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The Impact of Natural Resource Abundance on Manufacturing Exports from a Technology Intensity Perspective

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ABSTRACT

The association between natural resource abundance and economic performance has been the common concern of economists and political philosophers for centuries. While plenty of resources is a blessing for some countries, others suffer from the paradox of plenty known as Dutch disease. This study aims to search the interaction between natural resource rents and the manufacturing exports of the 34 Organization for Economic Co-Operation and Development (OECD) countries between the years 1990-2015, depending on the technology intensity of sectors using the gravity model of trade. The findings of the study indicate that there is Dutch disease in all of the classifications of manufacturing industries. In other words, for the 34 OECD countries, the upsurge in natural resource rents has an impact on the manufacturing sector's performance in all subcategories.

Keywords: Natural resource abundance, economic performance, Dutch disease, gravity model, technology intensity.

JEL Classification: O5, O13, Q32, Q33

Introduction

Until 1960s, the dominant belief about the role of resource abundance on economic growth was that being endowed with immense natural resources contributed to the industrialization process and economic growth of countries. Rostow (1959: 5) mentions the importance of productive exploitation of natural resources on growth. Canada's, Britain's and United States' growth trajectories are very much linked to their natural resources endowments. Tripathy (1985: 143) states that Canada owes its economic success to exploitation and exports of its abundant natural resources such as fur and fish. He argues that the export-led growth strategy of Canada was the basic reason for that development during the period 1886-1913. David and Wright (1997: 203), Mikesell (1997: 191), Wright and Czelusta (2007: 184-185) suggest that natural resource endowments triggered growth and development of the United States. Rostow (1961: 6) argues that Britain favored from natural resources for take-off.

Although it may be apparent that countries like the U.S., Britain and Canada owe their rapid industrialization and growth rates to their natural resource endowments, Auty (2007: 627) states that after the Second World War and especially after 1960s, evidence has suggested that numerous resource–rich countries experienced deterioration in their economic performance. Many of the studies conclude that natural resources, seldom if ever, provide the sustainable surplus required for economic growth. This negative correlation is called Resource Curse (Auty: 1993: 1).

Even though there are plenty of social and political comments for the Resource Curse, this study concentrates on one of the economic explanations, "Dutch disease", to analyze the impact of natural resource rents on the real economy. The contribution of this study to the existing Dutch disease literature is an analysis of the phenomena from a technology intensity perspective. The idea arises from the works of Bresser-Pereira (2008) and a more recent analysis found in Camargo and Gala

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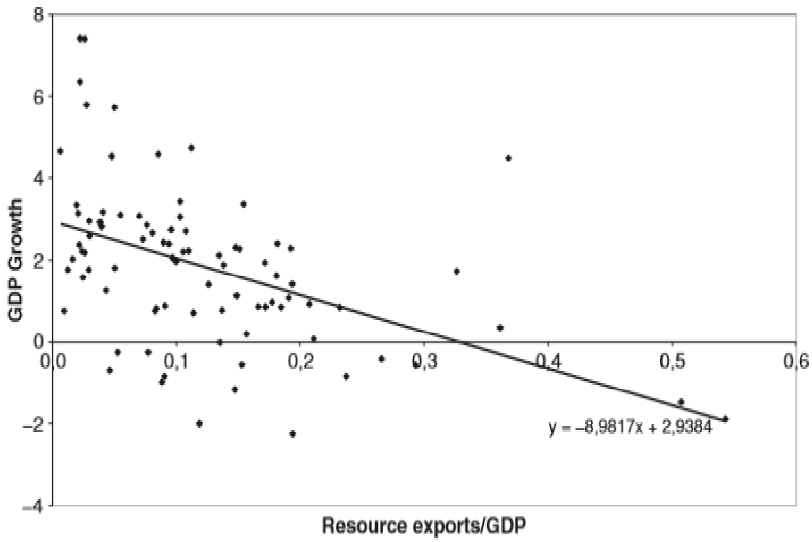
(2017). Bresser-Pereira (2008: 62) reports that among the symptoms of Dutch disease is a gradual decline in the export performance of high value-added manufactured goods produced by high-technology industries, meaning that these industries are more affected by the disease. The authors' reasoning behind this intuition is that increases in labor abundance result in cheap labor, which is also a cause for an extended version of the Dutch Disease, in the sense that since high-technology industries require highly skilled labor, a country with an abundance of cheap labor falls short of gaining a comparative advantage in these types of goods. We extend this view by stating that high-technology industries can be more vulnerable to Dutch disease due to their dependence on high levels of R&D requirements. Natural resources sectors also require high R&D research and are technology-intensive in nature (Fagerberg et al. 2009). Larsen (2006: 624) states that according to Cappelen, Eika and Holm (2000), capital/labor ratio in the Norwegian oil industry is 33 times larger than that of the Norwegian manufacturing industry. As a result, in the case that natural resources sectors boom, the transfer of resources into production in these sectors is likely to be from other technology-intensive manufacturing industries, in the form of skilled labor and capital, implying that there is reason to hypothesize that these sectors can be more likely to be affected by Dutch disease. Supporting this intuition is also Looney's (1989: 35) work stating that a boom in the oil sector can make it increasingly difficult to achieve complexity in the manufacturing sectors. Consequentially, we aim to scrutinize the influence of natural resource abundance on manufacturing exports, focusing whether the impact of the Dutch disease varies depending on the technology intensity of manufacturing goods produced, for 34 OECD countries[1] between the years 1990-2015.

