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# An Empirical Analysis of Dutch Disease: Developing and Developed Countries

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# An Empirical Analysis of Dutch Disease:*

## Developing and Developed Countries

by David Rudd
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## ABSTRACT

Dutch Disease occurs when a country discovers a substantial natural resource deposit and begins a large-scale exportation of it. As a result, the country's currency appreciates, thereby reducing the competitiveness of the country's traditional export sector. Therefore, this tradable goods sector should contract, leading to structural changes and unemployment in the economy. Neary and Van Wijnbergen (1986) develop the theoretical underpinnings by identifying the two components of Dutch Disease: the spending effect and the resource-movement effect. Using these theoretical components, the paper attempts to account for the decline in the Netherlands' manufacturing sector and Nigeria's and Indonesia's agriculture sectors. The paper uses ordinary least squares (OLS) analysis and time-series data from 1960-1990. It is shown that Dutch Disease contributed to the contraction of the countries' traditional export industries. However, the results also indicate the importance of several non-Dutch Disease factors. Finally, the paper discusses several policy implications.

## I. INTRODUCTION

How can a natural resource boom adversely affect a nation's economy? Recently, a body of literature called *booming sector economics*[1] has attempted to answer that question. From this work, researchers have dubbed the deleterious effects resulting from a resource boom as the Dutch Disease, referring to the Netherlands' economic problems after having discovered large natural gas deposits in 1959. Specifically, Holland witnessed a marked contraction in its manufacturing sector and a resultant increase in its unemployment rate.

In the late 1950s, the Netherlands discovered the huge Slochteren gas fields in the Groningen province. As a result, the country initiated a rapid exploitation of the natural resource, quickly becoming a net exporter of natural gas and experiencing a huge increase in revenues. Consequently, national wealth and overall general welfare increased. However, amid the beneficial results of the natural gas-based export boom, Holland witnessed several negative effects as well. First, the country's manufacturing sector declined throughout the 1960s and into the 1970s. Second, manufacturing employment declined steadily during the same time. For example, in 1964 the Netherlands had 1,823,000 workers in industry but by 1986 the number had fallen to 1,381,000--a 25%

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*Note: all italicized words are fully defined at the end of the paper under the **Definitions** section.

reduction in industry jobs (Labor Force Statistics). Table 1 (below) shows these perverse effects. As The Economist stated in 1977, in the first printed usage of the term Dutch Disease, the Netherlands experienced "external health and internal ailment" (82).

**Table 1**

**Manufacturing in the Netherlands: Average Annual Percentage Change**

| 1963/73 | 1974/78 | 1979/83 |
|---|---|---|
| 6.5 | 0.9 | 0.3 |

**Manufacturing Employment in the Netherlands: Average Annual Percentage Change**

| 1963/73 | 1974/78 | 1979/83 |
|---|---|---|
| -0.5 | -2.7 | -2.8 |

Source: Kremers 1986, p. 107

This paper answers the question of how a natural resource boom adversely affects a nation's economy by developing a theoretical framework of the intricate Dutch Disease mechanisms and how they function. The paper uses the Netherlands as the running example throughout the study, offering the reader insight into a classic case of Dutch Disease. In addition, the paper utilizes an econometric model that accounts for the several effects of the Dutch Disease phenomena. Also, a series of control variables are employed so as to separate the effects of Dutch Disease from several unrelated macroeconomic events occurring concurrently in the economy. Then, data from two other oil-exporting countries, Nigeria and Indonesia, are employed to demonstrate the

applicability of the model for less developed countries (LDCs). Finally, the paper outlines a series of policy implications which any country relying primarily on one resource for export earnings should consider.

## II. THEORETICAL FRAMEWORK

Dutch Disease refers to the adverse effects of a natural resource boom on the manufacturing or agriculture sector. Massive increases in revenue from the booming sector result in a temporary appreciation of the real exchange rate. The immediate impact of this is to reduce worldwide demand for other exports of this country. In addition, assuming that the country does not devalue the nominal exchange rate to maintain the old level, the booming energy sector causes domestic inflation greater than the world inflation rate; consequently, profits for exporters will decline as wages and other input prices rise more quickly than the world price of exports. Since their profits fall, producers of exports will produce less and incomes and employment will decrease (Ezeala-Harrison 1993, p. 199).

Said in another way, the boom and subsequent surge in resource exports cause an appreciation of the real exchange rate (through the appreciation of the nominal exchange rate and/or a rise in the domestic price level) which decreases the competitiveness of the country's other, non-resource tradable goods. This tradable goods sector experiences a decrease in production since fewer international buyers are purchasing these goods due to

their higher relative prices. In addition, since the boom causes the domestic price level to increase, producers of tradable goods face higher production costs, which causes them to reduce their output. Consequently, the tradable goods sector contracts, and deindustrialization or de-agriculturalization sets in.

It is relevant to establish here the fact that Dutch Disease begins in one of two ways.

**1)** The discovery of a large, easy-to-exploit source of oil can induce a rapid exploitation of the resource, triggering the onset of Dutch Disease. This is typical of many developing oil-exporting economies such as Nigeria and Indonesia. The mere discovery and the ensuing massive exportation of the oil cause the appreciation of the currency which leads to a contraction of the country's traditional export sector.

**2)** A sudden increase in the price of oil, such as what occurred in 1973 when OPEC nations restricted the supply of oil and caused prices to increase from $2.59 per barrel to $11.65 per barrel in less than 12 months (Eckley 1996), can induce countries to exploit their existing oil reserves. This is what happened with the European oil-exporting economies, such as Norway, England, and the Netherlands, who now found it profitable to exploit their North Sea oil and natural gas reserves. Before 1973, it was relatively unprofitable for these nations to pump oil, but the large price increase induced them to begin a massive exportation of these resources, consequently, leading to the onset of Dutch Disease symptoms.

The following paragraphs of this section offer theoretical explanations, set forth by

prominent experts in this field, for the above results of a resource boom.

Corden and Neary (1982) study the deindustrialization[1] aspect of Dutch Disease. They assume a small open economy composed of three sectors:

1) a traded goods sector whose output is not consumed within the country (the energy sector);

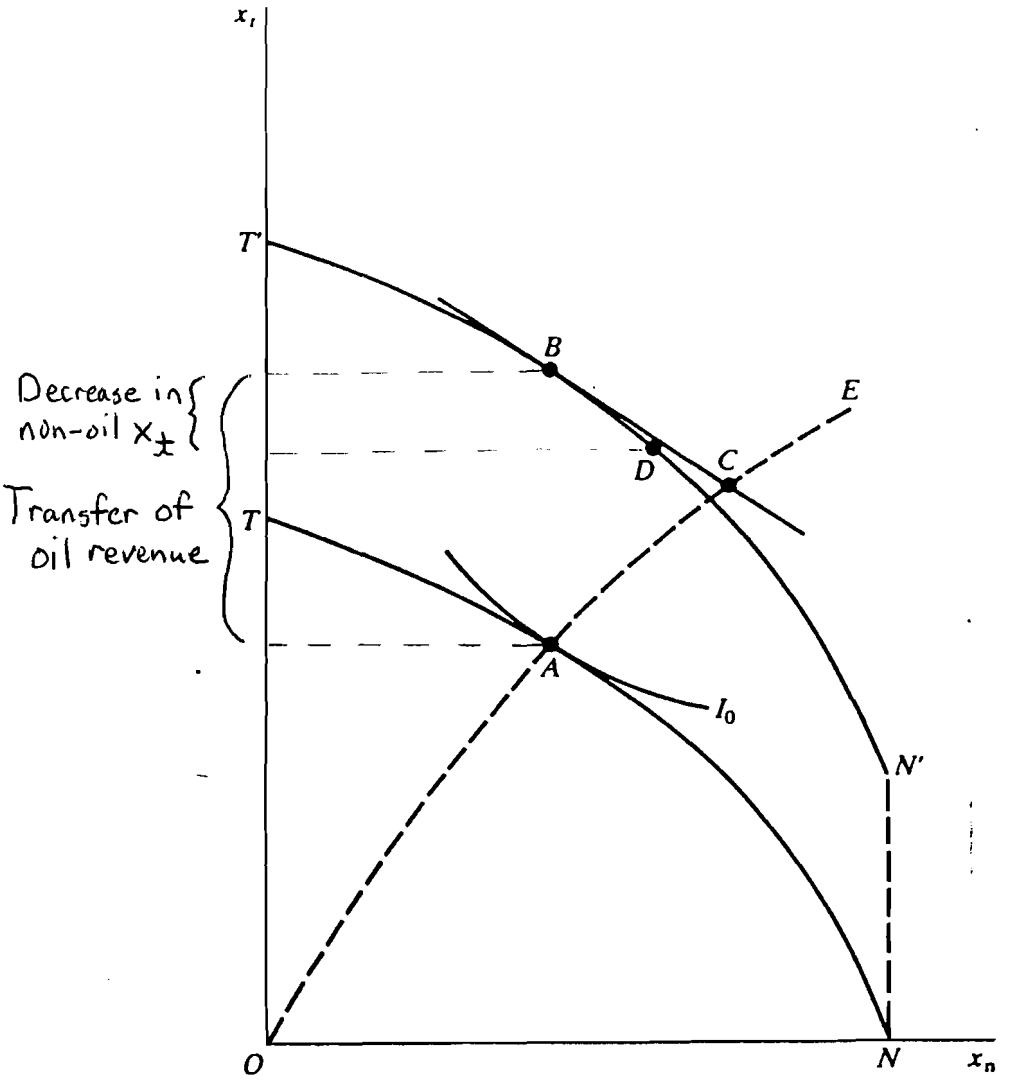
2) an import-competing sector (manufacturing sector); and

