

East Asian Economic Growth: Miracle or Bubble?

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The Economy of East Asia Today

- ◆ East Asia is the fastest-growing region in the world over the past two decades, the East Asian currency crisis of 1997-1998 notwithstanding
- ◆ Hong Kong, South Korea, Singapore and Taiwan are the first “Newly Industrialized Economies” (NIEs) in East Asia
- ◆ Industrialization has subsequently spread to Indonesia, Malaysia, Thailand, and to a lesser extent, Philippines (the wild-geese-flying pattern)
- ◆ The real GDP of the People’s Republic of China has grown at an average annual rate of almost 10 percent in the two decades since Chinese economic reform began in 1979
- ◆ The East Asian economies survived the East Asian currency crisis and with the exception of Indonesia and possibly Philippines have largely recovered from their troughs
- ◆ How has East Asia been able to achieve this economic performance?

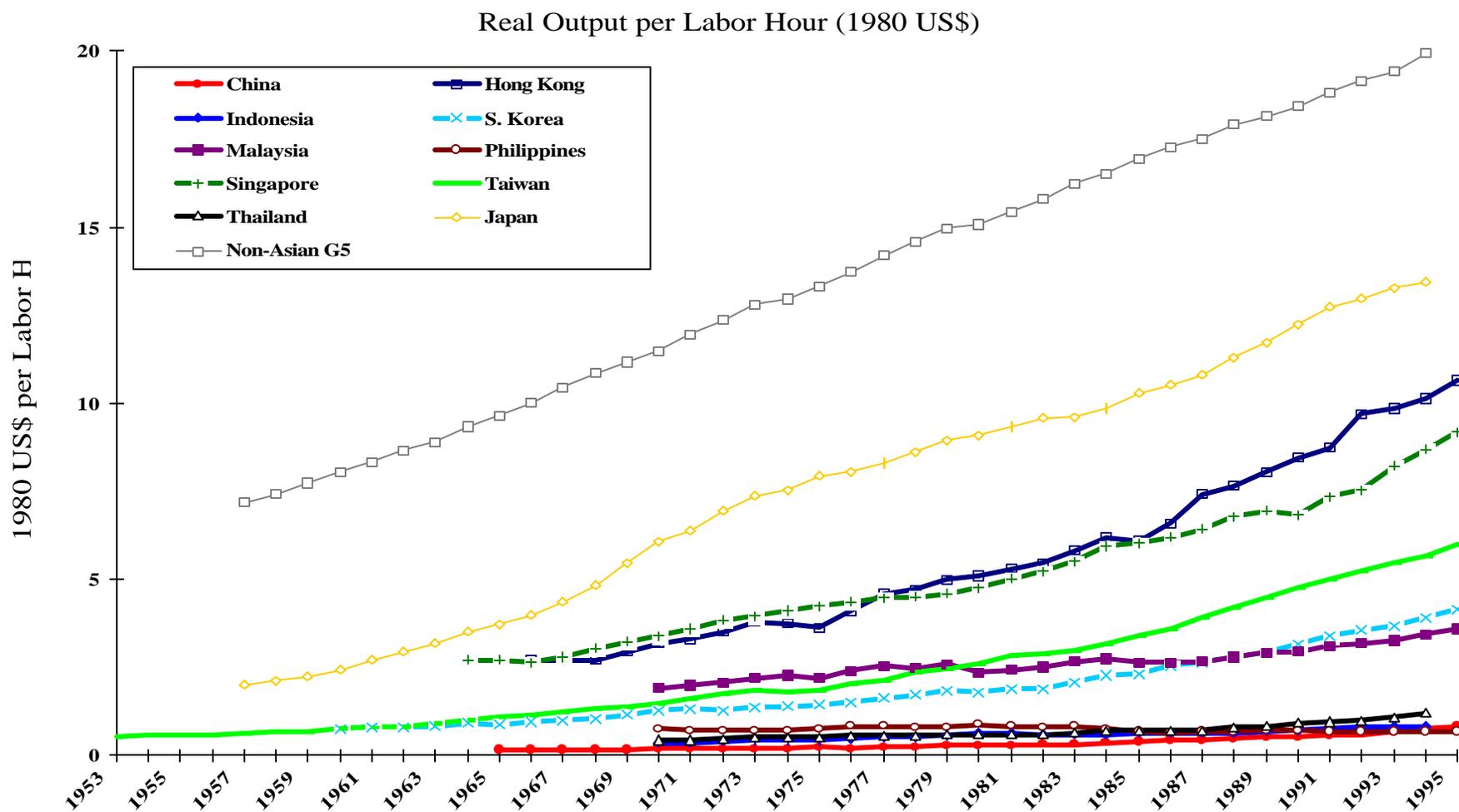
Rates of Growth of Inputs & Outputs of the East Asian Developing & the G-7 Countries

Table 3.1: Average Annual Rates of Growth of Real GDP, Capital, Labor and Human Capital (percent)

(Extended sample period)

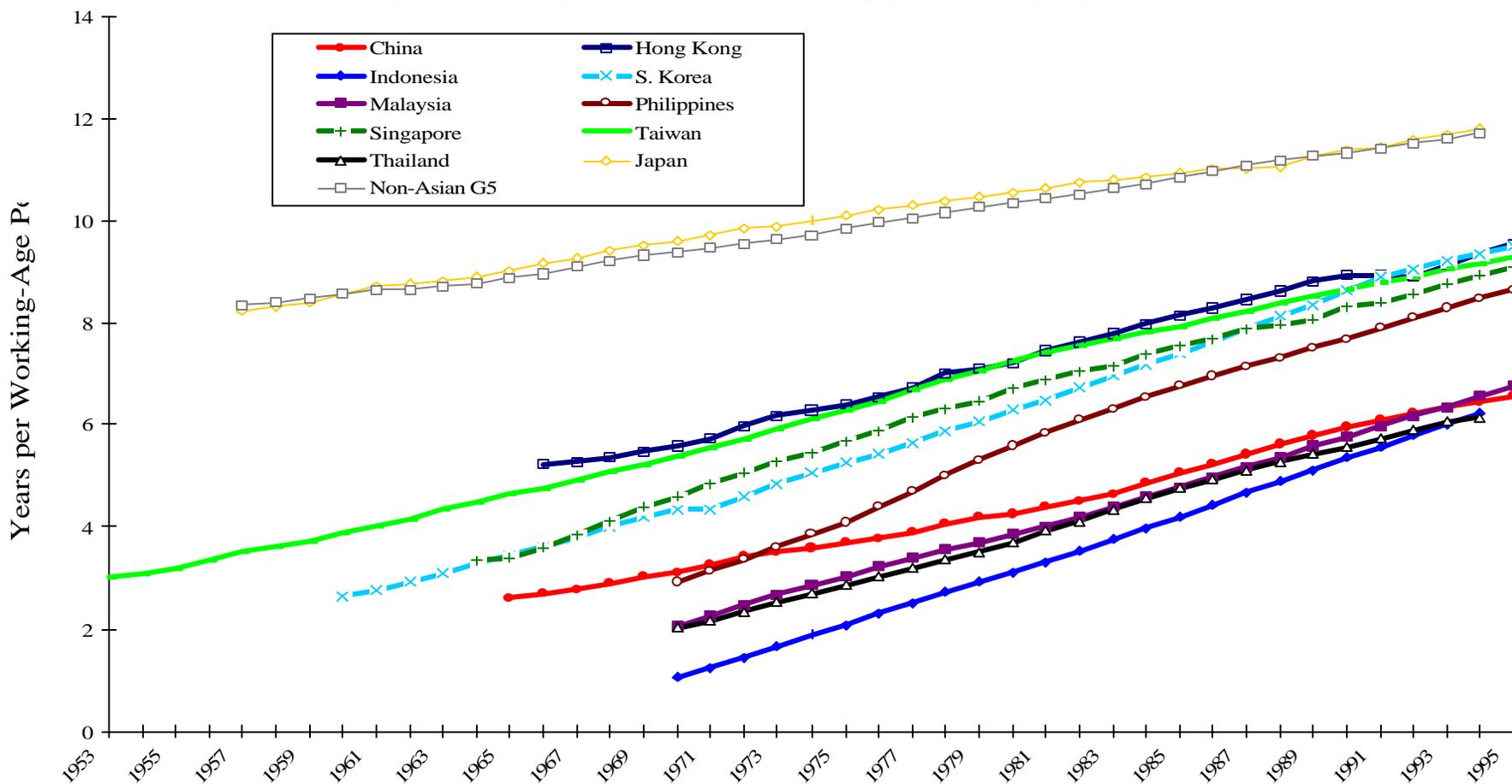
Country	Period	GDP	Capital Stock	Utilized Capital	Employment	Labor Hours	Human Capital	Average Human Capital
Hong Kong	66-95	7.4	8.8	8.6	2.6	2.4	4.8	2.1
S. Korea	60-95	8.5	12.3	12.3	3.1	3.3	6.2	4.0
Singapore	64-95	8.8	10.3	10.3	4.3	4.7	5.9	3.5
Taiwan	53-95	8.4	11.8	11.8	2.7	2.3	5.3	2.8
Indonesia	70-94	6.7	8.9	9.8	3.1	3.1	9.6	7.7
Malaysia	70-95	7.3	11.8	11.8	3.7	3.7	7.7	4.9
Philippines	66-95	4.0	5.8	5.9	3.2	3.2	10.8	8.5
Thailand	66-94	7.6	9.1	9.4	2.8	2.8	8.5	5.8
China	65-95	8.4	10.3	10.3	3.0	3.0	5.9	3.3
Japan	57-94	5.9	8.1	8.0	1.1	0.6	2.1	0.9
Canada	57-94	3.8	4.8	4.7	2.3	1.9	3.0	1.1
France	57-94	3.3	3.9	3.9	0.4	-0.2	2.0	1.1
W. Germany	57-94	3.2	3.3	3.1	0.1	-0.3	1.5	1.0
Italy	59-94	3.5	5.2	5.3	0.0	-0.3	1.8	1.3
UK	57-94	2.4	3.9	3.8	0.2	-0.1	1.2	0.8
US	49-94	3.1	3.0	3.3	1.7	1.3	2.1	0.8

Real Output per Labor Hour



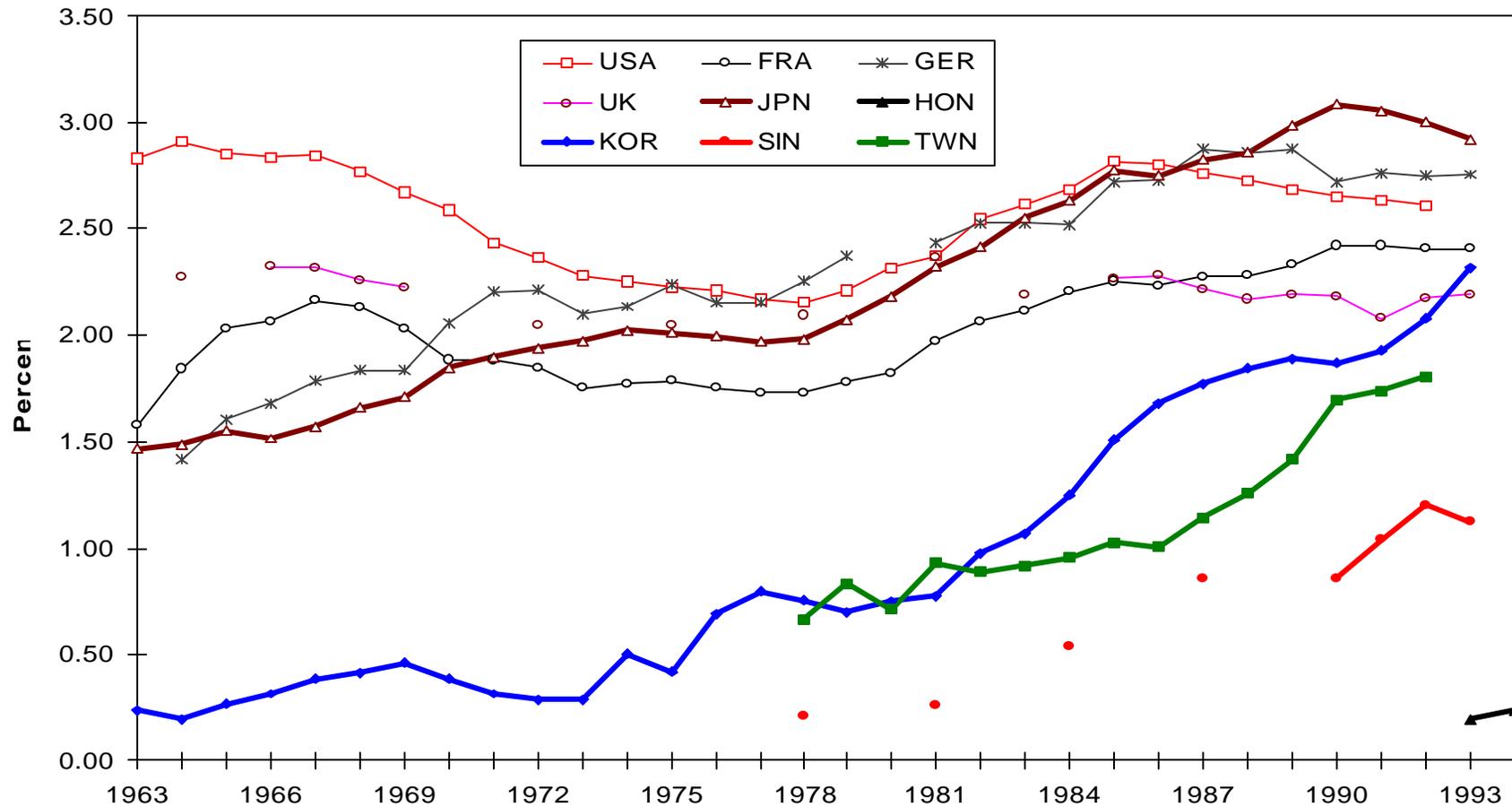
Human Capital

Average Human Capital (Years of Schooling per Working-Age Person)



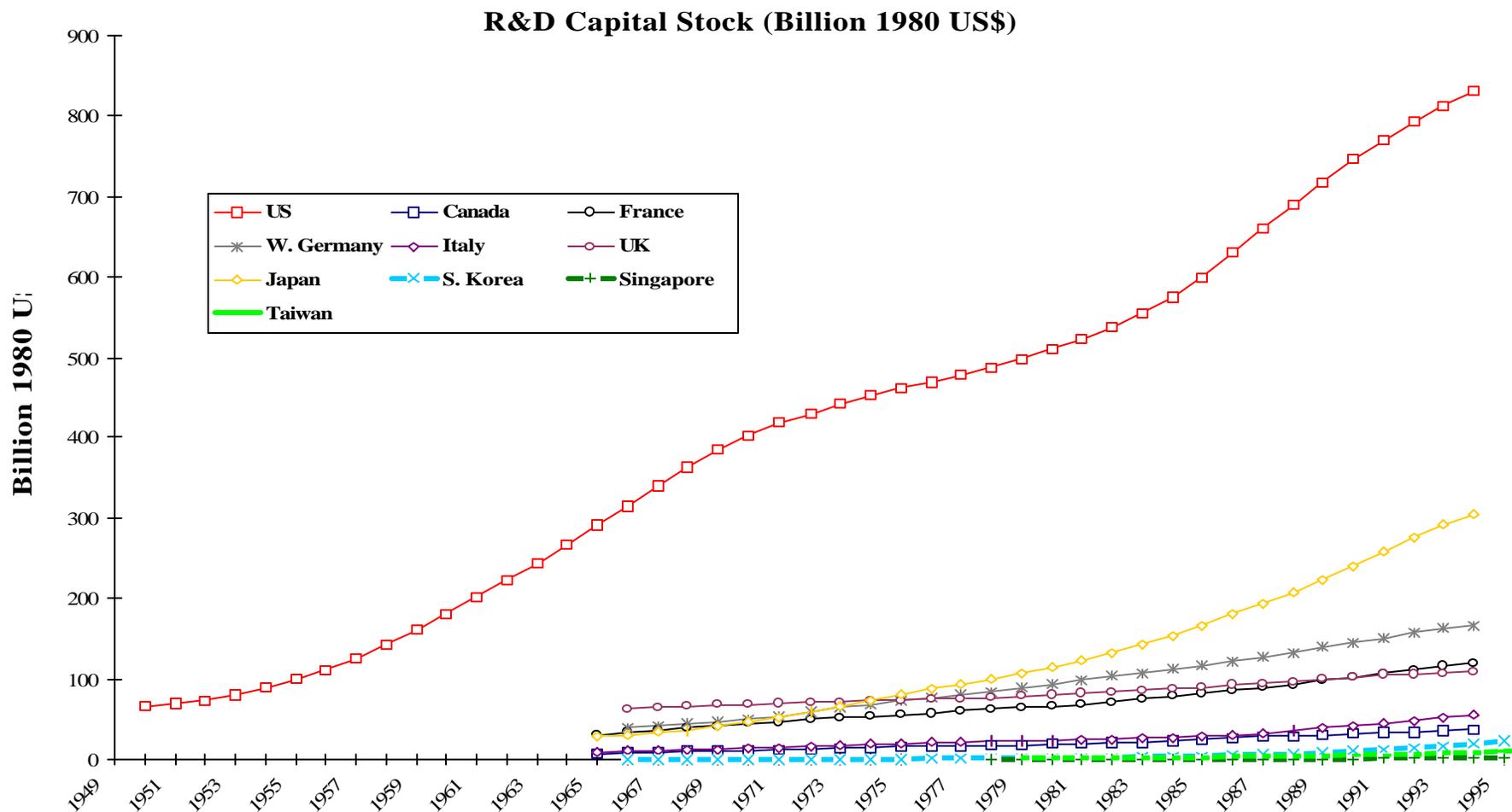
R&D Expenditure as a Percentage of GDP

Percentage of Total R&D Expenditure in GDP (Current Prices)



