MACROECONOMIC CAUSES OF UNBALANCED PRODUCTIVITY GROWTH IN OPEN ECONOMIES

Hans Tson Söderström
Peter Brundell

September 1983
CP-83-49

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
A-2361 Laxenburg, Austria

FOREWORD

This Collaborative Paper is one of a series embodying the outcome of a workshop and conference on Economic Structural Change: Analytical Issues, held at IIASA in July and August 1983. The conference and workshop formed part of the continuing IIASA program on Patterns of Economic Structural Change and Industrial Adjustment.

Structural change was interpreted very broadly: the topics covered included the nature and causes of changes in different sectors of the world economy, the relationship between international markets and national economies, and issues of organization and incentives in large economic systems.

There is a general consensus that important economic structural changes are occurring in the world economy. There are, however, several alternative approaches to measuring these changes, to modeling the process, and to devising appropriate responses in terms of policy measures and institutional redesign. Other interesting questions concern the role of the international economic system in transmitting such changes, and the merits of alternative modes of economic organization in responding to structural change. All of these issues were addressed by participants in the workshop and conference, and will be the focus of the continuation of the research program's work.

Geoffrey Heal
Anatoli Smyshlyaev
Ernő Zalai

MACROECONOMIC CAUSES OF UNBALANCED PRODUCTIVITY GROWTH IN OPEN ECONOMIES*

Hans Tson Söderström**
and Peter Brundell***

ABSTRACT

It is a well-known empirical fact that the goods producing (tradables) sector of industrialized economies tends to have a higher rate of labor productivity growth than the service (non-tradables) sector. The difference has been used to explain unbalanced sectoral growth patterns, structural inflation and other macroeconomic phenomena. This paper sets forth and tests the proposition that a significant part of the observed productivity growth difference is the result of a relative decline of the tradables sector, which in turn is caused by macroeconomic disturbances leading to a relative increase of the product wage in that sector. Explicit hypotheses on an endogenous determination of productivity growth differences are derived from a small macro model and tested on data from 1960 to 1975 for 14 OECD countries divided into two groups: large economies and small open economies. We find empirical support for the hypothesis of a structural explanation of the sectoral productivity growth difference in both large and small economies. For small open economies there is also a significant relationship between product wage disturbances and the relative decline of the tradables sector. The empirical analysis indicates that in these countries productivity growth is the same in both sectors in the absence of product wage disturbances.

---

* This paper was originally distributed as Seminar Paper No. 252 of the Institute for International Economic Studies, Stockholm. The authors would like to thank Michael Bruno, Lars Calmfors, W. Max Corden, Gene Grossman, Thor Gylfason, Assar Lindbeck, Lars E. O. Svensson, participants in the Institute's Workshop on Open Economy Macroeconomics and in seminars at the Stockholm School of Economics and the University of Lund for helpful comments on earlier versions of the paper. We relieve our critics from responsibility for remaining errors.

** Institute for International Economic Studies, Stockholm, Sweden.
*** Stockholm School of Economics, Stockholm, Sweden.

1. INTRODUCTION

It is a well established empirical fact that the goods producing ("tradables") sector of industrialized economies tends to have a permanently higher rate of labor productivity growth than the service ("non-tradables") sector of these economies. To some extent this observation has been explained by statistical anomalies like the national accounting convention of zero productivity growth in the public sector. But even when only the private sector is taken into account the stylized fact of unbalanced productivity growth is clearly observable for most countries and time periods as demonstrated by Table 1.

The stylized fact of unbalanced productivity growth has been used to derive propositions regarding the structural development of economies over time (urban crises, public sector growth, etc.) and also propositions regarding wage and price developments in open economies (structural inflation, etc.). The difference in productivity growth, on which such propositions are based, is traditionally explained by differences in "technological progressiveness" inherent in the production technology of the two sectors.

This paper sets forth and tests the proposition that unbalanced productivity growth can be explained as an effect of the relative decline of one of two equally technologically progressive sectors. Furthermore, for small open economies we suggest that a relative decline of the tradables sector is caused by macroeconomic disturbances emanating from the wage

TABLE 1: Growth rates of labor productivity in tradables and non-tradables sectors. (Average annual percentage rates of change)

Country	Period	Tradables sector $\hat{q}_T$	Private non-tradables sector $\hat{q}_N$	Difference $\hat{q}_T - \hat{q}_N$
AUSTRIA	1960-65	3.99	3.73	0.26
	65-68	5.52	3.50	2.02
	70-75	2.53	2.40	0.13
BELGIUM	1960-65	4.77	2.10	2.67
	65-69	7.62	2.30	5.32
	70-75	5.13	2.73	2.40
DENMARK	1960-65	4.51	2.13	2.38
	65-72	5.01	3.00	2.01
	72-75	3.93	0.55	3.38
FINLAND	1960-65	4.06	1.22	2.84
	65-70	5.15	1.81	3.34
	71-75	2.53	3.46	-0.93
NETHERLANDS	1960-65	4.36	2.73	1.63
	65-70	8.30	3.17	5.13
	70-75	5.70	4.07	1.63
NORWAY	1960-65	4.89	3.38	1.51
	65-70	3.14	2.63	0.51
	72-75	3.50	4.63	-1.13
SWEDEN	1960-65	6.65	4.11	2.54
	65-70	4.89	2.09	2.80
	70-75	1.96	2.15	-0.19
Unweighted Average		4.67	2.76	1.91
AUSTRALIA	1962-65	0.85	2.96	-2.11
	65-70	4.70	2.20	2.50
	70-75	4.09	2.23	1.86
CANADA	1961-64	3.93	3.08	0.85
	65-70	3.04	1.76	1.28
	70-75	2.13	1.01	1.12
FRANCE	1962-65	4.86	2.27	2.59
	65-68	6.78	3.08	3.70
	70-75	3.09	2.85	0.24
GERMANY	1962-65	5.83	3.03	2.80
	65-70	4.90	3.82	1.08
	72-75	2.63	1.10	1.53
ITALY	1962-65	5.62	3.83	1.79
	65-70	5.97	6.00	-0.03
	70-75	0.54	1.87	-1.33
UNITED KINGDOM	1960-65	2.84	1.79	1.05
	65-70	3.10	3.73	-0.63
	70-75	2.48	0.56	1.92
UNITED STATES	1960-65	4.56	2.12	2.44
	65-70	1.35	0.09	1.26
	70-75	1.85	-0.11	1.96
Unweighted Average		3.58	2.35	1.23

Tradables sector = Mining and quarrying and manufacturing (ISIC 2 and 3). Private non-tradables sector = Electricity, gas and water, construction and wholesale and retail trade, restaurants and hotels (ISIC 4, 5 and 6).

For derivation of the figures, see Data Appendix.

formation process. Specifically, a uniform increase in money wage rates at a fixed nominal exchange rate will be demonstrated to lead to an appreciation of the real exchange rate (the price of non-tradables in terms of tradables) in an economy where government expenditure is varied so as to maintain full employment. The resulting relative increase of the product wage in the tradables sector (the "squeeze" on the tradables sector) will cause a relative decline of that sector. A relative increase in the labor productivity of the declining sector will be recorded as only the most efficient production units in the sector survive.

Our hypothesis will thus be that the observed difference in productivity growth is the effect of macroeconomic disturbances. This is in contrast to the conventional wisdom, which claims that unbalanced productivity growth is the cause of macroeconomic imbalances as mentioned above and will be developed further in Section 2 below.

The paper is organized as follows. In the next section we present the two main propositions in the macroeconomics of intersectoral differences in productivity growth; the Baumol propositions and the Aukrust propositions. In Section 3 we bring out the difference between "autonomous" and "structural" determinants of labor productivity growth. In Sector 4 we present a macroeconomic framework where a structurally determined difference in productivity growth is caused by repeated disturbances from the wage formation process. After a diagrammatic interpretation of the model in Section 5, we then proceed in Section 6 to an empirical application of its predictions to 14 OECD countries as a check on their consistency with actual developments. The principal findings of our investigation are summarized and conclusions are drawn in Section 7.

2. MACROECONOMIC EFFECTS OF UNBALANCED PRODUCTIVITY GROWTH

The macroeconomics of intersectoral productivity growth differences has played an important role in the policy discussions of small open economies during the last decade. Problems of "deindustrialization", structural change and inflation are often seen as unavoidable effects of the uneven distribution of productivity change between the tradables and non-tradables sectors of the economy. We shall distinguish here between allocational effects and effects on price and wage formation. The former type of effects are summarized in what we shall call "the Baumol propositions" (Baumol 1967), and the latter type of effects are presented under the heading of "the Aukrust propositions" (Aukrust 1970). The two types of propositions are of course interrelated, but they have led virtually separate lives in the literature, and it will prove convenient to discuss them separately.

The sector characterized by faster productivity growth is identified throughout this paper with the tradables sector, i.e. the sector producing goods traded on international markets. The sector with slower productivity growth is assumed to be producing non-tradables, i.e. goods which for some reason - transport costs, service component, taste, protection - are only sold on domestic markets and are protected from international competition. This identification, which is crucial for the Aukrust proposition and for the arguments in this paper, is not explicitly made in Baumol's paper. It seems to be implicit, however, since he identifies the "technologically progressive

activities" with commodity production, and the non-progressive activities with activities where "labor is an end in itself", i.e. services. Even if the overlap between the two types of classification is not complete, we shall henceforth refer to the "technologically progressive" sector as the "tradables sector" and vice versa.

The Baumol propositions

The Baumol propositions deal with how unbalanced productivity growth affects the distribution of output and labor between the two sectors over time. Given cost-plus pricing in both sectors, the price development in the two sectors will be given by

$$(1) \quad \hat{p}_T = \hat{w} - \hat{q}_T$$

and

$$(2) \quad \hat{p}_N = \hat{w} - \hat{q}_N$$

where $\hat{w}$ is the proportional rate of money wage increase, assumed to be equal across sectors. (A complete list of variables is given in Table 2.) (1) and (2) together imply that unbalanced productivity growth:

$$(3) \quad \hat{q}_T - \hat{q}_N > 0,$$

must have as a result that the relative price of tradables will fall continuously:

$$(4) \quad \hat{p}_T - \hat{p}_N < 0 \qquad \text{(Proposition 1).}$$

The change in relative prices will affect the commodity composition of output. Specifically, if the price elasticity of demand for both commodities is unity, expenditure shares will be constant, i.e.