It has been a common trend in the literature to investigate the presence of the Dutch disease in a country or in country groups (Sachs and Warner: 1995, Usui: 1997, Beine et al.: 2012, Bjørnland and Thorsrud: 2016). This vein of literature often aims to diagnose whether the country under investigation explicitly suffers from the Dutch disease or not. On the other hand, we hypothesize that although a country might be explicitly suffering from the Dutch disease in the context of the total sum of its industry, not all the industries, just the weaker industries within the country may have been hurt by the disease. This indicates an implicit case of the Dutch disease, detectable not in individual countries but in individual industries. Therefore, the study at hand aims to diagnose manufacturing industries, not countries. Our aim is to search for a common manufacturing-sector-based impact of the disease in countries, rather than on a country-specific basis. The intuition behind this inquiry is that high-technology manufacturing industries may not be negatively affected by the Dutch disease, since higher value added production in those sectors may prevent the factors of production from moving to the natural resources sector. On the contrary, low-technology manufacturing industries might be suffering from the disease because opportunities for higher value-added production in the natural resources sector may crowd out the low-technology manufacturing sectors. The gravity model is implemented to search for the interaction between the change in total natural resource rents as a share of GDP and manufacturing sector's performance for four subcategories of that sector[2]. The findings show that there exists a crowding out effect of rise in natural resource rents on the manufacturing sector in the four subcategories for the 34 OECD countries.

Section 1 provides explanation of the Resource Curse together with a review of literature on "Natural Resource Curse/Blessing" and "Dutch disease". In Section 2, data and model are explained and the findings are presented. Finally, the study is concluded.

1. Literature Review

There exists a vast theoretical and empirical literature investigating the influence of natural resources on the economic performance. The findings of these studies suggest that the interaction between the two variables is not bulletproof. Some studies, (e.g. Brunnschweiler, (2007: 413), Alexeev and Conrad, (2009: 586)) conclude that the abundance of natural resources contributes to prosperity; others object to that view and claim that it causes economic contraction. Especially after the 1960s, the evidence has suggested that resource-rich countries grow slower on average than resource-poor ones. Auty (1993: 1) defines the negative relationship as "Resource Curse". Auty (2001: 3) states that per capita incomes of resource-rich countries grew less than half rate as compared to resource-poor countries between 1960-1990. Many empirical studies such as Gelb (1988: 143); Sachs and Warner (1995: 2; 1997: 2; 1999: 43; 2001: 827); Gylfason et al., (1999: 213, 223), Atkinson and Hamilton (2003: 1804), Neumayer (2004: 1636), Bulte et al. (2005: 1038) conclude that resource abundance might engender suffering in economic performance. Similarly, Torvik (2009: 242), in Figure 1, shows that as Resource exports/GDP increases the GDP growth declines using the data of Mehlum et al. (2006).



Source: Torvik (2009: 242).

Figure 1: Resource Abundance and Growth

Besides the voluminous literature that investigates the existence/non-existence of the resource curse, there are also many studies that try to figure out the channels of the intriguing relationship between natural resource rents and dragging economic performance. According to Frankel (2010: 34), the main transmission channels can be summarized as: long-term trends in world commodity prices, terms of trade volatility, political instability and civil wars, poor institutions (which lead to rent seeking) and finally Dutch disease. Arin et al (2019: 2) empirically investigate each of the mentioned channels to put forth how natural resources affect growth in the medium-run. In this study, we focus on the Dutch disease explanation of the Resource Curse hypothesis.

