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The cost problem according to standard theory
A critical note

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This paper examines and criticizes the standard theoretical basis for the argument that a cost-oriented government policy is necessary if a country with a high-cost problem is to improve its competitive powers. According to theory, a firm can only deal with a long-term high-cost problem by increasing its productivity. In attempting to increase productivity, the firm will encounter two problems:

(1) increased capital costs of investment may outweigh the gains achieved through increased productivity, and

(2) one's competitors are free to take advantage of the same labour-saving investments.

Thus, according to standard theory it seems that the firm has little room in which to manoeuvre, so that a high-cost problem can only be dealt with through an effective cost-oriented policy. However, the theory overlooks two important ways in which the firm may effectively deal with a high-cost situation:

(1) through organizational rationalization, and

(2) by strengthening production of goods whose purchase is determined more by quality than by price.

1. Introduction

The lesson from the economic crisis of the 1930s was that an active demand policy is a prerequisite for favourable economic development. The experiences from the 1950s and 1960s seemed to confirm the correctness of this theory. An expansive and wisely timed fiscal policy during recessions and a restrictive policy during booms seemed to ensure stable growth and full employment.

The deep recession and sluggish economic growth of the 1970s, together with an historically high inflation rate, have brought about a shift in interest from the demand side of the economy to the supply side. In recent years it has been 'correct' to counteract a weak market with a restrictive policy. In Norway this lesson has taken a long time to learn. The Norwegian government carried out a traditional expansive counter-cyclical policy all the way up to 1978. This policy was instrumental in allowing Norway to maintain full employment at a time when unemployment in neighbouring industrialized countries crep upward towards 20 million.

Critics, however, maintain that the counter-cyclical policy exacted a high price (Bakke 1980). As a direct result of this policy, it appears that the costs in Norwegian industry rose more rapidly than the costs for Norway's trading partners. In the period from 1970–77 the wage costs per unit produced rose 35% more rapidly in Norway than they did in foreign countries (Fig. 1). Norway had ended up in a high

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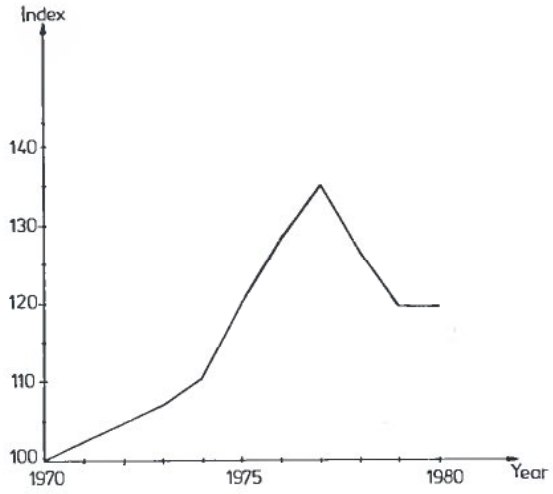

Figure 1. Wage cost per production unit for Norwegian industry in relation to its most important trading partners (Index 1970 = 100).

cost situation which attracted much attention (Nilsson and Kalgraf 1979). Combined with feeble production increases, this had the effect of increasing the calls for a cost-based policy (NOU 1979: 35). According to many experts, interest should be focused on the supply side. It is argued that Norway's economic problems—expressed in the form of stagnating industrial production—are a result of a weakening of the country's competitive power. To improve the competitive power has thus become the most important political task of economic policy (St.meld. nr. 1, 1979–80). Norway has finally accepted the new conventional wisdom that the way to success must be by means of a successful cost-oriented policy. In this article the theoretical point of departure for this belief is clarified, and a firm's possibilities of neutralizing a high cost situation are discussed.

2. The cost policy's theoretical point of departure

The root of the problem is of course that Norwegian industry is competing with foreign industry. The high cost situation arises when the production cost per unit produced rises faster in Norway than abroad. In addition, one often assumes that, because of the smallness of the country, Norwegian firms operate in markets where the competitors dominate the market and control the prices. Thus, the price is externally given and determined by the competitor's cost situation.

