

THE DUTCH DISEASE
Causes, Consequences, and Cures¹

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ABSTRACT

The Dutch Disease is the name of macroeconomic effects of natural gas income spending in the Netherlands in the 1970s. Spending resulted in increases in the national wage level, problems for exporting industries and economic instability. A system dynamics model of the Norwegian economy replicates the Dutch Disease for the case of oil income spending in Norway. The underlying causes of the Dutch Disease are discussed, and policies to cure problems are investigated. Subsidies to exporting industries have little effect on problems in this sector of the economy, and they exacerbate economic instability. A wage freeze has some positive effects on the Dutch Disease. However, this policy causes other problems. An attempt to increase labor mobility has some positive effects. The most effective policy has been found to be a smooth and slow increase in oil income spending, the original cause of the disease. All problems cannot be avoided, and inevitable problems must be balanced against the benefits of oil income spending.

1. INTRODUCTION

The Dutch Disease is the name of macroeconomic effects of natural gas production in the Netherlands in the 1970s. High profitability of natural gas production from the Groningen field provided increased income to the country. Higher income lead to higher demand for goods and services, increased production, and increased competition for a limited labor force. Consequently the

¹ The three C's in the sub-title are borrowed from Enders and Herberg [1].

national wage level increased and exporting industries came to suffer by higher labor costs. They lost market shares in their product markets and they lost labor to their competitors in the labor market.

Therefore, natural gas income caused a structural change of the Dutch economy. Similar structural changes also take place in other industrial countries with a large fraction of GNP generated by profitable oil and gas production. My focus is on the case of Norway.

The Dutch Disease can be divided into three subproblems. First, reduced production in traditional exporting industries precipitates involuntary labor migration, losses of invested capital, and dissatisfaction because of frustrated expectations.

Second, the immediate cause of the Dutch Disease, the high national wage level, can also be viewed as a problem. The high wage level is attracting much public attention and causing dissatisfaction with the economic and political development of the country. In fact the high national wage level is often viewed as an independent cause of problems in exporting industries.

Third, national economic activity can be destabilized both by governmental reactions to immediate problems and by market mechanisms. Resulting fluctuations in consumption and unemployment cause dissatisfaction.

The outline of the article is as follows. First I comment on three methodologies that have been used to study the Dutch Disease. Next, I present the most important mechanisms underlying the disease. These mechanisms are built into a system dynamics model of the Norwegian economy. I use this model to investigate how the Dutch Disease develops over time. Finally, I use the model to examine how various policies affect the disease.

2. STUDIES OF THE DUTCH DISEASE

I present three different methodologies that have been used to study the Dutch Disease. Typically these methodologies address different subproblems of the disease. The purpose of this section is to show that different studies attempt to answer different questions. Each methodology is useful for one or two of the subproblems but not necessarily for all three. This section also serves as an introduction to the methodology that I have used, a system dynamics national economic model.

The first methodology is the equilibrium model. The Norwegian Multi Sectoral Growth Model, MSG-4E, is one such model that has been used to study the Dutch Disease [2]. This model has 25 production sectors and it incorporates much information on expected development in sector characteristics like technological progress and prices of exports. Most of the sectors can approximately be classified as either competing with foreign products or as protected from such competition. Therefore, the MSG model can

be used to estimate necessary structural changes of the economy as oil income is spent. This is important information both for government and private long-term planning.

Since the MSG model is an equilibrium model, it assumes full mobility of labor and capital. Therefore the production sectors are completely flexible. For each new dollar of oil income that is spent the production sectors adjust immediately, and no increase in the national wage level is needed to precipitate the adjustment. Therefore the MSG model cannot be used to study the wage problem.

The second methodology is the two-sector disequilibrium model. A study of this type is made by Enders and Herberg, [1]. The two sectors are the competing sector (tradeable or manufactured goods) and the protected sector (non-tradeable goods or services). These two sectors compete for a limited labor force.

The disequilibrium model consists of economic relationships that normally would lead to an equilibrium solution. Typically as one applies the model to reason about development over time, assumptions about adjustment lags are made, so that intermittent disequilibria are found. For example, a step increase in demand for labor by the protected sector only affects wages in the short run. Labor migration is assumed to take place only after a certain delay time.

The disequilibrium models are qualitative models and they

are not intended to answer questions about the extent of the structural change. Their strength resides in analysis of policies to cure the Dutch Disease, for example, policies to reduce the national wage level. For this purpose the disequilibrium models are most useful because recommended policies are fairly insensitive to the extent of the final structural change.

