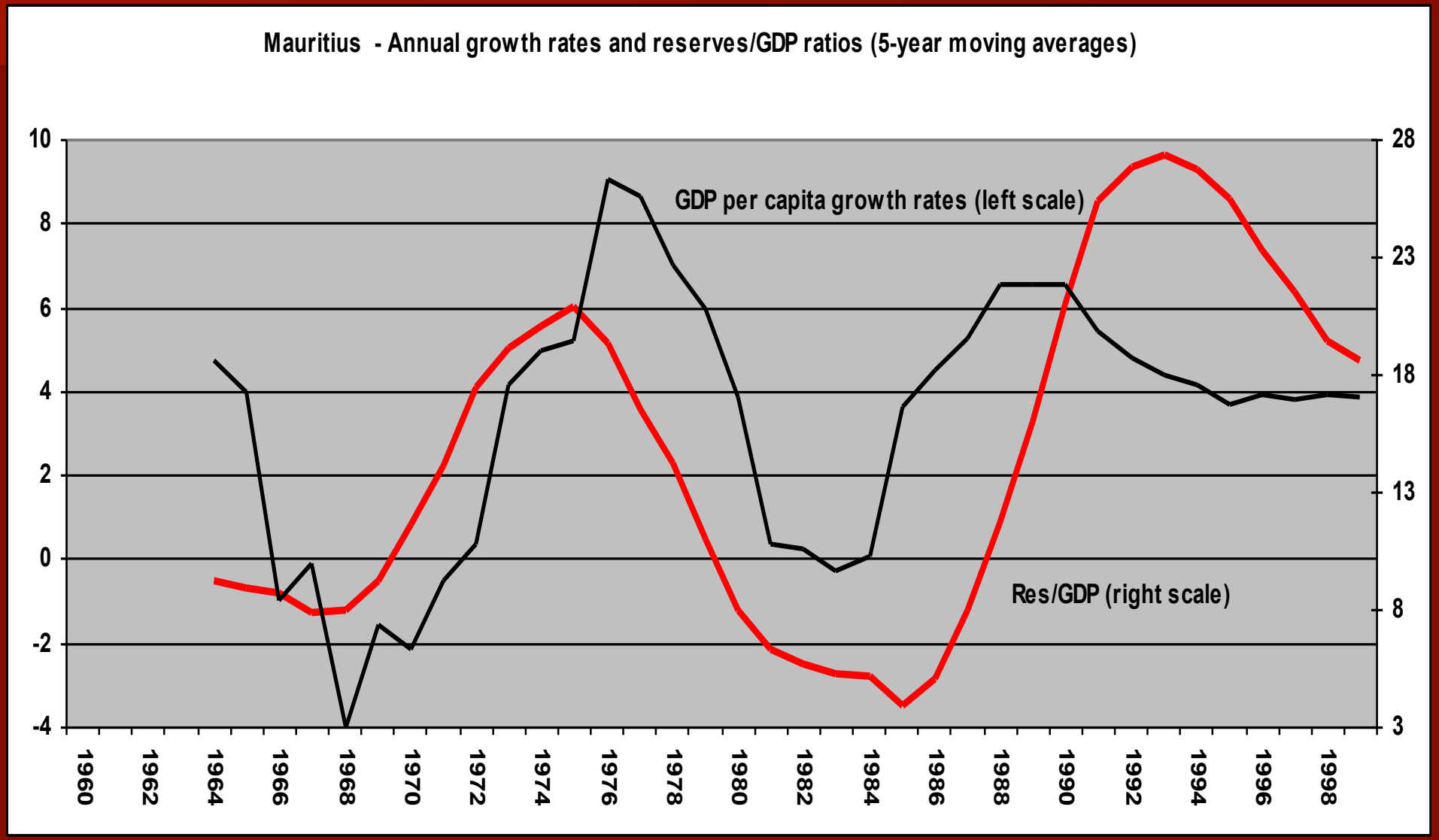
ACCUMULATION OF FOREX AND LONG TERM ECONOMIC GROWTH

Victor Polterovich, Vladimir Popov

In many countries accumulation of FOREX goes hand in hand with economic growth



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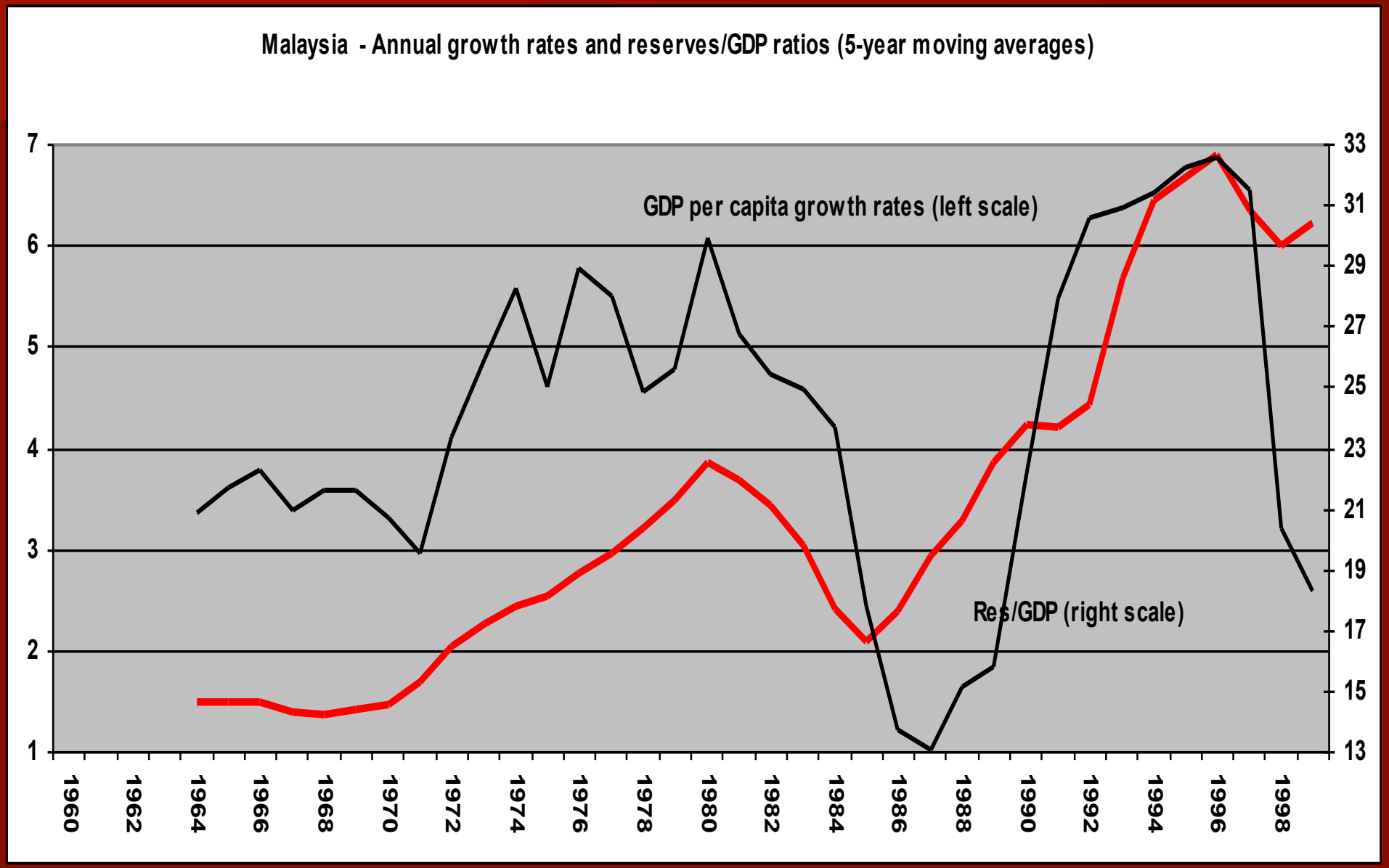

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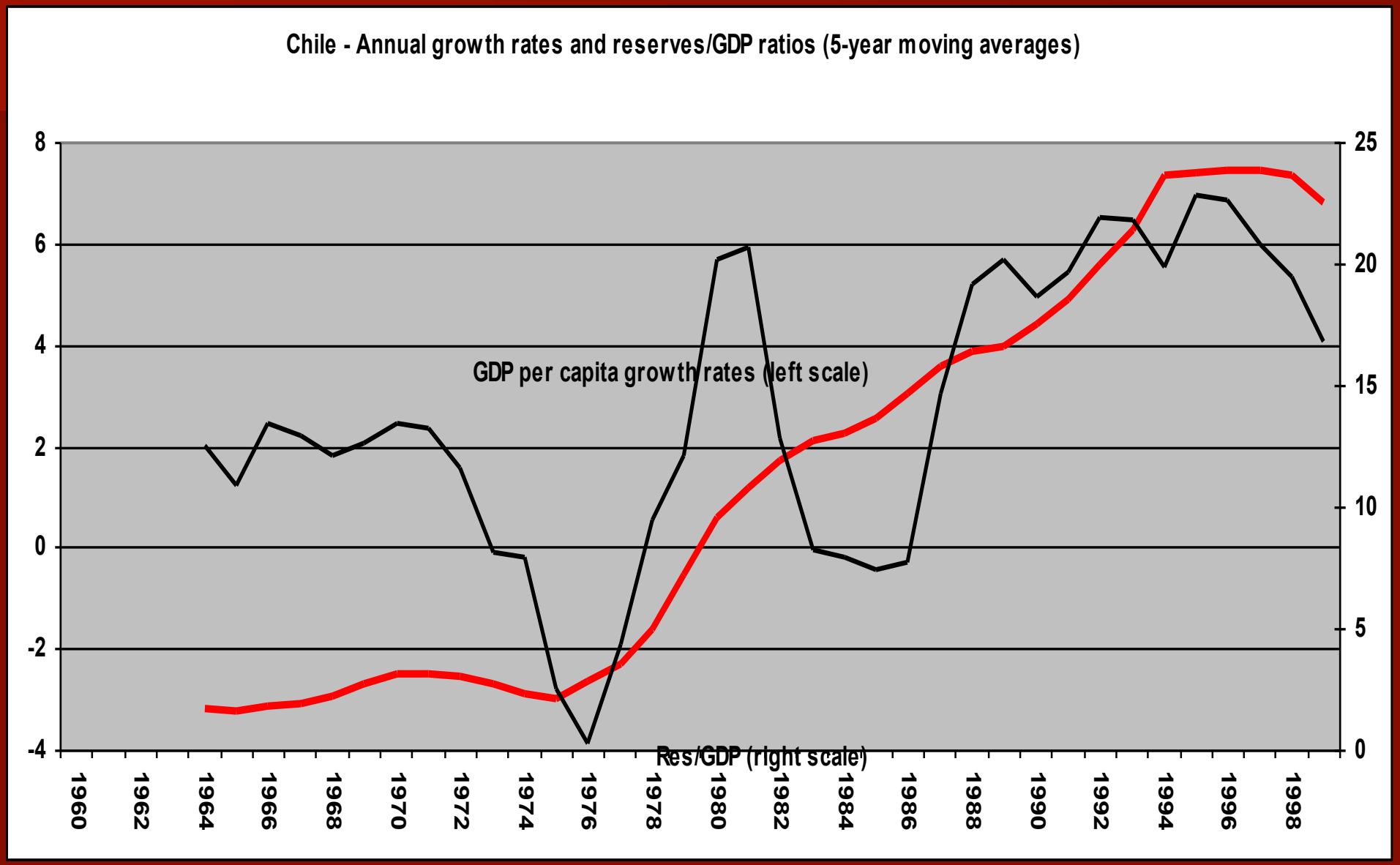

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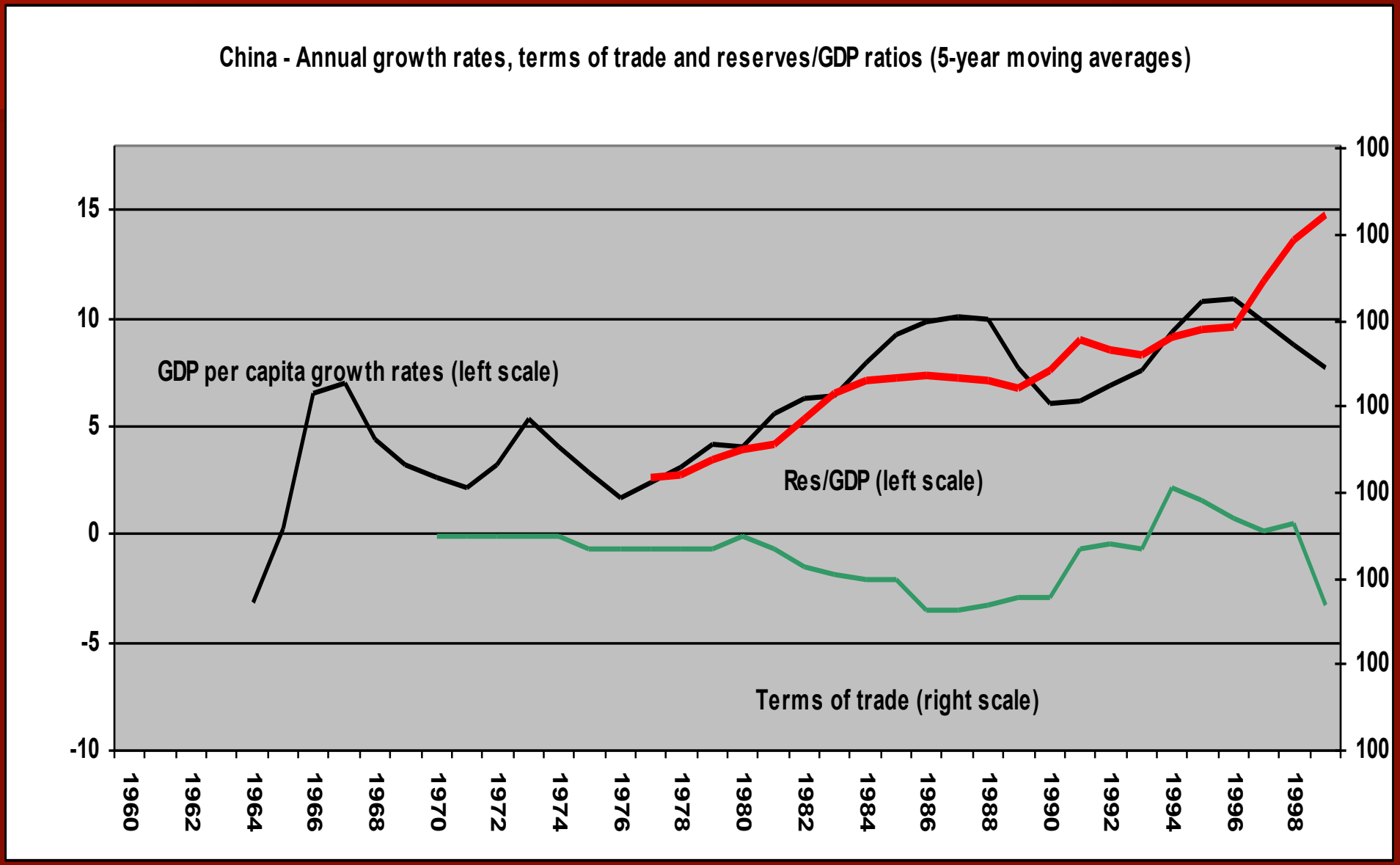

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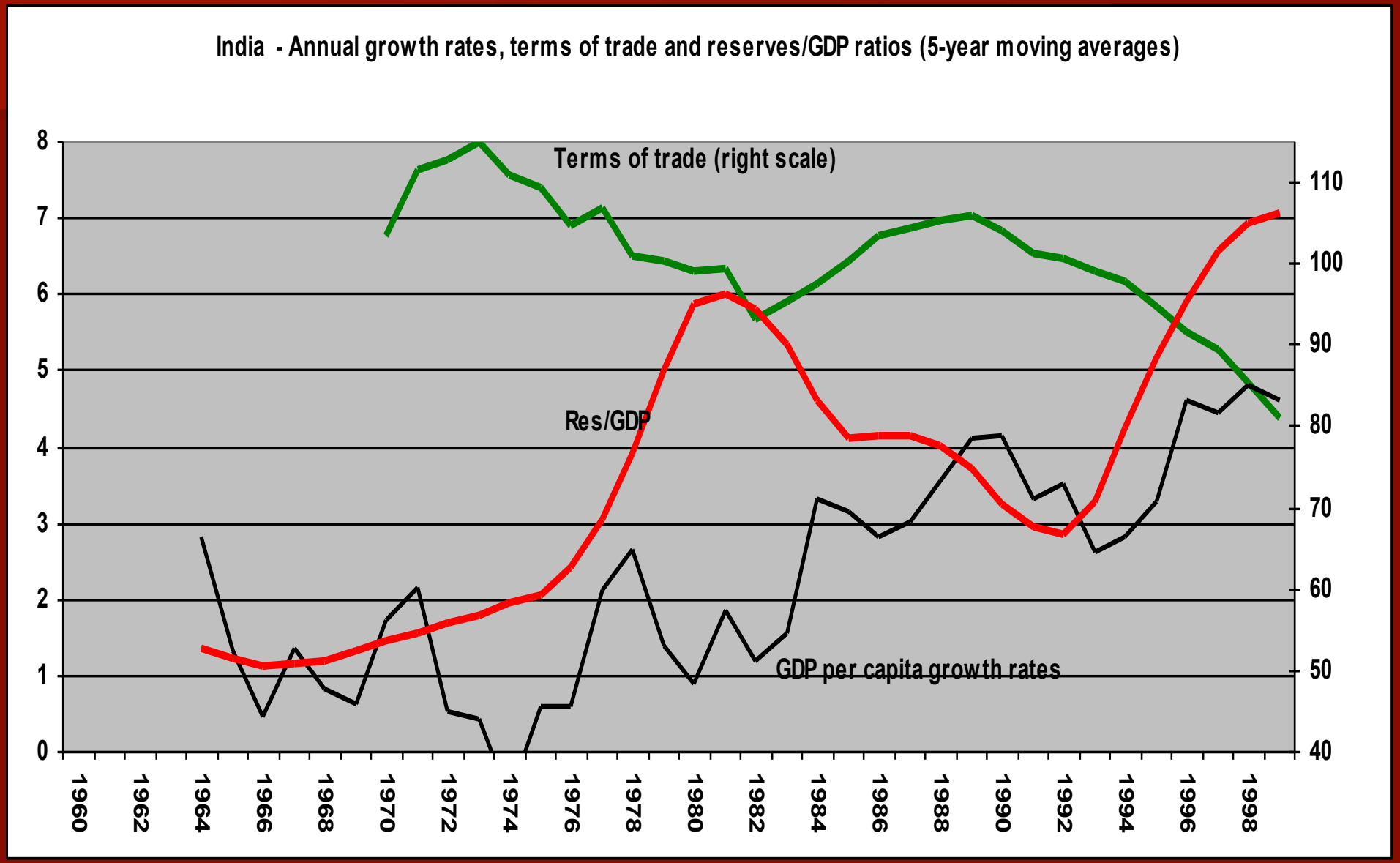