Dutch disease is a paradoxical situation where a boom in one sector hinders the growth of the other one. Smith (2014: 1) states that the Economist magazine named that paradox as Dutch disease, following the decline in Netherland's economic growth rate after the discovery of large natural gas fields in the 1960s. The standard core model regarding the analysis of Dutch disease was developed by Corden and Neary (1982: 825-848) and extended by Corden (1984: 360-376). Dutch disease causes the overall growth rate to deteriorate with respect to a de-industrialization process following a boom in natural resources sector. The boom causes a reallocation of resources through spending effect (demand side) which paves the way to indirect de-industrialization and resource movement effect (supply side) which gives rise to direct de-industrialization. Some of the countries experience the two effects together whereas some of them realize just one. Stijns (2005: 110) argues that the results of the boom are different for different countries. He states that the stories of developed countries differ from the less developed ones due to their structural differences such as property rights systems. Cherif (2013: 254) states that the Dutch disease is sterner in the developing countries.

Many empirical studies have been conducted to diagnose Dutch disease in OECD countries. For example, Corden (2012) and Bjørnland and Thorsrud (2016) are among the latest studies that examine Dutch disease in Australia. Larsen (2006), Holden (2013), Bjørnland et al. (2019) investigate the Dutch disease in Norway. James and Aadland (2011), Allcott and Keniston (2018) are among the studies that search for Dutch disease in the United States. Beine et al. (2012) investigate whether the Canadian economy suffers from Dutch disease.

Among the studies, which employ gravity model of trade to search for the existence of Dutch disease are Stijns (2003), Kubo (2014), van der Marel and Dreyel (2014) and Feshari (2016). Stijns (2003) conducts an empirical analysis using gravity model to investigate Dutch disease regarding world trade data and concludes that there is little evidence for the existence of Dutch disease. The study conducted by Kubo (2014) uses gravity model and finds signs of Dutch disease. van der Marel and Dreyel (2014) employs the model to analyze Dutch disease in Russia. The authors conclude that Russia suffers from Dutch disease and they relate this result to the weak rule of law prevailing in the country. Feshari (2016) investigates the existence of Dutch disease in the Iranian economy using the gravity model of trade for the 1990-2015 period and finds no evidence of Dutch disease.

2. The Model and the Data

The methodology of the study rests upon the gravity model of trade. It is used to search for the existence of

Dutch disease from a technology intensity perspective for 34 OECD countries between the years 1990-2015.

2.1. Conceptual Framework of the Gravity Model

Gravity model of trade resembles the gravity model of physics that is based on Newton's Law of Gravity[3]. In both physics and economics, there is an inverse relation between the distance and attraction or economic relations[4]. Trade among the countries is basically a function of the distance and the GDP of each country together with some other determinants[5].

The gravity model has been used in economics, after its initiation by Tinbergen (1962) and Pöyhönen (1963). Many researchers such as Anderson (1979: 106), Feenstra et al. (2001: 430), Brun et al. (2005: 99), Head and Mayer (2014: 132) present the model as a grindstone for grasping the international trade flows. The main criticism the gravity equation received was its inability to model what was generally called multilateral trade resistance term (MRT), a term that was coined in order to define a well-documented fact that a given country will trade with another given country at varying volumes depending on what other options it has in terms of trade patterns. Therefore, many scholars have focused on incorporating multilateral resistances into the gravity equation.

The gravity literature has been developing for decades and as Frankel states (1998: 2) it keeps developing towards more accurate theoretical baseline. The earlier contributions to the model have been made by studies such as Anderson and van Wincoop (2003: 170) and Feenstra (2004) and Baier et al. (2007). Bergstrand et al. (2013: 110) state that Anderson and van Wincoop (2003) strengthened the theoretical foundations of the gravity model. Head and Mayer (2014: 136) argue that the study conducted by Feenstra (2004) considered the impact of multilateral trade resistances by means of considering importer and exporter fixed effects. Behrens et al. (2012: 785) also state that Feenstra (2004) captures the impact of the multilateral trade resistance term by employing region-specific importer and exporter fixed effects. Finally, the most up-to-date contributions regarding the correct application of the gravity model have come from as Bergstrand et al. (2015) and Baier et al (2015). Extending these recent developments in an advanced guide to trade policy empirics published by the World Trade Organization, Yotov et al. (2016) demonstrate the latest developments in empirical gravity literature to obtain reliable estimates of the gravity model. The authors state that the use of exporter/importer-time fixed effects is a feasible way of controlling for the multilateral resistances as well as observable and unobservable characteristics that change over time for each exporter and importer (Yotov et al., 2016: 24).

