Review of Income and Wealth
Series 45, Number 1, March 1999

EFFECTIVE RATES OF ASSISTANCE FOR NORWEGIAN INDUSTRIES

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We measure the effective assistance to 24 Norwegian private industries in 1989 and 1991 from government budgetary subsidies, indirect commodity taxes, import protection through nominal tariffs and non-tariff barriers, and electricity market distortions. The assistance effects are measured by the change in the net-of-tax value added price due to a removal of the policy measures considered. Most industries were effectively assisted, but the effective assistance differs widely between industries, indicating the overall distortive effect on the industry structure. *Agriculture*, *Food Processing* and *Manufacture of Beverages and Tobacco* stand out as the most assisted industries. Budgetary subsidies and non-tariff barriers had the strongest effective assistance effect.

1. INTRODUCTION

Governments support private firms through a number of instruments intended to improve their profitability. According to general equilibrium theory, such policies affect the allocation of resources among industries. Quantification of these reallocations and the deadweight loss associated with them, have been made by several studies based on Applied General Equilibrium (AGE) models. However, for such purposes the appropriate AGE model has to be rather disaggregated in order to produce interesting results. In spite of considerable progress in AGE modelling over the last 20 years, large-scale models are still costly to construct. In particular, model builders very often have to rely on poor estimates or even pure guesstimates of parameters that are crucial to the equilibrium adjustments of the industry structure.

Given the costs of constructing relevant models and the uncertainty associated with the estimates of important parameters, it may be optimal to provide information about the distortive effects on the industry structure by less sophisticated and costly indicators. One such alternative to AGE analyses is *Effective Rates of Assistance* (ERA), which was first calculated for Australia, (OECD, 1992). This paper reports the results of ERA computations for 24 private industries in Norway.[1] ERA is a summary measure of government assistance that generalises the concept "Effective Rates of Protection" (ERP) introduced by Corden (1966). While ERP is restricted to the question of how nominal tariffs affect the allocation of resources, ERA extends this idea to include how government subsidies, various protective policies and other forms of assistance affect the unit

Note: The authors have benefited from the work of Taran Fæhn, Leo Andreas Grünfeld and Birger Strøm, and from comments by an anonymous referee. Financial support for this project was provided by the Norwegian Ministry of Finance and the Norwegian Research Council.

[1]A more comprehensive discussion of the calculations are given in Holmøy, Hægeland, Olsen and Strøm (1993) and Fæhn, Grünfeld, Holmøy, Hægeland and Strøm (1995).

factor income of an industry, sometimes referred to as the effective output price. The ERA framework describes in what form the policy measures should be presented when the focus is on their allocative consequences. Moreover, ERA computations transform various policy measures so that they can be compared and added together. One may also regard collecting and organising the data necessary to compute ERA as a necessary step towards a more complete general equilibrium model analysis.

ERA calculations improve transparency with respect to industry assistance. For some policy measures, such as transfers, indirect taxes and subsidies and nominal tariff rates, information is relatively easily available in budget documents or other official sources. On the other hand, other forms of assistance, such as Non-Tariff trade Barriers (NTBs) and regulatory practices, are less transparent.

The rationale for transforming industry assistance into ERAs is fundamentally the same as the reason for summarising nominal tariff rates into ERPs. Provided rather restrictive assumptions concerning market structures, industry technologies and mobility of commodities and factors in a small open economy, classical trade theory predicts that an increase in the effective value added price of an industry relative to that of other industries, induces an expansion of value added in this industry, see e.g. Woodland (1982).[2] Thus, the *direction* of relative price changes, gives information about changes in resource allocation. From this result, one can infer that industries which are most heavily supported as measured by ERA, have attracted a larger share of primary resources than they would if their ERAs were lower. This theoretical framework implies that conclusions about the allocative consequences of government policies can only be drawn from the relative distribution of assistance among all industries. Consequently, if the ERAs are to be used as indicators not only of industry assistance *per se*, but also of industry structure distortions, they have to be calculated for an exhaustive set of industries in the part of the economy where the allocation of labour and capital are likely to be determined according to the underlying neoclassical model of a small open economy.

ERA may be compared to other indicators suggested to measure the distortive effects of government policies. Recently, Anderson, Bannister, and Neary (1995) have developed a Trade Restrictiveness Index (TRI) which calculates the uniform tariff rate which would generate the same welfare loss as that created by the existing distortive policies. The TRI approach differs both with respect to purpose and informational requirements. TRI is a single indicator of the *welfare effects* of government policies. It is not constructed in order to indicate the direction of resource reallocations among industries, which is the rationale for ERA. Computation of TRI requires estimates of all substitution elasticities in all production sectors and in household preferences. However, if information of such estimates is available and reliable, the costs of constructing a relevant AGE model

[2]In the original article by 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 equilibrium effects is given by Holmøy, Hægeland, Olsen and Strøm (1993).

is dramatically reduced and one may question why one should compute TRI rather than relevant model simulations.

The results from ERA computations will of course depend on the policy measures included. In principle, all policy measures should be included. In practice, however, the costs of gathering the relevant data are in some cases prohibitive. In the current study, three main policy areas have been analysed for the years 1989 and 1991: (1) Indirect taxes and subsidies imposed on industries, (2) trade policy executed through nominal tariffs and NTBs, and (3) price regulations, including price discrimination in the electricity market.

The paper is organised as follows. Section 2 presents the model used for the ERA calculations. Data for the various types of government assistance are surveyed in Section 3. Section 4 presents the empirical results, by answering the following questions: Which industries receive most assistance as measured by ERA?, Are the ERAs stable between 1989 and 1991?, What policy measures have the strongest impact on unit factor income?, To what extent does the input–output relationships between industries influence the ERAs?, and To what extent do the ERA figures provide new information about assistance to Norwegian industries? Section 5 concludes.