3) a non-traded goods sector (services, local products, etc.).

The two researchers explore the question, what are the consequences of a resource boom upon the manufacturing sector? In answering the above question, Corden and Neary treat the increase in revenue brought by the resource boom as a *transfer* of income. The results of their theoretical study are presented graphically on the next page, making use of the framework later developed by Neary and Van Wijnbergen (1986).

In order to present the results graphically, Neary and Van Wijnbergen combine the energy sector and the manufacturing traded goods to form a general traded goods category, $x_t$, on the y-axis. $x_n$ on the x-axis represents the non-traded goods sector.

Before the boom, equilibrium is at point A (see graph on the next page) at the intersection of the highest attainable community indifference curve $I_0$ with TN, the production possibilities frontier (PPF). The slope of the line tangent to point A (not shown on the graph) is the real exchange rate or relative price line. The "transfer" of income caused by the boom produces a parallel upward shift of the PPF; this is represented by the new production possibilities frontier, T'N'. Therefore, assuming


$x_t$
T'
B
E
Decrease in non-oil $x_t$
D
C
Transfer of oil revenue
T
A
$I_0$
N'
O
N
$x_n$

initially that the slope of the relative price line remains unchanged after the boom, we move to point B (where there is no increase in $x_n$, only an increase in $x_t$ by the amount of the transfer of income). With production and domestic real income determined at point B, desired consumption must lie along a price line tangential to point B. Since relative prices are unchanged, it must take place at point C, where the price line intersects the income-consumption curve (OAE).

As a result, there is an excess demand for non-tradables represented by the horizontal difference between points B and C. This drives up the relative price of non-tradables (represented by an increase in the slope of the price line) until we reach the new equilibrium point at D.

Since the price of non-tradables has risen, it has become more profitable to produce these non-tradables, which consequently will lead to an outflow of labor, capital, and other factors of production from the now, relatively less-profitable manufacturing sector. Manufacturers of traded goods now have less incentive to produce these goods since they are relatively less profitable to produce. So, at the new equilibrium point D, domestic welfare has risen (society is on a higher indifference curve), but at the expense of a production reallocation. The output of the non-traded good has risen, whereas that of manufacturing has fallen.

The graphical representation of Dutch Disease is just one way to examine the problem. Other researchers have developed a more narrowly focused route.

Theoretical work on Dutch Disease suggests several mechanisms by which the economic illness ripples its way through the economy. For purposes of organization, the paper groups these mechanisms into two categories: 1) the spending effect and 2) the resource-movement effect. These two mechanisms are the essential components of the Dutch Disease theory.

**A. The Spending Effect**

Neary and Van Wijnbergen (1986) offer an insightful analysis into the components of Dutch Disease. First, there is a *spending effect* caused by higher domestic incomes due to the increased revenues coming from the resource discovery. The higher incomes lead to increased expenditures on both traded and non-traded goods. The price of traded goods is determined in international markets, so the increase in incomes in this small country has no effect on the traded goods price.

However, prices of non-traded goods are established in the domestic market and consequently, would rise due to the increase in demand caused by the rise in income and expenditures. Using supply and demand analysis, the reader can visualize the demand curve for non-traded goods shifting outward to the right, causing the price of those goods to increase. The higher relative prices of non-traded goods increase the relative profitability of the non-traded goods sector and resultantly, contract the traded goods sector (not including the boom sector) (Neary and Van Wijnbergen 1986, p. 2).

Since the increase in energy revenues usually accrues to the country's government,

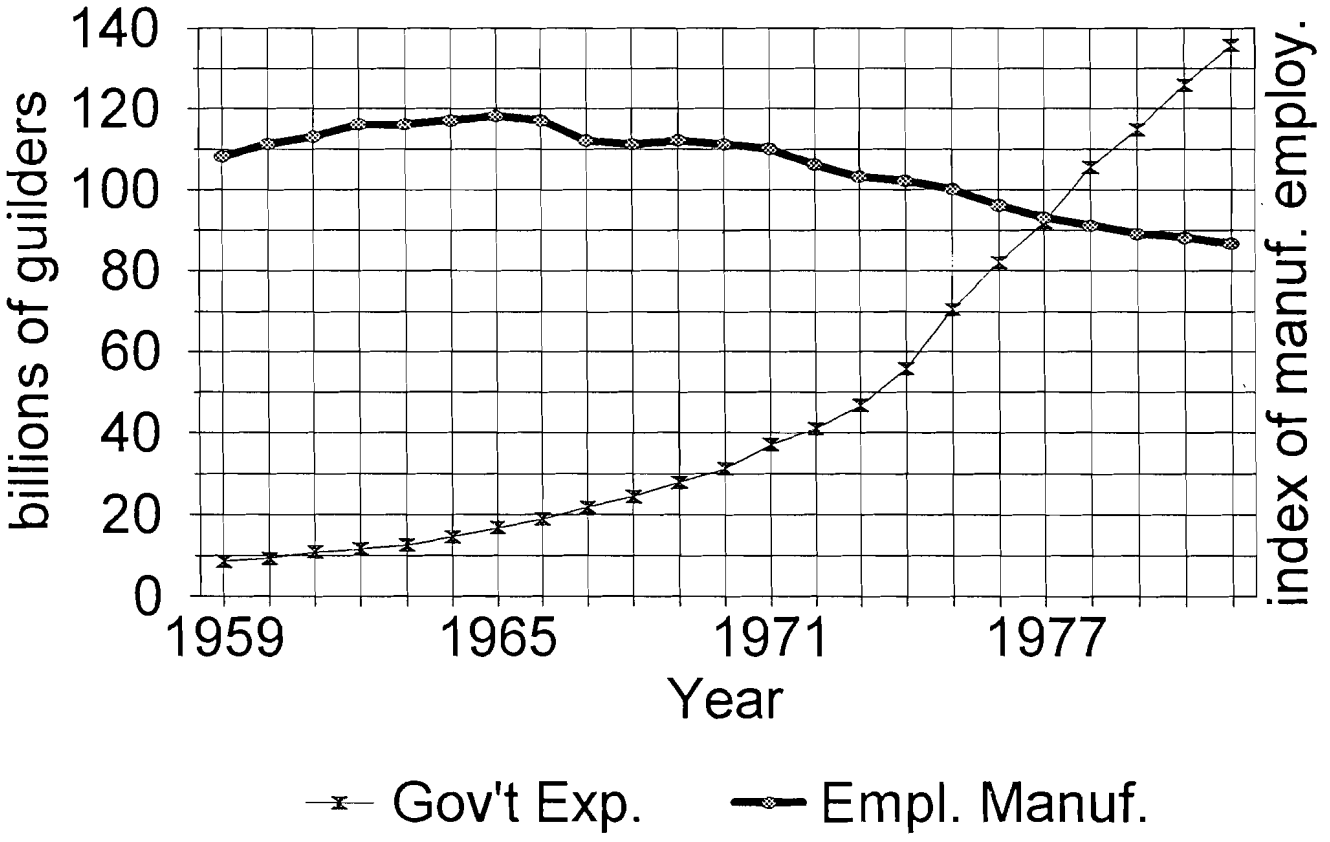
it is often the government that initiates the spending effect. In the Netherlands, a large portion of the revenue accrues to the government either through direct ownership of the natural gas facilities or through a tax on private natural gas companies' earnings. The graph on the following page illustrates that as government expenditures began to increase in 1959, manufacturing employment rose slightly and then decreased dramatically. Currently, manufacturing employment is just 82% of 1975 figures, while nominal government expenditures have risen by over 3500% since 1959 (International Financial Statistics Yearbook 1995). While some of the increase in government expenditures is probably due to natural tendencies of governments to expand, the oil windfall has undoubtedly inflated those figures.