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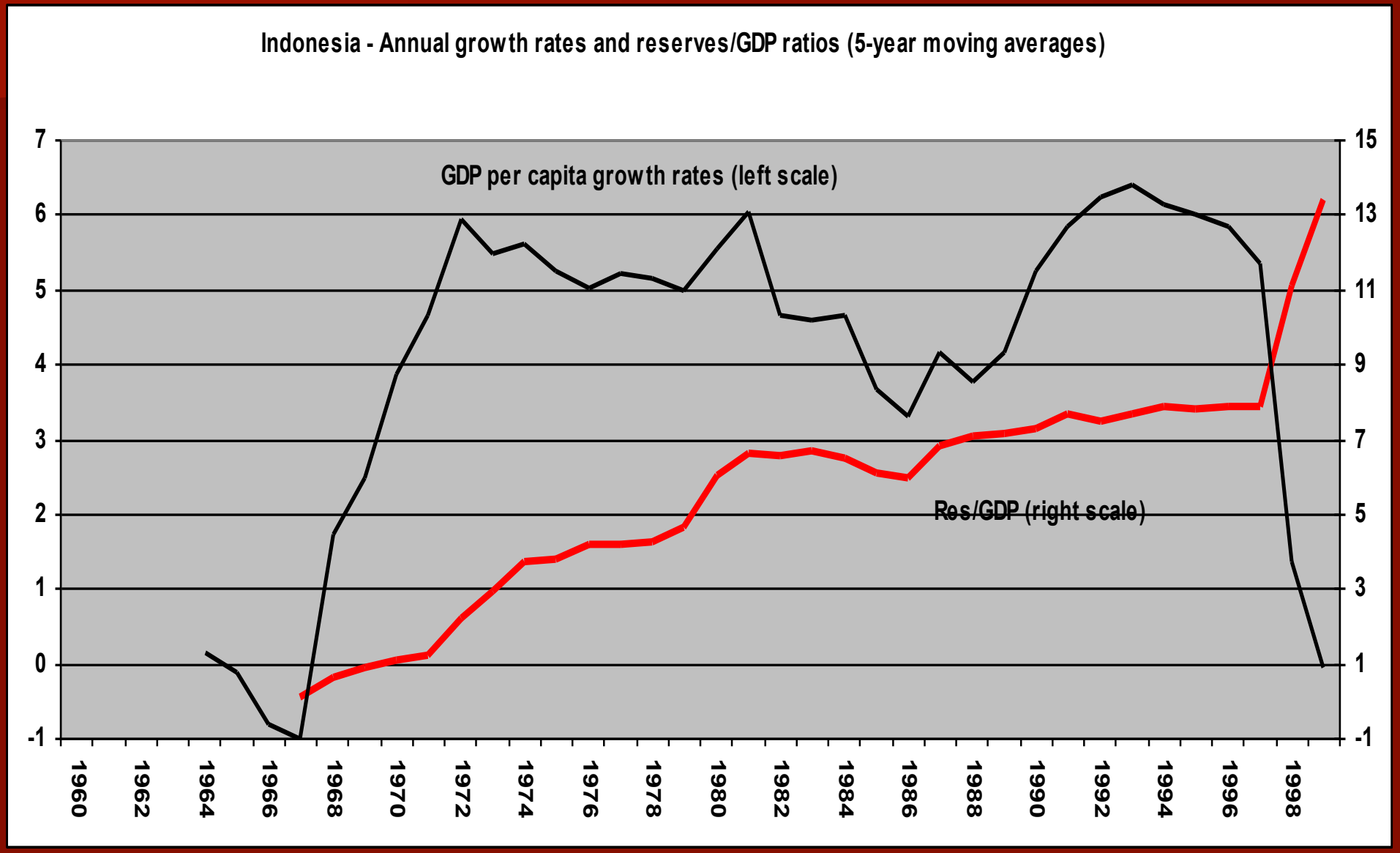

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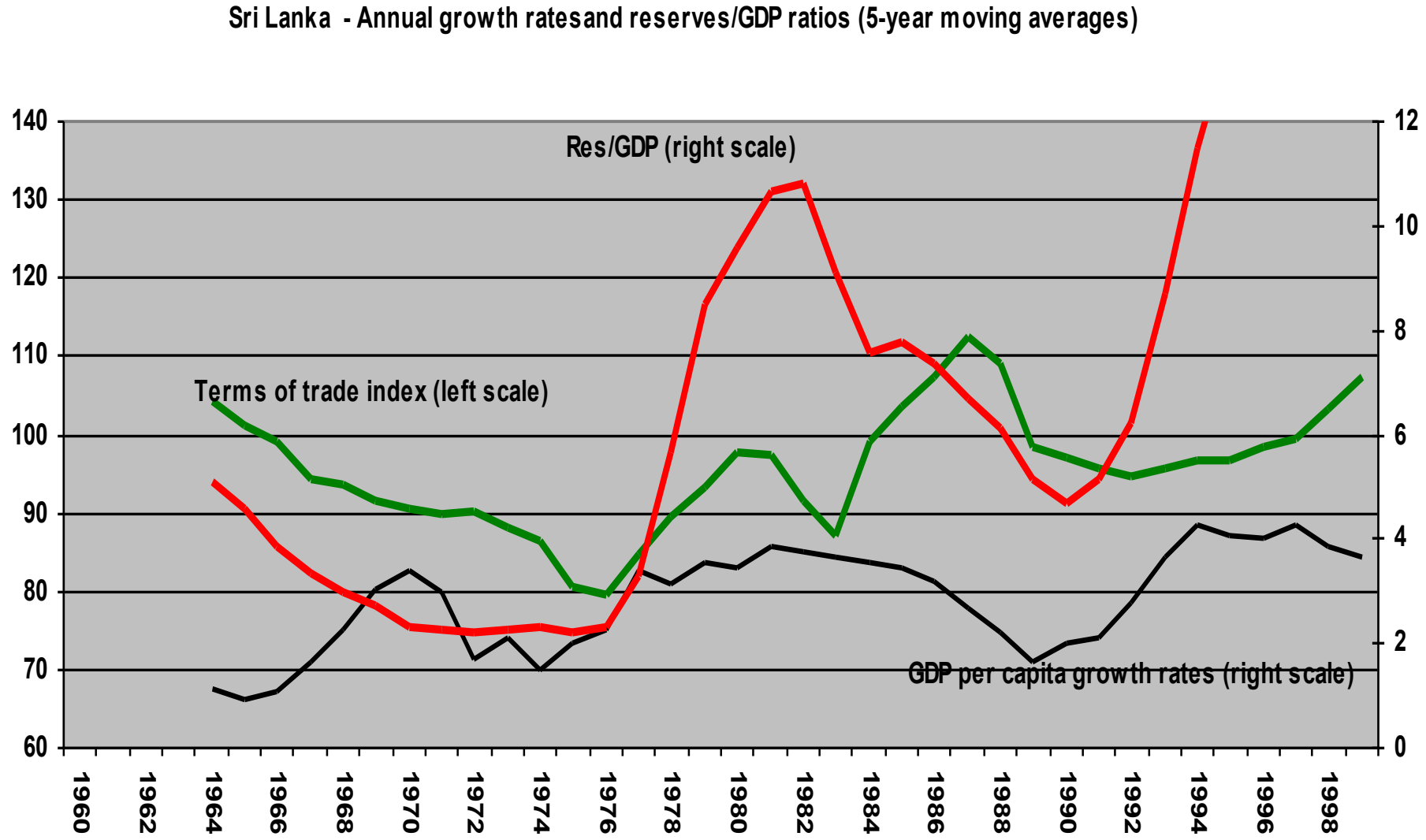

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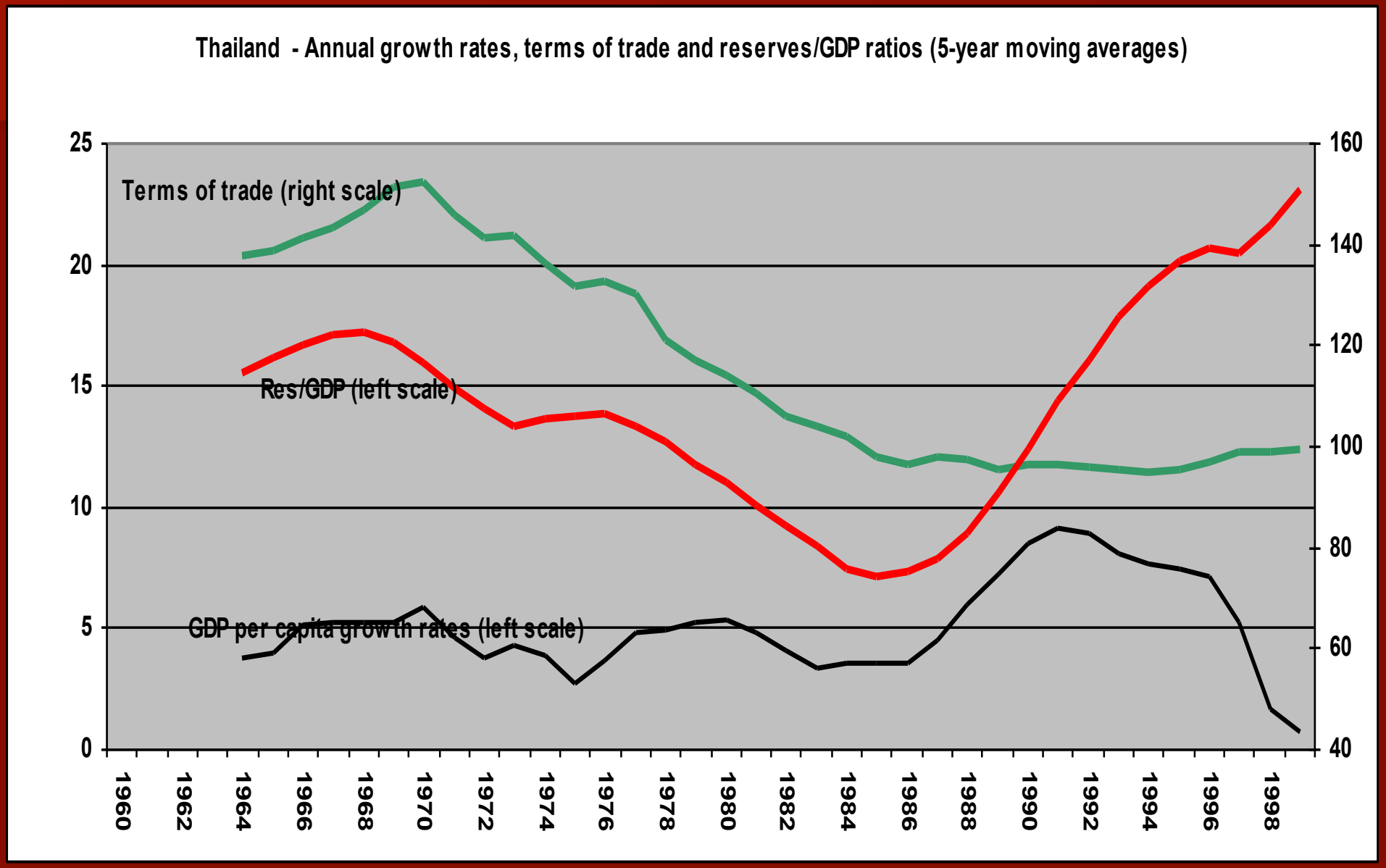

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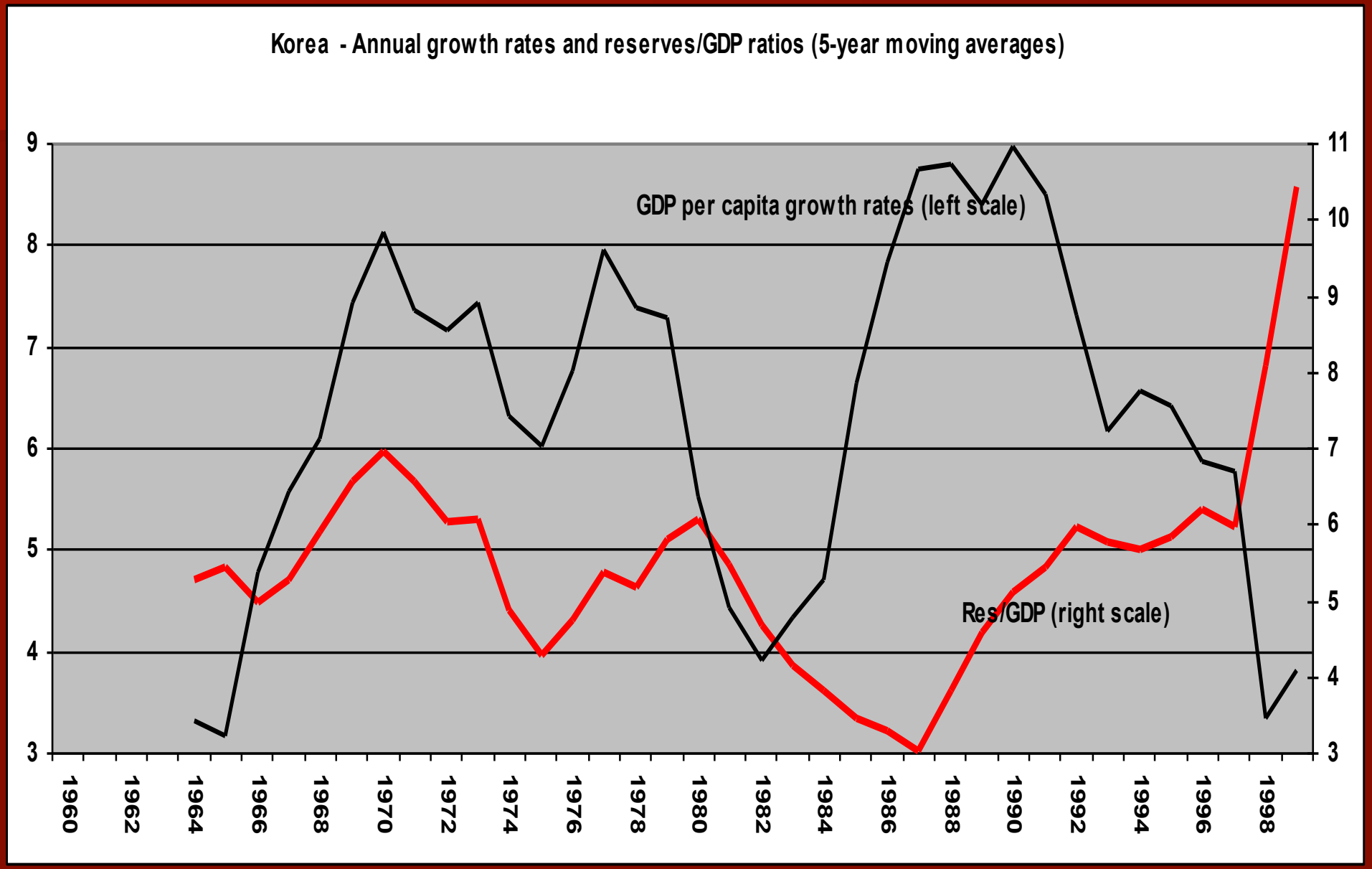