2. A Framework for Calculating ERA[3]

The model used for ERA calculations distinguishes between 41 commodities and 24 private industries.[4] T of the commodities may be traded internationally without any quantitative restrictions such as import and export quotas. These are included in the set **T** and will be referred to as *T-commodities*. **T** will also include commodities that are not produced domestically (non-competing imports). Domestic deliveries of *T-commodities* are assumed to be perfect substitutes for corresponding foreign deliveries. Consequently, arbitrage is assumed to eliminate any difference between the producer price and the import price of these commodities. Import prices can be decomposed into three components: (i) the world price including transport costs from the origin to Norway; (ii) nominal tariffs; (iii) costs associated with NTBs which take the form of increasing the costs of exporting to the Norwegian market. One category of NTBs are specific technical standard requirements and home preferences in government procurement. The increase in the import price generated by such NTBs will hereafter be referred to as *penetration costs*. Penetration costs will have an impact on the domestic producer price equivalent to that of a nominal tariff. For reasons that will be made clear below, NTBs causing penetration costs should be clearly separated from NTBs that imply quantitative restrictions on trade flows such as import quotas and voluntary export restraints. When nominal tariffs and penetration costs are measured as *ad valorem* rates, the domestic producer price of T-commodity i becomes

$$P_i = P_i^*(1+t_i)(1+t_i^T), \qquad i \in \mathbf{T} \tag{1}$$

[3]The model presented in this paper is somewhat simplified with respect to the specification of indirect taxation compared to the actual simulation model. A detailed description of the model is given in Holmøy *et al.* (1993).

[4]Government sectors and the petroleum sector are excluded from the analysis.

where P_i^* is the exogenous world price of commodity i; P_i is the domestic producer price; t_i is the nominal tariff rate and t_i^T is the rate of penetration costs.

The remaining N commodities belong to one of the sets **P** and **S**. **P** contains P commodities which may be traded internationally but are protected by quantitative import restrictions (*P-commodities*), whereas **S** contains $S = N - P$ non-tradables (*S-commodities*). The prices of both *P*- and *S*-commoditites are determined in domestic product markets independently of world prices. For a *P*-commodity i, a non-negative equivalent tariff rate, t_i^E, associated with the import quota is defined as

$$t_i^E = \frac{P_i}{P_i^*(1+t_i)(1+t_i^T)} - 1, \qquad i \in \mathbf{P} \tag{2}$$

which is strictly positive when the import quota is effective. t_i^E can also be interpreted as the quota rent in a competitive quota market.

Tariffs and NTBs are examples of policy measures affecting commodity prices. However, factors move between industries, not between commodities, so industries rather than commodities represent the interesting concept in a resource allocation perspective. This argument was the basic motivation for the ERP concept. More precisely, ERA measures the effect of different policies on unit factor income, which is an industry concept. In order to undertake such a transformation, the ERA calculations, like the ERP calculations, require input–output tables which link industry flows and commodity flows.

At any operational aggregation level, industries are in general multi-output producers. An industry may therefore produce both *T*-, *P*- and *S-commodities*. The grouping of firms into the $M = 24$ industries follows the "main commodity principle," which means that all firms where production of commodity j constitutes the largest output share belong to the same industry labelled j. An industry is labelled *Exposed* if it is a main producer of a *T-commodity*. There are K such industries, where $K \leq T$ due to non-competing imports. An industry which is the main producer of a *P-commodity* is labelled *Protected*, whereas main producers of *S-commodities* are called *Sheltered*. The number of protected and sheltered industries are equal to the number of commodities contained in the sets **P** and **S**. Consequently, $M = K + P + S$. For each industry unit factor income, net of taxes on labour and capital, is defined by the following identity:

$$\begin{aligned} y_j = {} & \sum_{i \in \mathbf{T}} b_{ij}^O P_i^*(1+t_i)(1+t_i^T) + \sum_{i \in \mathbf{P}} b_{ij}^O P_i^*(1+t_i)(1+t_i^T)(1+t_i^E) + \sum_{i \in \mathbf{S}} b_{ij}^O P_i + s_j \\ & - \sum_{i \in \mathbf{T}} b_{ij}^I P_i^*(1+t_i)(1+t_i^T)(1+t_{ij}^V) - \sum_{i \in \mathbf{P}} b_{ij}^I P_i^*(1+t_i)(1+t_i^T)(1+t_i^E)(1+t_{ij}^V) \\ & - \sum_{i \in \mathbf{S}} b_{ij}^I P_i(1+t_{ij}^V) - b_j^L t_j^L w_j^L - b_j^K t_j^K w_j^K, \qquad j = 1, 2, \ldots, M. \end{aligned} \tag{3}$$

In (3) t_{ij}^V and t_{ij} are industry-specific net commodity tax rates and nominal tariff rates on commodity i respectively; b_{ij}^I and b_{ij}^O are fixed input- and output-shares. b_j^K and b_j^L are the input shares of capital and labour in total output, w_j^K and w_j^L are net-of-tax service prices received by owners of capital and labour, while t_j^K and t_j^L are effective tax rates on services from these primary inputs. s_j denotes net subsidies per output unit, and y_j is the net unit factor income.

The first four terms in (3) constitute the unit revenue in industry j from (i) sales of tradables, (ii) sales of protected commodities, (iii) sales of sheltered commodities, (iv) net subsidies. The cost components in (3) include expenditures on intermediate goods, separated into tradables (the fifth term), protected commodities (the sixth term) and sheltered commodities (the seventh term). The two last terms on the RHS of (3) account for effective taxation of labour and capital. When y is divided by the share of real value added in gross production, the resulting variable can be interpreted as the effective value added price, which is the main concept in the ERP literature, see e.g. Woodland (1982). However, when the input shares are fixed and relative changes in net factor income are considered, such a transformation has no impact on the results.