**B. Resource-Movement Effect**

Besides the spending effect, Neary and Van Wijnbergen coin a second term that helps to account for the contraction of the tradable goods sector. The *resource-movement effect* occurs if the booming sector shares domestic factors of production with the other sectors of the economy. If so, then there is a tendency for the price of the factors to be bid up which would further squeeze the traded goods sector. "The boom increases the marginal product of factors initially employed in the booming sector, and so draws (mobile) resources out of other sectors" (Fardmanesh 1991, p. 712). Consequently, there is a decline in the traded goods sector whose producers would be unable to pay the higher prices for factors of production. These producers are unable to compete for the inputs,

# Gov't Expend. & Manuf. Employ.

## in the Netherlands: 1959-1981



thereby preventing the manufacturers from purchasing all of the supplies needed to maintain production levels. As a result, these producers decrease their output, contracting the traded goods sector (Nyatepe-Coo 1994, p. 329).

However, if the booming sector does not participate in the competition for factors of production, then according to Fardmanesh (1991) the resource-movement effect is nonexistent. For many oil-exporting countries this may be the case. In Norway, for example, a large exporter of North Sea oil, the energy sector employs only 9300 workers (Hutchison 1994, p. 315). This apparently is also the case in the Netherlands where the natural gas sector does not employ a large number of people. Kremers (1986) notes that the labor requirement of the gas industry in Holland has "never put pressure on other sectors" (p. 101) in terms of increased wages.

Nevertheless, Hutchison reports in a 1983 and 1984 OECD report, that although the Netherlands' gas sector may not directly cause wages to be bid up, the sector has an indirect effect on wages. According to this report, productivity in the natural gas sector has influenced aggregate indicators of labor productivity used in centralized wage negotiations. The Dutch government utilizes productivity tables from many sectors of the economy in establishing certain industry-wide wages. Therefore, the greater productivity in the gas sector would tend to have an upward, though indirect, push on wages in the economy. Perhaps then, the resource-movement effect is still existent, though not in the same form as theory would suggest.

It is also theoretically possible that the resource-movement effect results from the

government's increasing use of physical capital resources in the oil industry. Rather than wages being bid up, perhaps the price of capital would rise making it prohibitively expensive for producers of non-booming goods to compete for it. This, in turn, would cause these sectors to contract. However, many researchers would point out that much of the physical capital used in the oil industry is imported from Western nations, and consequently, the oil industry does not directly compete with the other sectors of the economy for capital. Therefore, the oil sector is basically an *enclave* industry which means that it is isolated from the rest of the economy.

In addition, if unemployed resources exist in the economy, then it is possible that the booming sector could draw upon these unutilized factors of production to facilitate its expansion. Rather than "stealing" resources from the manufacturing or agriculture sector, the oil industry could put to work the unemployed resources. This would minimize or perhaps entirely eliminate the resource-movement effect.

## III. FORMULATION OF THE MODEL

Using the two components of Dutch Disease, the paper formulates an empirical model. The model includes a measure of Dutch Disease as the dependent variable and presents explanatory variables that attempt to capture the impact of the two essential theoretical elements detailed in the preceding section. The decline in the manufacturing or agriculture sector is hypothesized to be a function of the spending effect and the

resource-movement effect.

**Decline in Manuf. or Agric.= f(Spending effect, Resource Movement effect).**

For the Netherlands the dependent variable would deal with the decline in the manufacturing sector, whereas with Nigeria and Indonesia, the dependent variable is the contraction of the agricultural sector. Other than this difference, the general model is equally applicable for both developed economies and *less developed economies (LDCs)*[2].

## A. Dependent Variable

The dependent variable of the model shows the contraction of either the manufacturing or agricultural sector, depending upon whether the country is developed for the former or developing for the latter. Nyatepe-Coo (1994) in his empirical model states that it is important to model this variable very carefully. Specifically, he says that it should be agriculture or manufacturing's percentage contribution to non-oil GDP. Nyatepe-Coo stresses that it must be non-oil GDP in that even if one of these sectors grew normally, its contribution to GDP would fall due to the sheer increase in GDP figures due to the oil boom. Therefore, by subtracting oil's contribution from GDP, it is possible to isolate the manufacturing sector or agricultural sector's true decline.

Since the dependent variable is at the heart of the model, it is called the *Dutch Disease dependent variable* and given the notation of $\%\mathbf{DD}_{AG}$ for a developing

economy's declining agricultural sector, or $\%DD_{MANUF}$ for a developed country's manufacturing decline.

It is worthwhile here to state that for developing countries, the use of the term "disease" to describe the contractions of their agriculture sectors' GDP shares might be inappropriate. It is pointed out here and fully described in a later section of the paper (see p. 19) that the agriculture sectors of most LDCs fall as they industrialize. Therefore, the word "disease" is perhaps too strong. Nevertheless, it is a "disease" in the sense that the agriculture sector is being squeezed out by Dutch Disease, over and above that which is a normal part of development.

## B. Dutch Disease Variables

### 1. Spending Effect

Developing a proxy for the spending effect is not difficult. Remember that the spending effect is brought about due to an increase in expenditures in the domestic economy as the oil windfall flows into the country. Most of the increased spending arises from the government sector as it is the substantial recipient of the oil revenues (through direct ownership or levying taxes on domestic oil producers). Therefore, a variable of government expenditures would capture most of the aspects of the spending effect.

However, recall that as national incomes rise, there is an excess demand for products which is mitigated only by an increase in the price level. The increase in the

domestic price level affects the real exchange rate, causing the country's agriculture or manufacturing products to become less competitive. Production of those goods should decrease then as the real exchange rate appreciates. If this is so, then perhaps the real exchange is a suitable proxy for the spending effect.

It is expected from the Dutch Disease theory that the government expenditures variable and the real exchange rate variable should be highly correlated. Correlation coefficients are presented below:

**Table 3**

**Correlation Between Government Expenditures and Real Exchange Rate**

| Nigeria | Indonesia | Netherlands |
|---|---|---|
| 0.4423 | 0.6027 | -0.5477 |

As the results show, the two variables are not highly correlated in any of the three countries. Therefore, both of variables can be included in the regressions without having to worry about multicollinearity between them. However, from an econometric perspective it is confusing to include both in the model. This confusion results from a fundamental principle of regression analysis (that all other variables are held constant when examining the effects of any one variable). For example, when examining the effects of the government expenditures variable, it is necessary to hold constant the real exchange rate if it is included in the model. However, in theory the government expenditures variable works through the changing real exchange rate. But if both are

included in the regression, then this econometrics principle prevents them from functioning according to theory.

Therefore, it is necessary to decide which one to include on a country-by-country basis. The government expenditures variable is chosen as the proxy for the spending effect in the Netherlands. The variable **GE** represents annual government expenditures. Data for this are found in the International Financial Statistics Yearbook. As government expenditures increase, one can expect that the spending effect will be evident, leading to a fall in manufacturing or agriculture.

However, for Indonesia and Nigeria the real exchange rate is used. The reasoning for this is as follows. Since many LDCs finance government expenditures through the printing of money, the government expenditures variable, therefore, takes into account much more than just the increase in oil revenue. In fact, the increase in revenue from oil may be totally lost, or at least distorted, if the government does indeed print a large amount of money to finance its expenditures. Consequently, the real exchange rate, **RER**, is used for the two developing countries in the study. Data for this are found in the World Tables CD-ROM. It is predicted that as $\mathbf{RER}^3$ increases (representing a depreciation of the country's currency), the country's agriculture sector should expand. According to Dutch Disease theory, the nation's currency should appreciate as the government spends more, which will eventually cause its traditional export sector, agriculture, to contract.

