Foreign Trade Elasticities in Centre-Periphery Models of Growth and Development *

The question of 'why growth rates differ' between countries continues to preoccupy and fascinate economists. In this paper I want to argue that at the heart of differences in growth performance is the strength of the balance of payments position of countries, determined largely by the propensity to export relative to the propensity to import, as distinct from movements in the terms of trade (except in dramatic cases such as oil and the oil producing countries). This may sound trivial, but I believe is a profound insight; unfortunately not discovered by me! It is not a mercantilist argument (there is no virtue in balance of payments surpluses as such), but an insight into the process of income determination in open economies when relative prices in international trade are sticky for whatever reason, which they may be under a variety of market structures and different exchange rate regimes. The insight is in Harrod (1933), but more frequently crops up in the literature on economic development and the relationship between developed and developing countries; in so-called centre-periphery models of growth and development. Models of this genre now abound, but the essential truths about the nature of trade and the balance of payments difficulties of slow growing countries are all contained in the early classic papers. I shall concentrate on three of these important papers and demonstrate that although on the surface they may look different, fundamentally they all boil down to the simple rule that one country's growth rate (g_1) relative to other countries (g_w) can be approximated by the ratio of the income elasticity of demand for its exports (ε) to its income elasticity of demand for imports (π), i.e.

$$\frac{g_1}{g_w} = \frac{\varepsilon}{\pi} \qquad (1)$$

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* This paper was prepared as part of a series of seminars given at the Universities of Messina and Palermo, May 1983. I am most grateful to my hosts at the Istituto di Economia, Statistica e Analisi del Territorio, particularly Professor Centorrino and Amalia Sofio.

The only assumptions needed to produce this result are that in the long run trade must be balanced on current account (or that there is a constant ratio of capital inflows to export earnings) and that the real terms of trade (or the real exchange rate) remains constant. This rule governing long run relative growth rate differences between countries can be shown, in turn, to be nothing more than the Harrod trade multiplier, made dynamic. The models to be focussed on are those of Raul Prebisch (1950), Dudley Seers (1962), and Nicholas Kaldor (1970) (as formalised by Dixon and myself, 1975), and it will be shown that what the conclusions of each depend on, when stripped to essentials, is differences in the income elasticities of demand for exports and imports. Price elasticities of demand only assume importance if (i) the real terms of trade alter significantly in the long run and (ii) if the sum of the elasticities differs significantly from unity. Both conditions must be met if relative price changes in international trade are to alter the relationship between growth and the balance of payments as determined by income elasticities.

Raul Prebisch was the first development economist in the post-war era to seriously question the doctrine of the mutual profitability of trade between developed and less-developed countries. The traditional approach to the measurement of the gains from trade is from the classical standpoint of real resource augmentation from specialisation which trade permits. Prebisch concentrated attention on the monetary, or balance of payments, aspects of trade arguing, in effect, that the real resource gains from specialisation may be offset by the under-utilisation of resources if foreign exchange is the dominant constraint on output. Classical (Ricardian) trade theory assumes away both unemployment of resources and monetary balance of payments constraints through the assumptions of constant returns in all activities and relative price adjustments in trade. But if some activities are subject to diminishing returns (such as land-based activities) the full employment of resources cannot be guaranteed in these activities; nor can full employment be guaranteed if relative price changes do not work to maintain balance of payments equilibrium on current account. Less developed countries tend to specialise in diminishing returns activities and also appear to suffer perpetual balance of payments difficulties which stifle growth and development. Prebisch attributed the latter to the low income elasticity of demand for primary commodities which less-developed countries produce and export, compared to the higher income elasticity of demand for manufactures that developed countries produce and export.