In the traditional model of a small open economy, the factor prices of labour and capital are assumed to be equalised between industries in equilibrium. The equation system in (3) then determines the level of these factor prices, the equivalent tariff rates and the prices of the S-commodities, i.e. $N+2$ variables. Moreover, the model determines which sectors that will be active through specialisation. Normally, the equilibrium number of sectors will equal $N+2$. These sectors are able to pay the maximum remuneration to labour and capital without violating (3).

ERA calculations answer a question which is quite different compared to those motivating a solution of the small open economy model. Now both the observed industry structure and the net-of-tax service prices received by owners of capital and labour are exogenously given. The endogenous variables to be determined by (3) are the net unit factor income in exposed industries, the equivalent tariff rates and the producer prices of S-commodities. The computed relative changes in net factor incomes due to changes in specified policy parameters are defined as the ERA-*effects* of these measures. ERA is defined as the ERA-effect of a complete elimination of all policy instruments introduced in (3). Unfortunately, all relevant data required for calculation of effective taxation of labour and capital, have not yet become available. Consequently, this paper is confined to calculating the ERA effects of the policy categories (1) nominal tariffs, (2) NTBs measured by equivalent tariffs, (3) indirect taxes and subsidies levied on commodities, (4) direct industry taxes and subsidies (net non-commodity taxes), (5) price regulations such as maximum prices and price discrimination in the electricity market.

Note that the value of t_i^E depends negatively on the assistance given to the corresponding protected industry through measures other than import quotas. For example, the more government transfers this industry receives, the lower is the unit cost and the output price charged in the domestic market. This interaction between quotas and other kinds of assistance may cause the non-negativity constraint of t_i^E to be binding if changes in non-protective measures cause sufficiently strong reductions in unit costs in the protected industry.

The model defined by (3) implies that changes in costs in a protected or sheltered industry are shifted forward to changes in the price of its main commodity, leaving net unit factor income unchanged. Consequently, the ERA effect of policy changes is bound to be zero for sheltered industries. The same conclusion holds for protected industries provided that the policy changes do not

affect their protected status. When policy changes include abolition of NTBs working like import quotas, the model will of course calculate a non-zero ERA effect for industries that change their status from protected to exposed.

Although there will be no ERA effects in either sheltered industries or in industries being protected both prior to and after the policy changes, these industries play a potentially important role in the ERA calculations by transmitting assistance to the exposed industries through the input-output structure of deliveries of intermediate commodities. For example, assistance to domestic transport services will have no effect on net unit factor income in this sheltered industry, but reduced prices of transport services will increase the ability to remunerate labour and capital in exposed industries. The ERA effects in the exposed industries of this policy will depend on the share of direct and indirect input of transport services in total costs. Changes in the producer prices for protected and sheltered industries summarise the net profitability effect in these industries of the policies considered. This measure may be used as an indicator of the effective assistance of sheltered and protected industries, but, contrary to ERA, such an indicator has no theoretical backing as bearer of information about the distortive effects on resource allocation.

When calculating the ERA effects from policy measures other than quota-like NTBs, it is necessary to define precisely what is meant by constant protection through NTBs working like import quotas. One definition (A) is to keep the underlying quotas constant, while the associated quota rents adjust endogenously. An alternative definition (B) is to keep the value of protection measured by the quota rents constant, which assumes adjustments of the underlying quotas . When the joint ERA-effects from all specified policy categories are computed, both closure rules of (3) are equivalent. When we decompose the total ERAs into contributions from different policy measures, including quota-like NTBs, these contributions are most clearly identified when closure rule B is applied.

3. Data and Empirical Implementation

3.1. *Indirect Taxes and Subsidies*

The major conceptual framework for the ERA calculations is the Norwegian National Accounts (NNA), which provide data for input–output coefficients, primary factor prices, indirect taxes, subsidies and nominal tariffs included in the model. Two main categories of indirect taxes and subsidies are distinguished in the NNA; commodity and non-commodity taxes and subsidies. While commodity taxes are related to commodity flows, non-commodity taxes are imposed on industries, cf. (3) above. In Norway, the revenues from non-commodity taxes and subsidies show substantial amounts, cf. Table 1.

Although the NNA is an indispensable data source for distributing indirect taxes and subsidies to industries, the national accounting conventions will in some cases produce misleading figures in an ERA context. First, one significant practical problem is that not all the items listed as taxes or subsidies in the NNA, such as e.g. outlays on labour market measures and support to cultural institutions, should be counted as support to specific industries. Second, some subsidies are

TABLE 1

INDIRECT TAXES AND SUBSIDIES IN NORWAY

	1989		1991	
	Billions NOK	Percent of GDP	Billions NOK	Percent of GDP
Non-commodity Subsidies	35.2	5.6	41.7	6.1
Non-commodity Taxes	16.4	2.6	19.2	2.8
Commodity Subsidies	1.4	0.2	1.1	0.2
Commodity Taxes	28.5	4.6	33.0	4.8

Source: Norwegian National Accounts, Statistics Norway.

distributed to other industries than those effectively receiving them. Examples of the latter are interest subsidies given through favourable loans in state banks, government support to specific research projects, and subsidies to the agricultural sector paid indirectly through higher prices on *Agricultural Commodities* delivered to the industries *Food Processing* and *Retail Trade*. The simplest way to capture the effects of such subsidies in the ERA calculations is to redistribute the subsidies to the sectors finally receiving them prior to the calculations. After a detailed evaluation of all items for non-commodity taxes and subsidies, nearly 20 percent of the non-commodity subsidies were redistributed to other industries compared to the original NNA in both 1989 and 1991.[5]

After relevant redistributions compared to the official NNA, *Agriculture* still receives the major part of the net non-commodity subsidies which we classify as industry assistance. Also *Fishing and Breeding of Fish* and *Building of Ships* receive substantial amounts. In the ERA calculations for 1989, we have removed non-commodity subsidies, non-commodity taxes and commodity taxes constituting 3.0 percent, 1.0 percent and 2.7 percent of GDP. In the 1991 calculations, the corresponding figures are 3.1 percent, 0.9 percent and 2.8 percent.

