was revised to lift the restriction of the establishment of new securities companies. The OTC transaction was permitted in 1989. Taiwanese government also approved foreign investors to invest limited amount in the domestic stock market since September 1990. However, the participation of foreign investors in the Taiwan stock market was allowed to increase gradually and slowly. In the stock markets, the maximum investment quota for each qualified foreign institutional investor was U.S. \$600 million before November 1999. In December 2002, it was raised to U.S. \$3 billion and was released in 2004.

In Korea, the government allowed direct foreign investment in stocks markets in 1981 for the first time.⁹ In the 1980s, foreigners were only allowed to invest in stocks through vehicles such as

⁹ See Bank of Korea (2002).

beneficiary certificates for foreigners and country funds. However, to join the OECD, Korea's financial liberalization and market opening had been accelerated since the early 1990s.¹⁰ By that time, Korea's interest rates and exchange rate policy were not completely liberalized. The branches of foreign securities companies and joint venture securities companies were permitted to set up in November 1991. Foreign investors were allowed to invest directly in stocks listed on the Korea Stocks Exchange in January 1992, which was later than Taiwan in 1991. The government expanded the investment ceilings on foreign investment in Korea stocks several times until it reached 55% in December 1997. And it was completely abolished in May 1998, according to the IMF program, except for investment in public corporations (see Lee, Lee, & Yang, 2001, p. 17). In 1994, Korean government lifted restrictions on short-term foreign borrowing by financial institutions and corporates, but retained controls on long-term borrowing. However, foreign firms could list on the Korea stock exchange in 1996. Foreigners were also able to engage in stock price index future transactions with the opening of this market at the same year. In April 1999, the Foreign Exchange Control Act was abolished and the external transactions of companies and foreign exchange banks were almost fully liberalized. Individuals external transactions such as external remittances were also liberalized as of January 2001.

The initial opening of the Korean bond market took place in July 1994 relatively later than the stock market, with foreign investment being allowed in convertible bonds issued by small and medium enterprises. All restrictions on foreign investment in listed bonds were finally abolished in December 1997. In May 1998, foreign investment in short-term financial products issued was also permitted.

In Japan, outward foreign direct investment was liberalized in June 1972, while inward direct investment was liberalized with exception of five categories of business in May 1973. Since 1976, the Japanese government had issued deficit bonds in large quantities, and this resulted in relaxing the restriction on financial market. Both primary and secondary bond markets expanded rapidly. Foreign exchange transactions were liberalized in December 1980, although some restrictions still remained. These include the following: extending non-residents' eligibility to issue Euro-yen bonds to some foreign private corporations, abolishing the withholding tax on non-residents' interest earnings on Euro-yen bonds issued by Japanese residents, giving foreign banks access to the Euro-yen bond market, and relaxing restrictions on Euro-yen lending to residents. The Japanese bond futures market was established in 1985. Both the U.S. and other foreign brokers become Tokyo Stock Exchange members. The Foreign Exchange Act was revised in 1997, which removed most international capital controls. Capital account and foreign exchange transaction were fully liberalized in April 1998.

2.5. Stylized facts

Based on the above discussion, we summarized the sequence of financial liberalization process of Taiwan, Korea, and Japan in Table 2. From Table 2, we could find that the financial liberalization process in Taiwan comparing with that in Japan and Korea during the last two decades followed the order suggested by McKinnon (1991) to transform the economy from a financial control economy to a market-oriented one. Although capital movements were liberalized much later in Taiwan, however, Taiwan's deregulation of financial system had followed an appropriate sequence. Before the opening of international market, Taiwan had just begun to deregulate the domestic

¹⁰ Japan and Korea joined the OECD in 1964 and 1996, respectively.

financial industry and to decontrol its domestic market. It had also followed an appropriate sequence to open up its financial account. The current account should be liberalized before the financial account, and long-term capital before short-term capital. While, Korea and Japan liberalized its domestic financial sector after external liberalization, in particular, the removal of controls on international capital markets before interest rate liberalization.

This conservative liberalization policy together with the partial deregulation of capital movement allowed the Taiwan economy to be free from the serious attack of the Asian financial crisis of 1997–1998. For example, from the end of June 1997 to the end of June 1998, the New Taiwan dollar against the U.S. dollar depreciated only 19.04% much less than the currencies of Korea (35.34%). Although Japan's currency only depreciated by 18.25%, the Taiwanese stock price dropped by only 12.37% much less than that of Japan (20.82%) and Korea (60.04%).¹¹ The bank's average ROE in Taiwan decreased 11.36% in 1996 to 9.29% in 1998, while in Korea from 3.8% to -52.53% and in Japan from -3.35% to -12.37% in the same period. The non-performing loan ratio for the banking sector increased from 3.68% in 1996 to 4.36% in 1998 lower than those in Korea (increased from 3.9% to 16.8%) and Japan (increased from 6.0% to 5.38%). Taiwanese average real GDP growth rate remained at 5.79% between 1996 and 1998, which was much higher than that of Korea (1.72%) and Japan (-1.03%) in the same period.

In order to further track the expansion of financial development in the three economies, we calculated four indicators of banking market development and four indicators of stock market development, which were commonly adopted in the literature.¹² Table 3 demonstrated the expansion of the banking sector development in the three nations during the period of 1981–2001. The first indicator, the number of domestic bank, is a rough measure of the level of banking development. The second indicator—M2GDP is defined as the ratio of M2 (broad money stock) to nominal GDP, which is to capture the overall size of the formal financial intermediary sector. This is a typical indicator of financial depth (see Goldsmith, 1969; King & Levine, 1993a). The third indicator, Private Credit, equals bank claims on the private sector divided by GDP. The measure excludes loans issued to governments and public enterprises. It also excludes credits issued by the central bank. It indicates the share of credit funneled through the private sector (see Beck et al., 2000; Levine et al., 2000). The fourth measure of banking development, Commercial–Central Bank, is defined as the ratio of bank domestic assets to total assets of bank and the central bank. It measures the degree to which commercial banks or the central bank in allocating the society's savings (see Beck et al., 2000). Table 3 also shows that the number of domestic banks, M2GDP and Private Credit in Korea were far less than those in Taiwan and Japan over the period. Also, it depicts a trend of increase in M2GDP and Private Credit for the three nations.