However, it is difficult to capture the richness of real economic behaviour with disequilibrium models. This is because it is so hard to keep track of even a small number of variables when delays are introduced in the relationships. For this reason it is extremely difficult to investigate fluctuating economic behaviour with disequilibrium models.

The third methodology is the two sector system dynamics model. This is the model I have used to study the Dutch Disease [3]. (Minor changes of the documented model are shown in an Appendix together with instructions for model tests). The two sectors coincide with the two sectors of the disequilibrium models. The system dynamics model can be viewed as an extension of the disequilibrium approach. The number and complexity of the relationships are increased and presumably all important delays are explicitly modelled. The power of the computer is used to calculate a development over time that is consistent with the assumed relationships. Like the two-sector disequilibrium models, the two-sector system dynamics model is not intended to answer questions about the extent of the structural change. Focus is on the dynamics of the Dutch Disease, both wage escalations and

potential fluctuations in economic activity, and on policies to cure the disease. The major source of information for model construction has been the System Dynamics National Model developed by the System Dynamics Group at the Massachusetts Institute of Technology, [4,5].

3. IMPORTANT RELATIONSHIPS IN THE MODEL

In this section I describe the most important relationships that underly the Dutch Disease. The model contains several other relationships than those described here. These relationships are of minor importance for the disease as I have defined it in the introduction. The main purpose with this section is to describe the mechanisms that cause the structural change and that work to establish a new equilibrium with a steady rate of oil income spending. In this respect delays and bottlenecks are important for the speed of the structural change.

Oil Production. Oil production does not take place in a production sector. Only an exogenous rate of oil income spending is represented in the model. This choice has been made because oil production generates large income with a relatively small use of labor and capital.

Demand for sector output and employment. Oil income is spent on competing and protected goods in the same proportions as the rest of the national income. This proportion changes if the price of protected goods changes relative to the price of compe-

ting goods. The elasticity of the proportion of protected products is -0.5 . It takes 5 years to perceive and react to a change in relative prices.

Figure 1 shows identical relationships for the two production sector, except for the difference in product markets. The protected sector faces no direct competition from foreign products. Consequently prices can be increased without loss of market shares. (Domestic competition prevents excessive profits in the long run). The competing sector loses market shares in its export markets if prices are increased. Market shares are lost to competitors in export markets abroad, and to importers domestically.

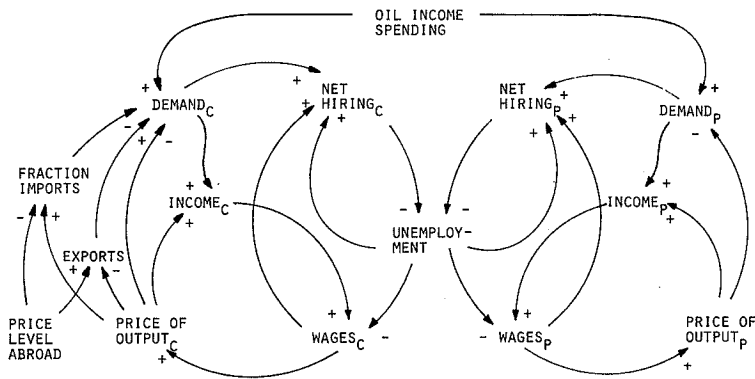


Figure 1: Cause and effect relationships for employment and sector output.

A large and rapid increase in competing sector prices can bring the actual rate of exports down quickly. The capacity to export will change more slowly, however, because it takes time for capital to wear out and for businesses to restructure. The import fraction also changes slowly as domestic prices relative to foreign process change. This is because it takes time to perceive and react to changes in prices. The import fraction reacts more quickly to changes in the delivery delay of domestic competing products. Foreign prices are assumed to be constant, which means that there is no inflation in the surrounding world.

Oil income spending leads to increased demand for output from both production sectors. When a sector faces increased demand it orders more labor to increase its production capacity. Ordering of labor takes place through advertisements, personal contacts, etc. The need for more labor is somewhat reduced through increases in capacity utilization and through use of overtime.

The labor market also influences hiring of labor. If the number of unemployed workers is low, hiring is slowed down, and a bottleneck is created for a large and expanding protected sector. A low unemployment also influences the rate at which workers quit their jobs. Low unemployment means that it is easy to get a new job, and the rate of quits increases. More labor quits work to widen the bottleneck for protected sector hiring. The total labor force is assumed to be constant. If sector wages are higher than average wages, hiring is positively influenced.