3.2. *Trade Policies*

Protection via nominal tariffs has become gradually less important in the Norwegian economy, see Table 2.[6] The rates in Table 2 are based on tariff rates on the 7-digit commodity level, calculated from tariff revenue and c.i.f. values of imports. These rates are aggregated to the classification of commodities in the model using production weights. Production weights, rather than import weights, are appropriate because it is the effect of tariffs on the producer price of perfect domestic substitutes which is to be measured. However, the tariff rates at the most detailed commodity level 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 indicated by these average figures. Thus, if commodities of different country origin are close substitutes, the fall in

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

[6]Due to the implementation of the Uruguay round in 1995, all kinds of protection except tariffs are prohibited. Our study deals with the years 1989 and 1991, when there were no such rules against non-tariff protection.

domestic prices following a removal of tariffs may be stronger than expressed by the estimated average rates.

Including NTBs in ERA calculations involves a number of both conceptual and computational problems. First, there are major problems of identification.[7] Internationally, the UNCTAD classification scheme has become the accepted definition of NTBs. Second, NTBs must be translated into equivalent tariff rates consistent with the ERA framework described in Section 2. 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 on industry and commodity characteristics and various kinds of trade policy regulations motivating differences between Norwegian and corresponding world prices is required. Our strategy has been to collect existing relevant information, including results from available industry studies. We have then classified the policies faced by a sector into quantitative restrictions or penetration costs. The estimated equivalent tariff rates have been aggregated to the model classification of commodities using production weights. A detailed discussion of these results on NTBs and equivalent tariff rates is given in Holmøy *et al.* (1993) and Fæhn *et al.* (1995). Here, only some major areas of government regulations and principles guiding our choices are presented. Estimates for the various commodity groups in our ERA model are shown in the last two columns of Table 2.

Domestic production of a number of commodities is protected from foreign competition by *quantitative import restrictions. Agricultural Commodities* stands out as by far most the protected commodity group. There are restrictive import quotas on all major agricultural products, combined with strict price regulations. For most agricultural products, our estimates of equivalent tariffs are based mainly on the OECD calculations of "Producer Subsidy Equivalents" (PSE), see (OECD, 1994). However, for some important products, such as milk and other dairy products, we have preferred to use comparisons of Norwegian and Danish prices, rather than the PSE estimates.[8] This is because Denmark is likely to be the main exporter of such commodities to Norway under a free trade regime. Based on this information, we have estimated an average equivalent tariff rate on agricultural commodities of 67 percent in 1989 and 71 percent in 1991.

Several commodities included in the group *Processed Food* are also subject to extensive import regulations through quotas. When estimating equivalent tariff rates, important sources of information have been the official Norwegian industry statistics and trade statistics, providing producer prices and import prices at the 8-digit commodity level. Extensive use has also been made of Purchasing Power Parity (PPP) calculations, documented in (Statistics Norway, 1990). These data enable us to use consumer prices net of indirect taxes from EU countries, or alternatively, one of these countries individually, as reference prices. To minimise problems of transportation costs being included in the price estimates, we have chosen the price levels in Denmark as a basis for assessing the differences between

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

[8]This material was provided by the Norwegian Agricultural Research Institute and other Norwegian sources.

TABLE 2

NOMINAL AND EQUIVALENT TARIFF RATES BY COMMODITY GROUP

Commodity Group	Nominal Tariff Rates 1989	Nominal Tariff Rates 1991	Type of NTB	Equivalent Tariff Rates 1989	Equivalent Tariff Rates 1991
Agricultural Commodities	0.16	0.41	Q	69	71
Commodities from Forestry	0.08	0.01		–	–
Commodities from Fishery	–	–		–	–
Processed Food	2.90	3.02	Q	44	49
Beverages and Tobacco	1.62	2.75	P	35	30
Textiles and Wearing Apparels	0.03	0.03	Q	2	1
Wood and Wood Products	6.32	0.05		–	–
Chemical and Mineral Products	0.36	0.45	Q/P	10	8
Commodities from Printing and Publishing	–	0.01		–	–
Mining and Quarrying	–	–		–	–
Pulp and Paper Articles	0.01	–		–	–
Industrial Chemicals	0.37	0.37	Q	3	3
Petrol	–	–		–	–
Fuel oils	–	–		–	–
Metals	0.05	0.07		–	–
Metal Products, Machinery etc.	0.68	0.66	P	2	2
Repair	–	–		–	–
Ships	–	–		–	–
Oil Production Platforms	0.02	–	P	3	3

Note: "–" means nil, "Q" means quantitative restrictions, "P" means penetration costs.

Norwegian and international prices. The estimated implicit tariff on *Processed Food* is 48 percent in 1989 and 53 percent in 1991.

Trade in textiles and clothes (included in the commodity group *Textiles and Wearing Apparels*) is limited by voluntary export agreements organised through the Multifiber Agreement. However, these agreements primarily apply to imports from low-cost countries. Based on Melchior (1993), the average equivalent tariff rate on such commodities is estimated to 13 percent in 1989 and 8 percent in 1991. The equivalent tariff on the commodity group as a whole is then 2 percent in 1989 and 1 percent in 1991.

For important manufactures in Norway, such as fertilisers (included in the commodity group *Industrial Chemicals*) and cement (included in *Chemical and Mineral Products*), the domestic markets are *de facto* monopolised. For these products there are no formal barriers to trade, but there are clear indications of trade being restricted by implicit agreements between major producers in different countries to supply their respective domestic markets. However, price regulations prevent the Norwegian producers of cement and fertilisers to exploit all of their potential monopoly power. The presence of imperfect competition complicates the interpretation of implicit tariffs. For fertilisers, an implicit tariff rate of 80 percent in 1989 and 81 percent in 1991 is estimated, based on information in Sørgard (1992). Information provided in Gabrielsen (1989), combined with time series of domestic and world prices, justify an implicit tariff rate on cement of 16 percent for both 1989 and 1991.