Table 4 reports the evolution of stock market development in these three economies. The first indicator is the number of listed companies. The second indicator is Market Capitalization, which equals the ratio of the market value of listed shares to GDP. This is a typical measure of stock market size. The third indicator is defined as the variable Turnover, which equals the value of the trades of shares on domestic exchanges divided by total value of listed shares. Turnover measures the value of stock transactions relative to the size of the market, and it is frequently used as a measure of market liquidity (see Demirgüç-Kunt & Levine, 1996a, 1996b,

¹¹ All the exchange rates are collected from the International Financial Statistics of the IMF except the exchange rate of Taiwan. The exchange rate of New Taiwan dollar against the U.S. dollar was obtained from the Financial Statistics published by the Central Bank of China in Taiwan.

¹² See King and Levine (1993a, 1993b), Demetriades and Hussein (1996), Levine (1997) and Beck et al. (2000).

Table 3
Indicators of the banking system development in Taiwan, Korea, and Japan

	Number of domestic banks			M2GDP (%)			Private Credit (%)			Commercial–Central Bank		
	Taiwan	Korea	Japan	Taiwan	Korea	Japan	Taiwan	Korea	Japan	Taiwan	Korea	Japan
1981	23	15 ^a	157	63.78	33.07	86.82	51.74	42.79	132.61	85.49	78.89	94.40
1982	24		157	74.01	36.57	89.60	56.43	46.61	139.02	85.70	80.55	94.00
1983	24		157	84.65	35.92	92.05	61.72	46.72	144.37	89.83	79.85	93.76
1984	24		156	91.09	33.84	91.50	64.33	46.69	145.02	93.61	78.78	94.41
1985	24		156	106.44	35.13	92.39	65.71	49.87	146.88	97.02	78.40	94.41
1986	24		155	115.54	35.67	97.58	60.67	45.94	154.91	97.36	78.47	94.85
1987	24		155	121.27	36.22	102.67	65.37	44.23	169.25	97.60	76.18	95.08
1988	24		155	134.04	37.04	105.16	84.87	43.40	178.51	99.60	76.81	95.40
1989	24		155	141.91	39.57	108.29	94.75	47.41	184.67	97.18	80.30	94.97
1990	24	21	154	143.99	38.43	109.95	100.58	48.47	191.59	96.27	81.65	94.51
1991	25	23	153	153.89	38.68	106.64	109.12	116.46	192.73	96.14	83.15	94.46
1992	40	24	151	165.08	39.18	105.41	126.58	121.49	199.64	97.14	82.38	94.16
1993	41	24	150	171.84	38.61	107.65	136.21	120.41	203.12	97.34	82.21	94.66
1994	42	24	150	181.06	39.15	108.55	144.91	128.17	203.10	96.84	84.77	94.75
1995	42	25	149	182.47	38.60	109.41	146.81	131.69	201.35	96.64	87.08	94.57
1996	42	25	146	182.00	39.75	108.51	142.24	138.67	200.40	96.70	90.11	93.98
1997	47	26	146	181.74	41.44	110.39	142.88	155.01	190.59	97.28	81.01	93.27
1998	48	20	138	184.13	53.41	116.82	144.12	165.22	195.17	97.03	86.37	88.55
1999	52	17	137	191.95	62.19	122.89	141.14	156.40	203.43	96.86	92.10	86.42
2000	53	17	136	196.60	71.38	122.14	138.28	141.08	191.14	98.12	95.46	87.38
2001	53	15	133	208.91	75.16	129.06	135.73	143.85	189.85	97.22	96.52	85.98

Sources. The data for Korea and Japan are from OECD Bank Profitability Statistics: Financial Statements of Banks Web site (<http://www.oecd.org/topicstatsportal>) and International Financial Statistics. For Taiwan, the figures are from Financial Statistics Monthly, Central Bank of China.

^a The figure is in 1980.

1996c). The fourth indicator of stock market development is Stock Return. It is defined as the rate of growth of the nominal stock price index which is the measure of stock market returns. It measures the nominal rate of return from holding the index portfolio of each country's major stock exchange.

In the three nations, Taiwanese listed companies increased by four times from 1980 to 2001. The number of listed companies shows an increasing trend in all three economies over the period. The Japanese stock market was largest in numbers, while Korea's turnover ratio of listed stocks was the largest among three economies but its stock market capitalization ratio was the smallest. The volatility of stock price index in Japan was lower than those in Korea and Taiwan.

3. Methodology and data

To explore the effect of financial development on economic growth in the three economies, we followed the growth model of Odedokun (1996). It is based on the standard neoclassical one-sector aggregate production in which financial development constitutes an input. The specification is the following:

$$Y_t = F(L_t, K_t, F_t, Z_t), \quad (1)$$

Table 4
Indicators of stock market development in Taiwan, Korea, and Japan

	Number of listed companies			Market Capitalization (%)			Turnover (%)			Stock Return (%)		
	Taiwan	Korea	Japan	Taiwan	Korea	Japan	Taiwan	Korea	Japan	Taiwan	Korea	Japan
1981	107	343	1412	11.35	6.08	34.81	10.28	79.2	50.00	0.35	16.27	15.42
1982	113	334	1427	10.69	5.38	35.64	6.76	65.5	34.60	-13.05	-3.52	4.10
1983	119	328	1441	14.57	5.32	44.26	14.28	56.36	44.30	37.11	-0.36	23.26
1984	123	336	1444	16.66	6.85	52.54	9.54	69.22	42.50	33.35	8.28	24.81
1985	127	342	1476	16.80	7.82	57.25	6.81	72.27	48.00	-14.54	5.23	14.89
1986	130	355	1499	19.21	12.23	83.08	16.21	110.81	75.10	26.71	64.23	48.31
1987	141	389	1532	42.82	22.73	92.75	26.75	129.89	96.10	125.99	82.92	10.89
1988	163	502	1571	96.03	47.07	122.49	29.50	154.14	98.10	143.66	66.17	36.57
1989	181	626	1597	156.75	61.70	144.62	52.35	111.85	73.10	65.62	32.68	22.25
1990	199	669	1627	62.27	42.33	84.23	45.87	68.57	38.40	-21.36	-18.80	-39.83
1991	221	686	1641	66.19	32.35	79.41	28.53	82.38	28.40	-27.25	-11.80	-1.10
1992	256	688	1651	47.67	32.89	60.21	14.63	133.42	19.90	-13.33	-10.98	-23.74
1993	285	693	1667	86.94	38.76	67.38	22.97	186.55	25.90	-1.33	24.35	10.07
1994	313	699	1689	100.63	44.45	72.84	32.77	174.04	24.90	48.36	32.53	8.32
1995	347	721	1714	72.79	35.39	72.94	20.18	105.11	26.80	-11.34	-3.15	1.19
1996	382	760	1766	98.00	26.16	67.21	21.56	97.26	28.90	8.30	-10.86	-6.77
1997	404	776	1805	116.75	14.45	53.62	31.66	137.3	30.70	40.09	-21.47	-20.12
1998	437	748	1838	94.13	28.46	53.38	22.70	274.8	35.20	-8.00	-37.96	-7.49
1999	462	725	1892	127.51	66.01	90.14	22.18	467.05	44.10	-4.02	98.69	58.44
2000	531	704	2055	85.22	32.50	69.95	17.38	387.45	49.20	5.66	-9.00	-25.46
2001	584	689	2103	108.47	41.13	59.54	14.92	599.83	59.20	-37.46	-21.98	-19.59