Sector wages increase if unemployment is below normal. This reflects increased competition for labor. Sector wages increase if sector income is higher than normal. In addition to these two influences shown in Figure 1, sector wages are also influenced by the rate of change in the consumer price index and by the traditional ranking of sector wages to average wages. The latter influence makes sector wages develop more or less in parallel. In Norway this effect is referred to as "the contagious effect". What is perceived to be the traditional ranking of wages changes only slowly as a result of new realities. Sector prices are influenced by wages, sector employment and cost of capital.

Investment. While labor is assumed to be a mobile factor of production, capital is assumed to be immobile between sectors. For example, shoe factories cannot easily be turned into hospitals. This means that production capital in a sector can be increased only by investments in new capital. Because it takes time to plan and produce production capital, new capital will not be as readily available as labor. In the short run, therefore, production in an expanding sector is increased more by labor than by capital.

In the long run, as new capital is installed, it might become necessary to reduce employment somewhat to ensure an optimal mix of labor and capital. (Production capacity is given by a Cobb-Douglas function of labor and capital. The optimal mix of labor and capital is calculated from marginal productivity and marginal cost of the factors and marginal revenue of output. The optimal mix only serves as one goal for decisions about ordering

of factors). In a declining sector, labor is reduced more quickly than capital.

Figure 2 shows how increased demand to the protected sector leads to ordering of labor and ordering of capital goods. Ordering of capital goods means increased demand to industries that produce capital goods, for example, construction firms and producers of machinery. Increased demand to these industries leads to further ordering of labor and capital. Capital is ordered from the capital producing industries themselves. This pushes up demand for capital goods when the expansionary period in the protected sector start. This leads to increased delivery delays of capital goods. The opposite effect takes place when the expansionary period ends.

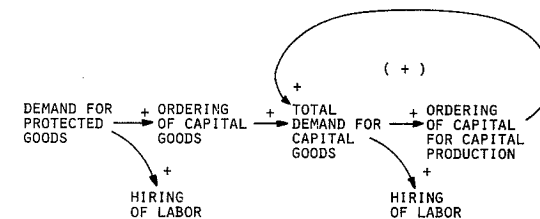


Figure 2: Cause and effect relationships for hiring of labor and ordering of capital goods.

Protected capital goods are produced in a separate sector, but for simplicity they can be assumed to be produced in a common protected sector. The separation of protected capital and con-

sumer goods production in the model has a somewhat stabilizing effect on the Dutch Disease problems.

Production, income and consumption. Figure 3 shows the mechanisms that underly the Keynesian Multiplier effect. If total demand increases because of oil income spending, production will increase. There are three main contributions to the increase in production: Use of overtime, increase in capacity utilization and increase in employment. (Increased use of capital is a fourth, but more long-term contribution). Higher production provides more income, and demand is further increased. Because of several delays around the feedback loops in Figure 3, the immediate effect of an increase in oil income spending is not as large as the Keynesian Multiplier of a long-term equilibrium might indicate. The effect is also constrained by upper limits for use of overtime, capacity utilization, and availability of labor.

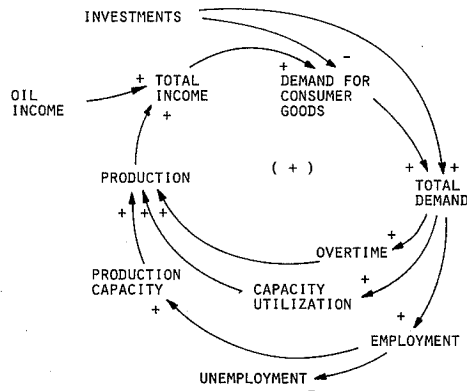


Figure 3: Cause and effect relationships for national production, income and demand.

Consumption equals income minus saving, and saving is set equal to investments. Investments are determined by the production sectors. The interest rate, which influences investments, is set constant. This choice is based on the assumption that those who receive oil income want to increase their total savings at exactly the same rate as the production sectors want to increase their net investments.

Exchange rate. The exchange rate (foreign currency per krone) influences the price of imports and exports, when these prices are measured in domestic currency. Therefore, the exchange rate has a similar effect on exports and imports as competing sector wages, see Figure 1.

