THE NORMAL PATTERN OF INTER-SECTORAL RESOURCE FLOWS : AN APPLICATION OF THE OUTPUT COMPOSITION FUNCTION

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THE NORMAL PATTERN OF INTER-SECTORAL RESOURCE FLOWS[1/]
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1. The Resource Transfer Problem

The transfer of resources across sectors is a classic concern of the theory of economic development. Nevertheless our state of knowledge on this question may be described as virtually pre-scientific. The proposition that a surplus has to be extracted from agriculture in order to provide the resources for industrialisation was orginally formulated by Preobrazhensky (1926) sixty years ago in his Law of Primitive Socialist Accumulation while adapting Marx's concept of primitive accumulation for his own theory of socialist transition. A similar idea was later put forward in the Lewisian tradition of modern development theory (Ranis and Fei, 1964).

Technically the Ranis-Fei concept of agricultural surplus, 'the difference between the truckloads of food and raw materials delivered to the industrial sector and the

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industrial goods sent in the opposite direction', is different from the Preobrazhensky concept. Since flows in both directions consist of bundles of heterogeneous goods, a vector of weights has to be employed to get around the adding up problem. For Preobrazhensky the weights in question are labour values, or labour embodied per unit of output in each commodity, such that the agricultural surplus is a quantity of labour values. Ranis-Fei did not specify the weights to be used but presumably these are a set of prices. For accounting purposes, current or some base year prices could be used, but in principle the prices in question would be equilibrium prices. Since a vector of market clearing prices would not in general correspond to labour values or their modern counterpart, Sraffian prices of production, the two measures of agricultural surplus are technically different.

However, the essential idea is the same, namely, that a surplus measured at some appropriate set of weights has to be extracted from agriculture to provide the necessary resources for industrialisation. That food and fibre must be supplied by agriculture to feed the industrial work force and provide it with the necessary raw materials is obvious.[1] But it does not follow that these goods must be supplied or can only be supplied in the form of a surplus. Such a surplus may indeed be extracted in the form of a tax or the manipulation of the terms of trade against agriculture or simply a balance of trade deficit for industry financed by savings transfers, net factor payments or other current transfers

1/ This is less obvious in the case of open economies since international trade is seen as an alternative source of supply. However, we can ignore geopolitical boundaries and view trading partners as belonging to a single integrated economy. The necessary relationship between agriculture and industry is then not obscured by the fact of trade.

from agriculture. But the food and fibre could just as well be supplied on the basis of balanced trade between the sectors at normal prices (or labour values) and a zero transfer of surplus out of agriculture or even a trade deficit (surplus inflow) for agriculture.

The precise conditions under which food and fibre have to be extracted as a surplus from agriculture are not well established. On the contrary, Ishikawa (1967) argued that industrialisation, at least under conditions typical of many Asian countries, would be facilitated by a transfer of resources into agriculture. Against this uncertain theoretical background a number of empirical exercises followed, starting with Ishikawa's own tentative estimates for several Asian countries, where attempts were made to measure the inter-sectoral flow of resources.

Among others we have Lee's estimate for Taiwan: 1895-1960 (Lee, 1971); Barsov's estimate for the Soviet Union: First Five Year Plan (Ellman, 1975); Mundle and Ohkawa's estimate for pre-war Japan: 1888-1937 (Mundle-Ohkawa, 1979); Sharpley's estimate for Kenya (Sharpley, 1979); Lardy's estimate for China (Lardy, 1980) and Mundle's estimate for India: 1951-1971 (Mundle, 1981). The various exercises seem to indicate conflicting resource flow patterns. In fact the different exercises are not really amenable to comparison, partly because of differences in the concept of resource flow employed and partly because of differences in the content, reliability or coverage of data which were available for the different countries. As such these empirical exercises have not really helped to clear up or resolve the theoretical controversy.2/

An answer to the question of surplus extraction from agriculture has proved elusive, it seems to me, because the question has been wrongly posed. We can certainly ask what has actually happened in one or another country, as the above exercises have done. But this is quite different from asking whether in general industrialisation requires surplus extraction from agriculture. The general question cannot be answered unambiguously if the resource flow requirements are embedded in structural conditions which may vary from one country to another.

The main purpose of this paper is to argue that indeed the inter-sectoral resource flow requirements are structurally determined. Given relative prices, the normal or required pattern of resource flow is determined by the particular combination of per capita output in agriculture, work force distribution and output composition obtaining in an economy. For some combinations industrialisation will require a net resource transfer out of agriculture while for other combinations resources may have to be transferred to agriculture. Policy on these questions should be guided by the nature of divergence between the normal and the actual

2/ For a heroic attempt to consolidate some of these estimates and produce a consistent explanation, see Ishikawa (1986).

pattern of resource flows in an economy. The second section of this paper deals with what I have called the Output Composition Function (OCF), a basic relationship from which the determinants of the normal resource flow pattern are then derived and analysed in section three. In the final section of the paper some cross-country data are examined in relation to the analytical discussion.

