Economic and Econometric Analysis of the Dutch Disease

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1. Introduction

The purpose of this paper is to analyze the Dutch Disease in terms of economics and econometrics. The Dutch Disease discussed in this paper is what happened in the Netherlands from 1970s to 1980s as a result of the natural gas discovery in the North Sea and its production. There has been the biggest and long-lasted boom of primary commodities in 1970s, which accelerated the Dutch natural gas industry to produce and export it. This natural gas discovery sounds positive for the Dutch economy but it has been said, in line with economics, that the other sectors and the country's economy itself were seriously damaged due to the fact that the natural gas export had dramatically increased and the exchange rate became extremely high.

This paper is written to implement econometric estimation of the Dutch Disease happened in the Netherlands while most of the related papers, as I refer to, explain the Dutch Disease by using economic models and theories. Therefore, more specific result will be showed in this paper even though this paper is based on these economic models and theories. Also, many economical studies about the Dutch Disease has been done in 1980s where the present currency, euro, did not exist yet. In this meaning, this paper suggests a new point of view by taking into account what happened after euro was introduced.

The detail of the Dutch Disease is explained in chapter 2. What has been said about the Dutch disease in line with economics will be mentioned in chapter 3 referring to economic theories and the models established by Corden and Neary. The econometric model to be analyzed is discussed in the chapter 4. Chapter 5 explains specific details about Econometric estimation using EViews and the result is explained in the chapter 6. As a conclusion, what to be seen from the comparison between econometric analysis and economic models and theories is mentioned in the chapter 7. The chapter 8 and 9 are showing the references written in English and Japanese, separately.

2. What is the Dutch Disease?

The economic term "Dutch Disease" was first stated in the magazine **The Economist** published in November, 26, 1977. Nagasaka, the professor at Takushoku University mentioned the Dutch Disease in his paper. The paper was written for a seminar held on June in 2001 organized by the Policy Research Institute in the Ministry of Finance Japan.

The Dutch Disease is the economic term, used in the correlation between natural resources and economic growth, that explains negative economic influence to a certain sector or economy itself due to the failure in economic policy after having acquired the windfall profit from increased price of natural resource. This term has been used for other similar cases in all over the world since the economic crisis in the Netherlands in 1970s and 1980s. (Translatoin: author)

In the case of the Netherlands, the natural gas was discovered in 1960s at the deep inside of the North Sea and they begun to extract it dramatically after the development in its extracting technology in 1970s. There was indeed the primary commodities boom after the World War II and the boom was overlapped with the success in the Dutch natural gas sector. This booming sector, the natural gas industry in case of the Netherlands, gained a big amount of profit out of its excess export and the Government also profited from increased amount of the tax revenue from the booming sector. Vast foreign currency revenue from the natural gas export was repeatedly spent for the investment of the development of the natural gas production and thus the exchange rate had soared. Other sectors were, hence, put in a difficult position in the international market by becoming uncompetitive because of the high exchange rate arose from the increase in export of natural gas. Having lost competitiveness meant decline in their output, investment and income but, at the same time, these sectors were forced to raise the wage to keep sufficient amount of labor force while the booming sector increased its output and thus wage. The natural gas discovery turned out that it pushed other sector in an economically difficult situation. Moreover, what the government did by using the vast but temporal revenue from booming natural gas sector was enriching in social welfare services, which left the big burden of tax payment, after the boom in primary sector has gone. The Dutch economy, after all, faced a serious depression due to this inappropriate fiscal policy that resulted in the economic crisis containing the increase of unemployment and the decline of export and competitiveness in the international market especially in manufacturing industry.

The economic term, Dutch Disease, is nowadays used not only for the case in the Netherlands but also for other countries with same/similar issues. In fact, there are multiple examples, mentioned by Corden (1984) that can be considered as Dutch Disease such as gold and other wealth brought from the Americas into Spain in 16th century, gold rush in Cairns, Australia in 18th century and also current oil production in Russia (Latsis, 2005). The discovery of oil in the North Sea by UK and Norway in 1970s to 1990s can be also considered as Dutch Disease.