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R&D Capital



Accounting for Economic Growth

- ◆ Decomposing the growth of output by its proximate sources:
 - ◆ How much of the growth of output can be attributed to the growth of measured inputs, tangible capital and labor? and
 - ◆ How much of the growth of output can be attributed to technical progress (aka growth in total factor productivity), i.e. improvements in productive efficiency over time?
- ◆ **TECHNICAL PROGRESS (GROWTH IN TOTAL FACTOR PRODUCTIVITY)**
= GROWTH IN OUTPUT HOLDING ALL MEASURED INPUTS CONSTANT

Interpretation of Technical Progress (Growth of Total Factor Productivity)

- ◆ Not “Manna from Heaven”
- ◆ The effects of growth in unmeasured “Intangible Capital” (Human Capital, R&D Capital, Goodwill (Advertising and Market Development), Information System, Software, etc.)
- ◆ The effects of growth in other omitted and unmeasured inputs (Land, Natural Resources, Water Resources, Environment, etc.)
- ◆ The effects of improvements in technical and allocative efficiency over time, e.g., learning-by-doing
- ◆ “Residual” or “Measure of Our Ignorance”

Difficulties in the Measurement of Technical Progress (Total Factor Productivity)

- ◆ (1) The confounding of economies of scale and technical progress
 - ◆ Solution: pooling time-series data across different countries--at any given time there are different scales in operation; the same scale can be observed at different times
- ◆ (2) The under-identification of the biases of scale effects and technical progress
 - ◆ Bias in scale effects--as output is expanded under conditions of constant prices of inputs, the demands for different inputs are increased at differential rates
 - ◆ Bias in technical progress--over time, again under constant prices, the demands of different inputs per unit output decreases at different rates
 - ◆ Solution: econometric estimation with flexible functional forms

Two Leading Alternative Approaches to Growth Accounting

- ◆ (1) Econometric Estimation of the Aggregate Production Function, E.g., the Cobb-Douglas production function

$$Y_t = A_0 e^{\gamma t} K_t^\alpha L_t^\beta$$

or, taking natural logarithms

$$\ln Y_t = \ln A_0 + \alpha \ln K_t + \beta \ln L_t + \gamma t$$

- ◆ (2) Traditional Growth-Accounting Formula
 - ◆ **Are Differences in Empirical Results Due to Differences in Methodologies or Assumptions or Both?**

The Meta-Production Function Approach as an Alternative

- ◆ Introduced by Hayami (1969) and Hayami & Ruttan (1970, 1985)
- ◆ Hayami & Ruttan assume that $F_i(.) = F(.)$:
 - ◆ $Y_{it} = F(K_{it}, L_{it}, t), i = 1, \dots, n; t = 0, \dots, T$
- ◆ Which implies that all countries have identical production functions in terms of measured inputs
- ◆ Thus pooling of data across multiple countries is justified

Extension by Boskin, Lau & Yotopoulos

- ◆ Extended by Lau & Yotopoulos (1989) and Boskin & Lau (1990) to allow time-varying, country- and commodity-specific differences in efficiency
- ◆ Applied by Boskin, Kim, Lau, & Park to the G-5 countries, G-7 countries, the East Asian Newly Industrialized Economies (NIEs) and developing economies in the Asia/Pacific region

The Extended Meta-Production Function

Approach: The Basic Assumptions (1)

(1) All countries have the same underlying aggregate production function $F(\cdot)$ in terms of standardized, or “**efficiency-equivalent**”, quantities of outputs and inputs, i.e.

$$(1) \quad Y^*_{it} = F(K^*_{it}, L^*_{it}) \quad , \quad i = 1, \dots, n.$$

The Extended Meta-Production Function

Approach: The Basic Assumptions (2)

(2) The measured quantities of outputs and inputs of the different countries may be converted into the unobservable standardized, or "efficiency-equivalent", units of outputs and inputs by multiplicative country- and output- and input-specific time-varying **augmentation factors**, $A_{ij}(t)$'s, $i = 1, \dots, n$; $j =$ output (0), capital (K), and labor (L):

$$(2) \quad Y^*_{it} = A_{i0}(t)Y_{it} \ ;$$

$$(3) \quad K^*_{it} = A_{iK}(t)K_{it} \ ;$$

$$(4) \quad L^*_{it} = A_{iL}(t)L_{it} \ ; \ i = 1, \dots, n.$$

The Extended Meta-Production Function

Approach: The Basic Assumptions (2)

- ◆ In the empirical implementation, the commodity augmentation factors are assumed to have the constant geometric form with respect to time. Thus:

$$(5) \quad Y^*_{it} = A_{i0} (1+c_{i0})^t Y_{it} ;$$

$$(6) \quad K^*_{it} = A_{iK} (1+c_{iK})^t K_{it} ;$$

$$(7) \quad L^*_{it} = A_{iL} (1+c_{iL})^t L_{it} ; i = 1, \dots, n.$$

A_{i0} 's, A_{ij} 's = augmentation level parameters

c_{i0} 's, c_{ij} 's = augmentation rate parameters

The Extended Meta-Production Function

Approach: The Basic Assumptions (2)

- ◆ For at least one country, say the i th, the constants A_{i0} and A_{ij} 's can be set identically at unity, reflecting the fact that "efficiency-equivalent" outputs and inputs can be measured only relative to some standard.
- ◆ The A_{i0} and A_{ij} 's for the U.S. are taken to be identically unity.
- ◆ Subject to such a normalization, the commodity augmentation level and rate parameters can be estimated simultaneously with the parameters of the aggregate production function.

The Commodity-Augmenting Representation of Technical Progress

One specialization of

$$Y = F(K, L, t) \text{ is}$$

$$Y^* = F(K^*, L^*), \text{ where}$$

Y^* , K^* , and L^* are efficiency-equivalent quantities. Thus, in terms of measured quantities,

$$Y = A_0(t) F(A_K(t)K, A_L(t)L).$$

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The Meta-Production Function Approach

- ◆ It is important to understand that the meta-production function approach assumes that the production function is identical for all countries only in terms of the efficiency-equivalent quantities of outputs and inputs; it is not identical in terms of measured quantities of outputs and inputs
- ◆ A useful way to think about what is the same across countries is the following—the isoquants remain the same for all countries and over time with a suitable renumbering of the isoquants and a suitable re-scaling of the axes

The Extended Meta-Production Function

Approach: The Basic Assumptions (3)

(3) The aggregate meta-production function is assumed to have a flexible functional form, e.g. the transcendental logarithmic functional form of Christensen, Jorgenson & Lau (1973).

The Extended Meta-Production Function

Approach: The Basic Assumptions (3)

- ◆ The translog production function, in terms of “efficiency-equivalent” output and inputs, takes the form:

$$(8) \quad \ln Y^*_{it} = \ln Y_0 + a_K \ln K^*_{it} + a_L \ln L^*_{it} \\ + B_{KK}(\ln K^*_{it})^2/2 + B_{LL}(\ln L^*_{it})^2/2 \\ + B_{KL}(\ln K^*_{it})(\ln L^*_{it}), \quad i = 1, \dots, n.$$

- ◆ By substituting equations (5) through (7) into equation (8), and simplifying, we obtain equation (9), which is written entirely in terms of **observable** variables:

The Estimating Equation

$$(9) \quad \ln Y_{it} = \ln Y_0 + \ln A^*_{i0} + a^*_{Ki} \ln K_{it} + a^*_{Li} \ln L_{it} \\ + c^*_{i0}t + B_{KK}(\ln K_{it})^2/2 + B_{LL}(\ln L_{it})^2/2 + B_{KL}(\ln K_{it}) \\ (\ln L_{it}) + (B_{KK} \ln(1+c_{iK}) + B_{KL} \ln(1+c_{iL}))(\ln K_{it})t \\ + (B_{KL} \ln(1+c_{iK}) + B_{LL} \ln(1+c_{iL}))(\ln L_{it})t \\ + (B_{KK}(\ln(1+c_{iK}))^2 + B_{LL}(\ln(1+c_{iL}))^2 \\ + 2B_{KL} \ln(1+c_{iK})\ln(1+c_{iL}))t^2/2,$$

$i = 1, \dots, n$, where A^*_{i0} , a^*_{Ki} , a^*_{Li} , c^*_{i0} and c_{ij} 's, $j = K, L$ are country-specific constants.

Tests of the Maintained Hypotheses of the Meta-Production Function Approach

- ◆ The parameters B_{KK} , B_{KL} , and B_{LL} are independent of i , i.e., of the particular individual country. This provides a basis for testing the maintained hypothesis that there is a single aggregate meta-production function for all the countries.
- ◆ The parameter corresponding to the $t^2/2$ term for each country is not independent but is completely determined given B_{KK} , B_{KL} , B_{LL} , c_{iK} , and c_{iL} . This provides a basis for testing the hypothesis that technical progress may be represented in the constant geometric commodity-augmentation form.

The Labor Share Equation

- ◆ In addition, we also consider the behavior of the share of labor costs in the value of output:

$$(10) \quad w_{it}L_{it}/p_{it}Y_{it} = a_{Lii}^* + B_{KLi}(\ln K_{it}) + B_{LLi}(\ln L_{it}) \\ + B_{Lti}t, \quad i = 1, \dots, n.$$

Instantaneous Profit Maximization under Competitive Output and Input Markets

- ◆ The share of labor costs in the value of output should be equal to the elasticity of output with respect to labor: $(11) \frac{w_{it}L_{it}}{p_{it}Y_{it}} = a^*_{Li} + B_{KL}(\ln K_{it}) + B_{LL}(\ln L_{it}) + (B_{KL} \ln(1+c_{iK}) + B_{LL} \ln(1+c_{iL}))t, i = 1, \dots, n.$
- ◆ This provides a basis for testing the hypothesis of profit maximization with respect to labor.

Test of Hypotheses: The Meta-Production Function Approach

- ◆ The maintained hypotheses of the meta-production function approach
 - ◆ “Identical Meta-Production Functions” and
 - ◆ “Factor-Augmentation Representation of Technical Progress”
- ◆ The different kinds of purely commodity-augmenting technical progress
- ◆ The hypothesis of no technical progress

The Different Kinds of Purely Commodity-Augmenting Technical Progress

$$Y = A_0(t) F(A_K(t)K, A_L(t)L)$$

= $A_0(t)F(A_K K, A_L L)$, purely output-augmenting (Hicks-neutral)

= $A_0 F(A_K(t)K, A_L L)$, purely capital-augmenting (Solow-neutral)

= $A_0 F(A_K K, A_L(t)L)$, purely labor-augmenting (Harrod-neutral)

The Hypothesis of No Technical Progress

- ◆ $c_{i0} = 0; c_{iK} = 0; c_{iL} = 0$
- ◆ This hypothesis is rejected for the Group-of-Five Countries.
- ◆ This hypothesis cannot be rejected for the East Asian NIEs.

The Sources of Economic Growth: Findings of Kim & Lau As Reported by Krugman (1994)

- ◆ Using data from the early 1950s to the late 1980s, Kim and Lau (1992, 1994a, 1994b) find that:
- ◆ (1) No technical progress in the East Asian NIEs but significant technical progress in the industrialized economies (IEs)
- ◆ (2) East Asian economic growth has been input-driven, with tangible capital accumulation as the most important source of economic growth (the latter applying also to Japan)
 - ◆ Working harder as opposed to working smarter
- ◆ (3) Technical progress is the most important source of economic growth for the IEs, followed by tangible capital, accounting for over 50% and 30% respectively, with the exception of Japan
 - ◆ NOTE THE UNIQUE POSITION OF JAPAN!
- ◆ (4) Technical progress is purely tangible capital-augmenting and hence complementary to tangible capital, confirming the earlier findings of Boskin and Lau for the Group-of-Five (G-5) Countries

The Findings of Kim & Lau (1992, 1994a, 1994b)

- ◆ (5) Despite their high rates of economic growth and rapid capital accumulation, the East Asian Newly Industrialized Economies actually experienced a significant decline in productive efficiency relative to the industrialized countries as a group
- ◆ (6) Technical progress being purely tangible capital-augmenting implies that it is less likely to cause technological unemployment than if it were purely labor-augmenting

Accounts of Growth: Kim & Lau (1992, 1994a, 1994b)

Table 2.2: Relative Contributions of the Sources of Economic Growth (percent)				
Economy	Tangible Capital	Labor	Technical Progress	
Hong Kong	74	26	0	
Singapore	68	32	0	
S. Korea	80	20	0	
Taiwan	85	15	0	
Japan	56	5	39	
Non-Asian G-5	36	6	59	