**2. Resource-Movement Effect**

The resource-movement effect could be proxied by a wage variable in the oil industry. As workers in the oil industry become more productive, their wages are bid up. As a result, other workers migrate to the oil industry, leaving a dearth of agricultural or manufacturing workers, depending on whether the country is an LDC or MDC. Faced with fewer workers and/or having to pay higher wages to keep their workers, farmers or manufacturers will have to decrease production, and this traded goods sector will decline. Therefore, it is hypothesized that as wages in the oil industry rise, agriculture's percentage share of non-oil GDP for LDCs and manufacturing's percentage share of non-oil GDP for MDCs should fall.

Therefore, a proper proxy for the resource-movement effect is the wage in the domestic oil industry, represented by $\mathbf{W_{OIL}}$. Ideally, it would be best to find wage data on each of the countries' oil sectors. However, consistent and reliable wage data for one particular sector could not be found for any of the three countries. Using an index of world oil industry wages was also considered as a proxy, but no such index was located.

Consequently, due to data constraints, the resource-movement effect cannot be modeled in this study. As the paper has already indicated, most researchers conclude that this effect is minimal since the domestic oil industry is usually an enclave. Consequently, the model should perform almost as well as if a resource-movement variable were included. However, since the variable is such an important aspect of the theory, it is included in the summary chart of the variables below. Nevertheless, the reader should

keep in mind that data constraints prevent the inclusion of the variable in the actual regression analysis.

## C. Control Variables

It is necessary to consider possible alternative explanations for the contraction of the manufacturing or agricultural sector. It is entirely possibly that some other factor, other than Dutch Disease, has led to these contractions. Therefore, it is important to account for these other explanations by using several control variables.

### 1. International Difference in Production Costs

One important consideration to take into account is the international difference in production costs or as some researchers call it, the world-price effect. Research on this mechanism began only recently with the first written usage of the phrase world-price effect by Fardmanesh (1990). Fardmanesh employs this effect as a fundamental explanatory variable of Dutch Disease, just as the resource-movement effect and spending effect are employed.

However, this paper takes a different view of the world-price effect. Rather than a fundamental explanatory Dutch Disease variable, the paper treats it as a control variable. In fact, Dutch Disease can occur without the presence of this effect, or quite possibly, the world-price effect can be present without the appearance of any Dutch Disease symptoms. Therefore, so as to not confuse the reader, it is heretofore called the *international difference in production costs.* But before attempting to delineate this

difference any further, it is crucial to explain in detail what is meant by the international difference in production costs.

In a World Development article titled "Dutch Disease Economics and the Oil Syndrome: An Empirical Study," Fardmanesh details his world price effect theory. In short, due to an exogenous increase in oil prices and the fact that oil is often an intermediate input in manufactured goods, the world price of manufactured goods relative to agriculture goods will increase. Fardmanesh reasons that the rise in this relative price affects developing oil-exporting countries differently than developed economies. The reasoning behind this statement is discussed below.

Specifically, the increase in the world price of oil increases the oil imports cost of developed countries. Since oil is used as an intermediate input, the production costs of manufacturing in the developed economy will increase. However, the increase in the world price of oil does not equivalently affect the domestic manufacturing production cost in developing oil-exporting economies for two reasons. Principally, the price of oil does not rise as much in these types of economies as it does internationally. Many governments of these countries purposely keep the price of oil low in order to encourage economic expansion. Fardmanesh notes that, in addition, oil price increases are politically unacceptable to the public in these countries. For example, in Iran when the government attempted to increase the domestic price of oil during the 1970s, street riots erupted, and consequently, the government was forced to lower prices (1991, pp. 712-3).

Secondly, the oil-intensity of manufacturing is less in developing oil-exporting

countries than it is in developed manufacturing-based economies. According to Fardmanesh, this is logical since oil and capital are complementary factors of production, and it is generally accepted that developing economies employ less capital-intensive methods of production. As such, production costs of manufacturing do not rise as much in these countries, leaving these producers with a cost advantage in manufactured goods.

Therefore, assuming all of the producers of manufactured goods are price-takers, those producers in countries who do not face rising costs of intermediate inputs experience an increase in profits. There is an incentive to produce manufactured goods in these developing oil-exporting economies as the result of the positive change in profitability. As the manufacturing sector in these countries expands, the agricultural sector becomes relatively less profitable. Assuming that there are no unemployed resources in the economy, the agriculture sector should contract as labor migrates toward the "booming" manufacturing sector. In a sense, a country neglects agriculture as it diverts more resources into manufacturing to take advantage of the increased profitability.

However, in LDCs, it is foolish to assume that there are no unemployed resources. David Ricardo in his The Principles of Political Economy and Taxation (1817) put forward this concept of labor surplus. He believed that as Britain began to industrialize in the 19th century, its manufacturing sector could draw away the rural surplus of labor without negatively affecting the agriculture sector. Further, even many of those people actively employed in the agriculture sector could be siphoned off into the manufacturing

sector with no adverse impact on agriculture. Ricardo reasoned that many agriculture workers in LDCs are underemployed meaning that "some members of the rural workforce could be removed entirely without a fall in production. Some remaining workers would simply change from part-time to full-time effort" (Gillis 1992, p. 53-4). For example, if a farmer has 18 members of his family working on the farm, the loss of one of these workers will not affect the output of that farm. This is because for many LDCs the marginal product of labor in agriculture is zero. What this means is that by adding or removing one unit of labor, output does not change. Therefore, assuming that unemployed or underemployed resources do exist in LDCs, the manufacturing sector can draw upon these resources without negatively affecting the agricultural sector.

As such, it is difficult to predict how the international difference in production costs impacts the agriculture sector of developing economies. Further considerations confuse the picture even more. Taking into account the income elasticity of food, it is possible that the agriculture sector could expand concurrently with the manufacturing sector. Since food is generally a *normal good*, then as incomes increase due to the expanding oil and manufacturing sectors, more agricultural goods might be consumed. Ernst Engel, a 19th century economist, conducted research on this very topic. Engel, in the now very famous Engel's Law, states that as households gain income, they spend an increasing amount of income on food[4]. Therefore, it is possible that the agricultural sector could expand in order to meet this increase in demand. For example, in 1965, Indonesians had a daily per capita calorie supply of just 1800 with a per capita income of

$180; but by 1986, with an increased per capita income of $436, Indonesians consumed 2579 calories, an increase of 43.3% (Gillis, 1992, p. 251). This shows that as a country develops and incomes increase, food production may have to expand to meet the increased caloric intakes of its citizens.

In summary, the international difference in production costs theory posits that a developing oil-exporting country will witness an expansion of the manufacturing sector while the agriculture sector may contract or expand. Since several factors influence the impact on the agriculture sector, it cannot be predicted a priori whether agriculture will expand or contract in these LDCs. (See Table 2 on next page for a summary of Fardmanesh's theory).

On the other hand, the Netherlands' manufacturing sector should decline as a result of the international difference in production costs since production costs increase as the price of oil rises. In most developed economies the domestic price of oil is regularly at or above the world price of oil. Developed countries generally do not promote economic expansion by subsidizing the private sector with cheap oil; in short, these countries have different energy policies than LDCs. For example, in Norway, a similar oil-exporting developed nation, the price of gas is regularly above the world mark[5]. An October 1995 Wall Street Journal article reported that in Norway the price of gas is four times that of the U.S., whose own price of gas is nine times more expensive than Venezuela's (Pope 1995 Section A, p. 1).

**Table 2**

**Fardmanesh's World Price Effect**

| | Manufacturing Sector | Agriculture Sector |
|---|---|---|
| Developed Oil-Exporter | contracts | ??? |
| Developing Oil-Exporter | expands | ??? |

Therefore, Fardmanesh implicitly reasons that a developed oil-exporting country's manufacturing sector contracts as it becomes relatively more expensive to produce manufactured goods. Hutchison (1994) confirms this by stating that since oil is an intermediate input in the manufacturing process, a world increase in the price of oil would cause manufacturing output to decline in developed countries.

As one can see, the international difference in production costs theory begins with an increase in the price of oil. This not only affects MDC and LDC oil exporters but, in addition, non-oil exporting MDCs and LDCs. For the non-oil exporting MDCs who allow the domestic oil price to increase, this increase negatively impacts their manufacturing sector. For example, Germany, a non-oil exporting MDC, is hurt by an increase in oil prices as this raises production costs in manufacturing. Since Germany is not a candidate for Dutch Disease, therefore, it is obvious that the international difference in production costs concept is not exclusive to booming oil exporters.

