Services, Inequality, and the Dutch Disease*

Bill Battaile†, Richard Chisik‡, Harun Onder §

July 8, 2014

Abstract

This paper shows how Dutch disease effects may arise solely from a shift in demand following a natural resource discovery. The natural resource wealth increases the demand for non-tradable luxury services due to non-homothetic preferences. Labor that could be used to develop other non-resource tradable sectors is pulled into these service sectors. As a result, manufactures and other tradable goods are more likely to be imported, and learning and productivity improvements accrue to the foreign exporters. However, once the natural resources diminish, there is less income to purchase the services and non-resource tradable goods. Thus, the temporary gain in purchasing power translates into long-term stagnation. As opposed to conventional models where income distribution has no effect on economic outcomes, an unequal distribution of the rents from resource wealth further intensifies the Dutch disease dynamics within this framework.

JELClassification: F11, D31, Q33, Q31

Keywords: Resource-rich, Services, Inequality, Dutch Disease

*We would like to thank Chad P. Bown, Leonardo Hernandez, Sudharshan Gooptu, Ahmad Ahsan and seminar participants at the World Bank for useful comments and suggestions.

†The World Bank, 1818 H Street NW, Washington, DC 20433, Mail-Stop: H 4-402. E-mail: bbattaile@worldbank.org. Phone: +1-202-473-1714.

‡Corresponding author, Department of Economics, JOR-211, Ryerson University, Toronto, ON, M5B 2K3. E-mail: rchisik@arts.ryerson.edu. Phone: +1-416-979-5000 Ext. 4620.

§The World Bank, 1818 H Street NW, Washington, DC 20433, Mail-Stop: H 4-402. E-mail: honder@worldbank.org. Phone: +1-202-473-5196.

1 Introduction

The Dutch disease is an old, well-known, and still relevant paradox in economics. It describes how the initial good fortune of an exhaustible natural resource find (or a commodity price boom, or a foreign transfer, or remittances) can turn sour in the long run. It has historically been considered an exchange rate phenomenon: world demand for a newly discovered natural resource inflates the discovering country's currency and inhibits development of the non-resource traded sectors.

Although the original use of the term Dutch disease (in the Economist magazine, 1977) referred to an appreciation of the Dutch Guilder after oil was found in the North Sea, there are several ways in which the disease can occur. In fact, although many countries lucky enough to be abundant in a valuable natural resource do suffer lower long-run growth,[1] it is not always clear that it is the result of an inflated currency. Historic mining towns provide a good example of the natural resource curse occurring without a concurrent currency appreciation. For example, many attractive ski towns in the western United States (from Aspen to Telluride in Colorado) were built during gold and silver booms in the mid-nineteenth century. These towns shared the same currency as the rest of the United States. Still, when the ore was depleted the towns found themselves without any other viable sources of income until the discovery of white gold (snow and lift serviced skiing) in the second half of the twentieth century. An older example is given by Potosí, Bolivia, which was famous as one of the richest cities in the world during its silver boom – that began in the sixteenth century – and has remained mired in poverty since the abundant silver stock was mostly depleted in the eighteenth century.

Recognizing the limitation of a pure exchange-rate explanation of the Dutch disease, several economists have developed models that provide additional non-monetary explanations of the natural-resource curse. Starting with Corden and Neary (1982) economists have recognized a factor of production movement effect and a spending effect as elements of the Dutch disease. In their seminal model the energy and manufactured sectors are tradable and services are non-tradable. The increased value of factors of production in the energy sector causes their movement to that

[1] Sachs and Warner (2001) note that "there is virtually no overlap in the set of countries that have large natural resource endowments – and the set of countries that have high levels of GDP". On the other hand, Lederman and Maloney (2008) highlight the difficulty of identifying a causal relationship between natural resource finds and economic growth.

sector and raises their nominal return which makes manufacturing more costly. Furthermore, the additional wealth from the commodity boom generates greater expenditures on services which can increase the real exchange rate. Both of these effects can generate increased reliance on imports of manufactured goods and a reduction in their production.