TABLE 2. Notation

Symbols

Q = volume of total output

T = volume of tradables

N = volume of non-tradables

X = current account balance in terms of tradables

G = government deficit spending in terms of tradables

L = total labor supply

L_i = labor employed in the ith sector, i = T, N

ℓ_i = ratio of labor employed in the ith sector to total labor (L_i/L), i = T, N

q = average labor productivity (Q/L)

q_i = average labor productivity in the ith sector, i = T, N

p_T = price of tradables (in units of domestic currency)

p_N = price of non-tradables

w = money wage rate

w_i = product wage in the ith sector (w/p_i), i = T, N

n = share of non-tradables in total output (N/Q)

τ = level of technology

λ = rate of technical progress $(= \hat{\tau})$

Operator

$\hat{X} = \dot{X}/X$ = proportional rate of change (per unit of time)

No subscript = whole economy

Subscript T = tradables sector

N = non-tradables sector

(5) $\hat{p}_T + \hat{T} - \hat{p}_N - \hat{N} = 0.$

(4) and (5) together imply

(6) $\hat{T} - \hat{N} > 0$ (Proposition 2),

i.e. with given expenditure shares the volume of non-tradables will decline as a proportion of total output. If, on the other hand, a balanced growth path, characterized by

(7) $\hat{T} - \hat{N} = \hat{L}_T + \hat{q}_T - \hat{L}_N - \hat{q}_N = 0,$

is for some reason attained, then (3) must imply

(8) $\hat{L}_T - \hat{L}_N < 0$ (Proposition 3),

i.e. at given output shares, employment in the tradables sector will be a declining proportion of total employment. Finally, overall productivity in the economy can be defined as

(9) $q \equiv \ell_T q_T + \ell_N q_N,$

Using (7) the overall rate of productivity growth can be written as

(10) $\hat{q} = \hat{q}_N - \ell_T(\hat{L}_T - \hat{L}_N)$

Now, (8) implies $\ell_T \to 0$ over time, so

(11) $\hat{q} \to \hat{q}_N$ as $t \to \infty$ (Proposition 4),

i.e. on a balanced growth path the overall rate of productivity growth in the economy will asymptotically approach the rate prevailing in the sector with a lower rate of productivity growth.

Note that not much has been said about the demand side so far. It is obvious that stringent conditions on the relations between the rate of change of labor productivity in the two sectors, price and income elasticities and wage formation are necessary to achieve a stable growth path in such an economy. Such conditions have been derived by Kierzkowski (1976) for small open economies. The role of the government in balancing the markets has been observed by Branson-Myhrman (1976) and analyzed by Söderström-Viotti (1979).

The Aukrust propositions

The Aukrust propositions (also known as the "Scandinavian" or "EFO" model) concern the effect of unbalanced productivity growth on wage and price formation in small open economies. Their main message is that uniform economy-wide money wage increases aimed at maintaining constant relative income shares between labor and capital will always lead to an overall rate of domestic inflation which is higher than the rate of "imported" inflation in an open economy.

Let money wage increases be determined by the sum of productivity and price change in the tradables sector:

$$(12) \quad \hat{w} = \hat{p}_T + \hat{q}_T .$$

Then cost based price increases in the non-tradables sector can be determined as

$$(2') \quad \hat{p}_N = \hat{w} - \hat{q}_N = \hat{p}_T + \hat{q}_T - \hat{q}_N .$$

Equation (2') and (3) again imply

(4) $\hat{p}_T - \hat{p}_N < 0.$ (Proposition I)

but now the emphasis is not on relative price changes but instead on differential rates of inflation. In general, the overall rate of domestic inflation $(\hat{p})$ will always exceed the domestic rate of price increase on tradables $(\hat{p}_T)$ as determined by

(13) $\hat{p} = \hat{p}_T + n(\hat{q}_T - \hat{q}_N)$, (Proposition 5)

where n is the share of non-tradables in total output. Here $\hat{p}_T$ stands for "imported" inflation as determined by world inflation and exchange rate adjustments. The component $n(\hat{q}_T - \hat{q}_N)$ determines what is sometimes called "structural inflation", which is, as we can see, directly proportional to the difference in productivity growth between the tradables and non-tradables sector, and to the relative magnitude of the non-tradables sector.

3. DETERMINANTS OF LABOR PRODUCTIVITY GROWTH

Both the Baumol and the Aukrust propositions rely entirely on the existence of an assumed exogeneous difference in the rate of productivity growth between the two sectors of the economy. The propositions will hold only if the productivity difference itself is independent of the economic phenomena (relative price changes, structural inflation, etc.) which it is supposed to cause.

We shall distinguish in this section between "autonomous" and "structural" determinants of labor productivity. Autonomous

determinants here comprise not only disembodied technical change, but also the effects of capital formation, which will be kept exogenous to our model. The only structural determinant under consideration will be the product wage, i.e. the wage rate in terms of units of final output. The product wage in the non-tradables sector will be endogenously determined in the macro model.

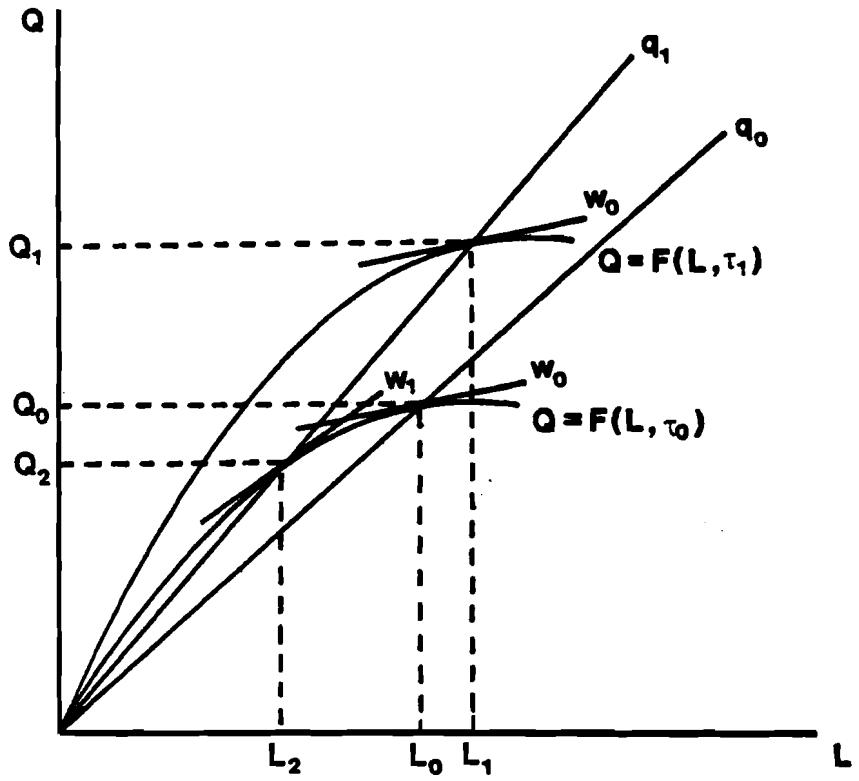
Consider a neoclassical production function $Q = F(L, \tau_o)$ as depicted in Figure 1. The production function is drawn for the level of technology and capital stock given by τ_o. The product wage $w_o = (w/p)_o$ determines the point of production, Q_o, and average labor productivity, q_o. Suppose now that we observe an increase in average labor productivity from q_o to q_1. There can be two distinct causes of this increase. *Autonomous* productivity growth is represented by a shift of the production function from $Q = F(L , \tau_o)$ to $Q = F(L , \tau_1)$ due to capital formation and/or technical change with the product wage remaining constant at w_o. *Structural* productivity growth is caused by an increase in the product wage from w_o to w_1 with the production function remaining constant at $Q = F(L , \tau_o)$. The latter change will unambiguously be associated with a decline in output and employment. Autonomous productivity growth, on the other hand, will unambiguously lead to an expansion of output, and (under normal circumstances)[1] employment as well.

In the neoclassical paradigm, the productivity increase which results from a higher product wage is normally interpreted as being due to the higher capital intensity, as a given homogeneous capital stock is being operated by fewer

---

1) The "abnormal" case refers to "ultra labor saving" technical change (marginal product of labor declining at a given capital-labor ratio).

FIGURE 1



workers. In the short and medium run, it does, however, seem more natural to interpret the product wage increase as operating on average labor productivity via Salter-type structural effects (Salter 1960). Plants with high labor input coefficients have to close down, as total revenue ceases to cover operating costs. As a result, both output and labor input in the sector will shrink, but labor productivity will increase. This structural effect can essentially be represented by the smooth neoclassical production function depicted in Figure 1. In the remainder of this paper we shall therefore stick to the neoclassical interpretation and taxonomy.

The two different causes of a recorded change in labor productivity have very different implications for wage formation. Technological productivity change is consistent with a corresponding increase in the product wage under full employment.[1] Structural productivity change on the other hand, which is caused by an exogenous increase in the product wage, obviously leaves no room for additional increases in the product wage.

The main proposition of the present paper is that the rate of technologically determined productivity growth is essentially equal between the tradables and non-tradables sector of the economy. The higher recorded rate of productivity change in the tradables sector is instead hypothesized to be primarily of the structural type, i.e. the result of a continuous relative decline of employment in this sector.

---

1) The exact magnitude of the real wage increase consistent with full employment will depend on the properties of the production function and the nature of technical change in a one sector model. In a two sector model it will also depend on relative price and income elasticities on the demand side. See Kierzkowski (1976).

This decline is hypothesized to be caused by a money wage increase resulting in an appreciation of the real exchange rate which in turn leads to a relative increase of the product wage in the tradables sector.

4. THE MACROECONOMIC FRAMEWORK

A relative decline of the tradables sector - a "deindustrialization" process - has been the focus of much recent macroeconomic research. In some models aimed at explaining a squeeze on the tradables sector, the driving force is an appreciation of the exchange rate. This appreciation may in turn be caused either by a resource boom, as in e.g. Corden and Neary (1982), or by a shift in monetary policy, as in e.g. Buiter and Miller (1981). Other models derive the squeeze on the tradables sector from the cost side, either via imported intermediate inputs, as in e.g. Bruno and Sachs (1979), or via money wage increases as in Söderström and Viotti (1979) and the present paper. The essential mechanism in all these approaches is that some exogenous event causes a decline of profitability in the tradables sector and consequently an outflow of resources from that sector. The central argument in this paper is that such disturbances are the main factor behind the observed superiority of the tradables sector as far as productivity growth is concerned.

The special features of our macro model are the following:

(a) The exchange rate is fixed and the money wage rate is exogenously determined, so the product wage rate in the tradables sector is also exogenous.

(b) The government has a binding committment to full employment, so that fiscal policy is endogenously determined via a labor market clearing condition. The arguments behind this specification are developed in Söderström and Viotti (1979).

We let the following variables be exogenous: 1) The domestic price of tradables, p_T, which is given by world market prices and a fixed exchange rate, 2) the money wage rate w, which is determined in central collective bargaining, and which is equal between the two sectors of the economy, and 3) the autonomous level of productivity, τ. This leaves three endogenous variables to be determined by the three equations:[1] 1) The price level of the non-tradables sector, p_N, which also determines the product wage in the non-tradables sector, w_N, 2) the level of real government deficit spending, G, and 3) the real current account surplus, X.

The system is recursive and can be solved as follows. For exogeneously given values of $w/p_T = w_T$ and τ, the demand for labor in the tradables sector is determined. Equation (16) can then be solved for the product wage for (and consequently the price of) non-tradables which is necessary to maintain full employment. Given w, p_T, and p_N, equation (15) can be solved for the level of government deficit spending which is necessary to maintain the warranted price of non-tradables. And, finally, given w, p_T, p_N, G, and τ, equation (14) can be solved for the current account balance. Obviously, if all private income is spent we will have $G = -X$, and one of the three equations will be redundant.

