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The Impact of the US Economy on the Asia-Pacific Region: Does it Matter?

Frank S.T. Hsiao

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(hereafter Korea), Taiwan, Singapore, and Japan, and the ASEAN4+: that is, Indonesia, Malaysia, Philippines, Thailand and China. When Hong Kong, which is increasingly integrated with China, is included in the ADCs, we denote them separately as the ADCs+. By 2000, about 30 to 50 percent of total exports of thes

We first check the pairwise Granger causality for ten pairs of the countries, and then use the vector autoregression (VAR) model to test Granger causality. Impulse response functions and variance decomposition of each variable are derived and illustrated. Similar methods are used in Section V to test the causality of the stock indexes of the five countries. Section VI concludes.

2. The interdependence of the United States and the Asia-Pacific region

Figure 1 shows the share of GDP of the world's 174 countries[1] in year 2000 (WB, 2002). The US GDP alone accounted for almost 31% of world GDP. Japan at 15.2% was a distant second, followed by China, 3.4%. In contrast, the NIEs (Korea, Taiwan, Singapore, and Hong Kong) had a 3.2% share, and the ASEAN4 had about a 1.4% share. Thus, the difference is so enormous that the US economy could be expected to exert significant influence over the individual countries in the region economically and politically.[2]

Place Figure 1 here

In fact, this is the case. Part (a) of Table 1 shows the merchandise trade with the United States as a percent of the total merchandise trade for each country in the region. In 1999, except in Hong Kong, the weight of the US trade is over 10%, and in the Philippines, China, and Japan even as high as 28% to 30% of their total trade. Generally speaking, the weight of the US decreased in the ADCs+ in the 1990s and increased in ASEAN4+ countries, indicating the success of diversification of the direction of trade in the ADCs+ economies. Nevertheless, for all these countries, trade with the US is still predominant.

Place Table 1 here

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[1] Taiwan's GDP data in current US$ (US$ 309 billion) is taken from ICSEAD (2002), and added to the world total of US$ 31.5 trillion to calculate percentage. EMU+ includes 12 countries in the European Monetary Union (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain) and United Kingdom (WB, 2002).

[2] In the original version of this paper, we presented the purchasing power parity share weight of GDP. In that case, the US GDP accounted for 22% of the world GDP, China, 11.5%, Japan, 7.5%, NIEs, 3.4%, ASEAN4, 3.6%. Since we are interested in the impact (instead of welfare) of the current US GDP on the GDPs of the Asia-Pacific countries, we decided to use GDP in current US dollars.

A more direct impact of trade volume on economic activity may be measured by taking the proportion of US trade as a percentage of GDP in each country, as shown in Part (b) of Table 1. The percentage apparently varies inversely with the size of the economy, as indicated in Figure 1: only 4% in China and 10% in Japan. Other countries range from 13% in Korea to a whopping 42% in Singapore. Thus, the transmission of macroeconomic fluctuations from the US to smaller countries through trade relations alone may be expected to be substantial.

Part (c) in the last two columns shows that the IT products hold the bulk of exports: Most are exported to the US, and the rest to other inter- or intra-regional countries. Except for Japan, which shows a slight decrease, the proportion of IT products in the total merchandise trade

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In general, the grand total of FDI investment

fourth, Taiwan seventh, Korea eight, and Malaysia tenth. Thus, a change in economic conditions

establishing special IT enclaves (ADB, 2000). As most of the IT products are exported, as shown in Part (c) of Table 1, strong international linkages may be expected to continue in the near future.

Furthermore, the governments of the ADCs have devoted large resources to R&D in the development of IT industries, facilitating technology absorption and adaptation, and further technological and managerial innovations, as evidenced by the patents granted in the United States mentioned above. Taiwan is now the world's third largest producer of IT products, next to the US and Japan, and Korea is the world's third largest producer of semiconductor chips, and is in the forefront of mobile-phone technology (ADB, 2000). This also implies that IT products in the ADCs are related horizontally to industries in other advanced countries like the United States and the OECD countries in Europe, and thus the ADCs' domestic business cycle of boom and bust in the IT industries is inevitably linked to the international business cycle, increasing the vulnerability of their economies (IMF, 2001, 123).