In Matsuyama (1992), increased labor demand by the suddenly more productive agricultural sector (which can be reinterpreted as any natural resource) and the resulting wage increase diminishes labor demand in the manufacturing sector. When the new source of wealth is exhausted, the lack of home-country learning-by-doing in these industries renders their production lost forever and the resulting long-run home-country relative wage and welfare are lower than they would have been in the absence of the resource find.[2] In Krugman (1987) the resource find generates increased expenditures on non-tradable goods which raises the home-country relative wage and, thereby, induces a loss of comparative advantage in some industries. Again the reduction of learning-by-doing in the now smaller manufacturing sector renders it less competitive, so that a short-run gain can generate long-run stagnation.[3]

In this paper we address three stylized facts about the Dutch disease that are not well accounted for in these previous papers. First, many countries do not suffer a large shift of labor towards the resource sector. As noted by Brahmbhatt et al (2010) this effect is less prevalent in low-income countries. Furthermore, in many of the wealthy gulf oil states in the Middle East, the workers are brought in from abroad. As shown by Kapiszewski (2006) the percentage of foreign-born workers in Kuwait, Qatar and the UAE (in 2004) is 64.4, 70, and 81 percent of the total population. A similar example is given by many South American countries where mining constitutes a large part of export revenues, but employs a very small part of the population. For example, mining made up 59 percent of Peru's exports in 2011 but employed only 1 percent of the labor force (Calfucura et al, 2013). Second, in countries with a large informal sector it is hard to see any evidence of wage appreciation. The informal sector is estimated to comprise 50 to 75 percent of the labor force in Latin America and Africa (Calfucura et al, 2013, document that it is 60 percent in Peru). Third, the

[2]Matsuyama (1992) not only provides an explanation of the Dutch disease, but, more importantly, shows how an increase in agricultural productivity can generate long-run growth in a closed but not an open economy.

[3]The basic premise of production factors shifting to the sector with increased productivity follows from standard textbook models of comparative advantage (Ricardo, Ricardo-Viner, and the Rybczynski effect) and by itself, without a consequent loss of learning-by-doing or external economies of scale, would not generate lower long-run growth.

disease does not occur in all countries that have a natural resource boom. [4]

In this paper we address the Dutch disease, as arising solely from a shift in demand. In particular, the new found wealth from the resource find increases demand for non-tradable luxury consumption services.[5] Labor that could be used to develop the manufacturing sector is pulled into the service sector. Manufactured goods are more likely to be imported and the learning and production process improvements accrue to the foreign exporters. Although the newly resource abundant country may develop increased expertise in providing these services, most of these services are targeted to domestic consumption and not easily exportable, and after the resource is diminished there is less income to purchase these services. In the end the resource find can generate economic stagnation.

The key to our framework is demand shifting to these luxury services as a result of the new found resource wealth. It is common in economic models to assume that the marginal (and average) propensity to consume a good are not dependent on income. These constant income shares, that result from the assumption of homothetic preferences, are standard in the economics literature. Although they have several nice mathematical properties and are much easier to work with in formulating models, they have two very important limitations. First, they are repeatedly contradicted by the empirical evidence. From Stone's (1954) seminal work on expenditures through Hunter and Markusen's (1988) groundbreaking work that demonstrates its importance in explaining the pattern of trade, the data continually confirm that preferences are non-homothetic and consumption bundles do change with income. Second, aggregate demand is not affected by income distribution under the assumption of homothetic preferences. As the distribution of natural resource wealth is often unequal it is necessary to consider how changes in the distribution of this wealth affects the prevalence of the Dutch disease. In our framework we consider not only per

[4] In addition to the well-known case of Norway, Lederman and Maloney (2008) cite literature showing that Australia, Canada, Finland, Sweden, and Chile are all net natural resource exporters with no obvious indications of Dutch disease.

[5] We use the term "luxury" to indicate an income elasticity greater than one. Thus "luxury services" pertain to services with demand that increases with income, such as housekeeping, hiring a nanny, yard maintenance and in part retail shopping. The association of increases of these types of services with resource dependence is consistent with empirical evidence of the structural transformation of non-renewable resource economies over time. Battaile and Mishra (forthcoming) show that these types of economies on average have demonstrated a large jump in the share of GDP coming from service sectors (from 26 percent in the 1980s to 44 percent in the 2000s). This 18 percentage point shift compares to 10 and 12 percentage point gains in the share of services in GDP for low and middle income countries, respectively. In addition, resource dependent economies have had generally lower levels of trade in services, relative to other countries at similar income levels.

capita income but also changes in the distribution of income.