The costs per unit produced can be divided into raw material costs (RC), wage costs (WC) and capital costs (CC). Hence, the variable production costs (VPC) will be:

$$VPC = RC + WC \text{ (currency unit/unit)} \tag{1}$$

$$RC = WR \cdot LIR \cdot SRR \text{ (currency unit/unit)} \tag{2}$$

where

WR = Wage in the production of raw materials (currency unit/man-year)

LIR = Labour intensity in the production of raw materials (man-year/ton raw materials)

SRR = Specific raw material requirement (ton raw materials/unit)

$$WC = WM \cdot LIM \text{ (currency unit/unit)} \tag{3}$$

where

WM = Wage in manufacturing (currency unit/man-year)

LIM = Labour intensity in manufacturing (man-year/unit)

The firm's gross margin will be:

$$GM = 1 - VPC/P \text{ (fraction)} \tag{4}$$

where

P = Selling-price (currency unit/unit)

The foreign competitor's variable production costs ($VPCC$) can be calculated as:

$$VPCC = WMC \cdot LIMC + WRC \cdot LIRC\ SRRC \text{ (\$/unit)} \tag{5}$$

In addition to these direct production costs come the indirect production costs, in the form of pension contributions and other social expenses. These expenses can be expressed as a percentage (T) of the yearly wage. The total variable production costs for the competitors can be formulated as follows:

$$VPCCT = (1 + TC) \cdot VPCC \text{ (\$/unit)} \tag{6}$$

When the goods are sold in Norway, a sales tax is added, which amounts to a percentage of the price set by the firm. Since the gross margin is that percentage of the price set by the firm, i.e. exclusive of the sales tax, which is added to the variable production cost, the competitor's price in Norway can be expressed as follows:

$$PC = \frac{(1 + TC) \cdot VPCC}{(1 - S)(1 - GMC)} \cdot E \text{ (kroner/unit)} \tag{7}$$

where

S = Sales tax (%)

E = Exchange rate (kroner/\$)

The variable production cost for Norwegian producers can be expressed in a similar way. Just as in the case with foreign competitors, the social costs which are added to the wage totals have to be taken into consideration in Norway as well. The variable production cost, including the social costs, can be written as:

$$VPCT = (1 + T) \cdot WM \cdot LIM + (1 + T) \cdot WR \cdot LIR \cdot PRPN + (1 + TC) \cdot WRC \cdot LIRC \cdot E \cdot (1 - PRPN) \cdot SRR \tag{8}$$

where

$PRPN$ = The percentage of raw materials purchased in Norway (%)

Assuming a desired gross margin level GM, and taking into consideration the sales tax, the price for Norwegian producers can be expressed as:

$$P=\frac{VPCT}{(1-S)\cdot(1-GM)} \text{ (kroner/unit)} \tag{9}$$

Since it is assumed that the foreign competitors control prices, i.e. that P is given by PC, the cost development has to find its outlet in changes in the gross margin. Solving for the gross margin we get:

$$GM=1-(1-GMC)\frac{VPCT}{VPCCT\cdot E} \tag{10}$$

which can also be formulated as:

$$GM=1-(1-GMC)\frac{\begin{array}{l}(1+T)\cdot WM\cdot LIM+[(1+T)\cdot WR\cdot LIR\cdot PRPN\\ +(1+TC)\cdot WRC\cdot LIRC\cdot E\cdot(1-PRPN)]\cdot SRR\end{array}}{(1+TC)[WMC\cdot LIMC+WRC\cdot LIRC\cdot SRRC]\cdot E} \tag{11}$$

Note that GM is not influenced by sales taxes (S). S is identical for Norwegian and foreign producers. It is just added to the calculated price by the foreign price-setter. These taxes, therefore are fully paid by the consumers.

The level and fluctuations of GM influence the firm's economic prospects of expanding and renovating its production capacity. If the gross margin is zero, the firm's income covers the costs of labour and raw materials exactly. From an isolated perspective, this implies that production can continue as long as the existing production equipment continues to function. If the gross margin is negative, it will be necessary for the firm to receive a continuous transfer of resources in order to maintain production.

3. The theoretical alternatives open to a firm

The ways of action which according to standard theory are available to politicians and firms to counteract a situation of too high costs in relation to foreign competition are indicated by the parameters of eqn. (11). Certain parameters only apply to the national level. This is the case for the magnitude of social costs, the exchange rate, and to a great extent the wage level. In the case of the wage level, it can be marginally influenced by the firm. Labour intensity, the specific raw material requirement, and the percentage of the demand for raw materials which is satisfied through imports represent the parameters through which the firm can act.