In addition to the supply side of production and exports, the rapidly falling prices of IT products and new services have also stimulated domestic demand for the products within these countries. Table 3 presents the degree of penetration of some IT products in the ADCs+ and the ASEAN4+ countries. While there is a very clear "digital divide" among the two groups, the popularity of IT products, like telephone main lines, mobile telephones, personal computers (PC),

development in these countries. The expansion of domestic markets for IT products may help to offset the volatility of exports, but at the same time, it make

IT-exporting countries. The last two columns of Table 3 show stock market capitalization relative to GDP as a proxy for the stock ownership in each country.

Except for Korea, the ADCs had capitalization ratios above 50% of GDP in 2000. Their equity capitalization ranked from second to nineteenth in the world[6], indicating the predominance of equity assets in these societies. Except for Malaysia, the ASEAN4+ countries had lower capitalization ratios, ranging from 20% to 60%, but still high in the world rankings, from twenty-second to twenty-fifth. This implies that sharp changes in equity prices will change individuals' wealth (the wealth effect in these societies), and since wealth is a key factor determining consumption, household consumption will also change (Edison and Slok, 2001; Bertaut, 2002), and therefore the growth of the economies will be affected. Thus, the IT revolution has strengthened international dependence and the real and financial linkages.

Parts (c) to (f) of Table 4 present the correlation coefficients of GDP time series, the growth rates of GDP from 1979 to 2000, 270 recent common transaction days' stock price indexes and their growth rates from September 18, 2001 to December 13, 2002 for the five countries. The correlation coefficients of GDP among the five countries are very high (0.81 to 0.98), but are low for GDP growth rates (-0.32 to 0.59). In terms of the growth rates, the correlation coefficients between the United States and all other countries are generally low, especially with Korea and China. Korea and Taiwan have higher correlation with Japan (0.56 and 0.58). Korea and Taiwan also have high correlation coefficient (0.59). There seems to have much similarity among the three countries in terms of the GDP levels and their growth rates (Hsiao and Hsiao, 2003). China's GDP growth rate consistently has negative correlation coefficients with all other countries. This may be due to China's high GDP growth rates during the past two decades and the slowdown of the GDP growth in

Taiwan even have small negative correlation coefficients. This may be due to the government control of the stock markets in China. In terms of the growth rates of the stock indexes, the movements among countries seem random, and no trend seems to exist, except that Japan and

rates of GDP) are all stationary at the 5% or 10% level of significance. Hence, we use the GDP growth rate series in the causality analysis. In addition, we have also applied the Johansen test of cointegration to the five GDP level series. The test results indicate no cointegration at the 1% level of significance. Therefore, the vector autoregression model (VAR) can be used in testing the causality relationship among the five GDP growth rate series.

A. Pairwise Granger causality tests

The annual GDP data set, however, is adequate for examining pairwise Granger causality relationship among the five countries using stationary first-difference series of GDP (Greene, 2003). The test involves in estimating the following two equations:

$$\Delta \quad \alpha \quad \sum \beta \ \Delta \qquad \sum \gamma \ \Delta \qquad + \mu \quad , \tag{1}$$

$$\Delta \quad \delta \quad \sum \lambda \ \Delta \qquad + \sum \theta \ \Delta \qquad + \nu \quad , \tag{2}$$

where Δx_t and Δy_t are the first-difference series of GDP for a pair of countries, respectively, e.g., Japan and China, the USA and Japan, etc. From five countries, we have a total of ten pairs of Granger causality tests. Δx_{t-i} and Δy_{t-j} are lagged dependent variables. μ_t and v_t are the random error terms in the equations. The causal relationship in equation (1) is seen from the Wald's coefficient F-test on the joint significance of the coefficients γ_j's of Δy_{t-j}'s, and that in equation (2) is seen from the joint significance of the coefficients λ_i's of Δx_{t-i}'s. In this bivariate case, we do not include the other variables' influence on the pair of variables in the equations. Thus, the causality relationship is due to the direct influence of the two variables.

