

INDUSTRIAL SUBSIDIES IN SWEDEN: Simulations on a Micro-to-Macro Model*

by Bo Carlsson

Background

Like many other countries, Sweden was hit by severe economic problems in the mid 70s, especially the shipping, shipbuilding, steel and mining and certain parts of the forest-based industries. Together, these crisis-stricken industries accounted for some 35 percent of total Swedish exports. Many firms and even whole industries were facing bankruptcy or drastic cutbacks. This situation created strong political demands for action on the part of the government. Thus, "in order to prevent or delay unacceptable reductions of employment in an industry or an enterprise or to facilitate re-structuring which can yield long-term profitability"¹ the government took direct action to save the threatened firms.

Thus, between 1973 and 1979, total industrial subsidies in Sweden rose from 3.2 billion SEK to 15.4 billion SEK, corresponding to about 5 percent and 16 percent, respectively, of value added in mining and manufacturing. The 1979 ratio is far above that in most other industrial nations.² Most of this increase consisted of firm specific subsidies, i.e. subsidies to specific firms in acute need. These subsidies increased from 0.2 billion SEK in 1973 to 7.5 billion SEK in 1979. Other industrial subsidies (export, R&D, sectoral, small firm, regional, and employment subsidies) also grew fast, raising the ratio of total subsidies in percent of GDP from 1 1/2 percent before 1973 to about 3.5 percent in 1979. See Figure 1.

*This article is based on a recent IUI study: B. Carlsson, F. Bergholm and T. Lindberg, *Industristödspolitik och dess inverkan på samhällsekonomin* (The Industrial Subsidy Program and Its Macroeconomic Impact), IUI, Stockholm, 1981. The study was commissioned and financed by the Government Committee on Industrial Subsidies (Industristödsutredningen). Financial support in the form of computer time provided by Industriøkonomisk Institutt, Bergen, Norway, is also gratefully acknowledged.

¹ According to the Directives given to the Government Committee on Industrial Subsidies.

² Our estimates show that total industry subsidies in the U.K. (1979-80), Italy (1978), Norway (1979) and West Germany (1980) amounted to 3.6, 7.1, 7.6 and 4.0 percent of value added, respectively.

Table 1. *Firm specific subsidies by receiving sector in Sweden 1977-79*
(Sum of grants and loans. Paid-out amounts. Credit guarantees not included.)

	Million SEK	In relation to		
		Value added %	Total wage-bill %	No. of employees, thousands of SEK
Shipyards	9 094	72.3	120.2	282
Steel	4 880	35.6	33.4	92
Forest-based	2 012	11.2	12.4	32
Mines	1 666	32.9	41.2	100
Textile and apparel	1 125	9.5	11.6	21
All manufacturing	20 238	6.9	8.5	21

Table 1 shows that over 20 billion SEK (or 77 percent of all subsidies during the 70s) was paid out during the last three years alone (1977-79). Approximately one-half of this amount went to the shipyards, roughly one-quarter to the commercial steel industry, and the remainder to the forest-based industry, the mining industry, and the textile and apparel industry. Most of these subsidies were given in the form of wage subsidies to the ailing firms.

During the three-year period 1977-79 the shipbuilding subsidies corresponded to 120 percent of the total wage bill. In 1978 and 1979, subsidies actually exceeded the value added in the shipbuilding industry - i.e., inputs in the production process were worth more when they arrived at the shipyards than they were when they left in the form of newly built ships. In the steel and the mining industries, subsidies corresponded to 30-40 percent of the wage bill or about 100 000 SEK per employee for the three-year period as a whole. Since nearly all of the steel subsidies have gone to the commercial steel sector, which represents one-third of total employment in the industry (specialty steel making up the remaining two-thirds), it turns out that the subsidies to the commercial steel industry were nearly as large as those to the shipyards, measured per employee. The subsidies to the forest-based industry have gone mainly to three firms, where they represented about 40 percent of the total wage bill 1977-79. Given its prominent place in the political debate, it may seem surprising that the textile and apparel industry ranks lowest among the subsidized industries. Nevertheless, that is the case; the number of recipient firms in the industry is also fairly large.

The following comparisons may be helpful in getting an idea of the magnitude of the subsidies given to crisis-stricken firms:

– Government revenue in the form of corporate income tax 1970-79 amounted to 13.8 billion SEK - i.e., about one-half of firm-specific subsidies during the same period.