Figure 4 shows the influences on the exchange rate in the model. A surplus on the current account leads to an increase in the exchange rate. Foreign investments, defined as an accumulation of surpluses or deficits on the current account, also lead to increases in the exchange rate. The purpose of this assumption is to ensure that all oil income is spent.

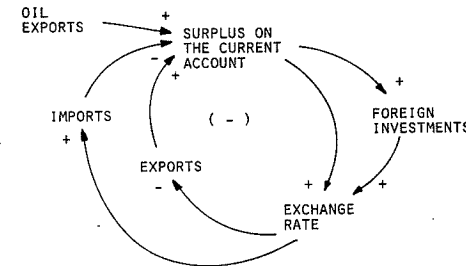


Figure 4: Cause and effect relationships for exchange rate and current account.

Mechanisms that are not modelled. The model does not capture general economic growth because technological progress is not accounted for. Also the labor force is fixed. These assumptions are not important for the Dutch Disease because the structural change will have to take place irrespective of the growth rate. The surrounding world economy is also assumed to have no general economic growth.

The model has no output inventories. According to Mass, the interplay between output inventories and sector employment gives rise to business cycle behavior [6]. Therefore one should expect inventories to affect the potential instabilities of the Dutch Disease. Most probably a low labor mobility in Norway reduces the destabilizing effect of output inventories.

4. BEHAVIOR OF THE DUTCH DISEASE

The system dynamics model is used to calculate behavior of the Dutch Disease that is consistent with the assumptions in the previous section. The model replicates the major symptoms of the Dutch Disease as it has been experienced historically in Norway. To replicate problem behavior, and to test policies to cure these problems, is the purpose of the model. The model is not built to make point predictions about the future. The exemption of general economic growth is one of many reasons for this. Actually, oil income is the only exogenous variable in the whole model. Without oil income the model would stay in its initial equilibrium.

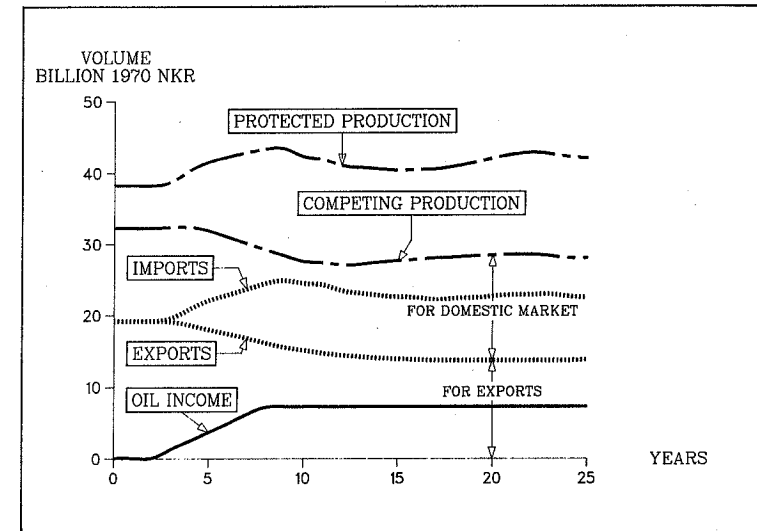


Figure 5: Reference behavior of the Dutch Disease.

I discuss the three subproblems of the Dutch Disease after each other, first the size of the structural change, next the increase in the national wage level, and finally economic instability.

Structural change. Figure 5 shows how oil income is assumed to increase from zero in year two to ten percent of GNP in year eight. After the six years of increase, oil income stays constant.

Oil income spending leads to growth in the protected sector. Demand for protected goods cannot be met by imports, and the protected sector has to increase. How much it increases depends on the fraction of total demand that is directed towards protected goods. This fraction is reduced until year 10, because the price of protected goods increases relative to the price of competing goods. This price development is indicated by the ratio of competing to protected sector wages shown in Figure 6. Protected sector wages increase about five percent above competing sector wages around year ten. This percentage is reduced to four in year 25. Historically, the competing sector in Norway has been viewed as a wage leader. If this is the way the labor market works, different from the assumptions in the model, one should expect protected wages to return to the average wage level more quickly. The consequence would be a greater and faster structural change.

The competing sector also faces increased demand as oil income is spent, but an increase in the national wage level makes the sector loose market shares. Figure 5 shows how exports are reduced. The figure also shows how production for the domestic market decreases slightly in spite of increased demand. After the tenth year, production for the domestic market increases, however, because the national wage level is reduced, see Figure 6. Imports increase rapidly as oil income is spent. The gap between imports and exports is payed for by exports of oil.