Several studies indicate that a number of Norwegian industries are favoured through the fact that foreign producers must undertake penetration costs in order to export to the Norwegian market. For *Beverages and Tobacco*, extensive standard requirements have led to a significant price differential between Norwegian and international prices. The tariff equivalent is estimated to 35 percent in 1989 and 30 percent in 1991. According to Norman (1990), specific commodity standards and technical design are the main sources underlying the estimated equivalent tariff rates on pharmaceutical products (included in *Chemical and Mineral Products*) and on various commodities within *Metal Products, Machinery and Equipment* in Table 2. Regarding government procurement, focus is frequently on industries producing equipment for use in the petroleum sector. At this point, official policy was that Norwegian firms should be preferred if their prices were competitive. Still, investigations and comparisons between prices offered by Norwegian and foreign suppliers indicate a price differential equal to 3 percent in 1989. Although major uncertainties exist, we impose also an implicit tariff of 3 percent for 1991 on imports of the commodity group *Oil production Platforms*.

3.3. *Electricity Market Distortions*

Price discrimination in the Norwegian hydro power electricity market has been part of explicit government regulation.[9] The presumably most important kind of price discrimination on hydro power electricity was due to favourable long-term contracts for large plants in energy intensive industries, i.e. producers of *Metals*, *Industrial Chemicals* and *Pulp and Paper Articles*.

The quantification of rates of price discrimination in the electricity market in 1989 and 1991 is based on Johnsen (1991). In short, the method decomposes the purchaser prices of electricity paid by different sectors into (i) a uniform producer price on homogenous electricity, (ii) sector specific cost components reflecting differences in utilisation time, distribution costs and reliability of deliveries, and (iii) a residual price-cost margin, which is interpreted as a measure of price discrimination.[10]

Table 3 reports the computed rates of price discrimination on electricity in 1989 and 1991. It confirms that the above mentioned energy intensive industries were relatively heaviest subsidised through favourable prices of electricity during these years. The price differentials were larger in 1991 than 1989, because the equilibrium price in the electricity market was higher in 1991, thereby increasing prices on non-contracted deliveries.

4. Computed Effective Rates of Assistance

4.1. *Relative Distribution of Effective Assistance Between Industries*

We first calculate ERAs by removing, simultaneously for all industries, indirect taxes and subsidies, nominal tariffs and NTBs, and price discrimination

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

[10]Energy intensive industries have a higher utilisation time than other users. The 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.

TABLE 3

RATES OF PRICE DISCRIMINATION ON ELECTRICITY BY INDUSTRY
(in percent of the producer price)

Industry	1989	1991
Potentially Exposed Industries		
Agriculture	36.4	55.8
Forestry	36.4	55.8
Fishing and Breeding of Fish etc.	36.4	55.8
Food Processing	29.5	58.1
Manufacture of Beverages and Tobacco	29.5	58.1
Manufacture of Textiles and Wearing Apparel	29.5	58.1
Manufacture of Wood and Wood Products	–9.1	–18.9
Manufacture of Chemical and Mineral Products	–9.1	–18.9
Printing and Publishing	–9.1	–18.9
Mining and Quarrying	–9.1	–18.9
Manufacture of Pulp and Paper Articles	–61.9	–69.2
Manufacture of Industrial Chemicals	–12.8	–46.2
Petroleum Refining	–39.2	–57.0
Manufacture of Metals	–40.1	–47.6
Manufacture of Metal Products, Machinery etc.	8.9	8.9
Building of Ships	43.2	43.2
Manufacture of Oil Production Platforms etc.	43.2	43.2
Sheltered Industries		
Construction, (excl. Oil Well Drilling)	73.6	81.5
Finance and Insurance	62.0	30.7
Production of Electricity	–	–
Domestic Transport	–14.4	–16.9
Wholesale and Retail Trade	54.3	72.0
Dwelling Services	43.7	30.6
Other Private Services	52.2	30.7

Note: "–" means nil.

on electricity. This is done by setting these measures equal to zero. Note that removal of quota-like protective measures implies that protected sectors become exposed. Thus, when import quotas are removed, protected sectors will suffer from reduction of other kinds assistance as well.

Table 4 shows that 14 out of a total of 17 exposed industries benefited from net government assistance in 1991, measured by ERA.[11] The industries *Agriculture*, *Food Processing* and *Manufacture of Beverages and Tobacco* were the industries with ERAs above the average level which was 30.5 percent in 1991.[12] For *Agriculture*, the ERA figure indicates that the remuneration of labour and capital would be negative after a removal of the policy measures considered. This provokes a reminder of caution when interpreting the results: The ERA figures are average numbers that may conceal large differences in profitability and dependency of government assistance within industries. Hence, our result does not necessarily indicate that all agricultural production in Norway would be unprofitable in an unassisted situation.

Diagram 1 shows ERAs for 1989 and 1991. While average ERA rose from 25.1 to 30.5 percent, the sectoral distribution of ERAs was mainly unchanged

[11]In the tables and diagrams in this section, the (potentially) exposed industries are ranked according to the size of ERA in 1991.

[12]Average ERA is calculated as a weighted average, using initial factor income as weights.