– During the period 1977-79, the total industrial subsidies (both general and specific) were somewhat larger than the total appropriations for national defense. At the same time, the firm specific subsidies corresponded to one-half of the payroll tax paid by all industrial firms.

– During the same period (1977-79), the firm specific subsidies corresponded to 2 500 SEK (about US\$ 500) per individual in Sweden or about 5 000 SEK (US\$ 1 000) per person employed in the whole economy. Nearly half of this went to the shipyards.

The Problem

What, then, has been the macro-economic impact of such firm-specific subsidies?¹ We are primarily interested in the long-term growth and allocation effects compared to the short-term stimulative effects. How do the effects of such a highly selective subsidy scheme compare to those of a more general subsidy program or a laissez-faire policy?

We have chosen to analyze these questions through simulations on a micro-(firm)-based simulation model of the Swedish economy, named MOSES. A short description of some of the most central features of the model will be given in the next section.

*The Model*²

The model is oriented mainly towards analyzing industrial growth. Therefore, the manufacturing sector is the most detailed in the model. Manufacturing is divided into four industries (raw material processing, semi-manufactures, durable goods manufacturing, and manufacture of consumer nondurables). Each industry consists of a number of firms, some of which are real (with data supplied mainly through an annual survey) and some of which are synthetic. Together, the synthetic firms in each industry make up the differences between the real firms and the industry totals in the national

¹ Eliasson, in *Micro (Firm) Foundations of Industrial Policy*, IUI Working Paper No. 86, 1983, even suggests that this subsidy scheme is by far the dominant explanation for the poor performance of Swedish industry during the 70s; the growth rate of manufacturing output trailed that of all other industrial nations, including the U.K. and was about 25 percent below the OECD industrial average for the decade.

² For a more complete description of the model, see Eliasson, 1978, (ed.), *A Micro to Macro Model of the Swedish Economy*, IUI Conference Report 1978:1, and "The Firm and Financial Markets in the Swedish Micro to Macro Model", 1983, IUI (forthcoming).

accounts. The 147 real firms (including the eight "crisis-stricken firms" - see next paragraph) in the model cover 70-75 percent of industrial employment and production in the base year, 1976. The model is based on a quarterly time specification.

In addition to the real firms which are normally included in the data base, certain "crisis-stricken firms" have been added in the present runs: two forest-based firms (Södra Skogsägarnas Cellulosa AB and NCB), the consolidated commercial steel company (Svenskt Stål AB), the consolidated Swedish shipyards (Svenska Varv, formed by merging the three large Swedish shipyards), and four textile and apparel "firms", each representing a subsector within that industry. Together, these firms received the great bulk of industrial subsidies during the 70s. Iron ore mining (also a major subsidy recipient) is outside the micro specified manufacturing sector in the MOSES model and therefore is not analyzed here.

Firms in the model constitute short- and long-run planning systems for production and investment. Each quarter they decide on their desired production, employment and investment. Armed with these plans they go into the labor market where their employment plans confront those of other firms as well as labor supply. The labor force is treated as homogeneous in the model, i.e. labor is recruited from a common "pool". However, labor can also be recruited from other firms. This process determines the wage level, which is thus endogenous in the model. Even though the labor market is homogeneous, wages vary among both firms and industries without any tendency to converge. Since the labor market is only subdivided into industries, not regions, mobility in the labor market is probably overestimated. This is important in interpreting the results.

The micro to macro model features an endogenous firm exit device. It is activated when net worth of a firm goes below a certain minimum level in percent of total assets (bankruptcy) and/or when the firm runs out of cash (liquidity crisis). The firm, of course, gradually fades away through lack of investment if its cash flow diminishes and if it cannot borrow in the capital market at the going interest rate.

Domestic product prices and the production volume in the four product markets are determined through a similar process. The export volume is determined endogenously in the following way.

Each quarter the firms determine their production volume in two steps. First, they determine their desired production volume, taking into account desired changes in their inventories of finished goods, based on their expected total sales (including exports) which are in turn based on the firms' historical experience. This first production plan is revised by the firms with regard to profit targets, capacity utilization, and the expected labor market situation. After this revision, the production plan is executed. The production volume is distributed to the export and domestic markets according to an export share, which is dependent on that for the previous

quarter, but which also depends on the difference during the previous quarter between the export price and the domestic price. If this export price (which is exogenous) was higher than the domestic price, the firms try to increase their export share during the present quarter. However, the adjustment takes place over several quarters, not instantly. If the export price is lower than the domestic price, the firms do not try to lower their export share but rather maintain it at a constant level. In spite of this asymmetry concerning the effect of positive or negative price differences between exports and the domestic market, it turns out that the export shares in the various markets can both increase and decrease. This depends on whether firms with high export shares fare better or worse than other firms in the market. The import share in the four markets is also determined by the difference between the export and domestic prices with a certain time delay. High domestic prices relative to foreign prices lead to increasing import shares.