Since we only have a small sample of annual data, we have tried to estimate the model with the lag length m = 1 and m = 2. In both cases, we obtained the same causality results. Therefore, we choose to present the results from the lag length m = 2 in Table 5. From the ten pairwise Granger causality tests, we have found two unidirectional causality relationships: Japan's GDP growth rate causes Korea's GDP growth rate at the 5% level of significance, and Japan's GDP growth rate also causes Taiwan's GDP growth rate at the 1% level of significance. These results show the strong dependency of the growth of Taiwanese and Korean economies on the Japanese economic growth, but not vise versa. The testing results also show the US's GDP growth rate unidirectionally causes Japan's GDP growth rate at the 25% level of significance.

Place Table 5 here

B. VAR Granger causality tests

To take into account the interactions among the five countries, we take one step further by formulating the GDP growth rate series into

error term. Especially, we have found that Korea and Taiwan have very strong positive responses to a change in Japan' GDP growth rate, and China also has positive response to a change in Korea's GDP growth rate. They peaked in the second periods, and lasted about four periods.

Place Figure 3 here

Figure 4 depicts the variance decomposition of each endogenous variable in the estimated VAR(1) system. We have found that a change in Japan's GDP growth rate has played a relative important role in explaining the variance (about 20%) of Korea's GDP growth rate and the variance (about 40%) of Taiwan's GDP growth rate. The changes in the GDP growth rate of Taiwan and Korea have played an important role in explaining the variance of China's GDP growth rate, about 30% and 10%, respectively. In the case of Japan, Taiwan and Korea have played a relatively important role (15% and 20%, respectively) than the United States (about 5%).

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Place Figure 4 here

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5. Causality tests on the stock price index series

The daily stock price indexes for China (Shanghai Composite, SSEC), Korea (Seoul Composite, KS11), Japan (Nikkei 225, N225), Taiwan (Taiwan Weighted, TWII), and the USA (S&P 500, GSPC) were retrieved[7] from the Major World Indices (finance.yahoo.com, on 12/15/2002). We have selected 270 recent common transaction days' stock indexes at the closing of the market[8] for each of the five countries, from September 18, 2001 to December 13, 2002. The period is chosen to eliminate the immediate effect of the September 11, 2001 tragic event in the New York City.

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[7] We have chosen S&P 500 instead of NASDAQ since the latter consists of 5000 or so technology stocks, while S&P 500 index consists of major stocks in both technology and non-technology, similar to the stock indexes of other countries.

[8]

We apply the same econometric procedures as in analyzing the GDP series above to examine the causality relationships among the stoc

$DLTSID_t$ $DLCSID_t$ $DLJSID_t$ $DLUSID_t$

Figure 6 depicts the variance decomposition of each endogenous variable in the estimated VAR(1) system. We have found that a change in the USA's financial market has played a relatively important role in explaining (about 17%) the variance of Japan's stock index growth rate, and a change in Korea's financial market has played a relatively important role in explaining (about 15%) the variance of Taiwan's stock index growth rate. For the case of the USA, only Japan has played some role in explaining the variance of the USA's stock index growth rate. The effects of other countries on Korea and China are almost negligible.

Place Figure 6 here

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6. Conclusions

Given the size of its economy and resources, one would expect that the United States would exert enormous influence on the stability and growth of closely allied countries in the Asia-Pacific region. This view is popular and intuitive. However, to our knowledge, the literature is still wanting in quantitative assessment of the role of the United States in this region. This paper attempts to fill this gap by first confirming the mutual dependence of the United States and the Asia-Pacific region, which includes the ADCs and the ASEAN4+ countries. We have pointed out that, while the United States is a predominant force in trade and investment in the region, it also relies on the countries in this region for its trade. The IT revolution enhanced the interdependence between the United States and the countries in this region through real and financial linkages.

Our study of linkages also highlights the possible routes of the transmission of the US recession, and more generally, the international business cycle, in the Asia-Pacific region. The impact of the US recession, and for that matter, of Japan and other countries, should be transmitted through trade, foreign direct investment, and stock markets. With this understanding, we then performed Granger causality tests on the time series data of five countries: The United States, Japan, Korea, Taiwan, and China. The results are quite unexpected. The pairwise Granger causality tests show that the GDP growth rates have unidirectional causality from the Japan to Taiwan and Korea. Surprisingly, we didn't find significant causality relationships between the United States and any other four countries.