We can illustrate the nature of the problem with a simple numerical example. Assume two countries: a less developed country (LDC) exporting solely primary commodities with an average income elasticity of demand of 0.5 ($\varepsilon_{LDC} = 0.5$), and a developed country (DC) exporting solely manufactured goods with an average income elasticity of demand of 2.0 ($\varepsilon_{DC} = 2.0$). The export elasticity of the LDC is the import elasticity of the DC ($\pi_{DC} = 0.5$), and the export elasticity of the DC is the import elasticity of the LDC ($\pi_{LDC} = 2.0$). For both countries to grow at the same rate, the situation is clearly not sustainable. For example, at a growth rate of 5 percent, the rate of growth of exports (x) and imports (m) in the two countries would be as follows:

LDC	DC
$x = 5 \times \varepsilon_{LDC} = 5 \times 0.5 = 2.5$	$x = 5 \times \varepsilon_{DC} = 5 \times 2 = 10$
$m = 5 \times \pi_{LDC} = 5 \times 2.0 = 10.0$	$m = 5 \times \pi_{DC} = 5 \times 0.5 = 2.5$

There would be a perpetual tendency to deficit in the LDC and a perpetual tendency to surplus in the DC. Balance of payments equilibrium in the LDC requires that the growth of output be constrained so that imports grow no faster than exports.

The constrained growth rate is equal to:

$$g_{LDC} = \frac{x_{LDC}}{\pi_{LDC}} = \frac{g_{DC} \times \varepsilon_{LDC}}{\pi_{LDC}} = \frac{5 \times 0.5}{2} = 1.25$$

Equilibrium balance of payments in both countries implies 1.25 percent growth in the LDC compared with 5 percent in the DC. The relative growth of the two countries is given by:

$$\frac{g_{LDC}}{g_{DC}} = \frac{\varepsilon_{LDC}}{\pi_{LDC}} = \frac{0.5}{2} = \tfrac{1}{4},$$

which is the simple growth rule enunciated in equation (1).

Prebisch's other major concern in his path-breaking paper was adverse movements in the barter terms of trade against developing countries which in his model is the means by which the fruits of technical progress are transferred from the 'centre' to the 'periphery'. A deterioration in the net barter terms of trade clearly means a reduction in real income by reducing the purchasing power of exports over imports, unless the balance of payments responds causing exports to

rise and the exchange rate to appreciate which improves the *real* terms of trade (the barter terms of trade adjusted for changes in the exchange rate) and real income. There has been some dispute in the literature whether the net barter terms of trade has moved consistently through history against the primary producing, LDCs as Prebisch claimed (see Johnson (1967) and Spraos (1980)). I do not want to enter this debate here except to say that the evidence since the second world war seems unequivocal; that the LDCs and primary commodities have both suffered, on average, a deterioration in purchasing power vis-à-vis other countries and manufactured commodities. The experience of primary commodities 1957-81 is shown in table 1, and the experience of low income, middle income, industrial, and capital surplus oil exporting countries is shown in table 2. It can be seen from table 1 that the purchasing power of all primary commodities declined from an index of 127 in 1957 (1975 = 100) to 94 in 1981, a drop of 24.1 percent. For individual commodities the degree of decline varies: 12.2 percent for food; 32.8 percent for beverages; 35.6 percent for agricultural raw materials and 24.4 percent for metals. Turning to table 2 we see that, on average, for LDCs within the low and middle income countries not exporting oil, the terms of trade deterioration averaged 14 percent; the position of the industrial countries remained virtually unchanged, and all real income gains from terms of trade changes accrued to oil exporters.

While the LDCs have experienced a deterioration in their terms of trade, however, the real income loss should not be exaggerated. The experience of individual countries varies considerably, but on average, the 14 percent deterioration amounts to less than one percent per annum, and makes no allowance for the possibility that such an adverse movement *may* have led to an improved balance of payments and higher exchange rate than otherwise would have been the case. It is often forgotten that when countries devalue their currency they deliberately deteriorate their terms of trade in the hope of real income gains from a greater volume of home production. Notwithstanding terms of trade losses, it would appear that the major factor to focus on in the Prebisch centre-periphery model is differences in the income elasticity of demand for primary commodities and manufactured goods.