Likewise, any non-oil exporting LDC that purposely keeps oil prices low as part of

their development strategy will witness a benefit for its manufacturing sector. In addition, even if this type of LDC allows the price of oil to increase, the manufacturing sector will still become relatively more profitable in that production processes in these countries often are less capital intensive (meaning, they use less oil to produce products) than MDCs. This evidence again confirms the point that the international difference in production costs theory is relevant to all countries, not just Dutch Disease candidates. As such, it cannot be included as an Dutch Disease-type variable for LDCs. Rather, this theory should be used as a control variable since it can indeed affect the manufacturing or agricultural sector. Therefore, it is treated as an important consideration, offering a possible alternative explanation (distinct from Dutch Disease) to the decline of a country's manufacturing or agricultural sector.

According to the innovator of the world-price effect concept, a reliable proxy for it is the index of the world relative price of manufactured goods to agricultural products. However, an even better proxy for the world price effect is the ratio of the price of manufacturing in more developed nations to the price of manufacturing in less developed countries. Fardmanesh includes the price of agricultural goods in the ratio which really is not as fundamental to the theory as the price of manufacturing. According to the concept of international differences in production costs, it does not matter if the price of agricultural goods changes. What this variable is concerned about is the discrepancy between the price of manufacturing in countries that vary in development status.

Therefore, the proxy for the theory needs to capture the difference between the two manufacturing prices. This variable is represented by the notation $\mathbf{IDPC_{MANUF}}$, the international difference of production costs in manufacturing. Specifically, it is defined as the price of manufactured goods of developed nations divided by the price of manufactured goods of lesser developed countries[6].

**2. Natural Development Process**

The paper has hypothesized that Nigeria's and Indonesia's agriculture sectors have declined due to the presence of Dutch Disease. However, it is possible that much of these declines are due, in part, to the natural tendency for the agriculture sector to contract as LDCs begin to develop. It is perhaps worthwhile to mention that in 1820, the U.S. agriculture sector employed 79% of the labor force and accounted for over 60% of GDP (Johnston 1975, p. 196). However, today, the agriculture sector accounts for just 2% of GDP and employs a mere 3% of the total number of workers[7]. This dramatic redistribution of the economy was merely a result of the country's development process. As such, the U.S. changed from a predominantly agrarian society to an industrialized nation, not due to Dutch Disease, but because that transition was part of its development process.

Consequently, it is necessary to account for this in Nigeria and Indonesia. For these two countries, per capita income should be an appropriate control variable for this development tendency. Per capita income is used by economists as the most common measure of a country's level of development. As the country develops and devotes more

attention to manufactures, per capita incomes should increase. As such, **PCY** is used as a control variable to account for this industrialization process. This is not to say that the changes in per capita income cause agriculture to expand or contract, but merely **PCY** accounts for this development trend.

However, for the Netherlands, a country that has already undergone the development process, a different variable needs to be included. It is interesting to point out that the manufacturing sectors of most European countries have declined since the late 1960s. Many economists have tried to account for this European-wide trend. Nevertheless, researchers generally do not agree on one particular factor that caused this deindustrialization. Some economists attribute the decline to the lack of R&D expenditures, whereas others say government neglect, foreign competition, or recessions have caused the shrinking of the European manufacturing ("On the Nature..." 1980, pp. 85-102). With no single evident factor causing the deindustrialization, the best possible proxy is one that somehow accounts generally for this European-wide trend. The paper uses real GDP, **RGDP,** in the hope that it captures this trend. Most importantly, this variable does not attribute the deindustrialization trend to Dutch Disease. Rather, some other yet unexplained phenomenon occurred that the **RGDP** variable is intended to capture.

### 3. Other Control Variables

Several other control variables are needed to account for possible other

explanations of the decline in the agricultural or manufacturing sector. The most obvious of these would be a money supply variable. In an article titled "Dutch Disease or Monetarist Medicine?: The British Economy under Mrs. Thatcher," Chrystal (1984) posits that contractionary monetary policy, rather than Dutch Disease, caused the decline in the U.K.'s manufacturing sector. Using descriptive statistics and convincing argument, the researcher refutes the Dutch Disease as an important underlying factor in the contraction of Britain's manufacturing sector. Another study, by Hutchison (1994), decomposes the variance of manufacturing output fluctuations into that part attributable to energy booms and disturbances in monetary conditions, using the Johansen method of co-integration analysis and the vector error correction modeling (VECM) approach. He concludes, using his empirical model, that monetary factors played a large role in the U.K., helping to explain slightly over 15% of unanticipated manufacturing output restrictions. As such, it is quite possible that tight monetary policy may lead to the neglect of certain tradable goods sectors, leading to contractions and sectoral shifts. This could easily be accounted for in the model by a money supply variable.

Other possible explanations include contractionary fiscal policy that similarly neglects certain sectors. For example, perhaps the government cuts agricultural subsidies so that producers within this sector can no longer remain competitive. As individual producers fold, total production would fall and sectoral contractions would be evident. Other possible explanations would be the substantial removal of tariffs and quotas that leave the tradable goods sector exposed to foreign competition. Contractions, due to

foreign competition crippling the domestic industry, could result concurrently with the resource boom.

Since reliable information concerning subsidies and tariffs is difficult to quantify, the best control variable accounting for the neglect of the tradable goods sector, therefore, is a money supply variable. Consequently, the gross money supply will be used as the control variable. This is represented by the variable **MS**. A positive relationship is expected to exist between **MS** and the growth of the tradable (non-energy) goods sector.

The following two tables list all of the variables and each of their expected signs:

**Table 4**

**The Netherlands**
**Variables and Their Expected Signs**

| Variable | Type | Explanation | Expected Sign |
|---|---|---|---|
| **$\%DD_{MANUF}$** | Dependent | % share of manuf. in GDP | |
| **GE** | Dutch Disease: Spending Effect | government expenditures | negative |
| **$W_{OIL}$** | Dutch Disease: Resource-Movement Effect | wage in the domestic oil industry | negative |
| **MS** | Control: Money Supply | annual rate of growth in money supply | positive |
| **RGDP** | Control: Real GDP | real GDP in constant 1987 dollars | negative |
| **$IDPC_{MANUF}$** | Control: Int'l Difference in Production Costs | ratio of price of manuf. goods of MDCs to LDCs | negative |

Table 5

**Indonesia and Nigeria**
**Variables and Their Expected Signs**

| Variable | Type | Explanation | Expected Sign |
|---|---|---|---|
| $\%DD_{AG}$ | Dependent | % share of agriculture in GDP | |
| **RER** | Dutch Disease: Spending Effect | real exchange rate | positive |
| $W_{OIL}$ | Dutch Disease: Res-Movement Effect | wage in the domestic oil industry | negative |
| **MS** | Control: Money Supply | annual money supply in home currency | positive |
| $IDPC_{MANUF}$ | Control: Int'l Difference in Production Costs | ratio of price of manuf. goods of MDCs and LDCs | ??????? |
| **PCY** | Control: Per Capita Income | per capita income in dollars | negative |

**D. The Basic Model**

The preceding model says that Dutch Disease is a function of two Dutch Disease variables and several control variables. The empirical model is given below:

**For Developed Countries**

$$\%DD_{MANUF} = a_0 + a_1GE + a_2IDPC_{MANUF} + a_3MS + a_4RGDP + e_1$$

**For Developing Countries**

$$\%DD_{AG} = b_0 + b_1RER + b_2IDPC_{MANUF} + b_3MS + b_4PCY + e_2$$

From the theory it is hypothesized that the two Dutch Disease variables will account for a

substantial part of the tradable (non-energy) goods sector contraction. Remember that the resource-movement effect variable, $\mathbf{W_{OIL}}$, cannot be included in the formal regression analysis due to data constraints. Consequently, it is not shown in the above empirical model. $\mathbf{e_1}$ and $\mathbf{e_2}$ are random error terms for their respective regressions.

## IV. DATA

The data for the formulated model were readily available for the most part in the International Financial Statistics Yearbook, The World Tables, World Data CD-ROM, and other international data sources. The dependent variables are expressed as percentages; the data for government expenditures are expressed in local currency units as are the data for the money supply; and the world relative price of manufactured goods of more developed countries to less developed countries is expressed as a ratio. Per capita income and real GDP are expressed in constant 1987 dollars. The real exchange rate variables are expressed as direct quotes, ie. the price of the foreign currency in terms of the domestic currency.