Sources. The data for Korea and Japan are from Korea National Statistical Office Web site (<http://www.nso.gov.kr/eng>) and Tokyo Stock Exchange. For Taiwan, the figures are from Taiwan Stock Exchange Corporation (TSEC).

where the subscript t refers to time, Y is real output or real GDP, L is labor, K is physical capital, F represents the level of financial development, Z represents other factors associated with economic growth.

By taking differentiation of Eq. (1), after appropriately manipulating and rearranging, Eq. (1) could be expressed as

$$\dot{Y}_t = \beta_0 + \beta_1 \dot{L}_t + \beta_2 \frac{\dot{I}_t}{Y_t} + \beta_3 \dot{F}_t + \beta_4 \dot{Z}_t + u_t, \quad (2)$$

where \dot{Y}_t , \dot{L}_t , \dot{I}_t/Y_t , \dot{F}_t and \dot{Z}_t represents the growth rate of real GDP, the rate of labor force growth, the investment rate, financial development indicators and other factors, respectively. u_t is the error term. Eq. (2) is our estimating equation, where the investment rate is the proxy of capital growth. It is the ratio of fixed-capital investment to GDP. The labor force growth is proxied by employment growth. The financial development indicators and other factors are explained below.

We follow the standard practice in the literature and measure financial development by aggregate variables that reflect bank versus market based structures (see Demirgüç-Kunt & Levine, 2001). For the bank-based, we used three indicators measures, which are commonly adopted in the literature: M2GDP, Private Credit, and Commercial–Central Bank. Regarding the

market-based, three indicators were utilized, i.e. Market Capitalization, Turnover, and Stock Return. These measures of financial development variables were described in Section 2.¹³

In order to compare the strength of the independent link between financial intermediary sector development and economic growth with that of the development of stock markets and economic growth, we also considered other potential determinants of economic growth in our regressions. Other variables are measured as follows. The inflation rate and the ratio of government consumption to GDP were the indicators to measure the macroeconomic stability (see Beck et al., 2000). The inflation rate is defined as the change rate of CPI.¹⁴ Real export growth was calculated as the annual growth rate of real exports of goods and services. And the growth rate of real export is to capture the degree of openness of an economy.

In addition to the financial development variables, we considered two variables that may capture the effect of international capital mobility on economic growth. One variable is capital outflow to GDP ratio, which is defined as the ratio of the sum of outward foreign direct investment and portfolio investment assets to GDP. Another variable is capital inflow and GDP ratio, which equals the sum of inward direct investment and portfolio investment liabilities to GDP.

Finally, as structural changes may have occurred in all three economies during the study period, two dummy variables had been introduced to capture the structural change. We focus on the effects of financial crisis and foreign exchange system change date. A financial crisis dummy variable (Crisis Dummy) equals 1 for the Asian financial crisis period 1997:3–1998:2, and 0 otherwise. Another dummy variable (Dummy) takes a value one when the country's exchange rate system was converted, and zero otherwise. For Taiwan and Korea, the exchange rate system change test started from 1987:3 and 1990:1, respectively. For Japan, the change test started from 1986:4 when the yen was internationalized. The experience has shown that the exchange rate policy is crucial to the success of liberalization. Usually liberalization leads to capital flows (see Gibson & Tsakalotos, 1994). To capture the effect of international capital mobility, we considered an interactive term between a dummy (Dummy) and capital outflow or inflow, respectively, in order to find the differential effect. In the empirical analysis below, all variables were expressed in logarithms, except for the growth rate and dummy variable.

Since most of the variables under study are likely to be endogenous, the OLS estimators are inconsistent.¹⁵ To overcome the difficulty, we use the generalized method of moments (GMM) techniques, which can deal with the possible simultaneity between financial development and economic growth. One and four-period-lagged dependent and independent variables are used as instruments. The estimated coefficients are consistent. All standard errors of estimates are corrected with the Newey and West (1987) procedure and thereby are heteroscedasticity and autocorrelation consistent. We examine the appropriateness of the instruments with Hansen's

¹³ This paper is more careful than past studies in financial development measures, when using a ratio of stock and a flow variable. Due to financial balance sheet items are measured at the end of the period, GDP is measured over the period. As yearly data are used, some authors partially correct this problem by using an average of period t and period $t - 1$ of balance sheet items and divide it by the GDP of period t (e.g., King & Levine, 1993a, 1993b). This, however, does not fully resolve distortions, especially in using quarterly data. We divide the financial balance sheet items in quarter by the GDP value measured in quarter, where GDP is adjusted at annual rates.

¹⁴ Fischer (1991, 1993) suggested that macroeconomic instability was negatively associated with economic growth.

¹⁵ For example, in our regressions, it is likely that financial intermediation and the rate of economic growth be simultaneously determined or that financial depth may feed back into the growth.

Table 5
Statistics summary (unit: %)

Variables	Country		
	Taiwan	Korea	Japan
The growth rate of real GDP	6.87 (3.05)	7.34 (4.25)	2.67 (2.06)
Fixed-capital investment to GDP ratio	20.81 (3.44)	30.29 (5.01)	28.30 (1.88)
Employment growth rate	1.79 (1.45)	2.20 (2.96)	-0.18 (1.73)
Real government consumption as share of real GDP	15.99 (2.30)	11.27 (2.19)	14.87 (0.73)
The growth rate of real export	9.40 (9.02)	13.20 (9.15)	4.62 (6.00)
Inflation	2.79 (3.74)	5.73 (4.45)	1.37 (1.50)
Capital outflow to GDP ratio	2.24 (2.08)	0.77 (0.80)	2.87 (1.95)
Capital inflow to GDP ratio	1.45 (1.99)	1.88 (2.04)	1.29 (1.68)

Note. Numbers in parentheses are standard error.