Prebisch makes no mention in his paper of trade multipliers, but it is interesting to note that his implied result concerning relative growth rate differences between countries can be shown to be the same as that derived from Harrod's trade multiplier when it is put in a dynamic context. As far as I am aware, Harrod himself did not appreciate the

TABLE 1

PRICE INDICES OF PRIMARY COMMODITIES
(1975 = 100)

Year	All Commodities[1]		Major Groups: Deflated[2]			
	Nominal[3]	Deflated[2]	Food	Beverages	Agricultural Raw Materials	Metals
1957	57	127	90	171	163	131
1958	53	118	84	171	137	123
1959	52	117	85	146	154	121
1960	52	115	83	133	158	121
1961	50	109	79	124	145	119
1962	49	106	80	120	138	115
1963	52	113	96	118	142	114
1964	55	118	90	133	139	139
1965	54	112	82	118	132	149
1966	56	114	81	121	133	157
1967	52	106	81	119	119	132
1968	52	105	79	120	116	137
1969	56	110	82	121	119	145
1970	58	107	82	129	103	145
1971	55	96	78	112	96	118
1972	62	100	83	113	116	109
1973	95	132	110	120	178	137
1974	122	138	144	117	141	140
1975	100	100	100	100	100	100
1976	113	112	81	189	123	105
1977	137	125	72	302	117	104
1978	130	103	71	190	109	95
1979	152	106	71	177	117	109
1980	166	104	86	140	110	108
1981	142	94	79	115	105	99

[1] Overall index of 30 primary commodities exported by developing countries (excluding gold and crude petroleum).
[2] Deflated by the UN index of manufactures exported by developed countries.
[3] In terms of U.S. dollars.
Source: IMF Survey, April 5th 1982.

TABLE 2

TERMS OF TRADE 1960-1979
(1975 = 100)

	Index		% Change
	1960	1979	
Low Income Countries	113	97	− 14.2
Middle Income Countries (Oil Importers)	109	94	− 13.8
Middle Income Countries (Oil Exporters)	69	113	+ 60.9
Industrial Countries	100	98	− 2.0
Capital Surplus Oil Exporters	26	118	+353.8

Source: World Development Report 1981. Table 8.

growth implications of the balanced trade model he outlined in 1933. His model with net autonomous expenditure (other than exports) zero, and the terms of trade constant, gives the linear foreign trade multiplier result of:

$$Y = \frac{X}{m} \qquad (2)$$

where Y is real income; X is the volume of export demand (exogenously determined), and m is the marginal propensity to import.[1] For balanced trade to be preserved in a growing economy requires that import growth and export growth are equal. We can make equation (2) dynamic in the following way:

From equation (2) $\frac{\Delta Y}{\Delta X} = \frac{\Delta Y}{\Delta M}$, and since M = X, we have:

$$\frac{\Delta Y}{\Delta X} \cdot \frac{X}{Y} = \frac{\Delta Y}{\Delta M} \cdot \frac{M}{Y}.$$

Therefore, $g = \frac{x}{\pi}$, where $\pi = (\Delta M/\Delta Y)\ (Y/M)$ is the income elasticity of demand for imports. Thus, in a balanced trade framework, with the real terms of trade constant, countries are constrained to grow at this rate. This is the Prebisch rule, and a country's relative growth rate will be equal to:

$$\frac{g_1}{g_w} = \frac{\varepsilon}{\pi} \quad (\text{since } x = \varepsilon g_w).$$

Seers' Model

In 1962 Seers outlined an elaborate and technically sophisticated centre-periphery model, which was largely ignored by the profession. It was, however, remarkably perceptive, and also has as its basis the disparate income elasticities of demand for goods exported and imported by two sets of countries.[2] Two of the assumptions of the basic model are also the same as those of Prebisch and Harrod: trade is balanced

[1] The marginal propensity is not necessarily equal to the average if there are autonomous imports in the system.

[2] Dudley Seers died on the 21st March 1983. He was perhaps best known as an international civil servant and propagandist, but he was also an accomplished and original theorist.

and the terms of trade remain unchanged. The periphery (p) exports only primary commodities, and the centre (c) exports only finished goods. The import functions are expressed in arithmetically linear form:

For the centre $M_c = A_c + B_c Y_c$ (3)

For the periphery $M_p = a_p + b_p Y_p$ (4)

Balanced trade requires: $a_p + b_p Y_p = A_c + B_c Y_c$ (5)

$$\text{or } Y_p = \frac{(A_c - a_p) + B_c(Y_c)}{b_p} \qquad (6)$$

$$\text{Therefore } \frac{Y_p}{Y_c} = \frac{A_c - a_p}{b_p Y_c} + \frac{B_c}{b_p} \qquad (7)$$

Equation (7) expresses the relative difference in income levels between the periphery and the centre in terms of the parameters of the import demand functions. What will happen to this relative difference through time? Assume income in the centre grows exponentially at rate r, so that $Y_{ct} = Y_{co}e^{rt}$.