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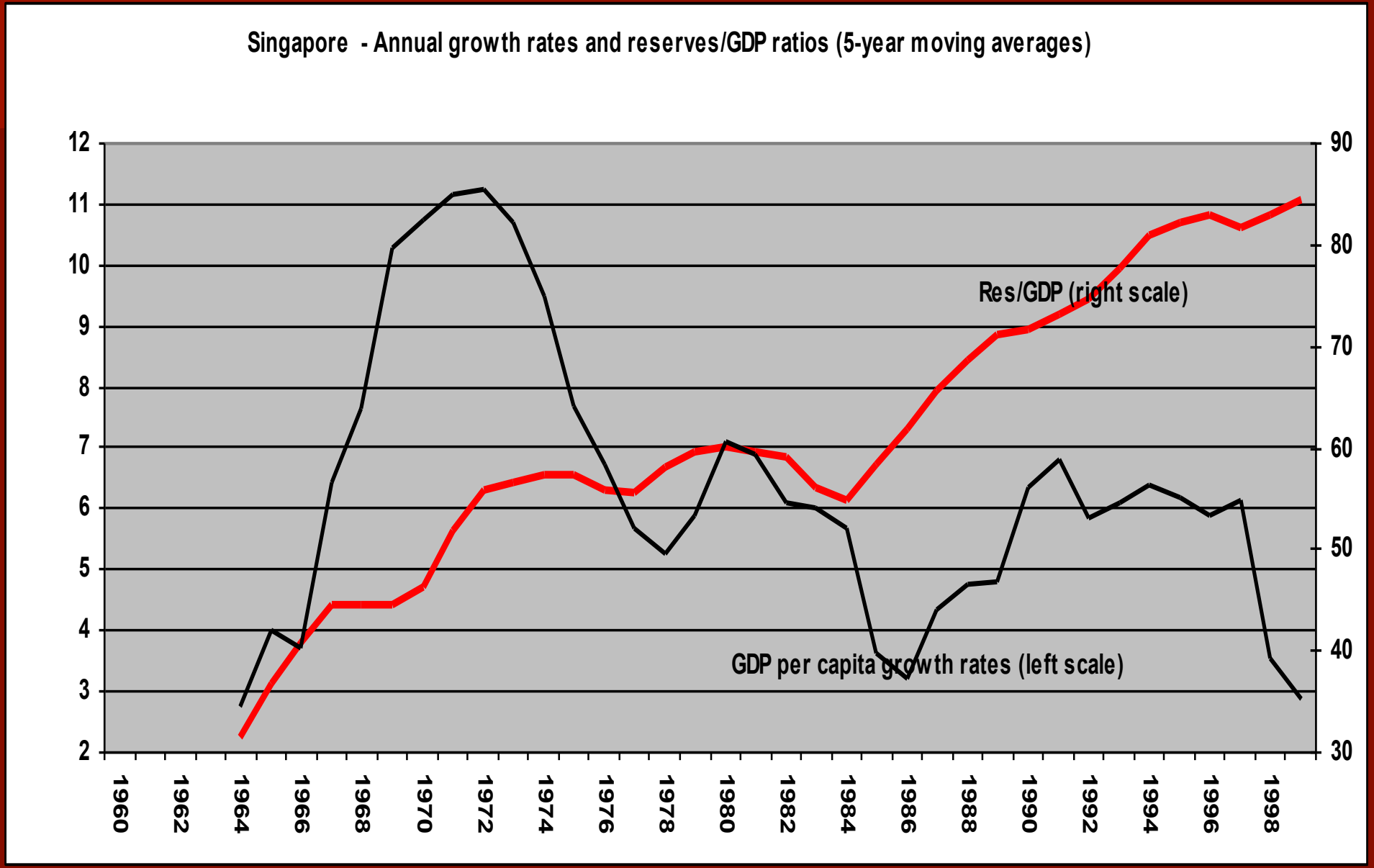

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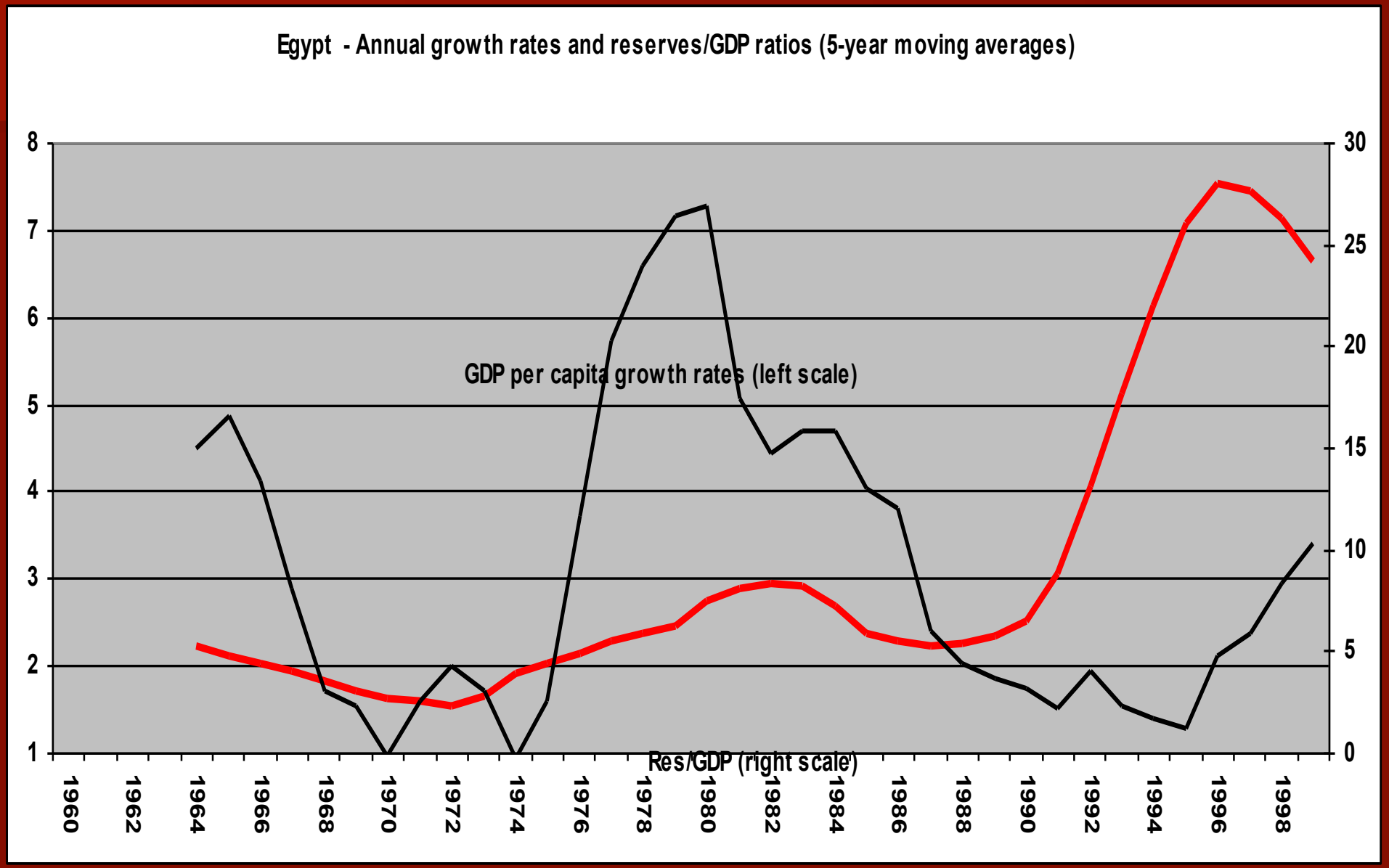

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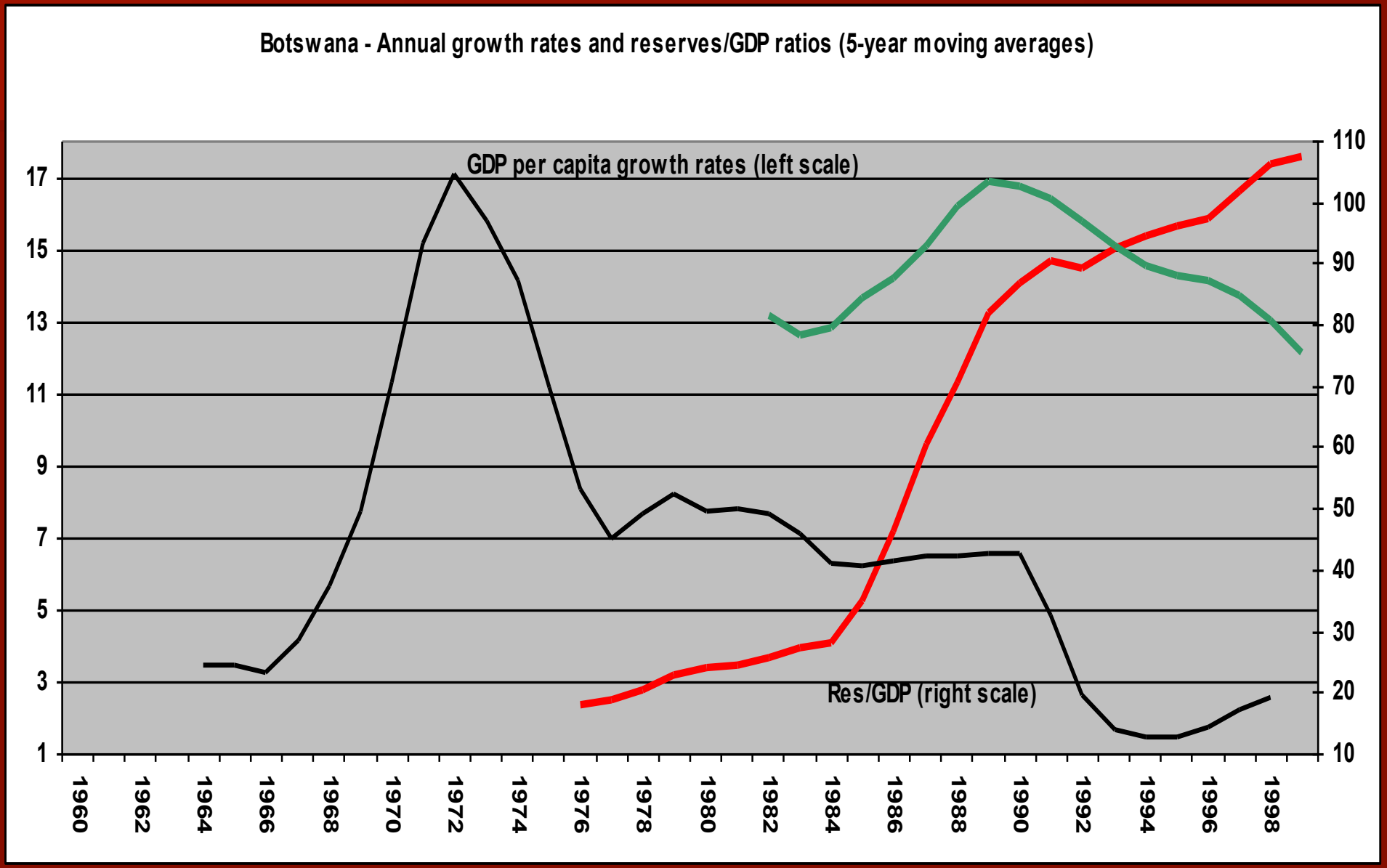


Russia - accumulation of FOREX and growth

Fig. GDP growth rates (%, right scale) and year end gross foreign exchange reserves, including gold, bln. $, left log scale

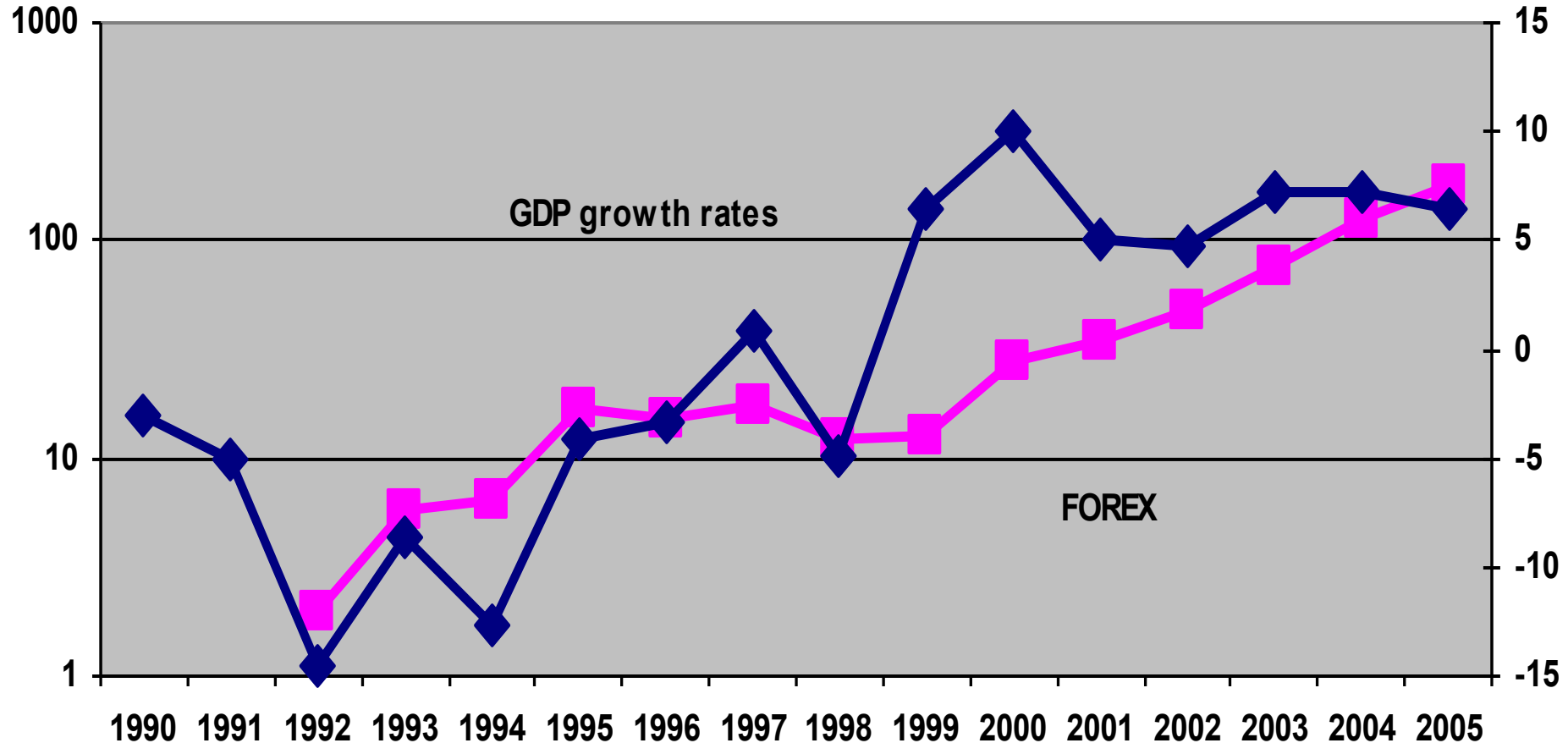


Fig. 3.3. Average ratio of gross international reserves to GDP and average annual growth rates of GDP per capita in 1960-99, %,

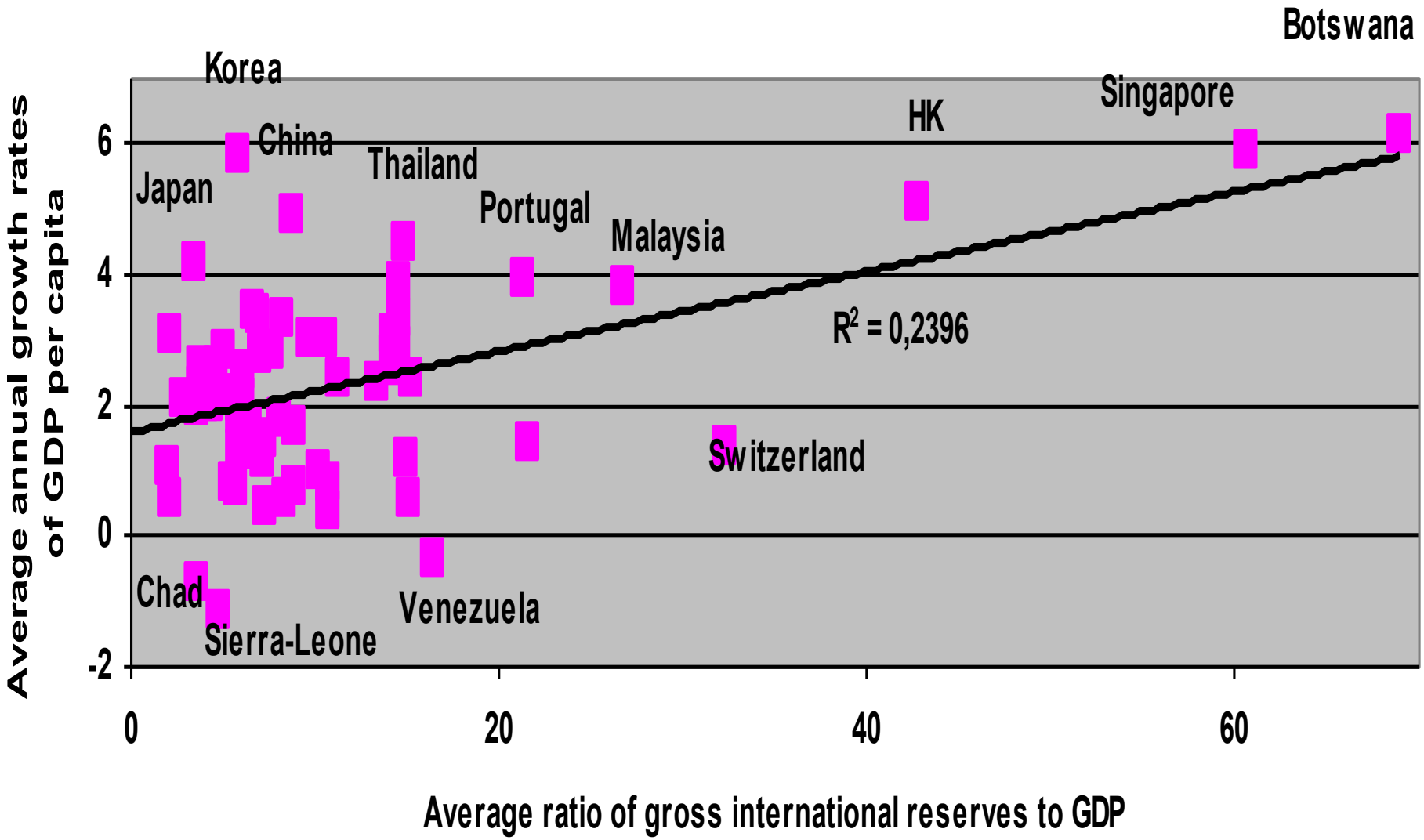


Fig. 3.7. Increase in the ratio of gross international reserves to GDP, p.p., and average ratio of gross capital investment to GDP in 1960-99, %, for ... countries