Our main result is that the Dutch disease is more likely to arise when resource rent distribution is less equal. This result is intuitive. A natural resource find is like finding money. By itself, it should not generate lower long-run welfare unless it creates expenditure distortions. If the resource wealth is narrowly distributed, then, as will be shown below the distortions are greater. Hence, given two countries with identical technologies, labor supplies, skill development, and natural resources, but differences in income distribution (solely as a result of ownership of the rents generated by the resources) the country with the less equal distribution will have less production of manufacturing goods and less development of learning-by-doing in this sector.[6]

A second important result of our paper is that the Dutch disease can occur without any movement of productive factors to the resource sector. This result is by design of the model. In particular, the natural resource sector is modeled in such a manner that it cannot hire factors from the rest of the economy.[7] Hence, we can see the paradox of plenty occurring only from the shift in demand that accompanies the new found wealth. A third important result of our model is that the wage in the country that has the resource boom (or the less equal income distribution) does not increase relative to that of the other country. In fact, it can decline over time. This result occurs mainly because international trade equalizes the domestic and foreign prices of manufactures, so that relative wages are given by productivity differences across countries. When the foreign production of manufacturing is increased by the home resource find, learning by doing generates long term productivity gains and real wage appreciation in the foreign country. Therefore, unlike traditional Dutch disease models, the manufacturing sectors does not need to be more costly production in the resource abundant country. It is simply not a priority in the short run.

In the next section we describe the economy of each country. We then consider trade when resource wealth is equally distributed. Our main results occur in the second part of this third section when the resource rents are unequally distributed in one country. Our conclusions are in the fourth section.

[6] In Corden's (1984) survey he suggests (in footnote 5) that changes in factor prices could actually overturn the spending effect found in Corden and Neary (1982). His suggestion is very different from our result which shows how the spending effect can be magnified (and not overturned) if the distribution of the resource rents is less equal.

[7] We are not the first to consider the natural resource sector as an endowment. See, for example van der Ploeg and Venables (2013).

2 Economic Environment

To establish our main points we develop as simple model that captures our main points. Following Corden and Neary's (1982) seminal work there are two tradable sectors in each country – natural resources (which they call energy and we will call oil) and manufacturing goods – and a non-tradable luxury consumption services sector (which we call services).[8] The manufacturing goods include manufacturing services as well as sales and infrastructure services. There is learning-by-doing in the manufacturing sector so that increased output in the current period increases labor productivity in later periods. Items in the services sector are not tradable and include construction, entertainment, and maintenance of imported Mercedes-Benz automobiles. Manufacturing and services are produced with a constant returns to scale technology using labor, the only factor of production. Each agent is endowed with the same amount of labor and the size of the identical labor force in each country is normalized to one. In addition to their labor endowment agents may also be endowed with oil. Oil can be consumed domestically or exported. In this simple model oil is not produced with labor but is realized as an endowment. By treating oil as an endowment we can demonstrate the Dutch disease without a resource movement effect. The price of oil is set on world markets and is normalized to unity.

Formally, one unit of labor produces M_t, (M_t^*) units of the manufacturing good in the home and foreign country. Similarly, $A = A^*$ are the identical labor productivities in the services sectors in both countries. The labor productivity in manufacturing is a function of the entire past output. In particular, the labor productivity at time t increases with past output as a result of the learning and refinement of the production process in previous periods. Formally, the output of manufactured goods in the home country at time t is

$$Q_{Mt} = \ell_t M_t = \ell_t \int_0^t \delta Q_{M\tau} d\tau, \tag{1}$$

where $\delta < 1$ and ℓ_t is the quantity of labor supplied to the manufacturing sector in period t. Foreign learning obeys the same process with the same δ. Of course, ℓ_t^* and Q_{Mt}^* may differ. From

[8] As Brahmbhatt et al (2010) point out "researchers typically model the economy as consisting of three sectors: the natural resource sector, the non-resource tradables sector (usually understood as agriculture and manufacturing), and the nontradables sector (including nontradable services and construction), as presented in Corden and Neary (1982)."

this point on we will not separately describe the foreign variables when the distinction is obvious. The instantaneous rate of change in labor productivity in the manufacturing sector is $\dot{M}_\tau = \delta Q_{M\tau}$. At times we will be interested in describing the labor productivity at time 0 before any learning has occurred (M_0). In addition we will suppress the time subscript when it is not necessary for the exposition.