There is also a capital market in the model where firms compete for investment resources and where the rate of interest is determined. However, in the present runs the rate of interest has been determined exogenously. At this given interest rate firms invest as much as they find it profitable to invest, given their profit targets. Competition among firms, the Government and households for capital hence does not raise the rate of interest in the subsidy case relative to the non-subsidy case. As a consequence, the effect of subsidies on investment is more favorable than would otherwise be the case.

Public sector employment is determined exogenously, and the rate of wage increase in the public sector has been set equal to the average wage change in manufacturing, preserving the relative, average salary and wage differential between the two sectors. Thus, public sector employment is the same regardless of the size and direction of subsidies.

The exogenous variables (besides government policies) which drive the model are the rate of technical change (which is specific to each sector and raises the labor productivity associated with new, best practice investment in each firm) the rate of change of prices in the export markets, and the labor supply. These variables are identical in all runs reported here.

In contrast to most econometric macro models, domestic prices and wages are determined endogenously in MOSES. These in turn influence the firms' profits and therefore their production plans, the allocation of sales to the domestic and export markets, their investments, and therefore their productivity. This is the main mechanism through which resource allocation is determined in the model. These features make the model especially suited for analyzing the effects of policy measures, which can be expected to influence the expectations and plans of firms and which influence the development of prices and wages. The advantage of a micro-based simulation model is, that one can introduce various policy measures affecting

individual firms, rather than industries and analyze the effects. In a more traditional macro model one is usually forced to make assumptions regarding the resource allocation effects, i.e. one has to *assume* a large portion of the results.

The Simulations

The point of departure for the simulations has been to compare the results of the type of policy actually conducted with those of other alternatives. All exogenous variables have been exactly the same in all the simulations except the specification of the subsidy program. In all cases, the simulations have covered 18 years beginning in the base year 1976, i.e. they have covered the period up through 1994.

Experiment 1: Selective Wage Subsidies

This experiment mimics the subsidy program actually carried out. It can be characterized in the following way. The eight subsidized firms in the model have been given temporary wage subsidies of a magnitude corresponding to the total level of actual support during the period 1977–79. The subsidies have been given in the form of that percentage of the total wage bill, which corresponds to the actual level for each recipient firm. This level of support has been assumed to continue for another three years and then be reduced to two-thirds in 1983 and one-third in 1984 and eliminated completely thereafter.

The subsidies paid out through this program during the entire subsidy period 1977–84 amount to 70 billion SEK. The program is financed in the model through a percentage increase in the level of the income tax applicable throughout the entire 18-year period 1977–94. Thus, the economy is stimulated at the beginning of the period through the subsidy program but at the same time held back through the income tax hike. However, most of the income tax revenue comes towards the end of the simulation, i.e. after the subsidies have been phased out.

Experiment 2: Export Subsidies

As an alternative to this extremely selective actual subsidy program (support given to specific firms in specific circumstances) we have specified a more general alternative, in which subsidies are given to all firms as a percentage reduction of their total wage bill in proportion to the rate at which they increased their exports in the preceding quarter. This is referred to as the *export subsidy case*. It should be noted that support is not necessarily given to the largest exporters or to the firms with the largest export share but rather to those which *increase* their exports at the highest rate.

Experiment 3: General Wage Subsidies (Reduced Payroll Tax)

An even more general alternative is to give wage subsidies to all manufacturing firms in proportion to their wage bill during the same period as the selective subsidy. This can be regarded as either a (temporary) *general wage subsidy* or a (temporary) *reduced payroll tax*. It turns out that in order to reach the same magnitude as the actual subsidies, the general wage subsidy has to be about 10 percent. In other words, the payroll tax, currently about 40 percent, has to be reduced to about 20 percent of the total wage bill.

In summary, the subsidy experiments can be described in the following way. We have studied the macro-economic impact of a temporary stimulus in the form of wage subsidies to either a) a group of non-competitive firms, b) a group of rapidly growing export oriented firms, or c) all manufacturing firms, all other things being equal. In all these cases, the magnitude and time profile of the subsidy program has been kept constant (about 70 billion SEK during the period 1977–84), changing only the type of policy measures used.