3. Macroeconomic Theories and Economic Studies about the Dutch Disease in the Netherlands

3-1. Basic macroeconomic theorem

Some of the basic macroeconomic theories and theorems are found in chapter 17, GDP in an open economy with government, in Economics written by Lipsy and Christal. First of all, how the Dutch Disease can be explained in line with macroeconomics requires careful consideration of government spending and net export. Supposed that a country has received windfall profit all of the sudden, that means there is a high possibility for its government to change the way of spending the tax they obtained from the sector that made windfall profit. The government will change their fiscal policy, defined in the book: the ability of the government to use its taxing and spending powers to affect the level of GDP. Also, at the same time, the people who obtained the profit directly/indirectly will change their consumption behavior. To make a difference from theories of closed economy, note, in an open economy, that government spending (or fiscal policy) and the foreign trade sectors are

the key factors for its whole economy to affect on government, individuals and firms in such a way that they will change how/what to consume. In addition, net foreign demand for domestic output is also an important source of final spending.

Firstly, two ways of desired spending by the government play crucial roles to see how the government will change fiscal policy. As generally known, the government receives taxes from individual households and firms and they are supposed to spend these tax revenues for the sake of increasing the living standard of the domestic residents. This happens somehow within the expectations since government controls to what extent they earn from the people. Chrystal calls this sort of expected spending induced spending, which is dependent upon national income thus GDP. However, there may be a government spending occurred by some external shock. This is what is referred as 'autonomous (exogenous) spending' in the book and is treated as constant and determined from outside of the model. These two desired government spending make 'aggregate desired spending' so that these two spending in the home economy equals to the output drawing a 45° line. Additionally, it is necessary to distinguish between government consumption spending on goods and services and government transfer payments for they bring about different effects on economy. The former, the desired government purchases, directly adds to the demand for the current economy's output of goods and services so this is categorized into a part of aggregate desired government spending. The latter, however, is not classified as such since government transfer, mainly known as pensions or unemployment benefit, influences aggregate spending only indirectly, which is namely through increase in disposable income via consumption function. On the contrary, tax payments diminish disposable income relative to national income. Therefore, net tax means total tax revenue minus total transfer payments.

Secondly, net exports (exports minus imports or X - IM) should also be considered when it comes to a measurement of GDP based on spending. The net export function is used to see how the balance of trade responds to change in GDP, the price level and the exchange rate according to Chrystal. The net export function is a negative relation between net exports and GDP. In other word, desired net exports are negatively related to GDP because of the positive relationship between desired imports and GDP. Exports are always achieved through purchase of the domestic products and the purchase is implemented due to the spending decision made by foreign consumers or overseas firms. Hence, exports affect exogenously on the desired net export function. Imports always depend on the spending decision by domestic residents as opposed to exports. Therefore, imports form induced factors of the net export function. People or firms import more when they have more income but imports are not directly changed by government spending, investment spending nor exports. Because of the negative relation, the net export function draws a downwards sloping.

What are the factors that affect on import and export thus the net export function? Two factors are found in macroeconomics: foreign GDP and relative international prices. Other things being equal, foreign GDP can have a positive effect on the output of domestic products due to the increased demand by foreign individuals and firms when foreign GDP goes up. However, NX line always shifts parallel to its original position as long as foreign residents import and export goods and services with the same proportion. Relative international prices are the other factor that plays an important role to change the net export function and inflation rates, and exchange

rates are the circumstances that cause the change in relative international prices. To focus firstly on how these circumstances affect the net export function, assume that the prices of domestically produced goods have risen compared to the prices in a foreign country. To avoid complication, the domestic country is called 'A' and the foreign country is called 'B' here. What happens is that the domestic (A's) residents will buy more foreign (B's) goods and buy less domestic goods thus relatively the domestic firms import more and export less. On the other hand, foreign (B's) consumers will buy less domestic (A's) goods and more foreign (B's own) goods thus foreign (B's) consumers will reduce importing goods from the domestic country (A). These reactions shift the net export function downwards and change its slope. In the same way, the net export function will go upwards when the prices of the domestically produced goods fall. Consider now the two circumstances: inflation rate and exchange rate. Positive inflation rate brings about positive change of price. Then, to take exchange rates into account, depreciation of domestic currency makes imports more expensive, and the exports from this country become cheaper for the foreign consumers. Therefore, the net export function shifts upwards and vice versa in case of appreciation of the domestic currency.