Agents earn income from their labor and oil endowments. Each agent in the home and foreign countries has the same identical labor supply. There is a unit mass of agents in each country and the unit supply of labor in each country earns a wage w (w^*). The oil endowment in each country is given as θ (θ^*). In the foreign country each agent is endowed with the same amount of oil. The measure of home country agents who are endowed with oil is κ, where $0 < \kappa \leq 1$. We will refer to the κ agents as rich and to the $1-\kappa$ as poor. Each of the rich agents owns θ^R units of oil and $\kappa\theta^R = \theta$. Hence, if $\kappa < 1$,then each of the rich agents owns more than the average so that $\theta^R > \theta$. The measure of rich agents indexes the natural resource (and income) distribution in the home country. Inequality is decreasing in κ and the distribution is equal when κ approaches one. We will refer to decreases (increases) in κ as a worsening (improvement) of the income distribution.

Preferences in home and foreign over the three goods are of the same Stone-Geary variety.

$$u\left(d_S, d_M, d_O\right) = (d_S + \gamma)^{\alpha}(d_M)^{\beta}(d_O)^{1-\alpha-\beta} \tag{2}$$

where d_j is the consumption of good j and $\gamma > 0$ are the amount of services that can be enjoyed without being purchased in the market. These services may consist of socializing with friends or family, playing sports, reading, or taking walks.[9] If $\gamma = 0$, then these preferences would be Cobb-Douglass and agents would spend a constant income share $(\alpha, \beta, 1-\alpha-\beta)$ on each of the goods. As will be seen below, with $\gamma > 0$ services become a luxury good so that the marginal propensity to consume services is increasing in income. Stone-Geary preferences are more commonly depicted with $\gamma < 0$ so that it determines a subsistence level of the good. This more common depiction does not allow for a consideration of income distribution because all agents must achieve the subsis-

[9]It has been suggested that these free services may also consist of publicly provided goods such as parks or city beautification. Although we like this interpretation we are wary of including it because there is no government sector or taxation in our model. In addition, as Corden (1984) suggested the Netherlands example of the Dutch disease may have been caused by the government spending the windfall on Dutch social services.

tence level of the good and, therefore, purchase all three goods. Our luxury good version, with $\gamma > 0$ allows some agents to purchase no services in the market and allows us to make meaningful statements about income distribution.

Maximization of the above utility function subject to the income constraint $P_S d_S + P_M d_M + d_O = I$, where P_j is the price of good j and I is income, yields the following demand functions.

$$d_S = Max\{0,\ \frac{\alpha I - P_S\gamma(1-\alpha)}{P_S}\}$$

$$d_M = Min\{\frac{\beta I}{(1-\alpha)P_M},\ \frac{\beta(I+P_S\gamma)}{P_M}\} \tag{3}$$

$$d_O = Min\{\frac{I(1-\alpha-\beta)}{(1-\alpha)},\ (I+P_S\gamma)(1-\alpha-\beta)\}.$$

The foreign country demand functions are similar. The income, I, consists of wages and oil endowment. When the oil endowment is equally distributed, we can treat the individual demand functions as the aggregate demand with income $I^E = w + \grave{}$. When it is not equally distributed, the income for the rich agents is $I^R = w + \kappa\theta^R$ and for the poor agents is $I^P = w$. In the foreign country, where the oil endowment is equally distributed, $I^{E*} = w^* + \grave{}^*$. In order to consider income distribution we assume that only rich people can purchase services. From equation (3) this restriction on the parameters implies that

$$w < \frac{P_S\gamma(1-\alpha)}{\alpha} = I^0 < w + \theta. \tag{4}$$

Hence, when income distribution is equal there is positive demand for services by all agents. Equation (4) will be rewritten in terms of the primitives after w and P_S are derived in equation (6) below. Inspection of equation (3) also reveals that rich home country agents also consume differing amounts of manufactured goods and oil. Although less people purchase services in the home country, (when income is not equally distributed) they purchase relatively more of them (as a result of the positive income effect given by the non-homotheticity of preferences). An important determinant of our results is that the larger purchases dominates the fewer purchasers so that

total purchases of services are larger when income is less equally distributed. In particular, the difference between the aggregate purchases of services by rich people when income is unequally distributed and when income is equally distributed is

$$d_S^R\kappa - d_S^E = \frac{\alpha I^R - P_S\gamma(1-\alpha)}{P_S}\kappa - \frac{\alpha I^E - P_S\gamma(1-\alpha)}{P_S}1 = \frac{P_S\gamma(1-\alpha)-\alpha w}{P_S}(1-\kappa) > 0. \quad (5)$$