In the short run it seems easiest for firms to meet a high cost situation by increasing the percentage of the raw material purchases from abroad. The economic consequences of this course of action depend upon the relative magnitude of the raw material's costs and the percentage of foreign purchases at the start. If we assume that the percentage of raw material costs amounts to 55%, it will be necessary for the percentage of foreign purchases to increase by 36% to re-establish the relation between Norwegian and foreign competitor's cost levels of 1970. It is obvious, however, that a shift in the purchasing pattern can only give a temporary and insufficient improvement in the cost level relationship. For one thing, unemployment will tend to increase in Norwegian raw material production. Moreover, when we reach the point, after a while, where all raw materials are imported, we will have used up the full cost reducing potential of this course of action.

In the light of what we have just said, it is hardly surprising that the possibilities entailed in an altered purchasing pattern have attracted so little attention. Instead, as the cost situation has deteriorated, there has been a mounting call for increases in productivity. It is assumed that an unfavourable cost development can be counteracted by a more rapid increase in productivity. An improvement in productivity corresponds in our terminology to a reduction in the labour intensity. This can either occur through a more efficient utilization of existing production equipment, by laying off redundant workers or through investments in new equipment with a higher inherent efficiency.

A more efficient utilization of existing production equipment has obvious limitations. There is considerable agreement that a given installation of production capital only offers a limited potential for improvements. Therefore, efficiency improvements of this form will only neutralize increased wage costs for a limited time. When the potential for efficiency improvements is used up, the cost increases will have undesireable effects on the gross margin, if no other measures are taken.

Usually it is overlooked that even investments in new capital goods with a higher inherent efficiency only have a limited potential. In many cases, an increase in the rate of investment is depicted as an effective remedy against a rising cost level. The critical limitation for this strategy is associated with the fact that one's competitors have similar opportunities to invest in less labour-intensive production equipment. Another limitation is associated with the fact that an increased rate of investment not only contributes to reducing the variable production costs but also results, as a rule, in increased capital costs. Thus, the net effect on costs of an aggressive investment strategy may be negative.

Suppose that the new equipment which is installed is optimal on the basis of the prevailing level of knowledge. Assume further that a gradual technical improvement is taking place in the production equipment. This means that the variable production cost in production based on new capital goods is decreasing exponentially with time.

$$VPCN = VPCN_0 \cdot \exp(-xt) \text{ (kroner/unit)} \tag{12}$$

$VPCN$ = Variable production cost of production on capital installed at time N (kroner/unit)

x = Yearly increase in the inherent efficiency of capital goods (1/years)

Moreover, we assume that invested capital's economic lifetime is B years, while before this time its rate of depreciation is zero. It is assumed that the volume of investments increases exponentially.

$$i = i_0 \cdot \exp(vt) \tag{13}$$

i = Volume of investments (capacity)

v = Rate of growth of investment (1/years)

The average variable production cost for the existing capital goods is thus:

$$VPC(t) = \frac{\int_0^B VPCN(t-\tau) \cdot i(t-\tau)\, d\tau}{\int_0^B i_0 \exp[v(t-\tau)]\, d\tau} \tag{14}$$

where

i = investments (capacity/year)

B = economic lifetime (years)

which can be expressed as follows:

$$VPC(t) = \frac{\int_0^B VPCN_0 \exp(-x(t-\tau)] \cdot i_0 \exp[v(t-\tau)]\, d\tau}{\int_0^B i_0 \exp[v(t-\tau)]\, d\tau} \tag{15}$$

After performing the integrations, we can rewrite the result as follows:

$$VPC(t) = VPCN(t) \cdot \frac{1-\exp[-(v-x)B]}{1-\exp(-vB)} \cdot \frac{v}{v-x} \tag{16}$$

Thus, the average variable production cost is equal to the production cost of new capital goods multiplied by a factor which is >1. The magnitude of this factor is dependent on the economic lifetime (B), the rate of growth of investment (v), and the yearly increase in the inherent productivity of capital goods which the technical development gives rise to (x). A high rate of growth of investment acts to reduce the magnitude of this factor. A short economic lifetime works in a similar way, so that the average variable production cost per unit approaches the production cost of new installations.