Ordinary least squares (OLS) regression methods are employed, using time-series data from 1960-1990[8]. Three regressions are run, one for each of the three countries: the Netherlands, Nigeria, and Indonesia. The results are detailed in the following section.

## V. RESULTS

Overall, the model performed well for each of the three countries. In each country the Dutch Disease explanatory variable was significant, indicating that Dutch Disease played a role in the decline of the countries' traditional tradable goods sector. The following sections discuss the results (see the below table for complete results) for each country individually.

### A. The Netherlands

First, examining the results from the Netherlands' regression, it is important to point out that all of the included variables are significant. In general, the regression performs very well, explaining over 98% of the variation in the dependent variable.

Specifically, the coefficient for the Dutch Disease variable, government expenditures (**GE**), modeling the spending effect, is significant at the alpha level of .01 and has the correct predicted sign. As the government spends its oil revenues, holding all of the other variables constant, the manufacturing sector will contract. More precisely, a 10 billion guilder[9] increase in government spending leads to a 0.9% decrease in manufacturing's contribution to non-oil GDP. In order to determine whether or not the spending effect is important, it is helpful to examine the government expenditures data. In 1960 the Dutch government spent just over 9 billion guilders, but by 1990 this number

had increased to over 268 billion guilders. This means that almost every year, the Netherlands witnessed a 10 billion guilder increase in government spending. Therefore, since a 10 billion guilder is not that large and produces a near 1% change in the

**Table 6**

## Regression Results

| VARIABLE | NETHERLANDS | INDONESIA | NIGERIA |
|---|---|---|---|
| **dependent variable** | manufacturing share | agriculture share | agriculture share |
| **constant** | 0.829718 | 0.634981 | 0.00675236 |
| **Government Expenditures** | -0.000000899 (3.3864)*** | | |
| **Real Exchange Rate** | | 0.00731031 (3.0329)*** | 0.0442083 (3.7155)*** |
| **International Diff. in Production Costs** | 0.0280320 (2.0194)* | 0.00633526 (2.5398)** | 0.0428993 (7.3104)*** |
| **Money Supply** | 0.00401525 (5.9384)*** | | 0.000013641 (6.2955)*** |
| **Per Capita Income** | | -0.000989036 (11.1966)*** | 0.000191193 (1.0316) |
| **Real GDP** | -0.00420707 (4.8178)*** | | |
| **adjusted $R^2$** | 0.9869 | 0.9551 | 0.9026 |
| **Durbin-Watson** | 1.3446 | 1.1735 | 1.1624 |

t-statistics are in parentheses:
* indicates significance at the .10 alpha level
** indicates significance at the .05 alpha level
*** indicates significance at the .01 alpha level

manufacturing sector, it is evident that, according to the results of the model, the spending effect is quite important. As such, the spending effect is an attributable cause of the Netherlands' deindustrialization.

The coefficient for the international difference in production costs variable, $\mathbf{IDPC_{MANUF}}$ also is significant. However, the result is somewhat paradoxical. Contrary to predictions, the Netherlands' results for this variable indicate a positive relationship. Specifically, an increase of one in the ratio of manufacturing prices in developed countries to LDCs' manufacturing prices, ceteris paribus, causes the manufacturing sector to increase by 2.8%. Theoretically, the manufacturing sector should decline as the manufacturing price ratio increases. It becomes less profitable for manufacturers in developed countries to produce goods since the price of oil rises more in these countries than it does in LDCs. However, the results of the model indicate that as the price of oil increases and causes the manufacturing price ratio to increase, the Netherlands' manufacturing sector actually expands. Perhaps the cause for this paradoxical result is that the variable does not measure Fardmanesh's concept precisely. In his study, Fardmanesh used cost data rather than price data of which this paper's model made use. With this difference in mind, it is possible to explain this paper's seemingly paradoxical result. The reasoning follows that if production costs did not rise but prices did (perhaps due to an increase in demand), then the manufacturing sector would increase its output. As such, the manufacturing sector would not need to contract. This could account for the positive sign on the $\mathbf{IDPC_{MANUF}}$ variable. Therefore, with more accurate modeling of the

theory using price data, it is possible that the result would follow more closely Fardmanesh's theory.

Other non-Dutch Disease factors seem to have played an important role in the Netherlands' deindustrialization. For example, the coefficient for the money supply variable, a control variable, is highly significant and has the correct predicted sign. A five billion guilder ($2.78 billion using 1992 exchange rate) decrease in the money supply, ceteris paribus, causes the manufacturing sector's contribution to non-oil GDP to decline by 2%. Therefore, any contractionary monetary policy that the Netherlands took, adversely affected the manufacturing sector.

The coefficient for the other important control variable, used as a proxy for the European-wide deindustrialization trend, **RGDP**, is also significant with the correct hypothesized sign. As real GDP increases in the Netherlands, holding everything else constant, the manufacturing sector share declines. Specifically, a 5 billion guilder[10] increase in real GDP leads to a 2.1% decrease in manufacturing's contribution to non-oil GDP. As one can see, the **RGDP** variable has quite a large impact on the manufacturing sector. As such, in the case of the Netherlands, Dutch Disease is not the sole factor contributing to the country's manufacturing decline. It seems that the multitude of factors, mentioned earlier, leading to the European-wide deindustrialization played a role in the Netherlands' economy.

Overall, the regression for the Netherlands performed very well, explaining a good portion of the dependent variable's variation. In addition, all four of the variables'

coefficients are significant, with only one having the wrong sign. Although the Durbin-Watson (DW) statistic, used to test for *autocorrelation*[11], is somewhat low, the results of a Lagrange Multiplier test reveal that autocorrelation is not a problem in this regression. However, since autocorrelation is often caused by an omitted variable, it is possible the exclusion of the resource-movement effect variable (due to data constraints) has caused the DW statistic to be low. If such data could be found, it is expected that the DW statistic would increase, indicating a reduction of autocorrelation.

**B. Indonesia**

The results for Indonesia had problems with *multicollinearity*. The inclusion of all of the variables in Indonesia's regression created problems. For example, the money supply variable, **MS**, was highly correlated with the **PCY** and **GE** variables displaying simple correlations of 0.9318 and 0.9238, respectively. From a theoretical perspective, it is logical that the **MS** and **GE** variables would be correlated. Often, LDCs finance government spending by monetizing their debt, thus increasing the money supply. Consequently, the high collinearity of **GE** and **MS** made it impossible to isolate the effect of the government expenditures variable. Therefore, the money supply variable, a control variable, had to be excluded from the final model. This is a logical action in that the increase in **GE** exceeded the increased oil revenues and was partially financed by the country's monetization of its debt. Hence, it was determined that the real exchange rate

variable, **RER**, would make better theoretical sense as the Dutch Disease variable for Indonesia.

The **RER** variable's coefficient is highly significant and displays the correct predicted sign. As the rupiah appreciated as Dutch Disease would predict, Indonesia's agriculture sector contracted. For example, suppose the real exchange rate, between the rupiah and the dollar, rises[12] from 3 rupiahs per dollar to 1 rupiah per dollar. Holding all of the other variables constant, the agriculture sector would contract by 1.5%. Therefore, the real exchange rate mechanism of Dutch Disease in Indonesia seems to play an important role. The reduced competitiveness of its agricultural goods in the world market causes that sector's contribution to non-oil GDP to decrease just as the Dutch Disease theory suggests.

The coefficient for the per capita income variable, **PCY**, that controls for Indonesia's economic development is highly significant, even at the alpha level of .01. Therefore, it can be reasoned that as per capita income increased in Indonesia from 1960 to 1990, it played a statistically significant role in explaining the decline in the agriculture sector. Specifically, a $100 increase in per capita income, ceteris paribus, leads to (though it does not cause) a 9.9% decrease in agriculture's share of non-oil GDP. This result suggests that the typical development pattern of the agricultural sector shrinking as the country modernizes plays a large role in explaining the contraction of Indonesia's agriculture sector. As such, it follows that Dutch Disease is not the sole cause of

agriculture's decline.