The above difference is strictly positive because of the restriction given in equation (4). This difference is decreasing in the measure of rich people and is, therefore, largest when income distribution is less equal (when κ approaches zero).[10] In particular, as the measure of rich agents drops and the total oil endowment remains the same, then each of them owns more of the oil. A similar comparison shows that the aggregate consumption of manufactured goods in the equal society is greater than that in the unequal one and that this difference is also increasing in the measure of poor people

$$d_M^A - (d_M^R\kappa + d_M^R(1-\kappa)) = \frac{(1-\kappa)\beta}{P_M}\frac{P_S\gamma(1-\alpha)-\alpha w}{1-\alpha} > 0.$$

It will be seen below that these differences play an important part in explaining the pattern of trade and learning-by-doing in otherwise similar economies.

3 International trade

We now consider international trade between the home and foreign countries. The price of the non-traded services can differ across countries, but the price of the traded manufactured goods are the same in both countries.[11] Given the above described technologies we have the following four prices

[10] Markusen (2013) makes use of a similar utility function with two goods and also shows that increased income inequality can increase demand for the luxury good. He uses this result to provide a possible explanation for the home bias effect in trade.

[11] If services were tradable, then our model would change in several ways. First, if there were zero transport cost, then our model would be Ricardian and the choice of manufacturing or services would be given by comparative advantage. Demand considerations and income distribution would only matter if they forced one country to not fully specialize. In this way, they are similar to the effects of country size on specialization and gains from trade in the standard Ricardian model with identical homothetic preferences. Allowing for a positive but non-prohibitive transport cost would not change the result but would reduce the gains from trade and allowing for prohibitive transport costs would return us to the present model.

$$P_M = \frac{w}{M} = \frac{w}{M^*},\ P_S = \frac{w}{A},\ P_S^* = \frac{w^*}{A},\ P_O = 1. \tag{6}$$

Using equation (6) we can rewrite equation (4) in terms of the primitives. We will refer to the restriction given in equation (7) below as assumption (1).

Assumption 1:

$$A < \frac{\gamma(1-\alpha)}{\alpha} < A + \theta. \tag{7}$$

This assumption clearly requires non-homotheticity of preferences ($\gamma > 0$). As long as the oil endowment is sufficiently large, it is more likely to be satisfied if services are more of a luxury good (larger γ), if they comprise a smaller share of total expenditure (smaller α) or if labor productivity in services (A) is not too large.

Oil can be traded, but is not produced, therefore, the total world demand must equal the total world endowment. The demand for the non-traded services must equal its supply in each country. The labor and all goods and services markets equilibrium is given by these equilibrium conditions.

$$d_O + d_O^* = \theta + \theta^*,\ d_S = A(1-\ell),\ d_S^* = A(1-\ell^*). \tag{8}$$

3.1 Equal income distribution in both countries

We start by considering international trade when both countries have the same equal income distribution. From the equality of world demand and supply for oil and the pricing equation for services we have

$$(w + w^* + \frac{w + w^*}{A}\gamma)(1-\alpha-\beta) = (\theta + \theta^*)(\alpha + \beta) \tag{9}$$

Combining the separate zero excess demand conditions for services in each country along with the pricing equation for services yields the following two wage equations for home and foreign.

$$w = \frac{A\alpha\theta}{A(1-\ell-\alpha)+\gamma(1-\alpha)},\ w^* = \frac{A\alpha\theta^*}{A(1-\ell^*-\alpha)+\gamma(1-\alpha)}. \tag{10}$$

Combining equations (9) and (10) along with the pricing equation for manufactured goods given in equation (6) completely describes the international trading equilibrium. The price of the manufacturing good and the measure of labor in the manufacturing sector in each country is then given by

$$P_M = \frac{A(\alpha+\beta)(\theta+\theta^*)}{(M+M^*)(A+\gamma)(1-\alpha-\beta)},\ \ell = \frac{(1-\alpha)(A+\gamma)}{A} - \frac{\alpha\theta}{MP_M},\ \ell^* = \frac{(1-\alpha)(A+\gamma)}{A} - \frac{\alpha\theta^*}{M^*P_M}. \tag{11}$$

We can now state our first proposition.