2. The Output Composition Function

One of the most firmly established observations in the 'patterns of development' literature of the Clarke-Kuznets-Chenery tradition is the existence of a distinct relationship between the level of output (per capita) in an economy and the composition of that output. The composition changes in a predictable way as the level of output rises. In a recent book, Pasinetti (1981) has provided what I would regard as a theoretical explanation of this observed pattern, though the book itself goes much beyond this.

Addressing himself to the classical question of long-term dynamics and accumulation, Pasinetti builds a model where, predictably, technical progress is the exogenous force which drives the whole mechanism of growth. Technical progress is embodied in rising productivity and decreasing unit costs which in turn lead to rising incomes. Pasinetti then replaces conventional consumer behaviour theory by an alternative theory of a hierarchy of wants under which the composition of consumption demand evolves in a particular manner along an Engel-like function with rising per capita income and population growth. By then replacing the usual

Leontief-type economy by a system of vertically integrated sectors, each one producing a final consumption good output, using suitably defined input coefficients, labour coefficients and capital stock coefficients (all reducible to labour coefficients), Pasinetti constructs a multi-sector full employment growth model where natural prices, natural rates of profit and natural outputs of all sectors are determined for all points of time.

The model stands in sharp contrast to the Leontief model since it is dynamic and technical change is central to its mechanism. The relevant coefficients are in a permanent state of change. It is also very different from the Von Neumann model since all sectors do not grow at a maximum uniform rate equal to the uniform rate of profit. Instead, each sector has its own equilibrium growth rate and its own natural rate of profit. The pattern of equilibrium growth so far established is pre-institutional, the model being closed by the assumption of full employment. By introducing capitalist institutions, in particular the tendency towards an equalisation of the rate of profit across sectors, even though productivity and demand conditions evolve differently for different sectors, cycles and instablity are now knitted into the long-term dynamic of growth and structural change.

This brief sketch does no justice to Pasinetti's pathbreaking work, but it serves our limited purpose of theoretically establishing the existence of a relationship between the level of output and its composition. Phenomena like business cycles and instability which are shown to arise from the tension between natural equilibria and profit-guided equilibria in Pasinetti's model are blurred as we shift our attention from the short run to the long run. Long-term phenomena like the structural relationship between the level of output and its composition now come into focus. In other words, we now have at the level of theory an explanation for the systematic changes in the composition of output with changes in the level of output, observed over time for individual countries or across countries at different levels of income at a given point of time, long established by empirical research in the Clarke-Kuznets-Chenery tradition.

Two remarks are in order here regarding the effects of foreign trade and cross-country differences in relative prices. The Pasinetti model establishes the existence of an output composition function in the context of a single closed economy. In an open economy the Pasinetti-type mapping from income levels to production bundles via consumption bundles may be disturbed by foreign trade. Furthermore, the output composition relationship may be distorted in a set of cross-section observations drawn from different countries by inter-country differences in relative prices. The Pasinetti theory of an output composition function, or any other theory which may replace it, can therefore be taken to explain observed patterns of change in output composition across countries only on the basis of two additional propositions:

One, the price elasticity of domestic demand for major commodity groups is relatively low, such that the consumption pattern is largely determined by the level of per capita income.

Two, foreign trade either reinforces, or is generally too small to offset, the relationship between the structures of domestic consumption and domestic production which the Pasinetti model establishes for a closed economy.

The validity of the first proposition is empirically well established (Weiskoff, 1971; Lluch, 1973). Regarding the second proposition Chenery and Syrquin (1975) have shown that it is valid for large economies with over fifteen million population and partly applicable for smaller economies where the ratio of traded goods to national income is typically higher. They agree that the data seem to support Hinder's theory of export patterns adjusting to domestic production patterns with a time lag. A similar point about domestic production leading exports has been made specifically in the context of Japan by Ohkawa and Rosovsky (1973).

On the basis of these arguments we can now move directly to our own estimation of the output composition function from cross-country data. Usually output composition changes have been observed at the two-, three- or four-sector level of disaggregation. At the two-sector level of disaggregation appropriate for our purpose, with a separation between agricultural and non-agricultural activities (labelled agriculture and industry for convenience), the observed change is quite simply a rise in the share of industry with rising income[3/]. There are alternative ways of representing

3/ For an alternative representation of this relationship at the four-sector level of disaggregation, along with several other 'development processes', see Chenery and Syrquin(1975). In their exercise four output composition variables were employed, i.e., the shares of primary sector, industry, utilities and services in total output. These composition variables were regressed on per capita income and size (population) using a semi-log quadratic function. This functional form was applied to all their ten 'development processes' for considerations of unity and comparability across processes even though it gave rather poor fits for some of the process variables.

the OCF. Here per capita industrial output is expressed as a function of total per capita output. The only a priori restriction on the form of the function is that industrial output per capita should change more than proportionately with a change in the level of total per capita output, technically a change elasticity greater than unity. Several functional forms satisfying this restriction were tried on two data sets consisting of 85 countries for 1960 and 98 countries for 1980 drawn from the World Bank tables.4/

Multiplicative forms such as the double-log, semi-log or semi-log quadratic forms yielded poor fits while additive forms such as the linear or quadratic functions gave extremely good fits. Of these the linear form was chosen though the quadratic form gave a marginally higher coefficient of explained variation since the coefficients of the quadratic terms were not different from zero upto the fourth or fifth decimal place. The estimates of the linear function for 1960 and 1980 are given below:

	a	b	$\bar{R}^2$	F	SE
1960	-42.8264* (3.9586)	+0.9506* (0.0059)	0.9968	26098.100	28.1920
1980	-173.90122* (19.6505)	+0.9831* (0.0035)	0.9988	80013.4276	164.03333

Note: Figures in parentheses are standard errors. Asterisk indicates statistical significance at the one per cent level.