In addition, the coefficient for the second control variable $\mathbf{IDPC_{MANUF}}$, which measures international differences in production costs, is significant with a positive sign. The results indicate that as the $\mathbf{IDPC_{MANUF}}$ ratio increases and it becomes relatively more profitable for oil exporting LDCs to produce manufacturing goods, resources are not "stolen" in a manner that negatively affects the agriculture sector. Unemployed and/or underemployed resources in the agriculture sector are drawn away from this sector and put to use in the manufacturing sector in such a way that does not hurt agriculture. Instead, as incomes rise, holding all other variables constant, due to the increase in manufacturing profitability, the agriculture sector expands . This is not to say that Indonesia's agriculture sector has actually expanded in reality, but merely within the context of the model and this particular variable, the agriculture sector share increases, ceteris paribus, as a result of the international differences in production costs.

Overall, the regression for Indonesia performs well, indicating that Dutch Disease along with a host of other factors contributed to its de-agriculturalization. However, a previous study has concluded that Dutch Disease did not play a role in Indonesia. Glassburner (1988) states that "In Indonesia. . .the shift of economic activity out of agriculture was relatively 'normal'" (pp. 214-5). What this means is that the agriculture percentage contribution to GDP fell in line with similar LDCs that did not experience oil-booms. This was mainly due to the fact that the Indonesian government consciously took steps to encourage agricultural growth. Unlike many other LDCs, Indonesia did not

abandon its agriculture sector. In fact after the first oil shock in 1973, the government increased its fertilizer subsidy by 300% for a period of 3 years (Glassburner 1988, p. 208). Due to this active encouragement of agriculture, an extreme case of Dutch Disease was prevented.

Nevertheless, the evidence presented in this study shows that Dutch Disease did play some role in Indonesia's de-agriculturalization although the natural development process played a larger role than Dutch Disease. The interesting aspect of the paper is that it separates the two concepts--the natural cause of agriculture's decline from the Dutch Disease aspect of it.

**C. Nigeria**

The results for Nigeria's regression presented the most problems for interpretation. Nevertheless, the regression performed well, explaining over 90% of the variation in the dependent variable. In addition, three out of the four coefficients, including the Dutch Disease variable's coefficient, are significant at the .01 alpha level, and two of the coefficients, including the one for the Dutch Disease variable, have the correct predicted sign.

Like the results for Indonesia, the coefficient for the real exchange rate variable, proxying the spending effect, is significant at the .01 alpha level and has the correct predicted sign. This means that as the spending effect leads to an appreciation of Nigeria's currency (the naira), the agriculture sector loses competitiveness in the world

market and subsequently contracts, holding all other variables constant. The results indicate that a rise of the real exchange rate between the naira and the dollar from 3 naira per dollar to 1 naira per dollar would contract agriculture's share of non-oil GDP by 8.9%. This compares with only a 1.5% contraction of Indonesia's agriculture sector. Therefore, it is evident that the spending effect is more pronounced in Nigeria than it is in Indonesia.

This is generally consistent with what other studies have found. Capital expenditure by the Nigerian government went from 3.6% of non-mining GDP in 1970 to 29.6% of non-mining GDP by 1981 (Bienen 1988, p. 240). This large increase in government spending helped to appreciate the naira, making its tradable agricultural goods less competitive in the world market. However, unlike in Indonesia, Bienen (1988) notes that much of this government spending went towards the nontraded sectors, not towards agriculture. Referring to the larger impact of the spending effect in Nigeria, Bienen concludes that "[t]he contrast to Indonesia is notable" (p. 243). The results of this paper confirm Bienen's conclusion.

The coefficient for the per capita income variable, **PCY**, controlling for Nigeria's economic development is statistically insignificant and further, displays the incorrect predicted sign. This result indicates that increases in per capita incomes have no measurable effect on the agriculture sector, ceteris paribus. However, this can be explained by the fact that despite increases in per capita incomes in Nigeria, no real development was taking place. Theory had predicted that as a country's per capita

income increases, it experiences some sort of industrial development at the expense of agriculture. As an example of this, it was pointed out that as the U.S. industrialized, its agricultural sector contracted dramatically. But, for Nigeria this seems not to be the case. Perhaps the oil revenues were squandered away without any lasting or significant improvements in the country's industrial or service sectors. Consequently, little true industrializing development at the expense of agriculture would have occurred.

The coefficient for the second control variable, $\mathbf{IDPC_{MANUF}}$, which measures international differences in production costs, is significant with a positive sign. This indicates that as Nigeria's manufacturing sector becomes more profitable due to the increase in the $\mathbf{IDPC_{MANUF}}$ ratio, resources are not diverted in a way that adversely affects the agriculture sector. This is the same conclusion that the results for Indonesia's regression indicate (see p. 35 for discussion of Indonesia's results).

Finally, the coefficient for the third control variable, the money supply, is significant and shows the correct predicted sign. As the country decreases the money supply, holding all other variables constant, agriculture's share of non-oil GDP decreases. This neglect of the agriculture sector, through tight monetary policy, helps explain the overall decline in Nigeria's agriculture sector. Specifically, a 1 billion naira[13] decrease in the money supply leads to a 1.4% decrease in agriculture's share of non-oil GDP.

Overall, the regression for Nigeria indicates that Dutch Disease is particularly important in explaining Nigeria's de-agriculturalization, much more so than for Indonesia. Nevertheless, several other variables, the money supply variable and the

international difference in production costs variable, also are significant factors in the Nigerian economy. Perhaps the most startling result is that per capita income, measuring development, is not an important variable in the explanation of agriculture's decline.

## VI. CONCLUSION AND POLICY IMPLICATIONS

Several conclusions can be drawn from the results, and from these, several policy implications can be formulated. As the results indicate, the spending effect plays a statistically significant, though not exclusive role in accounting for the countries' tradable goods sector contractions. The international difference in the production costs of manufacturing affects the three countries differently. Certainly, the results are not robust as the signs of the variables vary across the countries. Therefore, it is probable that each of these three countries experienced differentiated forms of the Dutch Disease, and perhaps, the Nigerian, Indonesian, and the Dutch governments each took different courses of action to combat the problems.

In summary, the goals of this paper were to create a model that is applicable across a wide selection of potential Dutch Disease countries. Moreover, it aimed to isolate the impacts of the various factors which explain the decline in the country's tradable (non-energy) goods sector. However, the results indicate that the applicability of the Dutch Disease model varies across countries. For Indonesia, the decline in the agriculture sector is also the inevitable consequence of its development process. However, for

Nigeria, the results indicate no conclusion of this sort. The spending effect plays a more important role in explaining Nigeria's de-agriculturalization.

In addition, the results for the Netherlands verify the presence of Dutch Disease. The spending effect variable is highly significant (ie. at the alpha .01 level) and exhibits the negative relationship with the dependent variable as theory would suggest. However, some economists are quick to point out that while the Netherlands did experience a moderate case of Dutch Disease, the reasons for the manufacturing sector's decline are more complex. Kremers (1986) writes "Thus, gas seems to be jointly responsible for its present economic difficulties, of which the origins lie already in the pre-gas era" (p. 118). This study confirms Kremers' conclusion that the Netherlands' basic economic problems of stagnating growth, unemployment, and major shifts in its sectoral structure are due at least in part to Dutch Disease.

Since Dutch Disease can lead to possible adverse consequences of energy booms, it is important to consider policies that reduce the negative effects of the disease. But it is difficult to develop such policies in that very little research has been undertaken in this area. Nevertheless, Herberg (1984) discusses several policies which attempt to mitigate the effects of Dutch Disease. However, a great majority of economists would not support Herberg's policies in that some of them might actually lead to worse problems than the disease itself[14]. Therefore, only the most logical policy, to which this paper's results lend support, is discussed below.

Herberg states that a country's government could directly subsidize the

traditionally exposed sector by helping farmers or manufacturers stay in business (1984, p. 72). It was shown that Indonesia suffered a much less severe case of Dutch Disease than did Nigeria in part because the Indonesian government subsidized the ailing agriculture sector. In effect, Indonesia consciously took steps to encourage agricultural growth. In fact, after the first oil shock in 1973, the government increased its fertilizer subsidy by 300% for a period of 3 years (Glassburner 1988, p. 208). Due to this active encouragement of agriculture, an extreme case of Dutch Disease was prevented. However, in Nigeria, Bienen (1988) indicates that much of the government's spending went towards the nontraded sectors, not towards agriculture. Partly as a result of this neglect, Nigeria suffered a severe case of Dutch Disease. Therefore, it is evident that governments can at least mitigate the effects of Dutch Disease by actively subsidizing their traditional export sectors upon the discovery of oil.