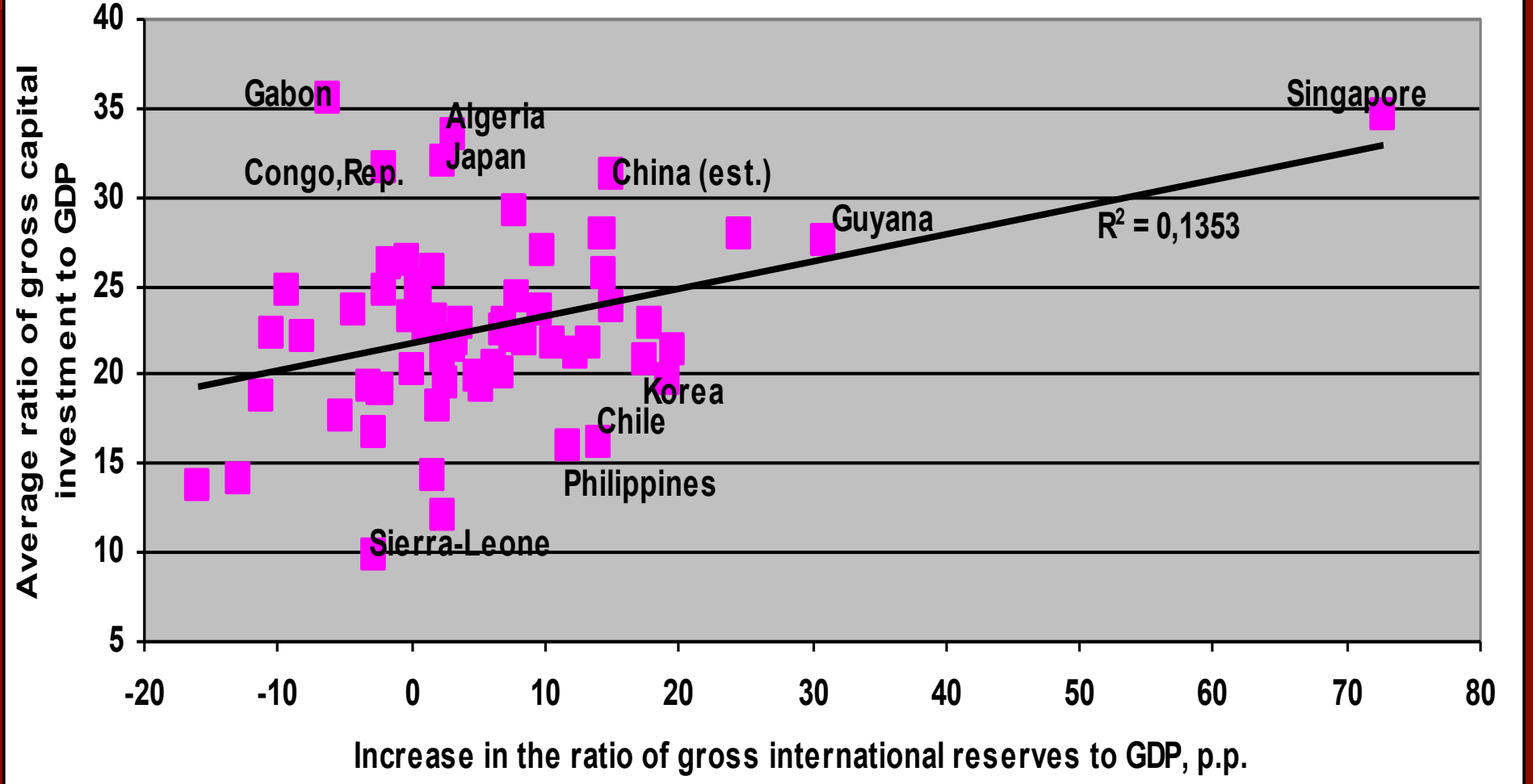


Fig. 3.3A. Average ratio of FOREX to GDP and GDP per capita growth rates in 1960-99

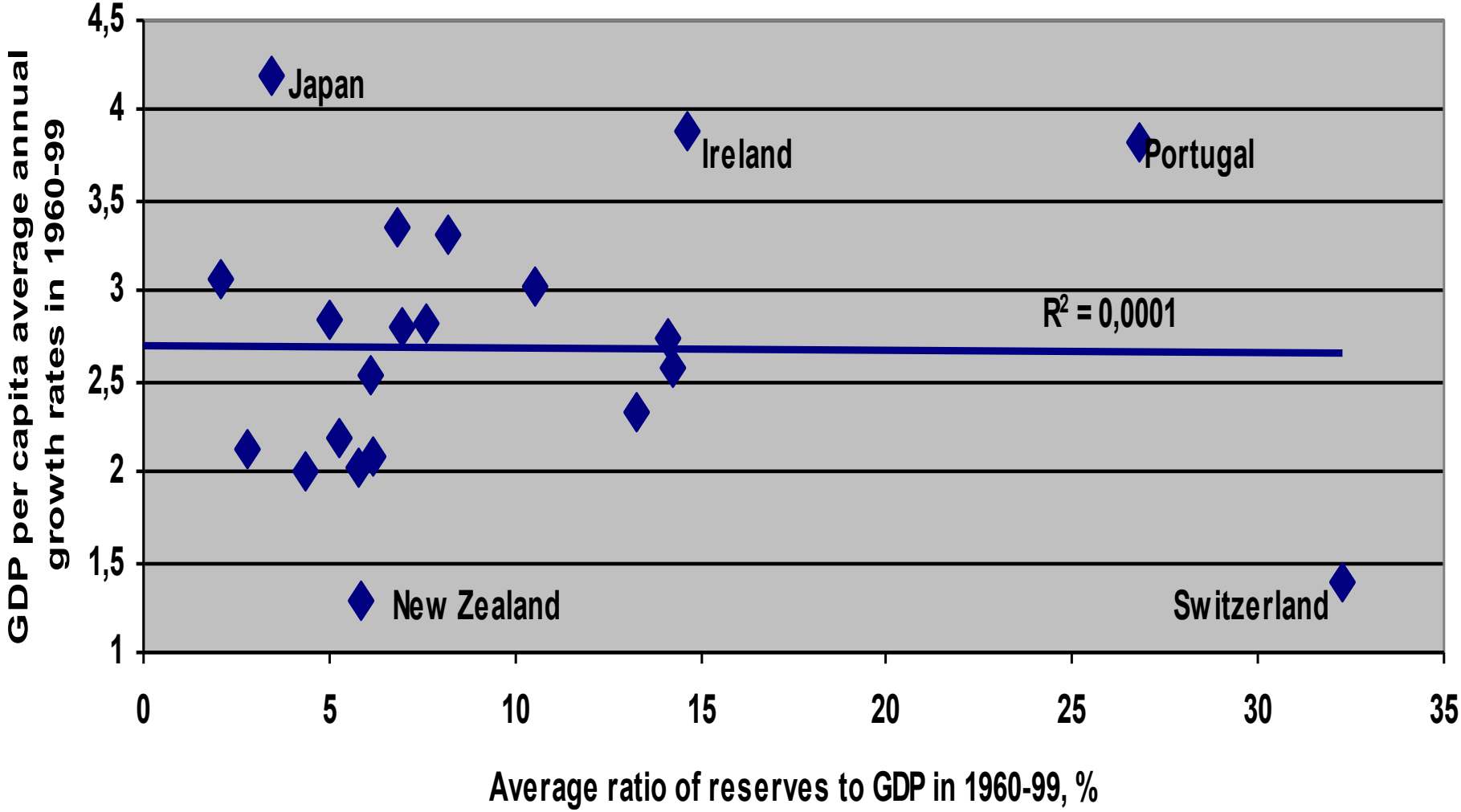


Table 2. Some macroeconomic indicators for rapidly growing countries in 1960-99

Countries	Annual average GDP per capita Growth rate, %	Increase in FER/ GDP ratio, 1960-99	Average FER/GDP ratio, %	Highest FER/ GDP ratio in 1960-99, %	Average FER in months of import, 1975-99
Botswana	6,13	86,93 (1976-99)	68,89 (1976-99)	121,82 (1998)	13,64
China	4,94	13,72 (1977-99)	8,68 (1977-99)	16,31 (1999)	7,36
Hong Kong, China	5,12	27,59 (1990-99)	42,74 (1990-99)	60,56 (1999)	3,61
Japan	4,18	2,37	3,42	6,76 (1999)	3,54
Korea, Rep.	5,82	14,17	5,89	18,21 (1999)	2,11
Singapore	5,87	72,76	60,55	90,52 (1998)	4,76
Thailand	4,51	14,44	14,75	27,97 (1997)	4,47

Literature overview

- Rodrik (1986) developed a model demonstrating how disequilibrium exchange rate in the presence of foreign trade externalities could lead to the acceleration of growth.
- In this early paper Rodrik assumes the import externality, which is used via the overvaluation of the exchange rate that stimulates imports of machinery and equipment.
- It was shown for developing countries that overvaluation of the exchange rate is detrimental for economic growth by including the variable that characterizes the undervaluation of the exchange rate into standard growth regressions (Dollar, 1992; Easterly, 1999).
- Aghion, Bacchetta, Ranciere, Rogoff (2006) examine mainly the impact of volatility of the real exchange rate on productivity growth, but also look at the impact on growth of under/ overvaluation of the exchange rate (the measure of overvaluation is basically the residual from the regression of RER on the GDP per capita – to control for the Balassa-Samuelson effect – and a couple of regional dummies. They find that overvaluation of RER negatively affects economic growth, especially in poorer countries.

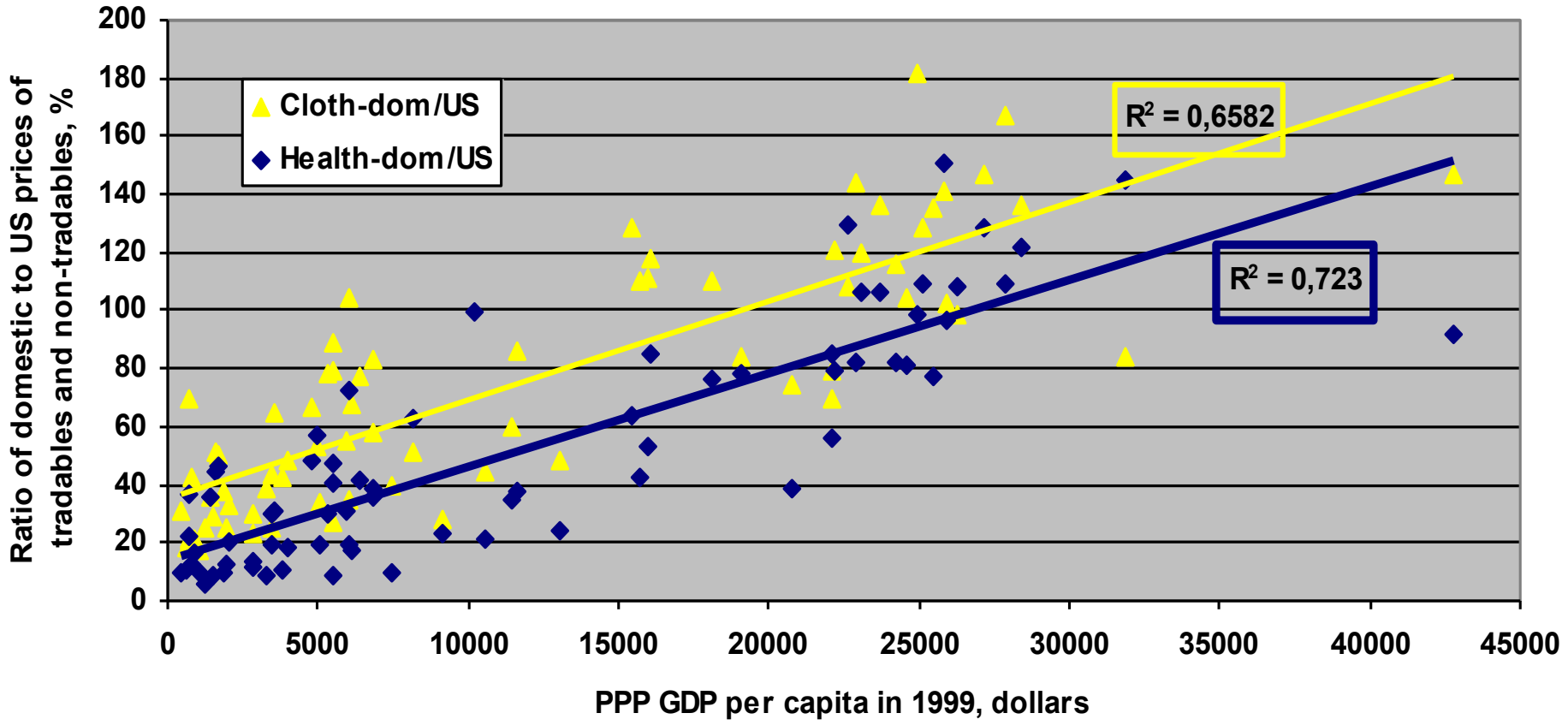
Literature overview: Balassa-Samuelson effect

- **Grafe and Wyplosz (1997) argue that even if the appreciation of the exchange rate in transition economies undermines business profits (in the export sector and in industries that compete with imports), this should not necessarily lead to a deterioration of the current account, since the need for capital accumulation in transition economies declines - that is, they can operate with lower savings ratios than they could before the transition.**

- **Halpern and Wyplosz (1997) argue that real appreciation in transition economies will continue until the transition is over, which may be "decades away."**
- **Another study (ESE, 2001) found evidence of Balassa-Samuelson effect in transition economies of Eastern Europe and former Soviet Union in the 1990s. The period is too short, however, and the increases in RER that actually took place in most transition economies may be the reaction to the overshooting initial devaluations that occurred in the beginning of the 1990s, when convertibility was introduced.**

Balassa-Samuelson effect: real exchange rate (national prices for non-tradables as compared to foreign prices) increase with the growth of GDP per capita

Fig. 3.6. PPP GDP per capita in 1999 and the ratio of domestic to US prices of tradables and non-tradables in 1993, %



Real exchange rate of national currencies versus the US dollar for major groups of countries

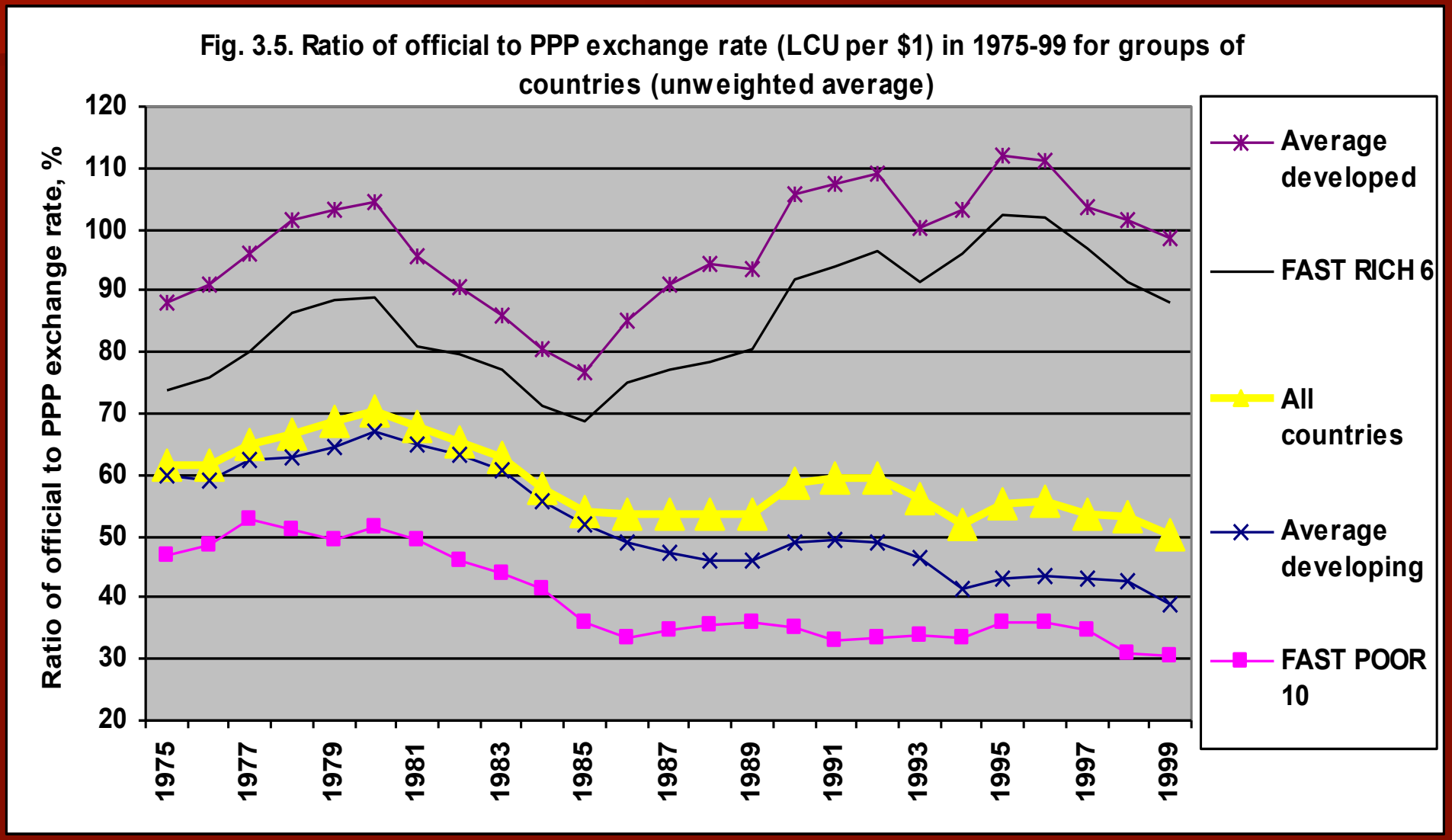


Table 1. Ratio of actual exchange rate of national currencies in $US to PPP for countries in 1993, % (figures in brackets - for 1996)

Countries/regions	Ratio, %	Countries/regions	Ratio, %
OECD*	116	Transition economies*	81
- Germany	126 (133)	-Central Europe*	54
- Japan	165 (158)	- Bulgaria	30 (25)
- U.S.	100 (100)	- Croatia	65 (94)
- Portugal	73 (77)	- Czech Republic	36 (48)
Developing countries*	44	- Hungary	62 (63)
-Asia*	36	- Poland	48 (59)
- India	24 (23)	- Romania	31 (34)
- Indonesia	30 (33)	- Slovak Republic	37 (47)
- Korea	72 (81)	- Slovenia	69 (78)
- Malaysia	(44)	-USSR*	91
- Philippines	35 (34)	-Armenia	(20)
- Thailand	43 (45)	- Azerbaijan	(32)
- Turkey	54 (48)	- Belarus	8 (30)
-Latin America*	46	- Estonia	29 (64)
- Argentina	(90)	- Georgia	(29)**
- Brazil	(70)	- Kazakhstan	(39)
- Chile	(43)	- Kyrghyzstan	(19)
- Mexico	58 (45)	- Latvia	27 (50)
- Peru	(56)	- Lithuania	19 (47)
- Venezuela	(36)	- Moldova	14 (28)
-Middle East*	83	- RUSSIA	26 (70)
- Kuwait	(67)	- Tajikistan	(3)
-Saudi Arabia	(68)	- Turkmenistan	(45)
- United Arab Emirates	(100)	- Ukraine	19 (39)
-Africa*	37	- Uzbekistan	(22)
- Ethiopia	(20)	China	22 (20)
- Mozambique	(17)	Mongolia	(21)
- Nigeria	36 (90)	Vietnam	(20)

* 1990. ** 1995.