TABLE 4

A DECOMPOSITION OF TOTAL ERA EFFECTS INTO CHANGES IN INCOME AND COST COMPONENTS, 1991

	Net Sector Taxes, Percent of Gross Production Value	Producer Price, Percent	Input Price, Percent	ERA
Potentially Exposed Industries				
Agriculture	42.8	−33.3	−26.6	−102.3
Food processing	0.6	−33.3	−24	−84.3
Manufacture of Beverages and Tobacco	−0.4	−24.3	−9.9	−46
Building of Ships	6.7	−1.1	−2.7	−24
Manufacture of Chemical and Mineral Products	1	−7.1	−4.4	−15.6
Manufacture of Pulp and Paper Articles	0.2	−0.1	3.2	−10.5
Manufacture of Oil Production Platforms etc.	0.8	−2.7	−2.7	−8.8
Mining and Quarrying	6.8	−0.3	−4.6	−8.3
Forestry	5.1	−0.2	−11.7	−6.4
Manufacture of Metals	0.4	−0.4	1.2	−6.3
Fishing and breeding of Fish etc.	11	−0.1	−16.6	−5.9
Manufacture of Industrial Chemicals	0.1	−3.3	−2.6	−5.8
Manufacture of Metal Products, Machinery etc.	0.9	−2.7	−3	−4.8
Manufacture of Textiles and Wearing Apparel	1.4	−3.5	−6.4	−2.3
Manufacture of Wood and Wood Products	1.1	−0.2	−2.2	0.8
Printing and Publishing	1.1	0	−2.6	0.9
Petroleum Refining	0	−0.8	−2.5	9.9
Average ERA (weighted by factor incomes)				−30.5
Sheltered Industries				
Finance and Insurance	2	0.5	−4.5	–
Electricity and Gas Supply	0	−0.7	−3.9	–
Dwelling Services	−0.4	−0.9	−2.2	–
Domestic Transport	−0.2	−2.4	−4.8	–
Construction (excl. Oil Well Drilling)	−0.2	−2.6	−3.6	–
Other Private Services	0	−2.7	−7.2	–
Wholesale and Retail Trade	−2.2	−3.6	−2.6	–

between the two years. The most significant changes were the increased effective assistance to *Agriculture* and *Food Processing*, due to higher equivalent tariffs on their main products. Also energy intensive industries experienced increased ERA, because of a rise in the general market price of electricity, thereby increasing the implicit subsidy in fixed price long-term contracts on electricity. These two phenomena clearly illustrate that changes in market prices may cause ERAs to vary considerably over time.

4.2. *The ERA-effects of Different Policy Measures*

In order to identify the policy measures which contribute most significantly to ERA for different industries, we have decomposed the ERA figures into contributions from the following policy categories: net non-commodity subsidies, commodity taxes, nominal tariffs and NTBs, and price discrimination on electricity. This is done by carrying out separate ERA calculations of each policy category, holding the other categories constant. In these calculations, constant non-tariff protection has been interpreted as constant price differences between domestic and world prices. Consequently, closure rule B, introduced in Section 1, is applied.

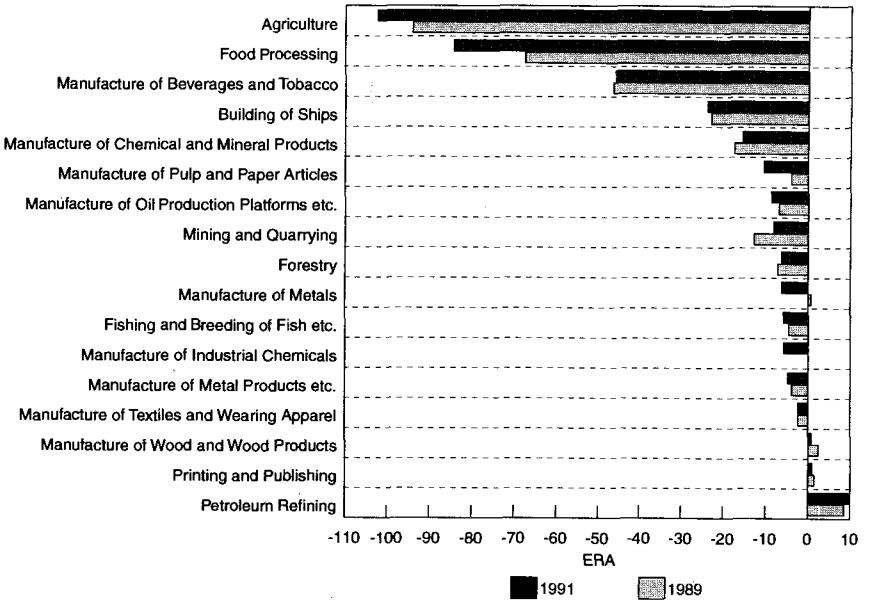

Diagram 1. ERA in 1989 and 1991 Compared

TABLE 5

ERA Effects of Different Policy Measures, 1991

	Net Sector Subsidies	Commodity Taxes	Trade Policies	Regulated Electricity Prices	Total = ERA
Agriculture	−72.2	2	−33	0.9	−102.3
Food Processing	−3.2	7.6	−87.9	0.8	−84.3
Manufacture of Beverages and Tobacco	2.7	2.9	−52.1	0.5	−46
Building of Ships	−27.5	1.7	1.6	0.3	−24
Manufacture of Chemical and Mineral Products	−2.8	2.7	−15	−0.5	−15.6
Manufacture of Pulp and Paper Articles	−0.6	7.2	1.7	−18.9	−10.5
Manufacture of Oil Production Platforms etc.	−5.3	2.5	−6.3	0.3	−8.8
Mining and Quarrying	−12.9	3.9	1.5	−0.7	−8.3
Forestry	−9.1	0.8	1.9	0	−6.4
Manufacture of Metals	−1.3	14.6	2.9	−22.6	−6.3
Fishing and Breeding of Fish etc.	−45.4	9.2	28.8	1.5	−5.9
Manufacture of Industrial Chemicals	−0.2	7	−3.9	−8.6	−5.8
Manufacture of Metal Products, Machinery etc.	−2.4	1.9	−4.3	0	−4.8
Manufacture of Textiles and Wearing Apparel	−3.6	1.4	−0.5	0.4	−2.3
Manufacture of Wood and Wood Products	−2.8	2.1	1.9	−0.4	0.8
Printing and Publishing	−3.1	2.4	1.7	−0.2	0.9
Petroleum Refining	0.4	14.9	−3.6	−1.8	9.9

