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# ACCOUNTING FOR ECONOMIC GROWTH: THE CASE OF NORWAY

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FOLLOWING the pathbreaking contributions of Chenery (1960) and Chenery, Shishido, and Watanabe (1962), several writers attempted to explain economic growth in terms of the contributions of demand factors (domestic demand and exports) and import substitution. In cases when total (as compared to direct) measures were used in the calculations, technological change or, more accurately, changes in input coefficients, was shown separately as a source of economic growth.[1]

Apart from Desai (1969), who considered the conceptual relationship of actual import substitution with an optimal situation, recent contributions to the subject aimed at refining earlier work on the measurement of the sources of growth. Morley and Smith (1970 and 1971) suggested redefining import substitution to take account of indirect imports in the form of intermediate inputs used in the import substituting industries. Fane (1971) proposed replacing estimation in discrete time by estimation in continuous time, so as to provide a complete decomposition of economic growth and to avoid interaction terms among its primary determinants. In another paper, Fane (1973) suggested a way to establish consistency between disaggregated and aggregate measures of import substitution. Finally, Frank, Kim and Westphal (1975) used a chained measure of import substitution in combining results for individual subperiods.

This paper differs from earlier contributions in taking a theoretical model of economic development and international trade as its point of departure. It will make use of this model, originating in the work of Harry Johnson (1959), in applying sources of growth analysis to examine the effects of policy changes in Norway during the period following the Second World War. Calculations will also be made with alternative models that were used by other researchers.

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[1] This type of analysis contrasts with the production function approach, which seeks to explain economic growth in terms of changes in the amount and the productivity of the factors of production.

Section I provides a brief background on the Norwegian economy and on the policies followed in the postwar period. Sections II and III describe the models employed in the paper and the derivation of the direct and indirect measures used in empirical estimation. In turn, Sections III and IV, respectively, present aggregate estimates for Norway and discuss the disaggregated results for the major sectors of the economy and for individual industries. Finally, Section V briefly summarizes the conclusions of the paper, and it makes a comparison with results obtained for Japan.

## I

In an earlier paper (1970), the author drew attention to the contrast between the inward-looking strategies followed by semi-industrial countries in Latin America (Argentina and Chile) and in Eastern Europe (Czechoslovakia and Hungary) on the one hand, and the outward-looking strategies applied in two Western European countries, Denmark and Norway, on the other. In a separate paper (1969), the case of Norway was examined in some detail.

In the early postwar period, Norway exhibited the characteristic features of a semi-industrial country. Its exports were largely dominated by primary products sold in raw and in simply processed form. Manufactured goods, defined in a narrower sense to exclude intermediate products at lower levels of transformation, accounted for less than one-tenth of exports, and only 3 percent of the output of the manufacturing sector was exported (Balassa, 1969, pp. 346–48).

The share of manufacturing thus defined in the gross national product was much lower in Norway (15 percent) than in the major European industrial nations (27 to 28 percent). Principal manufacturing activities included consumer goods industries established behind moderate protection to cater to domestic needs; the manufacture of wood and cork products benefiting from the availability of cheap raw material, and engineering industries specializing in the production of machinery used for the processing of domestic materials and in shipbuilding.

Given the limitations of its fishing, forestry, and mining resources, the continuation of this pattern of specialization would not have provided sufficient impetus for rapid economic growth in Norway during the postwar period, so that there was need to expand the manufacturing sector. Possible policy choices included adopting an inward-looking strategy oriented towards import substitution behind high protective barriers as was done in a number of Latin American and Asian countries or pursuing an outward-looking strategy aimed at export expansion. The decision was made for the

latter, with policy measures taken to stimulate exports and to increase foreign competition in domestic markets.

The adoption of realistic exchange rates and duty rebates on imported inputs used in export production, together with the elimination of quantitative import restrictions and reductions in tariffs, served these objectives. Tariffs on non-agricultural products were reduced to levels much below those in semi-industrial countries of Latin America and Asia[2] and were even lower than in the major industrial countries. In 1954, tariffs on manufactured goods averaged 8 percent in Norway and the average effective rate of protection was also 8 percent as compared to 12 and 20 percent in the United States, 16 and 18 percent in the United Kingdom, and 12 and 18 percent in the European Common Market. Only Sweden had comparable protection levels, with tariffs averaging 7 percent and effective rates of protection 12 percent (Balassa, 1965, p. 588).

Subsequently, Norway became one of the founding members of the European Free Trade Association, established in 1960. Other member countries were Austria, Denmark, Portugal, Sweden, Switzerland and the United Kingdom, with Finland joining at a later date. Tariffs on intra EFTA trade in non-agricultural products were eliminated by the end of 1966. In turn, following the entry of the United Kingdom and Denmark into the Common Market, Norway signed an association agreement with the EEC that entails free trade in practically all manufactured products.

The process of industrial transformation in Norway during the postwar period thus took place in the framework of an open economy, and Norwegian firms had to meet the test of the world market at home as well as abroad. Apart from stimulating merchandise exports, the maintenance of realistic exchange rates and the lack of foreign exchange restrictions also benefited service exports, consisting primarily of shipping.

This paper will investigate the effects of the policies applied in Norway on import substitution and exports, and hence on economic growth, during the period before and after the establishment of the European Free Trade Association (1953–61 and 1961–69). This will involve comparing observed magnitudes with hypothetical results derived under the assumption that relationships among the relevant variables would have remained unchanged in the absence of policy changes. The comparisons will be made by the use of alternative models.

The data used in this study have been expressed in terms of constant prices. However, as noted below, Laspeyres and Paasche indices have been used to indicate the sensitivity of the results to the choice of the base year.

[2] In the mid-sixties, averages of nominal and effective protection were 96 and 113 percent in Brazil, 111 and 182 percent in Chile, 24 and 26 percent in Mexico, 85 and 271 percent in Pakistan, and 25 and 61 percent in the Philippines. (Balassa, 1971, p. 54).

## II

Harry Johnson (1959) explains changes in imports in a growing economy in terms of pro- and anti-trade biases in production and in consumption, when "neutral growth" is defined as a situation when the production and/or consumption of importables is growing at the same rate as the national product. The growth of production will be anti (pro)-trade biased and positive (negative) import substitution in production will occur, if the supply of importables is growing more (less) rapidly than the national product. In turn, the growth of consumption will be anti (pro)-trade biased, and positive (negative) import substitution in consumption will occur, if the demand for importables is rising less (more) rapidly than the national product. In combining these biases, we obtain total anti-trade bias (positive import substitution) or pro-trade bias (negative import substitution) in production and consumption combined.