In this macro system exogenous shifts in the money wage rate and in technology will both have the effect of increasing average labor productivity in the tradables sector more than in the non-tradables sector, but the macroeconomic consequences of these two types of disturbances are quite different as we shall see.

---

1) A fourth market - the money market - is eliminated by Walras' Law. The money supply process could be specified as $\Delta M = G + X$.

Consider a small open economy under a fixed exchange rate regime, with two commodity markets (tradables and non-tradables) and a labor market, where the government is at each moment of time adjusting deficit spending so as to maintain full employment. The three markets are characterized as follows. Demand for tradables is a positive function of the real exchange rate, p_N/p_T (substitution effect), and a positive function of real government deficit spending, G,[1] (expenditure effect). Supply of tradables is a negative function of the product wage $w_T = w/p_T$ and a positive function of an autonomous productivity index, τ (determined by technology and the capital stock as discussed in Section 3 above). Excess supply of tradables equals the real surplus on current account, X.

Demand for non-tradables is a negative function of the real exchange rate and a positive function of real government deficit spending. Supply of non-tradables is a negative function of the product wage $w_N = w/p_N$ only (technical progress or capital/labor substitution are not assumed to occur in the non-tradables sector). Demand for labor in each sector is a negative function of the product wage in that sector, and autonomous productivity growth increases demand for labor at a given product real wage in the tradables sector. Supply of labor is assumed to be exogenously given.

The complete system reads:

$$(14) \quad T^D(\overset{+}{p_N/p_T}, \overset{+}{G}) - T^S(\overset{-}{w_T}, \overset{+}{\tau}) + X = 0$$

$$(15) \quad N^D(\overset{-}{p_N/p_T}, \overset{+}{G}) - N^S(\overset{-}{w_N}) = 0$$

$$(16) \quad L_T^D(\overset{-}{w_T}, \overset{+}{\tau}) + L_N^D(\overset{-}{w_N}) - L^S = 0$$

---

1) We let G be defined in terms of tradables.

Starting from an initial equilibrium with $G = X = 0$, let us first trace the effects of an exogenous increase in the money wage rate, dw. As a result of the increased product wage in the tradables sector, output and demand for labor in that sector will decline. (This reduction is what causes the increase in average labor productivity in the tradables sector as discussed above.) The price of non-tradables must rise to reduce the product wage in that sector in order to increase demand for labor to the full employment level. (This will tend to lower average productivity in the non-tradables sector.) From eq. (15) it is obvious that government spending must increase to bring about the higher price level in the non-tradables sector.[1] Finally, the increase in the real exchange rate and in total expenditure at a lower level of tradables output will produce a current account deficit.

Autonomous productivity growth, $d\tau$, also has the effect of increasing average labor productivity in the tradables sector, but the macroeconomic consequences are different. Starting from the same initial equilibrium as before, autonomous productivity growth will tend to increase demand for labor in the tradables sector at the given product wage. Consequently, p_N must fall to keep aggregate labor demand in line with supply. This in turn requires a government budget surplus ($G < 0$) from (15). Finally, the decline of the real exchange rate, the expenditure reduction and the increased supply of tradables will produce a current account surplus, which will be equal to the government budget surplus in the absence of private hoarding.

---

1) Note that the increase in government spending only partly brings about an increase in the production of non-tradables. The other part offsets the reduction in private demand for non-tradables due to the substitution effect. This element of crowding out is necessary when unemployment is entirely classical as in the present model.

The effects of these parameter shifts are summarized in Table 3. In addition, Table 3 shows explicitly the effects on the employment structure, L_T/L_N, which can be solved from eq. (16), and the effects on relative labor productivity, q_T/q_N.

TABLE 3 COMPARATIVE STATICS OF THE MACRO SYSTEM

		Endogenous variables				
		q_T/q_N	L_T/L_N	p_N/p_T	G	X
Parameter shifts	dw	+	-	+	+	-
	dτ	+	+	-	-	+

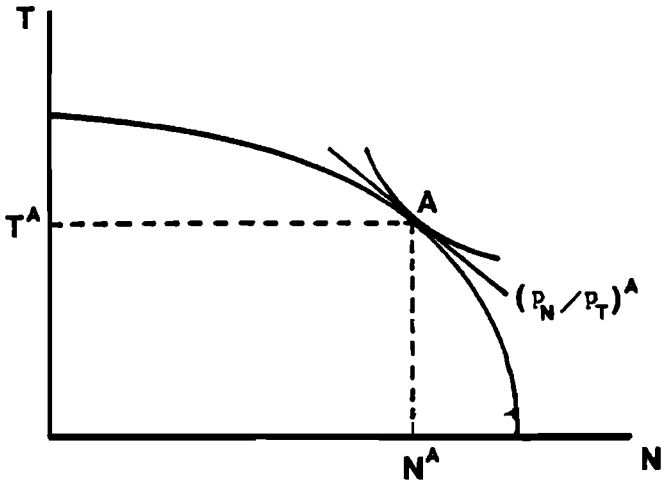
Table 3 demonstrates that exogenous *ceteris paribus* increases in the money wage level and in autonomous productivity both of which lead to unbalanced productivity growth - have opposite implications for the structure of employment, the real exchange rate, the government budget balance, and for the current account balance. Whereas autonomous productivity growth in the tradables sector leads to a relative increase in the size of that sector, a *ceteris paribus* money wage increase leads to a relative decline of the sector. These hypothesized relationships constitute the starting point for the empirical analysis in Section 6.

5. A DIAGRAMMATIC ILLUSTRATION

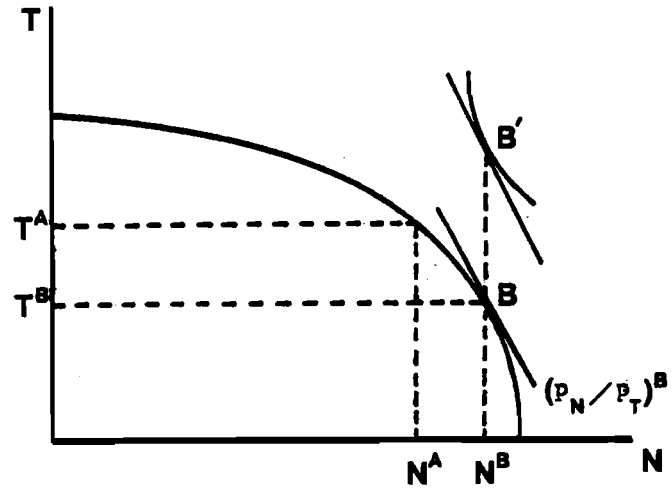
The arguments put forward in the previous section can also be illustrated diagrammatically. Figure 2 shows the traditional Swan-Salter diagram with a production possibility frontier between tradables and non-tradables. The initial equilibrium situation

FIGURE 2

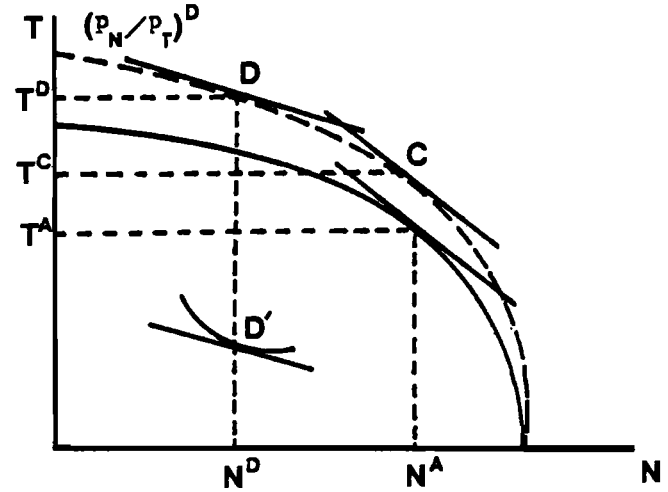
a)



b)



c)



depicted in panel 2(a) is at A with the real exchange rate $(p_N/p_T)^A$ reflecting the tangency point with the community indifference curve. At this initial equilibrium we have a balanced government budget (G=0) and current account equilibrium (X=0).

Now let a productivity increase in the tradables sector be generated by an increase in the money wage rate. The rise of money wages will lead to a product wage increase in the tradables sector as p_T is held constant. The consequent reduction of output (from T^A to, say, T^B) and employment in the tradables sector is the cause of the productivity increase. As can be seen from panel 2 (b), production of non-tradables must now be expanded from N^A to N^B if full employment is to be maintained. The real exchange rate must rise to $(p_N/p_T)^B$ in order to sustain the new production point B. The new consumption point will be B', and the distance B-B' is the magnitude (in terms of tradables) of the budget deficit necessary to sustain the new price ratio. It will be equal to the current account deficit. A productivity increase in the tradables sector, which is generated by an exogenous money wage increase (and hence a product wage increase in the tradables sector) from an initial equilibrium position is therefore expected to have three consequences: 1) A decline of the tradables sector relative to the non-tradables sector, 2) A government budget deficit, and 3) A current account deficit.

Consider now, in contrast, a productivity increase in the tradables sector which is generated by autonomous productivity growth in that sector. This shifts the production possibility frontier asymetrically outward as depicted in panel 2 (c). With a flexible real wage the new production point with a given

real exchange rate would have been the Rybczynski point C. However, point C presupposes a higher product wage (relative to A) in both sectors. With a given product wage in the tradables sector desired output in that sector must be higher than T^C, say T^D. For labor market equilibrium, output in the non-tradables sector must now contract to N^D. This is achieved by a fiscal contraction of domestic demand, which lowers the real exchange rate to $(p_N/p_T)^D$. The required budget surplus (in terms of tradables) is given by the vertical distance between production point D and the new consumption point D'. This distance will also be equal to the current account surplus.

An autonomous productivity increase in the tradables sector with money wages held fixed from an initial equilibrium position is therefore expected to have three consequences: 1) An increase of the tradables sector relative to the non-tradables sector, 2) A government budget surplus, and 3) A current account surplus. These consequences are opposite to the ones expected from a productivity increase caused by a money wage disturbance. It should therefore - in principle at least - be possible to discern which has been the predominant factor behind the observed faster productivity growth in the tradables sector simply by studying the concomitant macroeconomic developments. This is the task to which we turn in the next section.

6. AN EMPIRICAL APPLICATION

We have applied our model to data for 14 OECD countries for the period 1960-1975. A full account of data sources, definitions, and computational methods is given in Appendix B. Of the total 14 OECD countries included, seven (Austria, Belgium, Denmark, Finland, the Netherlands, Norway and Sweden) can be classified as small open economies. For these economies the strategic assumptions of the model - exogenous price level for tradables, centralized wage setting, and full employment policy - were approximately fulfilled during the time period under consideration. The remaining seven economies (Canada, the U.S., Australia, France, Germany, Italy, and the United Kingdom) are classified as "large economies", for which the strategic assumptions cannot be assumed to be fulfilled. The seven large economies therefore serve as a control group for the empirical applicability of the model.