How the accumulation of FOREX is financed?

- Formally, the following identities hold:

- $\Delta M = \Delta FOREX + \Delta B_{CB}$
- $BD = \Delta B_{CB} + \Delta B_P$
- $\Delta FOREX = \Delta M + BS + \Delta B_P$,

- where ΔFOREX – increase in foreign exchange reserves,
- ΔM – increase in money supply,
- BS – budget surplus (BD – budget deficit),
- ΔB_P – increase in bonds held by the public,
- ΔB_{CB} - increase in bonds held by the central bank.

- The last identity implies that the increase in foreign exchange reserves can be financed by the increase in money supply, i.e. inflation tax on everyone (ΔM), budget surplus (BS), accumulation of debt held by the public (ΔB_P).22

How the accumulation of FOREX is financed?

Table 3. Factors explaining the level of FER in 1960-99 and the sources of FER accumulation - cross country OLS regression results

Dependent variable	Average ratio of FER to GDP in 1960-99, %	Average ratio of FER to GDP in 1960-99, %	Increase in the ratio of FER to GDP from 1960 to 1999, p.p.	Increase in the ratio of FER to GDP from 1960 to 1999, p.p	Increase in the ratio of FER to GDI from 1960 to 1999, p.p
Number of observations	172	122	62	58	
Average budget surplus in 1960-99, % of GDP			0.55*	1.0***	1.07***
Average government debt in 1960-99, % of GDP				0.08*	0.09**
Average annual inflation (GDP deflator), 1960-99, %			0.05		0.07
Average import of goods and services, % of GDP	0.29***	0.32***			
2000 investment climate index, ICRG, %		0.18**			
Constant	0.09	-13.1**	7.1***	5.6**	4.5*
Adjusted R^2	26	32	2	8	7

*, **, *** - Significant at 10%, 5% and 1% level respectively.

Fig. 3.1. Foreign exchange reserves as a % of GDP, average ratios for 1960-99

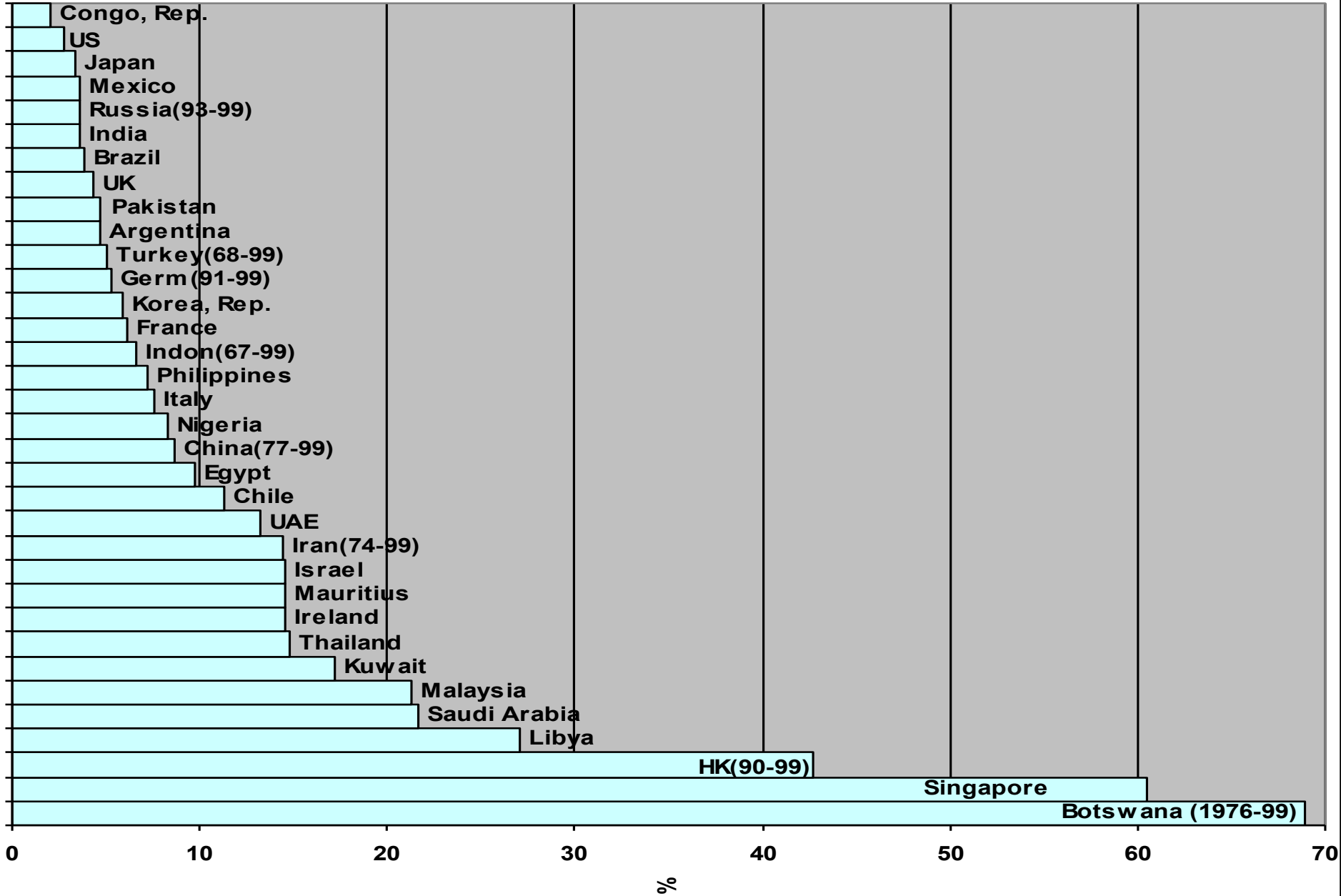


Fig. 3.2. Share of gold in reserves in the world and in the US (%, left scale) and the ratio of foreign exchange reserves to GDP in the world (%, right scale)

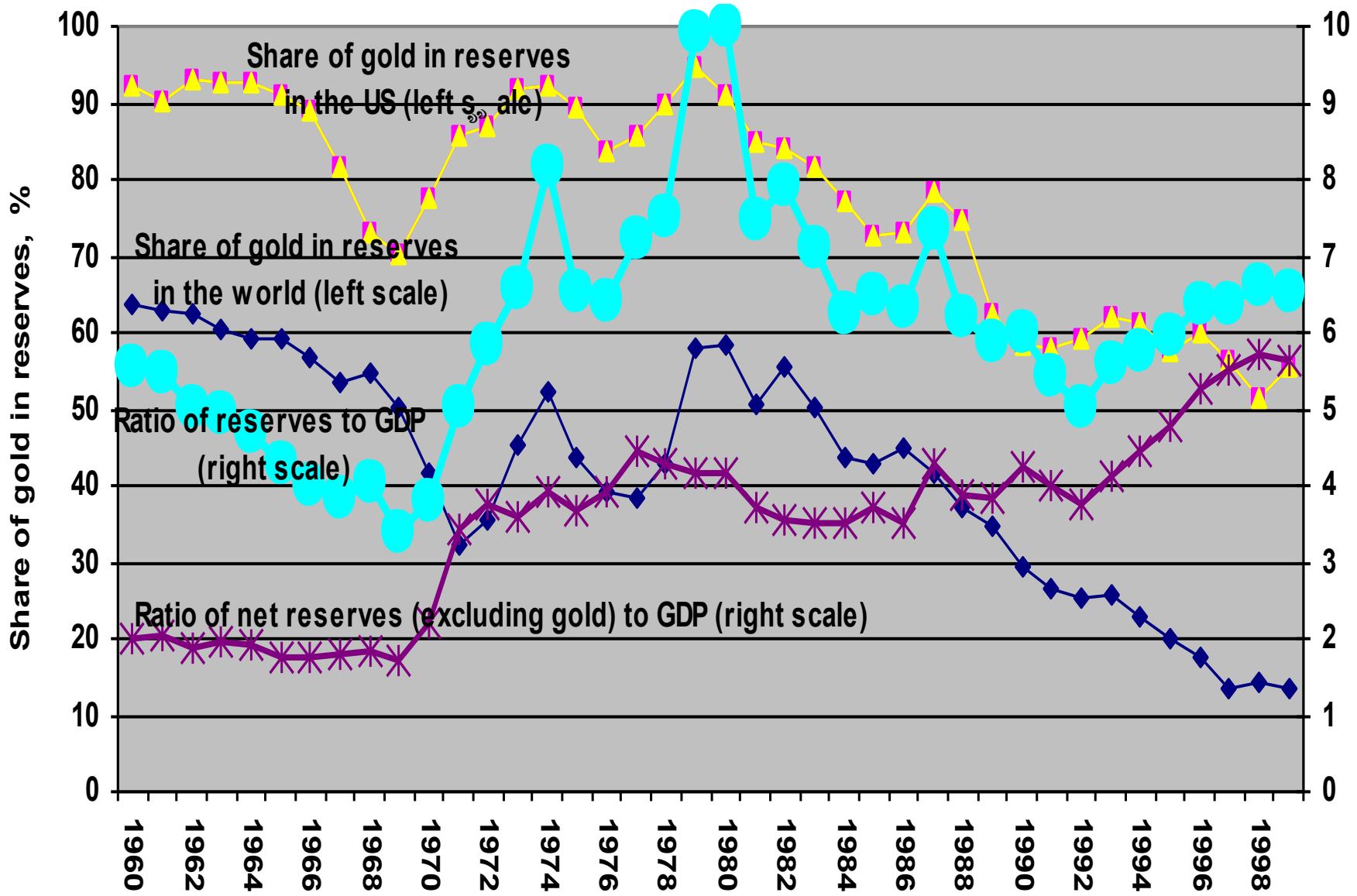
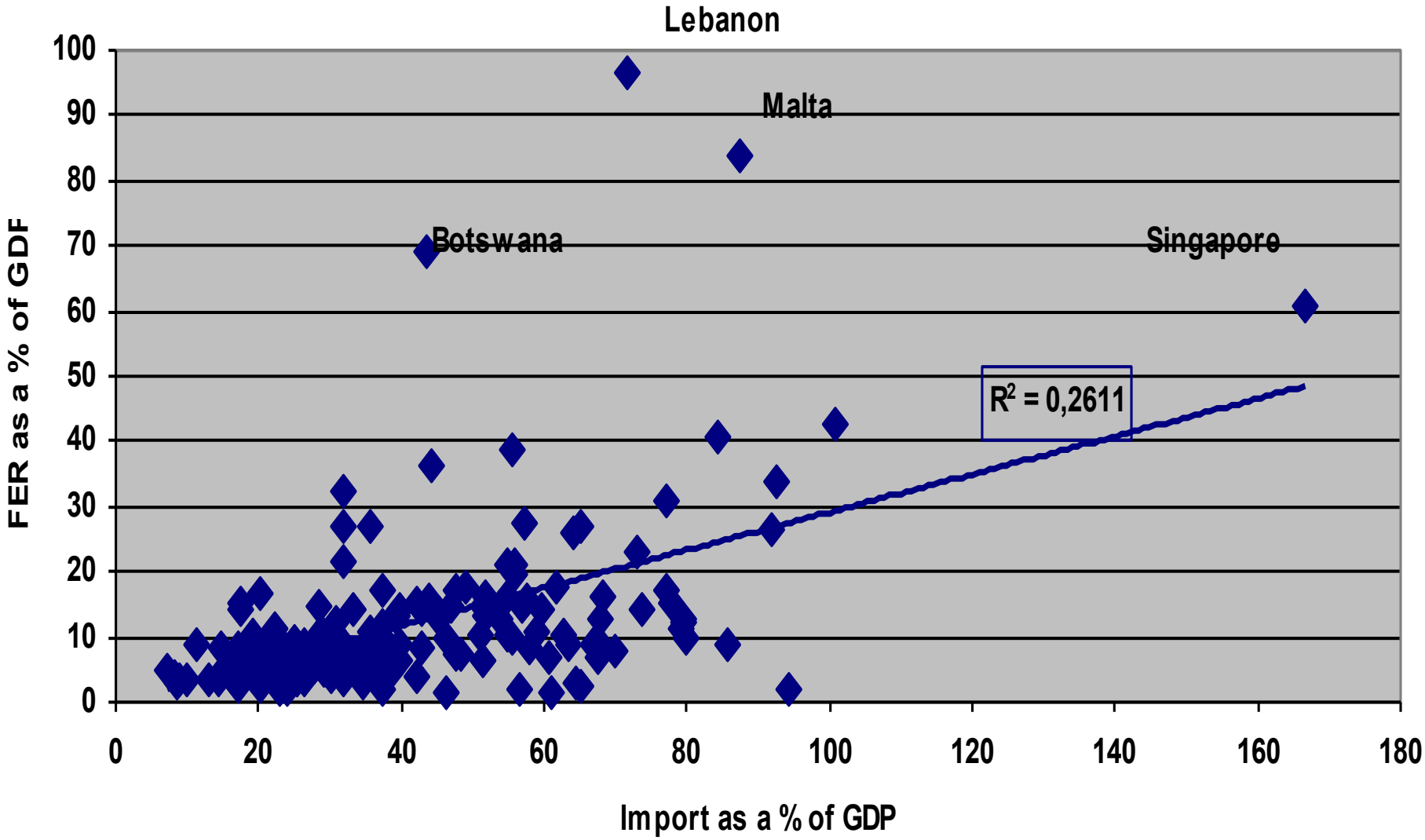


Fig. 3.2A. Average ratio of imports to GDP and average ratio of reserves to GDP in 1960-99, %



Why a country keeps FOREX?

- **The standard formula for explaining FER is:**

$$FER = Y^{\alpha} * O^{\beta} * \sigma O^{\gamma} * i^{\delta}$$

, where

- Y **is income,**
- O **is the measure of openness of the economy (external trade to GDP ratio),**
- σO **is the volatility of openness,**
- ***i*** **is the opportunity costs of holding foreign exchange reserves (difference between the interest rate earned on FER invested into short-term low risk securities and interest rate on alternative investment).**
- **The collapse of the Bretton-Woods fixed exchange rates system in 1971 did not have a large impact on the demand for FER (Grennes, 1984, Ch. 22).**

What are the determinants of the accumulation of FOREX?

- delta R = 38 – 11.4logYcap75 + 0.1(T/Y) + 0.24(delta T/Y)

(R^2=34%, N=82, all coefficients significant at 0.1% level).

- Then we considered the residual as the policy-induced change in reserves.
- Afterwards we used the *policy induced change in foreign exchange reserves* as one of the explanatory variables in growth regressions together with import taxes and change in government revenues/GDP ratio

Does policy induced FOREX accumulation influence growth?

- GROWTH= CONST.+CONTR.VAR.+ T(0.06–0.0027Ycap75us)+ Rpol (0.07-0.006T)
- The control variables are the rule of law index for 2001, the size of the economy in 1975, and the population growth rates in 1975-99.
- N=74, R2=44%, all coefficients are significant at less than 10% level, except for coefficients of Rpol (11%) and the PPP GDP in 1975 (16%).

What determines the accumulation of FOREX? Another definition of policy-induced changes in FOREX

- We also experimented with another definition of *policy induced change in foreign exchange reserves,* as a residual from regression linking the increase in reserves to GDP ratio to the following ratios: trade/GDP, increase in trade/GDP, external debt/GDP(ED/Y) and debt service/GDP(DS/Y):

$$\Delta R = 3.3 - 0.6(DS/Y) + 0.06(ED/Y) + 0.2(T/Y) + 0.28(\Delta T/Y)$$

- N=59, R^2=36%, all coefficients significant at less than 7%.

Does policy induced FOREX accumulation influence growth?

- GROWTH=CONST.+CONTR.VAR.+T(0.001RISK–0.0038Ycap75us)+Rpol(0.23-0.014T),
- N=48, R^2 = 46, all coefficients significant at 7% or less,
- control variables – PPP GDP per capita in 1975 and population growth rate.