Purely Capital-Augmenting Technical Progress

$$Y = A_0(t) F(A_K(t)K, A_L(t)L)$$

$$= A_0 F(A_K(t)K, A_L L)$$

$$= A_0 F(A_K(1+c_{iK})^t K, A_L L)$$

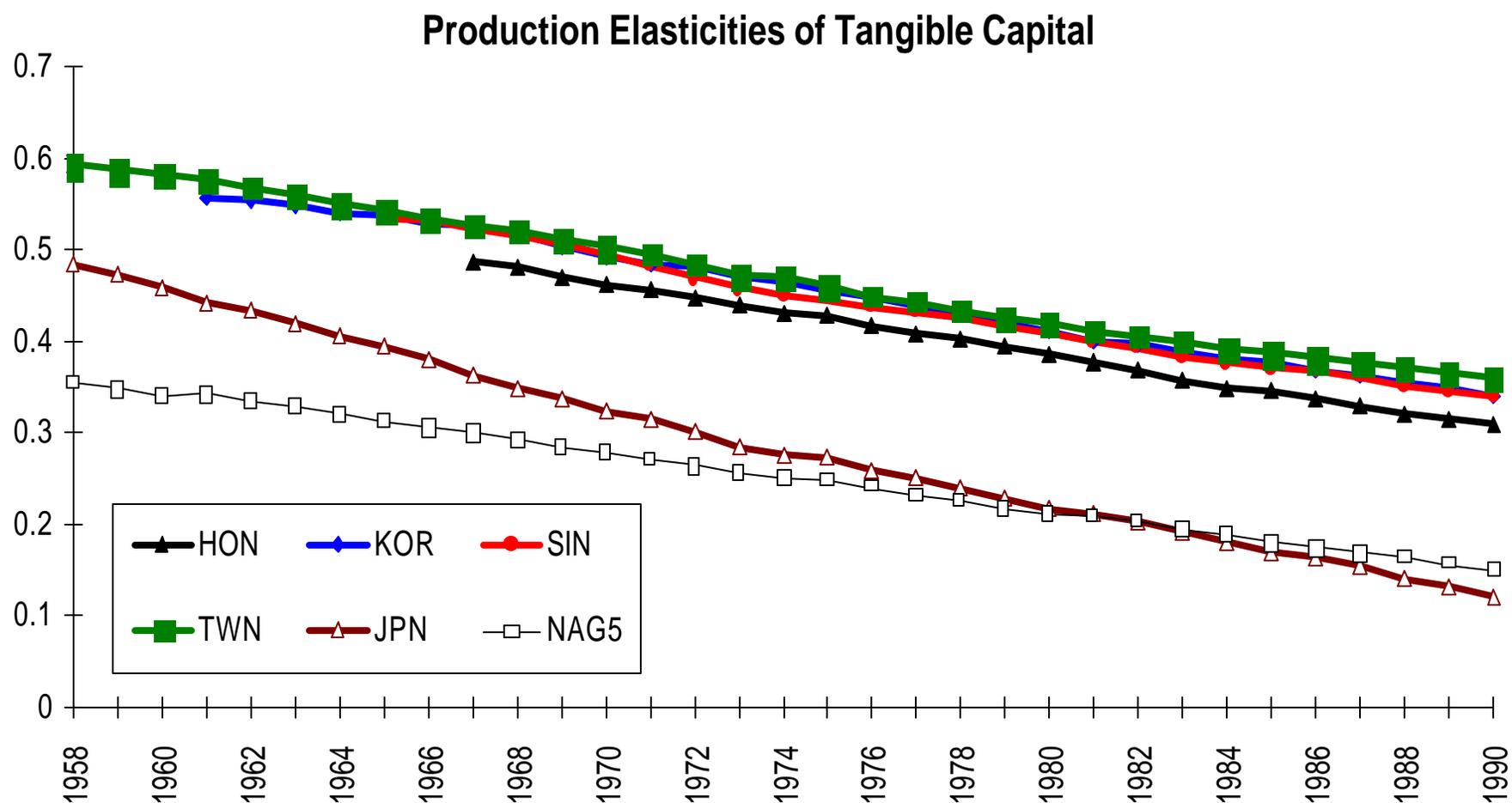
The production function can also be written as:

$$= A_0 F(A_K e^{c_{iK}t} K, A_L L)$$

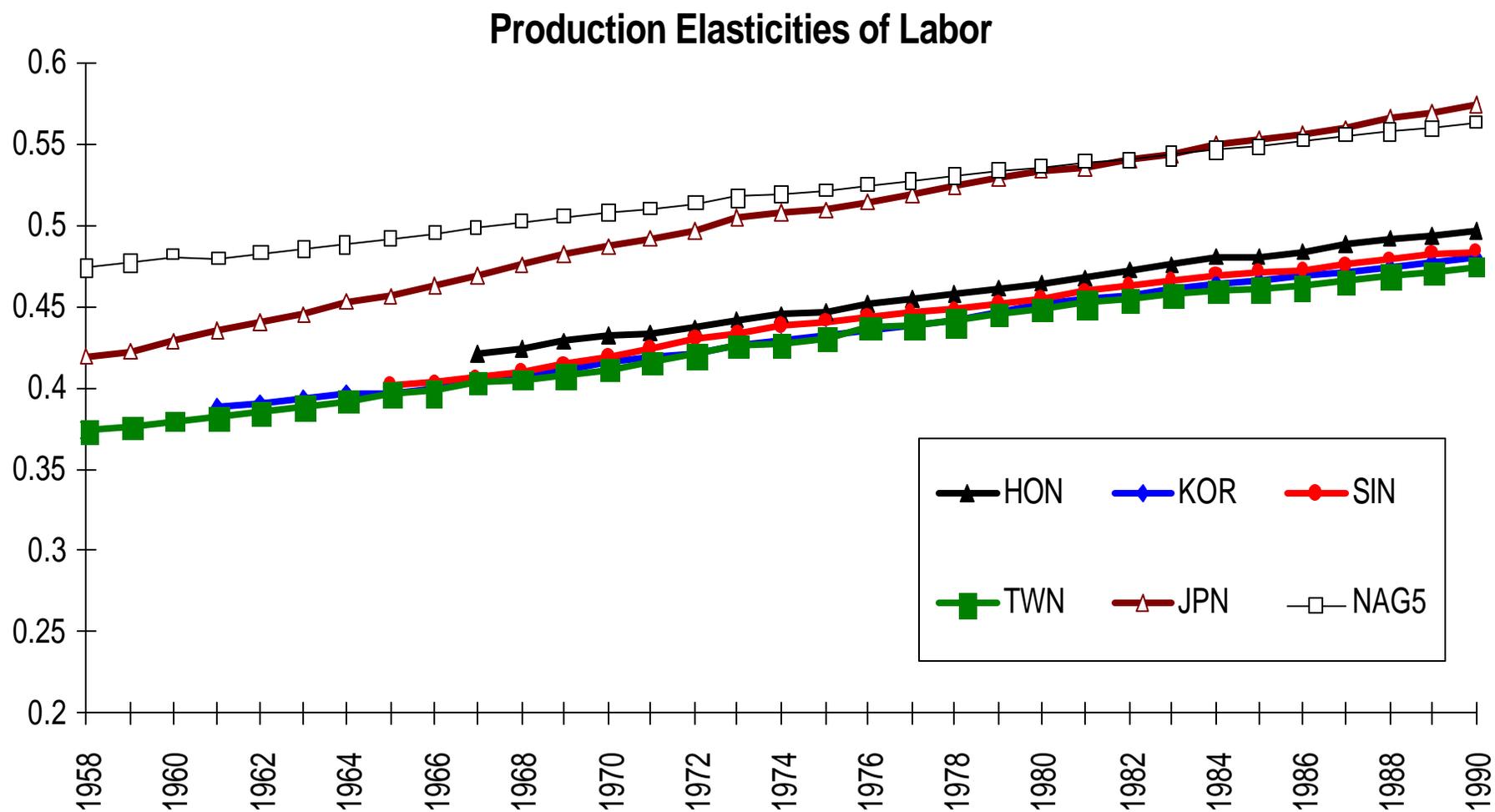
The Estimated Parameters of the Aggregate Meta-Production Function

Table 6.2 Estimated Parameters of the Aggregate Production Function						
Parameter			I+II+IV+V(2)+VI			I+II+IV+VI
Y_0			0.293	(399.295)		0.331 (318.414)
a_K			0.256	(8.103)		0.245 (7.929)
a_L			0.63	(6.666)		0.524 (5.077)
B_{KK}			-0.074	(-7.445)		-0.058 (-4.919)
B_{LL}			-0.073	(-1.101)		-0.012 (-0.178)
B_{KL}			0.032	(1.324)		0.025 (1.103)
C_{iK}						
	Hong Kong		0			0.062 (2.443)
	Singapore		0			0.045 (1.702)
	South Korea		0			0.026 (1.197)
	Taiwan		0			0.024 (1.523)
	France		0.083	(8.735)		0.1 (6.394)
	West Germany		0.074	(6.761)		0.089 (5.465)
	Japan		0.072	(3.927)		0.098 (3.483)
	UK		0.046	(5.749)		0.056 (5.045)
	United States		0.061	(7.592)		0.067 (6.321)
R-sq			0.753			0.753
D.W.			1.448			1.473

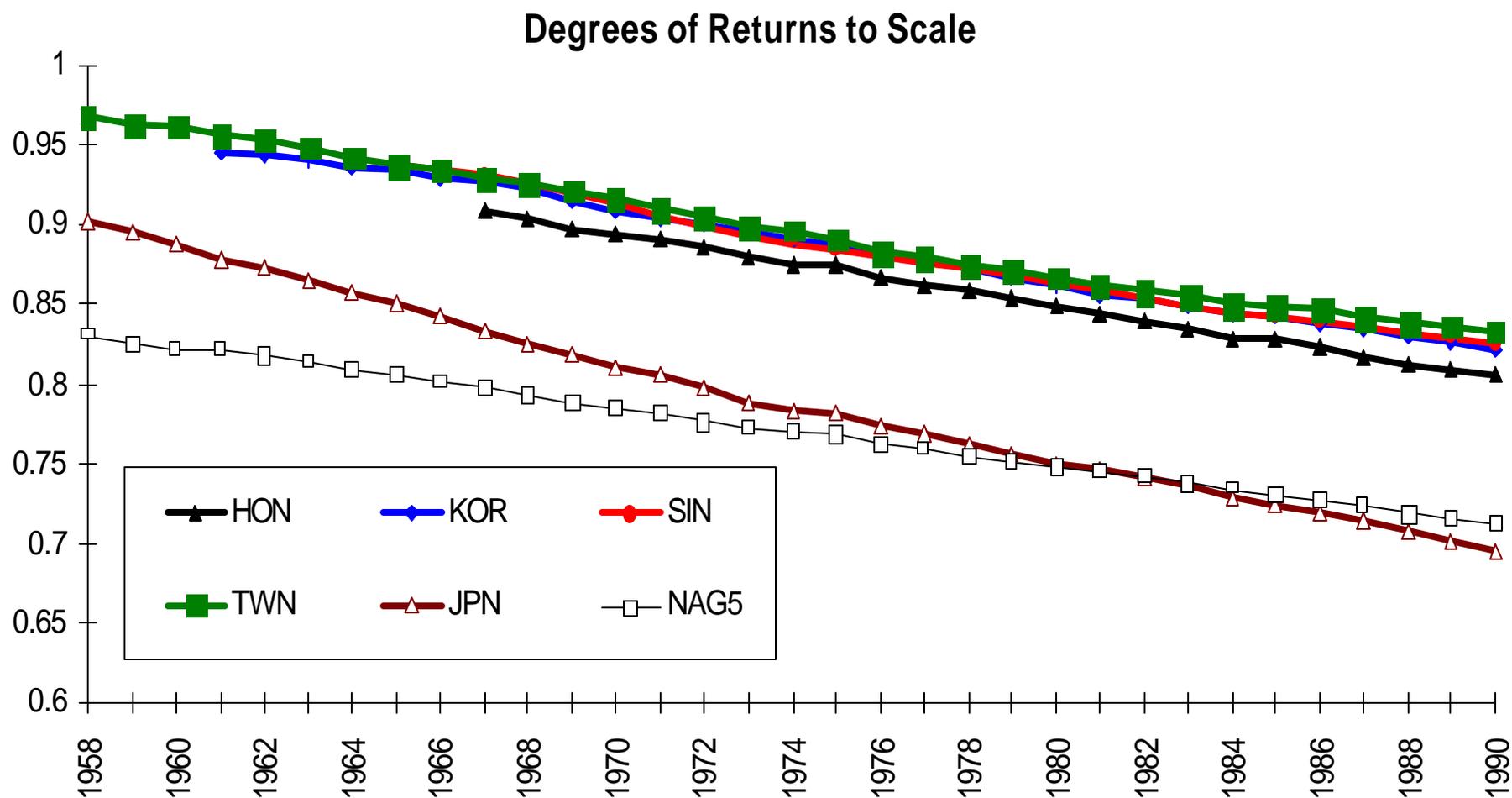
Production Elasticities of Capital



Production Elasticities of Labor



Degrees of Returns to Scale



Empirical Evidence for the Hypothesis of No Technical Progress in East Asian NIEs

- ◆ Tsao (1985) and Young (1992) for Singapore
- ◆ Kim & Lau (1992, 1994a, 1994b) and Young (1995) for the four East Asian NIEs
- ◆ Paul Krugman (1994)
- ◆ Kim & Lau (1996) extend the same finding to other East Asian economies--China, Indonesia, Malaysia, Philippines, and Thailand

Empirical Evidence Against the Hypothesis of No Technical Progress

- ◆ Young (1992) for Hong Kong
- ◆ The World Bank (1993)
- ◆ Credibility of such studies undermined by restrictive maintained hypotheses such as
 - ◆ CONSTANT RETURNS TO SCALE
 - ◆ NEUTRALITY OF TECHNICAL PROGRESS &
- ◆ INSTANTANEOUS COMPETITIVE PROFIT MAXIMIZATION

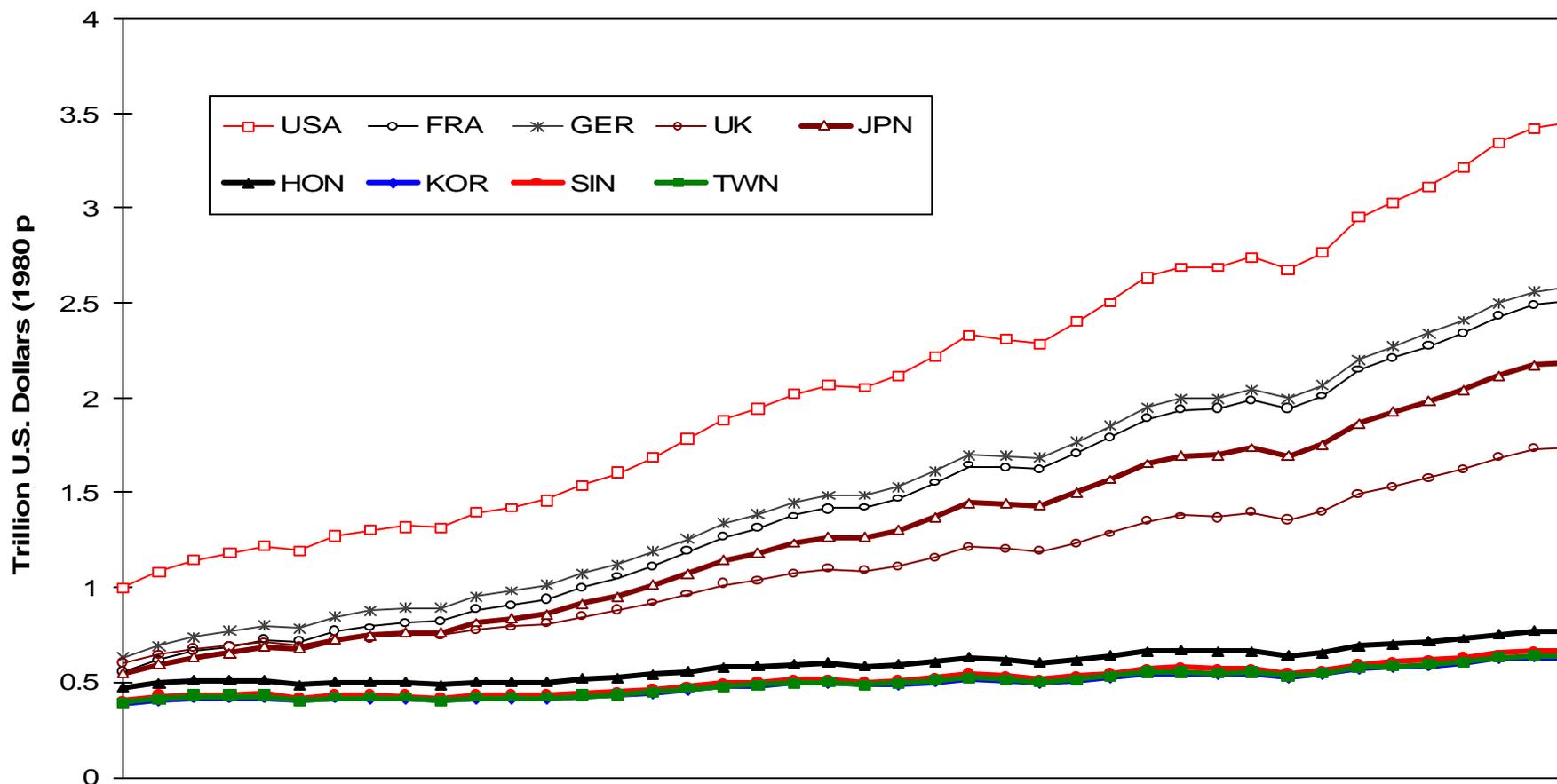
International and Intertemporal Comparison of Productive Efficiency: A Thought Experiment

- ◆ Suppose all countries have the same quantities of **measured inputs** of capital and labor as the United States
- ◆ What would have been the quantities of their real outputs? and
- ◆ How would they evolve over time?

