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**Abstract:**
We measure the effective assistance to 18 Norwegian private industries in 1989 caused by government budgetary subsidies, indirect commodity taxes, import protection through nominal tariffs and non-tariff-barriers, price discrimination of electricity and capital income taxation. The assistance effects are measured by the change in the net-of-tax value added price. Most industries were effectively assisted, but the effective assistance differs widely between industries indicating the overall distortive effect on the industry structure. *Agriculture*, *Fishery* and *Building of Ships and Oil Platforms* stand out as the most assisted industries. Budgetary subsidies and non-tariff barriers had the strongest effective assistance effect.

**Keywords:** Effective Rates of Assistance, Industrial policy

**JEL classification:** F13, H25, L60 , L71

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# 1. Introduction

During recent years, there has been increasing focus on structural economic policy and performance. This means policies working primarily through the supply side of the economy, affecting either the potential output or the overall flexibility of the economy. A major area of interest has been to define and calculate indicators of government assistance. Governments have a number of instruments for assisting private firms, including budgetary subsidies, trade policies and indirect and direct taxes. In some of these areas, information is readily available, in budget documents or other official sources. Other forms of assistance to industries, such as non-tariff trade barriers and other regulatory practices, are less transparent.

Empirical studies of government subsidies and transfers have been carried out within the OECD for specific industries, such as the agricultural sector. Discussions have also taken place within the organisation regarding the possibilities of establishing operational, more comprehensive indicators of government support to industries, see e.g. Argy, Plunkett and Wilson (1992).

One such generalised measure is *Effective Rates of Assistance (ERA)*. This is a summary measure of how government subsidies, protection and other forms of assistance affect the overall profitability (measured by a value added price) of a sector. A main purpose is to make various forms of assistance comparable and transparent. Moreover, underlying the use of the ERA concept is a perception that it can be used as an indicator of how different kinds of government policies affect the sectorial allocation of resources in the economy. Industries which are most heavily supported as measured by ERA, have improved their relative competitive position compared to a situation without government assistance. Accordingly, they may have expanded their production levels and use of resources.

ERA is a generalisation of the concept "Effective Rates of Protection" (ERP) which was introduced by Corden (1966). While the latter is restricted to the question of how nominal tariffs affect the allocation of primary production factors, ERA extends this idea to include other forms of government support as well. For a small open economy, a well known result from the classical trade theory is that, given certain assumptions, an increase in the price of a good (e.g. due to a nominal tariff) relative to other prices induces an expansion of the domestic production of this commodity. Thus, by observing the *direction* of relative price changes, one has qualitative information about the corresponding changes in industry structure and use of resources. Unfortunately, this relation between price- and quantity changes is no longer unique when extending the simple model to include intermediate inputs, non-traded commodities and multiple outputs[1]. To analyse impacts on the resource allocation in a more general setting, a complete general equilibrium model is needed. As opposed to this, the calculation of ERA restricts the analysis to the measurement of *price effects*. Thus, the rationale for using ERA as an indicator for distortions of the industry structure, implicitly relies upon the assumption that there still is a positive correlation between the relative pattern of these price effects and the industry structure.

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[1] In the original article of Corden (1966), fixed coefficients for intermediate inputs were assumed. Discussions of how the ERP concept is affected by more general forms of factor subsitution are provided by Jones (1971), Corden (1971) and Ethier (1972). Bruno (1973) and Woodland (1982) analyse the issue of tariff protection within a general equilibrium framework. A rather comprehensive discussion of the interpretation of the ERA concept and the relation to general equlibrium effects is given by Holmøy, Hægeland, Olsen and Strøm (1993).

Since it is the effects on relative prices that matters, ERA should be calculated for an exhaustive set of industries in an economy to serve its purpose.

The present paper reports from a project of calculating ERA for Norwegian industries, see Holmøy, Hægeland, Olsen and Strøm (1993). Strictly, such calculations should include all forms of government policy measures. In practice, calculations of ERA have to be based on some kind of a priori selection of main types of assistance. In the current study, three main areas have been analysed: indirect taxes and subsidies imposed on industries over fiscal budgets, nominal tariffs and other (non-tariff) trade barriers, and taxation of primary production factors. The ERA calculations, based on data for 1989, indicate that a number of industries in Norway benefited substantially from the various forms of government assistance that were in effect this year. Not surprisingly, agriculture stands out as by far the most supported industry. However, according to the calculations, also the fisheries, the ship building industry and the supply sectors to the off-shore industry were favoured through the government policies considered in this study.

The rest of the paper is organised as follows. Section 2 presents a stylised version of the simulation model actually used for the ERA calculations. The data for the various types of government assistance are surveyed in section 3, while section 4 presents the empirical results. Section 5 concludes.

# 2. A framework for calculating ERA

The model framework used for ERA calculations distinguishes between N = 41 commodities and M = 28 production sectors, of which 20 are private industries[2]. Below, the formal ERA-model is presented. In order to keep the exposition of the basic aspects clearer, some details in the representation of indirect taxes and subsidies are suppressed[3].

The calculations are based on a set of price equations ruling out pure profits in any sector j (j = 1,2,...,M):

$$\sum_{i=1}^{T} b_{ij}^{O} p_i^{*}\left(1+t_{ij}\right)+\sum_{i=T+1}^{N} b_{ij}^{O} p_i + s_j$$

$$-\sum_{i=1}^{T} b_{ij}^{I} p_i^{*}\left(1+t_{ij}\right)\left(1+t_{ij}^{V}\right)-\sum_{i=T+1}^{N} b_{ij}^{I} p_i\left(1+t_{ij}^{V}\right)-b_j^{L} w_j^{L}\left(1+t_j^{L}\right)-b_j^{K} w_j^{K}\left(1+t_j^{K}\right)=0 \qquad (1)$$

In (1) $p_i^{*}$ is the exogenous world price of commodity $i$. The first $T$ of totally $N$ commodities are traded internationally. $p_i$ is the producer price of non-traded commodity $i$. $t_{ij}^{V}$ and $t_{ij}$ is the net commodity tax and the nominal tariff rate on commodity $i$ respectively. $b_{ij}^{I}$ and $b_{ij}^{O}$ are fixed input- and output coefficients respectively. $b_j^{K}$ and $b_j^{L}$ are input coefficients expressing the capital and labour requirement per unit of total output. $w_j^{K}$ and $w_j^{L}$ are net-of-tax service prices received by

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[2] We have excluded the petroleum sector from the analysis, since the activity in this industry is highly regulated by the government.