Equation (7) can then be written as:

$$\frac{Y_p}{Y_c} = \frac{A_c - a_p}{b_p Y_{co} e^{rt}} + \frac{B_c}{b_p} \qquad (8)$$

Differentiating with respect to time (t):

$$\frac{d(Y_p/Y_c)}{dt} = \frac{-r(A_c - a_p)}{b_p Y_{co} e^{rt}} \qquad (9)$$

If $A_c > a_p$, the periphery will become relatively poorer through time; in other words, growth must be slower in the periphery than the centre if balance of payments equilibrium is to be preserved. If the income elasticity of demand for imports (of manufactures) in the periphery is greater than unity, a_p in the linear import demand function must be negative; and if the income elasticity of demand for imports (of primary commodities) in the centre is less than unity, A_c in the linear import demand function must be positive. Therefore $A_c > a_p$, and relative income levels will diverge. Relative *per capita* income levels will diverge even more if population growth is faster in the periphery than in the centre. Hypothetically, sufficient capital flows from the surplus centre to the deficit periphery could prevent the relative income gap from widening, but the flow would have to be at a constant proportionate

rate through time, implying a higher and higher *level* of flow and an ever-increasing debt repayment burden. This is feasible in the very short term, but not in the long term. As far as the long run solution to the problem is concerned, Seers draws the same conclusion as Prebisch, namely that there is no solution without a change in the structure of production to make the import functions of the periphery look more like those of the centre; in other words, to narrow the difference in the income elasticity of demand for exports of the two sets of countries by import substitution in the periphery.

A Model of Balance of Payments Constrained Growth with Capital Flows

In the models so far, the terms of trade have been assumed fixed, and trade has been balanced. Let us now develop a simple model in which these assumptions are relaxed to show formally what difference this makes. We can also see by imposing the restrictions again how the Prebisch, Harrod and Seers insight is obtained by another route.

The balance of payments may be expressed as:

$$P_{dt}X_t + C_t = P_{ft}M_tE_t \qquad (10)$$

where X_t is the volume of exports; P_{dt} is the domestic price of exports; M_t is the volume of imports; P_{ft} is the foreign price of imports; E_t is the exchange rate (measured as the domestic price of foreign currency) and C_t is the value of capital flows measured in domestic currency.

$C_t > 0$ measures capital inflows, and allows imports to exceed exports on current account, $C_t < 0$ measures capital outflows, and $C_t = 0$ implies balance of payments equilibrium on current account. Taking rates of change of the variables in equation (10) gives:

$$\frac{E}{R}(p_{dt} + x_t) + \frac{C}{R}(c_t) = p_{ft} + m_t + e_t\,, \qquad (11)$$

where lower case letters represent proportionate rates of change, and E/R and C/R represent the shares of exports and capital flows in total receipts to finance the import bill. We now need to specify export and import demand functions.

Assuming constant elasticities, let:

$$X_t = \left(\frac{P_{dt}}{P_{ft}E_t}\right)^{\eta} Z_t^{\varepsilon} \qquad (12)$$

and

$$M_t = \left(\frac{P_{ft}E_t}{P_{dt}}\right)^{\psi} Y_t^{\pi} \qquad (13)$$

where η (< 0) is the price elasticity of demand for exports; Z_t is the level of income outside the country; $\varepsilon(> 0)$ is the income elasticity of demand for exports; $\psi(< 0)$ is the price elasticity of demand for imports; Y_t is domestic income, and $\pi(> 0)$ is the income elasticity of demand for imports. Taking rates of change of the variables (represented by lower case letters) in equations (12) and (13), we have:

$$x_t = \eta(p_{dt} - p_{ft} - e_t) + \varepsilon(z_t) \qquad (14)$$

$$\text{and } m_t = \psi(p_{ft} + e_t - p_{dt}) + \pi(y_t) \qquad (15)$$

Substituting (14) and (15) into (11), and rearranging, gives the balance of payments equilibrium growth rate with capital flows:

$$y_{Bt} = \frac{(p_{dt} - p_{ft} - e_t) + \left(\frac{E}{R}\eta + \psi\right)(p_{dt} - p_{ft} - e_t) + \frac{E}{R}(\varepsilon(z_t)) + \frac{C}{R}(c_t - p_{dt})}{\pi} \qquad (16)$$