While Johnson's model has been formulated in a two-commodity framework, it can be readily extended to a multi-commodity context. In the following, the relevant formulas will be derived for import-substituting industry $i$, when the national product is denoted by $Y$, production for domestic use by $S$, consumption by $D$, imports by $M$; growth rates are shown by small letters.

For purposes of estimating import substitution, hypothetical imports are defined as $M_t^*$ in the case of neutral growth in production with consumption at observed levels, $M_t^{**}$ in the case of neutral growth in consumption with production at observed levels, and $\bar{M}_t$ in the case of neutral growth in both production and consumption. In a two-period model, equations (1) and (2) show actual imports while equations (3) to (5) indicate hypothetical imports derived under the alternative definitions.

$$M_{io} = D_{io} - S_{io} \tag{1}$$

$$M_{it} = D_{it} - S_{it} = (1 + d_i)D_{io} - (1 + s_i)S_{io} = (1 + m_i)M_{io} \tag{2}$$

where $$m_i = \frac{(1 + d_i) + D_{io} - (1 + s_i)S_{io}}{D_{io} - S_{io}} - 1$$

$$M_{it}^* = (1 + d_i)D_{io} - (1 + y)S_{io} \tag{3}$$

$$M_{it}^{**} = (1 + y)D_{io} - (1 + s_i)S_{io} \tag{4}$$

$$\bar{M}_{it} = (1 + y)D_{io} - (1 + y)S_{io} = (1 + y)M_{io} \tag{5}$$

Next, equations (6) to (8) show the extent of anti-trade bias (import substitution) in production, in consumption, and in production and consumption combined.

$$M_{it}^{*} - M_{it} = (1+s_i)S_{io} - (1+y)S_{io} = (s_i - y)S_{io} \tag{6}$$

$$M_{it}^{**} - M_{it} = (1+y)D_{io} - (1+d)D_{io} = (y - d_i)D_{io} \tag{7}$$

$$\begin{aligned} \bar{M}_{it} - M_{it} &= [(1+y)(D_{io}) - (1+y)S_{io}] - [(1+d_i)D_{io} - (1+s_i)S_{io}] \\ &= (1+y)M_{io} - (1+m_i)M_{io} = (y - m_i)M_{io} \end{aligned} \tag{8}$$

Rearranging terms, the relationship of the three formulas is indicated in equation (9), where total anti-trade bias (import substitution) is the sum of anti-trade bias in production and in consumption. Utilizing Johnson's terminology, $(s_i - y)S_{io}$ will indicate the production effects and $(y - d_i)D_{io}$ the consumption effects of economic growth on import substitution in industry *i*.

$$\begin{aligned} \bar{M}_{it} - M_{it} &= (M_{it}^{*} - M_{it}) + (M_{it}^{**} - M_{it}) \\ &= [(1+s_i)S_{io} - (1+y)S_{io}] + [(1+y)D_{io} - (1+d_i)D_{io}] \\ &= (s_i - y)S_{io} + (y - d_i)D_{io} \end{aligned} \tag{9}$$

This formulation of the import substitution term contrasts with that widely used in the literature (Lewis and Soligo 1965; Desai, 1969; Morley and Smith, 1970 and 1971; Fane, 1971 and 1973; and Frank, Kim, and Westphal, 1975) where, following the first paper by Chenery (1960), import substitution was defined in terms of changes in the share of imports in the domestic consumption of the products of a particular industry. A decrease (increase) in this share, associated with increases in the industry's production exceeding (falling short of) that of consumption, would accordingly represent positive (negative) import substitution. Under the share method then, import substitution is defined as $(d_i - m_i)M_{io}$, and the difference between the formulations of import substitution derived from Johnson's approach and under the share method equals $(y - d_i)M_{io}$.

The share method thus takes a constant share of imports in individual industries as the norm and neglects the changes in the sectoral composition of production and consumption. Thus, if production in an industry rose more rapidly than consumption, the existence of import substitution would be shown under the share method even though the industry's production grew less rapidly than national income.

By contrast, in defining import substitution in terms of deviations of the growth rates of the industry's production and consumption from the growth rate of the national product, the method based on Johnson's approach takes changes in domestic production and consumption as its point of reference. Non-neutrality in production, accompanied by neutral changes in consumption, will give rise to production effects while non-neutral changes in consumption, accompanied by neutral changes in production, will give rise to consumption effects.

Under the Johnson approach, then, changes in production and consumption in a particular industry are taken to be independent and the full effects of non-neutral changes in production and consumption will bear on imports. This is analogous to the treatment of "fully traded" goods in project evaluation, in the case of which increases in production resulting from the implementation of a new investment project lead to lower imports without affecting domestic consumption whereas increases in consumption result in higher imports without affecting domestic production (Joshi, 1972).[3]

Some further advantages of Johnson's approach over the share method should be noted. To begin with, the estimates of import substitution are invariant with the level of aggregation that is not the case under the share method. Also, in contradistinction with the share method, there is no interaction term as between the contributions of domestic demand and import substitution to the increment of the sector's output.[4] Finally, the Johnson approach permits us to consider the effects of incentives on the interindustry structure of production by decomposing import substitution into production and consumption effects.

The next question concerns the choice of an appropriate norm for exports. Taking the exports of the initial year as the norm in calculating their contribution to the growth of output assumes that exports would not have risen in the absence of policy changes. This assumption, used without any explicit justification in studies on Pakistan (Lewis and Soligo, 1965, Fane, 1971), Brazil (Morley and Smith, 1971), and Korea (Frank, Kim, and Westphal, 1975), may find relevance to Norway. For one thing, as noted before, limitations of natural resources impinged on the growth of primary exports. For another thing, policy changes were necessary in order to increase manufactured exports that were small at the beginning of the period.

We may now decompose increases in output ($x_i X_{io}$) in terms of the contributions of domestic demand, import substitution, and exports. As noted above, the contribution of import substitution is measured as the difference between hypothetical ($yM_{io}$) and actual ($m_i M_{io}$) increments in imports. In turn, the contribution of domestic demand is estimated by deducting the hypothetical import-increment ($vM_{io}$) from the actual increase in domestic demand ($d_i D_{io}$). Finally, the contribution of exports is taken to be $e_i E_{io}$. There is thus direct comparability between the domestic demand and the export contributions to the increment in output.

The share method, too, has been used to decompose increases in output.

[3] The result assumes that domestic prices equal marginal cost in domestic industries; protection takes the form of tariffs; and imports are available at a constant world market price. These assumptions are by-and-large fulfilled in Norway.

[4] However, there are interaction terms in the decomposition of the sector's output growth between changes in sectoral shares and in national income.