What are the determinants of the accumulation of FOREX? Another definition of policy-induced changes in FOREX

- For the 1975-99 period, for which more data are available, the best equation explaining changes in FER is shown below:

$$\Delta R = 39 - 0.4(R/Y_{60-99}) - 6.2\lg Y - 0.3ICI_{84-90} + 0.2(T/Y) + 0.3(\Delta[T/Y] \quad (1)$$

R^2=50%, N=72, all coefficients significant at 3% level or less, where:

- Y - initial (1975) GDP per capita,
- T/Y - average ratio of foreign trade to GDP over the period,
- $\Delta[T/Y]$ the increase in the same ratio over the period,
- *R/Y60-99*- average ratio of FER to GDP in 1960-99,
- *ICI84-90* - average investment climate index in 1984-90 (ranges from 0 to 100, the higher, the better).

Does policy induced FOREX accumulation influence growth?

- GROWTH = CONST. + CONTR. VAR. + Rpol (0.10 – 0.0015Ycap75us)
- R2 = 56, N=70, all variables are significant at 10% level or less,
- where Ycap75us – PPP GDP per capita in 1975 as a % of the US level.
- It turns out that there is a threshold level of GDP per capita in 1975 – about 67% of the US level: countries below this level could stimulate growth via accumulation of FER in excess of objective needs, whereas for richer countries the impact of FER accumulation was negative

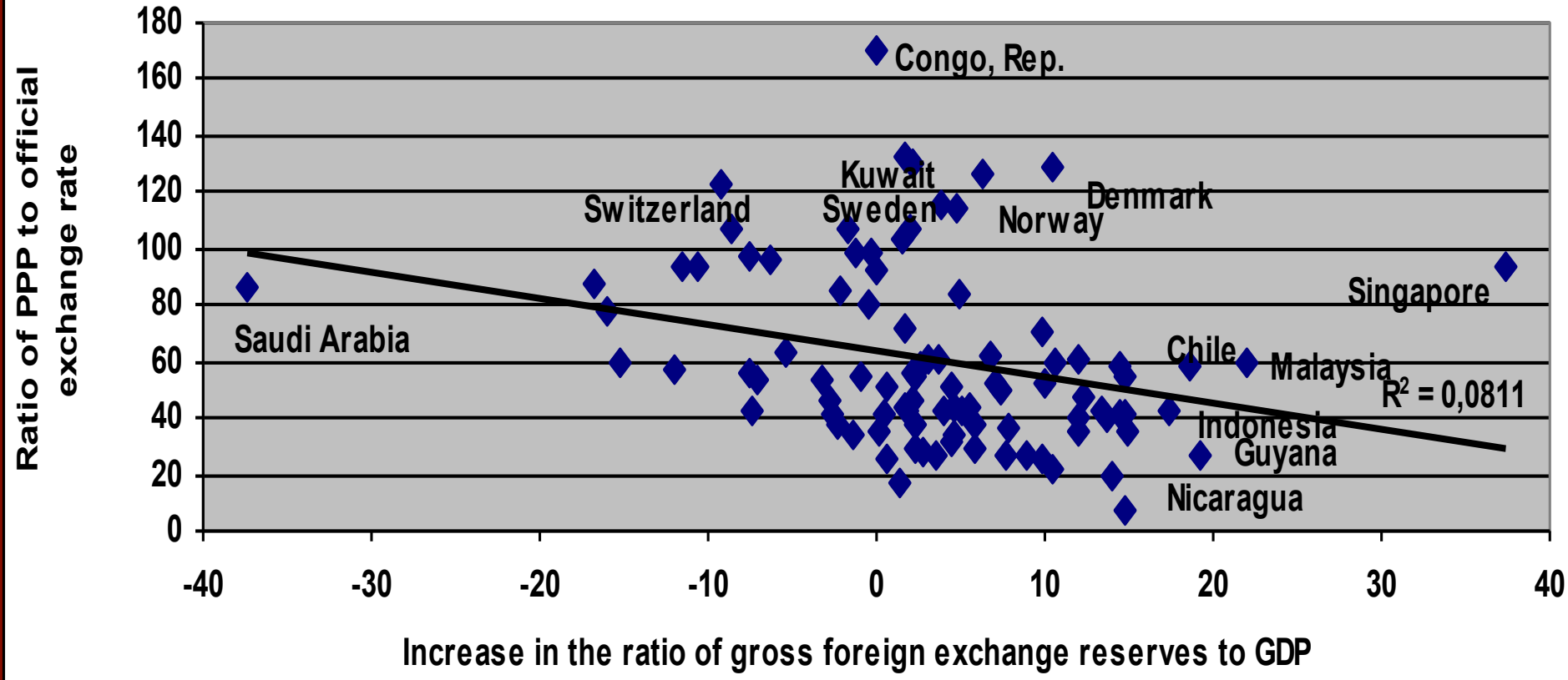
Does policy induced FOREX accumulation influence growth?

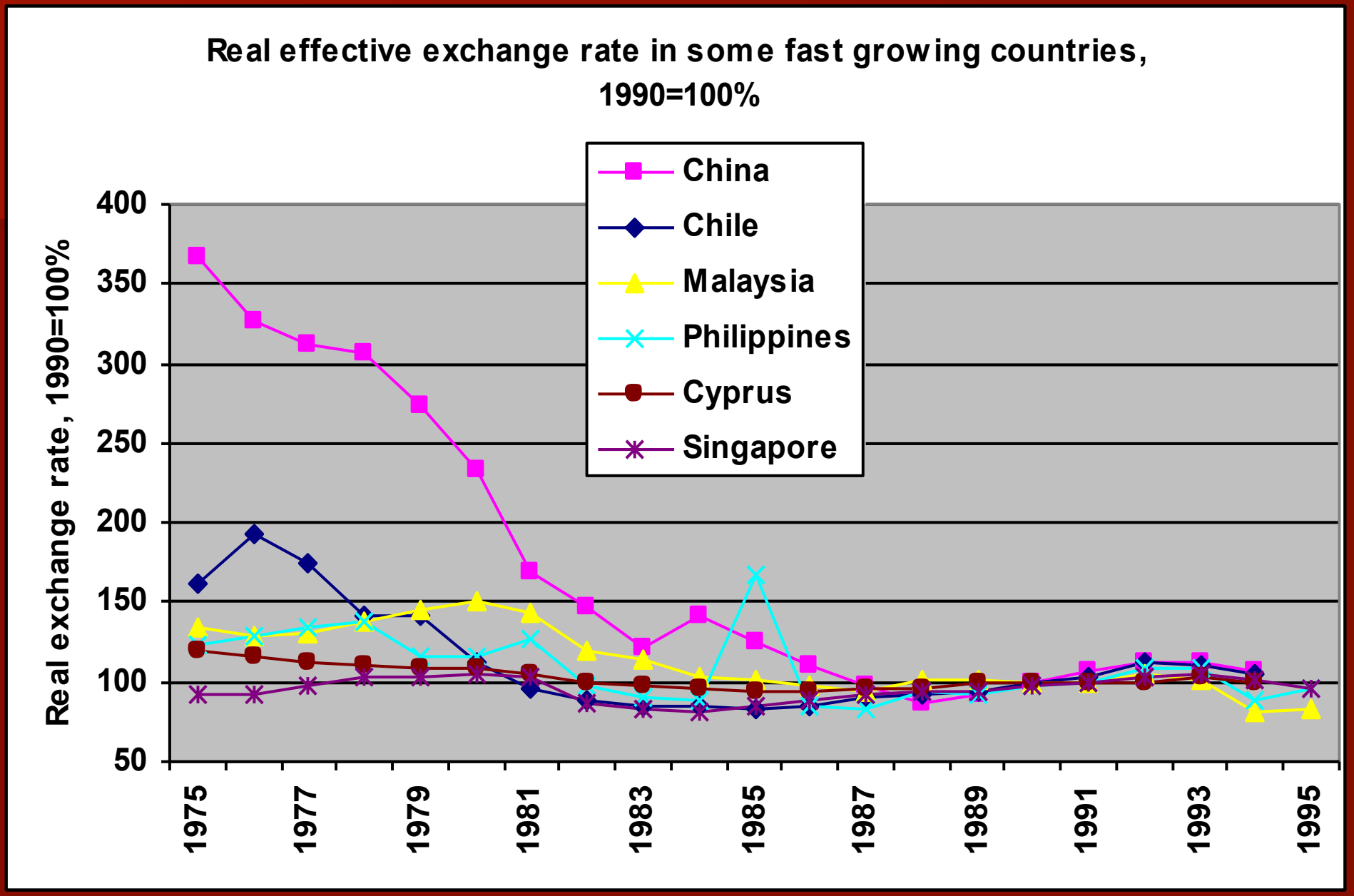
Table 4a. Factors explaining the average growth rate of GDP per capita in 1975-99 - cross country OLS regression results, robust estimates

Dependent variable	Average growth rate of GDP per capita in 1975-99						
Number of observations	92	77	90	90	90	70	70
Average population growth rate in 1975-99, %	-0.88 ***	-0.68 **	-0.77 ***	-.086 ***	-0.76 ***	-1.22 ***	-0.93 ***
Log PPP GDP per capita in 1975, $US		-1.16*	-1.44**			-1.15***	
1984-90 investment climate index, ICRG, %		0.06 ***					
Average investment/GDP ratio in 1975-99			0.12 ***		0.11 ***		
Annual average inflation in 1975-99, %			-0.01*	-0.01 **	-0.01 **	-0.01**	-0.01**
Total population in 1999, million				$3*10^{-09}$ ***	$3*10^{-09}$ ***	$2*10^{-09}$ **	$3*10^{-09}$ **
Population density in 1999, people per 1 sq. km				.0005 ***	.0003*	.0007 ***	.0004 ***
Increase in the ratio of FER to GDP from 1975 to 1999, p.p.	0.037 *	0.05 **	0.040 ***	0.040 **	0.032 *		
Increase in the ratio of FER to GDP, determined by objective factors – according to equation (1)							0.068**
Policy-determined increase in the ratio of FER to GDP in 1975-99 - ΔR pol						0.10**	0.059*
Interaction term = (Policy-determined in the ratio of FER to GDP in 1975-99)* (Per capita PPP GDP in 1975, % of US level)						-0.0015 **	
Constant	2.8***	2.9	0.11	2.65***	0.2	7.3***	3.0***
Adjusted R^2	27	38	50	46	55	56	56

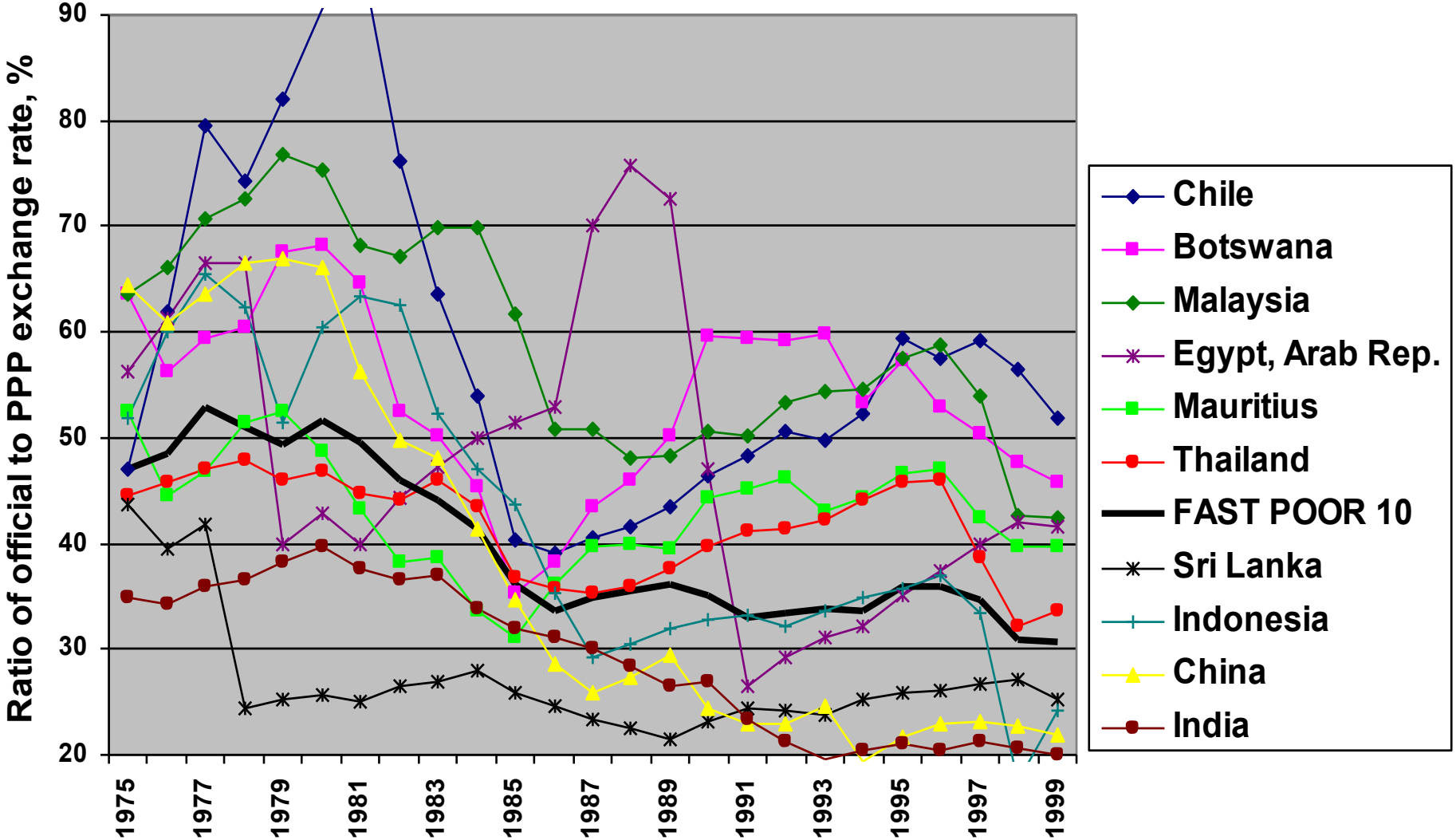
Countries with faster accumulation of FOREX had lower real exchange rates

Fig. 3.4. Increase in the ratio of gross foreign exchange reserves to GDP and the ratio of PPP to official exchange rate in 1975-99, %




Real effective exchange rate in some fast growing countries, 1990=100%
China
Chile
Malaysia
Philippines
Cyprus
Singapore
Real exchange rate, 1990=100%
400
350
300
250
200
150
100
50
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995

Ratio of official to PPP exchange rate in fast growing developing countries, 1975-99 (over 3% a year increase in GDP per capita)



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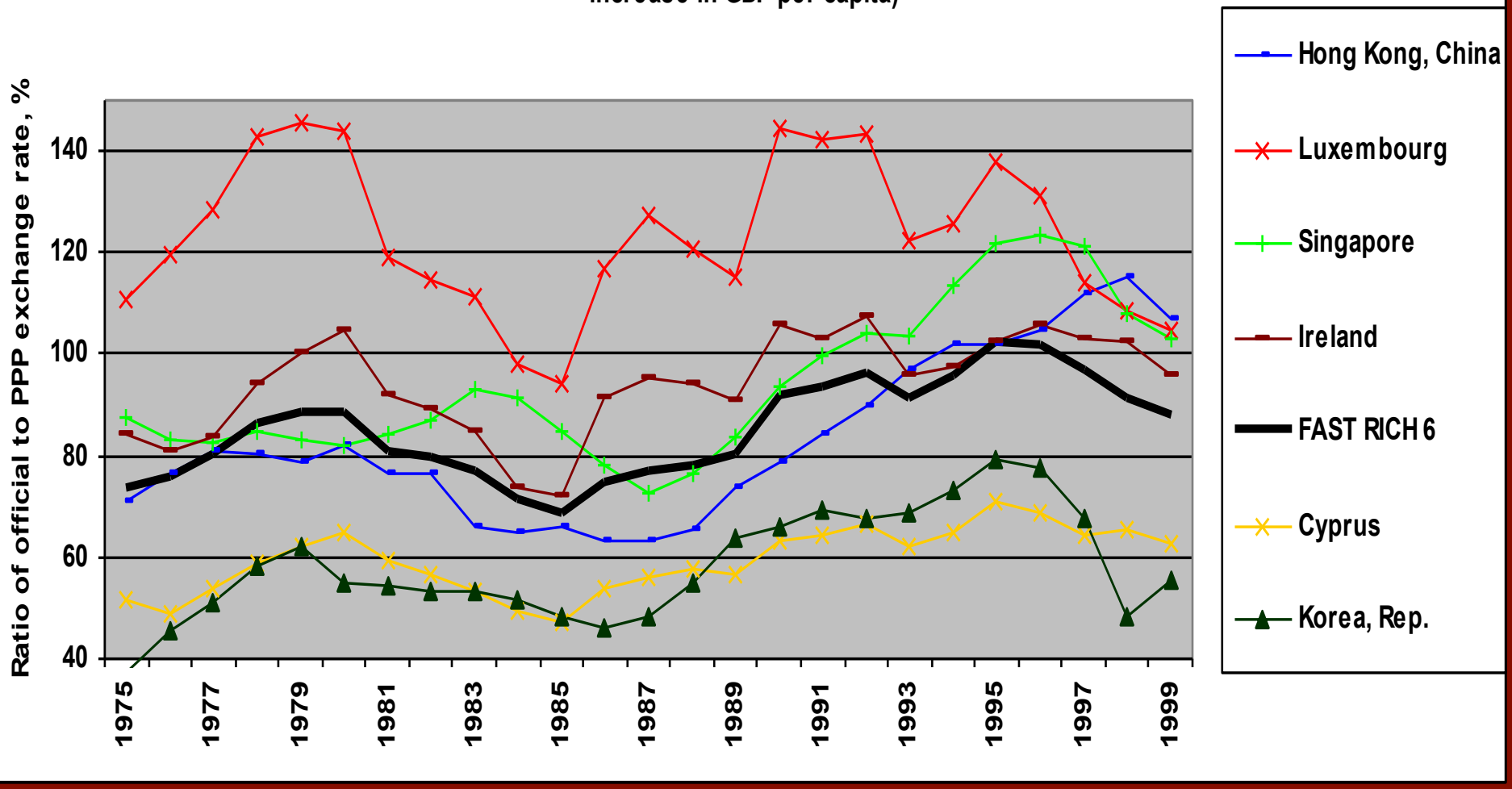


Table 5. Factors explaining the average ratio of domestic to US prices in 1975-99 - country OLS regression results

Dependent variable = average ratio of domestic to US prices in 1975-99

Number of observations	89	78	78	72 (dev. only)
PPP GDP per capita in 1975	.006***			
2000 investment climate index, ICRG, %		1.00***	1.37***	
Increase in the ratio of FER to GDP from 1975 to 1999, p.p.	**-0.53****	**-.88*****	**-0.54***	**-.57*****
Average ratio of trade to PPP GDP in 1980-99	.35***	.39***		.41***
Average external balance in 1975-99, % of GDP			1.37***	
Net fuel imports, % of total imports				-.27***
Constant	33.8***	-17.3	162.7***	39.7
Adjusted R^2	64	53	45	62

*, **, *** - Significant at 10%, 5% and 1% level respectively.