The theoretical investigation concerned the effects of different once-and-for-all changes in exogenous variables on relative productivities and other endogeneous variables. What we want to explain is, however, the ongoing process of unbalanced productivity growth. This process must then be attibuted to repeated macroeconomic disturbances, such as continuous wage disturbances resulting from periodic wage negotiations. Accordingly, we have to express our hypotheses in terms of proportional rates of change rather than levels. This adaption of the model is relegated to Appendix A.

In an empirical application it is important to keep in mind the intermediate-run character of the theoretical framework. One cannot expect the relations of the model to make empirical sense on, say, an annual basis. Our focus is not on cyclical productivity change but on medium run changes between years with a comparable

level of capacity utilization. We have therefore divided the time period covered into three five-year periods, 1960-65, 1965-70, and 1970-75. The proportional rate of change of a variable during each period constitutes one observation for each country. To facilitate identification of the individual countries in the data diagrams, the three observations for each country have been connected by lines.

In the theoretical sections we investigated two exogenous factors which both result in unbalanced productivity growth: (a) a *ceteris paribus* autonomous productivity increase in the tradables sector, and (b) a *ceteris paribus* increase of the product wage in the tradables sector in a full employment context. In most countries and time periods both factors will, of course, be operative more or less simultaneously. In our model the effects of such simultaneous changes depend on their relative magnitude. If the product wage increase is larger than the autonomous productivity increase then the effects should be qualitatively the same as for product wage increase alone. Conversely, if autonomous productivity rises faster than the product wage then the effects should be qualitatively indentical to the effects of an autonomous change in labor productivity at a given product wage.

The main purpose of the empirical investigation is to find out which of the two factors has been predominant behind the observed unbalanced productivity growth. As we have no direct observations on the autonomous part of productivity growth, τ, it is impossible to separate exogenous from endogenous variables on a *a priori* basis and to perform regular econometric tests of the model relationships.

Instead we will focus attention on the intermediate variables derived in the theoretical sections and presented in Table 3 in order to assess the relative importance of the two determinants. If the major disturbance is an autonomous increase of relative productivity in the tradables sector, it will be associated with a relative increase of tradables employment, as presented in Table 3. If, on the other hand, the major disturbance is an increase of the relative product wage in the tradables sector, it will be associated with a relative decline of tradables employment. The change in the structure of employment can hence shed some light on which has been the predominant causal factor behind unbalanced productivity growth. Other auxiliary variables in determining causality are the government budget deficit, G, and the current account deficit, X, as presented in Table 3.

The statistical examination of our data material is, for the reasons just stated, in principle limited to simple correlations between the endogenous variables on the basis of Table 3. But in addition we have run OLS regressions of the productivity differences on the intermediate variables. Because of omitted exogenous variables and potential simultaneity bias these regressions must be interpreted with caution. There are two reasons why we have performed them anyway.

The first reason is that the regressions have permitted us to include dummy variables for time periods and countries. This means that we have eliminated as a source of variation in our pooled data systematic differences between individual countries

over all three time periods, and between individual time periods over the seven countries in each group. Some of the omitted variables problem should be overcome by this procedure, since the country dummies should catch the effects of permanent country differences in structure and institutions (relative to Sweden and West Germany, respectively), while the time period dummies should catch the effects of time specific disturbances (relative to 1960-65) common to all countries.

some of the estimated coefficients can - with due reservations for potential simultaneity bias - be interpreted in terms of the structural parameters of the model. The derivation of the - admittedly quite stringent - conditions for this interpretation is given in Appendix A.

Results

The results of the empirical analysis are reported in Table 4 and in Figures 3-10.

Looking first at the relation between productivity growth differentials and changes in relative sector size (Equations 1 and 2 in Table 4 and Figures 3 and 4) we find a strong negative correlation between the two in both small and large economies. This indicates - as will be recalled from the theoretical section - that the productivity growth differences in both country groups are structural rather than autonomous. The linear relation formalizes the division of the total observed sectoral difference in productivity growth into an autonomous part, β_0, and a struc-

TABLE 4: Empirical results

Equation number	Y	X	Country group	σ_{XY}	$Y = \beta_0 + \beta_1 X$ β_0 (t)	β_1 (t)	$\bar{R}^2$	Dummies included: Country or period	β (t)	Figure
1	$\hat{q}_T-\hat{q}_N$	$\hat{L}_T-\hat{L}_N$	S	-0.65*	0.53 (1.46)	-0.80 (4.71)	0.64	Austria	-1.98 (2.98)	3
								65-70	1.14 (2.32)	
2	$\hat{q}_T-\hat{q}_N$	$\hat{L}_T-\hat{L}_N$	L	-0.67*	0.91 (3.15)	-0.59 (4.37)	0.47	70-75	-0.76 (1.56)	4
3	$\hat{L}_T-\hat{L}_N$	$\hat{W}_T$	S	-0.74*	3.12 (4.73)	-0.50 (6.58)	0.79	Belgium	-1.48 (3.37)	5
								Denmark	-1.04 (2.39)	
								Finland	-0.98 (1.94)	
								Austria	-1.48 (3.38)	
								65-70	-0.92 (3.01)	
4	$\hat{L}_T-\hat{L}_N$	$\hat{W}_T$	L	0.22	-1.30 (2.56)	0.15 (1.66)	0.15	France	-2.17 (2.08)	6
5	$\hat{q}_T-\hat{q}_N$	$\hat{X}$	S	-0.22	1.36 (3.65)	-0.13 (2.31)	0.24	Belgium	2.91 (2.80)	7
6	$\hat{q}_T-\hat{q}_N$	$\hat{X}$	L	0.08	1.42 (4.38)	0.03 (0.83)	0.04	Italy	-1.48 (1.66)	8
7	$\hat{q}_T-\hat{q}_N$	$\hat{G}$	S	-0.06	2.07 (5.32)	0.25 (1.53)	0.44	Belgium	2.09 (2.62)	9
								70-75	-2.37 (3.15)	
								The Netherlands not included in regressions		
8	$\hat{q}_T-\hat{q}_N$	$\hat{G}$	L	-0.02	1.37 (3.95)	0.04 (0.42)	0.02	Italy	-1.40 (1.52)	10

*Significant at the 0.001 level

tural part, $\beta_1(\hat{L}_T - \hat{L}_N)$. As detailed in Appendix A, β_0 can be interpreted as the difference between the two sectors in the rate of disembodied technical change, $\beta_0 = \lambda_T - \lambda_N$. With a standard t-test β_0 is not significantly different from zero in the small country group, i.e. for these countries there is no evidence of <u>any</u> sectoral difference in autonomous productivity growth. In the large country group there is a significant positive autonomous productivity growth differential but there is also a significant structural effect.

Next we investigate the relationship between relative sector size and product wage changes in the tradables sector (Equations 3 and 4 in Table 4 and Figures 5 and 6). For small open economies we find a significant relationship between product wage increases in the tradables sector and a relative decline of the tradables sector. The implication is that exogenous product wage increases rather than autonomous productivity increases have been the predominant factor behind unbalanced productivity growth. As demonstrated in Appendix A the rate of autonomous productivity growth in the tradables sector, λ_T, can be identified as $\lambda_T = -\beta_0/\beta_1$ in Equation 3 under the assumption of zero labor force growth. With due consideration to significant dummies we can compute $\lambda_T = -(2.10/-0.5) = 4.20$, as an average for the small country group in the three periods. The figure seems to be a bit on the high side.

In the large economy group we can trace no significant relationship between product wage increases and relative employment changes in the tradables sector. The interpretation is that the structural decline of the tradables sector which parallells unbalanced productivity growth has <u>not</u> been the result of product wage increases in these economies. Domestic demand conditions

not reflected in product wage changes as measured here may be one part of the explanation.

Finally, the relations between unbalanced productivity growth and current account deficits (equations 5 and 6) or government budget deficits (equations 7 and 8) do not help much to distinguish between the two causal factors along the lines of Table 3. Simple correlation coefficients are far from significant in all cases. For small economies we find a significantly negative slope coefficient in the current account regression, indicating product wage increases as the main source of disturbance behind unbalanced productivity growth in these economies, but the remaining regressions give no evidence in either direction. Obviously, the problem of omitted variables becomes quite serious in these regressions and not much significance should be attached to the result.

Altogether we seem to have found evidence of structural factors behind unbalanced productivity growth in both large and small economies. The autonomous part of the difference - to be explained by differences in "technological progressiveness" or different rates of capital deepening - seems to be very close to zero in small economies. Also, in small economies there seems to exist a clear link between product wage increases and the structural decline of the tradables sector. In large economies we also find a structural influence on unbalanced productivity growth but the link to product wage increases in the tradables sector cannot be established. This is as it should, since the stringent assumptions of the model - exogenous price level for tradables, centralized wage setting, and full employment policy - are not fulfilled in these economies.

7. CONCLUSIONS

The well-known empirical observation of unbalanced productivity growth between the tradables and non-tradables sector of the economy has been demonstrated in this paper to be only partially due to autonomous factors like a difference in "technological progressiveness". In essence, the difference is a result of a relative decline of the tradables sector, and in the absence of this structural determinant there is no clear superiority in the rate of productivity growth of the tradables sector in small open economies. The phenomenon of unbalanced productivity growth is thereby largely reduced to a mere reflection of the well-known "squeeze" on the tradables sector which can be the outcome of different macroeconomic processes. We have presented in this paper a macroeconomic framework - applicable to many small open economies - where a continuous squeeze originates in the wage formation process while the government simultaneously maintains a pegged exchange rate and full employment.

The analysis of the present paper is perhaps more suggestive than conclusive. The macroeconomic framework could be adjusted to differing institutional conditions and policy strategies in the various countries. In particular, the empirical analysis could be much more detailed. Cross country and time series comparisons of labor productivity give rise to formidable data problems and we do not claim to have overcome them all. The distinction between autonomous and structural productivity growth could be better empirically verified at a more disaggregated level on a country-by-country basis. Also, in a more disaggregated analysis the role of capital formation should be more carefully modelled and investigated.

Even so, we find our results suggestive enough to merit a few conclusions regarding the macroeconomics of balanced productivity growth. In a world with no autonomous sectoral difference in the rate of productivity growth the balance problems investigated by Baumol will not occur. In the absence of product wage disturbances the price of services in terms of commodities will remain constant over time and there will be no secular decline of tradables employment unless income elasticities are biased against tradable goods.

Furthermore, balanced productivity growth has implications for inflation analysis. The "structural" component in a Scandinavian model of inflation will drop out, and a domestic rate of inflation over and above the foreign rate must instead be attributed to other factors, e.g. money wage disturbances.

In general, an equal sectoral distribution of autonomous productivity growth puts a heavy stress on the role of wage formation in the macroeconomic process. A rising relative price of services/non-tradables, a relative decline of the tradables sector, and a domestic rate of inflation over and above the foreign rate can all be the result of money wage disturbances in combination with an accommodative fiscal policy under balanced autonomous productivity growth. Furthermore, the structurally determined superiority of productivity growth in the tradables sector may then be taken as an indicator of a higher margin for future wage increases, and the wage disturbance process will be self-perpetuating as long as fiscal acccmmodation can be maintained. Our results indicate that such a wage disturbance process has been going on for protracted periods of time in a number of small open economies.