(1982) test of the overidentifying restrictions. The instruments are appropriate if we cannot reject the null hypothesis.¹⁶

The data for the three nations are quarterly data over the period from 1981:1 to 2001:3. We choose 1981:1 as starting point partly due to the fact that Korea and Taiwan started their market liberalization regimes in 1981 and partly due to the limitation of data. The sources of data utilized in this study are reported in [Appendix A](#) of the paper.

4. Empirical results

4.1. Descriptive statistics and correlations

[Table 5](#) summarizes some of the macroeconomic trends. Taiwan and Korea have higher average growth rates with 6.87% and 7.34%, respectively. Korea and Japan have higher average fixed-capital investment to GDP ratio, which were 30.29% and 28.30%, respectively. It is usually suggested that investment share of GDP is the engine of economic development. Although Taiwan has achieved higher economic growth than Japan, Taiwanese average investment ratio was only three-fourth of Korea and Japan. Hence, high growth rates were not necessarily associated with high investment ratios. However, Taiwan and Korea had achieved higher export growth than Japan. It seems that high rate of economic growth were accompanied by even higher rates of export growth. As for the inflation rate, Taiwan and Japan had maintained stable price levels. Furthermore, the capital outflow to GDP ratio in Korea was lower than those in Taiwan and Japan.

[Table 6](#) shows the correlations between different measures of financial development and real GDP growth rate in these three economies. In Taiwan, the correlations between the economic growth rate and Commercial–Central Bank is only 0.08, while the correlations between the economic growth rate and other financial development indicators are within the range -0.05 to -0.42. In Korea, the correlations between the economic growth rate and Market Capitalization is only 0.11, while the correlations between the economic growth rate and other financial development indicators are within the range -0.02 to -0.42. Finally, the correlation between economic growth rate and all financial development indicators in Japan are within the range -0.37 to 0.51.

¹⁶ The software package used in this paper is Rats 5.0.

Table 6
Correlations between the growth rate of real GDP and financial market development

	The growth rate of real GDP	Financial intermediary development			Stock market development		
		M2GDP	Commercial–Central Bank	Private Credit	Market Capitalization	Turnover	Stock Return
Taiwan							
The growth rate of real GDP	1.00						
M2GDP	−0.36	1.00					
Commercial–Central Bank	0.08	0.70	1.00				
Private Credit	−0.42	0.97	0.55	1.00			
Market Capitalization	−0.17	0.74	0.60	0.68	1.00		
Turnover	−0.05	0.50	0.46	0.45	0.72	1.00	
Stock Return	0.34	−0.12	0.10	−0.17	0.10	−0.04	1.00
Korea							
The growth rate of real GDP	1.00						
M2GDP	−0.23	1.00					
Commercial–Central Bank	−0.14	0.82	1.00				
Private Credit	−0.42	0.79	0.79	1.00			
Market Capitalization	0.11	0.42	0.47	0.52	1.00		
Turnover	−0.15	0.67	0.55	0.73	0.51	1.00	
Stock Return	−0.02	−0.10	−0.18	−0.07	0.0010	0.33	1.00
Japan							
The growth rate of real GDP	1.00						
M2GDP	−0.37	1.00					
Commercial–Central Bank	0.51	−0.50	1.00				
Private Credit	−0.20	0.80	−0.03	1.00			
Market Capitalization	–	–	–	–	–	–	
Turnover	–	–	–	–	–	–	
Stock Return	0.33	−0.34	0.24	−0.36			1.00

In addition, the correlation between M2GDP and both Commercial–Central Bank and Private Credit in Taiwan and Korea are within the range 0.70–0.97 and 0.79–0.82, respectively. The correlation between M2GDP and Private Credit is 0.80 in Japan. It should be noted that M2GDP can be regarded as liquidity of banks as well as finance-size. Due to these variables are highly correlated over the sample period, multicollinearity might be serious in these nations. In addition, due to the function of banking system are not the only create money but also provide fund channel to the government, public or private enterprises. Using only one banking development indicator, however, may not be closely related to the complete information of financial services provided by banks. To solve the problem, we will follow Beck, Demirgüç-Kunt, Levine, and Maksimovic (2001) and utilize the method of principal components to find out the principal components of the highly correlated financial indicators in the particular category.¹⁷ Finance-aggregate, an alternative measure of financial intermediary, is a conglomerate indicator of the overall size,

¹⁷ The estimation software package used is SAS 6.12.

Table 7
Augmented Dickey–Fuller (ADF) unit-root tests for level variables

	Taiwan		Korea		Japan	
	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend
The growth rate of real GDP	−3.4358(3) ^a	−4.5074(3) ^a	−4.2600(3) ^a	−4.7248(3) ^a	−2.5675(0)	−3.3612(3) ^b
Fixed-capital investment to GDP ratio	−7.3075(0) ^a	−9.3651(0) ^a	−3.4270(0) ^a	−3.5010(0) ^a	−2.4410(7)	−2.0784(7)
The employment growth rate	−3.6602(3) ^a	−5.8556(3) ^a	−5.8565(0) ^a	−6.0317(0) ^a	−2.0677(2)	−3.2874(2) ^b
Real government consumption as share of real GDP	−2.0293(0)	−4.6842(0) ^a	−3.9597(0) ^a	−8.9871(0) ^a	−0.4864(5)	−0.6567(5)
The growth rate of real export	−6.1755(3) ^a	−6.6349(3) ^a	−5.0376(3) ^a	−4.9164(3) ^a	−6.1205(3) ^a	−6.0313(2) ^a
Inflation	−6.2386(1) ^a	−6.2386(1) ^a	−6.1621(2) ^a	−5.9856(2) ^a	−3.4569(0) ^a	−4.5828(0) ^a
Finance-aggregate	−4.9568(1) ^a	−3.1473(7) ^b	−0.7584(0)	−4.2982(1) ^a	−0.7375(2)	−2.3768(0)
Market Capitalization	−2.1259(7)	−1.9220(7)	−2.0029(8)	−2.1696(4)		
Turnover	−2.7643(0) ^b	−3.0271(0)	−3.7062(0) ^a	−5.3309(0) ^a		
Stock Return	−9.9473(0) ^a	−10.0950(0) ^a	−9.1599(0) ^a	−9.2210(0) ^a	−3.7715(3) ^a	−4.4641(3) ^a
Capital outflow to GDP ratio	−2.4255(0)	−3.3741(0) ^a	−5.0297(1) ^a	−6.3745(1) ^a	−5.3654(0) ^a	−5.3467(0) ^a
Capital inflow to GDP ratio	−3.8896(1) ^a	−5.1645(1) ^a	−5.1737(0) ^a	−7.1696(0) ^a	−8.3093(0) ^a	−8.4349(0) ^a

Note. The figures in parentheses denote the number of lags that were selected by minimum Akaike Information Criterion (AIC). The critical values are from Fuller (1976, p. 373). The statistics for all the first differences are not reported because there is statistically significant.