4/ Sources, limitations and organisation of the data are discussed in a separate appendix. Interested readers can obtain copies from the author on request.

We note that both in 1960 and 1980 variations in industrial output per capita across countries are almost completely explained by variations in per capita output. A unit increase in total output per capita yielded an increase of 0.95 of a unit of industrial output per capita in 1960 and 0.98 of a unit in 1980. The very high coefficient of explained variation and high levels of statistical significance of the estimated parameters together indicate an extremely good fit for the estimated function.

This linear form implies that influences other than total output operating on the level of industrial output are either additively separable from total output or operate _via_ their effect on the level of total output itself. However, we also know that less than one per cent of the variation in industrial output is left unexplained by total output variations such that the additively separable influences are very minor. This and the relative stability of the slope, estimated from two different sets of cross-section data separated by twenty years in time, together indicate that the linear function properly specifies the relationship between per capita industrial output and total output which we have earlier described as the output composition function for a two-sector economy. The high slope of the estimated functions also has far-reaching implications regarding the normal pattern of inter-sectoral resource flow. These will be taken up in the final section of the paper.

3. The Normal Resource Flow Relationship

The output composition function (OCF) estimated above plays no important role in the received theory of long-term economic development, indeed it is hardly recognised in the theory, even though the existence of this relationship has been long established empirically by studies in the Clarke-Kuznets-Chenery tradition. This omission is intriguing and certainly unfortunate since strategically the place of this relationship in the long-term process of development is perhaps no less important than, say, the role of the consumption function in the Keynesian short-period theory of income determination. Here we discuss only one of the numerous possible applications of the OCF, namely, the normal inter-sectoral resource flow relationship.

The estimated OCF tells us that per capita expenditure on industrial (non-agricultural) goods and services is a linear function of per capita income. The residual expenditure on agricultural goods is also determined by the same function. This linear relationship can now be used to analyse the normal pattern of inter-sectoral resource flows and its determinants.

Where N_a, N_m and N denote the size of population (= work force) in agriculture, industry and the whole economy respectively, we have the identity

$$N = N_a + N_m \qquad (1)$$

Where b is the marginal propensity to spend on industrial goods and y_a is per capita income in the agricultural sector, the per capita demand for industrial goods in agriculture 'd' is given by the linear function

$$d = by_a - a \qquad (2) \qquad 0<b<1$$

Similarly, where y_m is per capita income in industry, the per capita demand for agricultural goods in industry 'r' is given by

$$r = a + (1 - b)\, y_m \tag{3}$$

Finally, denoting D for the value of total deliveries from industry to agriculture, R for the value of total receipts by industry from agriculture and B as the balance of trade for agriculture against industry or the net transfer of real resources from one to the other, we have the identity

$$B = R - D \tag{4}$$

From equations (1) to (4) we now get

$$B = [a + (1-b)\, y_m] N_m - (by_a - a)\, N_a \tag{5}$$

Defining $n = N_a/N$, from (5) we get

$$B = aN + (1-b)\, y_m\, (1-n)\, N - by_a\, nN \tag{6}$$

From (6) we get the relationship

$B \gtrless 0$ if and only if

$$aN + (1-b)(1-n)\, y_m\, N \gtrless by_a\, nN \tag{7}$$

Dividing through by N we get

$$B \gtrless 0 \Leftrightarrow a + (1-b)(1-n)\, y_m \gtrless by_a\, n \tag{8}$$

Dividing through by $(1-b)(1-n)$ on the right hand side of the equivalence and rearranging terms, we get

$$B \gtrless 0 \Leftrightarrow y_m \gtrless \frac{bn}{(1-b)(1-n)}\, y_a - \frac{a}{(1-b)(1-n)} \tag{9}$$

Defining y_m^* as that value of y_m for which $B = 0$ we get the relationship

$$Z^* = \frac{bn}{(1-b)(1-n)} - \frac{a}{(1-b)(1-n)y_a} \qquad (10)$$

where Z* is the output-composition ratio (y_m^*/y_a) along what may be called the zero resource transfer frontier. As depicted in figure 1 an industrially oriented economy which lies above this line would normally require a net resource flow from agriculture to industry while agriculturally oriented economies lying below this line would require a net resource flow to agriculture from industry.