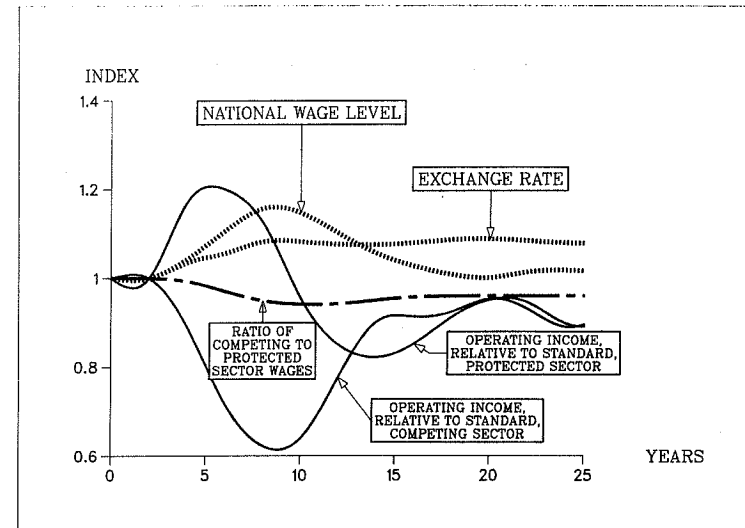


Figure 6: Reference behavior of the Dutch Disease.

A high national wage level. Figure 6 shows how the national wage level peaks 16 percent above the foreign wage level in year nine. 8 percent of the increase is caused by an increase in the exchange rate (foreign currency per krone). The exchange rate increases because the unexpected increase in oil income creates a surplus on the current account. This surplus exists till year seven. The rest of the increase in the national wage level is caused by nominal wage increases. Why do wages increase?

Figure 5 indicates how demand to the protected sector increases as oil income is spent. Figure 6 shows how operating

income relative to standard operating income increases in the sector. Increased demand leads to ordering of labor, and high operating income facilitates wage increases to attract labor.

The result is increased hiring and a reduction in unemployment, see Figure 7. Increased competition for labor, forces the competing sector to increase its wages and prices with loss of market shares and income as the result. Figure 6 shows how the sector's operating income relative to standard drops to nearly 60 percent in year 9. Reduced demand for output makes the competing sector reduce ordering of labor, and low operating income prevents great wage increases to attract labor. Consequently the competing sector loses labor to the protected sector. A high national wage level for a period of time is of great importance to bring about this change in employment.

The drop in the ratio of competing to protected sector wages is as moderate as 5 percent. This is because of the resistance toward changes in the traditional relative position of wage levels. This effect brings wages in the competing sector higher than they otherwise would go. Higher wages make the competing sector lose market shares because of high production costs. However, a similar loss of market shares would have taken place even if relative wages had been more flexible. In this case the competing sector would have lost production capacity because of outmigration of labor. Delivery delays would have increased, which would have caused the loss of market shares.

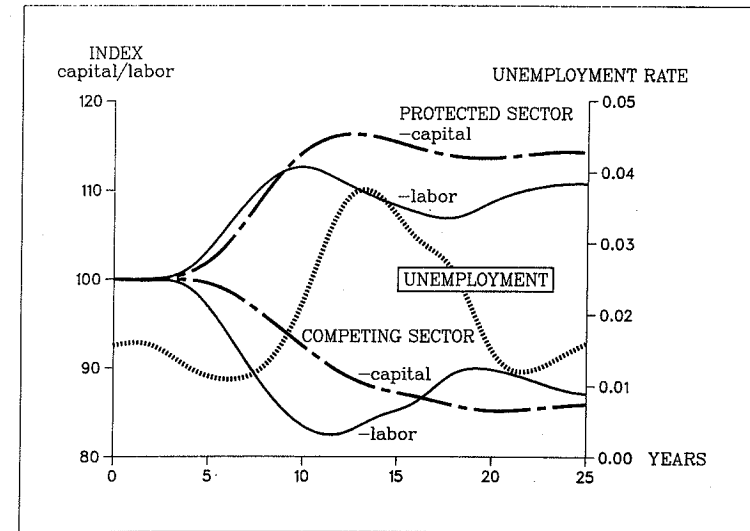


Figure 7: Reference behavior of the Dutch Disease.