In the work of the authors cited above, the contributions of domestic demand, import substitution, and exports have been defined as $(d_iD_{io} - d_iM_{io})$, $(d_iM_{io} - m_iM_{io})$, and $e_iE_{io}$. The difference in the two methods, then, lies in measuring the contributions of domestic demand and import substitution.

An alternative hypothesis involves the assumption that, in the absence of policy changes, exports would have grown at the same rate as the national product. This is the assumption made by Johnson in his two-commodity model that includes an exportable and an importable. In Johnson's model, neutrality obtains if the production and the consumption of both the exportable and the importable, and hence exports and imports, grow at identical rates.

In setting out to explain the sources of economic growth, Chenery, Shishido, and Watanabe (1962) derived hypothetical values under the assumption that exports and imports in individual industries, and hence the industry's output, grew at the same rate as domestic aggregate demand (for short proportionate growth).[5] Correspondingly, these authors decomposed deviations from proportionate growth in output levels for individual industries in terms of deviations from proportionate growth in domestic demand, exports, and imports.

In this study, three models have been used to indicate the contribution of exports and import substitution to changes (deviations) in output. Models I and II decompose absolute increments in output and determine the contribution of exports to the growth of output by taking hypothetical exports to equal the exports of the base period. At the same time, they differ in that import substitution is measured by the use of the share method in Model I and by employing the Johnson approach in Model II.

A simple algebraic presentation of the two models is given below, together with the Chenery, Shishido, and Watanabe approach that has been designated Model III. In all three models, the domestic demand, export, and import substitution terms have been expressed as the difference between actual and norm (hypothetical) values. In the equations, domestic output ($X$) equals the sum of production for domestic use ($S$) and exports ($E$), and actual as well as norm values have been expressed as differences from base year values.

As noted earlier, Models I and II decompose increments in output while under Model III deviations from proportionate growth are calculated. Chenery, Shishido, and Watanabe have also compared the sum of the absolute value of these deviations in domestic demand, imports, and exports

[5] It makes no difference for the results whether we used domestic aggregate demand or the national product as a norm as long as they grow at the same rate. For comparability, we have followed Chenery, Shishido, and Watanabe in using aggregate demand norms.

| | *Changes (deviations) in output* | *Domestic demand effect* | *Export effect* | *Import substitution effect* |
|---|---|---|---|---|
| | *Actual Norm* | *Actual Norm* | *Actual Norm* | *Norm Actual* |
| Model I | $x_t X_{to} - 0$ | $= (d_t D_{to} - d_t M_{to})$ | $+ (e_t E_{to} - 0)$ | $+ (d_t M_{to} - m_t M_{to})$ (10) |
| Model II | $x_t X_{to} - 0$ | $= (d_t D_{to} - \gamma M_{to})$ | $+ (e_t E_{to} \quad 0)$ | $+ (\gamma M_{to} \quad m_t M_{to})$ (11) |
| Model III | $x_t X_{to} - \gamma X_{to}$ | $= (d_t D_{to} \quad \gamma D_{to})$ | $+ (e_t E_{to} \quad \gamma E_{to})$ | $+ (\gamma M_{to} \quad m_t M_{to})$ (12) |

on the national economy level, (1962, p. 113). Such a calculation is of limited usefulness, however, since the results depend on the degree of aggregation. In the present study, we have compared instead *net* deviations from proportionality in exports and in import substitution to the absolute increment in output. Further comparisons have been made between actual and hypothetical exports and imports, with hypothetical values being derived on the assumption that exports and imports grew in proportion with the national product.[6]

## III

Thus far, we have conformed to the theoretical models of international trade that are formulated in terms of final goods to the exclusion of trade in intermediate products. Next, we admit the existence of intermediate products, which can be produced domestically or imported. Intermediate products may be treated as if they were final products by decomposing changes (increments) in an industry's output, irrespective of whether it is destined for final or for intermediate uses (direct method). Alternatively, we may trace back the intermediate product requirements of the various components of final demand and imports by the use of the inverse of the Leontief matrix (total method).

Both of these methods have their uses. Results obtained by applying the direct method can be interpreted to indicate the effects of the system of incentives on exports and on import substitution in individual industries. In turn, the total method permits measuring the output contribution of changes in input-output coefficients, which has been customarily equated to technological change. Finally, differences in the results obtained by the use of the direct and the total method show the extent of indirect demand for an industry's products.[7]

[6] Similar calculations have been made for domestic demand, but it should be understood that deviations would sum to zero if aggregate demand and the national product were growing at the same rate.

[7] Note further that under the direct method one overestimates the contribution of domestic demand to increases in output by including all intermediate uses under this heading although some of them are related to exports or import substitution.

In previous uses of the direct method, the same norms were used for an industry, irrespective of whether its products were destined for final or for intermediate uses. While this calculation permits decomposing import substitution into production and consumption effects in a consistent manner, using separate norms for final and for intermediate demand allows separating import substitution in final and in intermediate products. As both of these comparisons are of interest, estimates based on the direct method have been made by using aggregate total demand as the norm for both final and intermediate uses (Alternative A) as well as by using aggregate final demand and aggregate intermediate demand as norms for final and for intermediate uses, respectively (Alternative B).

Aggregate final demand will be the appropriate norm for calculations made under the total method. The application of the total method further necessitates setting norms to estimate the effects of changes in input-output coefficients. Chenery, Shishido, and Watanabe (1962) used total (domestic plus imported) input-output coefficients for this purpose. Since, however, we are attempting to explain changes in domestic output, a more appropriate procedure is to use domestic input-output coefficients.[8] In the present study, this has been done with regard to all three models.

A further question concerns the choice of the base year for the calculations. We have regarded this choice as an index number problem and made calculations for the two subperiods using both Laspeyres and Paasche indices, thus "bracketing" possible values by the use of the two index number formulas.[9] For the entire period, we have derived chained measures by combining the Laspeyres, as well as the Paasche, results for the two subperiods.[10] This solution has been chosen since the use of Laspeyres or Paasche indices for the period as a whole would have meant taking unchanged product composition as a norm for a period of sixteen years.

Under the direct method, the choice of the base year pertains to the sectoral composition of domestic consumption of production, and hence imports, that is used to calculate hypothetical values for making comparisons with actual values. Under the total method, a base year needs to be established also for measuring changes in input-output coefficients (technological change). Consistency required using data on the sectoral composition of consumption, production, and imports as well as on input-output coefficients in the first year as the base for calculations with the Laspeyres formula and data on sectoral composition and on output coefficients in the terminal year as the base for calculations with the Paasche formula.

[8] This alternative was suggested to the author by Larry Westphal.

[9] This solution has been considered preferable to assuming a constant rate of growth for all variables between benchmark years (Lane, 1973) that is necessarily arbitrary.