Table 6. Correlation coefficients between prices of tradadbles and non- tradables (55 observations)

	All domestic to US prices, 1980-99	Domestic prices of clothing to US prices	Domestic prices of healthcare to US prices	1975 PPP capita
All domestic to US prices, 1980-99	1			
Domestic prices of clothing to US prices	0.6681	1		
Domestic prices of healthcare to US prices	0.7061	0.8392	1	
1975 PPP GDP per capita	0.7009	0.8365	0.8946	1

Table 7. Factors explaining 1993 price levels of health care and education, clothing and footwear

Dependent variable	Ratio of pr health care to clothing	Ratio of pr education to clothing	Ratio of health care pric prices	Ratio of clothing and prices to the U
Number of observations	77	77	58	58
PPP GDP per capita in 1999	.000647*	.0008086*	0.0033***	0.0032***
Average ratio of domestic to US prices in 1975-99	0.26**	0.28**		
Increase FER/GDP ratio in 1980-99			-0.33**	-0.32 (T stat=-
Constant	38.93***	34.57***	17.95***	41.52***
Adjusted R^2	23	23	78	64

*, **, *** - Significant at 10%, 5% and 1% level respectively.

Table 8a. Factors explaining the average share of investment in GDP in 1975-99 – cross country OLS regression results

Dependent variable = average share of investment in GDP in 1975-99

Number of observations	79	79	79	72	59 (dev. only)	85	46	46	48	42
Log PPP GDP per capita In 1975					-.0008 **					
2000 investment climate index, ICRG, %	0.17 ***	0.17 ***	0.21 ***		0.27 ***	0.15 ***	0.23 ***	0.26 ***	0.24 ***	
1984-90 investment climate index, ICRG, %				0.14 ***						0.14 ***
Increase in the ratio of FER to GDP from 1975 To 1999, p.p.	0.15 ***	0.24 ***	0.22 ***		0.23 ***		0.19 ***	0.26 ***		
Policy-determined in-Crease in the ratio of FER to GDP from 1975 To 1999, p.p.				0.28 ***						0.22 ***
Ratio of prices for health-Care to prices for clothing In 1993							-0.06 ***	-0.07 ***	-0.08 ***	-0.08 ***
Average external balance In 1960-99, % of GDP			-0.21 ***	-0.20 **						
Net fuel imports in 1960-99, % of total imports		-0.09 ***	-0.12 ***	-0.09 ***	-0.12 ***	-0.06 ***		-0.15 ***	-0.13 ***	-0.11 ***
Interaction term = (increase in reserves) x (foreign/domestic prices)x (external balance)						0.03*			0.03 *	
Constant	10.3 ***	9.5 ***	6.3 **	33.8 ***	4.63	11.3 ***	10.7 ***	9.6 ***	11.5 ***	20.2 ***
Adjusted R^2	17	34	39	37	42	16	37	63	44	55

*, **, *** - Significant at 10%, 5% and 1% level respectively.

Investment/GDP ratio and export/GDP ratio

Fig. 3.8. Investment/GDP ratio and average ratio of foreign trade to PPP GDP in 1980-99

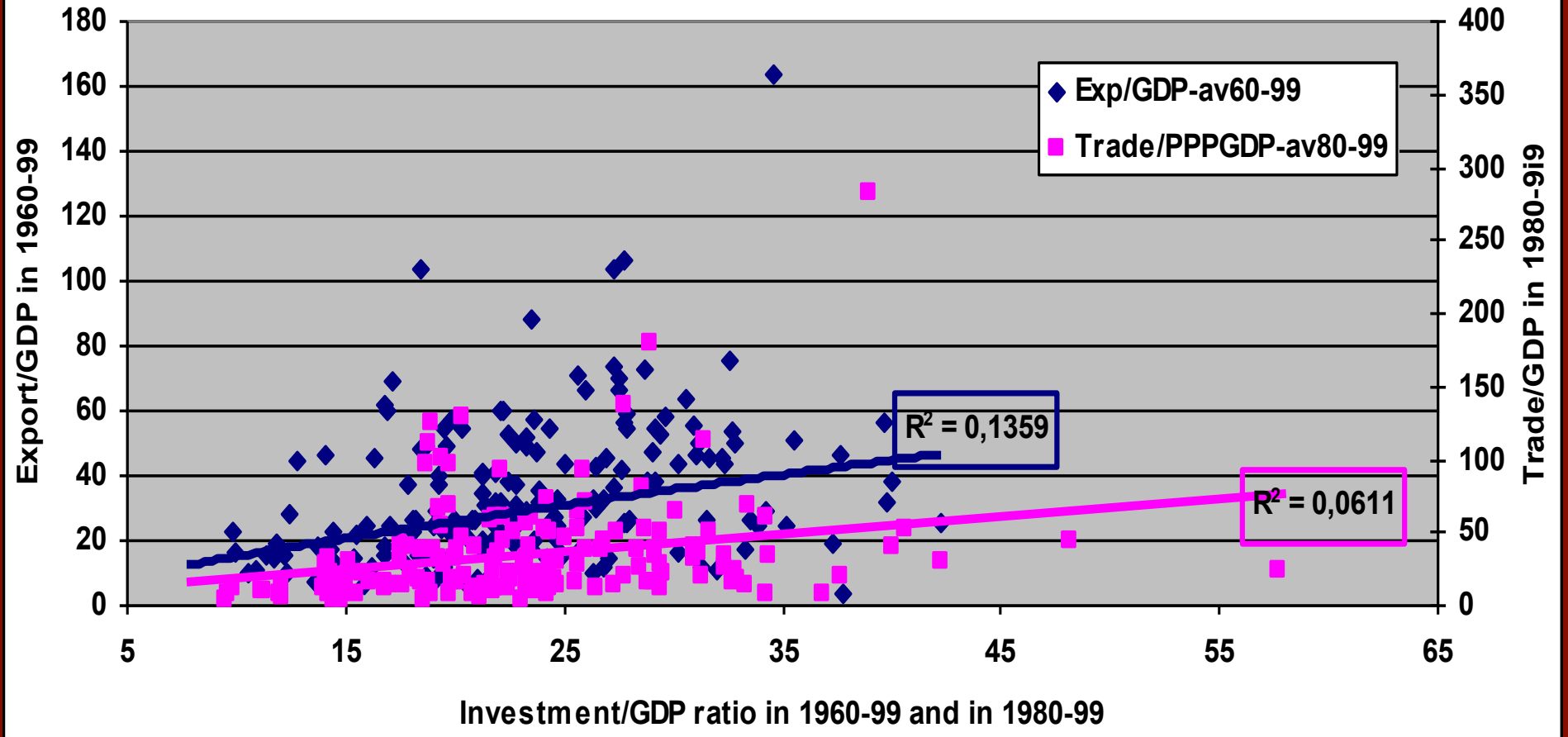


Table 3.9. Factors explaining the share of export and foreign trade in GDP in 1960 – cross country OLS regression results

Dependent variable	Increase in the ratio of export to GDP in 1960-99			**Average ratio of trade to PPP GDP in 1980-99**		Increase in the ratio to PPP GDP in 1980-99, p.p.		
Number of observations	59	47	30	94	**62**	86	93	81
Log PPP GDP per capita in 1975	15.59 ***							26.7 ***
PPP GDP per capita in 1975				0.0085 ***			0.007 ***	
PPP GDP per capita in 1999					**.003 *****			
2000 investment climate index, ICRG			0.76 *					
Average ratio of export to GDP in 1960-99		0.77 ***	0.71 ***					
Average ratio of trade to PPP GDP in 1960-99,%								-0.19 ***
Terms of trade improve-ment index, 1960-99		-0.23 ***						
Net fuel imports in 1960-99, % of total imports			0.39 ***		**-.31****	0.53 ***		0.40 ***
Increase in the ratio of FER to GDP from 1960 to 1999, p.p.	1.06 ***	0.37 (Tst= 1.6)	0.56 *					
Average ratio of domestic to US prices in 1980-99, %							-0.49 ***	-0.18 **
Increase in the ratio of FER to GDP from 1960 to 1980 , p.p.					**1.79 *****			
Increase in the ratio of FER to GDP from 1980 to 1999, p.p.				0.7 8***	**1.44 *****	0.58 ***		0.74 ***
PPP GDP in 1999, bill.$	-.004*			-0.009 ***	**-.009 **			
Average annual FDI net inflow in 1980-99, % of GDP			4.9 **					
Constant	-25.57	12.3	-67.9 **	-15.40 ***	**.87**	8.9 ***	3.82	-80 ***
Adjusted R^2	41	38	61	21	**49**	29	19	57

*, **, *** - Significant at 10%, 5% and 1% level respectively.

Accumulation of FOREX and FDI

Fig. 3.9. Increase in the ratio of FOREX to GDP in 1960-99 and average net inflows of FDI as a % of GDP in 1980-99

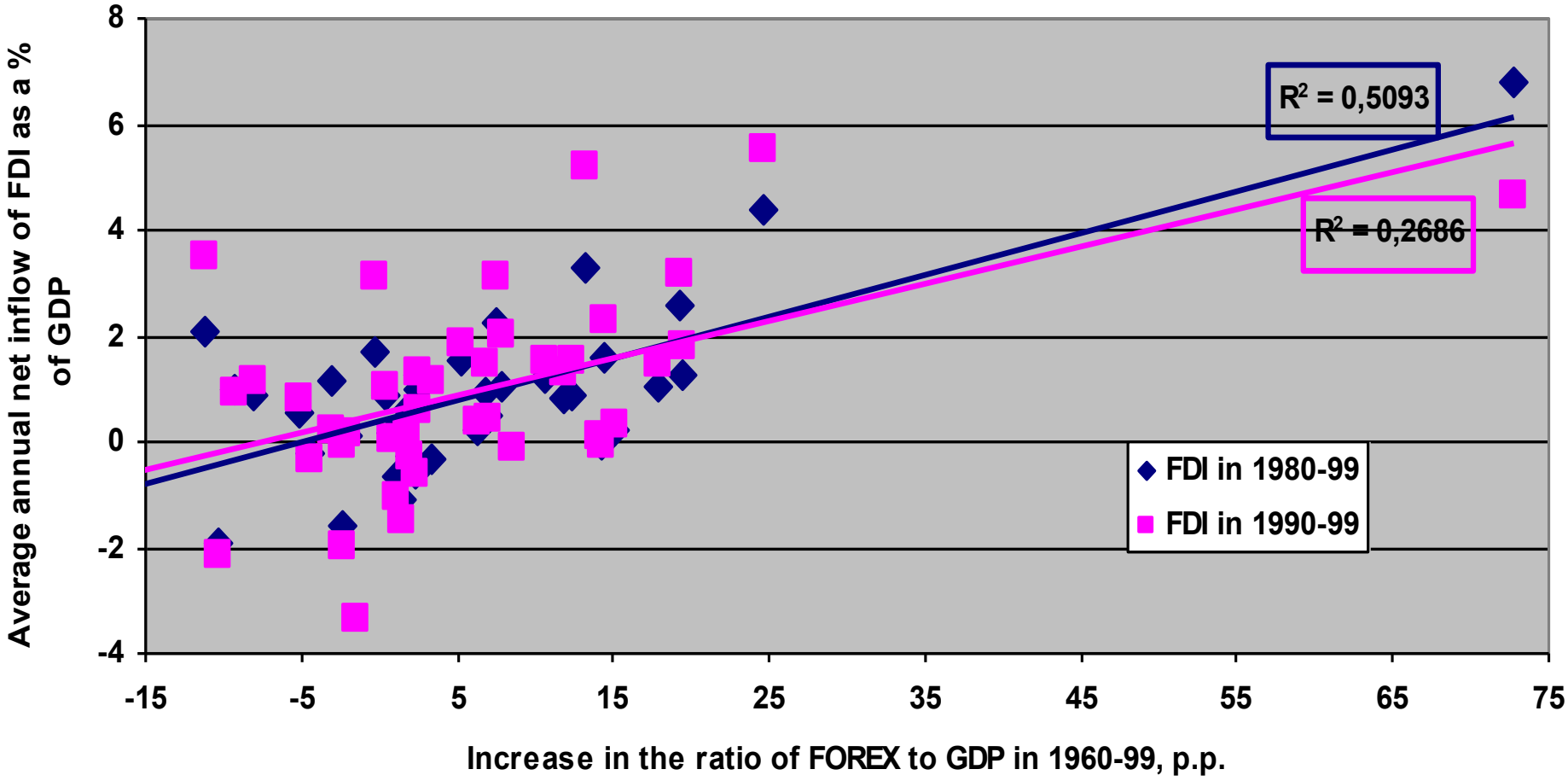


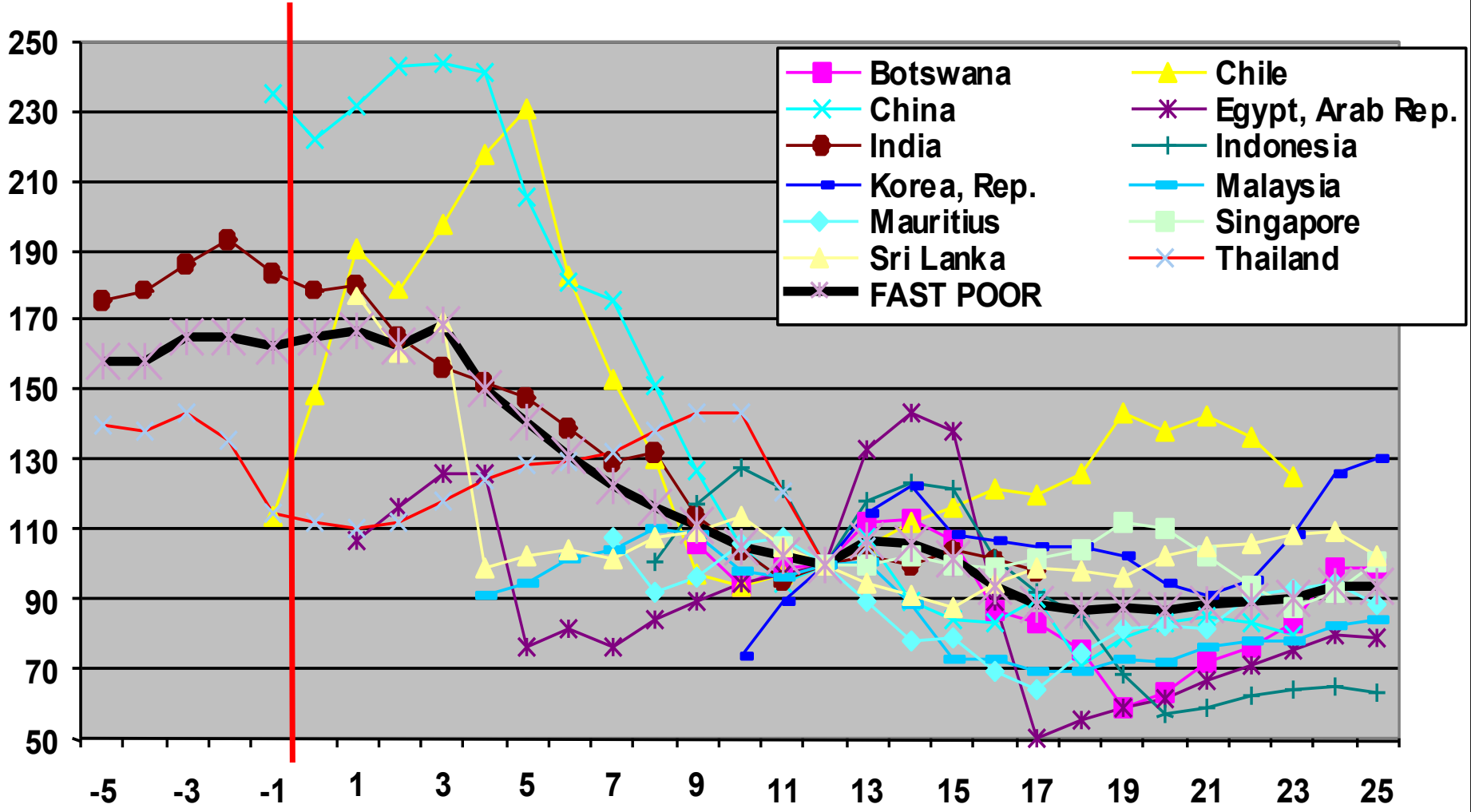
Table 10. Factors explaining the net inflow of foreign direct investment (FDI) in 1980-99 – cross country OLS regression results