^a Rejection of the unit-root hypothesis at critical value of 5%.

^b Rejection of the unit-root hypothesis at critical value of 10%.

activity, and efficiency of financial intermediaries. Specifically, it is the first principal component of M2 to GDP ratio, Private Credit, and Commercial–Central Bank.¹⁸ The principal component analysis has just followed that of Jolliffe (1986).

Furthermore, the correlation between the change rate of stock price index and both stock market capitalization ratio and turnover ratio are 0.10 and −0.04 in Taiwan and 0.0002 and 0.33 in Korea, respectively.

4.2. Regression results

Before estimation, to ensure stationarity of the data, we performed the augmented Dickey–Fuller (ADF) unit-root test on the utilized variables and reported in Table 7. As we can see, most of the variables are stationary in level. Table 8 reports the GMM estimation results for these economies. The last row in each table reports *p* values for the Hansen test which cannot reject the null of overidentifying restrictions. That is, the null hypothesis that the instruments are appropriate cannot be rejected.

¹⁸ The principal components analysis results in three principal components, the first principal component that accounts for 85.75% of overall variance in Taiwan. While, in Korea and Japan, they explain 86.98% and 65.26% of the total variances, respectively.

Table 8
Regressions on economic growth rate

Variable	Country					
	Taiwan		Korea		Japan	
	(1)	(2)	(1)	(2)	(1)	(2)
Fixed-capital investment to GDP ratio	−0.9400 (0.6200)	−0.4726 (0.4781)	−3.4165* (1.7869)	−3.2462** (1.1445)	38.0438** (4.7952)	37.7683** (4.0858)
The employment growth rate	0.9886** (0.1349)	0.9862** (0.1112)	0.7504** (0.1828)	0.1838** (0.0863)	0.5021** (0.0878)	0.4856** (0.0815)
Real government consumption as share of real GDP	9.7850** (1.3983)	3.5495** (1.2643)	14.7312** (1.7361)	8.5568** (1.7090)	23.9500** (7.3584)	25.8226** (5.8537)
The growth rate of real export	0.1915** (0.0195)	0.1722** (0.0141)	0.1652** (0.0278)	0.2244** (0.0244)	0.0276 (0.0181)	0.0262 (0.0173)
Inflation	−6.9318 (8.4650)	−16.2538** (8.1114)	−64.1648** (11.6693)	−31.6344** (8.0194)	−1.0312** (0.3075)	−0.7993** (0.3018)
Finance-aggregate	0.3084** (0.1407)	0.3605** (0.1034)	0.3977 (0.2537)	0.2691 (0.1693)	−1.3168** (0.1605)	−1.1696** (0.1975)
Market Capitalization	1.9266** (0.2542)	1.6470** (0.1949)	3.2865** (0.7880)	2.8241** (0.4214)		
Turnover	−0.6303** (0.1903)	−0.3254 (0.2148)	−3.8861** (0.5561)	−3.0142** (0.4649)		
Stock Return	0.0047** (0.0021)	0.0052** (0.0016)	−0.0242 (0.0195)	0.0104 (0.0147)	0.0248** (0.0057)	0.0259** (0.0068)
Capital outflow to GDP ratio × Dummy		−48.1729** (8.6992)		−89.3626** (29.7215)		2.3879 (5.1238)
Capital inflow to GDP ratio × Dummy		−11.0679 (8.9767)		1.5651 (11.2323)		−4.7652 (8.9480)
Crisis Dummy		−0.5255 (0.3328)		−7.6460** (1.1856)		−0.7537** (0.3402)
\bar{R}^2	0.8115	0.8466	0.4928	0.7168	0.6011	0.6034
<i>P</i> value of Hansen test	0.9483	0.8834	0.9428	0.9181	0.7333	0.7546

Note. Numbers in parentheses are standard errors. **Significant at the 5% level. All regressions have an intercept which is not report. Inflation is $\log(1 + \text{inflation rate})$ for the period.

In Table 8, Column (1) reports the economic growth effects of those variables such as the fixed-capital investment to GDP ratio, the employment growth rate, real government consumption as share of real GDP, the growth rate of real export, inflation rate, finance-aggregate, Market Capitalization, Turnover, and Stock Return.¹⁹ Column (2) further includes Crisis Dummy and the interactive term between Dummy and capital outflow and inflow, respectively.

Table 8 shows that, as expected, all coefficients of growth rates of employment and real export are statistically significant. This implies that both employment and real export have contributed to economic growth. As for the effect of fixed-capital investment to GDP ratio, in each country it behaves differently. The estimated coefficient of fixed-capital investment to GDP ratio is significantly positive in Japan, while it becomes significantly negative in Korea and is little or even become negative in Taiwan. The fixed-capital investment to GDP ratio is not a significant factor for accounting for the economic growth over the past two decades in Taiwan and Korea. One possible reason for these might effects may be due to that investment did not exhibit dynamic efficiency among these countries. The other reason was that investment only exhibited effect on GDP, but it did not reveal growth effect. The finding is consistent with what Lin, Lee, and Huang (1996) had got using Taiwan's and Korea's data. In other words, there might exist overinvestment during the study period. It should be noted that the national investment includes private and public investment.

In addition, the finance-aggregate variable has a positive and significant effect on economic growth in Taiwan, while it becomes insignificant or the sign of the coefficient even negative in Korea and Japan cases.²⁰ This may be due to the relative stability of financial system and appropriate sequence to financial liberalization in Taiwan from 1980 as discussed in Section 2. However, Japanese banking system in these periods, dominated by large banks, had been suffering from serious problems with non-performing loans since the bursting of the stock market and urban real estate bubbles at the beginning of the 1990s. At the same time, the Japanese economy slumped into the long stagnation. To solve the problem, the Japanese government started to encourage financial reforms. However, it was clear that the financial reform was not sufficient to terminate the stagnation in the early 1990s. Being delay by regulatory authorities and due to the fact that the Japanese banks had an intertwined relationship with the government the Japan economy had been led to a banking crisis burst in the late 1990. Similarly, Korea's banks also had an intertwined relationship with the government. And many financial reforms just followed Japan's steps. Moreover, to join the OECD and to meet the OECD's requirements, without taking account of financial structural imperfections, the process of financial deregulation not only continued but also had been accelerated. The Korea government even further abolished financial account controls. The financial and currency crisis eventually burst in 1997–1998.