In a larger VAR model in which the influence of other countries are included, the VAR Granger causality tests confirm again the same unidirectional causality of the GDP growth rates from Japan to Taiwan and Korea, and additionally, the unidirectional causality from Korea to China. Apparently, so far as GDP growth is concerned, despite the apparent dominance of the US economy and its increasing interdependence with the Asia-Pacific region, the recent US recession has minimal impact on the GDP growth of the Asia-Pacific region. The recent recession in Taiwan and Korea is more likely influenced by Japan rather than the United States. These results may be due to the fact that the annual GDP time series data are too short for causality analysis. A further study is called for.

We had no sample problems on the stock price indexes, and the results are much more illuminating. The pairwise Granger causality tests of the stock indexes show that, other things being equal, there is a very strong unidirectional causality from the United States to Japan, Korea and Taiwan, and also from Japan to Taiwan. In addition, there is a bidirectional causality between Korea and Taiwan. When our analysis is extended to the VAR model, we still obtain the same unidirectional causality from the United States to the three major ADCs, but not to China. Whether the case of China can be found similarly in the ASEAN countries will be our next project of study. We have also found very strong unidirectional causality from Korea to Taiwan, and weak unidirectional causality from Japan to China, as well as from China to the United States, a finding that is not intuitive.

In general, based on our data set, so far as the GDP real linkage is concerned, we have not found the significant unidirectional causality from US GDP growth to the growth of Japan, Korea, and Taiwan, or China. On the other hand, from the financial point of view, the recent US IT recession in the stock market during the past two years have shown a significant unidirectional causality from the United States to Japan, Korea and Taiwan, but not to China. This shows that the impact of the US recession is transmitted only through the stock markets, or more generally, the financial linkage. In short, the US recession does matter for Japan, Korea, and Taiwan through the financial linkage. Our empirical results seem to confirm the current economic experience between the United States and the Asia-Pacific region.

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Table 1. Merchandise Trade with the United States and in IT Products

	(a) Trade with USA % Total Trade			(b) Trade with USA % GDP			(c) IT Exports % Total Trade	
	1980	1990	1999	1980	1990	1999	1990	1999
World Avg	12.2	13	15.5	4	4	5.7	8.8	14.1
ADC+								
Korea	23	26	21	15	13	13	22.1	29.7
Taiwan	29	28	22	28	21	18	21.0	37.1
Singapore	12	16	16	43	49	42	36.5	52.8
Japan	21	29	28	2	5	10	23.3	21.8
HK	18	10	7	27	23	15	15.6	22.0
ASEAN-4+								
Indonesia	21	11	14	8	5	9	0.5	6.1
Malaysia	17	16	21	16	20	39	27.9	52.4
Philippines	29	30	30	12	14	26	22.7	63.0
Thailand	14	15	19	7	10	16	15.3	26.1
China	14	22	28	5	5	4	...	15.4
United States							13.1	18.1

Sources: (a), (b) from Arora and Vamvakidis (2001), which is based on IMF Direction of Trade Statistics and World Economic Outlook. Taiwan's data are calculated from TSDB (2002) in nominal US dollars. (c) WTO (2000). Table IV. 57. Exports of office machines and telecom equipment of selected economies, 1990-99

Table 2. Share of FDI flow and Stock of Lending (in US$ billions, %)