Dependent variable	Average annual net inflow of FDI in 1980-99, % o						
Number of observations	59	40	47	40	39	37	36
PPP GDP per capita in 1975					-.0001 *		-.0004 ***
2000 investment climate index, ICRG			-0.1			-0.02	0.05*
Average ratio of FER to GDP in1960-99, %	0.05 ***						
Increase in the ratio of FER to GDP from 1960 to 1999, p.p.		0.08 ***				0.08 ***	
Increase in the ratio of FER to GDP from 1960 to 1980, p.p.				0.1 ***	0.09 ***		0.09 ***
Increase in the ratio of FER to GDP from 1980 to 1999, p.p.				0.07 ***	0.06 ***		
Increase in the ratio of FER to import from 1980 to 1999, p.p.							0.1, Tst.= 1.6
Constant	0.4	0.4*	1.7	0.26	0.8**	1.7	
Adjusted R^2	18	50	-2	50	53	51	52

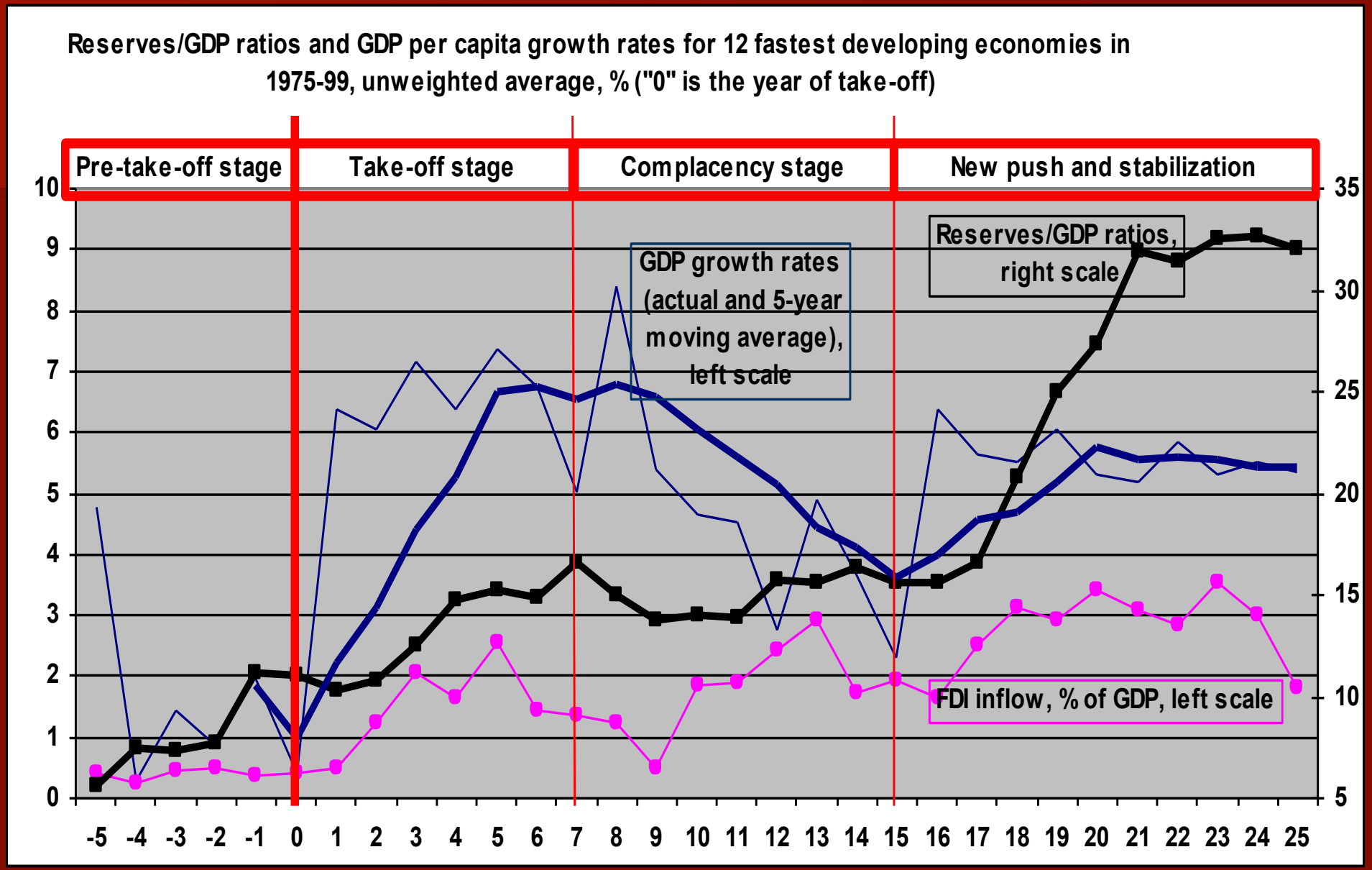
*, **, *** - Significant at 10%, 5% and 1% level respectively.

Real exchange rate in fast growing developing countries

Fig.6. Average real exchange rate versus the US $ (Year 12 = 100%) in fast growing developing economies, year "0" denotes the point of take-off



Reserves/GDP ratios and GDP per capita growth rates for 12 fastest developing economies in 1975-99, unweighted average, % ("0" is the year of take-off)



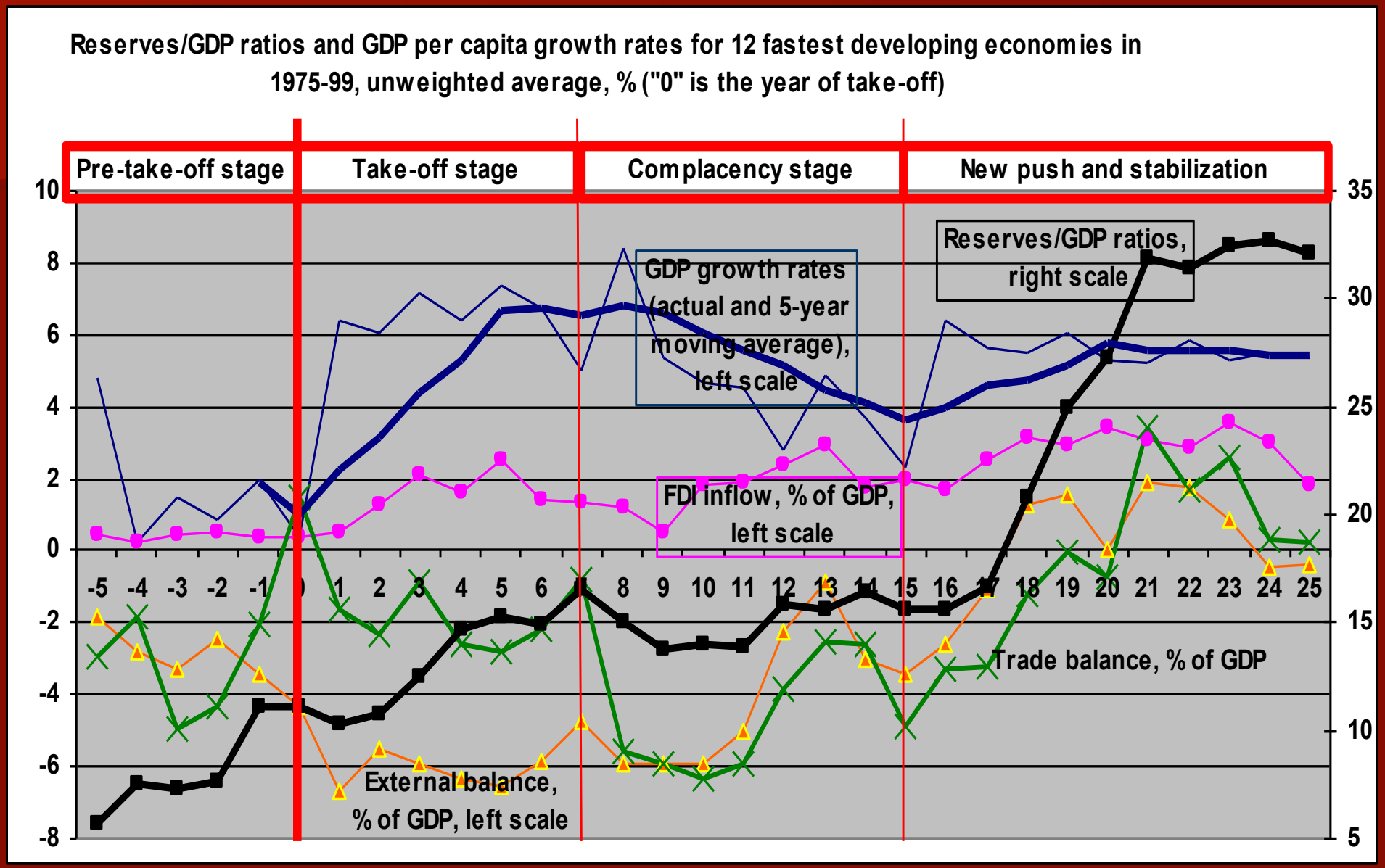
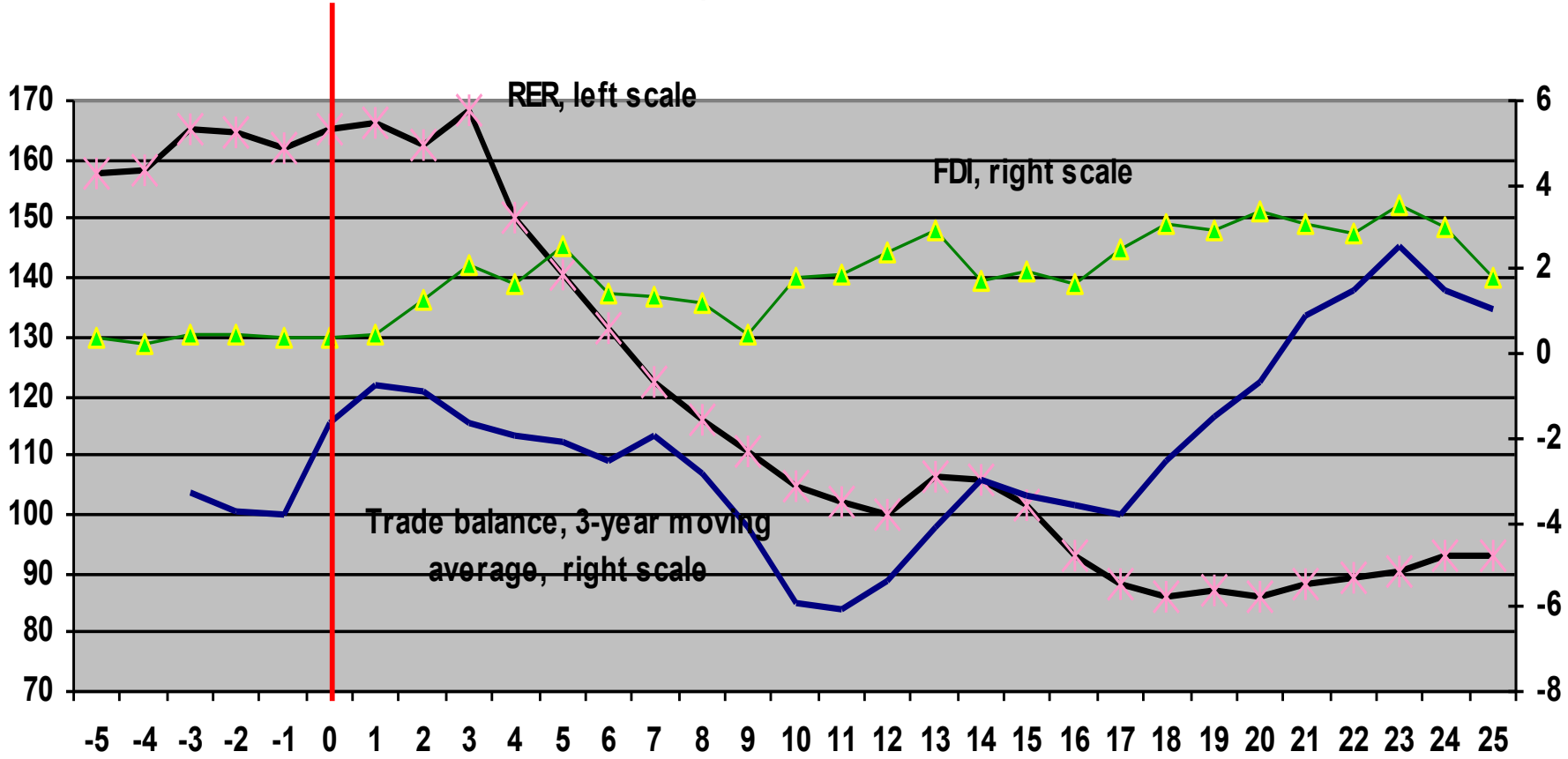
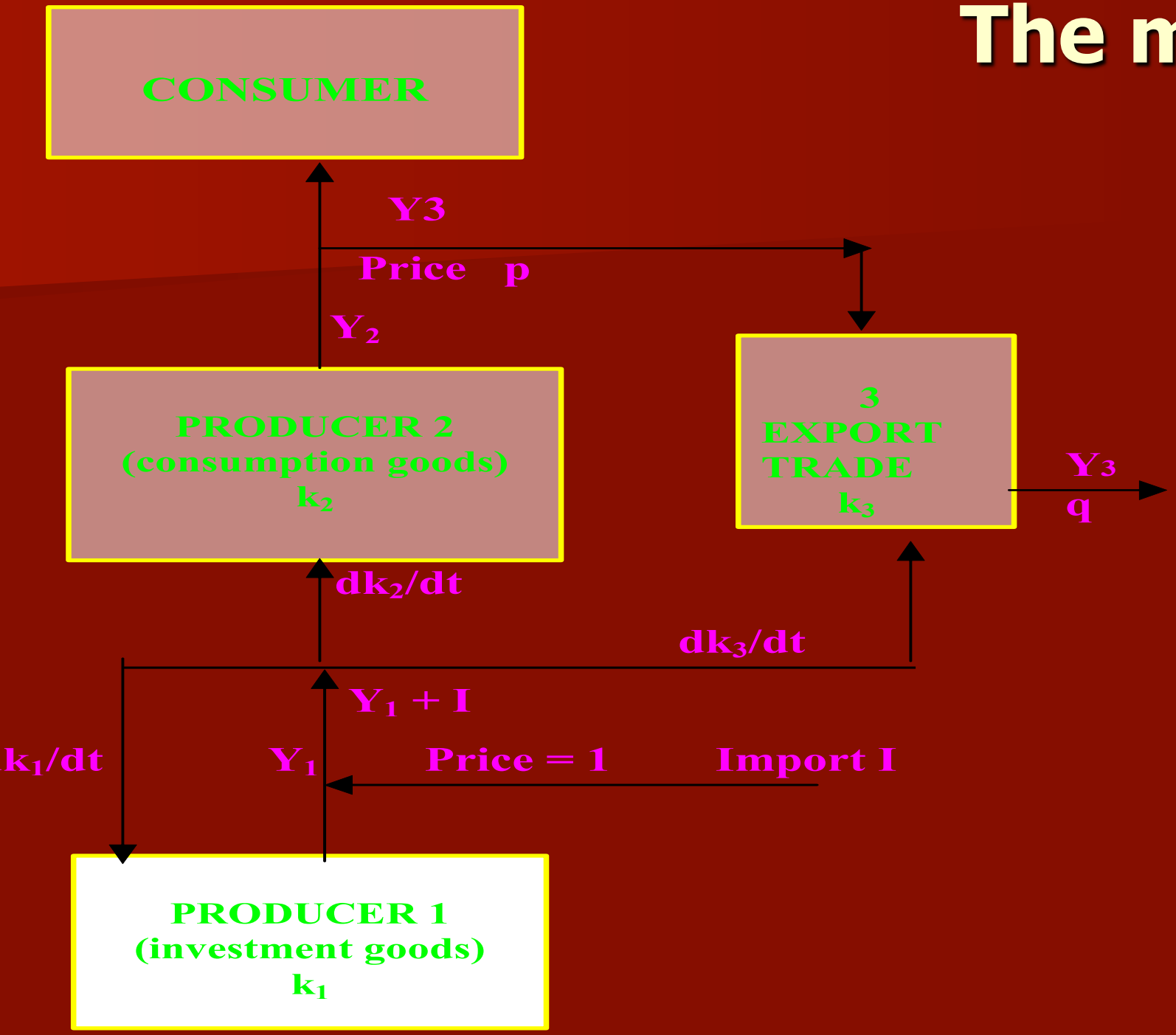

Reserves/GDP ratios and GDP per capita growth rates for 12 fastest developing economies in 1975-99, unweighted average, % ("0" is the year of take-off)
Pre-take-off stage
Take-off stage
Complacency stage
New push and stabilization
GDP growth rates (actual and 5-year moving average), left scale
Reserves/GDP ratios, right scale
FDI inflow, % of GDP, left scale
Trade balance, % of GDP
External balance, % of GDP, left scale
10
8
6
4
2
0
-2
-4
-6
-8
35
30
25
20
15
10
5
-5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

Fig. 3. 12. Average real exchange rate versus the US $ (Year 12 = 100%), trade balance and net inflow of FDI as a % of GDP in 12 fast growing developing economies, year "0" denotes the point of take-off



The model


CONSUMER
Y3
Price p
Y2
PRODUCER 2
(consumption goods)
k2
3
EXPORT
TRADE
k3
Y3
q
dk2/dt
dk3/dt
Y1 + I
k1/dt
Y1
Price = 1
Import I
PRODUCER 1
(investment goods)
k1