Economic Instability. When the structural change is over with the economy should reach a new equilibrium situation. The return to equilibrium is not smooth, however. I will discuss the behavior of three important indicators of welfare, first unemployment, then consumption and investments.

Figure 7 shows how unemployment is below its normal level of frictional unemployment when oil income spending increases. After the increase stops, unemployment increases to 2.2 percent above the normal frictional level. There are three major reasons for this peak in unemployment in year 13.

First, labor is assumed to be more mobile than capital. This means that labor adjusts more quickly than capital when a sector increases or decreases its production capacity. Indexes for labor and capital in Figure 7 show that this is the case for both production sectors as oil income spending increases. When oil income has ceased increasing, protected sector production declines somewhat, see Figure 5. The capital stock continues to increase for a while because the high wage level makes it profitable to substitute capital for labor. Furthermore, a long lifetime of capital prevents capital in the protected sector from declining rapidly as production is reduced. Employment on the other hand can be reduced more easily, and unemployment is the result. Competing sector employment is influenced by a surplus of long-lived capital up to year 20.

Second, total demand grows very high during the first years because demand from oil income comes in addition to existing demands for output. Competing production declines more slowly than demand from oil income increases, see Figure 5. However, as the national wage level increases, competing production declines more and more rapidly. As oil income ceases increasing the national wage level peaks and competing production has its largest rate of decline. The high wage level pushes competing production below its new equilibrium level. Total demand decreases and this results in unemployment.

Third, the tendency toward instability is amplified by the Keynesian multiplier mechanisms. Figure 8 shows two indexes for

total national production. The index for total production capacity increases as unemployment is reduced and it grows somewhat because of higher investments. After year 9, production capacity decreases as unemployment increases. Total production varies more than production capacity because of varying capacity utilization and use of overtime. The peak in production is about 4.5 percent above initial production. The trough is about 3.0 percent below initial production. Increased income resulting from the increase in production adds to oil income and amplifies the effect on total demand. Similarly, the reduction in income exacerbates the contraction and the unemployment problem.

The instability in income is not only important for unemployment, but also for consumption and investments. Figure 8 shows indexes for these two variables. Investments have to increase very much to provide capital for the expansion in the protected sector. In addition, investments must increase to provide capital for increased production of capital goods. The period with rapid expansion of the protected sector is of short duration. After the expansion the additional production capacity in capital goods production is not needed.

Consumption also contracts slightly after year nine. This contraction will particularly cause dissatisfaction if consumer expectations are built on the growth trend in consumption the previous five years. The contraction in consumption is smaller than the contraction in total income because saving is drastically reduced as investments are reduced. (Remember, saving is assumed to equal investments).

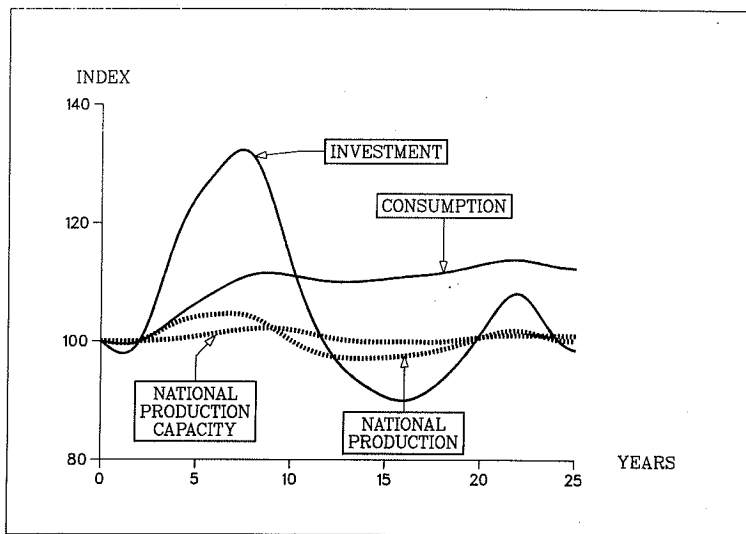


Figure 8: Reference behavior of the Dutch Disease.

The exchange rate stays approximately constant after the expansion of oil income. This indicates that the current account is approximately in balance, and that very little oil income has accumulated as foreign savings.

In the long run the instability is dampened and all variables approach a new equilibrium. The path toward equilibrium has not been without problems, however. Competing industries have suffered from a high national wage level, there has been unemployment, and large variations in investments. In the next section I investigate policies to cure these problems of the Dutch Disease.