		(a) FDI					(b) Lending		
Country			1990	1995	1998	Notes	1990	1995	2000
1	Korea	Total	0.8	1.9	8.9	a	28.7	77.5	58.8
	% **US**		**40**	**33**	**34**		**14**	**10**	**11**
	% *Japan*		*29*	*22*	*6*		*32*	*28*	*18*
2	Taiwan	Total	2.3	2.9	3.7	a	10.0	22.5	18.1
	% **US**		**25**	**45**	**25**		**18**	**12**	**12**
	% *Japan*		*36*	*20*	*14*		*29*	*14*	*17*
3	Singapore	Total	2.6	3.1	8.5		140.6	192.5	100.0
	% **US**		**33**	**41**	**53**	(97)	**3**	**3**	**3**
	% *Japan*		*36*	*38*	*10*		*56*	*40*	*27*
4	Japan*	Total	2.8	3.9	10.2	a			
	% **US**		**24**	**48**	**60**				
	Total	ADCs	9	12	31		179	293	177
	Average % **US**		**30**	**42**	**43**		**12**	**8**	**8**
	Average % *Japan*		*34*	*26*	*10*		*39*	*27*	*20*
5	Indonesia	Total	8.8	39.9	33.8	a	24.7	44.5	40.2
	% **US**		**2**	**7**	**3**	(97)	**5**	**6**	**8**
	% *Japan*		*26*	*9*	*16*		*61*	*47*	*25*
6	Malaysia*	Total	1.7	2.3	1.5		7.3	16.8	20.8
	% **US**		**6**	(91) **22**	**15**		**5**	**9**	**5**
	% *Japan*		*37*	*23*	*18*		*61*	*44*	*27*
7	Philippines	Total	0.2	0.8	0.9		9.3	8.3	16.5
	% **US**		**27**	**7**	**28**		**34**	**35**	**11**
	% *Japan*		*28*	*30*	*17*		*32*	*12*	*18*
8	Thailand*	Total	2.5	2.0	2.8		13.6	62.8	26.6
	% **US**		**10**	**13**	**22**	(97)	**9**	**7**	**4**
	% *Japan*		*43*	*28*	*36*		*55*	*59*	*37*
9	China	Total	3.5	37.5	45.3		22.3	48.4	58.2
	US		**13**	**8**	**7**	(97)			

Table 4. Correlation Coefficients

Stock Price Indexes, GDP, and Growth Rates

a **1995-1999**

Countries	USA(Nasdaq)	Japan	Taiwan
Japan	0.200		
Taiwan	0.133	0.438	
Singapore	0.024	0.448	0.098

b **2000-2001**

Countries	USA(Nasdaq)	Japan	Taiwan
Japan	0.772		
Taiwan	0.744	0.812	
Singapore	0.717	0.713	0.712

Correlation coefficients among five countries

c **GDP 1979 - 2000**

	USA	Japan	Korea	Taiwan
Japan	0.92			
Korea	0.92	0.97		
Taiwan	0.98	0.97	0.97	
China	0.95	0.81	0.86	0.91

d **Growth rates of GDP 1980 - 2000**

Japan	0.04			
Korea	0.01	0.56		
Taiwan	0.31	0.58	0.59	
China	-0.04	-0.32	-0.01	-0.29

e **Daily stock indexes 9/18/01 - 12/13/02**

	USA(S&P500)	Japan	Korea	Taiwan
Japan	0.72			
Korea	0.19	0.56		
Taiwan	0.43	0.60	0.90	
China	0.21	0.32	-0.18	-0.14

f **Growth rates of daily stock indexes 9/19/01 - 12/13/02**

Japan	0.23			
Korea	-0.01	0.11		
Taiwan	0.04	0.01	0.25	
China	0.02	0.08	-0.10	0.03

Sources: (a), (b) Cheng (2002). (c)-(f) Authors' calculations.
(c), (d) WB (2002). (e), (f) Finance.Yahoo.com (2002)

Table 5. Pairwise Granger causality tests: growth rates of GDP, 1980 - 2000, lag:2

Pair	Test result	F-stat	p-value		Causality direction
1	Japan does not cause China	0.449	0.65		
	China does not cause Japan	0.493	0.62		
2	Korea does not cause China	0.150	0.86		
	China does not cause Korea	1.533	0.25		
3	Taiwan does not cause China	0.014	0.99		
	China does not cause Taiwan	0.456	0.64		
4	USA does not cause China	0.567	0.58		
	China does not cause USA	1.250	0.32		
5	Korea does not cause Japan	1.530	0.25		
	Japan does cause Korea	5.369	0.02	**	Unidirectional
6	Taiwan does not cause Japan	1.092	0.36		
	Japan does cause Taiwan	9.584	0.002	***	Unidirectional
7	USA does not cause Japan	1.542	0.25		
	Japan does not cause USA	0.041	0.96		
8	Taiwan does not cause Korea	0.929	0.42		
	Korea does not cause Taiwan	0.024	0.98		
9	USA does not cause Korea	0.185	0.83		
	Korea does not cause USA	0.063	0.94		
10	USA does not cause Taiwan	1.415	0.28		
	Taiwan does not cause USA	0.257	0.78		

Note: *** (**) denotes significant at the 1% (5%) level.