Proposition 1. *Assume that oil endowments are equally distributed within each country. (i) If oil endowments are the same in both countries, then the country with greater labor productivity in manufacturing at time 0 will have a comparative advantage in manufacturing. (ii) If manufacturing technology is the same in both countries, then the country with the smaller oil endowment will have a comparative advantage in manufactured goods. (iii) If* $\frac{M_t}{M_t+M_t^*} > \frac{\theta}{\theta+\theta^*}\frac{\alpha}{1-\alpha}\frac{1-\alpha-\beta}{\alpha+\beta}$ *and* $\frac{M_t^*}{M_t+M_t^*} > \frac{\theta^*}{\theta+\theta^*}\frac{\alpha}{1-\alpha}\frac{1-\alpha-\beta}{\alpha+\beta}$*, then both countries produce manufactured goods. (iv) If the condition in part (iii) holds, then an increase in the oil endowment of the home country will increase the manufacturing production in the foreign country and decrease it in the home country.*

Proof. Substituting P_M into the manufacturing labor supply equations and taking the ratio yields

$$\frac{\ell_0}{\ell_0^*} = \frac{M_0^*M_0(\alpha+\beta)(\theta+\theta^*) - M_0^*(1-\alpha-\beta)\theta}{M_0^*M_0(\alpha+\beta)(\theta+\theta^*) - M_0(1-\alpha-\beta)\theta^*}. \tag{12}$$

Taking the partial derivative of the above equation with respect to M_0 and θ yields parts (i) and (ii) at time 0. From equation (1) manufacturing productivity at time t is an increasing function of the labor supply in manufacturing in all of the the previous periods. Hence, any initial comparative advantage will be magnified over time.

To establish part (iii) we solve for when ℓ_t (ℓ_t^*) are positive. To prove part (iv) we start by taking the partial derivative of the home and foreign country labor supply in manufacturing in any time period t with respect to the home oil endowment.

$$\frac{\partial \ell_t}{\partial \theta} = \frac{\alpha}{M_t (P_{Mt})^2} \left(\theta \frac{\partial P_{Mt}}{\partial \theta} - P_{Mt} \right)$$

$$\frac{\partial \ell_t^*}{\partial \theta} = \frac{\alpha}{M_t^* (P_{Mt})^2} \theta \frac{\partial P_{Mt}}{\partial \theta} \tag{13}$$

Combining these above derivatives along with

$$P_{Mt} > \theta \frac{\partial P_{Mt}}{\partial \theta} = \frac{A(\alpha + \beta)\theta}{(M_0 + M_0^*)(A + \gamma)(1 - \alpha - \beta)} > 0 \tag{14}$$

yields part (iv). □

The condition in part (iii) provides a lower bound for manufacturing productivity, or an upper bound for the size of oil endowment, so that a country keeps producing manufacturing goods. In the case where the country no longer produces the manufacturing goods, it obviously still suffers from Dutch disease in our model, however, a further increase in their oil endowment (or their relative productivity) cannot generate a further deterioration in manufacturing. For this reason, the proposition focuses on the more interesting interior solutions.

Proposition 1 shows that oil can generate a Dutch disease effect. Furthermore, it does not require labor shifting to the natural resource sector. On the other hand, as the proof illustrates it does not require non-homotheticity of preferences. All of the results would obtain even if $\gamma = 0$. The novel results in proposition 1 occur in part because services are non-traded and because oil production requires no labor. Hence, an increase in the oil endowment allows a country to increase its oil exports, therefore, reduces the need for export revenue from manufactures. Thus allows manufacturing labor to be reallocated to the service sector.

Still, it is important to note that our simple model can produce a Dutch disease effect without labor shifting to the natural resource sector. In addition, as the next proposition shows, it does

so without increasing the relative wage of the country that finds the oil. In fact, as a result of the reduction in manufacturing output the relative wage will decrease it in the long run.

Proposition 2. *An increase in the oil endowment of the home country does not change the relative home to foreign wage in the short run, but decreases it in the long run.*

Proof. From equations (10) and (11) the relative home wage is $\frac{w_t}{w_t^*} = \frac{M_t}{M_t^*}$ which does not depend on θ or θ^*.