It can be seen from equation (16) that any country's growth rate can be disaggregated into four component parts. The first term on the R.H.S. gives the pure terms of trade effect; the second term gives the volume effect of relative price changes on balance of payments constrained real income growth; the third term gives the effect of exogenous changes in income growth abroad, and the last term gives the effect of the growth of *real* capital inflows (outflows). The effect of all these terms is 'deflated' by π. In principle the contribution of each of these terms to a country's measured growth rate can be evaluated (see Thirlwall and Hussain, 1982). It can also be seen that if relative prices measured in a common currency are assumed constant, so that $p_{dt} - p_{ft} - e_t = 0$, the model reduces to:

$$y_{Bt} = \frac{\frac{E}{R}(\varepsilon(z_t)) + \frac{C}{R}(c_t - p_{dt})}{\pi} \qquad (17)$$

The balance of payments equilibrium growth rate *without* capital flows would be $\varepsilon z_t/\pi$ or x_t/π, and a country's relative growth would be $y_{Bt}/z_t = \varepsilon/\pi$ as before. With capital flows, the growth rate will be higher or

lower than the simple rule depending on whether real capital inflows grow at a faster or slower rate than the volume of exports. If real capital inflows into the periphery are faster than the growth of export volume, the relative gap in income differences between centre and periphery would narrow. From (17) we have:

$$\frac{y_{Bt}}{z_t} = \frac{\frac{E}{R}\varepsilon + \frac{C}{R}(c_t - p_{dt})}{\pi} \qquad (18)$$

which is a faster relative growth rate than ε/π, if $(c_t - p_{dt}) > (\varepsilon z_t)$.[3]

Kaldor's Model

The centre-periphery model of Kaldor is an export-led growth model in the tradition of models of circular and cumulative causation. These models were brought to the fore in the post-war period by Myrdal (1957) and Hirschman (1958) and have at their base the phenomenon of macro-increasing returns in the sense of Allyn Young (1928) which is captured by the so-called Verdoorn relation — the relation between the rate of growth of productivity *induced by* the growth of output itself. There are a number of *a priori* reasons for expecting such an induced relation, the most obvious being that output growth induces capital formation and this embodies technical progress. Learning by doing and other externalities also play a part. There is no balance of payments constraint in the Kaldor model but it is easy to incorporate one (see Thirlwall and Dixon, 1979) and to show that if balance of payments equilibrium is a requirement and relative prices are constant, the Kaldor model reduces to the Prebisch-Harrod-Seers result. Kaldor did not formalize his model. This was later done by Dixon and myself (1975) in the following way:

Consider an open economy — a region or country — in which exports are the major component of autonomous demand, to which

[3] I have applied the simple model without capital flows to Italy's growth rate over the period 1951-1973. With $x = 11.7\%$ and $\pi = 2.25$, a growth rate of 5.2 percent per annum is predicted compared with the actual growth rate of 5.1 percent. With $\varepsilon = 2.95$, Italy's *relative* growth rate is predicted as $2.95/2.25 = 1.31$, which also fits the historical facts. See Thirlwall, 1979, 1983.

other components of demand adapt. Exports not only have a direct multiplier effect on output, but a Hicks super-multiplier effect allowing other components of demand to increase without balance of payments difficulties arising.[4] Hence:

$$g_t = \gamma(x_t) \qquad (19)$$

We already derived an expression for export growth in equation (14):

$$x_t = \eta(p_{dt} - p_{ft} - e_t) + \varepsilon(z_t) \qquad (20)$$

Now let export prices be based on a markup on unit labour costs so that:

$$p_{dt} = w_t - r_t + \tau_t \,, \qquad (21)$$

where w_t is the growth of money wages; r_t is the growth of labour productivity and τ_t is the rate of change of (1 + % markup).