With regard to Market Capitalization, it had played a positive role in Taiwan and Korea. However, the estimated coefficient of Turnover is insignificantly or even negative in Taiwan and Korea cases. This result is inconsistent with the findings of Levine and Zervos (1998). They found that the liquidity of the stock market was a robust predictor of economic growth. Moreover, all coefficients of Stock Return were significantly positive except that in Korea. It seems that the

¹⁹ Stock market capitalization ratio and turnover ratio are not available for Japan's quarterly data.

²⁰ In Appendix B, we compare the difference between principal components estimates and original least square estimates.

stock market development had contributed to Taiwan's economic growth comparing with those in Korea and Japan.

The coefficients on Crisis Dummy are not only statistically significant but negative in Korea and Japan. This result implied that Taiwan's economy did not worsen significantly over the Asian financial crisis period. Finally, the interaction between capital outflow to GDP ratio and Dummy has a statistically significant negative correlation with economic growth in Taiwan and Korea, although the effect is positive but insignificant in Japan. However, the coefficient estimate for the interaction of capital inflow to GDP ratio with Dummy is insignificantly positive or even negative in all three economies. These results reveal that capital outflows had negative effects on Taiwan and Korea economic growth, while the capital inflows might hurt Taiwanese and Japan's economic growth when the foreign exchange deregulation.

5. Conclusions

In the past two decades, Taiwan and Korea had experienced rapid economic growth, while Japan did not. This paper tries to investigate the sources of economic growth in these economies. Particularly, we focus on the role of financial development and structure (including banking and stock markets), monetary and financial policies, as well as the degree of international capital mobility in the economic growth processes.

The major findings could be summarized as follows. (1) High investment had accelerated economic growth in Japan, while high investment to GDP ratio did not necessarily lead to better growth performance if investment did not have been allocated efficiently or if overinvestment exist, e.g. in Taiwan and Korea cases. (2) Real export growth rate had contributed to Taiwan and Korea. (3) The finance-aggregate had positive effects on the economy of Taiwan, but had negative effect on Korea and Japan. One possible reason may be due to the relatively sound financial system and prudentially financial regulation and supervision in Taiwan comparing with those in Korea and Japan. (4) The stock market development had positive effects on economic growth in Taiwan. (5) Taiwanese economy suffered less from the Asian financial crisis. (6) After foreign exchange deregulation, capital outflows had negative effects on all three economies, while the effect of capital inflows is negative but insignificant.

In this paper, we had combined the principal component analysis with time series analysis to investigate the relation of financial growth and structure with economic growth. In order to do so, we categorize the banking and financial indicators into financial aggregate, instead of putting all financial variables separately in the regression model. However, there still some work to be done. In the future study, it is fruitful to test the model by using the cross-country panel data. Also, it may extend the study by including more country data as long as the data are available.

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Appendix A. Data sources

The data included in this study have contained consist of real GDP, real fixed-capital investment, employment, real government consumption, real export of goods and services, consumer price index (CPI), money, quasi-money, bank claims on the private sector by deposit money banks, deposit money bank domestic assets, central bank domestic assets, the total value

of listed shares, the value of the trades of shares on domestic exchanges, the stock price index, direct investment abroad, direct investment in domestic, portfolio investment assets, and portfolio investment liabilities. First, about the data for real GDP, real fixed-capital investment, employment, real government consumption, real export of goods and services, Taiwan data are from *Quarterly National Economic Trends Taiwan Area, the Republic of China*, Directorate-General of Budget, Accounting and Statistics, Executive Yuan, ROC. The Korea data are from Web site <http://www.nso.gov.kr/eng>. The Japan data are from *IMF International Financial Statistics*. Second, about employment, Taiwan data are from *Monthly Bulletin of Manpower Statistics Taiwan Area, Republic of China*, Directorate-General of Budget, Accounting and Statistics, Executive Yuan, ROC. The data of Korea and Japan are, respectively, from Web site <http://www.nso.gov.kr/eng> and *IMF International Financial Statistics*.

The data for money, quasi-money, bank claims on the private sector by deposit money banks, the deposit money bank domestic assets, central bank domestic assets, direct investment abroad, direct investment in domestic, portfolio investment assets, and portfolio investment liabilities of Korea and Japan are all from *IMF International Financial Statistics*, while those of Taiwan are from *Financial Statistics, Taiwan District Republic of China* (compiled in accordance with IFS format), Central Bank of China. The CPI data of Korea and Japan are from *IMF International Financial Statistics*, while that of Taiwan is from *Commodity-Price Statistics Monthly in Taiwan Area of the Republic of China*, Directorate-General of Budget, Accounting and Statistics, Executive Yuan, ROC. The data for total value of listed shares, the value of the trades of shares on domestic exchanges, the stock price index of Taiwan and Korea are from *TEJ Data Bank*, Taiwan Economic Journal Co. Ltd., and Web site <http://www.nso.gov.kr/eng>, respectively. The data of the stock price index of Japan is from *IMF International Financial Statistics*.

Appendix B. Principal components

Since the three variables for financial intermediary development indicator are highly correlated, we use principal components regression to solve this multicollinearity problem. We select one principal component to capture the main elements of three variables and name it “finance-aggregate”. The new estimated coefficient of finance-aggregate is a simple function of original least squares estimators of these three variables. Though the principal components estimator is a biased estimator, it may be more precise than its least squares counterpart.

B.1. Principal components regression analysis

Let the model under consideration be

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon},$$

where \mathbf{y} is $(T \times 1)$, \mathbf{X} is $(T \times K)$ and non-stochastic, $\boldsymbol{\beta}$ is $(K \times 1)$, and $\boldsymbol{\varepsilon}$ is $(T \times 1)$ and distributed as $N(\mathbf{0}, \sigma^2\mathbf{I})$. Consider the transformation:

$$\mathbf{y} = \mathbf{XPP}'\boldsymbol{\beta} + \boldsymbol{\varepsilon} = \mathbf{XP}\boldsymbol{\theta} + \boldsymbol{\varepsilon} = \mathbf{Z}\boldsymbol{\theta} + \boldsymbol{\varepsilon}, \quad (\text{B.1})$$

where \mathbf{P} is a $(K \times K)$ matrix whose columns (\mathbf{p}_i) are orthogonal characteristic vectors of $\mathbf{X}'\mathbf{X}$ ordered to be correspond to the relative magnitudes of the characteristic roots of the positive definite matrix $\mathbf{X}'\mathbf{X}$ and \mathbf{Z} is the $(T \times T)$ matrix of principal components. Accordingly, $\mathbf{z}_i = \mathbf{Xp}_i$ is

called the i th principal component, where $\mathbf{z}'_i \mathbf{z}_i = \lambda_i$ and λ_i is the i th largest characteristic root of $\mathbf{X}'\mathbf{X}$.