[3] A detailed description of the model is given in Holmøy et al (1993).

owners of capital and labour in sector j, while $t_j^K$ and $t_j^L$ are effective tax rates on services from these primary inputs. $s_j$ denotes net subsidies to industry $j$[4].

In the traditional model of a small open economy, the factor prices of labour and capital are assumed to be equalised between sectors in equilibrium. The equation system in (1) then determines the level of these factor prices and the prices of non-traded commodities, i.e. (N - T) + 2 variables. Moreover, the model determines which sectors that will be active through specialisation. Normally, the equilibrium number of sectors will equal (N - T) + 2. These sectors are able to pay the maximum remuneration to labour and capital without violating (1).

When calculating ERA, a quite different problem is solved compared to the small open economy model. Now both the actually observed industry structure and the net-of-tax service prices received by owners of capital and labour are taken as given. We then calculate the change in the left hand side of (1) that follows from changes of the specified policy parameters. The resulting relative change is defined as the ERA-*effect*. This figure summarises all effects on net-of-tax factor income per unit of production from different policy measures. In the following we will refer to the net-of-tax factor income pr unit of production as the *effective value added price*[5]. The ERA-effect may alternatively be interpreted as the change in net-of-tax factor income necessary in order to maintain the price-cost balance represented by (1). ERA is defined as the ERA-effect of a complete elimination of all policy instruments introduced in (1).

For a sector being the sole producer of a non-traded commodity, cost changes are shifted forward to corresponding changes in the output price, leaving the effective value added price unchanged. With a joint output technology, each sector produces in general both traded and non-traded commodities. Still, in our model framework we distinguish between *sheltered* and *exposed* industries. A sheltered industry is defined as the main producer of a non-traded commodity. By assumption, for sheltered industries changes in costs are reflected in corresponding shifts in the output prices. Thus, for these sectors, a simultaneous system of (N - T) equations similar to those specified in (1), determines the prices of (N - T) non-traded commodities. It follows that the ERA-effect of any policy change is bound to be zero for sheltered industries. However, the cost shifts in sheltered industries due to policy changes are measured by the changes in the prices of non-traded commodities. These will be discussed in the empirical part of this paper.

*Exposed industries* are by definition main producers of traded commodities with exogenous world prices. For these sectors, policy changes can be transformed into ERA-effects. We have computed ERA-effects by solving the system in (1) where the net subsidies to industry j, $s_j$, has been written as

$$s_j = s_j^P + s_j^E \tag{2}$$

where $s_j^P$ denotes the actual net subsidies to industry $j$, and $s_j^E$ is a hypothetical net subsidy to sector $j$ which exactly compensates the effect on net-of-tax factor income per unit of production induced by a policy change. Thus, in the equation system (1) $s_j^E$ is treated as an endogenous variable. For a

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[4] In the national accounts, these are classified as "non-commodity" taxes and subsidies, see also section 3.

[5] The net-of-tax factor income per unit of production is often labelled the "effective output price".

sheltered industry, $s_j^E = 0$. Inserting (2) into (1), the ERA-model consists of M equations determining (N - T) prices of non-traded commodities and the (M - N + T) hypothetical net subsidy rates. The ERA-effect is computed as the relative change in $s_j^E$. It should be noted that the input-output structure of the model implies that the ERA for an exposed industry accounts for both policy changes directly affecting incomes and costs in the same sector as well as indirect effects caused by changes in the prices of non-traded commodities used as inputs.

Within the group of sheltered sectors, a further distinction can be made between naturally sheltered sectors, and what may be denoted *protected* sectors. A protected sector is defined as the main producer of a tradable commodity which is subject to non-tariff (quantitative) trade barriers (NTBs). In effect, protected sectors are able to set prices in the same way as sheltered industries. (In Norway, agriculture represents a typical example of a protected industry.) It is well known that the wedge between the domestic price and the world price of a protected commodity can be interpreted as an equivalent tariff rate or a shadow price of the import barrier. In order to simulate the ERA-effect of NTBs, the producer price of a protected commodity is decomposed in the following way:

$$p_s = p_s^*\left(1+t_s\right)\left(1+t_s^E\right), \quad s \in \mathbf{P} \tag{3}$$

where $t_s^E$ is the equivalent tariff rate corresponding to the NTB restricting imports of commodity $s$. The set **P** of protected commodities is included in the set of non-traded commodities $\{T+1,...,N\}$.

When integrating protected sectors in the ERA calculations, it is useful to distinguish between

i) effects of removing the non-tariff trade barriers
ii) effects of changing or removing other forms of government assistance

To analyse i) is rather straightforward. Technically, when trade barriers for a protected commodity are removed completely, the equivalent tariff rate is set to 0 so that the domestic producer price is equal to the world price including the nominal tariff. Furthermore, $s^E$ is endogenised for the sector being the main producer of this commodity. In effect, this industry is transformed from a sheltered to an exposed sector; the output price will be reduced with the size of the equivalent tariff, and this price effect can be transformed to an ERA-effect as described above.

When calculating the ERA-effects corresponding to ii), the results will depend on what is assumed to happen with the implicit protection through trade barriers. We may distinguish between two polar interpretations. The first assumes that the quantitative barriers are kept constant, whereas their corresponding (shadow) values measured by the equivalent tariff rates adjust endogenously. Technically, the equivalent tariff rate is determined by (3) after having found the producer price from (1). In this case, sectors which are main producers of protected commodities can be treated as strictly sheltered; changes in costs are fully compensated through adjustments in domestic output prices, and the ERA-effect is identically zero. In this case a rise in the world price or the nominal tariff rate has no effect on the producer price as long as the constraint on import is constant and effective.

The second interpretation assumes that the NTBs adjust so that their corresponding equivalent tariff rates are kept constant. Technically, this implies that protected industries can be analysed in the same way as exposed sectors, and specifically, that ERA can be calculated even for this group of industries.

# 3. Data and empirical implementation

Within the model framework presented above, the following policy measures relevant for ERA calculations can be identified:

1) indirect taxes and subsidies
2) effective tax rates on labour
3) effective tax rates on capital
4) regulated prices of intermediate inputs
5) nominal tariffs
6) non-tariff barriers to trade

In this section, we briefly describe how the data for the different kinds of government assistance to Norwegian industries have been uncovered. All data refer to the year 1989. Thus, in the ERA calculations presented in section 4, changes have been made in policy variables estimated for that year.