2.1.1. The data and the model

2.1.1.1. The Data

The manufacturing exports data has been compiled from the OECD Structural Analysis Database for 34 OECD countries. The data have been categorized according to OECD's classification of manufacturing industries based on technology intensity. According to ISIC Rev 3 classification[6], we organized manufacturing exports data in four groups in order to investigate whether the impact of the Dutch disease varies depending on different levels of technology intensity.

Total natural resources rent as a share of GDP data is gathered from the World Bank Database. Total natural resources rents are found by adding oil, natural gas, coal, mineral and forest rents. We use the annual change in GDP share of total natural resources rent. We form the rest of the gravity model variables in accordance with the contemporary gravity literature using CEP II [7] gravity data set.

2.1.1.2. The Model

The econometric model in this study is an application of a theoretical gravity model in accordance with the methodology suggested by Yotov et al. (2016: 24). In line with their recommendation, we employ exporter-year and importer-year fixed effects to account for the multilateral resistance terms in our analysis. We run five separate regressions based on the following equation. In Model 1, the dependent variable is the natural logarithm of total manufacturing exports without any classification of technology intensity. Construction of this model is important in understanding if there is any crowding-out effect on the total manufacturing exports of the countries as a consequence of increases in total natural resources rents. Each of the remaining four models investigates the case for a different level of technology intensity using the following equation to see whether there is any difference among the industries with different technology intensity.

Equation: $\ln(X_{ijt}) = \beta_0 + \beta_1 rent_{it} + \beta_2 lndist_{ij} + \beta_3 exporter\_year\_FE + \beta_4 importer\_year\_FE + \varepsilon$

where;

X_{ijt}:	Natural logarithm of manufacturing exports from country i to j in year t (dependent variable)
$dist_{ij}$:	Natural logarithm of distance between trade partners
$rent_{it}$:	Percentage change in the GDP share of total natural resource rents
exporter_year_FE :	Vector of exporter-year fixed-effect dummies
importer_year_FE :	Vector of importer-year fixed-effect dummies

The dependent variable in each model is the manufacturing exports. The key independent variable of investigation in our model is "rent". This variable measures annual percentage change in the GDP share of total natural resource rents. The aim is to capture the impact of changes in the GDP share of the total natural resources rent on manufacturing exports as an indicator of Dutch disease. In that sense, if an increase in the size of the total natural resources rent in a country results in a decrease in total manufacturing exports, this finding can be interpreted as a sign of Dutch disease. Therefore, we expect a negative sign on the coefficient of the "rent" variable. Exporter-year and importer-year fixed-effect dummy variables control for the multilateral resistance terms.

2.1.1.3. Estimation Results

Table 1 presents our regression results. The findings of Model 1 suggest a negative impact of increases in GDP share of total natural resources rent on total manufacturing exports, with the sign of the "rent" variable negative as expected and statistically significant at 1%. Thus, the presence of Dutch disease symptoms in Model 1 further justify our convictions that a technology-intensity based analysis could be fruitful. Models 2, 3, 4 and 5 cover high-technology, medium-high technology, medium-low technology and low-technology manufacturing industries, respectively. In all of the five models, the distance variable is significant at 1% with the expected sign. The "rent" coefficient is also negative and significant at 1 % in the remaining four models. This finding implies that there exists a negative relationship between manufacturing exports and the change in total natural resource rents in all four categories of technology intensity, signaling towards symptoms of Dutch disease.

On the other hand, we find a significant trend in the respective impacts of the percentage change in the GDP share of total natural resource rents on manufacturing exports. The movement of the coefficient of the rent variable across the four models indicate that the impact of the change in total natural resources rent varies with the technology-intensity of the manufacturing sectors. This is apparent by the result that the coefficient of the variable rent is -0.029 in Model 5, -0.043 in Model 4, -0.076 in Model 3 and -0.081 in Model 2. That is, the more technologically-intensive manufacturing industries become, the higher is the negative impact of increases in total natural resources rents on manufacturing exports. The case seems to be that high-technology manufacturing industries are more prone to Dutch disease symptoms than low-technology manufacturing industries in the OECD countries for the period between 1990-2015. This finding is in line with the study conducted by Bresser-Pereira (2008), which states that high-technology industries are more affected by the disease.