Experiment 4: Laissez-faire

As a contrast to subsidy policies with varying degrees of selectivity we have also constructed a *laissez-faire* case in which no measure is taken, i.e. no subsidies are given at all. In this case, there is of course no need to finance a subsidy program; therefore there is no extra income tax increase either.

Most of the ailing firms are highly export oriented; protecting their domestic market in a "protectionist" experiment – something we considered originally – would not have yielded very interesting results.

Simulation Results

Through the selective subsidies, the recipient firms survive in the simulation at least until the subsidies begin to be phased out in 1983. In this experiment, one of the forest-based firms as well as the commercial steel firm and the shipyards are closed down in 1983–84 when deprived of their subsidies. The other recipient firm in the forest-based industry is closed down in 1988 and one of the textile firms in 1990. The other textile and apparel "firms" survive throughout the whole simulation.

But what happens if these firms are *not* subsidized? In the *laissez-faire* case, the largest among them (the shipyards, the commercial steel and the two forest-based firms) are eliminated during the first few years of the simulation, while the textile and apparel firms are phased out more gradually. But even in the cases when the selective subsidies are replaced by more general subsidies, the shipyards, steel and forest firms are forced to close down rather quickly. In the export subsidy case, the textile firms also

gradually fail, but in the general subsidy (reduced payroll) case, three of the four textile "firms" survive throughout the simulation.

The conclusion to be drawn from this is that it would have been difficult to maintain employment in the crisis-stricken firms, or even to prevent these firms from failing, without direct subsidies. But what are the more general effects of these selective policies? What, e.g., would have happened to unemployment in the longer run?

As shown in Figure 2a, closing down several of the ailing firms at the beginning of the period would have led to considerable unemployment for a few years at the end of the 70s. However, the additional unemployment would have been smaller than the number of people employed initially in the closed-down firms, because approximately one-third as many jobs would have been created elsewhere in the manufacturing sector during the first couple of years.

One of the main reasons for this result is that when the wages in non-competitive firms are subsidized, these firms maintain their employment. Non-subsidized firms therefore have to raise their wage offers in order to be able to recruit people from either new entrants into the labor market, from the subsidized firms or other firms or from the unemployment pool (which is reduced because of the subsidies). It should be mentioned in passing that the wage level is generally higher, and in some cases substantially higher in the subsidized firms than average manufacturing wages. This empirical fact is explicitly represented in the wage setting process in the model. This causes generally higher wages, lower profits in non-subsidized firms, and therefore fewer incentives for and hence less expansion in the non-subsidized firms.¹ The result is that the adjustment to changing external circumstances which necessitated the subsidies in the first place is delayed.

The basic reason why the unemployment rate becomes substantially higher during the first half of the 80s in the selective subsidy case than in the other cases is that when the subsidies are phased out, most of the recipient firms fail. In order to rescue them permanently, the subsidies would either have had to be larger or be continued for a longer period than we assumed. Thus, in our simulations the effect of the subsidies as far as unemployment is concerned is largely to delay unemployment and hold back expansion outside the subsidized firms.

Of course, in the absence of direct subsidies to crisis-stricken firms, industrial production would have been lower for a few years but would then have been higher for the rest of the simulated period after the subsidies are phased out, for reasons similar to those given above. See Figure 2b. This

¹ This growth reducing effect of a dynamically non-efficient incentive system has already been demonstrated in simulation experiments.

conclusion does not hold for the laissez-faire case, however. In that case, the production lost during the subsidy period is not made up later.

If direct subsidies had not been given to the ailing firms, the balance of trade would also have suffered a relative decline during the first few years. See Figure 2c. This is due to the fact that several of the firms receiving subsidies, e.g. the shipyards, are large exporters. Therefore, when the subsidies are phased out and several of the subsidized firms close down, the trade balance suffers. After the elimination of the subsidies, the more general subsidy policies turn out to yield a more positive trade balance than the selective policy. Again, the laissez-faire policy turns out to perform less well. Looking over the entire simulated period, both export subsidies and a general wage subsidy (reduced payroll tax) are clearly more favorable as regards the trade balance than the selective policy.

However, as far as private consumption is concerned (see Figure 2d), the selective wage subsidy policy may be said to yield the most favorable development over the simulated period as a whole and especially during the period of the subsidy program. This indicates that direct subsidies to crisis-stricken firms is a more effective means of maintaining capacity utilization and therefore also private consumption than the other policy alternatives. On the other hand, as just pointed out, these other alternatives are more successful in improving the trade balance.