3-2. Corden and Neary

One of the well-known economic models about the Dutch Disease was developed by W. M. Corden and J. P. Neary in 1980s and the core model they used was called Spending Effect and Resource Movement Effect. This model can be found in two papers; Booming Sector and De-industrialization (Corden and Neary in 1982) and Booming Sector and Dutch Disease Economics (Corden in 1984). The Dutch Disease, in these papers, means the adverse effects on Dutch manufacturing of the natural gas discoveries of nineteen sixties, essentially through the subsequent appreciation of the Dutch real exchange rate. Note that Corden (1984) also footnoted that it might be arguable that what was wrong in the Netherlands is rather inappropriate usage of booming sector revenue for enriching social service levels, which was disable to sustain but politically difficult to reduce. However, in this paper, I will not mention the latter and only the former consequence of the Dutch Disease is discussed since social service cannot be accurately estimated by the econometrical manner.

To explain spending effect and resource movement effect by basically referring to Corden (1984), first of all, assume the three sectors, the Booming Sector (B), the Lagging Sector (L) and the Non-Tradeable Sector (N). B and L produce tradable goods and face given world prices. All output is produced specifically by the factors that belong to each sector and labor is domestically mobile between all sectors. Three assumptions can be thought of as the reasons why the boom has occurred; (1) a once-for all exogenous technical improvement in B, represented by a favorable shift in the production function, happened limitedly within the country concerned, (2) there has been a windfall discovery of the new resources, which increased in supply of the specific factor and (3) B produces only for export, with no sales at home and there has been an exogenous rise in the price of its product on the world market relative to the price of imports. Assumption (1) is mainly considered in the paper.

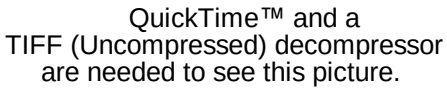


Figure 1: Corden, 1984

The spending effect occurs when some part of extra income acquired in B is spent either directly by the employer or indirectly by the government through getting extra tax revenue collected from B. If the income elasticity of demand for N is positive, the price of N becomes higher compare to tradeables. As is seen in the figure 1, the two dimensions are composed by price of N and that of tradeables, the transformation between N and tradeables takes place as supply shifts. As long as expenditure equals to income, the demand curve in the figure shows the relative demand for N to tradeables. Thus, when the relative demand for N increases, the demand curve shifts to upper-right and the price of N rises. This increase in price N caused by the increase in the demand of N derived from the occurrence of the resource boom is spending effect.

Resource movement effect is the reaction derived from the boom in natural resource sectors that requires more labor so that there has been a labor shift especially from L but also from N. As Corden explains, resource movement effect contains two parts.

(1) The movement of labor out of L into B lowers output in L, which is what he calls direct de-industrialization. It is because this labor shift occurs with no effect on the real exchange rate thus with no effect on Non-tradeables' market and their labor demand.
(2) There is also a movement of labor out of N into B at a constant real exchange rate. As mentioned above, resource movement effect means an increase in natural resource production therefore, the supply curve shifts to upper left, S_0 to S_1 in Figure 1. Then, the demand for N has risen because people will consume more non-tradeables when the output and thus revenue of B increases. The combination of these two effects brings about labor shift from L to N. The demand and output of L drops after the natural resource boom

(direct de-industrialization) while N gains more demand due to the boom. This is called indirect de-industrialization. In other word, spending effect tends to make output of N higher than initial situation and resource movement effect tends to make it lower.

3-3. New currency's launch

To explain briefly about the euro launch in some EU member states, the idea of sharing the same currency was established by the Maastricht Treaty in 1992. Euro firstly started being used for transactions between banks in 1999 and the 12 member states have started using euro coins and notes on January 1st, in 2002. There are strict criteria that have to be complied by members of the monetary union in order to make the currency stable. For example, budget deficit had to be less than 3% of their GDP, the debt ratio had to be less than 6% of their GDP, the interest rate hat to be kept low and also the exchange rate had to be as close as the EU average. Achieving these conditions were resulted from ERM (European Exchange Rate Mechanism) that had been already introduced since 1979 by the European Community, and the member countries were required to comply them before becoming a part of single currency group. The Dutch economy was in a recession, in 1980s, and they were supposed to improve the present economic situation to apply to the ERM just after all the effort and expense for the booming sector had been put.