It follows that the required pattern of resource flow between sectors does not depend either on the absolute level of per capita income in an economy or on the absolute levels of per capita income in agriculture or industry <u>per se</u>. Rather it depends on a specific structural relationship between per capita incomes in the two sectors and the industrial or agricultural orientation of the economy <u>with reference to this structural relationship</u>.

Furthermore, this relationship incorporates the sectoral distribution of population n. As will be evident from equation (10), the zero resource flow frontier shifts upwards or downwards for higher or lower values of n, the share of agriculture in total population. The same applies to the parameters 'a' and 'b'. The higher the level of 'b' or lower the level of 'a' the higher would be the threshold y_m^*, given y_a, beyond which an economy would require a net resource transfer out of agriculture. This has been illustrated in figure 2 for the parameter 'b'.

FIG-1

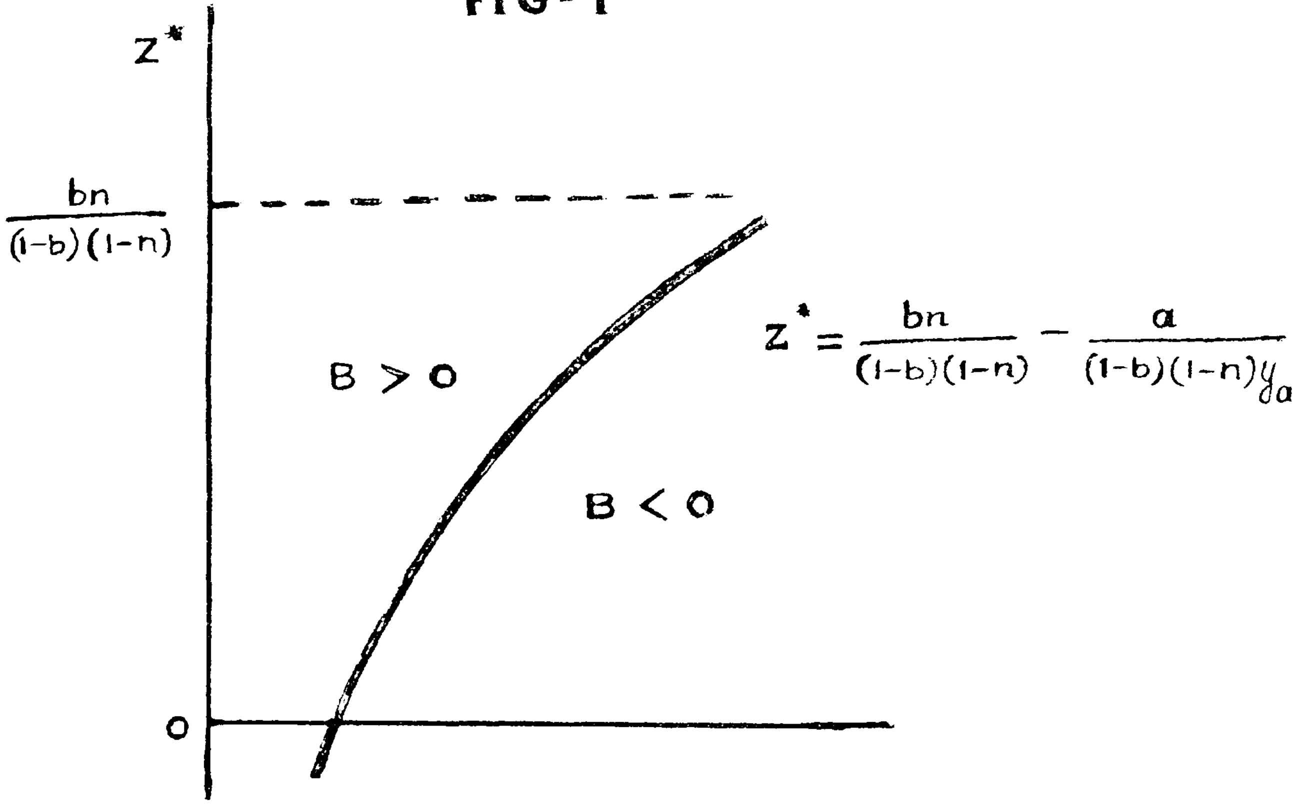
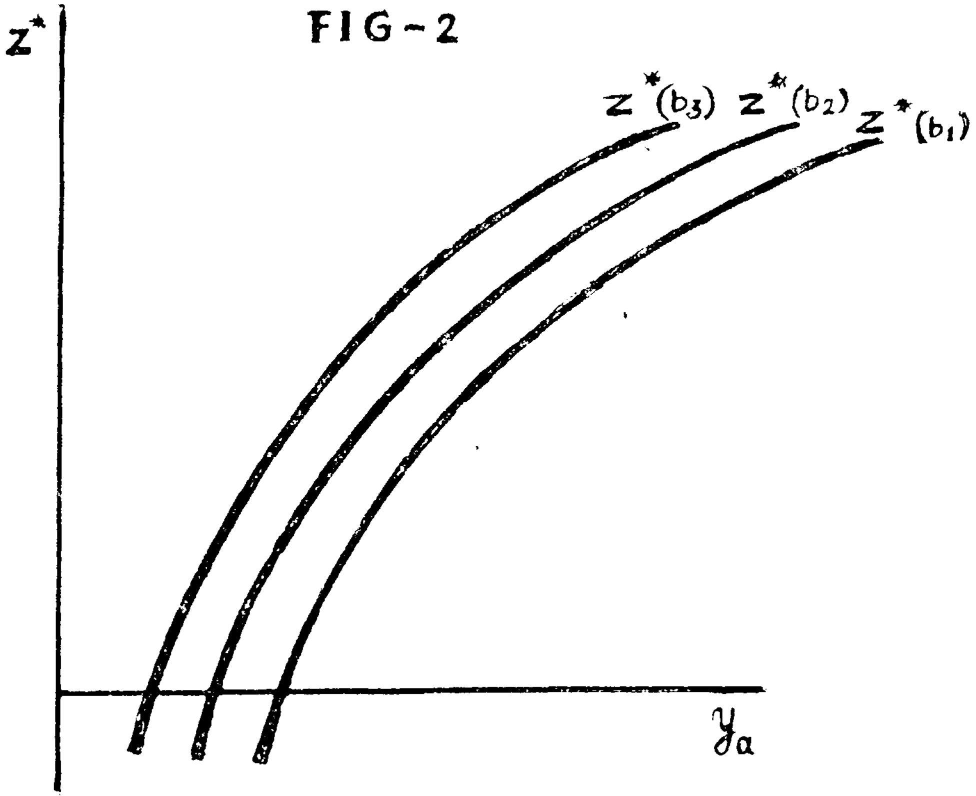