Table 5 shows that the assistance effects of the specified policy categories differ between industries. In *Agriculture*, more than two thirds of the ERA can be attributed to non-commodity subsidies. Such subsidies also stand out as particularly important in *Fishing and Breeding of Fish* and *Building of Ships*. Commodity taxes affect the ERAs directly through purchaser prices of intermediate inputs and indirectly through changes in producer prices of non-traded input commodities. These taxes hit *Petroleum Refining* and *Manufacture of Metals* hardest, where the effective output price is reduced by about 15 percent. The large assistance to *Food Processing* and *Manufacture of Beverages and Tobacco* was almost entirely due to protective trade policies, especially NTBs on the product markets. Even if trade liberalisation would benefit *Food Processing* by lowering its input prices (on agricultural goods), this effect is by far dominated by the negative effect on output prices in this industry. This is partly due to the relatively low share of intermediate inputs in this industry. The potential importance of taking into account tariff effects on input prices is also illustrated by the results for *Fishing and Breeding of Fish*. Here, the branch *Breeding of Fish* paid much higher prices of important inputs, especially those supplied by the *Food Processing* industry, than in a free trade regime. As a result, the factor income in *Fishing and Breeding of Fish* was reduced by nearly 30 percent due to the trade policy implemented in 1991. Not surprisingly, price discrimination in the electricity market benefited the energy intensive industries.

The results in Table 5 are also informative when examining to what extent the different policy measures reinforce or counteract each other. Counteracting policies may be a signal of "lack of consequence" in the industrial policy, but it may of course also reflect that policy measures may have purposes other than affecting the profitability of certain industries. Counteracting effects may also reflect that the industries at the selected aggregation level are heterogeneous w.r.t. government policy. As seen from Table 5, assistance through subsidised electricity in energy intensive industries are partly offset by commodity taxes on other inputs. Another example is *Fishing and Breeding of Fish* which was heavily assisted through non-commodity subsidies (45 percent of factor income), but almost all of this support is offset by commodity taxation and trade policies. In this case, however, heterogeneity is the basic explanation to counteracting ERA-effects. The major part of the subsidies to this industry is received by *Fishing*, while trade policies mainly affect input prices in *Breeding of Fish*.

4.3. *Are Changes in the Costs of Intermediate Inputs Important to the ERAs?*

Table 4 shows that the prices of intermediate inputs are significantly affected by the policy measures considered in this study. The figures illustrate that the arguments for evaluating the tariff structure in terms of ERPs rather than nominal tariff rates are more than theoretical—they have significant empirical consequences when one also includes policy measures other than tariffs into the framework. The calculations also reveal that the shifts in gross income and cost components which add up to the ERA figure, do not always work in the same direction. In *Agriculture*, a removal of the different policy measures leads to a large increase in net sector taxes and reductions in producer prices, but these effects are partly offset by reductions in input prices.

4.4 *Are Endogenous Price Effects Important?*

Although ERA for sheltered industries per definition is zero, ERA calculations generate changes in producer prices in sheltered industries, reflecting the net cost effects on costs associated with these measures. As shown in Table 4, the removal of tariffs, NTBs and commodity taxes reduce prices of intermediate inputs. Combined with reductions in net non-commodity tax rates (not in *Finance and Insurance*), unit costs and producer prices fall in all industries except *Finance and Insurance*. Through the input–output structure these changes affect input prices in exposed industries, and finally influence their ERA-figures. To illustrate the empirical importance of accounting for endogenous changes in the prices of non-traded commodities, we have calculated ERAs on a completely recursive model, where prices on *S*-commodities are kept constant.

The differences are shown in Table 6. Exclusion of price effects in sheltered industries does not change the overall picture significantly. For sectors with high ERAs, it does not matter very much whether sheltered sectors are included or not. For some industries, however, there are significant effects. In *Manufacture of Oil Production Platforms*, ERA is 2.9 percentage points lower when taking the price effect into account. For *Printing and Publishing* and *Manufacture of Wood and Wood Products* the price effects from sheltered industries even change the sign of ERA: From the "naive" calculations on the recursive model, these industries appear to be effectively taxed by the policy measures considered in this study. However, the original calculations, which account for the effects of endogenous prices of non-traded inputs, show that they are effectively assisted.

4.5. *Do the ERA-calculations Provide New Information about Assistance to Norwegian Industries?*

In order to evaluate to what extent our ERA calculations provide information that substantially changes the *empirical* picture of industry assistance, it

TABLE 6

EFFECTS ON ERA FROM INCLUDING SHELTERED INDUSTRIES IN THE CALCULATIONS

	Total ERA	ERA When S-prices are Kept Constant	"Feedback" Effects
Agriculture	−102.3	−102.8	0.5
Food Processing	−84.3	−85.4	1.1
Manufacture of Beverages and Tobacco	−46	−47.2	1.2
Building of Ships	−24	−25	1
Manufacture of Chemical and Mineral Products	−15.6	−16.7	1.1
Manufacture of Pulp and Paper Articles	−10.5	−11.6	1.1
Manufacture of Oil Production Platforms etc.	−8.8	−11.7	2.9
Mining and Quarrying	−8.3	−9.2	0.9
Forestry	−6.4	−6.4	0
Manufacture of Metals	−6.3	−7.3	1
Fishing and Breeding of Fish	−5.9	−6.7	0.8
Manufacture of Industrial Chemicals	−5.8	−6.7	0.9
Manufacture of Metal Products, Machinery etc.	−4.8	−5.6	0.8
Manufacture of Textiles and Wearing Apparel	−2.3	−2.9	0.6
Manufacture of Wood and Wood Products	38	−0.4	1.2
Printing and Publishing	0.9	−0.5	1.4
Petroleum Refining	9.9	8.8	1.1

is necessary to evaluate the alternative available sources of relevant information.