4. Econometric model

All estimation results are explained with details in the chapter 6 so in this chapter, the focus is on the econometric models that are applied to the estimations. This paper aims at examining whether or not and how economic factors of the Dutch Disease are correlated in terms of econometrics using the existing statistic data in the Netherlands. To relate economic theories to the econometric model, macro date such as GDP, net export of natural gas, inflation rate and exchange rate are required. Note that many of studies about the Dutch Disease in the Netherlands were done before the euro launch therefore, these studies automatically neglect the effect of the currency change. Several years after the economic crises, euro has been introduced and the introduction has completed in 2002. In this paper, whether/ how the euro introduction has affected the Dutch economy is examined by making a time series estimation which takes the natural gas boom, the economic crisis and the euro launch into account.

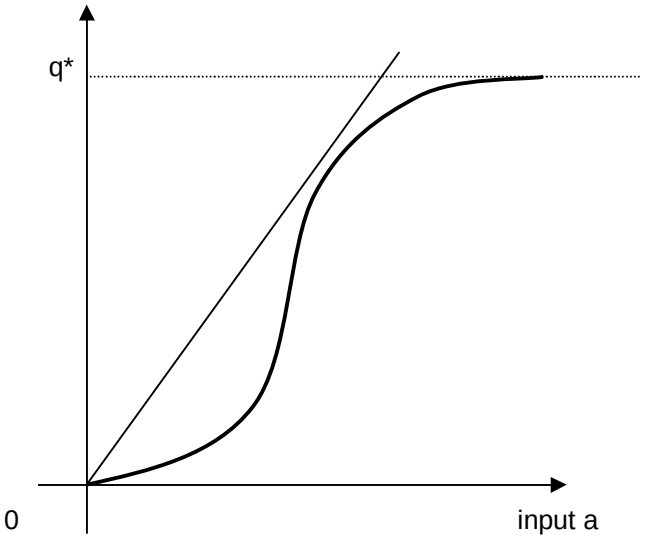
Applying to economic theories and models mentioned in the previous chapter, the econometric model and its expected consequence are as follows:

$$GDP^* = XGAS + INFL + EX$$
$$(+) \quad (-) \quad (+) \quad (-)$$

XGAS: natural gas export
INFL: inflation rate
EX: exchange rate

GDP*
Assumed production function is determined only by quantity of resource input of A. Under this assumption, the production function can be written as in this form:

$$q = q\,(a)$$



Labor is actually used as a single variable that determines output (natural gas export, in this paper).

I will show five diversities of estimations below because now we need a special attention to euro introduction in the Netherlands since all money-related statistic data have been changed in their values after 1999. Five estimations indeed show different results when changing the combinations of explanatory variables. To examine the effect of currency change, dummy variable is added. The dummy variable is made by first, making time trend and then, distinguishing the sample after 1999 in the time trend from the rest. The first estimation is done without dummy variable and the second is with the dummy, which is the only difference between Estimation 1 and Estimation 2 otherwise, the variables are all the same. Estimation 3 adds the number of labor force and the dummy variable and 4 with labor but not together with the dummy variable. The explanatory variable in equation 5 is just composed by labor force to see the simple production function.

5. The estimations using EViews

This chapter is for giving technical information of the estimations. The EViews version 6 and 5.1 are used as the only tools for the entire process of making econometric analyses in this paper. The analyses are based on the time series estimations with annual 40 samples (41 only in the case of estimation 5) in each variable at any estimation. The period is from 1965 to 2004 (estimation 5 is between 1965 and 2005) for the reason of availability of the data yet the data cover all of concerned events; the natural gas boom, the economic crisis and the euro introduction. The method for estimation is the Ordinary Least Squares. The symbolic names of