FIG-2



$0 < b_1 < b_2 < b_3 < 1$

The above results have a direct bearing on policies with regard to inter-sectoral resource transfers. General propositions that resources must be either transferred out of agriculture or into agriculture as part of a general programme of industrialisation are untenable. Taking the zero resource transfer frontier to represent a balanced growth path for our purpose, the required resource transfer policy depends on how far a particular country's development programme is industry-oriented or agriculture-oriented with respect to its own balanced growth path. Moreover, the location of this path depends, along with the parameters 'a' and 'b', on the population distribution coefficient n. All that can be said in general is that the further away a country chooses to locate itself above or below its own balanced growth path, the greater is the volume of resources which must be transferred out of agriculture or into agriculture.

This is all that can be said in general. But empirically we have seen that the slope of the estimated OCF function is very high. It is easy to see from equation (10) that for high values of the slope term 'b', an economy would have to be highly industrially oriented in order to require a net resource transfer out of agriculture. Simulated values of Z* corresponding to varying ranges of y_a and n presented in the next section illustrate this point very sharply.

However, before going on to these illustrations it is necessary to take note here of the effects of the individual arguments which enter the resource flow equation (6). Partially differentiating B with respect to the arguments we get the following results:

$$\partial B/\partial y_m = (1-b)(1-n)\ N > 0 \qquad (11)$$

$$\partial B/\partial y_a = -bn\ N < 0 \qquad (12)$$

$$\partial B/\partial n = -\left[(1-b)\ y_m + by_a\right].\ N < 0 \qquad (13)$$

$$\partial B/\partial N = a + (1-b)(1-n)\ y_m - by_a\ n \gtreqless 0 \qquad (14)$$

Thus the net effect of population increase on the normal pattern of inter-sectoral resource transfer is indeterminate and depends on the specific values of y_a, y_m, a, b and n. This apart, the volume of resource flow varies positively with y_m and inversely with y_a and n. In the following section we attempt to establish empirically the sign of the population increase effect and test which of the various effects are statistically significant in the determination of the normal pattern of inter-sectoral resource flows.

4. Some Numerical Exercises

Several analytical inferences have been drawn in the preceding section regarding the factors which affect the normal pattern of inter-sectoral resource flow and in particular the zero transfer expansion path. Here some of these inferences are re-examined as numerical exercises.

In the first exercise the changing output composition associated with rising values of per capita output along the zero resource transfer frontier has been traced for alternative combinations of the population distribution ratio 'n' and the marginal propensity to spend on industrial goods 'b' in Table 1. The parameter 'a' has been held constant at 174, its approximate US $ value in 1980 for the estimated OCF.[5] It is evident from equation (10) that as y_a rises, the output composition ratio along the frontier Z* approaches the limiting value $\frac{bn}{(1-b)(1-n)}$ asymptotically from below. This appears quite clearly in the table by reading down any column. Reading along rows we see the upward shift of the frontier with rising b, given n, or rising n given b.

The blank cells indicate negative values of Z* which appear numerically at lower levels of y_a because the intercept of the OCF is negative. These have been deleted since a negative value of the ratio Z* is economically meaningless. Notice that for very low values of n and b no positive Z* threshold appears even at the US $ 1000 level of per capita income in agriculture, i.e., for very low values of n and b we would always require a net resource transfer out of agriculture even at fairly high levels of per capita income

As development proceeds an economy would move up along the frontier as per capita agricultural income rises,

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5/ It is important to note that the numerical calculations reported here are merely illustrative and not representative of any particular country. Recall that the OCF is a normal or average relationship estimated from data across countries. Also the data set reflects differences in relative prices between agriculture and industry across countries. Furthermore data constraints have restricted us to estimates based on value-added figures; hence the estimated parameters measure relationships between added values rather than outputs.