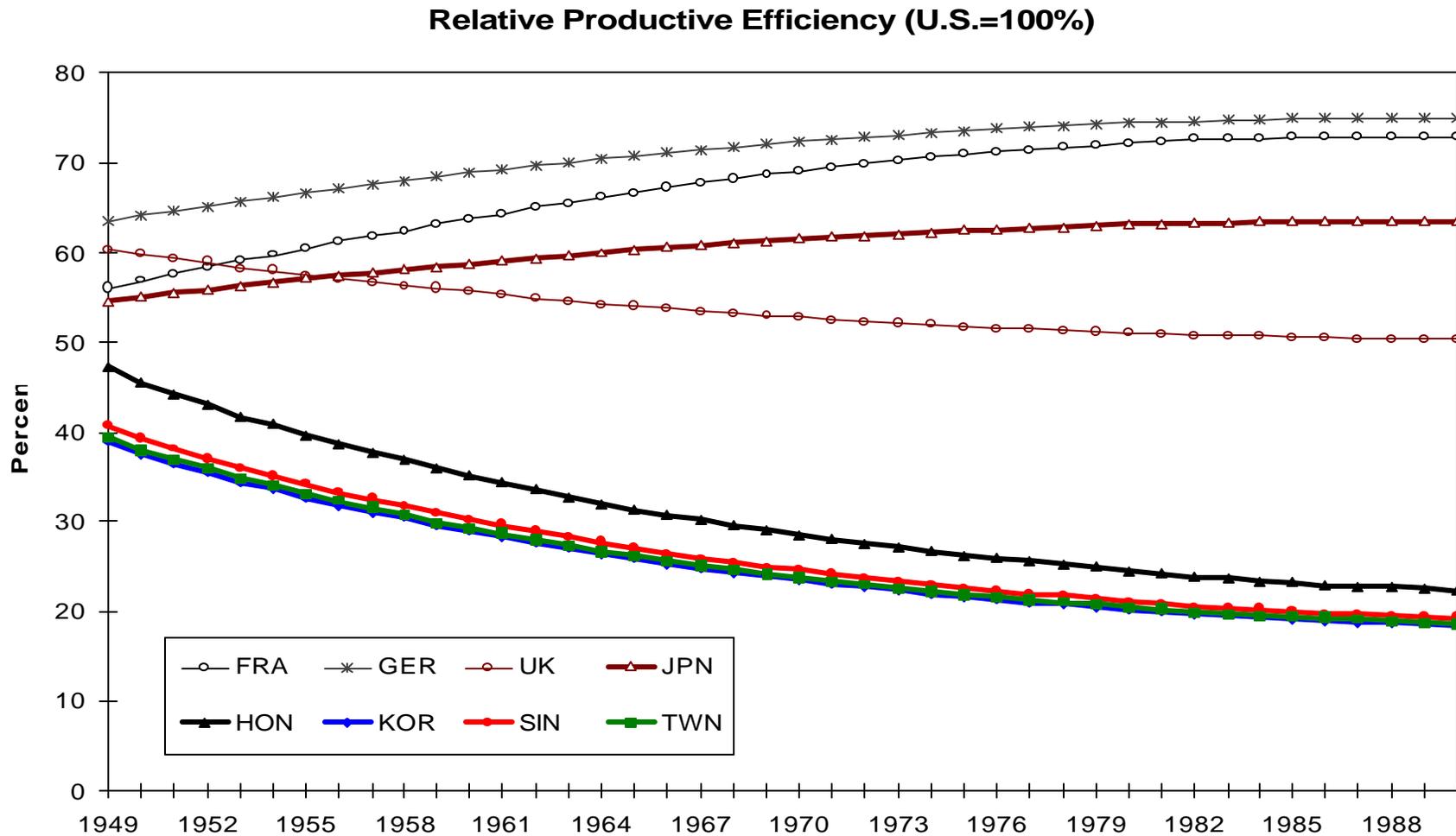
WE COMPARE THEIR OUTPUTS
HOLDING MEASURED INPUTS CONSTANT!

Hypothetical Output Levels

Hypothetical Output Levels (Trillion US\$ in 1980 prices)



Relative Productive Efficiency (U.S.=100%)

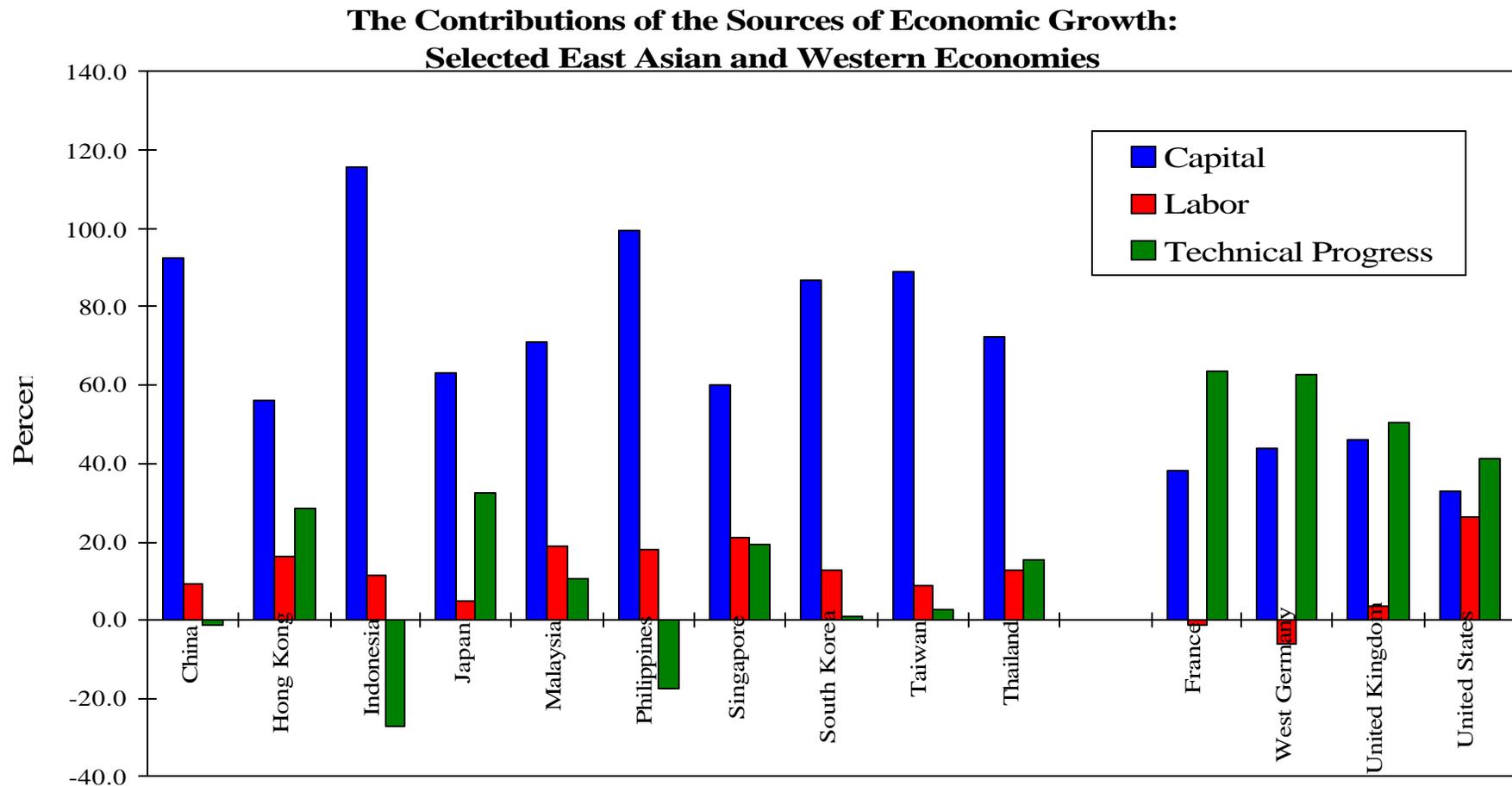


The Sources of Economic Growth: Selected East Asian and Western Economies

The Contributions of the Sources of Growth (percent)

	Capital	Labor	Technical Progress
East Asian Economies			
China	92.2	9.2	-1.4
Hong Kong	55.8	16.0	28.2
Indonesia	115.7	11.5	-27.2
Japan	62.9	4.7	32.4
Malaysia	70.9	18.7	10.4
Philippines	99.5	18.0	-17.5
Singapore	60.0	20.9	19.1
South Korea	86.3	12.7	1.0
Taiwan	88.9	8.6	2.5
Thailand	71.9	12.7	15.4
Western Industrialized Economies			
France	37.8	-1.3	63.5
West Germany	43.7	-6.3	62.6
United Kingdom	46.0	3.7	50.3
United States	32.9	26.2	40.9

The Sources of Economic Growth: Selected East Asian and Western Economies



Sources of Economic Growth with Explicit Inclusion of Human Capital

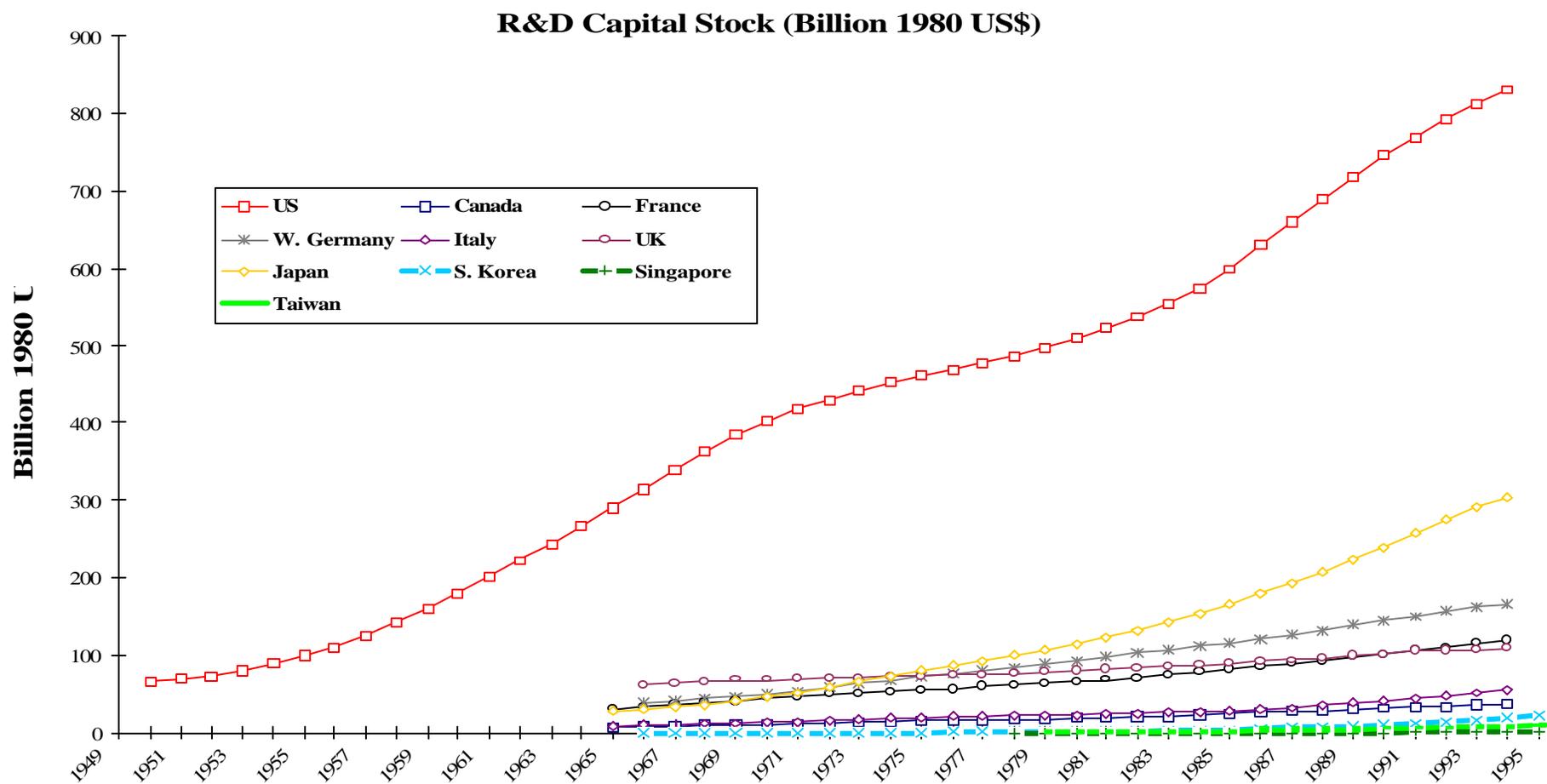
Table 2.3: Relative Contributions of the Sources of Economic Growth (percent)

			Intangible Capital			
	Tangible	Labor	Human	R&D	Technical	Total
	Capital		Capital	Capital	Progress	
Hong Kong	66	22	11	NA	0	11
Singapore	63	25	13	NA	0	13
S. Korea	67	19	14	NA	0	14
Taiwan	75	14	11	NA	0	11
Japan	48	6	3	NA	43	46
Non-Asian G-5	32	7	5	NA	57	62

Simultaneous Capital- and Human Capital- Augmenting Technical Progress

$$\begin{aligned} Y &= A_0(t) F(A_K(t)K, A_H(t)H, A_L(t)L) \\ &= A_0 F(A_K(t)K, A_H H, A_L L) \\ &= A_0 F(A_K K, A_H(t)H, A_L L) \\ &= A_0 F(A(t)K^\alpha H^\beta, A_L L) \end{aligned}$$

R&D Capital



Sources of Economic Growth with Explicit Inclusion of Human and R&D Capital

Table 2.4: Relative Contributions of the Sources of Economic Growth (percent)						
			Intangible Capital			
	Tangible	Labor	Human	R&D	Technical	Total
	Capital		Capital	Capital	Progress	
Korea	62	18	5	15	0	20
Singapore	56	22	5	16	0	21
Taiwan	65	15	4	16	0	20
Japan	37	5	1	8	49	58
Non-Asian G-7	40	4	4	10	43	56

The Sources of Growth: Further Results with Extended Sample--Lau and Park (2000)

Sample (G-5 + 4 NIEs)			
	Tangible Capital	Labor	Technical Progress
Hong Kong	74.46	25.54	0
South Korea	78.2	21.8	0
Singapore	64.8	35.2	0
Taiwan	84.04	15.96	0
Japan	49.9	4.84	45.26
Non-Asian G-5	38.71	2.77	58.52
Sample (G-5 + 9 Asian)			
	Tangible Capital	Labor	Technical Progress
Hong Kong	74.61	25.39	0
South Korea	82.95	17.05	0
Singapore	63.41	36.59	0
Taiwan	86.6	13.4	0
Indonesia	88.79	11.21	0
Malaysia	66.68	33.32	0
Philippines	66.1	33.9	0
Thailand	83.73	16.27	0
China	94.84	5.16	0
Japan	55.01	3.7	41.29
Non-Asian G-5	41.51	1.97	56.53

The Sources of Growth: Further Results with Extended Sample--Lau and Park (2000)

	Tangible Capital	Labor	Human Capital	R&D Capital	Technical Progress
South Korea	63.35	13.61	2.1	20.94	0
Singapore	47.33	21.55	1.37	29.75	0
Taiwan	58.73	11.42	1.32	28.54	0
Japan	44.83	5.2	0.82	14.63	34.52
Non-Asian G-7 Countries	33.71	3.71	1.32	12.53	48.72

Sources of Economic Growth with Breaks in the Rates of Capital Augmentation (1985)

Sample (G-5 + 4 NIEs)				
	Tangible Capital	Labor	Human Capital	Technical Progress
Hong Kong	48.41	27.57	8.16	15.86
South Korea	51.23	24.78	11.59	12.4
Singapore	46.73	32.43	10.86	9.99
Taiwan	58.26	21.61	9.87	10.27
Japan	38.89	9.17	3.24	48.7
Non-Asian G-5	30.13	7.09	5.21	57.57
Sample (G-5 + 9 Asian)				
	Tangible Capital	Labor	Human Capital	Technical Progress
Hong Kong	56.89	23.65	2.51	16.94
South Korea	65.45	18.62	3.84	12.08
Singapore	53.1	33.94	3.23	9.73
Taiwan	71.26	15.61	3.15	9.99
Indonesia	71.2	14.59	9.38	4.83
Malaysia	54.22	32.47	5.12	8.19
Philippines	54.05	37.81	8.15	-0.01
Thailand	60.84	18.06	5.65	15.44
China	83.87	11.92	4.21	0
Japan	49.04	5.23	1.08	44.65
Non-Asian G-5	37.44	3.36	1.7	57.49