5. POLICIES TO CURE THE DUTCH DISEASE

A large number of policies can be used and have been used, to influence the various problems of the Dutch Disease. I start by an investigation of policies that attack symptoms rather than causes and that are precipitated by immediate problems. Then I progress to policies that attack causes and that are based on a long-term consideration of problems.

Subsidies to the competing sector. A subsidy to the competing sector is motivated by economic problems in the sector, and by rapid outmigration of labor. The policy is implemented in the model as a price support for exports. The subsidy increases with outmigration of labor. Figure 9 shows how the policy changes the reference behavior described in the previous section.

There is almost no effect of the policy on the reduction in competing sector employment. There is no effect in spite of subsidies, around year nine, capable of paying wages for half of all the workers that have to leave the sector. The reason for this is a drastic increase in the national wage level because of increased competition for labor. The protected sector is bound to win in this competition because it does not lose market shares when prices are increased to cover increased wages.

The subsidy leads to an increase in competing sector production and total national demand as oil income expands. This effect exacerbates the instability in unemployment. The high wage

level after the expansion also contributes to high unemployment.

A legislated wage reduction. A wage reduction can be motivated by problems in the competing sector or by the idea that the problematic high wage level is an independent cause of both competing sector problems and price inflation. Because the model operates without general inflation it is not sufficient to implement a wage freeze to bring real wages down. Therefore, all wages are reduced by 10 percent in year seven from the level they otherwise would have reached.

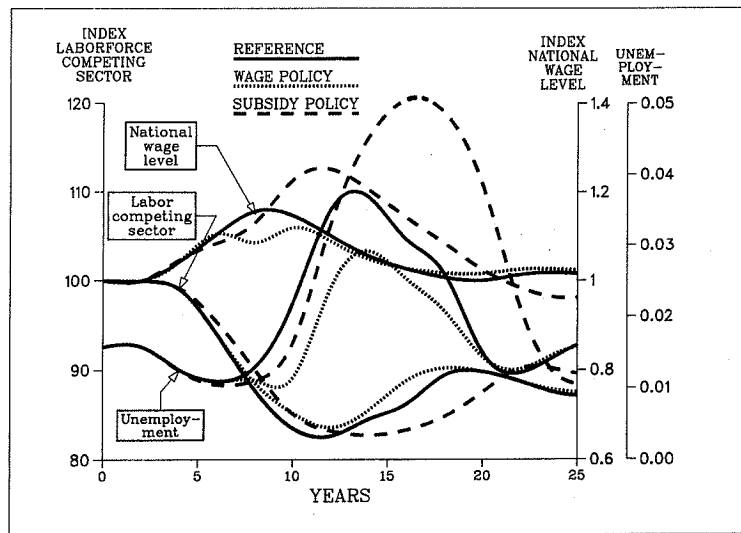


Figure 9: Effects of a subsidy policy and a wage policy.

Figure 9 shows that the policy has a positive short-term effect on the national wage level. After three years the effect has dwindled. The effect dwindles because the exchange rate increases due to a resulting surplus on the current account. It also dwindles because the protected sector increases its wages more rapidly after year seven than in the reference case. This is because of increased competition for labor, see the curve for unemployment in Figure 9.

The protected sector should be expected to be opposed to the wage policy because it impedes hiring. Increased ordering (advertisements and personal contacts) makes up for some of the loss in attractiveness because of smaller differentials in wages, however. Therefore, even a lasting wage freeze, could not hinder the structural change in labor.

The wage reduction has a positive effect on unemployment. If the wage policy had been implemented three years later the effect would have been even greater. At this point in time it seems correct to name the high wage level an "independent cause" of unemployment. The high wage level has precipitated the necessary structural change, and it is no longer needed. It is only "friction" that prevents it from falling more rapidly. This "friction" is a benefit to wage earners, however, who avoid drastic reductions in income.

Increase Labor Mobility. This policy is designed to reduce the growth in the national wage level as oil income is

spent. The policy anticipates friction in the labor market to cause wage increases. Because involuntary labor migration is a problem in itself, the policy should make use of positive means to increase mobility. Therefore, the policy might be costly. It is implemented in the model as a tripling of the additional labor quits in the competing sector that follow a reduction in unemployment or a reduction in competing sector wages.

Figure 10 shows that the policy has a positive but modest effect. Labor migration increases, and the wage level is reduced. The reduction in the wage level makes the competing sector more competitive which counteracts the wage reduction. Reduced wages have a positive effect on unemployment.