TABLE 1

Estimates of Z* for Selected Combinations of y_a, n and b

y_a (US $)	n = / b =	.900			.600			.300		
	b =	.960	.640	.320	.960	.640	.320	.960	.640	.320
30.000		-	-	-	-	-	-	-	-	-
100.000		-	-	-	-	-	-	-	-	-
300.000		71.00	-	-	-	-	-	-	-	-
500.000		129.00	6.33	-	14.25	.25	-	-	-	-
800.000		161.62	9.96	1.04	22.41	1.16	-	2.52	-	-
1000.000		172.50	11.17	1.68	25.12	1.46	.07	4.07	.07	-
9000.000		211.17	15.46	3.95	34.79	2.53	.63	9.59	.68	.16
$\frac{bn}{(1-b)(1-n)}$		216.00	16.00	4.23	36.00	2.67	0.71	10.32	0.77	0.20

thus raising the threshold degree of industrial orientation Z* beyond which a resource transfer from agriculture becomes necessary. We have also seen from a comparison of the estimated output composition functions for 1960 and 1980 that the slope b has tended to rise, thus entailing an upward shift of the Z* frontier. On the other hand, the population share of agriculture n will decline with development, thus inducing a downward shift of the frontier. In addition the actual degree of industrial orientation Z is also likely to be rising. With all these mutually offsetting processes at work simultaneously it is unlikely that a general pattern of location either above or below the frontier will emerge.

Typically we may expect a random distribution of countries with some located above and others below the frontier. It is important to remember however that each country has its own specific frontier at a given point of time. The question whether resources should normally be transferred out of agriculture or into agriculture can only be answered for each country by comparing its actual degree of industrial orientation Z with its own zero transfer threshold Z*. This has been demonstrated in Table 2.

Required resource flow patterns have been calculated for a set of 97 countries using our estimated OCF parameters and observed sectoral per capita incomes for 1980. These have been presented in Table 2 along with the associated actual degree of industrial orientation Z and the zero transfer degree of industrial orientation Z* where these are positive. The entire set of countries fall into three natural categories. In the left side panel we have 50 countries with positive Z* arranged in ascending order of B. The first 37 countries are those which require a net resource transfer into agriculture (B negative). Notice that these are all countries which lie below the frontier with $Z < Z^*$.

The remaining 30 countries still have a positive Z* but the actual degree of industrial orientation Z is higher than Z*. Accordingly the normal resource flow pattern is a net outflow from agriculture (B positive). In addition, we have in the right hand panel another 47 countries for which Z* is negative. Since the actual degree of industrial orientation Z cannot be negative, these countries also lie above their respective zero transfer frontiers and, accordingly, they all require a net resource transfer out of agriculture.

Notice that in the first group of countries we have both high income countries as well as low income countries. Similarly, while our third group of countries is largely made up of low or middle income countries, the second group, which also requires a net resource flow from agriculture, includes several countries with very high per capita incomes. As predicted by the earlier analysis, there is no clear association between the level of income and the direction of normal resource flow.

But it is interesting to note that the half dozen countries with the largest volumes of required resource transfer out of agriculture include the most populous countries in the Asian region including China, India, Bangladesh, Indonesia, Pakistan and Burma in that order. This seems to run counter to Ishikawa's earlier thesis that countries in the Asian region would typically require a net resource transfer into agriculture at the early stages of industrialisation.

TABLE 2

Normal Resource Flow Patterns for 1980

Countries	Z* Positive: B (US $ Mill., 1980)	Z	Z*
(1)	(2)	(3)	(4)
Ghana	-7862.57	.58	52.27
Uganda	-7312.94	1.54	219.40
Italy	-7092.14	1.93	4.13
Spain	-6014.45	2.02	5.99
France	-5768.38	2.08	3.22
Japan	-3737.47	3.27	3.99
Turkey	-3652.35	3.93	24.51
Greece	-3432.77	3.08	24.00
Colombia	-3137.69	.90	8.78
Malaysia	-2848.40	3.16	32.95
Yugoslavia	-253[illegible].91	2.99	11.21
Finland	-2297.57	1.42	5.64
New Zealand	-2061.82	.66	4.70
Nigeria	-1958.29	4.69	12.16
Mexico	-1717.79	5.06	8.49
Canada	-1701.21	1.26	1.79
Korea, Rep. of	-1693.71	2.70	8.25
Romania	-1507.27	3.30	9.06
Netherlands	-1423.39	1.53	2.34
Norway	-1183.95	1.44	3.31
Ivory Coast	- 827.95	7.31	84.69
Syrian Arab. Rep.	- 757.13	1.97	10.98
Portugal	- 776.58	2.11	7.20
Paraguay	- 703.40	2.24	32.31
Austria	- 475.31	2.39	3.30
Cameroon	- 360.78	10.35	64.53
Costa Rica	- 359.56	2.00	12.60
Papua New Guinea	- 283.26	8.83	99.09
Dominican Rep.	- 222.74	4.38	14.30
Uruguay	- 195.38	1.11	2.82
Sweden	- 166.61	1.68	1.81
El Salvador	- 75.22	2.70	7.57
Liberia	- 26.03	4.15	13.77
Bolivia	- 21.18	4.55	5.69
Honduras	- 9.92	3.78	5.23
Tunisia	- 4.80	2.52	2.64
Nicaragua	- .07	2.12	2.12
Venezuela	2.43	3.43	3.42
Ecuador	104.30	7.25	2.72
Israel	170.15	1.41	.43
Iraq	375.57	9.61	3.19
Thailand	375.97	9.50	1.06
Libya	421.38	11.49	2.36
Chile	438.29	3.11	.01
Brazil	865.32	3.85	2.93
South Africa	1129.56	5.69	.20
Belgium	1340.41	1.49	.45
United States	5654.55	.65	.57
Germany, Fed. Rep.	8034.66	2.04	.83
United Kindom	8089.78	1.00	.06