[10] The chained measure was also employed by Frank, Kim, and Westphal (1975) but these authors used a Laspeyres index only.

## IV

Table 1 shows the percentage decomposition of the aggregate estimates for Model II that is our preferred alternative. The table shows results obtained by the use of the Laspeyres and Paasche formulas for the 1953–61 and 1961–69 subperiods as well as the chained results for the entire period. In the following, we will first discuss the estimates obtained under the direct method and will come to the total method results afterwards.

The direct method results point to the important role played by exports in economic growth following the adoption of outward-looking policies in Norway. For the 1953–69 period, increases in exports accounted for 31 percent of the increment in output.[11] Within this period, the contribution of exports to the growth of output increased following Norway's entry into the European Free Trade Association. This contribution was 28 percent between 1953 and 1961 and 34 percent between 1961 and 1969.

The contribution of import substitution to output growth was negative throughout the entire period, and the results are practically identical in the two subperiods. Import substitution was estimated at −12·6 and −8·7 percent of the increment in output in 1953–61 and at −11·9 and −8·2 percent in 1961–69, depending on whether the Laspeyres or the Paasche formulas are used. The Paasche results are lower in absolute terms as expected.

Negative import substitution is consistent with an outward-looking policy that leads to increases in exports *and* imports. At the same time, on the national economy level, negative import substitution must be due to production effects, since domestic aggregate demand is used as the norm for calculating consumption effects.[12] Thus, the small absolute figures shown in the table indicate the existence of differences between the rate of growth of domestic aggregate demand and that of the national product; i.e. differences between the rate of growth of exports and imports.

Replacing the total demand norm by final and intermediate demand norms (Alternative B) hardly affects the results, with the differences between the two sets of estimates ranging between 0·2 and 0·6 percent. At the same time, negative import substitution is shown for both final and intermediate products for the entire period as well as for the two subperiods.

Applying the total method enhances the role of exports in explaining increases in output, with their contribution to the growth of output being 37 percent in 1953–61 and 46 percent in 1961–69.[13] Also, negative import

[11] The Laspeyres and the Paasche results are definitionally identical in this case.

[12] Consumption effects relate to all elements of domestic aggregate demand (private and public consumption as well as investment).

[13] It should be recalled that under the direct method all intermediate uses are included under the contribution of domestic demand.

TABLE 1

*Factors contributing to economic growth in Norway: model II*

| Estimation period | Base year | Change in production Million kroner | Domestic demand contribution Total % | Final % | Intermediate % | Export contribution % | Import substitution contribution Total % | % | % | Contribution of changes in I – O coefficients % |
|---|---|---|---|---|---|---|---|---|---|---|
| Direct Method | | | | | | | | | | |
| Alternative A | | | | | | | | Production | Consumption | |
| 1953–1961 | 1953 | 21862 | 84·9 | — | — | 27·8 | −12·6 | −15·6 | 2·9 | — |
| 1953–1961 | 1961 | 21882 | 81·0 | — | — | 27·8 | −8·7 | −10·8 | 2·0 | — |
| 1961–1969 | 1961 | 34682 | 78·3 | — | — | 33·6 | −11·9 | −11·9 | 0·0 | — |
| 1961–1969 | 1969 | 34682 | 74·6 | — | — | 33·6 | −8·2 | −8·2 | 0·0 | — |
| 1953–1969[1] | 1953 | 56564 | 80·9 | — | — | 31·3 | −12·2 | −13·3 | 1·1 | — |
| 1953–1969[1] | 1969 | 56564 | 77·1 | — | — | 31·3 | −8·4 | −9·2 | 0·8 | — |
| Alternative B | | | | | | | | Final | Intermediate | |
| 1953–1961 | 1953 | 21882 | 84·3 | 46·2 | 38·1 | 27·8 | −12·0 | −9·0 | −3·0 | — |
| 1953–1961 | 1961 | 21882 | 80·7 | 43·6 | 37·1 | 27·8 | −8·5 | −6·5 | −2·0 | — |
| 1961–1969 | 1961 | 34682 | 78·1 | 42·2 | 36·0 | 33·6 | −11·7 | −4·9 | −6·8 | — |
| 1961–1969 | 1969 | 34682 | 74·4 | 40·7 | 33·7 | 33·6 | −8·0 | −3·4 | −4·5 | — |
| 1953–1969[1] | 1953 | 56564 | 80·5 | 43·7 | 36·8 | 31·3 | −11·8 | −6·5 | −5·3 | — |
| 1953–1969[1] | 1969 | 56564 | 76·9 | 41·8 | 35·0 | 31·3 | −8·2 | −4·6 | −3·5 | — |
| Total method | | | | | | | | | | |
| 1953–1961 | 1953 | 21882 | 57·6 | — | — | 36·8 | −20·7 | −14·2 | −6·5 | 16·3 |
| 1953–1961 | 1961 | 21882 | 64·6 | — | — | 36·8 | −14·0 | −10·2 | −3·8 | 12·6 |
| 1961–1969 | 1961 | 34682 | 62·1 | — | — | 46·6 | −17·0 | −8·4 | −8·6 | 8·3 |
| 1961–1969 | 1969 | 34682 | 60·1 | — | — | 45·5 | −10·9 | −5·7 | −5·3 | 5·4 |
| 1953–1969[1] | 1953 | 56564 | 64·2 | — | — | 42·8 | −18·4 | −10·6 | −7·8 | 11·4 |
| 1953–1969[1] | 1969 | 56564 | 61·8 | — | — | 42·1 | −12·1 | −7·4 | −4·7 | 8·2 |

[1] Chained results of periods 1953–61 and 1961–69.

Note: The transfers sector was deleted from the input-output data base before performing the calculations for this and the following 3 tables, as explained in the text of this paper.

substitution in both final and intermediate products is about one-half greater under the total method than under the direct method. The results are explained by the fact that the total method accounts for the indirect contribution of exports and import substitution through demand for domestically-produced intermediate products.

Changes in input-output coefficients are a further contributing factor to the growth of output under the total method. The results show a contribution of 13–16 percent in 1953–61 and 5–8 percent in 1961–69; in both cases, the first figure refers to the Paasche and the second to the Laspeyres results. Thus, one tends to over (under) estimate the contribution of changes in input-output coefficients using the data of the first (last) year as weights.

The measured positive contribution of changes in input-output coefficients to the growth of output may reflect the influence of a variety of factors, including savings in factor inputs relative to savings in material inputs, changes in product composition as well as changes in the degree of vertical integration on the firm level. Further research would be necessary however, to separate the effects of these changes.