These effects can be illustrated with three examples:

Assume that $v=5\%$/year, $x=4\%$/year, and the economic lifetime is 10 years. In this case $VPC_1 = VPCN \cdot 1{\cdot}21$. The actual variable production cost is thus 21% higher on the average than the production cost of brand new plants.

Assume now that, as a response to the high cost situation, the firm quadruples its rate of growth of investment. Thus we set v equal 20%/year, while the remaining parameters stay the same. In terms of costs this means that:

$$VPC_2 = VPCN \cdot 1{\cdot}15$$

After the increase in the investment rate, the actual variable production costs exceed the production costs for optimal capital goods by an average of 15%. Thus, a quadrupling of the investment rate results in a cost reduction of 6% units. If the increase in the rate of growth of investment is combined with a shortening of the economic lifetime of capital goods, the modernity will increase. If we halve the economic lifetime for capital goods, B will be reduced from 10 to 5 years, while the remaining parameters are the same as before: $v=20\%$/year and $x=4\%$/year. We end up with the following production cost:

$$VPC_3 = VPCN \cdot 1{\cdot}09$$

Thus, a quadrupling of the investment rate combined with a halving of the economic lifetime of the capital goods subsequently results in a reduction of the relation between the average variable production cost and the lowest possible production costs by 12% units. The average actual costs exceed the optimal production costs by 9% in this case.

The possibilities for cost reductions depend on the rate of increase in the productivity of capital goods. A high rate of increase in productivity creates greater possibilities of reducing variable costs through an increase in the rate of investment. In the case where the rate of growth in the inherent productivity of capital goods is assumed to be 4% per year, an increase in the investment rate from 5 to 30% will bring about a cost reduction of 7%. If we double the rate of increase in productivity, the cost reduction will also be doubled. On the other hand, a high rate of increase in productivity entails at the same time that the gap between the actual average production cost and the optimal variable cost level—the ratio $VPC(t)/VPCN(t)$—will increase

In the preceding calculations we have only considered the variable production costs. Therefore, the capital costs are kept out of the calculations. If we assume that the economic lifetime of capital goods is to be halved, however, this will cause the capital costs to about double. Thus, we must also take the capital costs into consideration under these conditions. Without explaining the mathematics in detail here, we make some simplifying assumptions and end up with the following equation:

$$TPC(t)=TPCN(t)\cdot\left(\frac{CCP}{B/BN}+VPCP\right)\cdot\frac{1-\exp\left[-(v-x)B\right]}{1-\exp\left(-vB\right)}\cdot \quad r \tag{17}$$

where

TPC = Total production costs per unit (kroner/unit)
$TPCN$ = Total production costs per unit in new plants (kromer/unit)
CCP = Percentage of total costs devoted to capital costs (%)
B = Economic lifetime (years)
BN = Normal economic lifetime (years)
$VPCP$ = Percentage of total costs devoted to production costs (%)
v = Growth rate of investment (1/year)
x = Rate of increase in the inherent efficiency of capital good (1/year)

If we set $CCP=0{\cdot}15$ and $VPCP=0{\cdot}85$, we get a different picture of the economic consequences of halving the economic lifetime of the capital goods:

$$TPC_4=TPCN\cdot 1{\cdot}27$$

The reduction of the economic lifetime will, under certain conditions, bring about an increase in the capital costs which more than neutralizes the cost reduction afforded by an increased investment rate through increased modernity. The total cost in the case in question will be greater than the cost of a lower rate of investment. The cost level will actually be less favourable than the original level.

The conclusion can be generalized and illustrated graphically (see Fig. 2). The total costs per unit are optimal for a particular economic lifetime. If the actual lifetime of the capital goods deviates from the optimal economic lifetime, the costs are suboptimal. A shortening of the lifetime yields increased total costs as a result of mounting capital costs. A lengthening of the lifetime of the capital goods will in most cases also result in increased production costs. The lengthening of the lifetime entails that the firm takes less advantage of the improvements in efficiency which are inherent in new capital goods. The production equipment may also become obsolete in relation to the equipment of other producers. As a result, the variable production cost will be higher than that of one's competitors.