## 3.1 Indirect taxes and subsidies

The major conceptual framework for the ERA calculations is the Norwegian national accounts, which provide base year data for input-output coefficients and prices in the formal model. The national accounts also form the data basis for indirect taxes, subsidies and tariffs included in the model.

Two main categories of indirect taxes and subsidies are distinguished in the national accounts; commodity taxes and other (non-commodity) taxes[6]. While commodity taxes are related to commodity flows in the accounts, the non-commodity taxes are imposed on industries. Differences in the latter type between sectors thus indicate government assistance. On the other hand, commodity taxes are neutral, in the sense that they do not discriminate between source of delivery, either domestically or between Norwegian or foreign producers. It should, however, be noted that changes in commodity taxes and subsidies have *indirect* effects in the ERA calculations, via intermediate deliveries, see (1) above.

In Norway, the proceeds from non-commodity taxes and subsidies show substantial amounts, as seen from table 1. In 1989, the total value of subsidies to industries in the national accounts exceeded 35 bill. NOK, near 5 percent of GDP. At the same time, industries paid more than 16 bill. NOK in taxes to the central government. While commodity taxes totalled 28,5 bill. NOK in 1989, commodity subsidies were almost insignificant.

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[6] As a matter of convenience, in the following we use the word "taxes" for both positive and negative magnitudes, i.e. covering also subsidies.

**Table 1: Indirect taxes and subsidies in the National accounts.**
**Billions NOK, 1989.**

| | |
|---|---|
| Sector subsidies | 35,2 |
| Sector taxes | 16,4 |
| Commodity subsidies | 1,4 |
| Commodity taxes | 28,5 |

Source: Statistics Norway

Within the ERA context, a major problem is that all the items listed as taxes or subsidies in the national accounts should not be counted as support to specific industries. To take some examples, the national account figures comprise outlays on labour market measures and support to cultural institutions. Moreover, to some extent, general funding of research is also placed under the heading "subsidy" in the national accounts.

Given these problems of classification and the purpose of the present study, it was necessary to undertake a detailed evaluation of all items for non-commodity taxes and subsidies in the national accounts. This proved useful in two ways. First, based on supplementary information, a number of changes in the tax flows were undertaken. For instance, a portion of the amounts placed as "general research purposes" was redistributed to specific sectors, likely to benefit from this kind of support[7]. Second, by surveying and evaluating the detailed tax items, we had a good starting point for carrying out the ERA calculations. In these calculations discussed in the next section, sector subsidies totalling about 18 bill. NOK are removed. At the same time, we have nullified 12 bill. NOK of taxes imposed on production sectors, while commodity taxes are reduced by more than 16 bill. NOK compared to the actual situation in 1989.

## 3.2 Trade policies

As mentioned, the national accounts also include data on the structure of *nominal tariffs*. Over the years, this kind of protection has become less important in the Norwegian economy. This is confirmed by table 2, which shows that the nominal tariff rates estimated for 1989 are quite small. It should be stressed that the calculated tariffs in table 2 are based on import weights, through the aggregation over commodities in the National accounts. Import weights are generally regarded as inferior to production weights when measuring the effect on domestic prices from tariffs. However, detailed production weights were not available at this stage of the project. Moreover, the tariff rates in table 2 are average rates, based on an observed composition of imports from different countries. Nominal tariffs on imports from specific countries may be significantly higher than these figures. If commodities from different parts of the world are close substitutes, the fall in domestic prices following a removal of tariffs, may be stronger than expressed by the estimated average rates.

*NTBs* include a number of measures (other than nominal tariffs) with the aim of protecting domestic producers from foreign competition. Examples of non-tariff restrictions on trade are

[7] A detailed overview of all reclassifications and changes in tax flows is given in Holmøy et al (1993).

- quotas on imports of foreign commodities
- preferences for domestic producers in government contracts
- voluntary export restraints
- technical trade barriers (standards, design)

To include NTBs in ERA calculations, involves a number of problems both conceptually and computationally[8]. First, there are major problems of identification. Internationally, the UNCTAD classification scheme has become the de facto accepted definition of NTBs. Second, the existence of NTBs must be translated into equivalent tariff rates consistent with the ERA framework described in section 2.

In the case of imperfect competition, quantitative import restrictions provide opportunities for domestic producers to reap monopoly profit. In order to neutralise or reduce such potential benefits to domestic producers, NTBs are often combined with price regulations. Within the ERA framework, this means that prices are exogenous, so that formally such industries can be treated in line with exposed sectors. The highly different interpretations of exposed versus protected and regulated industries should, however, be kept in mind.

In order to identify and estimate equivalent tariff rates for Norwegian industries, data on domestic producer prices and world prices of corresponding commodities are necessary but not sufficient. In addition, information about commodity characteristics and various kinds of regulations motivating differences between Norwegian and corresponding world prices is required. At this point we have made no attempt to carry out independent studies of estimating implicit tariffs. Instead, our strategy has been to collect relevant information and utilise results from available studies aiming at assessing tariff equivalents. A detailed discussion of these results on NTBs and equivalent tariff rates are given in Holmøy et al (1993). Here, only some major areas of government regulations and principles guiding our choices are presented. The resulting estimates for implicit tariffs for the various sectors in our ERA model are shown in the third column of table 2.

In addition to being supported by subsidies and income transfers over government budgets, Norwegian agriculture is sheltered from foreign competition by import quotas on all major products. This is combined with strict price regulations, in particular for dairy farm products. The estimate of the equivalent tariff rate for this sector is mainly based on OECD's calculations of "Producer Subsidy Equivalents" (PSE). For each member country, these comprise a comparison of domestic and world market prices for a detailed list of commodities. The PSE calculations are supplemented with comparisons of Norwegian and Danish[9] prices provided by the Norwegian Agricultural Research Institute, to account for differences in product refinement and classification in the sample of commodities used by OECD. Based on this information, we have estimated an average equivalent tariff rate for agricultural commodities of 190 percent. As seen from table 2, this is much higher than for any of the other commodities specified in the model framework.

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[8] A comprehensive overview of NTBs is given in Laird and Yeats (1990).