Sources of Economic Growth with Breaks: Sub-periods

Sample (G-5 + 9 Asian)				
1960s-1985				
	Tangible Capital	Labor	Human Capital	Technical Progress
Hong Kong	65.34	31.65	3	0
South Korea	74.66	20.58	4.76	0
Singapore	60.09	35.97	3.94	0
Taiwan	79.92	16.43	3.64	0
Indonesia	76.44	12.41	11.15	0
Malaysia	61.14	32.69	6.17	0
Philippines	55.78	35.36	8.86	0
Thailand	70.77	20.92	8.31	0
China	83.05	12.36	4.59	0
Japan	50.84	5.48	1.06	42.62
Non-Asian G-5	39.69	0.88	1.71	57.72
1986-1995				
Hong Kong	40.81	8.61	1.58	49
South Korea	44.96	14.19	1.8	39.06
Singapore	37.35	29.19	1.6	31.86
Taiwan	41.45	12.61	1.4	44.53
Indonesia	60.25	19.09	5.63	15.03
Malaysia	43.3	32.04	3.44	21.22
Philippines	49.71	44.03	6.29	-0.03
Thailand	49.01	14.61	2.51	33.86
China	85.75	10.9	3.35	0
Japan	34.99	3.17	1.19	60.64
Non-Asian G-5	27	14.66	1.63	56.72

The Sources of Economic Growth--Developing Economies in East Asia

- ◆ Different types of measured inputs play different roles at different stages of economic growth
- ◆ Tangible capital accumulation is the most important source of growth in the early stage of economic development
- ◆ But simply accumulating tangible capital is not enough--it must also be efficiently allocated
- ◆ Efficient tangible capital accumulation is the major accomplishment of the East Asian NIEs in the postwar period
- ◆ Intangible capital accumulation becomes important only after a certain level of tangible capital per worker is achieved; it has begun to be significant for some East Asian NIEs such as South Korea and Taiwan

Why is There No Measured Technical Progress in East Asian NIEs? (1)

- ◆ (1) Low level of investment in intangible capital (human capital, R&D capital, knowledge capital and other forms of intangible capital)
 - ◆ The effects of technical progress in these production function studies are essentially captured by the estimated parameters of the time trend, which is supposed to reflect the influence of the changes in the omitted or unmeasured inputs, such as human capital, R&D capital, R&D capital, knowledge capital, land or more generally the natural endowment of resources, and other intangible "investments" such as software and market development.
 - ◆ However, since the developing East Asian economies, until very recently, have invested relatively little in intangible capital (e.g., R&D, especially in basic research), such omitted or unmeasured variables are actually unlikely to be important in them.

Why is There No Measured Technical Progress in East Asian NIEs? (1)

- ◆ Thus the indigenously generated improvements in technology have been quite scarce in developing East Asian economies other than Japan.
- ◆ By contrast, the industrialized economies invest a significant percentage of their GDP in R&D and even greater amounts in innovation and other productivity-enhancing activities.
- ◆ Thus, it should not be surprising that technical progress, or the "residual", is much larger in the industrialized economies than in the developing East Asian economies.
- ◆ Moreover, utilization of other countries' intangible capital is not costless--royalties, license fees, maintenance and service contracts, cross-licensing, full pricing of capital goods
- ◆ Complementary indigenous investment is required, e.g., the new rice varieties of the Green Revolution

Why is There No Measured Technical Progress in East Asian NIEs? (2)

- ◆ (2) The distribution of "Innovation Rents" (quite properly) favors the innovators and investors
 - ◆ The industries in the developing East Asian economies typically employ mature technologies with limited innovation possibilities but the capital goods and technology for which, mostly imported, have been fully priced (i.e., the acquisition as well as royalty costs fully reflect the possible efficiency gains and the amortization of R&D and other developmental costs) in the international market, so that there may be little or no net increase in value added, over and above the normal returns to the factor inputs. In other words, the "innovation rents" have been largely captured by the inventors, manufacturers and distributors of the new equipment or intermediate inputs in the industrialized economies in markets that are only very imperfectly competitive.

Why is There No Measured Technical Progress in East Asian NIEs? (2)

- ◆ The "rents" can also take the form of royalties and licensing fees paid to the foreign technology licensors by the developing East Asian economies, or through transfer pricing by foreign direct investors, reducing correspondingly the domestic part of the real value-added.
- ◆ Monopolistic pricing of capital equipment, technology licenses and critical components (e.g., systems integration capability for aircraft manufacturers; plastic lens for cameras), which limit the value added by manufacturers/assemblers in developing East Asian economies, e.g., notebook computers
- ◆ Monopsonistic pricing for OEM manufacturers--the benefits of learning-by-doing on the part of the OEM manufacturers accrue mostly to the owners of brand names, designs, and marketing organizations
- ◆ Consequently, even if a new technology were adopted, its effect might not be reflected in the form of a higher real value-added, holding measured factor inputs constant.

Why is There No Measured Technical Progress in East Asian NIEs? (3)

- ◆ (3) Problems of Measurement of Capital
 - ◆ Fixed investment in equipment in industrialized economies are typically measured, at factor costs, net of the intangible inputs required, whereas fixed investment in equipment in developing economies, being mostly imported from developing economies, are measured inclusive of intangible inputs, returns to intellectual capital, monopoly rents, and turnkey installation costs
 - ◆ E.g., the fixed investment in equipment of the same semiconductor fabrication plant may well be higher in a developing economy as compared to an industrialized economy
 - ◆ A simple way to understand this point is that capital equipment in industrialized economies may be sold unbundled with the “soft” costs (including software), whereas capital equipment in developing economies are typically sold bundled with the “soft” costs

Why is There No Measured Technical Progress in East Asian NIEs? (4)

- ◆ (4) Aggregation
 - ◆ It is possible, in fact likely, that there may have been positive technical progress in certain efficient (tradable) sectors and industries in the developing East Asian economies.
 - ◆ However, this may be largely offset by rising inefficiency in certain other industries, especially those in the nontradable sectors.
 - ◆ The economy as a whole may exhibit no measured technical progress.
 - ◆ Rising inefficiency can persist only in protected markets under monopolistic or oligopolistic conditions. Thus, technical progress at the microeconomic or industrial level may be nullified by the inefficiency caused by the lack of competition in the domestic market.

Why is There No Measured Technical Progress in East Asian NIEs? (5)

- ◆ (5) Economies of Scale
 - ◆ There are significant measured economies of scale, in all inputs taken together, for the developing East Asian economies. For economies in which both output and inputs have been growing, economies of scale and technical progress provide alternative explanations for the ability of producing more than doubled the output by merely doubling the inputs.
 - ◆ We have found is that as far as the developing East Asian economies are concerned, it is economies of scale, rather than technical progress, that have contributed to the outstanding economic performance.

Why is There No Measured Technical Progress in East Asian NIEs? (6)

- ◆ (6) Omission of the value of the quality of life
 - ◆ It is also possible that in some East Asian economies, such as Singapore, some public infrastructural investments have been made to improve the quality of life, e.g., cleaner air and water, less traffic congestion, etc., rather than to increase real GNP directly. Since these non-pecuniary benefits are not reflected in the measurement of the output (real GNP) but are included in the measurement of inputs (tangible capital), it may appear, from considering the growth of output alone, that tangible capital has not been employed efficiently, and that the efficiency of its use has not improved over time.

The Non-Uniqueness of the Postwar East Asian Experience

- ◆ Abramovitz and David (1973): U. S. economic growth in the 19th Century can be largely attributed to the growth of inputs
- ◆ Tostlebee (1956): The growth in U.S. agriculture in the 19th Century can be attributed to the growth of inputs, with a negative rate of growth of total factor productivity
- ◆ Hayami and Ogasawara (1999): Japanese economic growth between the Meiji Restoration and the World War I can be largely attributed to the growth of inputs, principally capital
- ◆ Godo and Hayami (1999): Confirm the lack of technical progress in prewar Japan (with human capital included)

A Brief History of the East Asian Currency Crisis

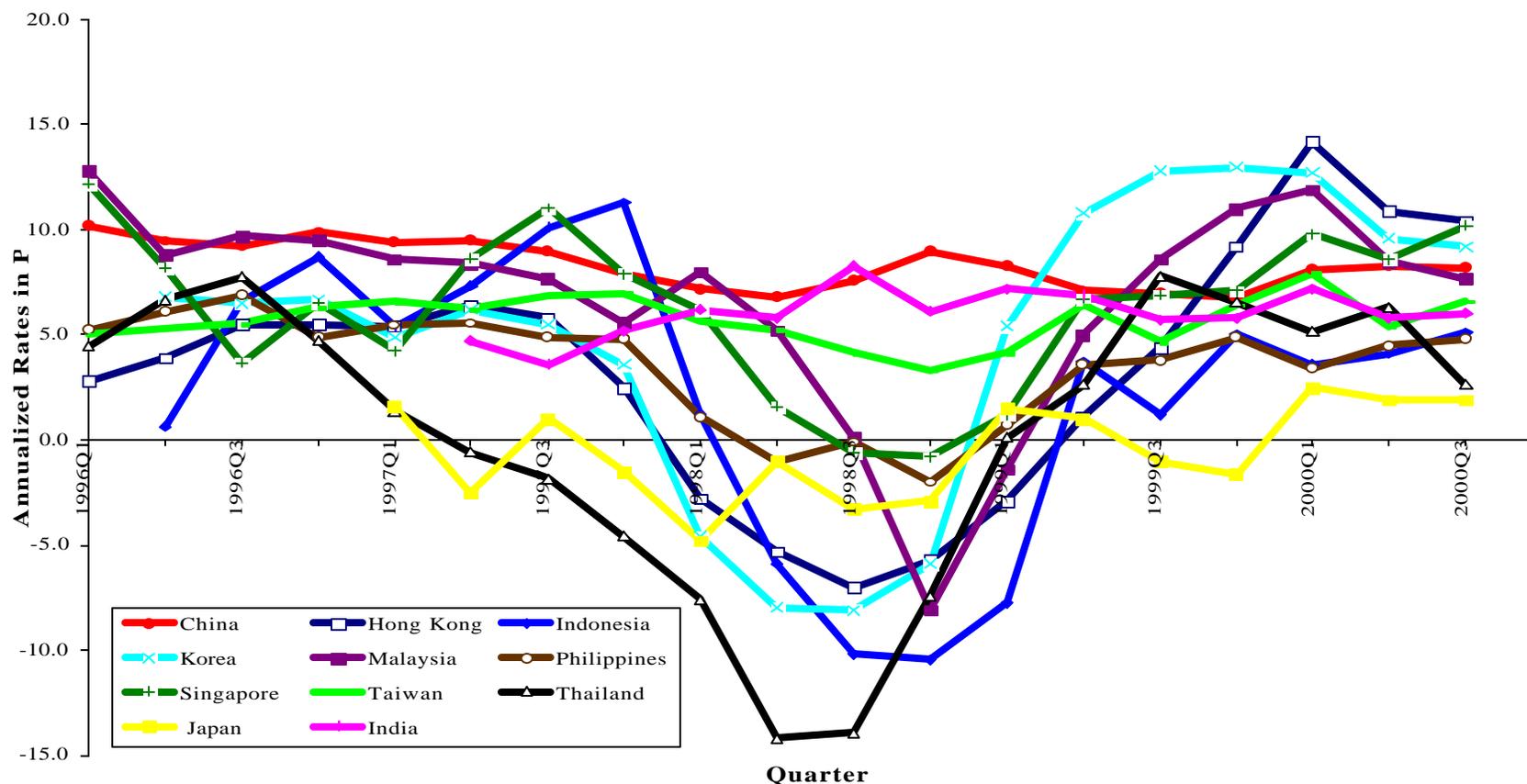
- ◆ The East Asian currency crisis began in Thailand in late June of 1997 and essentially stabilized in the last quarter of 1998
- ◆ While the simultaneous downturns in the East Asian economies exacerbated the problems of one another, leading to exceptionally sharp declines in real GDPs, the simultaneous upturns have also allowed the recovery to be extraordinarily and unexpectedly rapid, with the rising import demands of each economy feeding into rising export demands of its trading partners
- ◆ For most of the East Asian economies, the bottom was reached (0% rate of growth of real GDP) in 2Q/1999; by mid-1999 the real GDPs of all of the affected economies began to show positive rates of growth
- ◆ With the exception of two currencies, the Chinese Yuan and the Hong Kong Dollar, all other East Asian currencies lost significant value vis-à-vis the U.S. Dollar, albeit by varying degrees, and did not recover to pre-crisis levels

The Recovery Followed the Stabilization of the External Environment

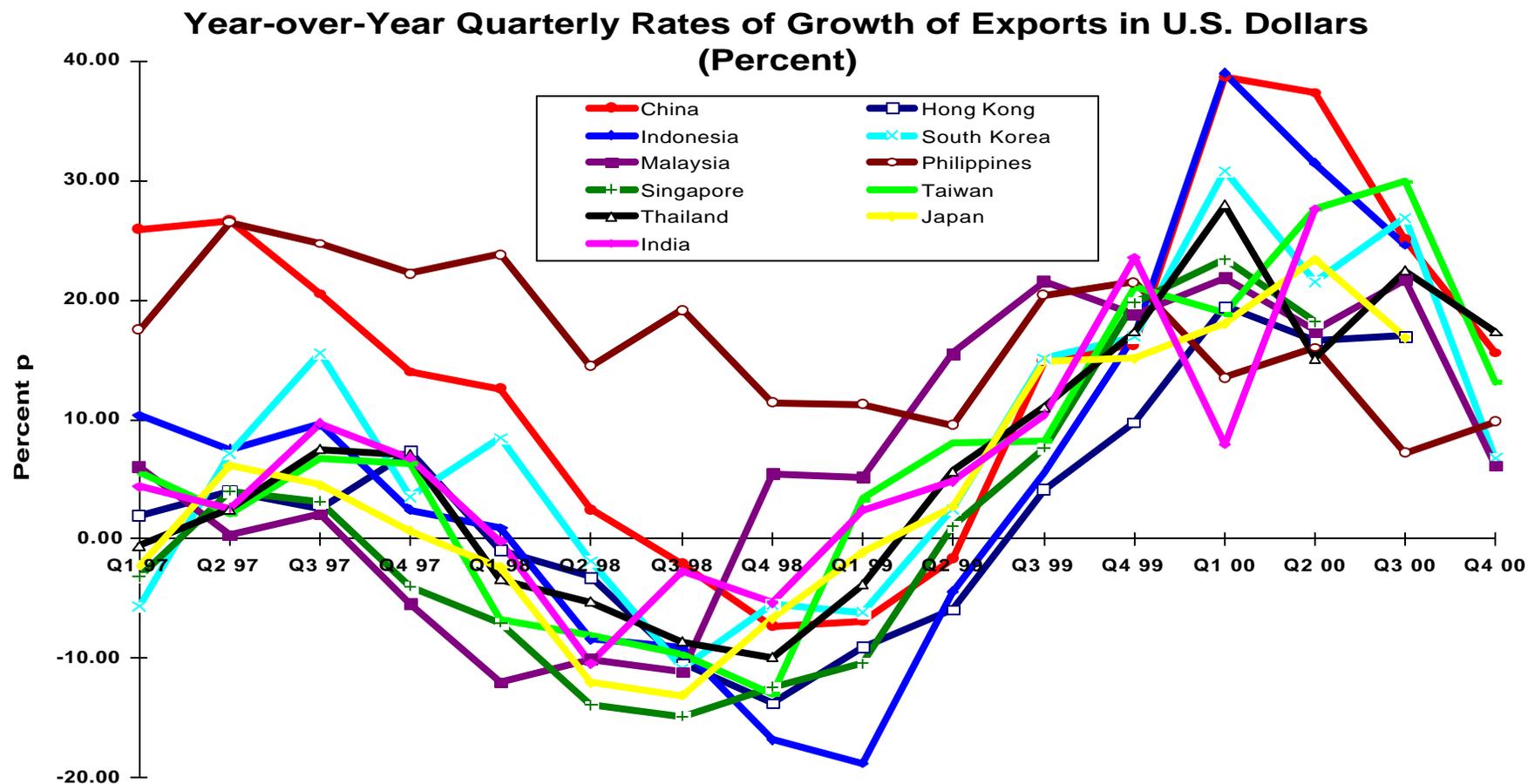
- ◆ After 3Q/1998, there were no more speculative attacks on the Thai Baht or any other East Asian currency--the hedge funds had a “credit crunch” due to losses, net redemption and curtailment of available credit lines in the aftermath of the collapse of the Russian ruble and the “Long-Term Capital Management” crisis.
- ◆ Once the exchange rates stabilized at their new (lower) levels, the rates of interest began to fall to more reasonable levels that permit normal real economic activities to resume.
- ◆ The U.S. economy was exceptionally strong throughout period of the East Asian currency crisis (until 4Q/2000), providing a market for East Asian exports and compensating for the very slow recovery of the Japanese economy.