A Slow Increase in Oil Income Spending. A reduction in oil income spending could be motivated by immediate economic problems in the competing sector or by the high national wage level. Later on, an increase in oil income spending could be motivated by high unemployment. These two policies together can be represented by a slower increase in oil income spending than in the reference case. The policy works from the beginning of the expansion period and therefore it must be based on a long-term view. The effects of the policy are shown in Figure 10, where the expansion of oil income spending is assumed to take 12 years instead of the 6 years in the reference case. Maximum spending is the same.

Maximum outmigration of labor from competing sector is reduced to about 60 percent of the outmigration in the reference

case. The national wage level peaks at about 55 percent of the peak in the reference case. Unemployment above the frictional level peaks at 40 percent of the reference case number. All the problems are significantly reduced, and the need for additional policies is reduced. The problems of the Dutch Disease lasts longer, however.

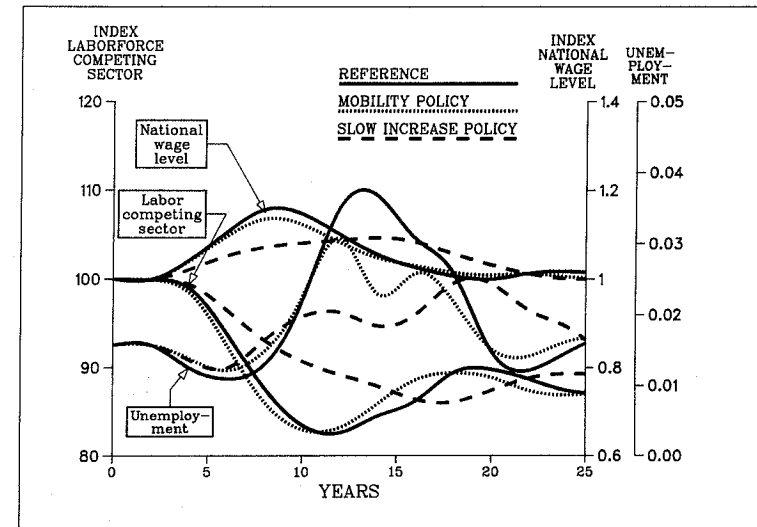


Figure 10: Effects of a labor mobility policy and a slow increase in oil income spending.

6. CONCLUSION

It seems as if a certain amount of Dutch Disease problems are inevitable as oil income spending is expanded. Some policies reduce the problems, other policies exacerbate the problems. When the rate of growth in expansion of oil income spending is determined, Dutch Disease problems must be balanced against the benefits of oil income spending.

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APPENDIX

NOTE RUN INSTRUCTIONS FOR DUTCH DISEASE ARTICLE
 NOTE EXOGENOUS OIL INCOME SPENDING
 T TXIEO=0/7.3/7.3/7.3/7.3
 NOTE MODEL CHANGES
 C SWEM=0
 C WEOIE=0
 C CFCEM=0
 C WSCA=3
 T TMPEE=1/1/1/1/1/1/1/1
 C NFQRN=.05
 C EFCFQ=.6
 C IWP=.027
 T TMPEP=.3/.5/.75/.86/.93/1/1.02/1.04/1.08/1.12/1.16
 T TFCSEO=-.15/-.12/-.08/-.4/0/.02/.05
 NOTE REFERENCE RUN
 PRINT EXP,IMPS,PRODZ,PRODPT,IEO,RWZP,RWE,ER
 PRINT OIRSP,OIRSZ,INDLZ,INDLP,INDCZ,INDCP
 PRINT RU,INDTI,INDGSC,PROD,SP
 RUN
 NOTE WAGE POLICY
 T TGIFCW=0/0/0/0/0/-1/0/0/0/0/0
 PRINT RWE,RU,INDLZ,ER,SUB
 RUN
 T TGIFCW=0/0/0/0/0/0/0/0/0/0/0
 NOTE SUBSIDY POLICY
 T TAPEM=0/.03/.06/.09/.12/.15/.18
 C CSUB=1
 RUN
 T TAPEM=0/0/0/0/0/0/0
 NOTE MOBILITY POLICY
 C MPIQZ=3
 RUN
 C MPIQZ=1
 NOTE SLOW INCREASE IN OIL INCOME SPENDING
 T TXIEO=0/3.65/7.3/7.3/7.3
 RUN