[9] Denmark is likely to be the main exporter of agricultural commodities to Norway under a free trade regime.

**Table 2: Nominal and equivalent tariff rates by commodity group. Percent, 1989.**

| Commodity group | Nominal tariff rates | Equivalent tariff rates |
|---|---|---|
| Agricultural Commodities | 1,7 | 190,0 |
| Commodities from Forestry | 0,2 | - |
| Commodities from Fishery | 0,0 | - |
| Processed Food, Beverages and Tobacco | 1,3 | 9,5 |
| Textiles and Wearing Apparels | 3,5 | 6,2 |
| Various Manufacturing Products | 0,5 | 3,3 |
| Pharmaceutical Products | .. | 15,0 |
| Cement | .. | 80,0 |
| Pulp and Paper Articles | 0,0 | - |
| Industrial Chemicals | 0,4 | 3,2 |
| Fertilisers | .. | 16,0 |
| Refined Petroleum Products | 0,0 | - |
| Metals | 0,2 | - |
| Metal Products, Machinery and Equipment | 1,1 | 3,2 |
| Office Macinery | .. | 9,0 |
| Electric Motors and Generators | .. | 42,0 |
| Electric Household Machinery | .. | 17,0 |
| Repair | 0,0 | - |
| Ships | 0,0 | 0,0 |
| Oil Production Platforms | 0,1 | 7,7 |

".." means that data are not available. "-" means nil.

Imports of commodities included in the group *Processed Food, Beverages and Tobacco* are subject to extensive regulations through quotas. Regarding imports from the EU, the quantitative restrictions on trade are limited to food products. From other parts of the world, quotas exist for a broader set of products. In addition, for some commodities imports are restricted by technical standards. The main source of information for assessing price differentials for food and beverages has been Statistics Norway (1990), presenting so-called Purchasing Power Parity (PPP) calculations. These data enable us to use consumer prices net of indirect taxes from nine member countries of EU (not including Spain, Portugal and Greece), or alternatively, one of these countries individually, as a reference of measurement. To minimise problems of transportation costs included in the price estimates, we have chosen the price levels in Denmark as a basis for assessing the differences between Norwegian and international prices of food and beverages. As revealed from table 2, this has resulted in an implicit tariff of 9,5 percent for this commodity group as a whole.

Trade in textiles and clothes (included in the group *Textiles and Wearing Apparels*) are limited by the voluntary export agreements organised through the Multifiber Arrangement. However, these agreements apply primarily to imports from low-cost countries in the third world. Based on Melchior (1993) , the average equivalent tariff rate protecting Norwegian producers of such commodities is estimated to 6 percent.

For important manufacturing products in Norway, such as fertilisers and cement, the domestic market is de facto monopolised. For these products, formal barriers to trade do not exist. However, in the

cement market, there are clear indications of trade being restricted by implicit agreements between major producers in different countries to supply their respective domestic market. For fertilisers, Norsk Hydro supplies more than 90 percent of the domestic market, having a significant share of the European market as well. For both these manufacturing products, price regulations prevent the Norwegian producers to exploit all of their potential monopoly power. As mentioned above, the presence of imperfect competition complicates the interpretation of implicit tariffs. Based on the available information provided in Sørgård (1992) and Gabrielsen (1989), implicit tariff rates of 80 and 16 percent are estimated for cement and fertilisers respectively.

Several studies indicate that a number of Norwegian industries are favoured, either directly through government procurement, or indirectly via requirements to specific commodity standards or technical designs. According to Norman (1990), the latter barriers are the main source underlying the estimated equivalent tariff rates for *Pharmaceutical Products* and for the commodity groups constituting *Metal Products, Machinery and Equipment* in table 2. Regarding government procurement, focus is frequently on industries taking part in the deliveries to the petroleum sector. At this point, the official policy was that Norwegian firms should be preferred if their prices are competitive. Still, investigations and comparisons between prices offered by Norwegian and foreign suppliers indicate significant price differentials in 1989. Although major uncertainties exist, we impose an implicit tariff of 11 percent on imports to the petroleum sector.

## 3.3 Price discrimination in the electricity market

More than 99 percent of the Norwegian electricity consumption is produced by domestic hydro power plants. The studies by Johnsen (1991) and Bye and Johnsen (1991) show that large price differentials exist in the Norwegian electricity market, which cannot be accounted for by corresponding cost differentials. This price discrimination is a result of an explicit government policy, since the Norwegian electricity market has traditionally been highly regulated[10]. The individual hydro power producers sell their electricity (competitively) to regional distribution companies and to some large firms within the group of the energy intensive industries *Manufacture of Metals, Manufacture of Industrial Chemicals* and *Manufacture of Pulp and Paper Articles*. The presumably most important kind of price discrimination on (hydro power) electricity has taken place through favourable long-term contracts between the producing plants and these firms.

The quantification of rates of price discrimination in the electricity market in 1989 is based on Johnsen (1991). In short, the method decomposes the purchaser prices of electricity to different sectors into i) a uniform producer price on homogenous electricity, ii) various sector specific cost components reflecting qualitative differences between the deliveries to different sectors and iii) a residual price-cost margin. The differences in these margins are interpreted as a measure of price discrimination. Regarding qualitative heterogeneity of the hydro power deliveries to different sectors, the observed differentials in the purchaser prices are corrected for the following elements: First, energy intensive industries have a higher utilisation time than other users. Norwegian Water Resources Administration has calculated that the long-run marginal cost on deliveries of hydro power to energy intensive industries equals 89 percent of the average long-run marginal cost on deliveries to other sectors. Second, the distribution costs (including power losses) differ. Third, the security of

[10] In 1992, implementation of a new "Energy Law" implied substantial deregulation of the Norwegian electricity market.

delivery differs between different categories of electricity. Surplus power is inferior to contracted deliveries, and this is reflected in the price structure. Fourth, indirect taxes on electricity differ between sectors.