The Rates of Growth of Real GDP Have All Turned Significantly Positive and Remained So

Quarterly Rates of Growth of Real GDP, Year-over-Year, Selected East Asian Economies

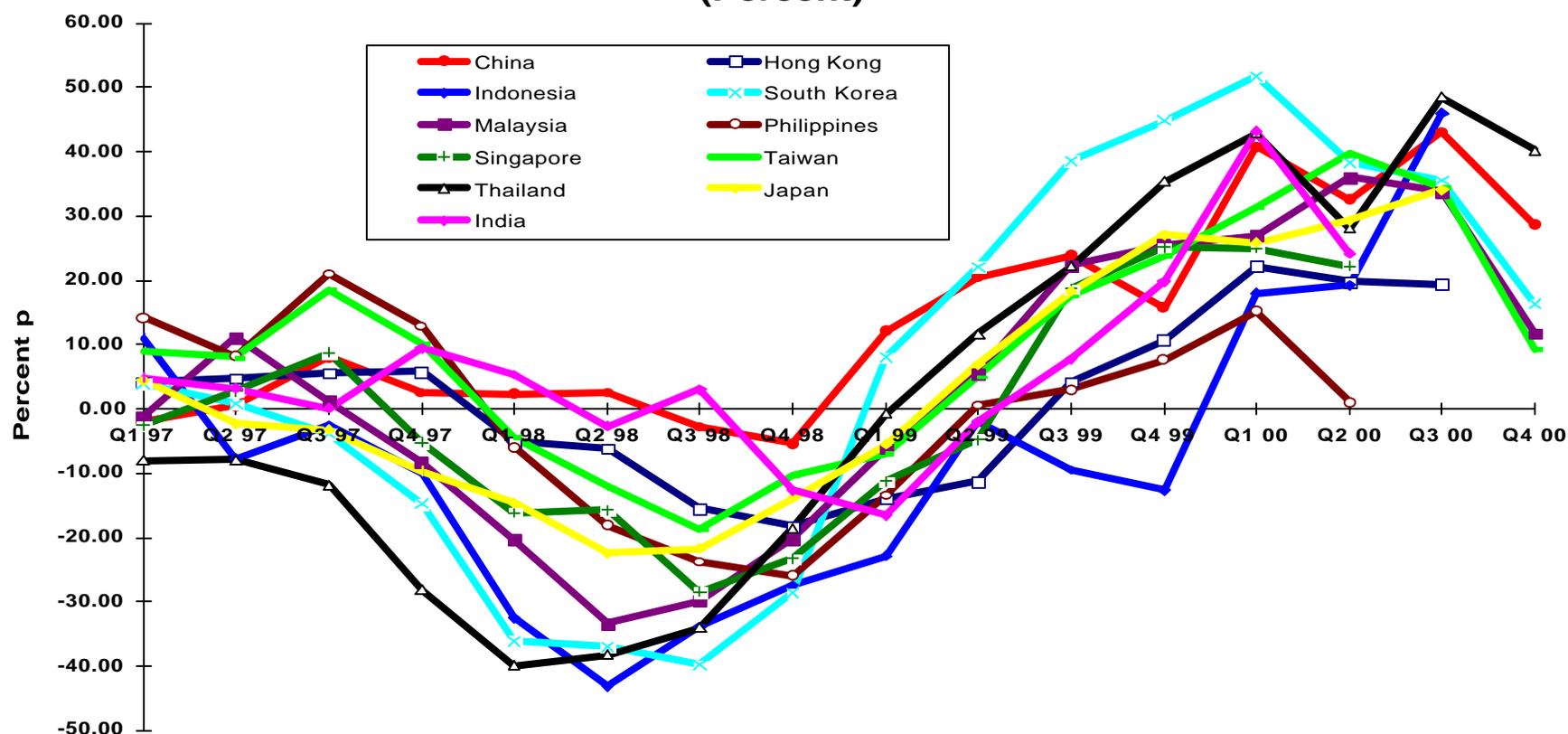


Quarterly Rates of Growth of Exports



Quarterly Rates of Growth of Imports

Year-over-Year Quarterly Rates of Growth of Imports in U.S. Dollars
(Percent)



The Effects of the East Asian Currency Crisis

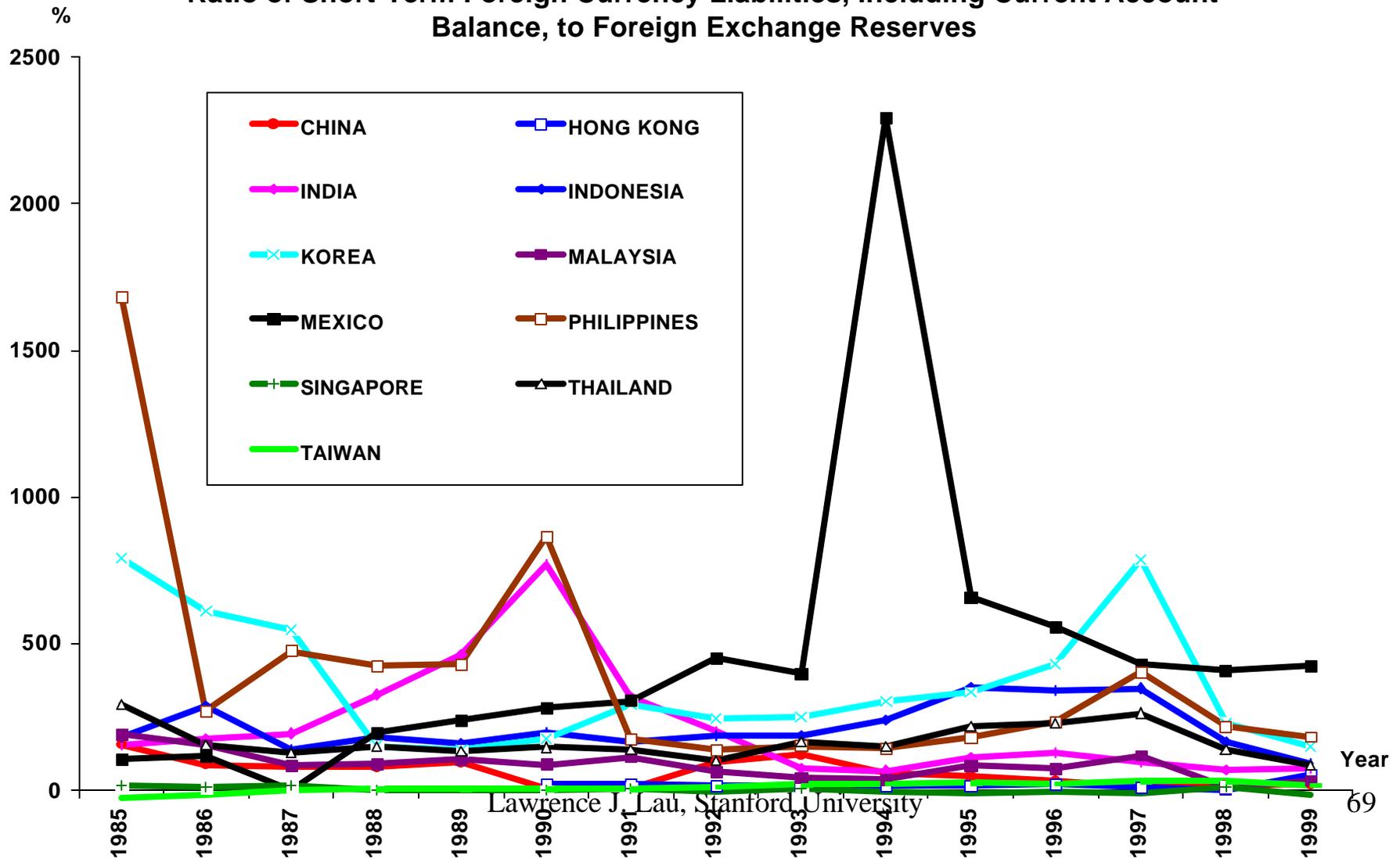
- ◆ The East Asian currency crisis was a currency crisis inducing a financial crisis
- ◆ The problem was triggered by perceived insufficient liquidity in terms of foreign exchange reserves
- ◆ Unexpected outflow of short-term capital (including non-renewal of foreign-currency denominated loans) caused the exchange rate to plunge
- ◆ A “bank run” on foreign exchange ensued
- ◆ Financial insolvency caused by the resulting revaluation of the foreign-currency denominated debt and the rise in the rate of interest (due to expected further devaluation and increased volatility of the exchange rate)
- ◆ Domino effects of insolvency and bankruptcy, magnified by high leverage (that is, debt to equity ratio), leading to systemic failure

Ratio of Short-Term Foreign-Currency Liabilities to Foreign Exchange Reserves

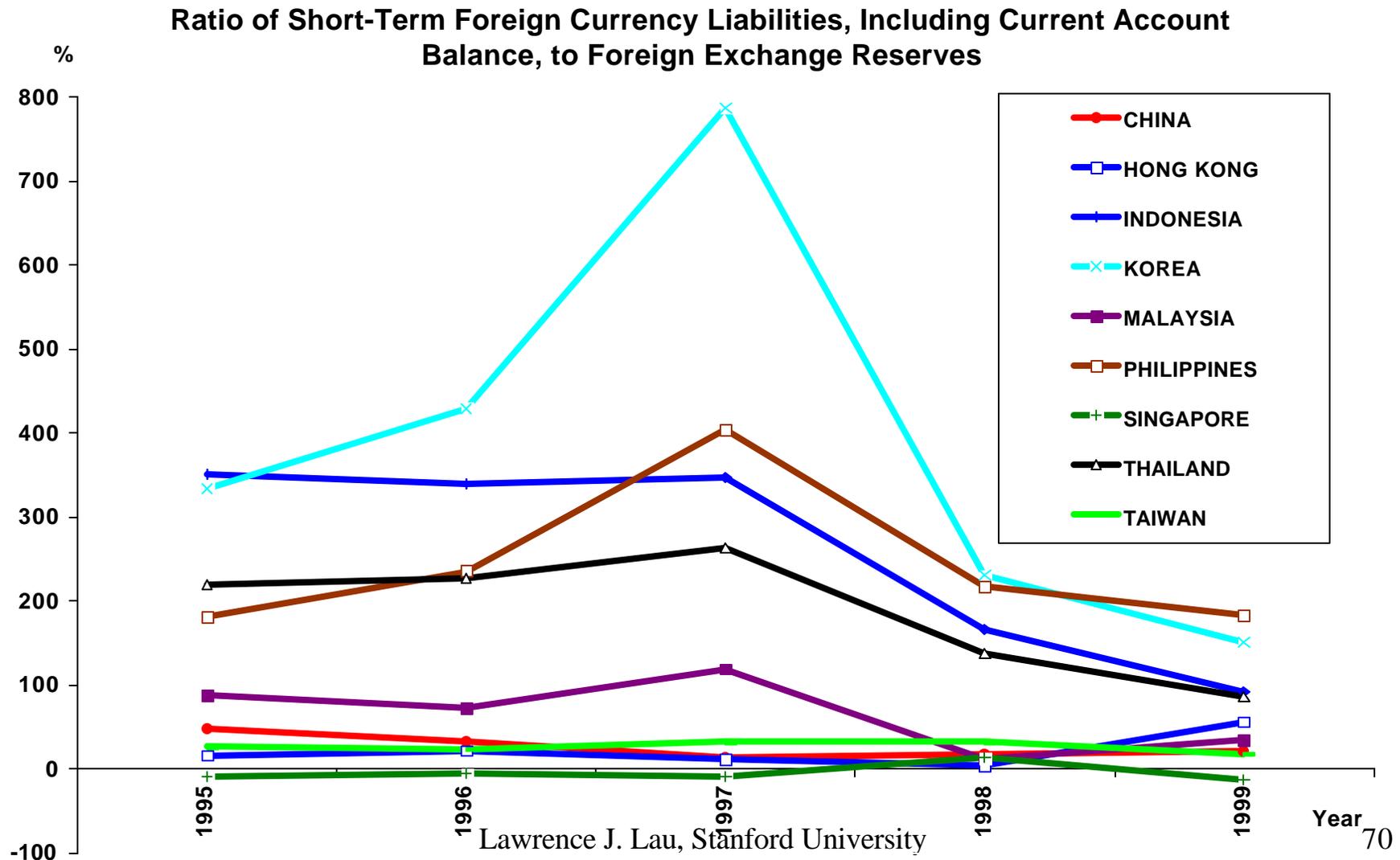
- ◆ The potential short-term foreign exchange liabilities, that is, the foreign exchange that can be withdrawn from the country with little or no prior notice, consists of the stock of foreign portfolio investment and short-term foreign loans
- ◆ The stock of foreign portfolio investment can be estimated by cumulating past foreign portfolio investments; however, the existing stock may be under- or over-estimated by this procedure because of the possibilities of gains and losses from these investments
- ◆ To these may be added the current account deficit of the current period
- ◆ If foreign exchange reserves are low relative to these potential demands for withdrawals of foreign exchange, the currency may be vulnerable to a run

Ratio of Short-Term Liabilities, Including Current Account Balance, to Reserves

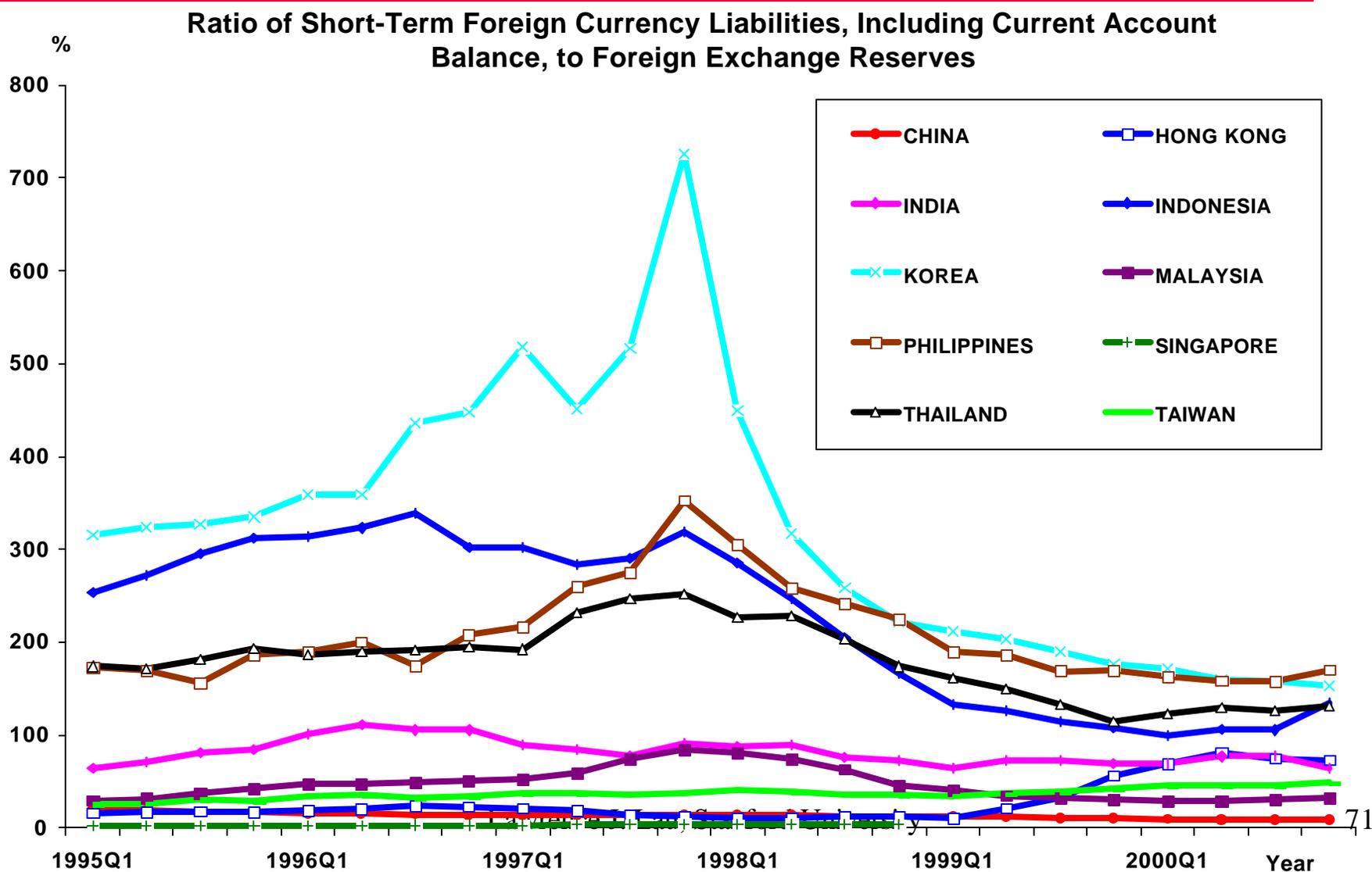
Ratio of Short-Term Foreign Currency Liabilities, Including Current Account Balance, to Foreign Exchange Reserves



Ratio of Short-Term Liabilities, Including Current Account Balance, to Reserves



Ratio of Short-Term Liabilities, Including Current Account Balance, to Reserves



Is East Asian Economic Growth Sustainable? Was It a Bubble?