FIGURE 3: Productivity growth differences and changes in relative sector size in small open economies

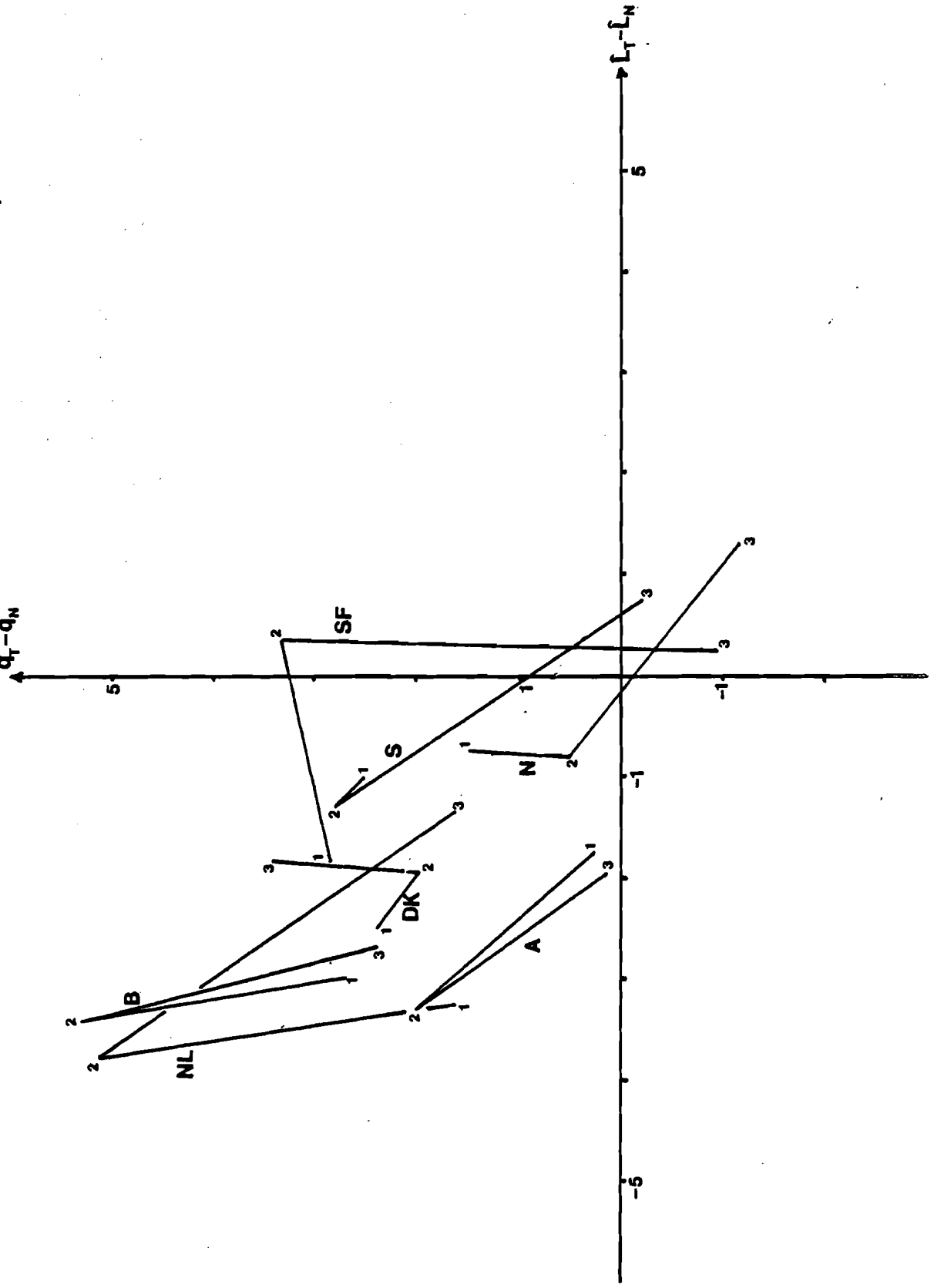
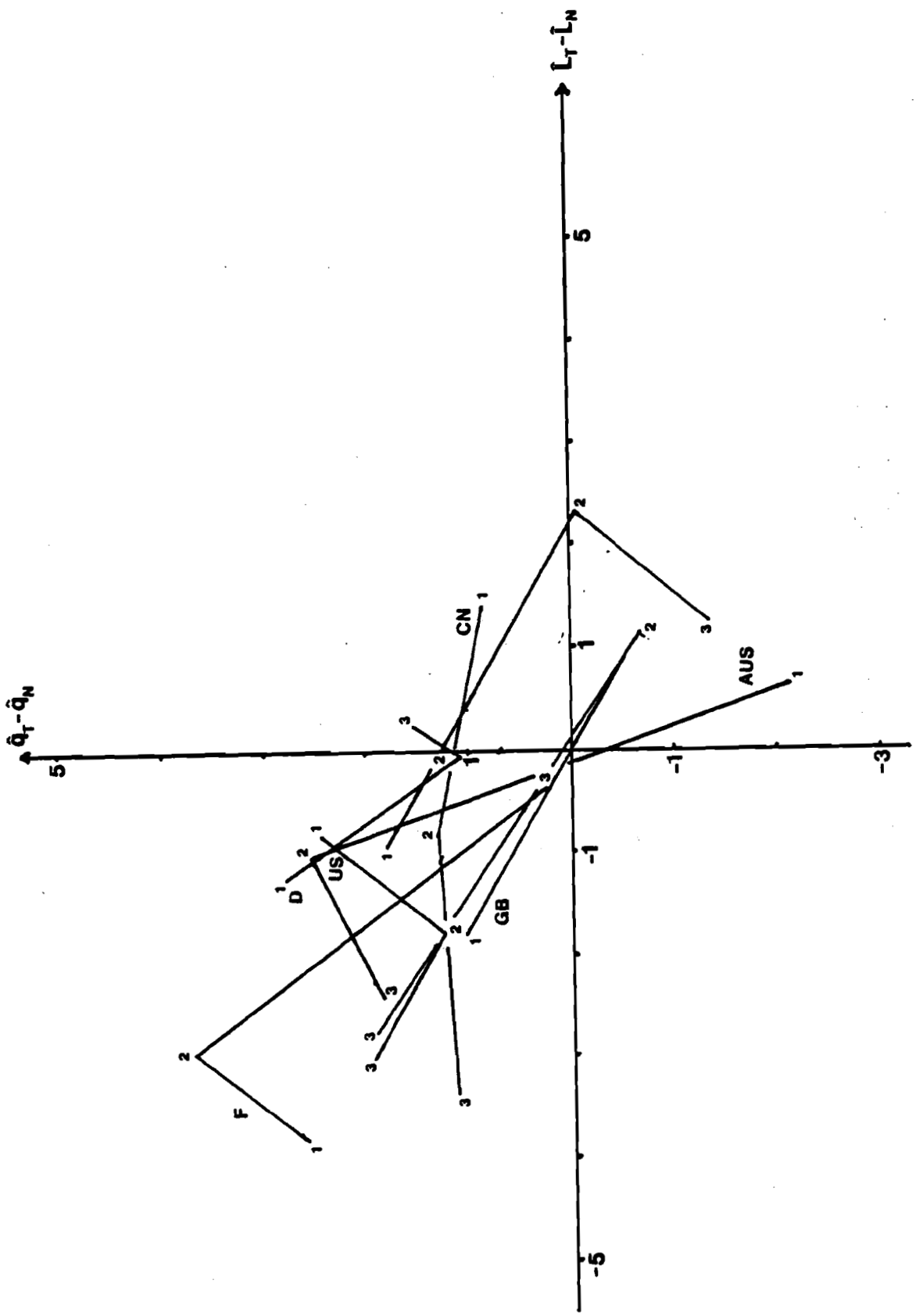


FIGURE 4: Productivity growth differences and changes in relative sector size in large economies.



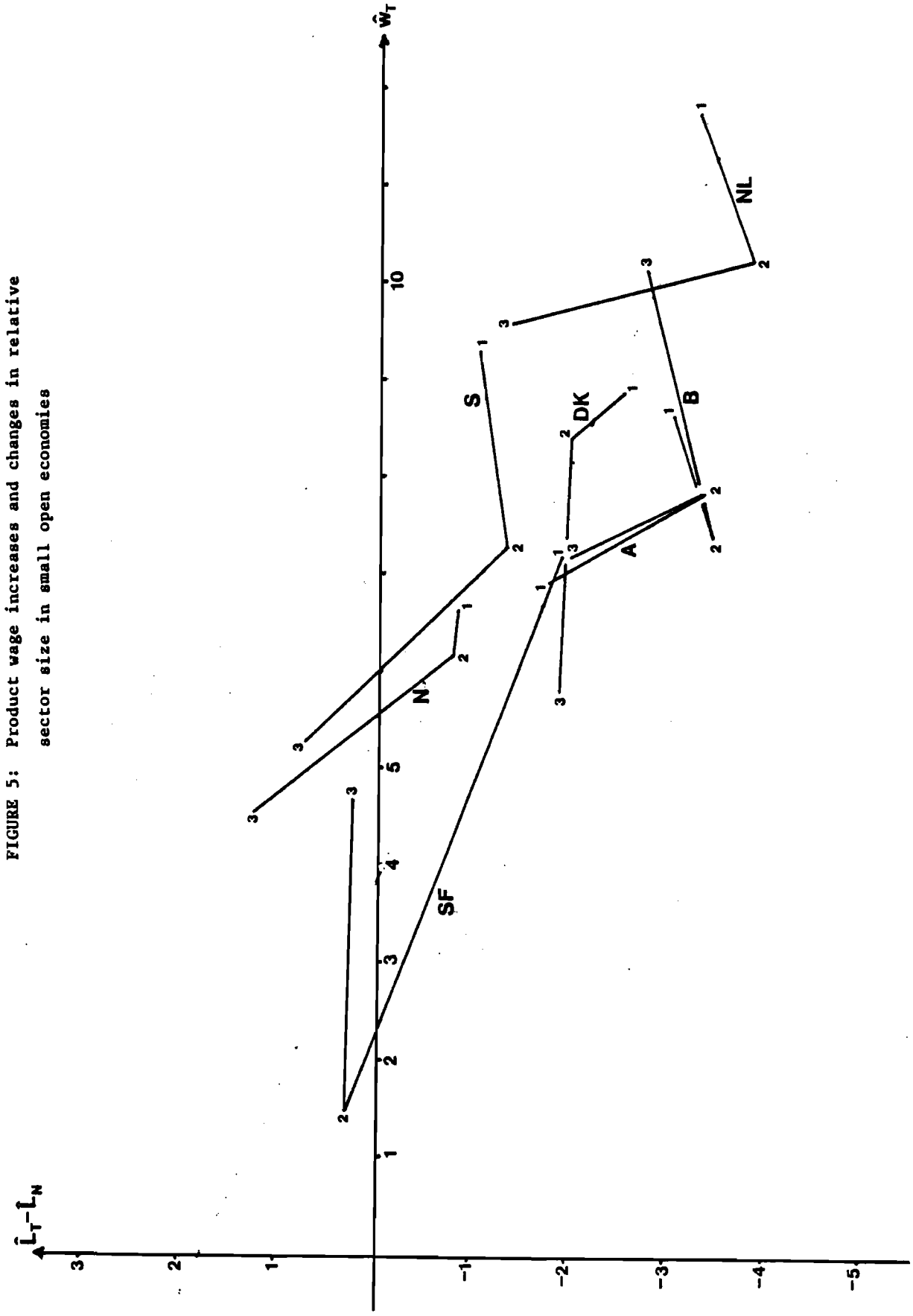


FIGURE 5: Product wage increases and changes in relative sector size in small open economies