Table 6. Vector autoregression estimates, VAR(1): growth rates of GDP, 1980 - 2000

	Eq. Number	1	2	3	4	5
	Country	Korea	Taiwan	China	Japan	USA
Country	Dep. Var.	DLKOR	DLTWN	DLCHN	DLJPN	DLUSA
Korea	DLKOR(-1)	-0.141	-0.169	0.367	-0.346	-0.039
		[0.66]	[0.22]	[0.07] *	[0.20]	[0.42]
Taiwan	DLTWN(-1)	0.109	0.234	-0.445	0.115	0.089
		[0.85]	[0.35]	[0.22]	[0.82]	[0.33]
China	DLCHN(-1)	-0.101	0.085	0.044	-0.048	0.045
		[0.82]	[0.64]	[0.86]	[0.89]	[0.49]
Japan	DLJPN(-1)	0.661	0.561	-0.137	0.497	0.005
		[0.10] *	[0.004] ***	[0.56]	[0.14]	[0.94]
USA	DLUSA(-1)	-0.668	-0.895	0.129	-1.035	0.073
		[0.71]	[0.25]	[0.90]	[0.49]	[0.79]
	Constant	0.104	0.100	0.096	0.129	0.048
		[0.40]	[0.07] *	[0.20]	[0.22]	[0.02] **

Table 8. Vector autoregression estimates, VAR(1): growth rates of stock indexes, sample: 270

Eq. Number	1	2	3	4	5
Country	Korea	Taiwan	China	Japan	USA

Figure 1. World Share of GDP, 2000 (in current US$)