- ◆ Past economic growth neither a miracle nor a mere bubble
 - ◆ Economic growth experience replicated in different East Asian economies
 - ◆ Sustained economic growth over decades
 - ◆ Recent crisis due to many factors, of which “irrational exuberance” is only one
 - ◆ Economic fundamentals remain sound--high savings rates, investment in human capital, and more recently in R&D capital, entrepreneurship, market orientation
- ◆ Past economic growth input (especially capital)-driven rather than technical progress-driven--it is attributable to growth in inputs, particularly the efficient and rapid accumulation of tangible capital

Is East Asian Economic Growth Sustainable?

Paul Krugman's Worry

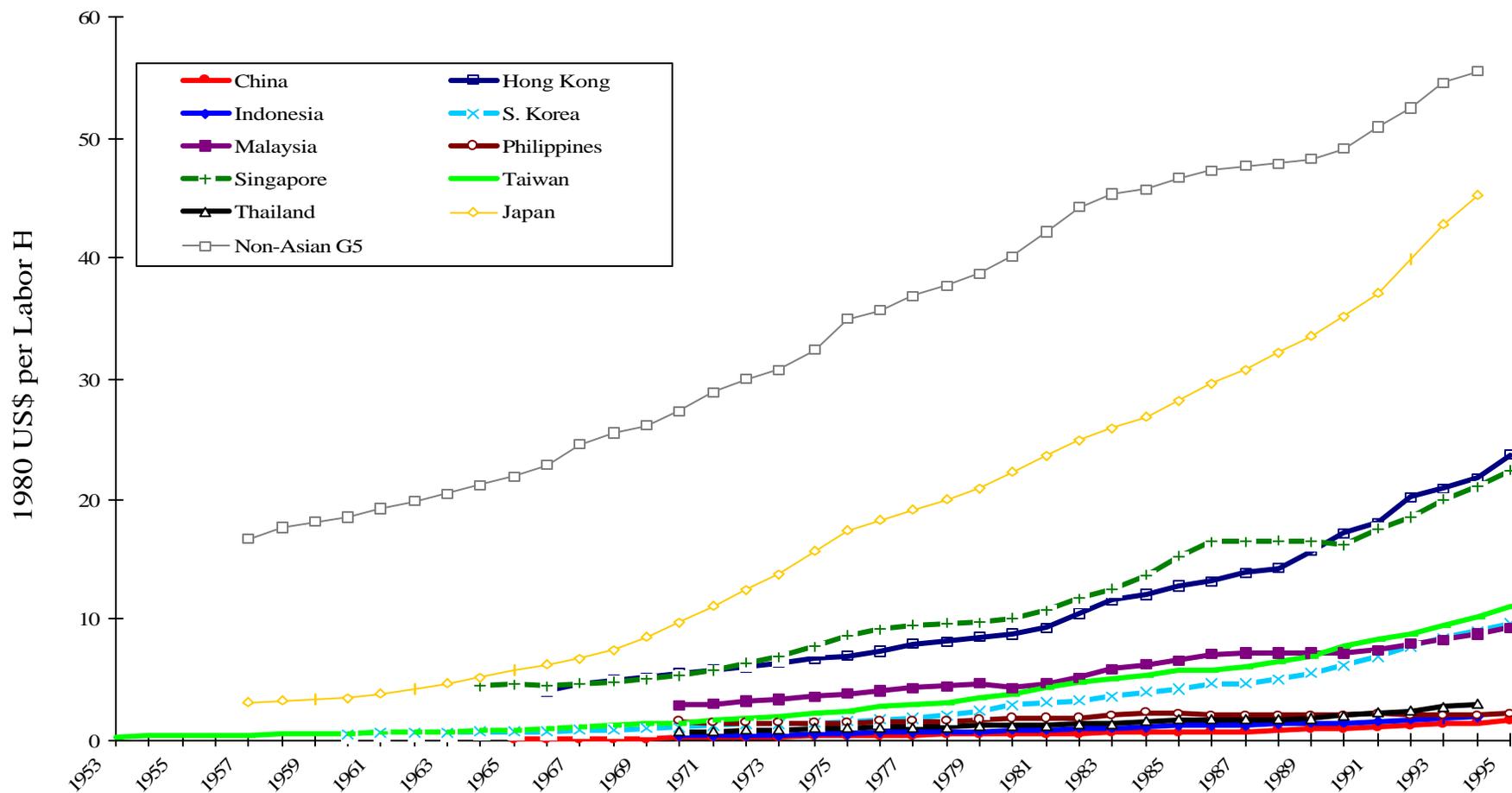
- ◆ Since the major source of postwar East Asian economic growth is found to be the growth of tangible capital (Kim and Lau, 1992), given the diminishing marginal productivity of tangible capital, as more and more tangible capital is accumulated, each additional unit of tangible capital will be less productive than the unit before it. Eventually economic growth must slow down and then stop altogether.
- ◆ The former Soviet Union was used as an example where a great deal of tangible capital was accumulated but failed to be productive; the Chinese economy prior to its economic reform in 1979 is another possible example

Is East Asian Economic Growth Sustainable?

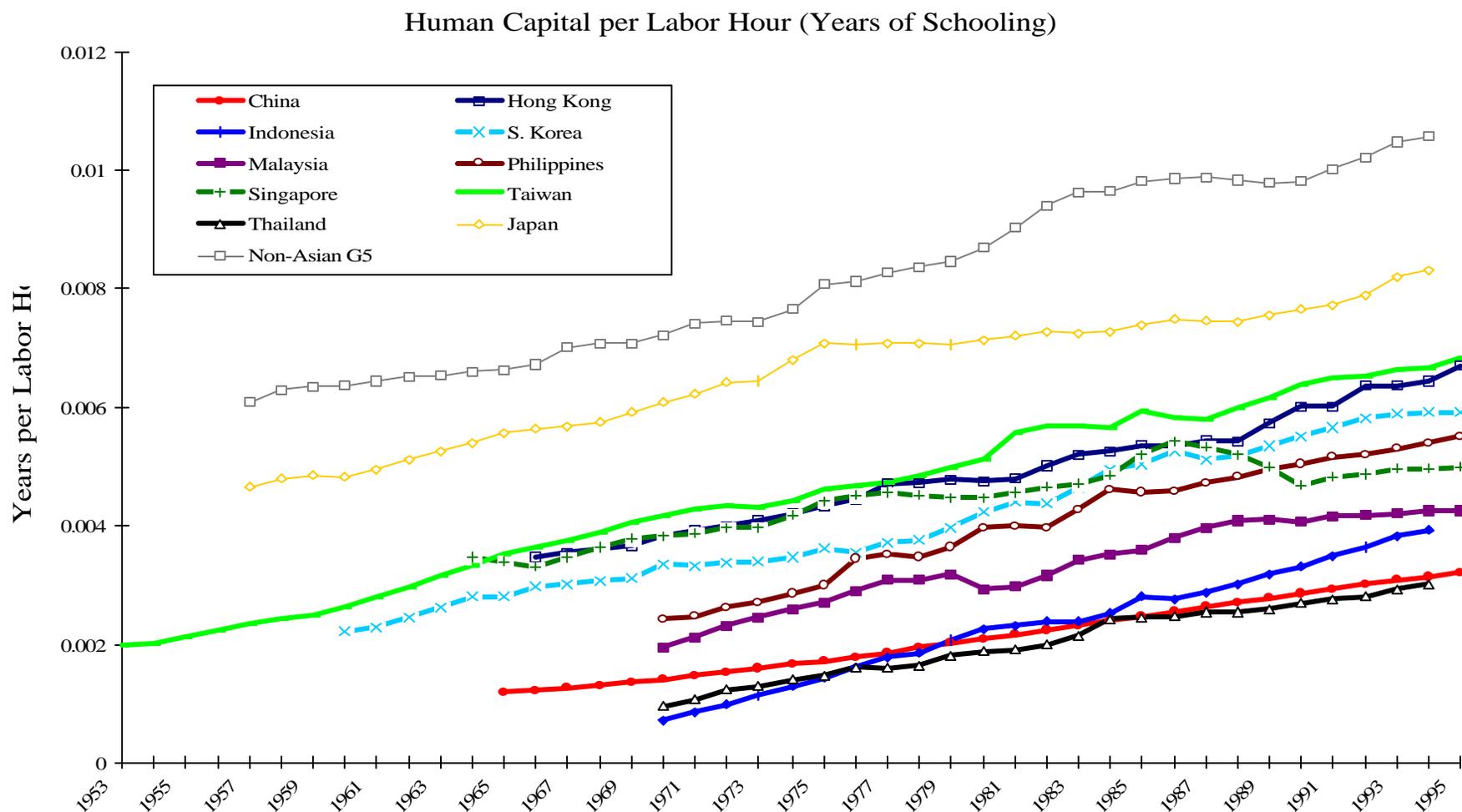
- ◆ Considerable room for continuation of rapid tangible inputs-driven economic growth in the future--tangible capital per unit labor in East Asian economies, with the exception of Japan, still lags significantly behind the developed economies
- ◆ Intangible capital per unit labor, e.g., R&D capital, lags even further behind, offering additional opportunities for improvement
- ◆ Investment in intangible capital, e.g., R&D investments, has begun to increase in the East Asian NIEs
- ◆ Because of its complementarity with tangible capital, investment in intangible capital can enhance the productivity of tangible capital and counteract the diminishing marginal productivity of tangible capital
 - ◆ JAPAN HAS SHOWN HOW THIS CAN BE DONE!

Capital Intensity

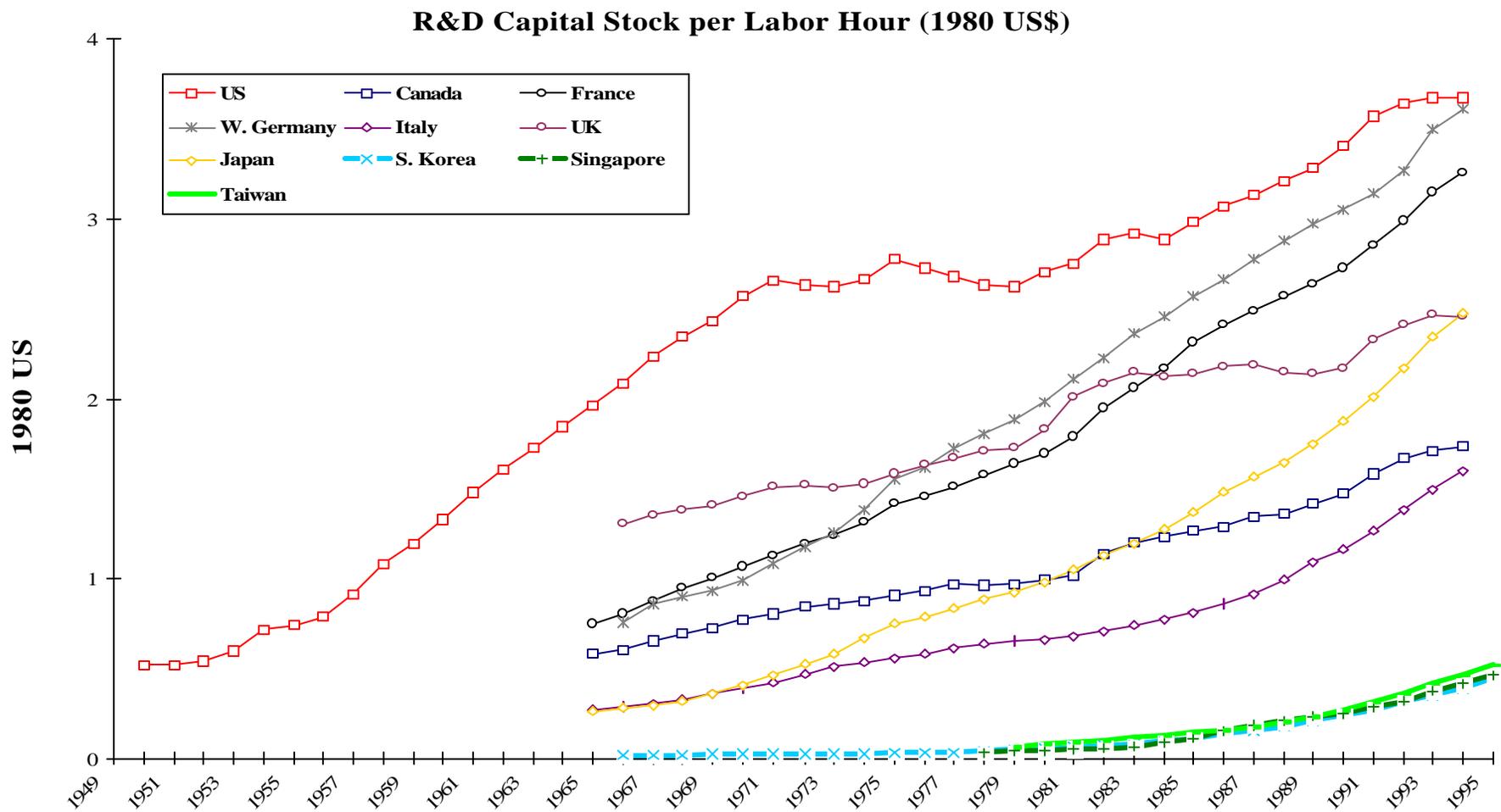
Tangible Capital Stock per Labor Hour (1980 U.S.\$)



Human Capital per Unit Labor



R&D Capital Stock per Unit Labor



Where Is the “Miracle”?