Contrary to our ERA figures, existing indicators of assistance are either "measure-specific" or "industry-specific." An example of a measure specific indicator is the simple and widely used listing of budgetary industry assistance reported annually by the Ministry of Finance in the National Budgets. The figures in the National Budgets roughly correspond to the net non-commodity subsidies included in our calculations. It is reasonable to suspect that these figures, together with additional information about *Agriculture*, to a large extent have formed the general public impression of the patterns of assistance. This information is presented in terms of absolute amounts rather than rates indicating shifts in the effective output price. Although such a form of presenting the assistance data may be more transparent to the general public and politicians, the theoretical model of resource allocation in an open economy clearly implies that assistance should be transformed into changes in effective prices.[13] For the sake of comparison, however, we have transformed our ERA figures into corresponding *effective amounts of assistance*, which is ERA times initial factor income. Diagram 2 illustrates that the picture of assistance implied by the effective amounts of assistance differ significantly from the picture implied by the net budgetary industry assistance reported in the National Budgets.

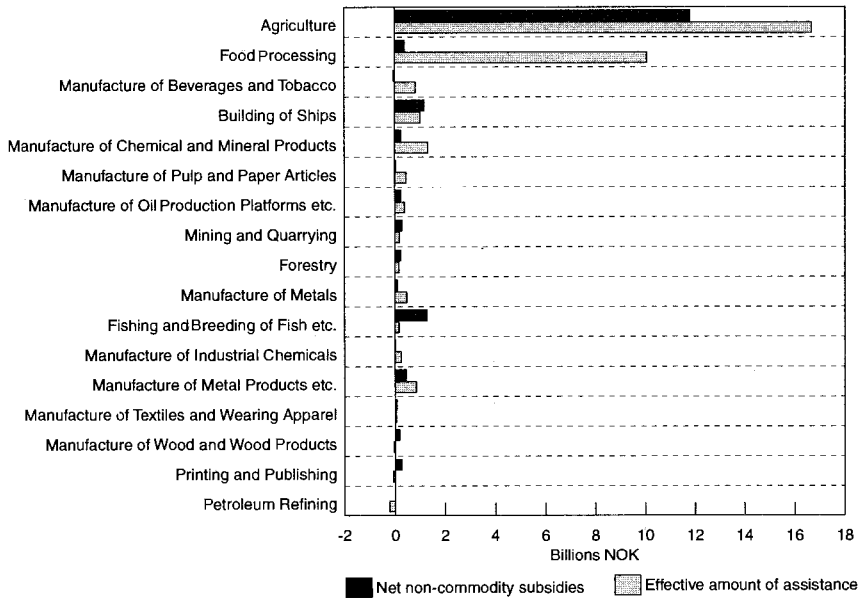

Diagram 2. Net Non-commodity Subsidies Compared to Effective Amounts of Assistance

[13]A comparison of the results for different industries, shows that equal changes in income and cost components yields rather unequal ERA figures. The reason for such a possibility lies in the definition of ERA—the percentage change in the factor income due to removal of policy measures. The ERA effect of a given change in industrial incomes or expenditures caused by a change in a policy measure depends on the share of factor income in the gross production value.

Food Processing is perhaps the most striking example of the discrepancy between the two sets of assistance amounts. Net budgetary support was less than 1 billion NOK in 1991, but extensive non-tariff protection had a large impact on effective assistance, which amounts to a total of 10 billions NOK. Also for *Manufacture of Beverages and Tobacco* and *Manufacture of Chemical and Mineral Products* the effective amounts of assistance are much larger than direct budget payments. The corresponding large difference for *Agriculture* represents much less of a surprise, because the authorities are well informed about the profitability in this industry due to of political targets regarding the income of farmers. On the other hand, *Fishing and Breeding of Fish* stands out as the most striking example of an industry where the direct budget payments are substantial whereas the effective amount of assistance is almost insignificant. As pointed out above, the reason is that NTBs on the products from *Processed Food* induce higher input prices for fish breeding.

The most prominent example of an industry indicator is perhaps the PSE measure of agricultural support regularly calculated by the OECD, (see OECD, 1994). One might argue that ERA is nothing more than PSE calculated for a set of industries. However, this is not the case. First, PSE does not capture inter-industry links. Second, as a single industry measure PSE lacks a point of reference. At least when allocative distortions are considered, one can infer nothing from a single industry figure of assistance no matter how thoroughly it has been estimated. Our ERA figures clearly show that the assistance to the majority of other industries makes the relative assistance to *Agriculture* substantially less than indicated by the single industry figure.

5. Conclusions

The present study indicates that most of the potentially exposed industries in Norway were effectively assisted through various forms of policy measures in 1989 and 1991. *Agriculture*, *Food Processing*, *Manufacture of Beverages and Tobacco* and *Building of Ships* stand out as the most heavily assisted industries in both years. Among the policy categories included in this study, budgetary subsidies and NTBs were found to be the most important channels of effective assistance. The fact that most industries were assisted also suggests that the allocative impact, if intended, could have been brought about at a lower level of government interference. It is also tempting to conclude that the complexity of the effects underlying the ERA figures and the substantial discrepancy between previous information about industry assistance and our ERA results, indicate that the allocative impacts are not likely to be intended.

Compared to existing indicators, ERA has clear advantages as an "organising principle" when assessing the level of government assistance. However as emphasised, ERA has its limitations as a predictor for resource allocation effects of government assistance. In particular, it is a serious problem that the existence of sheltered industries, which employ the dominant share of labour and capital, is likely to weaken the correlation between effective prices and sectoral allocation of resources. This makes a case for complete AGE analyses. An AGE analysis will require all the information utilised in ERA calculations. Therefore, ERA

calculations may be regarded as a necessary step towards a more complete model analysis.

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