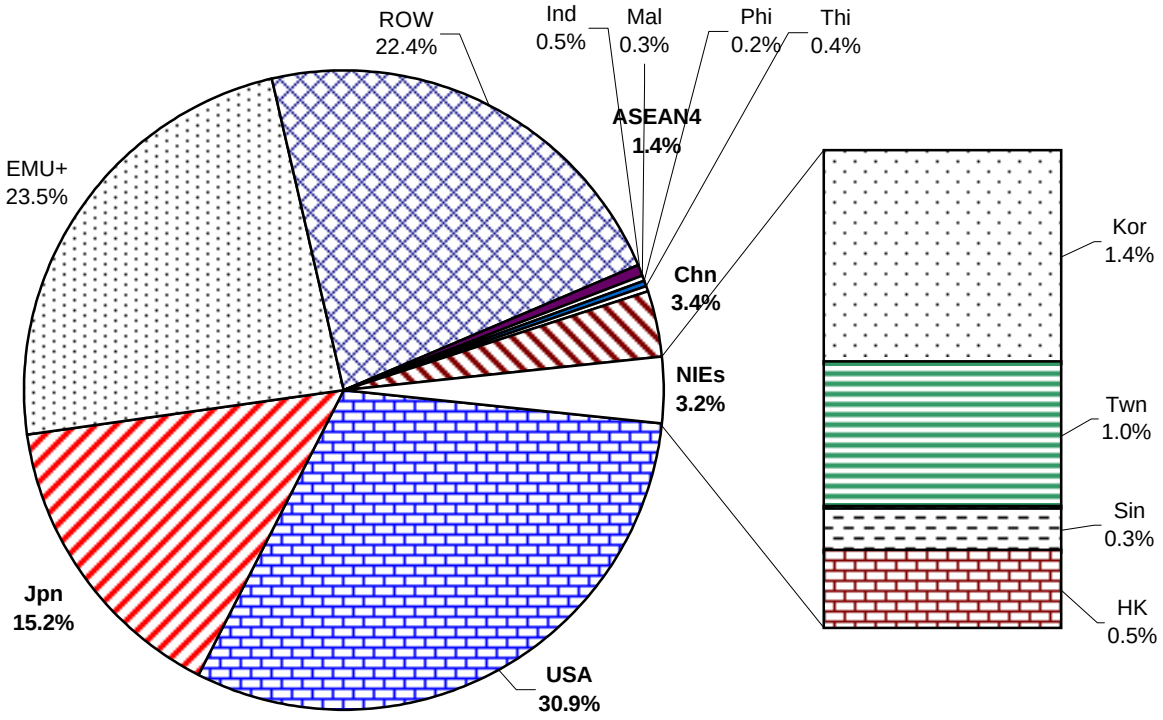
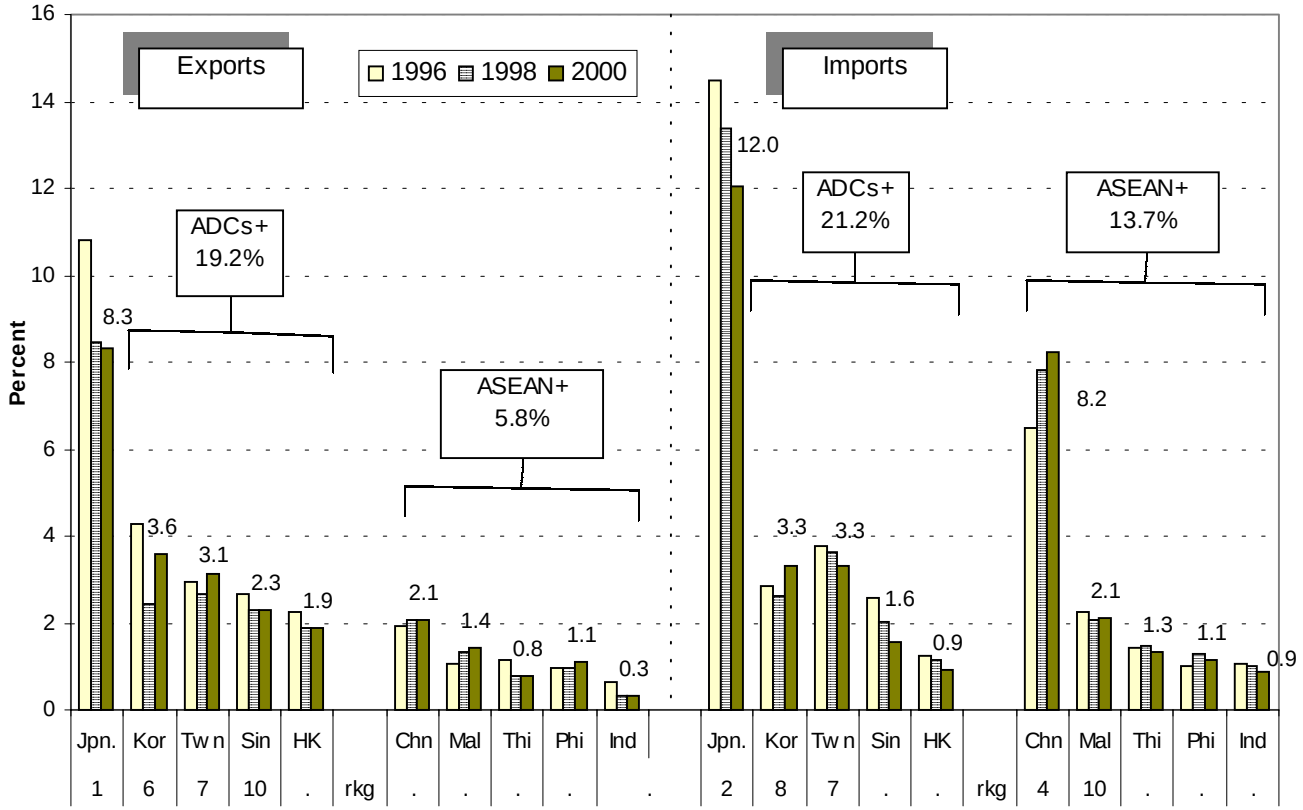
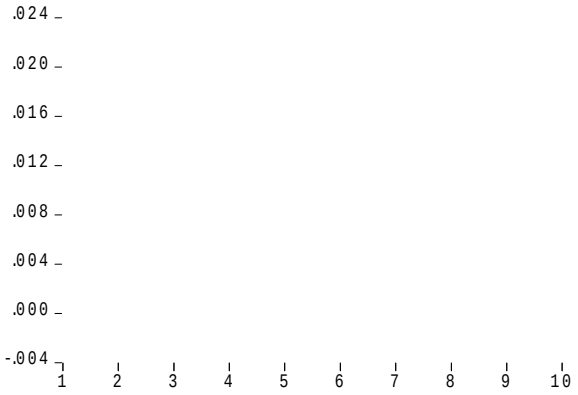


Figure 2. US Exports and Imports from Asia-Pacific Region
Ratios to Total Exports and Imports

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