In addition, one other possible policy is worth mentioning. Leekley (1996) notes that the Alaskan government prevented the Dutch Disease phenomenon by using its oil revenue to reduce taxes rather than undertaking a spending spree. The reasoning is as follows. If consumers' marginal propensity to import is greater than the government's marginal propensity to import, then the increase in imports can offset the appreciation of the currency. As the consumers dump the domestic currency in order to purchase the foreign currency with which to buy the imported products, the domestic currency's value will fall. This will counteract or at least mitigate the appreciation of the currency that Dutch Disease causes. If so, then the country's traditional exports do not become less

competitive in world markets, and therefore, these sectors would not need to contract. Since the paper's results indicate that the spending effect (through the appreciation of the country's currency) plays a significant role in accounting for the contraction of the traditional export sector, this "Alaskan solution" seems to be an especially appropriate method of avoiding or at least reducing the impact of Dutch Disease.

Since little research has been conducted on effective policies to fight Dutch Disease, this is perhaps the most important area for future research. It is an important topic of discussion in that countries must realize all of their options in combating Dutch Disease. Perhaps the overriding concern is what will the country do when the oil dries up and it no longer has a strong manufacturing or agricultural sector? This is precisely the situation that the Netherlands will face early in the next century when its natural gas deposits are depleted: little or no revenue from its gas sector and a vastly contracted manufacturing sector. Having taken few measures to "save" its manufacturing industry, the Netherlands faces an uncertain future. However, for many other countries, it is not too late to take remedial action, mitigating the Dutch Disease effects, and ensuring a productive post-boom era.

## ENDNOTES

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1. Other researchers concentrate on the decline of the agriculture sector, called de-agriculturalization, rather than focusing on the contraction of the manufacturing sector. Researchers note that de-agriculturalization occurs in developing oil-exporters since their agricultural sectors usually dominate the economies before the discovery of oil. On the other hand, developed oil-exporting countries should witness a decline in their manufacturing sector. Consequently, researchers have to adapt their theories and models to account for this difference.

2. This paper uses the term LDC to refer to those countries that have not fully developed their economies. LDCs are primarily agrarian societies that are just beginning to industrialize. More developed economies (MDCs) have reached a fairly advanced stage of industrialization. MDCs include the OECD nations and perhaps the four Asian Tigers.

3. The **RER** is defined as the nominal exchange rate (domestic currency per foreign currency unit) multiplied by the ratio of the foreign price index to the domestic price index.

4. This is only half of Engel's Law. It is true that as households gain income they spend an increasing amount of income on food, but they spend a decreasing proportion of their income on food.

5. The following chart gives further evidence that developing countries often keep gas prices lower than developed countries.

**Prices for One Gallon of 97RON Gas in Selected Countries**

| | 1971 | 1981 |
|---|---|---|
| Indonesia | $0.32 | $0.91 |
| Netherlands | $0.69 | $2.89 |
| U.S. | $0.35 | $1.22 |
| Mexico | $0.24 | $0.66 |
| Norway | $0.82 | $2.87 |

| | | |
|---|---|---|
| W. Germany | $0.66 | $2.46 |
| Venezuela | $0.08 | $0.13 |
| U.K. | $0.65 | $2.60 |

(source: Yearbook of World Energy Statistics)

6. Specifically, for Nigeria the $\mathbf{WP}_{\mathbf{MANUF}}$ is defined as the index of the price deflator of manufactured goods from Japan divided by the index of the price deflator of manufactured goods from the Philippines, a lesser developed nation. No complete data could be found for Nigeria; therefore, a similar less developed country had to be used. For Indonesia, the variable uses data from Japan and Indonesia. Since Japan is one of Indonesia's principal trading partners it seems reasonable to use this data. Time constraints prevented the inclusion of an aggregated index of manufacturing prices of developed nations versus developing nations.

7. Agriculture's relative percentage contribution to the labor force began to decline in 1820 from a high of almost 80%. However, it wasn't until 1910 that the agricultural labor force began to decline in absolute size (Johnston, p. 196). This decline continued until around 1980 when the level of agriculture employment stabilized somewhat. In 1960 the U.S. had 7,057,000 total farm workers, but by 1976 that number had fallen to 4,620,000--a decrease of almost 2.5 million workers (Handbook, p. 24)!

8. Data could not be found for all of the variables from 1960 to 1965. Therefore, not all of the regressions are run using data from 1960 to 1990.

9. 10 billion guilders is equivalent to $5.56 billion using 1992 exchange rates.

10. A 5 billion guilder increase is equal to an increase of $2.78 billion using 1992 exchange rates.

11. Autocorrelation is an econometrics disease whereby the error terms of a regression are correlated to successive error terms. In general, autocorrelation indicates that if one error term is positive, the next error term will also be positive or vice versa. One of the principal rules in econometrics is that error terms cannot be correlated; they should be completely random, meaning successive error terms should have a small correlation coefficient.

Generally, the Durbin-Watson statistic is used to test for the presence of autocorrelation. Ideally, the DW statistic should be close to 2.00 which indicates that there is no autocorrelation. If autocorrelation is found, first differences of all of the variables need to be taken and then a new regression is run using these "transformed variables" in place of the other variables. Usually, this eliminates the problem.

Sometimes, it cannot be determined from the DW statistic whether or not the regression has an autocorrelation problem. In such a case, a Lagrange Multiplier test is used to determine conclusively if autocorrelation is present.

12. This appreciation of the rupiah could be due to an increase in the nominal exchange rate and/or a decrease in the ratio of world prices to domestic prices.

13. 1 billion naira is approximately equal to $55.56 million using 1992 exchange rates.

14. For example, the fifth policy of enacting trade barriers to ensure that domestic industries are not driven out of business, would not be advocated by many economists. Erecting trade barriers almost always results in a loss of welfare for the country. Therefore, a country would not necessarily want to install quotas or raise tariffs. Also, this would most likely violate the General Agreement on Tariffs and Trade (GATT).

## Definitions

***Booming Sector Economics***: refers to the study of how a natural resource boom impacts a nation's economy. Studies both the positive and negative results of the boom. Some studies in this area have also focused on foreign aid booms in a similar light as a natural resource boom.

***Transfer***: refers to how the inflow of revenues of the resource boom act as like a transfer of income from abroad into the domestic economy of one country. This causes a nation's production possibilities frontier to shift out parallel to old PPF by the amount of the transfer.

***Spending Effect***: due to higher incomes from the windfall revenue gain, people spend more money. For goods whose price is determined in the domestic economy, an excess demand results causing these goods' prices to increase. As a result, it becomes more profitable to produce these types of goods. On the other hand, producers of tradable goods, whose prices are determined in international markets, will witness no increase profitability since an increase in demand in one small country cannot affect the prices. Consequently, the tradable goods sector will contract since it is now relatively less profitable to produce these goods.

***Resource-Movement Effect***: upon the discovery of a natural resource, those factors initially employed in this booming sector will see an immediate increase in productivity. Since factors of production are paid according to their productivity, the booming sector factors' prices will be bid up. This, in turn, draws mobile resources away form the traditional sectors to the booming sector. As a result, all other sectors would be expected to contract.

***Less-Developed Countries (LDCs)***: refer to those countries that have not fully industrialized. These countries usually have per capita incomes of less than $8,000 and still rely on agriculture as the primary source of GDP.

***International Difference in Production Costs***: since oil is an intermediate input in manufacturing, a world increase in the price of oil would increase manufacturing production costs and make this sector less profitable. However, in developing countries, the price of oil does not increase as much as in the developed world. Therefore, their production costs would not rise as much. Consequently, it is now relatively more profitable to produce manufacturing goods at the expense of the agricultural sector.

***Enclave***: refers to an industry that is isolated in an economy, not sharing any factors of

production. Such a sector does not compete for land, labor, or capital.

***Normal Good***: a good whose consumption increases as incomes rise.

***Dutch Disease Dependent Variable***: the dependent variable of the paper. It represents the decline in the traditional tradable goods sector: agriculture for developing countries and manufacturing for developed countries.

***Multicollinearity***: an econometric disease where two or more of the independent variables are correlated. Multicollinearity can distort the results, making certain variables insignificant that are in reality significant. However, if all of the variables are significant, then no action needs to be taken to correct for Multicollinearity.

***Autocorrelation***: an econometric disease where the error terms of a regression are correlated to each other. Specifically, successive error terms tend to have the same sign. This violates the econometric principal of uncorrelated, completely random error terms.

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