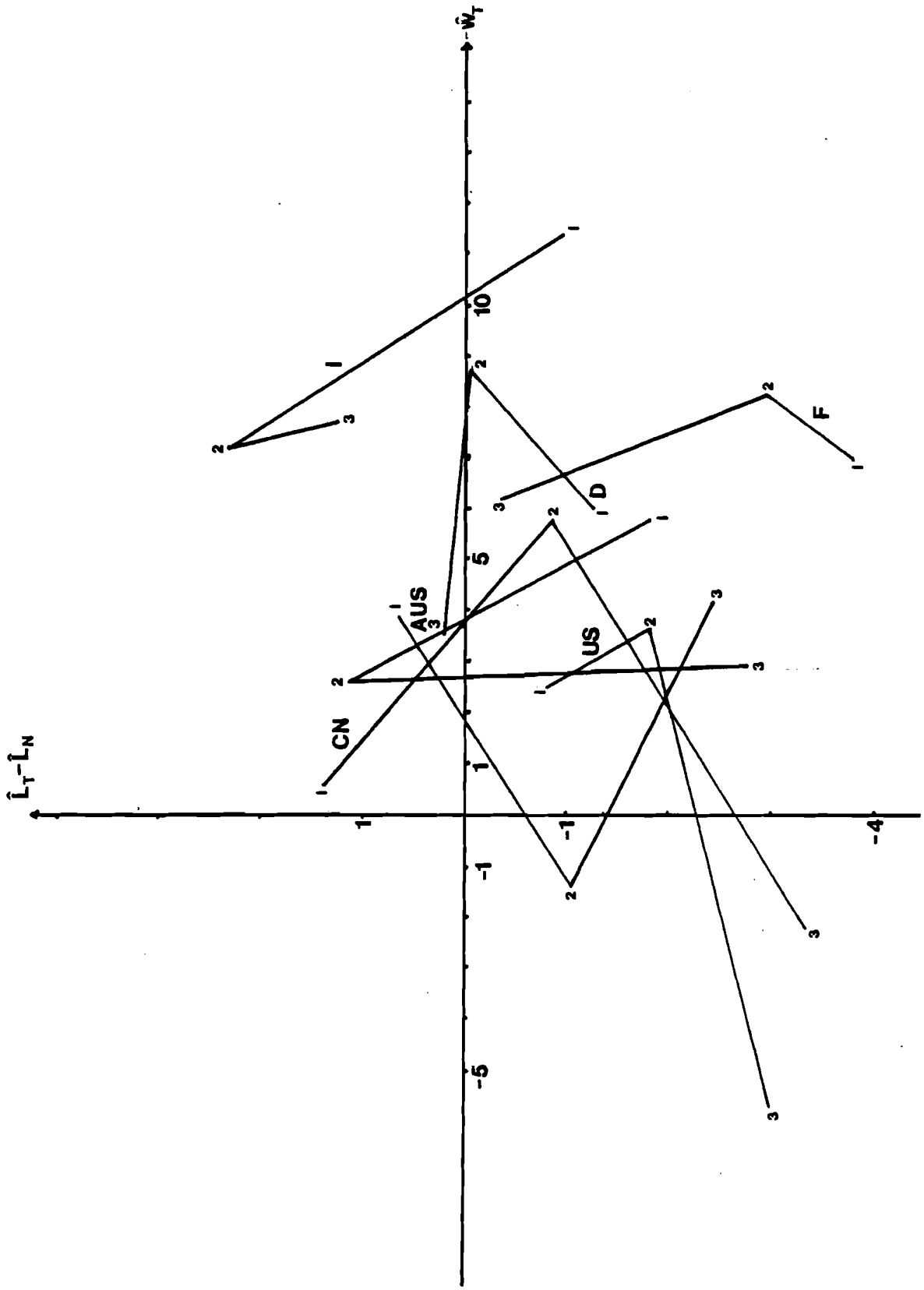


FIGURE 6: Product wage changes and changes in relative sector size in large economies

FIGURE 7: Productivity growth differences and current account in small open economies

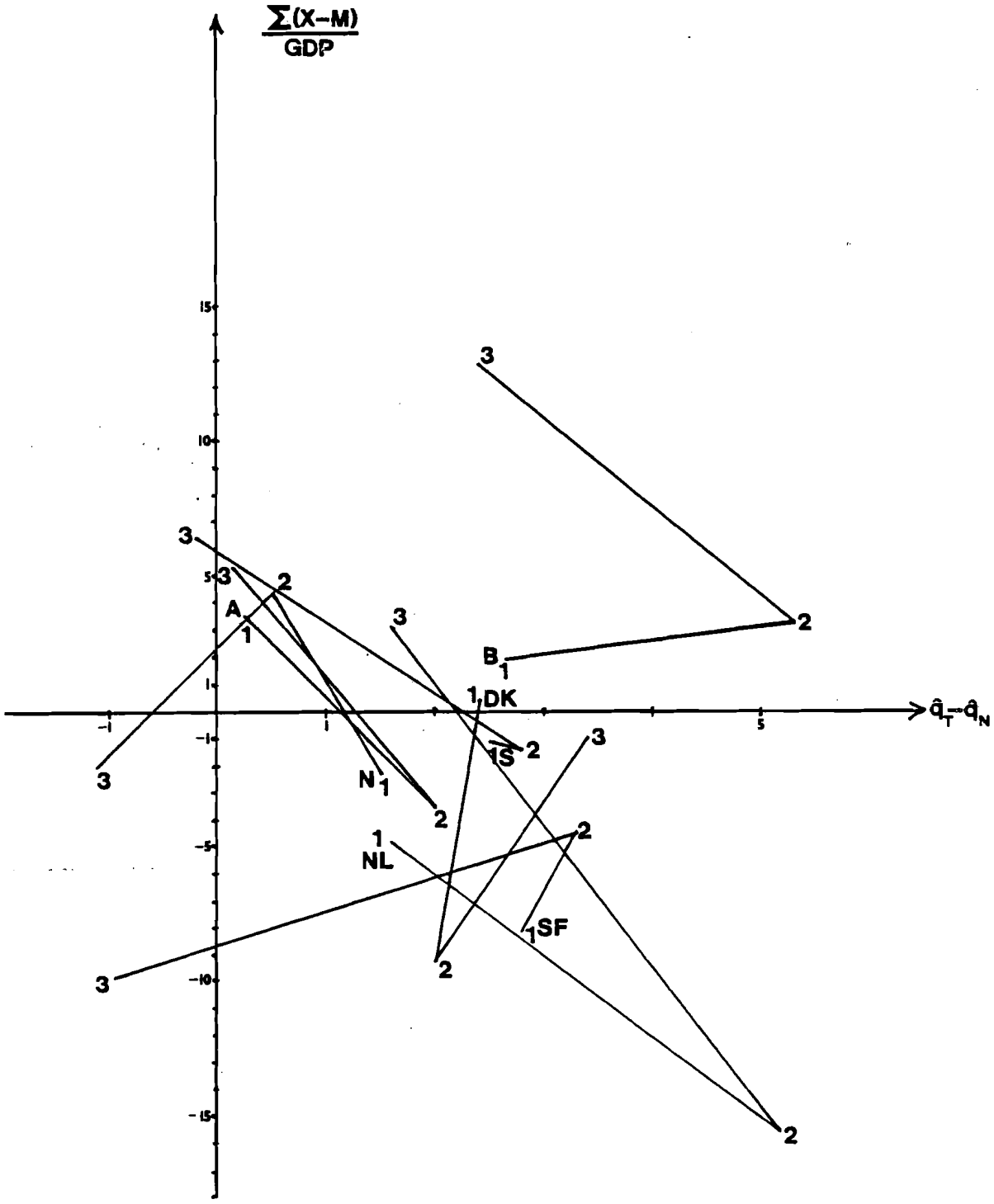
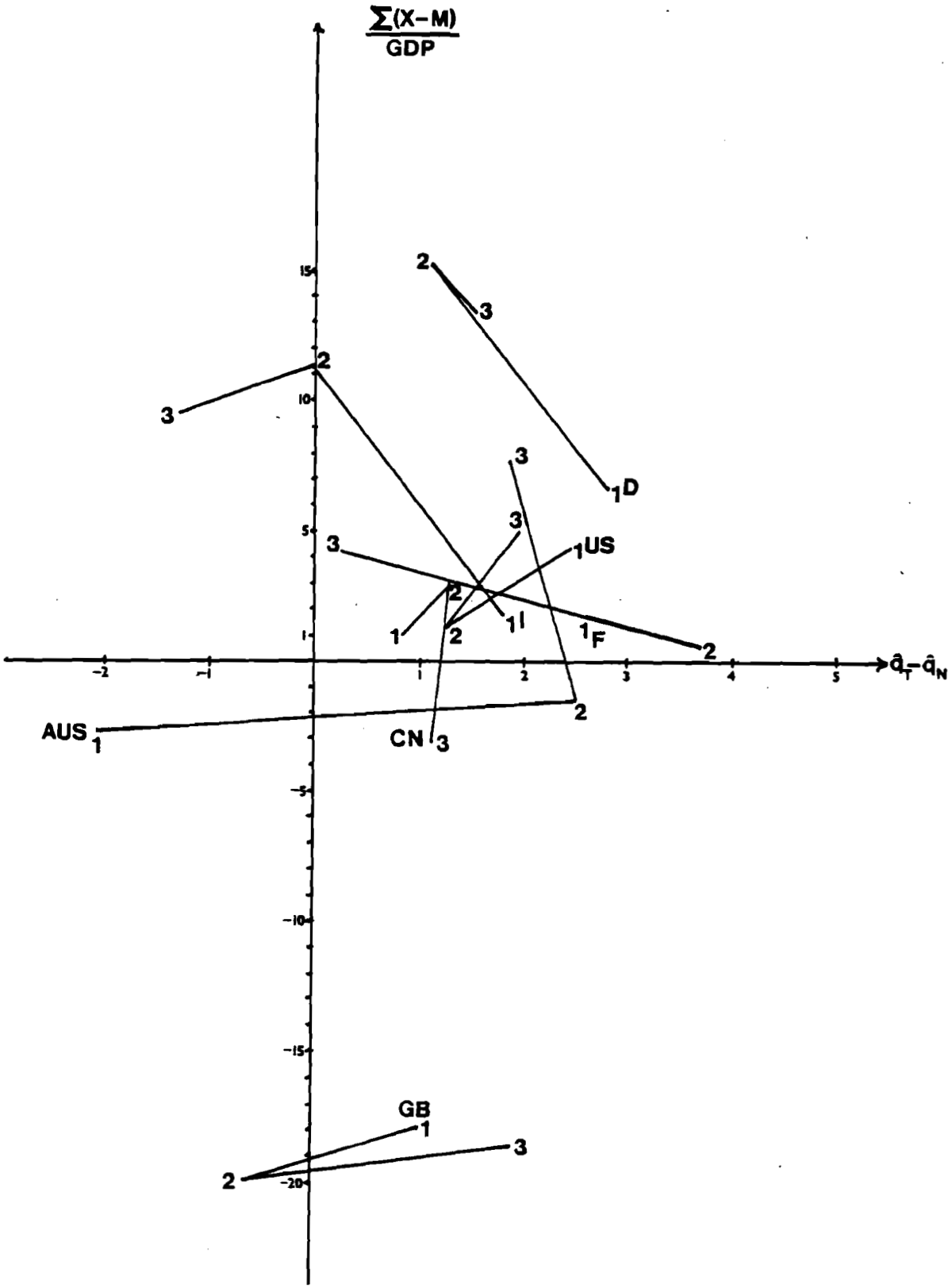