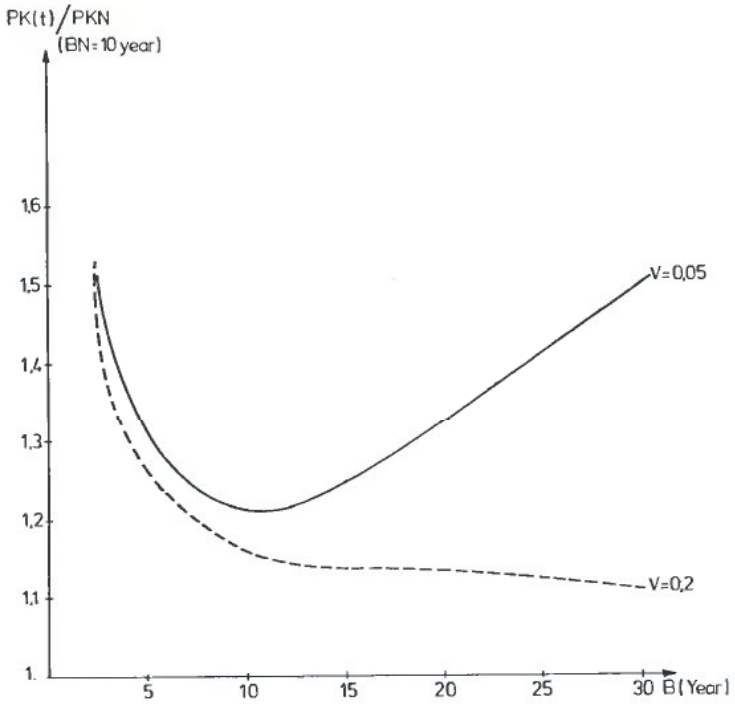

Figure 2. The gap between the actual average total costs and the optimal costs given different assumptions about the lifetime of capital goods and for different rates of investment.

In conclusion, it can be argued that, when it comes to neutralizing a high cost situation, the firm does not have a great deal of room in which to manoeuvre. The effects of increasing the rate of investment depend on a number of conditions, such as the inherent increases in productivity of capital goods, the capital costs as a percentage of the total costs, and also the actions of one's competitors. The latter factor alone can effectively neutralize attempts to counteract an unfavourable cost development through increases in the rate of investment. The competitors alternatives coincide, of course, with those of the high cost firm.

4. From model to reality

The fact that the discussion of the preceding model gives the firm only limited room in which to manoeuvre, when it comes to neutralizing a high cost situation, usually leads to the conclusion that it is the task of the government to carry out an economic policy which counteracts the emergence of a high cost situation. One important task for the authorities is to limit an unfavourable increase in costs. A failure may seem to make itself felt in the form of a more modest increase in production. Thus, the theory provides a good argument for implementing a cost-oriented economic policy.

The conclusion is obvious, but at the same time gloomy. An unfavourable cost development from the point of view of the firm comprises a favourable development

in the buying power of the wage earners—at least in the short term. For this reason, it is relevant to take a closer look at the model's assumptions, to see whether or not they are realistic. Perhaps the jump from the model to reality is so great that there is also room for drawing other sorts of conclusions. An important assumption in the theoretical analysis is that technical progress is incorporated in new capital goods. A perpetual modernization of capital goods is therefore a necessary condition, if the firm is to realize the increases in productivity which are possible as a result of the technical development. Organizational rationalization, which arises from the firm's internal characteristics such as the technology which is employed, the qualifications of the employees, the layout of the workplace, etc., is assumed to represent only a limited potential for rationalization.

Empirical studies indicate that the purely technically oriented measures to increase productivity are, on the average, only marginally greater than the organizationally oriented measures. As a rule of thumb, it seems reasonable to say that the measures to increase productivity are about equally divided with half of them aimed at the effects of introducing new technology (investment), and half of them focused on organization (IUI/IVA 1979). In many cases, however, we can observe a mutually interdependent relationship between both of these types of productivity increases. Usually, new technology creates a potential for further rationalization through re-organization. Organizational rationalization is dependent, in this case, on new investments and the introduction of new technology. The assumption in our model that productivity increases through investment also covers this type of organizational rationalization, even though a time delay will occur before the potential for efficiency improvements is realized. However, the question remains whether there also exists a productivity increase which is independent of the technical development.