**Table 3: Rates of price discrimination on electricity (in percent of the producer price) by industry, 1989.**

| | |
|---|---|
| ***Exposed industries*** | |
| Agriculture | 36,4 |
| Forestry | 36,4 |
| Fishing and breeding of fish etc. | 36,4 |
| Manufacture of Consumption Goods | 29,5 |
| Manufacture of Intermediate Inputs and Capital Goods | -9,1 |
| Manufacture of Pulp and Paper Articles | -61,9 |
| Manufacture of Industrial Chemicals | -12,8 |
| Petroleum Refining | -39,2 |
| Manufacture of Metals | -40,1 |
| Manufacture of Metal Products, Machinery and Equipment | 8,9 |
| Building of Ships and Oil-Platforms | 43,2 |
| | |
| ***Sheltered industries*** | |
| Production of Electricity | - |
| Construction, excl. Oil Well Drilling | 73,6 |
| Wholesale and Retail Trade | 54,3 |
| Domestic Transport | -14,4 |
| Finance and Insurance | 62,0 |
| Dwelling services | 43,7 |
| Other Private Services | 52,2 |

"-" means nil.

Table 3 reports the computed rates of price discrimination on electricity in 1989. The industries *Manufacture of Pulp and Paper Products, Petroleum Refining* and *Manufacture of Metals* were relatively heaviest subsidised through favourable prices of electricity this year. The implicit subsidies were slightly lower for the sectors *Manufacture of Industrial Chemicals* and *Manufacture of Intermediate Inputs and Capital Goods*. On the other hand the construction sector and private services paid higher prices than implied by cost pricing.

## 3.4 Sectorial differences in the effective taxation of income from fixed capital

The effective tax rate on capital income from sector j, $t_j^K$, is calculated as

$$t_j^K = \frac{w_j^K(t)}{w_j^K(0)} - 1 \qquad (4)$$

$w_j^K(t)$ is the user cost of capital under the actual tax system and $w_j^K(0)$ is the user cost in the case of neutral capital income taxation given by the standard formula

$$w_j^K(0) = (i + \delta_j) q_j \tag{5}$$

where $i$ is the nominal interest rate, $\delta_j$ is the rate of "true" economic depreciation including physical deterioration and capital gains. (5) is derived from the neoclassical model of intertemporal competitive producer behaviour assuming that the producer maximises the present value of the cash-flow received by the owner of the capital. A neutral tax system is characterised by a design that does not affect the relative profitability of the different options available for the investor. Thus, under neutral capital income taxation tax rates have no impact on the user cost. From (4) it is clear that the effective tax rates summarise the total impact on capital costs from the different elements of the tax system. The lower the effective tax rate, the stronger is investment in fixed capital favoured relative to financial assets through the tax system.

The user cost of capital under the actual tax system has been calculated by applying the same method and data as those described in Holmøy, Larsen and Vennemo (1993)[11]. The theoretical model of financial decisions is the same as in Sinn (1987). Since the value of the firm is calculated from the owner's point of view, the taxation on both the corporate and the personal level is taken into account. The user cost of capital depends on

1) the type of capital invested, because depreciation and depreciation allowances differ between capital goods
2) whether the firm is incorporated or a personal enterprise, due to different tax rules
3) the source of finance

Independent of legal status, the user cost facing a firm can be expressed as:

$$w_j^K(t) = \beta_j d_j + (1 - \beta_j) e_j + \delta_j - c_j \tag{6}$$

where $\beta_j$ is the maximum debt equity share, $c_j$ is the tax credit implied by the difference between true economic depreciation and the rules of depreciation allowances and taxation of capital gains, $d_j$ and $e_j$ are the interest costs of debt financing and equity financing respectively. The relationship between these interest costs depends on whether the firm is legally organised as a personal or an incorporated enterprise. In particular, an incorporated enterprise choose retained profits or issues of new shares as the source of equity financing depending on what is the cheapest alternative. The detailed relationship between the various elements specified in (6) and the tax parameters is given in Holmøy, Larsen and Vennemo (1993).

Table 4 reports the tax rates relevant to the user cost calculations in 1989. The rates of depreciation allowances are reported in table 5 together with the assumed rates of physical capital depreciation.

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[11] Expectations are assumed to be static, i.e. the tax system, prices of output, capital goods and other factors, depreciation and interest rates are assumed to prevail constant in the future.

The difference between the "true" depreciation and the depreciation allowances according to the tax code is essential for the non-neutrality of the tax system and thereby the effective taxation of income from fixed capital. Reliable estimates of the rates of actual depreciation are of course difficult to obtain. We have, in lack of any better alternatives, relied on the depreciation rates provided by the national accounts in Norway. The relevant measure of actual depreciation takes capital gains into account in addition to physical depreciation. In the calculation these gains were set to 4 percent which approximates the actual growth in prices of new capital goods in 1989.

The user cost of capital by sector is obtained in the following way: First, we calculate the user cost of capital for the capital goods *Enterprise Buildings, Other Buildings and Constructions, Machinery, Ships and Boats, Aircraft* and *Other Transport Equipment.* The share of each capital good in the total fixed capital stock is given by the national accounts asset-to-industry matrix that prevailed in 1989. For each capital good a corresponding user cost is calculated for both *incorporated* and *personal enterprises.* The distribution of firms with respect to these two alternatives of legal status are taken from Statistics Norway (1991). For both incorporated and personal enterprises a maximum constraint on the debt-equity ratio is assumed to be effective. For personal enterprises retained profits is the only alternative to borrowing. Housing is given a special treatment described by Berg (1989).

**Table 4: Formal tax rates. Percent, 1989.**

| | |
|---|---|
| ***Incorporated enterprises*** | |
| Profits | 50,8 |
| Dividends | 27,8 |
| Sales of physical capital | endogenous ≈ 0 |
| Wealth | 0,3 |
| ***Personal enterprises*** | |
| Ordinary tax on profits | 52,4 |
| Profits in primary industries | 46,0 |
| ***Persons*** | |
| Interest income | 36,0 |
| Dividends | 23,0 |
| Capital gains | 0,0 |

**Table 5: Depreciation allowances and rates of physical depreciation. Percent, 1989.**

| | Ordinary rates of depreciation allowances | Rates of immediate write-offs | Rates of physical depreciation |
|---|---|---|---|
| Commercial buildings | 3,0 | 3,0 | 2,1 |
| Buildings and structures | 7,4 | 10,8 | 2,5 |
| Transport equipment except ships, fishing vessels and airplanes | 25,9 | 0 | 32,0 |
| Machinery except oil rigs etc. | 30,0 | 33,4 | 6,7 |
| Ships, fishing vessels and airplanes | 25,0 | 29,5 | 11,5 |