In Table 2, the results obtained by the use of Model II are compared to those derived with Models I and III. The table shows the estimates derived under the first method utilizing Alternative B only. As we have seen, Alternatives A and B gave practically identical results under Model II; the same conclusion applies to Models I and III.

The estimates for the period 1953–69 derived by using the direct method differ little as between Models I and II. And even these small differences practically disappear when we use the total method. Correspondingly, further comparisons will be limited to Models II and III.

While in Model II we explain changes in domestic output in terms of changes in domestic demand, exports, and import substitution, in Model III deviations in output levels from proportionate growth are decomposed in terms of deviations from proportionate growth in domestic demand, exports, and imports. These estimates have in turn been related to the absolute increment in output as noted above.

The importance of the contribution of exports is apparent in the Model III results, even though exports are now measured in terms of deviation from proportional growth rather than as an absolute increment. The estimates derived by the use of this model thus confirm our conclusions on the role of exports in the growth process in Norway. This result, as well as the existence of negative import substitution,[14] has been the effect of the outward-looking policy adopted by Norway described earlier.

[14] The numerical results for import substitution in final demand are identical since this has been defined in the same way in Models II and III. This is not the case for intermediate demand for which different norms have been used under Model II (aggregate intermediate demand) and Model III (final demand).

TABLE 2

*Factors contributing to economic growth in Norway, growth contributions: models I, II, and III*[1/]

| | *Base Year* | *Total* | *Domestic demand contribution* | | | *Export contribution* | *Import substitution contribution* | | | *Contribution of changes in input-output coefficients* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | *Final* | *Intermediate* | *Total* | | *Total* | *Final* | *Intermediate* | |
| | | | % | % | % | % | % | % | % | % |
| Direct Method Alternative B 1/ | | | | | | | | | | |
| Model I | 1953 | 100·0 | 42·7 | 34·4 | 77·2 | 31·3 | −8·5 | −5·5 | −3·0 | — |
| | 1969 | 100·0 | 41·8 | 33·5 | 75·3 | 31·3 | −6·6 | −4·6 | −2·0 | — |
| | Average | 100·0 | 42·3 | 33·9 | 76·3 | 31·3 | −7·5 | −5·1 | −2·5 | — |
| Model II | 1953 | 100·0 | 43·7 | 36·8 | 80·5 | 31·3 | −11·8 | −6·5 | −5·3 | — |
| | 1969 | 100·0 | 41·8 | 35·0 | 76·9 | 31·3 | −8·2 | −4·6 | −3·5 | — |
| | Average | 100·0 | 42·8 | 35·9 | 78·7 | 31·3 | −10·0 | −5·6 | −4·4 | — |
| Model III | 1953 | 10·7 | −0·6 | 10·6 | 9·9 | 15·5 | −14·8 | −6·5 | −8·3 | — |
| | 1969 | 7·7 | −0·4 | 7·5 | 7·1 | 11·0 | −10·5 | −4·6 | −5·9 | — |
| | Average | 9·2 | −0·5 | 9·1 | 8·6 | 13·3 | −12·7 | −5·6 | −7·1 | — |
| Total Method | | | | | | | | | | |
| Model I | 1953 | 100·0 | — | — | 62·7 | 42·8 | −16·9 | −9·1 | −7·8 | 11·4 |
| | 1969 | 100·0 | — | — | 61·8 | 42·1 | −12·1 | −7·4 | −4·7 | 8·2 |
| | Average | 100·0 | — | — | 62·3 | 42·4 | −14·5 | −8·2 | −6·2 | 9·8 |
| Model II | 1953 | 100·0 | — | — | 64·2 | 42·8 | −18·4 | −10·6 | −7·8 | 11·4 |
| | 1969 | 100·0 | — | — | 61·8 | 42·1 | −12·1 | −7·4 | −4·7 | 8·2 |
| | Average | 100·0 | — | — | 63·0 | 42·4 | −15·3 | −9·0 | −6·2 | 9·8 |
| Model III | 1953 | 10·7 | — | — | −2·9 | 20·6 | −18·4 | −10·6 | −7·8 | 11·4 |
| | 1969 | 7·7 | — | — | −2·7 | 14·3 | −12·1 | −7·4 | −4·7 | 8·2 |
| | Average | 9·2 | — | — | −2·8 | 17·4 | −15·2 | −9·0 | −6·2 | 9·8 |

[1/] Chained results of periods 1953–61 and 1961–69, arithmetic average of Laspeyres and Paasche indices.

Under the direct method, Model III results can be expressed alternatively in terms of annual rates of growth. Now, the growth contribution of exports is indicated by the fact that, in both subperiods, exports grew at a higher rate than the gross national product. The relevant growth rates are 6·9 and 3·7 percent in 1953–61 and 9·5 and 4·8 percent in 1961–69. In turn, imports grew at average annual rates of 7·3 and 9·2 percent in the two subperiods, respectively, indicating the existence of negative import substitution. For the period as a whole, actual exports increased by 10·7 billion kroner as against a hypothetical increase of 3·5 billion had exports grown at the same rate as GNP; the corresponding results are 15·2 and 6·4 billion kroner for imports.

The contribution of exports and that of (negative) import substitution is enhanced by using the total method, which takes account of the demand for intermediate products in producing final goods. At the same time, the differences between the total and the direct method results are somewhat smaller in Model III than in Model II. In turn, the relative contribution of import substitution and changes in input-output coefficients are of similar magnitude under the two models.

## V

Thus far we have considered estimates of the sources of growth in Norway at the national economy level. Further interest attaches to the decomposition of the aggragate estimates. Disaggregated estimates have been made for five sectors, including agriculture, mining, food, beverages, and tobacco, manufacturing, and services, as well as for individual industries within the last three sectors for which detailed data are available. Combined results for the primary activities (agriculture and mining) are also reported.

Tables 3 and 4 provide the relevant estimates for the period 1953–69, derived by the use of Model II, under both the direct and the total methods. The tables show the arithmetical average of chained results for the two subperiods using initial as well as terminal years as the base.

The estimates of Table 3 indicate that increases in exports made the largest contribution to the growth of output in mining (65 percent), followed by manufacturing, (43 percent), services (28 percent), and food, beverages and tobacco (14 percent); their contribution was slightly negative (−3 percent) in agriculture. In turn, negative import substitution is shown in mining (−95 percent), manufacturing (−25 percent), and food, beverages, and tobacco (−7 percent), while import substitution was positive (+13 percent) in agriculture and negligible in services (−1 percent).