FIGURE 8: Productivity growth differences and current account in large economies



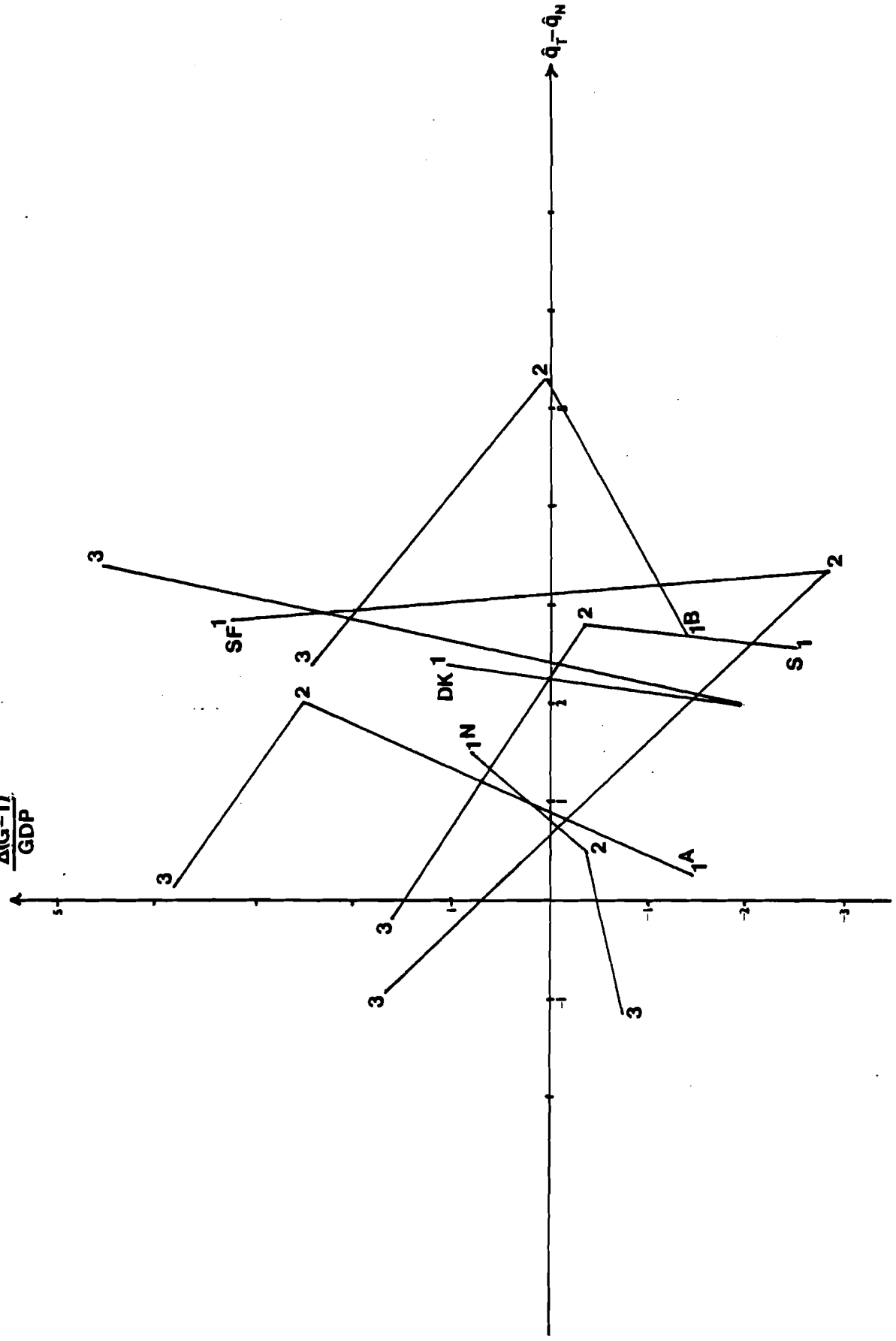
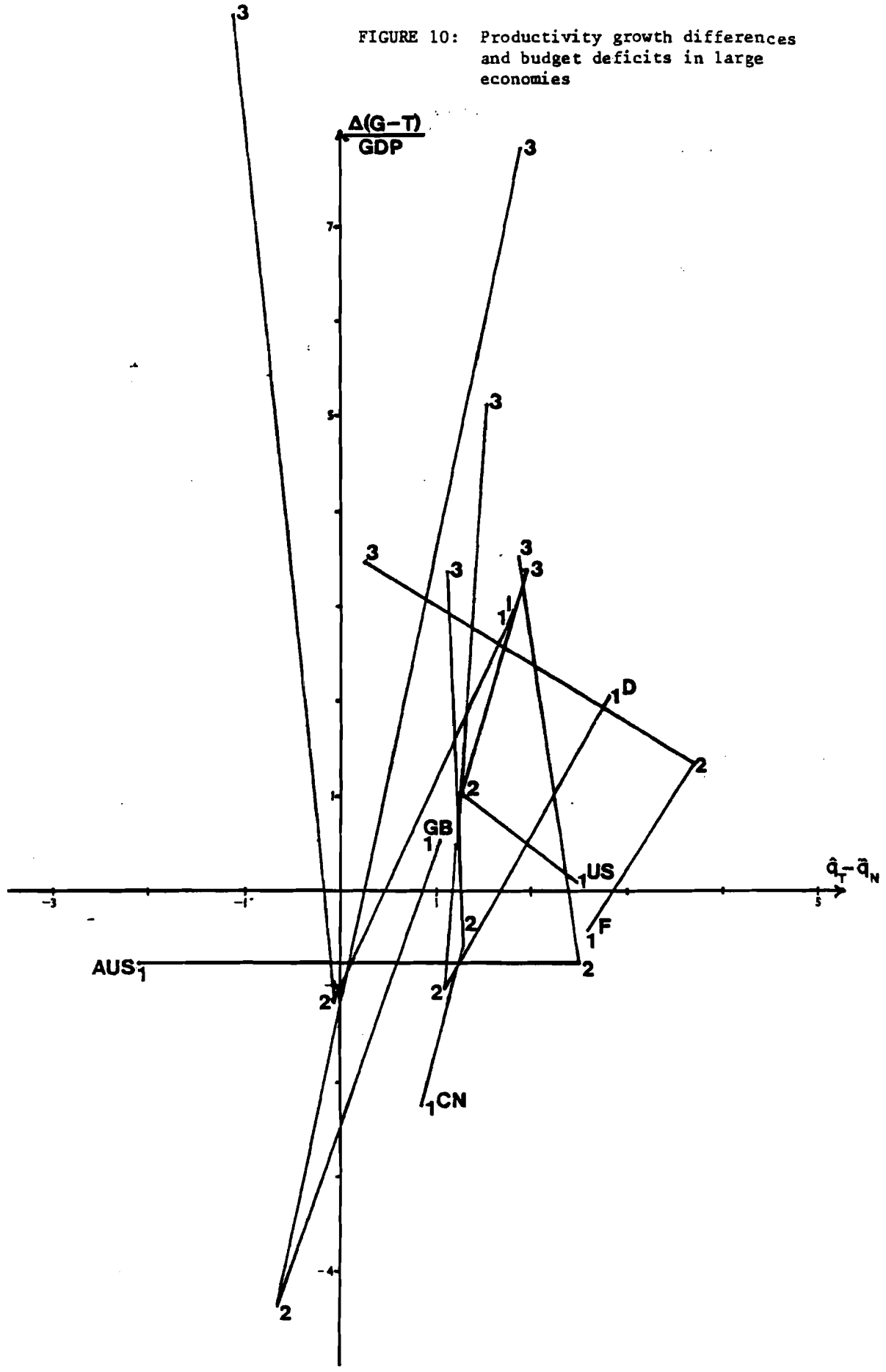


FIGURE 9: Productivity growth differences and budget deficits in small open economies

FIGURE 10: Productivity growth differences and budget deficits in large economies



REFERENCES

Aukrust, O., (1970) "PRIM: A model of the price and income determination mechanisms of an open economy", The Review of Income and Wealth, March.

Baumol, W.J. (1967) "Macroeconomics of unbalanced growth. The anatomy of urban crisis", American Economic Review 57, June.

Branson, W.H. and J. Myhrman (1976) "Inflation in open economies: Supply determined versus demand-determined models", European Economic Review 7.

Bruno, M. and J. Sachs (1979) "Macroeconomic adjustment with import price shocks: Real and monetary aspects", Institute for International Economic Studies, University of Stockholm, Seminar Paper No. 118.

Buiter, W.H. and M. Miller (1981) "Monetary policy and international competitiveness, Oxford Economic Papers, Vol. 33.

Corden, W.M. and J.P. Neary (1982) "Booming sector and de-industrialization in a small open economy", Institute for International Economic Studies, University of Stockholm, Seminar Paper No. 195.

Kierzkowski, H. (1976) "Theoretical foundations of the Scandinavian model of inflation, The Manchester School 44, September.

Salter, W.E.G. (1960) Productivity and technical change, Cambridge University Press: Cambridge.

Söderström, H.T. and S. Viotti (1979) "Money wage disturbances and the endogeneity of the public sector in an open economy", in A. Lindbeck, ed., Inflation and employment in open economies, North-Holland Publishing Co.: Amsterdam.

APPENDIX A: Derivation of equations 1-2 and 3-4 in Table 4

Let production in the two sectors be determined by a neo-classical production function with disembodied technical change

$$(A1) \quad Q_i = F^i(\bar{K}_i, L_i)e^{\lambda_i t} \qquad i = N, T$$

where

$$\frac{\partial F^i}{\partial L_i} = F^i_L > 0, \qquad \frac{\partial^2 F^i}{\partial L_i^2} = F^i_{LL} < 0$$

and the capital stock in each sector is fixed. Define average labor productivity as

$$(A2) \quad q_i \equiv Q_i/L_i.$$

Differentiating logaritmically with respect to time, we obtain

$$(A3) \quad \frac{d \ln q_i}{dt} \equiv \hat{q}_i = \frac{F^i_L L_i}{F^i}\hat{L}_i - \hat{L}_i + \lambda_i .$$

The sectoral difference in productivity growth can now be written

$$(A4) \quad \hat{q}_T - \hat{q}_N = (\frac{F^T_L L_T}{F^T} - 1)\hat{L}_T - (\frac{F^N_L L_N}{F^N} - 1)\hat{L}_N + \lambda_T - \lambda_N .$$

Under profit maximization the money wage rate, w, will be equal to the marginal value product of labor, $p_i F^i_L e^{\lambda_i t}$ in each sector, and (A4) can be rewritten

$$(A5) \quad \hat{q}_T - \hat{q}_N = (\alpha_T - 1)\hat{L}_T - (\alpha_N - 1)\hat{L}_N + \lambda_T - \lambda_N$$

where $\alpha_i \equiv wL_i/p_iQ_i$ is the relative income share of labor in the respective sectors.