**Table 6: Effective tax rates on income from fixed capital by industry. Percent, 1989.**

| | |
|---|---|
| ***Exposed industries*** | |
| Agriculture | -21,0 |
| Forestry | -30,8 |
| Fishing and breeding of fish etc. | -12,4 |
| Manufacture of Consumption Goods | -43,1 |
| Manufacture of Intermediate Inputs and Capital Goods | -42,4 |
| Manufacture of Pulp and Paper Articles | -42,1 |
| Manufacture of Industrial Chemicals | -40,6 |
| Petroleum Refining | -43,5 |
| Manufacture of Metals | -42,6 |
| Manufacture of Metal Products, Machinery and Equipment | -45,8 |
| Building of Ships and Oil-Platforms | -45,4 |
| | |
| ***Sheltered industries*** | |
| Production of Electricity | .. |
| Construction, excl. Oil Well Drilling | -33,6 |
| Wholesale and Retail Trade | -20,1 |
| Domestic Transport | -36,8 |
| Finance and Insurance | -45,0 |
| Dwelling services | -75,7 |
| Other Private Services | -43,2 |

".." means that data are not available.

The resulting figures in table 6 indicate that the effective tax rate on income from fixed capital is lower than the tax rate on income from financial assets. The main reason is that the depreciation allowances exceed the assumed rates of economic depreciation. This gives rise to a tax credit since taxation is postponed. Dwellings represent an extreme case of non-neutral taxation because the imputed tax value on dwellings is very low compared to the market value. The calculations show small differences in the effective tax rates between the manufacturing industries. However, the effect on total unit costs may vary between sectors not only because the effective tax rates differ, but also because of differences in the direct and indirect use of capital services per unit of output.

# 4 Computation of Effective Rates of Assistance

Our most aggregate measure of ERA includes the effect of

- nominal tariffs
- NTBs measured by equivalent tariffs
- indirect taxes and subsidies[12]
- capital income taxation
- price discrimination in the electricity market

[12]Indirect taxes considered not to affect the profitability of private industries are excluded from the analysis, see section 3.1.

When computing the ERA from the separate policy measures, all other forms of assistance have been kept unchanged. Regarding constant 1989-levels of non-tariff protection, we have, as our base case, assumed that equivalent tariff rates are kept unchanged, cf. the discussion in section 2. This choice is made primarily of expositional reasons since it facilitates the decomposition of the total ERAs into ERA-effects from the separate categories of policy measures. However, in subsection 4.2 we illustrate how the results are affected when we choose the alternative interpretation of unchanged non-tariff protection.

## 4.1 Total and separate ERA-effects (Constant equivalent tariff rates)

Table 7 reports ERA-effects of the policy measures listed above with reference to 1989. Table 8 provides additional information about the most important changes in the income and cost components in the 19 specified industries when the various forms of assistance are abolished.

**Table 7: ERA effects of different policy measures. Percent, 1989.**

| Potentially exposed industries | Nominal tariffs (ERP) | Non-tariff barriers | Indirect taxes and subsidies | Capital income taxation | Regulated electricity prices | Second order effects[13] | Total |
|---|---|---|---|---|---|---|---|
| Agriculture | -0,1 | -49,0 | -67,3 | -12,4 | 0,1 | 0,8 | -128,3 |
| Forestry | -0,1 | 2,4 | -9,6 | -7,6 | 0 | -0,0 | -14,9 |
| Fishing and breeding of Fish etc. | 0,9 | 5,8 | -28,2 | -7,5 | 0,9 | -0,1 | -28,2 |
| Manufacture of Consumption Goods | -2,7 | 18,2 | 6,2 | -8,4 | 0,6 | -1,1 | 12,9 |
| Manufacture of Intermediate Inputs and Capital Goods | -0,7 | -6,2 | -1,0 | -7,1 | -0,1 | 0,0 | -15,0 |
| Manufacture of Pulp and Paper Articles | 0,4 | 1,4 | 4,9 | -13,2 | -10,9 | 0 | -17,4 |
| Manufacture of Industrial Chemicals | -0,3 | -6,9 | 6,1 | -9,8 | -1,7 | 0,0 | -12,6 |
| Petroleum Refining | -0,1 | -0,8 | 12,3 | -10,6 | -0,7 | 0 | 0,1 |
| Manufacture of Metals | -0,1 | 0,8 | 12,3 | -11,7 | -15,8 | 0 | -14,5 |
| Manufacture of Metal Products, Machinery and Equipment | -1,3 | -6,1 | 0,2 | -5,6 | 0,2 | 0,1 | -12,5 |
| Building of Ships and Oil-Platforms | 0,5 | -18,5 | -12,3 | -6,8 | 0,5 | 0 | -36,7 |

[13]These effects arise because a removal of some policy measures affect the basis for other measures. For example, removal of non-tariff trade barriers may reduce the basis for ad valorem indirect taxes.

**Table 8: A decomposition of the total ERA effects into shifts in income and cost components.**

| | Change in net sector subsidies in percent of gross production value | Change in equivalent tariff rates, percentage points | Change in producer price, percent | Change in the input price, percent |
|---|---|---|---|---|
| ***Potentially exposed industries*** | | | | |
| Agriculture | 43,4 | -190,0 | -66,3 | -22,8 |
| Forestry | 5,8 | - | -0,2 | -12,8 |
| Fishing and breeding of Fish etc. | 10,0 | - | 0,0 | -6,0 |
| Manufacture of Consumption Goods | 0,4 | -9,3 | <-9,7, -11,6> | -20,1 |
| Manufacture of Intermediate Inputs and Capital Goods | 1,3 | -3,3 | -3,7 | -2,1 |
| Manufacture of Pulp and Paper Articles | 0,3 | - | 0,0 | 21,4 |
| Manufacture of Industrial Chemicals | 0,2 | -3,2 | -3,5 | -2,7 |
| Petroleum Refining | 0,0 | - | 0,0 | -2,2 |
| Manufacture of Metals | 0,4 | - | -0,2 | 0,2 |
| Manufacture of Metal Products, Machinery and Equipment | 0,6 | -3,2 | <-3,1, -4,1> | -1,9 |
| Building of Ships and Oil-Platforms | 2,5 | -7,7 | -7,2 | -3,5 |
| ***Sheltered industries*** | | | | |
| Production of Electricity | 0,0 | - | -0,2 | -0,7 |
| Construction, excl. Oil Well Drilling | -0,2 | - | -1,1 | -2,4 |
| Wholesale and Retail Trade | -2,1 | - | -2,4 | -1,9 |
| Domestic Transport | -0,3 | - | 3,3 | -2,3 |
| Finance and Insurance | -0,4 | - | 4,6 | -2,7 |
| Dwelling services | -0,4 | - | 110,4 | -1,6 |
| Other Private Services | -0,3 | - | -0,5 | -4,4 |

"-" means nil.