The results for the manufacturing sector point to the success of outward-looking policies. Separating production and consumption effects, we further

TABLE 3

*Factors contributing to economic growth in Norway: sectoral results—direct method*[1/]

| | *Change in production million kroner* | *Domestic demand contribution* % | *Export contribution* % | *Import substitution contribution* | | |
|---|---|---|---|---|---|---|
| | | | | *Total* % | *Production* % | *Consumption* % |
| Agriculture | 2180 | 89·5 | −2·8 | 13·3 | −110·3 | 123·6 |
| Mining | 507 | 130·0 | 64·5 | −94·5 | −3·1 | −91·4 |
| Primary products | 2688 | 97·1 | 9·9 | −7·1 | −90·0 | 83·0 |
| Food | 3546 | 86·8 | 15·4 | −2·2 | −27·8 | 25·6 |
| Beverages | 412 | 128·1 | 1·0 | −29·1 | −63·2 | 34·1 |
| Tobacco | 54 | 238·3 | 16·6 | −154·6 | −690·4 | 535·6 |
| Food, bev., tobacco | 4014 | 93·1 | 14·0 | −7·1 | −40·5 | 33·5 |
| Textiles | 352 | 41·7 | 68·1 | −9·7 | −189·2 | 179·5 |
| Footwear & wearing apparel | 259 | 344·1 | 25·1 | −269·2 | −405·2 | 136·0 |
| Wood & cork products | 1649 | 111·2 | 7·6 | −18·8 | 4·0 | −22·7 |
| Paper & paper products | 2119 | 69·6 | 48·1 | −17·7 | 2·6 | −20·2 |
| Printing & publishing | 744 | 102·6 | 8·7 | −11·3 | −30·8 | 19·5 |
| Leather & leather products | 2 | −833·1 | 1954·5 | −1021·5 | −5384·3 | 4362·8 |
| Rubber products | 205 | 143·6 | 36·6 | −80·2 | −7·2 | −73·0 |
| Chemicals & chemical products | 3910 | 93·7 | 42·7 | −36·4 | 19·4 | −55·8 |
| Nonmetallic mineral products | 738 | 87·0 | 21·2 | −8·2 | 1·3 | −9·5 |
| Basic metal industry | 3620 | 18·2 | 90·2 | −8·4 | −8·0 | −0·4 |
| Metal products except elec. mach. | 5032 | 55·0 | 29·6 | −14·6 | 7·3 | −22·0 |
| Electrical machinery | 1340 | 92·2 | 31·9 | −24·1 | 11·1 | −35·2 |
| Miscellaneous manufactures | 773 | 155·5 | 28·7 | −84·1 | 30·1 | −114·2 |
| Manufacturing | 20749 | 82·3 | 42·7 | −25·0 | −3·6 | −21·4 |
| Construction | 3664 | 99·7 | 0·3 | 0·0 | −42·9 | 42·9 |
| Electricity, gas & water | 2007 | 95·3 | 3·1 | 1·6 | 41·9 | −40·4 |
| Trade | 7417 | 95·1 | 5·7 | −0·7 | 2·0 | −2·7 |
| Banking & insurance | 794 | 83·4 | 4·8 | 11·8 | −0·2 | 12·1 |
| Real estate | 1589 | 100·0 | 0·0 | 0·0 | −6·9 | 6·9 |
| Transportation & communication | 9563 | 23·4 | 76·8 | −0·3 | −2·3 | 2·0 |
| Other services | 4077 | 101·7 | 3·3 | −5·0 | −15·9 | 10·9 |
| Services | 29112 | 73·0 | 27·5 | −0·5 | −5·4 | 4·8 |
| All sectors | 56564 | 79·0 | 31·3 | −10·3 | −11·2 | 1·0 |

[1/] Model IJ, Alternative A, chained results of periods 1953–61 and 1961–69, arithmetic average of Laspeyres and Paasche indices.

TABLE 4

*Factors contribution to economic growth in Norway: sectoral results—total method*[1]

| | *Change in production million kroner* | *Domestic demand contribution* % | *Export contribution* % | *Import substitution contribution* | | | *Changes in Input-output coefficients* % |
|---|---|---|---|---|---|---|---|
| | | | | *Total* % | *Final* % | *Intermediate* % | |
| Agriculture | 2180 | 70·6 | 37·0 | −11·8 | −3·2 | −8·6 | 4·2 |
| Mining | 507 | 23·2 | 96·7 | −51·9 | −6·3 | −45·6 | 32·0 |
| Primary products | 2688 | 61·7 | 48·3 | −19·4 | −3·8 | −15·6 | 9·5 |
| Food | 3546 | 53·4 | 21·5 | −5·3 | −2·2 | −3·2 | 30·5 |
| Beverages | 412 | 140·7 | 2·4 | −34·7 | −38·3 | 3·7 | −8·4 |
| Tobacco | 54 | 246·3 | 16·7 | −162·0 | −161·8 | −0·2 | −1·0 |
| Food, bev., tobacco | 4014 | 65·0 | 19·4 | −10·5 | −8·1 | −2·4 | 26·1 |
| Textiles | 352 | 100·2 | 84·5 | −129·4 | −68·8 | −60·6 | 44·7 |
| Footwear & wearing apparel | 259 | 354·9 | 28·0 | −288·4 | −285·5 | −3·0 | 5·6 |
| Wood and cork products | 1649 | 95·5 | 15·2 | −24·4 | −15·9 | −2·5 | 13·7 |
| Paper & paper products | 2119 | 31·0 | 73·6 | −30·8 | −8·1 | −22·7 | 26·1 |
| Printing & publishing | 744 | 107·5 | 30·0 | −21·4 | −16·2 | −5·2 | −16·1 |
| Leather and leather products | 2 | 3768·6 | 2156·0 | −3481·9 | −3324·5 | −157·3 | −2342·7 |
| Rubber products | 205 | 130·9 | 43·6 | −92·3 | −75·8 | −16·5 | 17·9 |
| Chemicals & chemical products | 3910 | 40·8 | 57·4 | −36·4 | −11·6 | −24·8 | 38·2 |
| Nonmetallic mineral products | 738 | 48·5 | 28·1 | −13·2 | −4·7 | −8·5 | 36·7 |
| Basic metal industry | - 3620 | 9·1 | 99·5 | 0·8 | −0·8 | 1·6 | −9·7 |
| Metal products except elec. mach. | 5032 | 71·3 | 36·5 | −20·7 | −14·0 | −6·7 | 13·0 |
| Electrical machinery | 1340 | 68·8 | 35·9 | −23·9 | −13·1 | −10·8 | 19·2 |
| Miscellaneous manufactures | 773 | 111·8 | 33·5 | −88·1 | −70·4 | −17·7 | 42·8 |
| Manufacturing | 20748 | 59·4 | 53·8 | −30·0 | −17·9 | −12·1 | 16·7 |
| Construction | 3664 | 99·7 | 0·4 | −0·1 | −0·1 | −0·0 | 0·1 |
| Electricity, gas & water | 2007 | 49·7 | 27·4 | −0·7 | −0·7 | −0·0 | 23·6 |
| Trade | 7417 | 88·3 | 24·1 | −17·6 | −11·6 | −5·9 | 5·2 |
| Banking & insurance | 794 | 94·0 | 17·8 | 9·5 | −1·5 | 11·0 | −21·2 |
| Real estate | 1589 | 51·4 | 5·8 | −1·8 | −1·2 | −0·6 | 4·6 |
| Transportation & communication | 9563 | 19·8 | 82·8 | −2·5 | −1·5 | −1·0 | −0·2 |
| Other services | 4077 | 92·6 | 5·8 | 1·4 | 2·3 | −0·9 | 0·2 |
| Services | 29112 | 65·5 | 36·9 | −5·0 | −3·3 | −1·7 | 2·6 |
| All sectors | 56564 | 63·0 | 42·4 | −15·3 | −9·0 | −6·2 | 9·8 |