Countries	Z* Non-Positive: B (US $ Mill., 1980)	Z
(5)	(6)	(7)
Somalia	19.28	3.04
Angola	76.89	1.55
Congo	97.78	3.73
Central African Rep.	124.13	12.25
Mauritania	140.38	16.50
Lesotho	153.27	14.84
Togo	174.90	5.78
Benin	199.28	1.12
Jamaica	214.48	3.03
Senegal	267.95	7.74
Yemen, PDR	269.52	5.55
Sierra Leone	291.09	3.29
Burundi	292.31	4.26
Niger	329.57	20.37
Guinea	349.25	7.77
Rwanda	385.19	10.88
Madagascar	393.96	15.99
Jordan	418.45	2.87
Malawi	473.76	8.17
Singapore	489.26	2.10
Yemen Arab. Rep.	504.36	7.34
Zambia	504.58	11.54
Chad	507.73	4.24
Morocco	586.63	4.93
Sudan	641.32	4.19
Mali	649.10	3.73
Upper Volta	685.33	6.81
Kenya	829.14	6.87
Zimbabwe	911.31	10.99
Philippines	957.23	2.88
Tanzania	976.38	4.15
Hong Kong	1026.37	3.00
Mozambique	1106.04	2.47
Nepal	1510.35	10.04
Sri Lanka	1566.81	3.01
Algeria	1567.73	5.21
Peru	1811.65	7.66
Egypt, Arab Rep.	2026.00	3.34
Saudi Arabia	2359.56	154.88
Zaire	3054.38	6.38
Ethiopia	3588.61	3.84
Burma	3592.44	2.38
Pakistan	8003.92	2.94
Indonesia	8524.14	3.93
Bangladesh	9562.30	2.42
India	6923.42	3.78
China	[illegible]5915.95	5.44

A caveat must be entered here that the estimates of B presented in Table 2 do not purport to be estimates of actual inter-sectoral resource transfers. They are instead estimates of the resource flow which would normally be required, given the actual production structures, if the parameters of the estimated OCF were applicable to the individual countries. However, we know that the OCF only reflects a typical or average relationship and the relevant parameters for an individual country estimated from, say, time series data could be different.

Furthermore, data constraints have caused us to restrict our calculations to transactions of final goods only.[6] The picture could be altered if transactions in intermediate goods were also included. The input-intensive Green Revolution in developing countries notwithstanding, the value coefficient of total non-labour inputs per unit output is typically lower in agriculture than in industry. Stated another way, the ratio of non-wage prime costs to unit prices is generally higher in industry. Therefore if we shifted our empirical analysis from value-added configurations to gross value of output configurations, the profile of observed production structures Z would be higher. But this would also shift the OCF upwards. The increase in the values of the parameters 'a' or 'b' or both would mean an upward shift of the Z* frontier also. The net effect of these changes on the profile of B cannot be predicted *a priori*. The data on normal resource flow patterns is presented here subject to these qualifying remarks.

6/ See footnote 5.

We now turn to the observed effects of the individual arguments in the resource flow function (6) discussed earlier. Theoretically we have seen that the volume of normal resource transfer from agriculture (B) is positively associated with industrial per capita income (y_m) while it is inversely related to per capita income in agriculture (y_a) and the share of agriculture in total population (n). The sign of the relationship with aggregate population (N) turned out to be ambiguous.7/ These implied relationships were checked statistically against observed data by regressing first differences of the estimated values of B on first differences in the arguments y_m, y_a, n and N for cross-country observations arranged in ascending order of B. It is evident from equation (6) that these independent variables are not additively separable in the resource flow function. However, by taking first differences we were able to check the relationships with a linear regression equation of the form

$$dB = \alpha + \beta\, dy_m + \gamma\, dy_a + \lambda\, dn + \mu\, dN + \varepsilon \qquad (15)$$

This linear relationship was fitted to data covering 96 countries for 1980. The results are presented in Table 3.