- ◆ Achievement of a high savings rate
- ◆ Translating domestic savings into investments--the role of self-fulfilling expectations
- ◆ Creating and maintaining an environment in which investments are productive
 - ◆ Export orientation
 - ◆ Private enterprise
- ◆ Philippines as a counter-example

The Savings Rate and Real Output per Capita: Chinese Societies

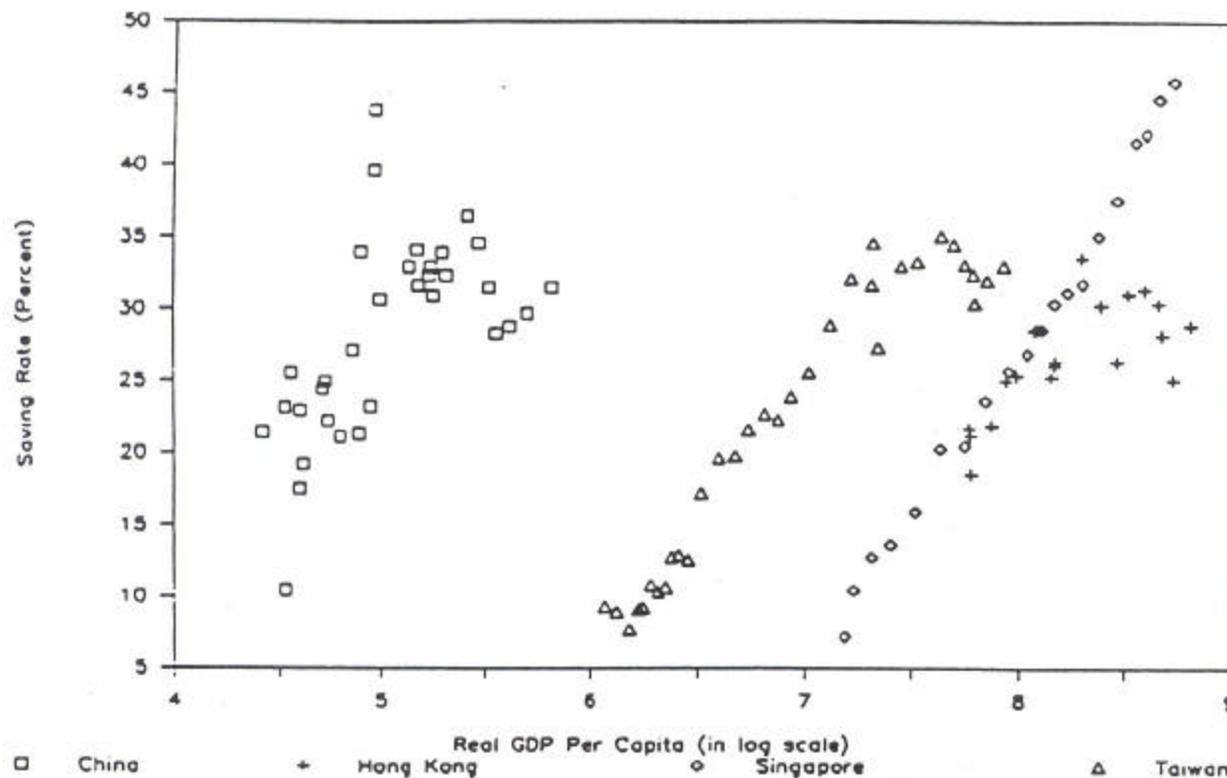
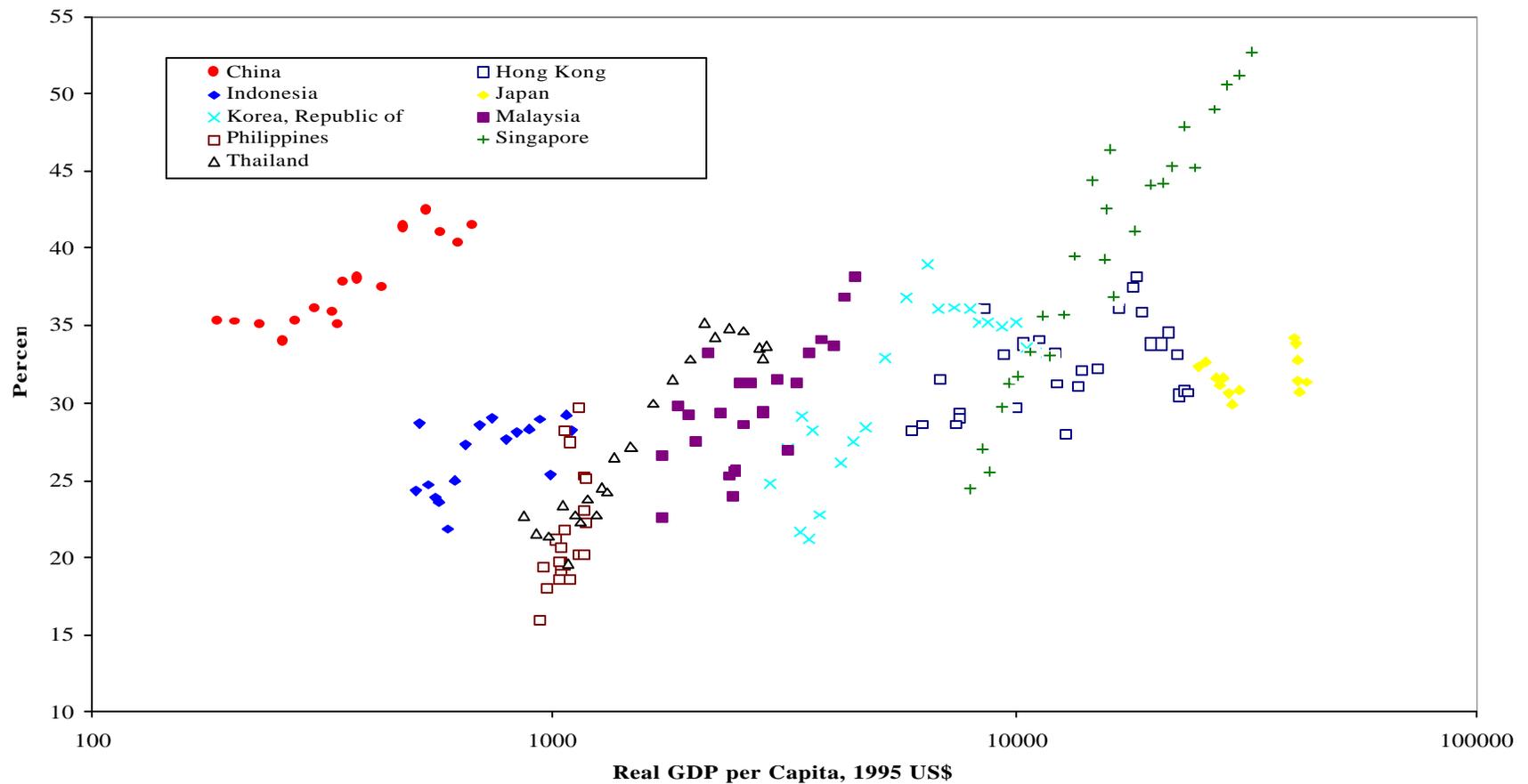


Fig. 2. Saving rates vs. real GDP *per capita*.

- Notes:
1. For China, national income is used as the denominator instead of gross domestic product (GDP).
 2. The periods covered by the data are respectively 1952–84 for China, 1966–84 for Hong Kong, 1966–84 for Singapore and 1952–84 for Taiwan.
 3. The real GDP per capita is measured on a logarithmic scale.

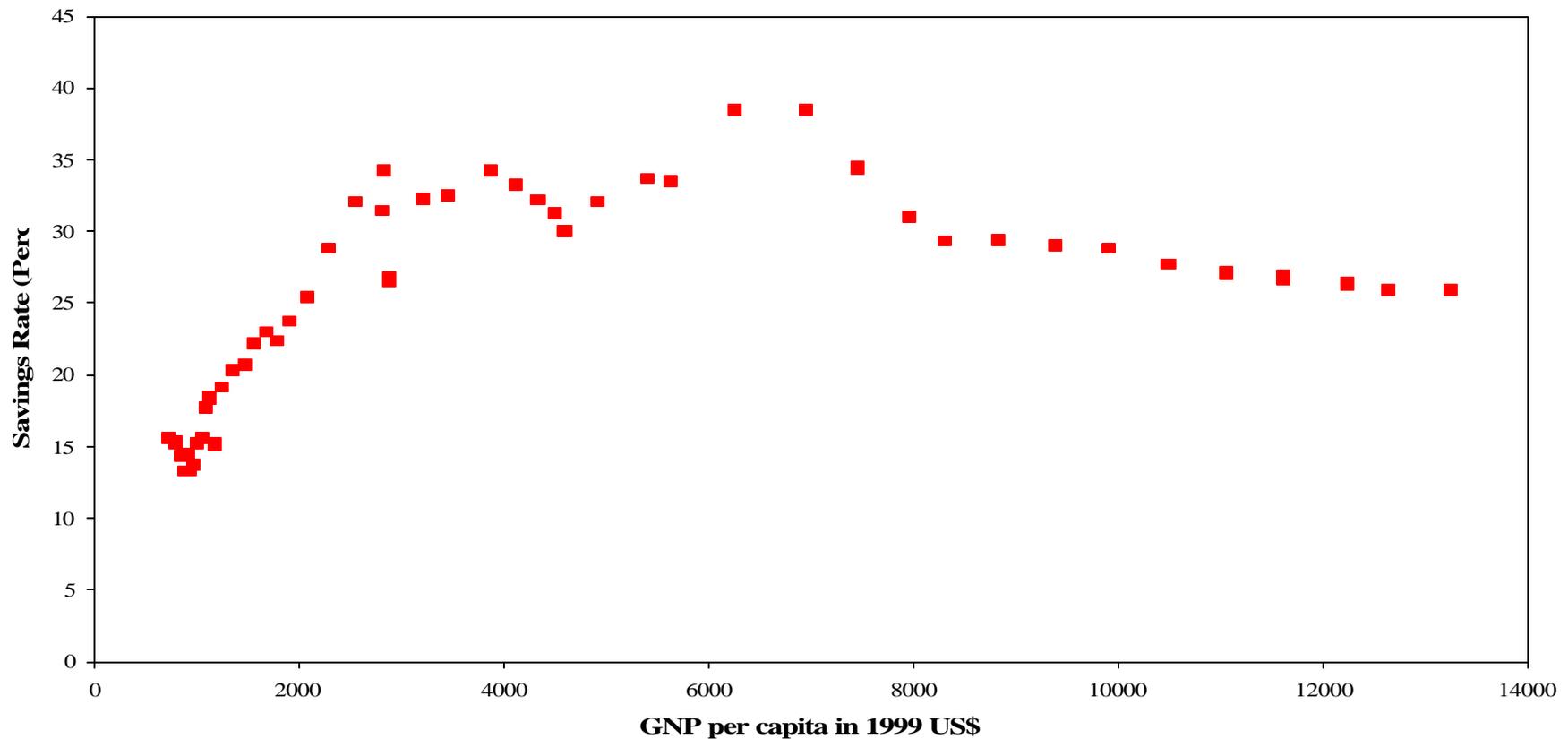
The Savings Rate and Real Output per Capita: East Asian Economies

National Savings Rate and Real GNP per Capita



The Savings Rate and Real Output per Capita: Taiwan

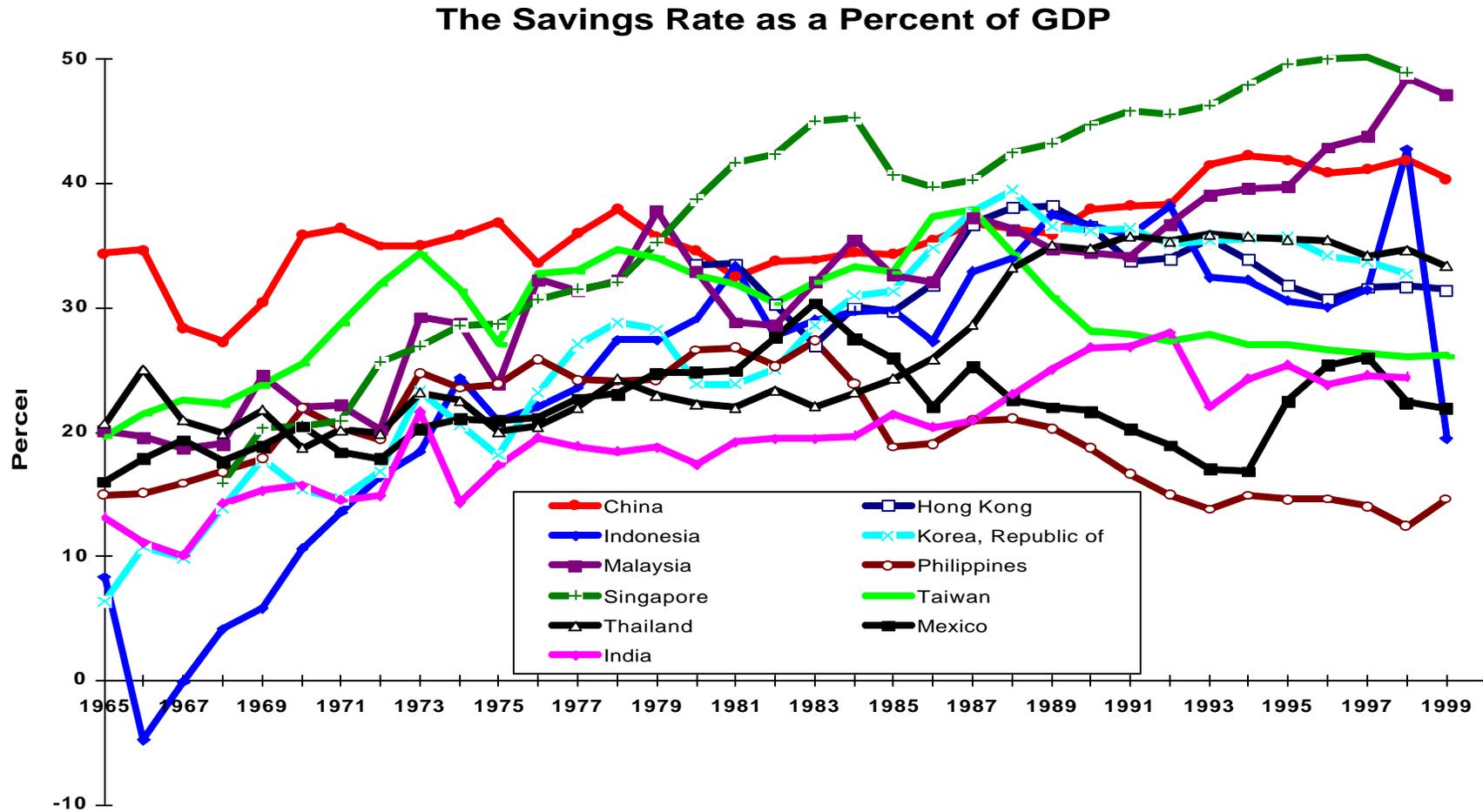
Savings Rate versus Real GNP per Capita



The Savings Rate and Real Output per Capita

- ◆ Note that the developing countries typically have very low aggregate savings rates at low real GNP per capita
- ◆ Aggregate savings rates tend to rise rapidly with rising real GNP per capita
- ◆ After a certain level of real GNP per capita is reached, the savings rates tend to stabilize and remain approximately constant
- ◆ The slopes of the aggregate savings rate with respect to real GNP per capita during the rapidly rising phase appear to be quite similar

Savings Rates as a Percent of GDP of Selected East Asian Countries



How is Efficiency Achieved in the East Asian NIEs?

- ◆ Market-directed allocation of new investment, aided by export orientation, promotes efficiency
- ◆ Private enterprises have the incentives for prompt self-correction

Is East Asian Economic Growth Sustainable?

- ◆ The attractiveness of investment in intangible capital depends on the protection of intellectual property rights, which in turn depends on whether a country is a producer of intellectual property--some of the East Asian economies, e.g., Hong Kong, South Korea, Singapore and Taiwan are ahead of other East Asian economies with the possible exception of Japan on this score

Prospects for Future Economic Growth Remain Good

- ◆ Prospects for continued economic growth in East Asia remain good—room for continuation of tangible-inputs-driven growth
- ◆ Fundamentals are sound—high savings rates, priority for education, private-enterprise market economy
- ◆ The experience of developed economies, especially that of Japan, suggests that investment in R&D capital and other forms of intangible capital has high returns
- ◆ Because of its complementarity with tangible capital, investment in intangible capital can retard the decline in the marginal productivity of tangible capital and counteract the “Krugman effect”
- ◆ There is also evidence of positive technical progress in the more recent period
- ◆ The people of East Asia are entrepreneurial, hard-working, and thrifty--all they need is a good, market-friendly, predictable and stable environment