[1] Model II, chained results of periods 1953–61 and 1961–69, arithmetic average of Laspeyres and Paasche indices.

find that production effects were negligible and consumption effects accounted for almost the entire (negative) import substitution in this sector. This means that production for domestic use in manufacturing nearly kept up with the growth of the national product (more accurately, domestic aggregate demand) but not with the domestic consumption of manufactured goods that grew at a much faster rate.

Similar conclusions apply to the mining sector. Exports made a large positive, and import substitution a large negative contribution to output growth, and import substitution was almost entirely due to consumption effects. These results reflect the rapid expansion of the exports of iron ore and increased reliance on the imports of other minerals that are available in limited supply in Norway.

In agriculture, increases in production as well as in consumption fell substantially behind that of the national product. At the same time, positive import substitution has been due to the continued protection of this sector, while the adverse effects of protection and Norway's comparative disadvantage in agriculture may explain the negative contribution of exports to output growth.

On the whole, Norway also has a comparative disadvantage in food, beverages, and tobacco. This explains that the contribution of exports to the sector's output was small, although, processed fish and to a lesser extent, cigarettes made a positive contribution. In turn, with the slow growth of production in the sector, negative import substitution is shown on account of production effects although this was nearly offset by positive consumption effects due to the ralatively low rate of growth of consumption.

There was practically no import substitution in the service sector, where by the nature of the activities imports tend to be small. At the same time, shipping made a large positive contribution to the sector's exports.

The industry breakdown of the results for the manufacturing sector indicates Norway's comparative disadvantage in industries that rely to a considerable extent on unskilled labor and its comparative advantage in industries that intensively use skilled-labor. They further show Norway's comparative advantage in energy-intensive industries that benefit from the availability of hydro-electricity at a low cost, as well as in forest products that are based on domestic natural resources.

Among individual industries, leather and leather products seem to be an aberrant case, with very large percentages shown in all the columns. These results are explained by the fact that the absolute increment in production—the base of our calculations—was negligible while exports expanded and production for home consumption declined. At the same time, exports were limited to specialty products whereas the observed negative import substitution reflects Norway's comparative disadvantage in leather and in

mass-produced leather goods. For one thing, the raw material, hides and skins, is not available in substantial quantities in Norway; for another, the processing of leather and its simple transformation is intensive in unskilled labor.

Norway also has a comparative disadvantage in textiles and in footwear and wearing apparel that rely to a considerable extent on unskilled labor. These industries exhibit large negative import substitution in production, which was partly mitigated by the fact that domestic consumption rose at a lower rate than the national product. However, the exports of synthetic woven fabrics and special textile products (e.g. ski clothes and shoes) expanded, accounting for a substantial proportion of the increase in output

Apart from the aforementioned sectors, as well as printing and publishing where international trade is of little importance, domestic consumption in all manufactured industries rose more rapidly than the national product, thereby giving rise to negative consumption effects. And while most of these industries exhibited positive production effects as production for domestic use also grew more rapidly than the national product, they all showed negative import substitution for consumption and production effects combined.

Negative import substitution in the industries in question can be seen as the result of trade liberalization which led to larger imports and to intraindustry specialization in the form of the increased exchange of differentiated products (Balassa, 1966). At the same time, with the exception of nonmetallic minerals, which in most part do not enter international trade, exports accounted for at least one-fourth of the growth of output in all of these industries.

Exports made the largest relative contribution to the growth of output (90 percent) in basic metals, chiefly aluminum, pig iron, ferroalloys, and nickel, which are highly energy intensive. In the chemicals industry which had an overall export contribution of 43 percent, the production of fertilizers, too, benefited from low energy costs. But expansion occurred also in other chemical derivatives, in particular plastics, indicating the increased diversification of Norwegian industry.

In turn, an export contribution of 48 percent in paper and paper products reflects Norway's comparative advantage in forest products. Finally, the contribution of exports to output growth was 37 percent in rubber products, 32 percent in electrical machinery, 30 percent in metal products other than electrical machinery, and 29 percent in miscellaneous manufactures, all of which rely to a considerable extent on skilled and technical labor that is relatively abundant in Norway.

The results derived by the use of the direct method show the effects of the incentive system on export growth and on import substitution in Norway. Further interest attaches to the results derived by the total method that are

reported in Table 4. The estimates show the contribution of changes in input-output coefficients to the expansion of output. In turn, differences between the total and the direct results for particular industries reflect the extent of backward linkages (indirect effects).

Apart from the aberrant case of leather and leather products noted earlier, there are few manufacturing industries where input-output coefficients would have declined in Norway. Increases in input-output coefficients were especially large for textiles, chemicals and chemical products, non-metallic mineral products and miscellaneous manufactures, ranging between 37 and 45 percent of the increment in output as against 17 percent for the entire manufacturing sector. Among the other sectors, mining (32 percent) and food, beverages, and tobacco (26 percent) showed relatively large changes while the corresponding figures are 4 percent for agriculture and 3 percent for services.

Comparisons of the direct method and the total method results show the indirect effects of exports to be small in manufacturing, amounting to 26 percent of the direct effects while the corresponding ratios were 50 percent in mining and 39 percent in food, beverages, and tobacco. Among individual industries, backward linkages were the largest in wood and cork products, paper and paper products, and printing and publishing; these were low in the basic metal industry; and practically nil in the tobacco industry.

Agriculture presents an interesting case as the direct contribution of exports to output growth is −2·8 percent and their total contribution—including the use of agricultural inputs in export production—37·0 percent. Finally, while exports in the service sector are dominated by shipping, backward linkages were by far the largest in electricity, gas, and water, trade, and banking services.