each variable used in the estimations are as follows: GDP (dependent variable), XQGAS, PGAS, EXCH, INFL, DUMMY and LABOR (explanatory variables). GDP stands for the gross domestic product and the data is the net GDP, excluding consumption of fixed capital, with nominal value. Inflation rate is considered into the explanatory variable so the nominal GDP is used here to keep the explained variable independent. XQGAS stands for quantity in exported natural gas whose unit is million m^3. PGAS stands for average price of natural gas. The unit of the data between 1990 and 2004 was expressed by euro per gigajoule and that of the data between 1965 and 1989 was expressed by eurocent per m^3. According to the website, SaskEnergy, to convert ¢ per m^3 (¢/m^3) to $ per Gigajoule ($/GJ) is to divide by 0.03743* and move the decimal point two digits to the left. However, the overlapped period in both ways of calculations in statistics did not match by being divided by 0.03743 but instead, they do almost match by being divided by 0.61 so I use this rate to make a series of price change. EXCH stands for the exchange rate that is the amount of guilder or euro per 1 U. S. dollar. Since this is converted value of guilder or euro by 1 USD, the value should become higher when the Dutch currency gets weakened so that the Dutch economy has more advantage to exports. INFL stands for inflation rate. Remind that, in euro zone, there is a problem with the currency unification when it comes to econometric estimations that use existing data because the primary exchange rate between guilder and euro was determined and fixed on purpose on 31 of December in 1998. In order not to ignore this fact and also to examine whether there is an influence of euro launce on the other variables, the dummy variable is taken into account, which is indicated as DUMMY. As is already mentioned in chapter 4, the dummy variable has been set to make a difference between the data till 1998 and later. LABOR stands for the population who is between the age 20 and 65 and the unit is 1000. Available datum of employed labor force did not cover the period sufficiently for the estimations in this paper so that the number of labor force are substituted by the productive-age population whose values are slightly larger than that of employed labors.

6. The result

Estimation 1: estimation without dummy variable

Dependent Variable: GDP
Method: Least Squares
Sample (adjusted): 1965 2004
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	289941.2	42449.39	6.830279	0.0000
XQGAS	-1.089337	0.507576	-2.146158	0.0389
PGAS	7211.665	1080.726	6.672982	0.0000
EXCH	-86229.23	10227.82	-8.430849	0.0000
INFL	2019.672	2859.494	0.706304	0.4847

R-squared	0.932845
Adjusted R-squared	0.925170

This estimation result shows the strong correlations except inflation. The t-Statistic of inflation is deficient so that its coefficient should be neglected. The negative

correlation between export of natural gas and GDP can be considered as an explanation of the Dutch Disease and the positive price change affects directly on the increase in output in regards to macroeconomics. Also the coefficient of exchange rate is significantly negative, which means when the exchange rate goes down, GDP will grow. This result explains the expectation for the Dutch economy tends to have positive amount of exports (see the graph in appendix). However, notice that the result has changed when adding the dummy variable (see Estimation 2).

Estimation 2: Estimation with dummy variable
Dependent Variable: GDP
Method: Least Squares
Sample (adjusted): 1965 2004
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	245841.5	42199.30	5.825726	0.0000
XQGAS	-0.211397	0.566145	-0.373398	0.7112
PGAS	5571.368	1159.977	4.802998	0.0000
EXCH	-64629.93	12275.41	-5.264993	0.0000
INFL	-2325.394	3070.131	-0.757425	0.4540
DUMMY	58338.53	21337.34	2.734105	0.0099

R-squared	0.944948
Adjusted R-squared	0.936853

The dummy variable is significant in this result and the exchange rate is again, significantly and negatively correlated to GDP but we still cannot see the significance of inflation rate. What to be taken into account in this estimation is that the negative coefficient of natural gas export turned insignificant when the dummy variable is added.

Estimation 3: Estimation with dummy variable and labor force
Dependent Variable: GDP
Method: Least Squares
Sample (adjusted): 1965 2004
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-495210.0	92280.07	-5.366381	0.0000
XQGAS	0.016346	0.327521	0.049909	0.9605
PGAS	488.0284	905.5545	0.538928	0.5936
EXCH	2197.956	10701.32	0.205391	0.8385
INFL	1024.202	1815.056	0.564281	0.5764
DUMMY	101898.6	13367.39	7.622926	0.0000
LABOR	76.07165	9.137783	8.324957	0.0000

R-squared	0.982242
Adjusted R-squared	0.979014

When putting all variables together, the result did not show sufficient significance. Now the question is, does the combination of dummy and labor mean anything? Or what about other combinations? Remind that dummy variable is added to avoid euro introduction from mixing it with guilder.

Estimation 4: Estimation with labor
Dependent Variable: GDP
Method: Least Squares
Sample (adjusted): 1965 2004
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-164372.1	133310.4	-1.233002	0.2260
XQGAS	-1.363799	0.446777	-3.052531	0.0044
PGAS	4736.111	1168.425	4.053414	0.0003
EXCH	-53701.34	12758.37	-4.209108	0.0002
INFL	6250.184	2751.103	2.271883	0.0295
LABOR	48.80557	13.76470	3.545704	0.0012

R-squared	0.950973
Adjusted R-squared	0.943763

The significance of the estimation has been improved after adding labor as an explanatory variable, which will explain the positive correlation between labor force and GDP as microeconomics stresses. All t-Statistics except that of constant term become significant and all variables seem to affect on GDP as they are expected yet the effect of euro has been ignored in this estimation.