The principal components estimator of $\boldsymbol{\beta}$ is obtained by deleting one or more of the variables \mathbf{z}_i , applying ordinary least square to the resulting model and making a transformation back to the original parameter space. Assume for the moment that \mathbf{Z} has been partitioned into two parts \mathbf{Z}_1 , the \mathbf{z}_i to be retained, and \mathbf{Z}_2 , the \mathbf{z}_i to be deleted. This partitioning imposes an identical partitioning on \mathbf{P} . Thus (B.1) becomes

$$\mathbf{y} = \mathbf{X}\mathbf{P}_1\boldsymbol{\theta}_1 + \mathbf{X}\mathbf{P}_2\boldsymbol{\theta}_2 + \boldsymbol{\varepsilon} = \mathbf{Z}_1\boldsymbol{\theta}_1 + \mathbf{Z}_2\boldsymbol{\theta}_2 + \boldsymbol{\varepsilon},$$

where $\mathbf{X}\{\mathbf{P}_1:\mathbf{P}_2\} = \{\mathbf{Z}_1:\mathbf{Z}_2\}$. The principal components estimator is obtained by an inverse linear transformation. Since $\boldsymbol{\beta} = \mathbf{P}\boldsymbol{\theta} = \mathbf{P}_1\boldsymbol{\theta}_1 + \mathbf{P}_2\boldsymbol{\theta}_2$, omitting the components in \mathbf{Z}_2 means that $\boldsymbol{\theta}_2$ has implicitly been set equal to zero. Hence $\mathbf{P}_2\boldsymbol{\theta}_2 = \mathbf{0}$ and the principal components estimator of $\boldsymbol{\beta}$ is

$$\hat{\boldsymbol{\beta}} = \mathbf{P}_1\hat{\boldsymbol{\theta}}_1 = \mathbf{P}\hat{\boldsymbol{\theta}}^*,$$

where $\hat{\boldsymbol{\theta}}_1 = (\mathbf{Z}'_1\mathbf{Z}_1)^{-1}\mathbf{Z}'_1\mathbf{y}$ and $\hat{\boldsymbol{\theta}}^* = (\hat{\boldsymbol{\theta}}'_1, \mathbf{0}')'$ with $\mathbf{0}$ a null vector of conformable dimension.

B.2. Comparison of the results

The following table shows the difference between least square estimators and principal components ones. In Taiwan case, the principal components estimate is positive and this shows that the effect of Commercial–Central Bank dominates Private Credit and M2GDP. In Korea case, the principal components estimate is also positive but insignificant, so the effect of Commercial–Central Bank dominates that of Private Credit and M2GDP. In Japan case, the principal components estimate is significantly negative, but the effect of M2GDP and Commercial–Central Bank dominates Private Credit. These results indicate that these indicators of financial development have different effect in different country.

Variable	Country					
	Taiwan		Korea		Japan	
	(1)	(2)	(1)	(2)	(1)	(2)
M2GDP	−3.7088 (2.3060)	−0.9852 (2.5516)	0.4131 (1.7113)	−1.2237 (1.0712)	18.5844** (3.4166)	24.0707** (3.1986)
Commercial– Central Bank	29.5640** (5.3181)	19.3131** (6.0658)	33.2187** (6.9038)	22.8464** (4.0316)	67.5537** (14.1235)	67.0784** (12.5787)
Private Credit	0.0718 (1.5906)	−1.0157 (1.6561)	−15.3537** (1.2360)	−9.1268** (1.4573)	−33.4183** (3.8891)	−35.8399** (3.1618)
Finance- aggregate	0.3084** (0.1407)	0.3605** (0.1034)	0.3977 (0.2537)	0.2691 (0.1693)	−1.3168** (0.1605)	−1.1696** (0.1975)

Note. See Table 8.

References

- Arestis, P., Demetriades, P. O., & Luintel, K. B. (2001). Financial development and economic growth: the role of stock markets. *Journal of Money, Credit, and Banking*, 33, 16–41.
- Bank of Korea. (2002). *Financial system in Korea*. Bank of Korea.