The figures of total ERA in the last column in table 6 show that all industries except *Manufacture of Consumption Goods* and *Petroleum Refining* were assisted in 1989. As pointed out in section 1, it is the relative ERA-effects that cause those distortions of the allocation of value added factors. attributable to industry assistance policy. In order to draw conclusions about these distortions, some kind of an average measure of assistance should be calculated, and the sectorial ERA figures should be ranked with this as a reference. However, it is not clear how such an average should be defined, and we make no attempt in trying to identify such a reference point. Instead, we comment on the results as they appear in table 7 and 8.

*Agriculture* stands out as the far most supported sector. Actually, since the fall in ERA is more than 100 percent, the calculation indicates that agriculture would not be able at all to pay for labour and

capital services if the sector is not compensated in connection with a removal of the assistance. Next to agriculture, the sector *Building of Ships and Oil Platforms* receives significant assistance. The remuneration to labour and capital (value added) would have to be reduced by 36,7 percent in 1989. *Fishery* is also relatively more supported than other industries according to the calculations. The effective assistance to the primary factors in the remaining exposed industries (except *Manufacture of Consumption Goods* and *Petroleum Refining*) was roughly neutral since the relative reduction in ERA is approximately uniform (12 - 14 percent). *Manufacturing of Consumption Goods* is the only sector which would benefit substantially (12,9 percent) from a removal of the policy measures considered.

Some points should be recalled when interpreting the ERA figures. First, the industry classification of the private business sector is quite aggregated. Hence, the industries are rather heterogeneous, and the ERA-figure for an industry may provide little insight about the effective assistance to particular activities within an industry group. The policy measures may be directed unevenly to these subactivities, and differences in the cost structure imply different effects of the various measures. Virtually, the profitability prior to policy changes also differs between activities within the same industry. In particular, it is unrealistic that all kinds of agricultural production will disappear in Norway as a consequence of the policy changes considered in this study. Second, the ERA-computations disregard substitution possibilities that will reduce shifts in costs due to policy changes. Third, ERA is meant to provide information about fundamental structural patterns brought about by adjustments over a relatively long period. The calculated ERA-figures refer to the actual situation in 1989 which may include characteristics which are untypical for a longer period. For instance, changes in world prices change the equivalent tariff rates related to NTBs.

Table 7 also include partial ERA-effects from the separate categories of policy measures, calculated by keeping the other supportive measures constant. The results show that for most of the potentially exposed industries indirect taxes, non-tariff trade barriers and capital income taxation have the greatest impact on the ability to remunerate labour and capital. The ERP figures (the column for nominal tariffs) are seen to be quite negligible compared to the total ERA figures. In spite of the weaknesses pointed out above concerning the treatment of nominal tariffs, we still think that the figures make a good case for switching focus from ERP to ERA.

Subsidies and non-tariff protection are the main ERA determinants in *Agriculture*, constituting 52,6 and 38,3 percent respectively of the total effects. As seen from table 7, the removal of NTBs implies that the output prices in this sector on average are reduced to 1/3 of the price level in 1989. Compared to such a drastic decline in output prices it turns out rather insignificant that the prices of material inputs fall by close to 23 percent. As to subsidies, agriculture loses 11,5 bill. NOK in net sector transfers which amounts to 43 percent of the value of gross production in 1989. The ERA effect from indirect taxes and subsidies separately includes commodity taxes as well as subsidies given more directly to the sector. The commodity taxes affect the input prices paid by the sector. Still, a more detailed examination of the results reveals that the sector subsidies dominate the total assistance from indirect taxes and subsidies.

The results for *Fishery* illustrate that removal of protection may have significant ERA-effects even for industries that do not directly benefit from import barriers. Remuneration to labour and capital in this sector can increase by 5,8 percent if all quantitative import barriers were eliminated. The reason is

that the average price of intermediate inputs falls by 3 percent. This gain is roughly neutralised by the joint effect of increasing the capital income taxation and removing nominal tariffs. Hence, the total ERA is almost identical to the ERA effect from the indirect taxes and subsidies.

The decomposition of the total ERA effect for the sector *Building of Ships and Oil-Platforms* indicates that half of the total assistance were provided through non-tariff import barriers and the remaining share was caused by the tax system. However, these average figures turn out to be rather misleading for the two major activities in the sector. While the ship building industry receives significant support through net sector subsidies (about 1 bill. NOK net), sector subsidies are unimportant for the part of the industry supplying the petroleum sector. On the other hand, ship building is not protected by import barriers, whereas this seemed to be the case in 1989 for deliveries to the petroleum sector. As pointed out in section 3.2, price differentials between domestic and foreign producers, combined with the actual assignment of contracts, indicate that domestic producers were favoured. Elimination of this kind of import barrier will reduce the output price faced by the producers of oil platforms etc. by 11 percent, see section 3.2. The decline in the average output price for the sector as a whole is 7,2 percent when the price changes are weighted with the shares of gross production. Hence, the picture of this sector reveals that ship building and building of oil platforms etc. should be treated as two separate industries in a more appropriate choice of industry classification.

Another heterogeneous industry is the sector *Manufacture of Consumption Goods*, which is the main producer of processed commodities from agriculture and fishery, in addition to beverages, tobacco, textiles and wearing apparels. The sector received a relatively modest amount of net sector subsidies in 1989 (0,4 percent of gross production value), but the benefit from non-tariff protection is estimated to correspond to an average equivalent tariff rate of 9,3 percent. On this background, it may seem contra intuitive that the remuneration to labour and capital can be increased by 12,9 percent when all policy measures are removed (the total ERA effect). The main reason is that input prices fall by 20,1 percent as seen in table 8. Lower equivalent tariff rates on inputs account for 17,2 percentage points of the reduction. This effect is by far most important in the processing of agricultural products for which the prices drop to 1/3 of the initial level. More detailed calculations reveal that a reduction of input prices by 2,8 and 0,9 percent respectively can be attributed to lower indirect taxes and nominal tariff rates on inputs. Thus, the results for this sector again constitutes an instructive example of the importance of accounting for changes in prices of intermediate inputs when assessing the effective assistance. At the same time the results for this sector again stress the point that a more disaggregated analysis would have been preferable; the picture that emerges from the results for the sector as a whole is misleading for important subactivities. The fact that the sector stands out as the most discriminated by the policy measures in 1989 is clearly not representative for the subactivity production of textiles.