Table 1: Regression results

Manufacturing Exports, 1990-2015					
Explanatory Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
constant	21.28**	18.50**	20.73**	23.50**	22.69**
	(55.76)	(51.16)	(41.45)	(50.05)	(54.36)
dist	-1.51**	-1.44**	-1.63**	-1.90**	-1.75**
	(-166.90)	(-124.86)	(-169.15)	(-172.76)	(-184.07)
rent	-0.060**	-0.081**	-0.076**	-0.043**	-0.029**
	(-8.75)	(-12.48)	(-8.72)	(-5.19)	(-3.50)
R-Squared	0.8632	0.8209	0.8504	0.7997	0.8030
Number of Observations	116.178	106.641	110.626	106.444	109.821

* Significant at 5%
** Significant at 1%

To sum up, the models' results demonstrate that significant changes in natural resource rents in countries bring about significant effects on manufacturing exports by countries, as the variable is statistically significant in all four models. This implies that the results reported in Table 1 comes in harmony in implying that symptoms of a Dutch disease appear when international trade of goods are categorized in accordance with the level of technology.

Conclusion

One of the highly discussed issues in economics literature is the linkage between the natural resource endowments and the growth rate of countries. Some scholars argue that natural resources bring prosperity to countries, while others oppose that view and argue that natural resources act like a curse for the countries that have plenty of them.

The impact of natural resource rents on economic performance is generally analyzed within the context of Resource Curse literature. This literature highlights the several channels through which windfall resource revenues may affect economic performance. In this study, we focus on the so-called Dutch disease channel to examine the impact of natural resource rents on manufacturing exports to capture evidence for Dutch disease from a technology intensity perspective.

We first check if there is a significant relationship between changes in GDP share of total natural resources rent and manufacturing exports, as a symptom of Dutch disease. After we detect the presence of the relationship, we try to find out if there is any difference, in terms of the intensity of Dutch disease symptoms, among the high-technology, medium-high technology, medium-low technology and low-technology manufacturing industries for the 34 OECD countries, for the period between 1990-2015. The results show that the negative impact of increases in total natural resources rents on manufacturing exports becomes higher as the manufacturing industries become more technology-intensive. In other words, high-technology manufacturing industries seem to be more prone to Dutch disease symptoms than low-technology manufacturing industries. One of the reasons behind this result might be related to the constraint on R&D expenditures. Since natural resources sectors also require high R&D investments, expansions of the natural resource sectors might put a drag on the R&D activities in the technology-intensive manufacturing industries. On the other hand, a booming natural resources sector might hinder diversification and complexity in the manufacturing sector. Future research might shed light on the magnified impact of Dutch disease on high-technology manufacturing industries.

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Endnotes

1 The list of the 34 OECD countries : Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

2 These subcategories are defined as: high technology (high-tech), medium-high technology (medium-high tech), medium-low technology (medium-low tech) and low technology (low tech) industries by the OECD Directorate for Science, Technology, Industry Economic Analysis and Statistics Division.

3 $GF_{ij} = M_i M_j / D_{ij}$ $i \neq j$ where GF_{ij}: gravitational force between the two objects i and j, M_i: mass of object i M_j: mass of object j and D_{ij} : distance between the two objects. This equation clearly shows that the masses of the objects are directly proportional but distance is inversely proportional to the gravitational force between the two objects. This explanation implies that the countries with relatively larger GDP tend to have larger bilateral trade flows.

4 Anderson (2010: 2) states that a good found at origin i, Y_i, is attracted by a mass of another good at origin j, E_j, but the potential flow is negatively affected by the distance between the two locations, d_{ij}. Then, X_{ij} shows the movement of goods between the two places.

$$X_{ij} = \frac{Y_i E_j}{d_{ij}^2}$$

5 Anderson and van Wincoop (2004) accentuate that trade costs matter by the statement “the death of distance is exaggerated”. This implies that trade among nations is highly affected from the trade costs which is generally related to transportation availabilities, insurance, freight and other related costs.

6 To see the details of Classification of manufacturing industries according to ISIC Rev. 3 Technology Intensity Definition please visit https://www.oecd.org/sti/ind/48350231.pdf

7 To gather more information visit http://www.cepii.fr/CEPII/en/cepii/cepii.asp