- Barro, R. J. (1991). Economic growth in a cross-section of countries. *Quarterly Journal of Economics*, 106, 408–443.
- Beck, T., Demirgüç-Kunt, A., Levine, R., & Maksimovic, V. (2001). Financial structure and economic development: Firm, industry and country evidence. In A. Demirgüç-Kunt, & R. Levine (Eds.), *Financial structure and economic growth: A cross-country comparison of banks, markets, and development* (pp. 189–241). Cambridge, MA: MIT Press.
- Beck, T., Levine, R., & Loayza, N. (2000). Finance and the sources of growth. *Journal of Financial Economics*, 58, 261–300.
- Bencivenga, V. R., & Smith, B. D. (1991). Financial intermediation and endogenous growth. *Review of Economic Studies*, 58, 195–209.
- Bencivenga, V. R., Smith, B. D., & Starr, R. M. (1995). Transactions costs, technological choice, and endogenous growth. *Journal of Economic Theory*, 67, 153–177.
- Chopra, A., Kang, K., Karasulu, M., Liang, H., Ma, H., Richards, A. J. (2001). From crisis to recovery in Korea: Strategy, achievements, and lessons, IMF Working Paper No. 01/154.
- Demetriades, P. O., & Hussein, K. A. (1996). Does financial development cause economic growth? Time-series evidence from 16 countries. *Journal of Development Economics*, 51, 387–411.
- Demirgüç-Kunt, A., & Levine, R. (1996a). Stock market, corporate finance and economic growth: An overview. *The World Bank Economic Review*, 10, 229–239.
- Demirgüç-Kunt, A., & Levine, R. (1996b). Stock market development and financial intermediaries: Stylized facts. *The World Bank Economic Review*, 10, 291–321.
- Demirgüç-Kunt, A., & Levine, R. (1996c). The financial system and public enterprise reform: Concepts and cases. In N. Hermes, & R. Lensink (Eds.), *Financial development and economic growth: Theory and experiences from developing countries* (pp. 247–286). London: Routledge.
- Demirgüç-Kunt, A., & Levine, R. (Eds.). (2001). Bank-based and market-based financial systems: Cross-country comparisons. In *Financial structure and economic growth: A cross-country comparison of banks, markets, and development* (pp. 81–140). Cambridge, MA: MIT Press.
- Fischer, S. (1991). *Growth, macroeconomics, and development*, NBER macroeconomics annual. Cambridge, MA: MIT Press. pp. 329–364.
- Fischer, S. (1993). The role of macroeconomic factors in growth. *Journal of Monetary Economics*, 32, 485–511.
- Fuller, W. A. (1976). *Introduction to statistical time series*. New York, NY: John Wiley.
- Gibson, H. D., & Tsakalotos, E. (1994). The scope and limits of financial liberalisation in developing countries: A critical survey. *Journal of Development Studies*, 30, 578–628.
- Goldsmith, R. W. (1969). *Financial structure and development*. New Haven, CT: Yale University Press.
- Greenwood, J., & Jovanovic, B. (1990). Financial development, growth and the distribution of income. *Journal of Political Economy*, 98, 1076–1107.
- Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica*, 50, 1029–1054.
- Hanson, J. A. (1994). An open capital account: A brief survey of the issues and the results. In G., Caprio, Jr., I. Atiyas, & J. A. Hanson (Eds.), *Financial reform: Theory and experience*. Cambridge, NY: Cambridge University Press.
- He, D. (2004). The role of KAMCO in resolving nonperforming loans in the Republic of Korea, IMF Working Paper, WP/04/172.
- Honda, E. (2003). Financial deregulation in Japan. *Japan and the World Economy*, 15, 135–140.
- Hoshi, T., & Kashyap, A. (1999). The Japanese banking crisis: Where did it come from and how will it end? In B. S. Bernanke, & J. J. Rotemberg (Eds.), *NBER macroeconomics annual* (pp. 129–201). Cambridge, MA: MIT Press.
- Hsu, C. M., & Lin, S. M. (2000). Financial development and endogenous growth model. *Industry of Free China*, 9, 21–47 (in Chinese).
- Ji, D., & Park, J. (1999). *The Korean banking sector: Current issues and future direction, in rising to the challenge in asia: A study of financial markets*. Asian Development Bank. pp. 27–54.
- Johansen, S., & Juselius, K. (1992). Testing structural hypotheses in a multivariate cointegration analysis of PPP and the UIP for UK. *Journal of Econometrics*, 53, 211–244.
- Johnston, B. R., Darbar, S. M., & Echeverria, C. (1997). Sequencing capital account liberalization: Lessons from the experiences in Chile, Indonesia, Korea, and Thailand, IMF Working Paper, WP/97/157.
- Jolliffe, I. T. (1986). *Principal component analysis*. New York: Springer-Verlag.
- Kim, D. C., & Suh, D. (1998). Financial liberalization and Korean corporations' financing policy for globalization. *Journal of Asian Economics*, 9, 31–66.
- Kim, H. E. (2003). *Institutional development in the Korea financial sector accompanying globalization and its economic effects*. Korea Institute for Monetary and Economic Research, The Bank of Korea.

- King, R. G., & Levine, R. (1993a). Finance and growth: Schumpeter might be right. *Quarterly Journal of Economics*, 108, 717–737.
- King, R. G., & Levine, R. (1993b). Finance, entrepreneurship, and growth: Theory and evidence. *Journal of Monetary Economics*, 32, 513–542.
- Leahy, M., Schich, S., Wehinger, G., & Pelgrin F. (2001). Contributions of financial systems to growth in OECD countries, OECD Economics Department Working Papers No. 280.
- Lee, J. W., Lee, H. H., & Yang, D. Y. (2001). Structural reform in Korea: Its process and consequences. In T. V. Hoa (Ed.), *The Asia recovery: Issues and aspects of development, growth, trade and investment* (pp. 15–33). Cheltenham, UK: Edward Elgar.
- Levine, R. (1991). Stock markets, growth, and tax policy. *The Journal of Finance*, 46, 1445–1465.
- Levine, R. (1997). Financial development and economic growth: Views and agenda. *Journal of Economic Literature*, 35, 688–726.
- Levine, R., Loayza, N., & Beck, T. (2000). Financial intermediation and growth causality and causes. *Journal of Monetary Economics*, 46, 31–77.
- Levine, R., & Zervos, S. (1998). Stock markets, banks, and economic growth. *American Economic Review*, 88, 537–558.
- Lin, K. S., Lee, H. Y., & Huang, B. Y. (1996). The role of macroeconomic policy in export-led growth: The experience of Taiwan and South Korea. In T. Ito, & A. O. Krueger (Eds.), *Financial deregulation and integration in East Asia* (pp. 193–224). The University of Chicago Press.
- McKinnon, R. I. (1973). *Money and capital in economic development*. Washington, DC: The Brookings Institution.
- McKinnon, R. I. (1991). *The order of economic liberalization financial control in the transition to a market economy*. Baltimore: Johns Hopkins University Press.
- Ministry of Finance. (1996). *The ROC financial system and policy*. Ministry of Finance.
- Newey, W. K., & West, K. D. (1987). A simple, positive semi-definite heteroscedasticity and autocorrelation consistent covariance matrix. *Econometrica*, 55, 703–708.
- Odedokun, M. O. (1996). Alternative econometric approaches for analysing the role of the financial sector in economic growth: Time-series evidence from LDCs. *Journal of Development Economics*, 50, 119–146.
- Saint-Paul, G. (1992). Technological choice, financial markets and economic development. *European Economic Review*, 36, 763–781.
- Schumpeter, J. A. (1911). *The theory of economic development*. Cambridge, MA: Harvard University Press.
- Shaw, E. S. (1973). *Financial deepening in economic development*. New York: Oxford University Press.
- Smith, H. (2000). The state, banking and corporate relationships in Korea and Taiwan. In P. Drysdale (Ed.), *Reform and recovery in East Asia—The role of the state and economic enterprise* (pp. 59–98). London: Routledge.
- Takahashi, W., & Kobayakawa, S. (2003). Globalization: Role of institution building in the Japanese financial sector, Bank of Japan Working Paper Series No. 03-E-7.
- Taniuchi, M. (1997). Recent development in Japan's financial sector: Bad loans and financial deregulations. *Journal of Asian Economics*, 8, 225–244.
- Tsuruta, H. (1999). The bubble economy and financial crisis in Japan. *International Journal of Political Economy*, 29, 26–48.
- World Bank. (1993). *The East Asian miracle: Economic growth and public policy*. New York: Oxford University Press.