Conclusions

Summing up, if we first confine the discussion to the stated objectives of the subsidy program, it is quite clear that in terms of the first objective, that of preventing or delaying unacceptable reductions of employment, the selective wage subsidies have favorable short-run effects relative to all other alternatives investigated here. But in the longer run, this policy performs worse than the other alternatives (except the laissez-faire case) even in pure employment terms. And in terms of the second objective, that of facilitating restructuring, this policy is worse than both export subsidies and general wage subsidies.

If we broaden the evaluation to include more than just employment effects, the conclusions are rather similar. The selective wage subsidy yields higher industrial production and exports during the first few years than the alternative policies investigated, because the subsidized firms, most of which are heavily export oriented, do not fail like in the other policy alternatives. However, both export subsidies and general wage subsidies lead to more favorable long-term effects on industrial production as well as trade performance (and unemployment). We also find that a general wage subsidy is superior to a "selective" export subsidy in terms of dynamic allocation effects (long-run growth). The firms exhibiting fast export growth in the initial state *need not be* the most efficient, profitable and expansive firms in

the longer run. The general wage subsidy also generates more real income to households and hence more consumption than the export subsidy alternative. In comparison with all alternatives, the selective subsidy program yields negative long-run output growth effects.

It is of course impossible, in a brief article like this to document all the technical details and evaluate all the assumptions that have gone into these experiments.¹ One of the most interesting features in the model is that it is possible to analyze the allocation effects of various policies both over time and between firms (or industries). There is perhaps one exception to what appears a priori plausible: the *laissez-faire* experiment seems to give a considerably less favorable outcome than one might have expected. Otherwise, the results seem on the whole to confirm to what one would expect.

Compared to the *laissez-faire* case, the effects of the selective policies are very favorable in the short run and yet not particularly costly in the long run. The virtual absence of long-term (allocative) effects in the selective relative to the *laissez-faire* case is explained by several circumstances: (1) that the subsidies are actually phased out after eight years and that the firms which fail then are allowed to close down; and (2) that the subsidies are limited and non-negotiable. The recipient firms receive "only" a certain percentage of their total wage bill - even though this percentage is very high in some cases. They are not allowed to negotiate for more subsidies. Therefore, their incentives are not destroyed. It is not likely that such constraints apply in the real world. In other words, it is likely that the negative long-run effects of the selective subsidy policy on incentives and labor morale in industry relative to the *laissez-faire* policy have been underestimated.²

¹ For this the reader is referred to Carlsson-Bergholm-Lindberg op. cit. and the documentation on the model referred to above.

² An alternative way to view the *laissez-faire* case is the following. The subsidy cases all involve both a subsidy scheme and an income tax hike to finance the subsidies. Suppose we disregard the latter (fiscal) aspect and simply take the income tax increase as given. Then the *laissez-faire* experiment would represent a case of a fiscal stimulus to the household sector (in the form of the absence of an income tax increase) rather than to firms. The magnitude of the stimulus is the same as that of the subsidies, although with a different time profile. That is why private consumption holds up relatively well in this case, and it also explains the relatively large negative impact on the trade balance, particularly towards the end of the simulation. But since the fiscal stimulus is channeled through the pockets of consumers rather than going directly to firms, the long-run impact on growth is reduced, compared to the general wage subsidy and export subsidy cases. Apparently, the stimulus to growth-oriented firms is sufficient, in these cases, to more than make up for the income tax hike. But in the selective wage subsidy case, the subsidized firms do not have the same growth potential. Therefore, the *laissez-faire* case tends to yield somewhat higher manufacturing output during the second half of the simulation than the selective subsidy case.

It should perhaps also be pointed out that the whole issue of how subsidies affect the incentives of firms has not been dealt with adequately in this study. While using a micro-based model for the analysis offers considerable advantages in examining allocation effects between firms compared to conventional macro and sector models, the question of incentives *within* firms has been handled here only by assumption. Here remains an important topic for further research.