If the marginal and average products of labor are equal, $F_L^i e^{\lambda_i t} = q_i$, so that each sector's production function is linearly homogeneous in labor alone, i.e. $\alpha_i = 1$, then the difference in productivity growth is determined only by the difference in the rate of technical progress, $\lambda_T - \lambda_N$. However, in this paper we have postulated decreasing returns to labor, i.e. $\alpha_i < 1$, and therefore $\hat{L}_T$ and $\hat{L}_N$ will also be determinants of the difference in productivity growth.

Under the assumption that both sectors are characterized by Cobb-Douglas production functions with identical labor elasticities, $\alpha_T = \alpha_N = \alpha$, and (A5) reduces to

$$\hat{q}_T - \hat{q}_N = \beta_0 + \beta_1(\hat{L}_T - \hat{L}_N), \qquad \beta_1 < 0,$$

where we can identify

$$\beta_0 = \lambda_T - \lambda_N \gtrless 0$$

and

$$\beta_1 = \alpha - 1 < 0.$$

The estimates for these parameters are reported in Table 4, equation 1 and 2.

Let us next look at the determinants of the change in relative sector size, $\hat{L}_T - \hat{L}_N$. Starting from the profit maximization condition

$$\text{(A6)} \quad w/p_i \equiv w_i = F_L^i e^{\lambda_i t},$$

and differentiating with respect to time we get

$$\text{(A7)} \quad \hat{w}_i = \frac{F_{LL}^i e^{\lambda_i t} \cdot \partial L_i/\partial t + F_L^i \cdot \lambda_i e^{\lambda_i t}}{F_L^i e^{\lambda_i t}}$$

From (A7) we can now solve

$$\text{(A8)} \quad \hat{L}_i = \varepsilon_i(\hat{w}_i - \lambda_i),$$

where

$$\varepsilon_i \equiv \frac{F_L^i}{F_{LL}^i L_i} < 0,$$

which for a Cobb-Douglas production function reduces to

$$\varepsilon_i = \frac{1}{\alpha_i - 1} .$$

From the labor market clearing condition (3) in the main text we know that

$$\text{(A9)} \quad \hat{L}_N = \frac{\hat{L} - \ell_T \hat{L}_T}{\ell_N}$$

where $\ell_i \equiv L_i/L$. We therefore have

$$\text{(A10)} \quad \hat{L}_T - \hat{L}_N = (1 + \frac{\ell_T}{\ell_N}) \hat{L}_T - \frac{\hat{L}}{\ell_N} .$$

Using (A8) we derive

$$\text{(17)} \quad \hat{L}_T - \hat{L}_N = \beta_o + \beta_1 \hat{w}_T$$

where

$$\beta_o = - (1+\ell_T/\ell_N)\varepsilon_T\lambda_T - \hat{L} / \ell_N \gtrless 0.$$

and

$$\beta_1 = (1 + \ell_T/\ell_N)\varepsilon_T < 0 .$$

Estimates for β_o and β_1 are reported in Table 4, equation 3 and 4. Obviously, the rate of technical progress in the tradables sector, λ_T, can be identified only if we have <u>a priori</u> information on the rate of labor force growth, $\hat{L}$, and the employment structure, ℓ_N. For $\hat{L} = 0$ we have $\lambda_T = - \beta_o/\beta_1$

APPENDIX B: Data and Classifications

Our search for data has to a large extent been governed by the requirement that data must be classified in a way that makes a division between tradables and nontradables which is the same for all countries possible. Furthermore, output data, employment data, etc., must be classified according to the same standards to make meaningful calculations possible.

Output: Gross domestic product by kind of economic activity is taken from National Accounts of OECD countries. The total production is divided between different activities classified according to ISIC 1968, which not only makes a division into tradables and nontradables sector possible but also guarantees that this division is the same for all countries. To constitute the tradables sector (T) Mining and Quarrying and Manufacturing (ISIC 2 and 3) are brought together. The nontradables sector (NT) consists of Electricity, Gas and Water, Construction and Wholesale and Retail Trade, Restaurants and Hotels (ISIC 4, 5 and 6). The remaining activities have not been included due to the difficulties of unambiguously classifying them as tradables or nontradables and when it comes to public activities, due to the problems of measuring output.

With the above definition of the sectors, their joint share of the respective country's GDP varies between 47 percent (Sweden) and 69 percent (Austria).

Labor input: The total number of hours worked in the respective activities turned out to be impossible to collect for a large number of countries. To get a labor input measure that permits a sector division corresponding to the one made

above we have been forced to use the number of persons employed - wage earners and salaried employees by activities. These numbers are taken from the OECD Labor Force Statistics. This measure of labor input causes some problems that are unavoidable due to the limited supply of reliable data.

First, the numbers are not adjusted for the share of employees working part time only. Second, self-employed and unpaid family workers are not included. Activities with a large share of part time workers will then show a lower productivity level than the "true" one. The opposite effect will arise if the share of self-employed is high. Since we study changes in productivity the above defects are not so serious provided that the shares of part time workers and self-employed are constant or have a similar development over time in both sectors.

Productivity: The productivity in the respective sector was calculated in the following way: Σ output of the activities belonging to each sector divided by Σ number of employees in the corresponding activities. This was done for the years 1960, 1965, and 1975. After that the average annual rate of change of labor productivity during each five-year period was calculated (see Table 1). These years were chosen because they are relatively comparable from a business-cycle point of view (peaks) and we are here only interested in productivity changes between full employment situations (not changes over the business-cycle). It has been necessary to use partly different time periods for some of the countries, due to changes in the time series, particularly for labor input data.

Wage costs: The wage cost development, average annual percentage rate of change, during each five year period is calculated on the basis of data from the U.S.Department of Labor. They publish index series on the hourly compensation in manufacturing for a large number of countries. These data are adjusted to include employment taxes that are costs to employers.

World market prices: The world market price change was measured as average annual rate of change of export price index for industrial countries published by IMF. The index is based on export unit values expressed in US dollars.

Exchange rate changes: As a measure of exchange rate changes we used average annual rate of change of the respective country's currency relative to the US dollar.

Product wage change: The product wage change in the tradables sector was measured as the change in money wage cost minus the change in world market prices plus the exchange rate changes.

Current account balance: The development of the current account balance was measured as the difference between Exports of goods and services and Imports of goods and services cumulated over five year periods, as a proportion of GNP. Data were taken from National accounts of OECD countries.

Budget balance: The difference between government expenditure measured as current disbursements - transfers to the rest of the world + gross capital formation + purchases of land and intangible assets, and government income measured as current recipts + capital transfers recieved, net, as a proportion of GNP was calculated for the first and last year in each five-year period. The percentage point change between these two years was then used as a measure of the budget balance change.

Countries: Our ambition has been to cover the OECD countries. Due to lack of data, Japan, New Zeeland and Switzerland were excluded. Greece, Ireland, Portugal, Spain, Turkey and Yugoslavia were excluded because of their low degree of industrilization compared with the rest of the OECD-members. This leaves Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Sweden, United Kingdom and United States to be the countries studied.

Classification of countries: To get a notion of the respective country's openness to trade the average of Exports and Imports (of goods and services) as a share of GDP has been calculated (see table B1).

TABLE B1: Degree of openness

	Percent
Australia	16
Austria	31
Belgium	42
Canada	20
Denmark	31
Finland	26
France	15
Germany	22
Italy	18
The Netherlands	44
Norway	42
Sweden	26
United Kingdom	23
United States	12

Degree of openness = $(\frac{\text{Export + import}}{2})$/GDP expressed in percent

Average of the years 1965, -70 and -75.

Source: National Accounts of OECD countries

Our hypotheses applies to small open economies and accordingly, not only a country's degree of openness is of interest but also its share of the world market. The market share gives a notion of whether the country acts as a price-taker or has a possibility to influence the price of its export commodities (see table B2).

TABLE B2: World market share

	$\Sigma\lambda ij \cdot \theta ij$
Australia	11,8
Austria	0,7
Belgium	3,3
Canada	7,7
Denmark	7,2
Finland	6,3
France	2,2
Germany	6,7
Italy	3,6
Netherlands	3,3
Norway	3,3
Sweden	4,3
United Kingdom	3,9
United States	9,8

World market share = $\Sigma_i \lambda ij \cdot \theta ij$ where λij = country j:s share of world trade with commodity i and θij = commodity i:s share of country j:s total export. Commodity i is taken to be the five most important exports (in value using the SITC three digit classification) for each country. Average of the values for the years 1967, 1970, and 1975.

Source: UNCTAD Handbook of Int. Trade and Development Stat. 1976 and 1979.

Another way to measure to what extent a country act as a price taker is to compare the covariation beteen export prices and world market prices with the covariation between export prices and domestic prices. OECD (1973) has made such a study and the results were the following:

a) In the USA the domestic price influence dominates almost completely.

b) In Germany and United Kingdom the domestic price influence is smaller but still dominates.

c) In Canada and France domestic prices and world market prices are of equal importance.

d) In the smaller countries, such as Austria, the Netherlands, Norway and Sweden, the influende of world market prices dominates.

In our model we assumed that the money wage rate is exogenously given and determined in central collective bargaining. The degree of centralisation in the bargaining process is consequently of interest when we try to determine for which countries our hypotheses are valid. An OECD-report (OECD 1979) gives a subjective grading of a numer of countries according to typical level of bargaining. A high degree of centralisation characterises Austria, Belgium, Denmark, Finland, Norway and Sweden. USA, Canada and France are characterized by a low degree of centralisation and in the middle we find Australia, Germany, Italy, Netherlands and United Kingdom.

On the basis of the facts given above we have classified Austria, Belgium, Denmark, Finland, the Netherlands, Norway and Sweden as small open economies for which our hypotheses ought to be valid.

DATA SOURCES

International Labour Office, various years, Yearbook of Labor Statistics.

International Monetary Fund, International Financial Statistics, 1977, No. 5, May, Supplement Annual Data 1952-76.

OECD, various years, National Accounts of OECD Countries.

OECD, various years, Labor Force Statistics.

OECD, 1973, Economic Outlook 13, July.

OECD, 1979, Collective Bargaining and Government Policies.

UNCTAD, various years, Handbook of International Trade and Development Statistics.

United Nations, various years, Yearbook of National Accounts Statistics.

U.S. Department of Labor, 1978, Output per hour, hourly compensation and unit labor costs in manufacturing, eleven countries, 1950-77.