7/ See the partials with respect to each of these arguments in equations (11) to (14) above.

TABLE 3

OLS Regression Estimates for First Differences in the Normal Resource Flow Equation: 1980

Intercept	Coefficients of dy_m	dy_a	dn	dN
304.0084 (314.8149)	0.0755 (0.0588)	-0.2407** (0.1134)	+492.2093 (1058.6793)	+76.8533*** (4.1618)
	$\bar{R}^2$	F	SE	
	0.7802	85.2702	3056.8048	

Note: Figures in parentheses give standard errors. Asterisks indicate significance at 1% level (***) and 5% level (**).

A very large proportion of the variations in first differences of B is explained, with an adjusted coefficient of about 78%. Of the determinants the signs of dy_m and dy_a are respectively positive and negative as predicted. But while the dy_a coefficient is significant at 5% level the dy_m coefficient is nearly significant only at the 10% level and the coefficient of n is not significant. As against these relatively weak relationships, the coefficient of the population argument N turns out to be highly significant with a positive sign. It will be recalled from Table 2 that the first half dozen countries requiring the largest volume of resource outflow from agriculture were indeed the most populous countries in the Asian region.

Concluding Remarks

In the past our ideas have remained somewhat confused and ambiguous on the question of whether or not resources ought to be transferred out of agriculture to support industrialisation in transitional economies. In this paper the question has been analysed with the help of a function which relates the level of output to its composition. The existence of this output composition function (OCF) has been long suggested by studies in the Clarke-Kuznets-Chenery tradition. The recent work of Pasinetti has also given us a theoretical proof of the existence of this function. Yet, remarkably, the function has hardly been recognised in the received theory of economic development. Here we have identified this function as a linear relationship in a two-sector framework and estimated its parameters on the basis of cross-section data for 83 countries in 1960 and 96 countries in 1980. The function has then been used to derive the conditions under which resources would normally have to be transferred out of agriculture or into agriculture.

It has been shown that there can be no uniform policy or strategy on this question. The answer depends on whether a particular economy is structurally situated above or below the zero resource transfer frontier, a path traced by the loci of those critical output level-structure combinations at which no net resource transfer in either direction is required. The location of this expansion path depends on the sectoral distribution of population and the parameters of the OCF, especially the slope which measures the marginal propensity to spend on industrial goods with respect to per capita income.

Finally, regarding the required volume of resource outflow from agriculture, regression analysis of data from 96 countries for 1980 shows that as much as 78 per cent of the variation in normal resource flow volumes across countries is explained by the arguments of our resource flow function in terms of first differences. Resource flow variations reveal a weak negative association with variations in per capita agricultural income, a positive association with variations in per capita industrial income and a very strong positive association with variations in population size. These factors and the parameters of the OCF discussed earlier jointly determine what ought to be the normal pattern of resource flow between sectors. The solution for each country is embedded in its own specific structure and any *a priori* judgement on this question appears to be untenable.

REFERENCES

Chenery, H. and Syrquin, M. (1975). Patterns of Development, 1950-1970, World Bank, Oxford University Press London,

Ellman, M. (1975). "Did the Agricultural Surplus provide Resources for the Increase in Investment in USSR during the First Five Year Plan ?" Economic Journal 85.340, December.

Ishikawa, S. (1967). Economic Development in Asian Perspective, Tokyo, Kato Bumeisha Printing.

Ishikawa, S. (1986). Patterns and Processes of Inter-Sectoral Resource Flows : Comparisons of Cases in Asia (mimeo), Twenty Fifth Anniversary Symposium, Economic Growth Centre, Yale University.

Lardy, N. (1980). Inter-Sectoral Resource Flows in Chinese Economic Development (mimeo), Conference on Agricultural Development in China, Japan and Korea, Institute of Economics, Taiwan.

Lee, T.H. (1971). Inter-Sectoral Capital Flows in the Economic Development of Taiwan 1895-1960, Cornell University Press, Ithaca, N.Y.

Lluch, C. (1973). The Extended Linear Expenditure System, European Economic Review, 4.21-32, April

Mundle, S. (1981). Surplus Flows and Growth Imbalances, New Delhi, Allied Publishers.

__________ and Ohkawa, K. (1979). Agricultural Surplus in Japan: 1888-1937, Developing Economies, 17.3, September.

Ohkawa, K. and Rosovsky, H. (1973). Japanese Economic Growth, Stanford University Press, Stanford, CA.

Pasinetti, L.L. (1981). Structural Change and Economic Growth, Cambridge University Press.

Preobrazhensky, E. (1926). The New Economics, (translation by Pearce, 1965), Oxford University Press.

Ranis, G. and Fei, J.C.H. (1964). Development of the Labour Surplus Economy : Theory and Policy, Irwin, Homewood, IL.

Sharpley, J. (1979). Inter-Sectoral Capital Flows; Evidence from Kenya, Journal of Development Economics, 6.4, December.

Weiskoff, T.E. (1971). Demand Elasticities for a Developing Economy : An International Comparison of Consumption Patterns. In H.B. Chenery (ed.) Studies in Development Planning Harvard University Press.