Estimation 5: Estimation with labor only
Dependent Variable: GDP
Method: Least Squares
Sample: 1965 2005
Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-630585.8	44823.51	-14.06819	0.0000
LABOR	96.31095	5.223182	18.43913	0.0000

R-squared	0.897098
Adjusted R-squared	0.894460

This estimation simply but precisely explains the supply function in microeconomics. Showing this significant correlation between labor input and production output implies adequacy of the GDP used in the estimations.

7. Conclusion

The Dutch Disease features negative consequence caused by some variables, which is opposed to the general/non-economic impression of wealth brought by natural

resource discovery. Nevertheless, unignorable numbers of studies about the Dutch Disease represented such as the core model by Corden and Neary have been somehow appreciated in terms of economics. Wijnbergen, however, concludes that it cannot be definitively declared that decline in output of non-booming sectors is derived from increased revenue of a natural resource production and thus increase in real exchange rate. The estimated result in this paper also illustrates negative correlation between GDP and natural gas export when the euro is not distinguished.

Each estimation result differs the conclusion. As is shown in Estimation 4, theoretical expectation could be proven by econometric estimations using statistic figures. However, taking euro introduction into consideration may bring about another result, which also implies that some other ways of econometric estimation will show the different results. In other words, how to build up the economic models will affect how the estimation goes. The Dutch disease seems to have negatively affected on the Dutch economy under a certain condition like in this paper, but it is not deniable to say that applied econometric analysis with different economic models can give rise to a different interpretation of the Dutch Disease.

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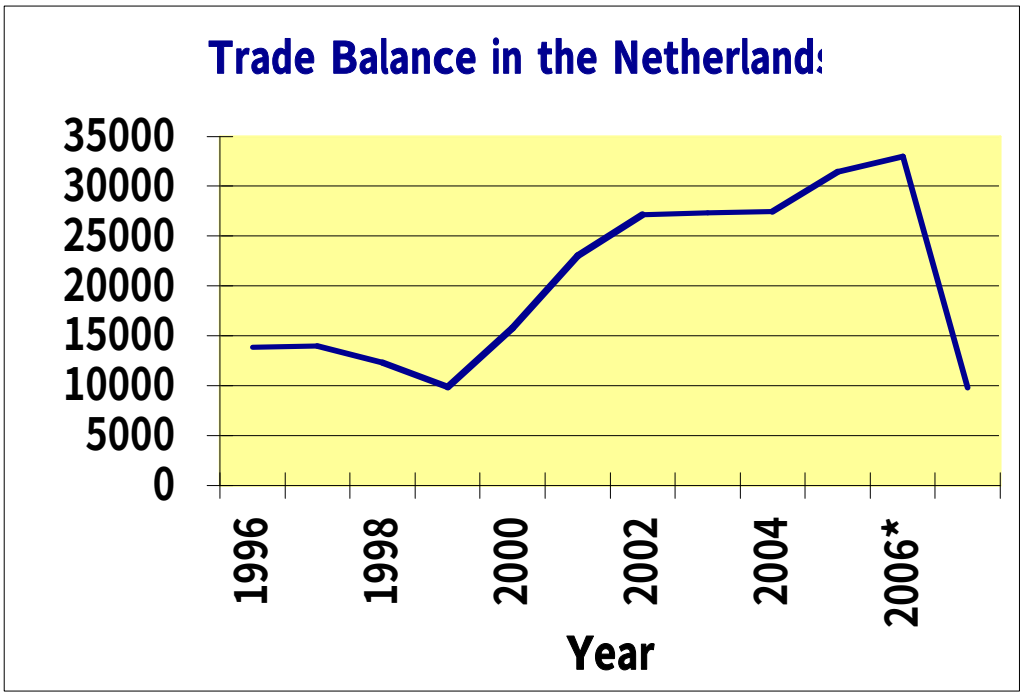
10. Appendix



Data: Statline, the CBS statistic database