Figure 1. *Swedish industrial subsidies 1970–79*
(Paid-out amounts in current prices)

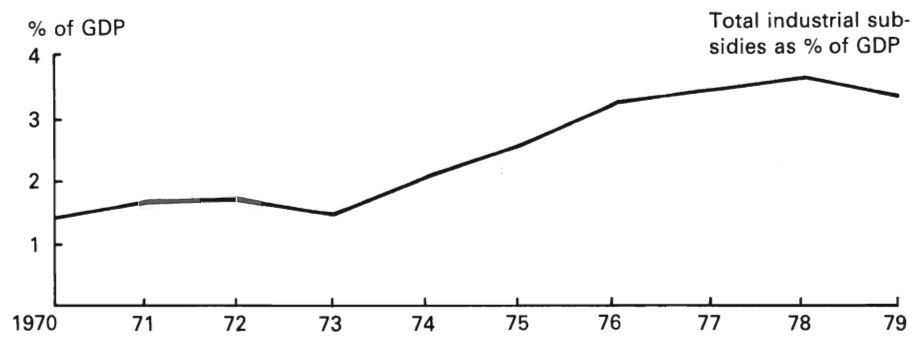


Figure 2a. *Unemployment difference between the simulations*
(Percentage points, selective policy = 0)

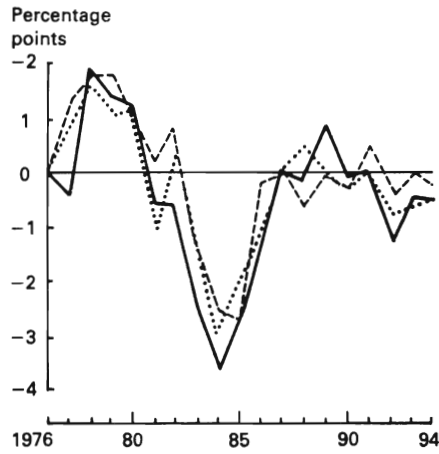


Figure 2b. *Manufacturing output*
(Index, selective policy = 100)

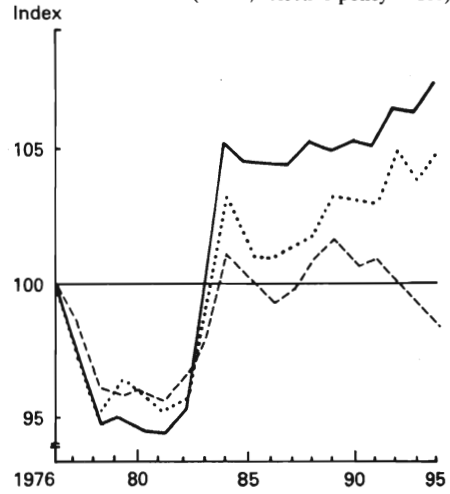


Figure 2c. *Net trade balance in percent of GNP*
(Index, selective policy = 100)

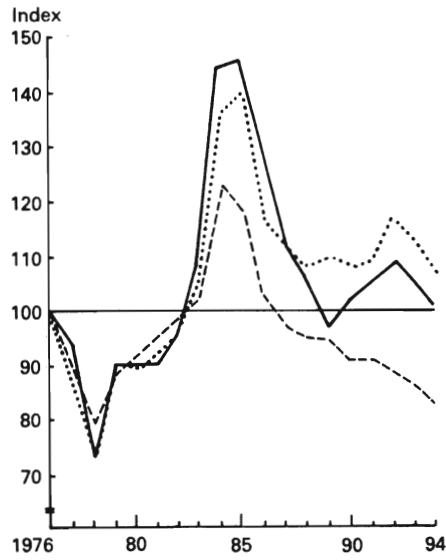
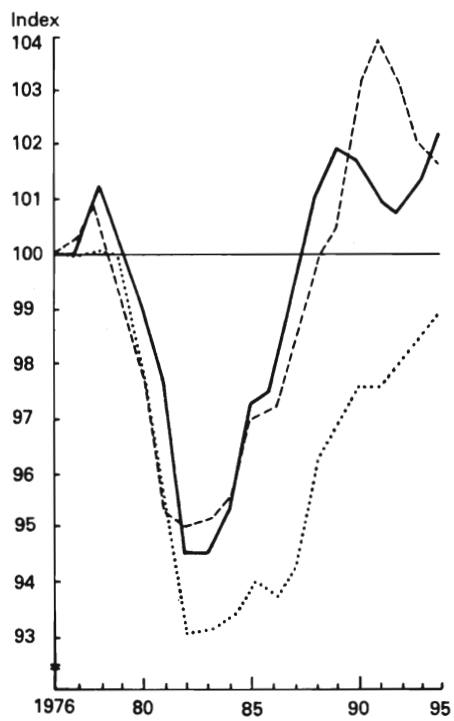


Figure 2d. *Private consumption*
(Index, selective policy = 100)



- Selective wage subsidy 1977-84
- General wage subsidy 1977-84
- Export subsidy 1977-84
- - - Laissez-faire