Backward linkages in import substitution show a different pattern. In the case of agriculture, the total contribution of import substitution is negative, indicating that positive direct import substitution is more than offset by increases in imported agricultural inputs. For mining, negative import substitution is smaller under the total than under the direct method while the opposite conclusion applies to food, beverages, and tobacco and to manufacturing, where backward linkages amount to one-half and one-fifth of direct (negative) import substitution, respectively. Finally, backward linkages much exceed direct (negative) import substitution in the case of services.

## VI

The interpretation of the results reported in this paper is rather straightforward. The adoption of an outward-looking policy has led to increases in both exports and imports in Norway, entailing the reallocation

of resources according to comparative advantage among industries as well as specialization within industries.

While the method applied does not permit us to gauge the extent to which improved resource allocation has contributed to economic growth, the historically high growth rates of incomes per head shown for the period under study (3·3 percent a year) can be taken as an indication of the success of the outward-looking policy. In this connection it is noteworthy that per capita incomes grew more rapidly in the 1961–69 subperiod (4·0 percent) when the establishment of the European Free Trade Association gave a boost to exports, than between 1953 and 1961 (2·5 percent).

Comparisons with Japan offer further interest as the two countries are at similar levels of industrial development. For the 1935–54 period, Chenery, Shishido, and Watanabe show the contribution of exports to economic growth to be negative and that of import substitution to be positive (1962, p. 112). These results are in sharp contrast with those obtained for Norway.

However, the Japanese results refer to a period encompassing the Sino–Japanese war, the Second World War, and the postwar reconstruction when import substitution was given impetus by high protection in the form of tariffs and quantitative restrictions.[15] In turn, following the liberalization of trade, export expansion became a positive factor contributing to economic growth in Japan while negative import substitution took place. This is shown by results obtained for the period 1955–65 (Chenery and Watanabe, 1976), when Japan's GNP grew at an average annual rate of 9·2 percent, the rate of growth of exports was 17·0 percent and that of imports 13·7 percent (World Tables, 1976).

These trends continued during the 1965–73 period that was characterized by the further liberalization of trade. During this period, Japan's gross national product increased at an average annual rate of 10·5 percent while the growth rates of exports and imports were 13·3 percent and 15·6 percent, respectively. All in all, it would appear that the adoption of an outward-looking policy importantly contributed to the high rate of economic growth in Japan over the last two decades.

Thus, the experience of Norway and Japan during the period of import liberalization was not dissimilar, although available data indicate that exports made a larger contribution to economic growth in Norway than in Japan. These differences may have been due to factors such as the size of the domestic market, rates of import protection, and Norway's free trade arrangement in manufactured goods within EFTA.

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[15] In this connection, note that due to war devastation, the loss of markets and the adverse effects of high protection, in 1954 exports were lower in absolute terms than in 1935 (Chenery, Shishido, and Watanabe, 1962, p. 111).

## APPENDIX

Jonathan Levy*

*Formulas used under the total method*

While the direct method treats intermediate demand as an exogenous source of growth, total method decompositions are based on the assumption that intermediate demand is endogenously determined by final demand (domestic and export) and imports. Under the total method input-output matrices are used to trace back the total (direct plus indirect) intermediate input requirements of a given vector of goods and services. The procedure will be illustrated by reference to Model II in the main text of this paper.

$$\Delta X = (I - A_0^d)^{-1}[(\Delta D^F - y_0 M_0^F) + (\Delta E) + (yM_0^F - \Delta M^F) - (A_t^m - A_0^m)X_t + (A_t - A_0)X_t] \quad \text{(A1)}$$

In equation (A1) subscripts 0 and $t$ represent initial and terminal time period, $y_0$ is the first-year based growth rate of income (defined as $(Y_t - Y_0)/Y_0$), $A$ is the input-output matrix, superscripts $d$ and $m$ refer to matrices of domestic and imported input coefficients, and $M^F$ is imports for final demand. In the equation itself, all capital letters represent vectors or matrices.

The first three terms in parenthesis represent the direct effects of domestic final demand expansion, export expansion, and import substitution in final products, respectively. Multiplying these terms by the Leontief inverse formed by the domestic input-output coefficient matrix $A^d$ gives the total (direct plus indirect) effects of the expansion in domestic demand, exports, and import substitution on the change in output.

The last but one term represents the direct effects of changes in the imports of intermediate goods. As in the case of the final import term, it enters with a negative sign. Multiplying this term by the Leontief inverse gives the direct and indirect effects on intermediate goods production associated with changes in intermediate import demand. The resulting estimates are shown in the tables as import substitution contribution–intermediate demand.

The last term shows the direct effects of changes in domestic input-output coefficients. Changes in total requirements are again obtained by multiplying the term by the Leontief inverse. The estimates thus derived are shown in the tables under the heading "contribution of changes in input-output coefficients".

The decomposition shown in equation (A1) is a Laspeyres formulation as year 0 base is used for the input-output matrix as well as for the growth rate calculation. A symmetrical decomposition using year $t$ as the base will provide the Paasche formulation. This is shown in equation (A2)

$$\Delta X = (I - A_t^d)^{-1}[(\Delta D^F - y_t M_t^F) + (\Delta E) + (y_t M_t^F - \Delta M^F) - (A_t^m - A_0^m)X_0 + (A_t - A_0)X_0] \quad \text{(A2)}$$

The total method decompositions for Model I are obtained in the same way as for Model II, except that the diagonal matrices of sectoral final demand growth rates $\hat{G}_0^F$ and $\hat{G}_t^F$ are substituted for the growth rates of income $y_0$ and $y_t$. The decompositions for Model III, which is based on the work of Chenery, Shishido, and Watanabe (1962) are provided below. All comments made above on individual terms in the various equations for Model II also apply to the equivalent terms in Model III. The equations for Model III are

Laspeyres version:

$$\delta X = (I - A_0^d)^{-1}[\delta D^F + \delta E - \delta M^F - (A_t^m - A_0^m)X_t + (A_t - A_0)X_t]; \quad \text{(A3)}$$

where $\delta X_t = x_t X_{t0} - y_0 X_{t0} = \Delta X_t - y_0 X_{t0}$;

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Paasche version:

$$\overset{*}{\delta}X = (I - A_t^d)^{-1}[\overset{*}{\delta}D^F + \overset{*}{\delta}E - \overset{*}{\delta}M^F - (A_t^m - A_0^m)X_0 + (A_t - A_0)X_0]. \quad \text{(A4)}$$

where $\delta^* X_i = -x_t X_{it} + y_t X_{it} = -\Delta X_i + y_t X_{it}$

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