Among the remaining manufacturing industries, the remuneration to value added in *Petroleum Refining* is almost unaffected by the removal of all policy measures. Taken together, government assistance is thus unimportant for this industry. The total ERA result is due to a cost reduction on inputs caused by reduced indirect taxation, which neutralises the effect of a somewhat higher effective taxation of capital income. For the other manufacturing industries, it is a common pattern that even though the total ERA figures are of the same magnitude, there are substantial differences with respect to the impacts of the various policy measures. Neutralisation of the capital income taxation implies a reduction of ERA by 6 - 13 percent. It should be recalled that in addition to the direct effect, changes

in the effective taxation of capital income have indirect effects on the prices of intermediate inputs due to changes in costs in the sheltered sectors. However, separate calculations show that in most of the sectors the input prices rise by less than 1 percent and that the indirect effects are small compared to the direct effects.

Except for *Manufacture of Intermediate Inputs and Capital Goods* and *Building of Ships and Oil-Platforms*, all manufacturing industries would have benefited from removing indirect taxes and subsidies. The reason is that they received relatively small net sector subsidies, whereas the reduction in costs due to lower indirect tax rates and prices of non-traded commodities is important. For industries such as *Petroleum Refining* and *Metal Production*, abolishing the taxes on electricity and mineral oil has significant ERA effects.

Trade liberalisation is the most important component in the total ERA in *Manufacture of Intermediate Inputs and Capital Goods*, *Chemical Raw Materials* and *Metal Products, Machinery and Equipment.* Each of these industries loses effective tariff rates equal to 3,2 - 3,3 percent. The corresponding reduction in ERA lies in the interval of 6 - 7 percent.

Not surprisingly, the calculations show that the energy intensive sectors *Manufacture of Metals* and *Manufacture of Pulp and Paper Articles* were strongly subsidised in 1989 through the regulations of the electricity market. The fall in ERA is 15,8 and 10,9 percent respectively. The ERA effect in the sector *Manufacture of Industrial Chemicals* is much smaller, reflecting that this sector was not subsidised to the same extent through cheap hydro power as the other energy intensive industries.

As pointed out in section 2, the change in the producer price summarises the net effect of the various policy measures on costs and incomes for sheltered industries. *Dwelling services* stands out as strongly subsidised in 1989; the producer price would have to increase by 110 percent in order to break even. The far most important subsidy component in this extremely capital intensive sector, is the favourable taxation of capital income. Recall that the effective tax rate on capital income from dwelling services was estimated to be -76 percent in 1989, see table 6. For the other sheltered sectors the net cost effect of an abolishment of all measures is much more uncertain a priori because of contradictory effects. Input prices are reduced but so are also net sector subsidies whereas capital income taxation increases. The calculations show that the net unit costs increase by 3,4 percent in *Domestic Transport* and by 4,6 percent in *Finance and Insurance* respectively. For the remaining sheltered industries the net cost effect is weakly negative.

## 4.2 ERA-effects when equivalent tariff rates adjust endogenously

In section 2 it was pointed out that one can give different interpretation of the assumption of constant NTBs. While the equivalent tariff rates were kept constant in the calculations presented above, in the calculations reported in this section they are allowed to adjust endogenously. The purpose is to illustrate how the two polar interpretations of constant non-tariff trade barriers affect the ERAs. This is done by calculating partial ERA-effects of similar changes in indirect taxes and subsidies as those examined in section 4.1. In table 9 the results are presented and compared with the case of constant equivalent tariff rates.

**Table 9: The ERA-effect of indirect taxes and subsidies. Percent, 1989**

| Potentially exposed industries | Endogenous equivalent tariff rates | Constant equivalent tariff rates |
|---|---|---|
| Agriculture | - | -67,3 |
| Forestry | -12,8 | -9,6 |
| Fishing and breeding of Fish etc. | -37,4 | -28,2 |
| Manufacture of Consumption Goods | - | 6,2 |
| Manufacture of Intermediate Inputs and Capital Goods | - | -1,0 |
| Manufacture of Pulp and Paper Articles | 4,5 | 4,9 |
| Manufacture of Industrial Chemicals | - | 6,1 |
| Petroleum Refining | 12,2 | 12,3 |
| Manufacture of Metals | 12,1 | 12,3 |
| Manufacture of Metal Products, Machinery and Equipment | - | 0,2 |
| Building of Ships and Oil-Platforms | - | -12,3 |

"-" means nil.

With equivalent tariff rates adjusting endogenously, ERA-effects can be calculated for only five of the eleven potentially exposed industries. The figures show that the net factor income in these 5 industries decreases more than when equivalent tariff rates are kept constant. The changes in indirect taxes and subsidies have a positive effect on net factor income in the five industries, and the positive price adjustment in protected sectors implies an increase in the input costs in exposed industries. However, this indirect influence is important only in *Forestry* and *Fishing and breeding of Fish etc.*

# 5. Conclusion

The present study indicates that most of the potentially exposed industries in Norway were effectively assisted through various forms of policy measures in 1989. In addition to budgetary subsidies, substantial support is given through other and less transparent channels. Non-tariff import barriers seem to be especially important in this respect, whereas the assistance from nominal tariffs, summarised by the standard ERP measure, is relatively small.

Before one can draw conclusions about the impact on resource allocation from the policy measures considered, the ERA figures for each sector should be compared to some kind of average ERA measure for the business sector as a whole. However, the reported ERA figures for Norway obviously provide considerable information about the most significant distortions of the relative net-of-tax remuneration to the value added factors. It is little doubt that the sectors *Agriculture, Fishery* and *Building of Ships and Oil Platforms* were relatively more supported than the business sector as whole in 1989, irrespective of the precise definition of a reference point. The fact that almost all industries were assisted also implies that the change in the relative net-of-tax remuneration, if intended, could have been brought about at a lower level of government interference.

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