Studies of individual firms indicate that this may be the case (Lundberg 1961, IUI/IVA 1979). For a long while productivity can be raised despite the fact that the production process remains technologically unchanged. An important explanation for this phenomenon is frequently the fact that the product mix is altered. In this case, a change in the product mix does not mean that the firm moves into new fields of production. From the point of view of the consumer, production seems unchanged, while it is substantially altered from the point of view of the producer. Thus, we can conclude that the firm's possibilities of counteracting a high cost situation are probably underestimated in the preceding model analysis. Even a technologically unchanged production process allows considerable room for rationalization.

A second important assumption in the model analysis is that, because of their smallness, Norwegian firms operate in markets where foreign competitors control prices. Implicit in this assumption is a supposition that the competing products are identical. This assumption is relevant for standardized production of bulk goods, such as paper pulp, ores, oil, etc., but hardly for the remaining types of production. In the machine industry, for example, the product's qualities are a much more important competitive asset than its price. The question whether Norwegian firms which are exposed to foreign competition always follow the prices set by their foreign competitors—which is a standard assumption in the PRIM-models—has been examined by Vidar Ringstad, who finds that very often this is not the case (Ringstad 1974). Moreover, an empirical study of a number of English firms' reasons for purchasing foreign textile machines illustrates this point (see the table).

The Table indicates that, in 45% of the purchases, the product's qualities were of decisive importance in the decision to purchase it. Price played a correspondingly

	Percentage
(1) Not available in UK	27
(2) No suitable UK alternative	11
(3) Superior overall performance and design of foreign machine	32
(4) Foreign machine technically more advanced in design	13
(5) Better service provided by foreign suppliers	6
(6) Foreign-built machinery cheaper	4
(7) Foreign manufactures more aware of specific use requirements	3
(8) Other	4
	100

Reasons for UK companies purchasing imported textile machinery, 1970–75. Source: Rothwell (1980).

important role in only 4% of the purchases. Obviously, the assumption in the model analysis that the products are homogeneous limits the generality of the conclusions that are drawn. In markets where there is competition between products which are not identical, the product's qualities will often play a more important role than the price in determining a firm's competitive powers. This indicates still further room in which the firm can manoeuvre.

The firm can manoeuvre itself, through product development and product innovation, into positions where the actual cost situation is a matter of lesser importance. In this case, the problem posed in the theory lacks practical relevance.

5. Conclusion

Developing a theory entails building a logically consistant system which can explain a given phenomenon. In this article we have analysed how a high cost situation can be explained and how it can be remedied. A rapid development in wage costs, an unfavourable development in the exchange rate, or a sluggish increase in productivity are the main causes of the high cost problem. In the theoretical sphere the causes of a problem usually also indicate the alternative courses of action which are available. In our case, as seen from the perspective of a firm, this entails that the measures to stimulate increases in productivity are a necessary condition, if the firm is to survive a high-cost situation. However, the model analysis indicated that the possibilities of investing oneself out of the problem are limited. If we assume that foreign competitors will answer with the same strategy, then an increased rate of investment amounts to little more than marking time on a treadmill, and hence a continued cost problem. In this case the theory recommends that the high-cost problem be solved at the national level. This recommendation amounts to a call for a cost-oriented policy. It ought to/will be the main task of the economic policy to maintain a cost level per unit produced which is equivalent to that of one's trading partners.

However, recommendations based on standard theory tend to underestimate the actual possibilities which exist in reality. These possibilities involve breaking precisely

those assumptions which are inherent in the logically consistant theory. The political challenge does not necessarily entail holding down the cost level, but rather strengthening the production of those goods for which foreign competitors do not define the price for the Norwegian firm. The challenge does not necessarily entail introducing new machines, which are available on the global market, ahead of one's competitors, but rather finding organizational solutions adapted to Norwegian conditions, which make a rapid increase in productivity possible. In other words, the political challenge is of a far more offensive nature than indicated by the theory's recommendations. The practical problem is to get the decision-makers to realize this.

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