Finally, let productivity growth be a function of the growth of output itself:

$$r_t = r_{at} + \lambda(g_t) \qquad (22)$$

It is this relation that makes the model 'circular and cumulative'; that is, fast export growth leads to high output growth which leads to fast productivity growth which feeds back to fast export growth and output growth through the favourable effect of productivity growth on relative prices. Once a country obtains a growth advantage it will tend to keep it by making it difficult (at least without protection) for other countries to establish the same activities. This is also the essence of the mechanism whereby the opening up of trade between countries may create growth differences which are sustained or even widened by the process of trade. Combining equations (19) (20) (21) and (22) gives an expression for the equilibrium growth rate of:

$$g_t = \frac{\gamma[\eta(w_t - r_{at} + \tau - p_{ft} - e_t) + \varepsilon(z_t)]}{1 + \gamma\eta\lambda} \qquad (23)$$

Remembering that $\eta < 0$, the growth rate is shown to vary positively with r_{at}, p_{ft}, e_t, ε, z_t and λ and negatively with w_t and τ. As far as growth rate differences between countries are concerned, the Verdoorn coefficient (λ) serves to exaggerate those differences. Whether growth between countries is divergent or convergent depends on the behaviour of the system out of equilibrium. It can be shown that cumulative

[4] See McCombie (1983) for a discussion of the relation between the Harrod trade multiplier and the Hicks super-multiplier.

divergence in a two-country model will depend on whether for one country $|(-\gamma\eta\lambda)| > 1$. If we assume for the moment a constant proportion of exports to total output so that $\gamma = 1$, and that $\lambda = 0.5$, [5] the price elasticity of demand for exports (η) would have to exceed 2 for divergent growth. This is possible, but we do not observe the world 'exploding'! It is more likely that differences in country growth rates reflect differences in equilibrium rates, rather than a divergent process proceeding through time. But different equilibrium growth rates will, of course, still cause relative differences in levels of income to widen. Peripheral countries, producing and exporting primary products, will tend to have a low equilibrium growth rate owing to a low ε, while centre countries producing and exporting manufactured goods will tend to have a much higher equilibrium growth rate not only because ε is higher but also because the price elasticity of demand for exports and the Verdoorn coefficient are higher. In agricultural regions, there is unlikely to be a Verdoorn relation.

If the Kaldor model is simply treated as an export-led growth model, with no feed-back relation through the Verdoorn effect, and relative prices are held constant, we see that equation (23) reduces to

$$g_t = \gamma\ \varepsilon(z_t) \qquad (24)$$

Further, if a balance of payments constraint is imposed $\gamma = 1/\pi$, where π is the income elasticity of demand for imports. Therefore, once again, $g_t = \frac{\varepsilon(z_t)}{\pi}$ or $\frac{g_t}{z_t} = \frac{\varepsilon}{\pi}$. The ratio of one country's growth rate to others is the ratio of its export elasticity to its import elasticity.

Conclusion

In this paper I have tried to show how the various centre-periphery models of Prebisch, Seers and Kaldor all have as their essential feature the lower income elasticity of demand for primary commodities in world trade than manufactured goods, and that if long run balance of payments equilibrium on current account is a requirement and the real terms of trade is constant, the relative growth rates of the periphery and

[5] This is a typical estimate of the Verdoorn coefficient found in manufacturing.

centre will approximate to the ratio of the periphery's export elasticity to its import elasticity. It has also been shown that this result can be derived from the dynamic Harrod trade multiplier on the same assumptions. The extent to which the terms of trade do remain constant over the long run, and current account balance is maintained, are empirical questions which can only be answered by appeal to the historical facts. Data for several countries in the post-war period do not suggest that relative price movements in international trade are an efficient mechanism for relieving countries of a balance of payments constraint on growth, or that capital inflows can raise the growth rate permanently above the level that otherwise would prevail. To understand relative growth performance in open economies, it is to the income elasticities of demand for exports and imports that we must look.

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