After any increase in the oil endowment of the home country, the total change in the manufacturing labor productivity at any time t is given by

$$dM_t = \int_0^t \delta \frac{\partial Q_{M\tau}}{\partial \ell_\tau} \frac{\partial \ell_t}{\partial \theta_\tau} d\theta_\tau d\tau = \int_0^t \delta M_\tau \frac{\partial \ell_t}{\partial \theta_\tau} d\theta_\tau d\tau \tag{15}$$

which, from proposition 1, part (iv) is strictly negative as long as $d\theta_\tau \geq 0$ for all τ and $d\theta_\tau > 0$ for at least one $\tau < t$. □

3.2 Unequal oil endowment distribution in the home country

We now consider the effects of an unequal distribution of the oil revenues in the home country. In this case κ of the home agents have income $w + \theta^R$and the renaming $1 - \kappa$ have income w. The equilibrium is still described by the pricing, goods, services, and labor market conditions given in equations (6) and (8), however, the aggregate demands for each good and service are different when the agents consume differing bundles.

Rewriting the world trading equilibrium conditions for each market when the home oil endowment is not equally distributed and the rich and poor consume different amounts of goods and services yields the following equations. The world oil market equilibrium is given by

$$\left[w(1-\kappa) + (1-\alpha)w\kappa + (1-\alpha)w^* + (1-\alpha)\frac{w\kappa + w^*}{A}\gamma\right][1-\alpha-\beta] = (1-\alpha)(\alpha+\beta)(\theta+\theta^*). \tag{16}$$

From the services market equilibrium in each country we can derive the following wage equations

$$w = \frac{A\alpha\theta}{A(1-\ell-\alpha\kappa)+\gamma(1-\alpha)\kappa},\ w^* = \frac{A\alpha\theta^*}{A(1-\ell^*-\alpha)+\gamma(1-\alpha)}. \tag{17}$$

Note that the foreign services market is the same as in the previous section.

The manufactured goods market equilibrium is then described by

$$P_M = \frac{A(\alpha+\beta)(\theta+\theta^*)(1-\alpha)}{[(M\kappa+M^*)(A+\gamma)(1-\alpha)+MA(1-\kappa)][1-\alpha-\beta]},$$

$$\ell = \frac{A(1-\alpha\kappa)+\gamma(1-\alpha)\kappa}{A} - \frac{\alpha\theta}{MP_M},\quad \ell^* = \frac{(1-\alpha)(A+\gamma)}{A} - \frac{\alpha\theta^*}{M^*P_M}. \tag{18}$$

Note that these equilibrium conditions are derived for the case where the distribution of the oil rents are unequal. We are now in a position to state our main result.

Proposition 3. *If oil endowments and initial time zero manufacturing technologies are the same in both countries, then the foreign country will have a comparative advantage in manufactured goods if and only if oil endowments are not equally distributed in the home country.*

Proof. Using equation (18) to write the ratio of home to foreign manufacturing output in free trade at time 0 yields

$$\frac{\ell_0}{\ell_0^*} = \frac{[A(1-\alpha\kappa)+\gamma(1-\alpha)\kappa](\alpha+\beta)(\theta+\theta^*) - M_0^*\theta\tilde{Y}(\kappa)}{[(A+\gamma)(1-\alpha)](\alpha+\beta)(\theta+\theta^*) - M_0\theta^*\tilde{Y}(\kappa)}. \tag{19}$$

where $\tilde{Y}(\kappa) = \alpha[(M_0\kappa+M_0^*)(A+\gamma)(1-\alpha)+M_0A(1-\kappa)][1-\alpha-\beta]$. If $M_0 = M_0^*$,$\theta = \theta^*$, and $\kappa = 1$, then this ratio is equal to one and both countries produce the same output of manufactured goods. If $M_0 = M_0^*$,$\theta = \theta^*$, and $\kappa \neq 1$, then this ratio can be written as $\frac{\ell_0}{\ell_0^*} = \frac{[A(1-\alpha\kappa)+\gamma(1-\alpha)\kappa]X-Y(\kappa)}{[(A+\gamma)(1-\alpha)]X-Y(\kappa)}$. To show that this ratio is less than one we must show that $[A(1-\alpha\kappa)+\gamma(1-\alpha)\kappa] < [(A+\gamma)(1-\alpha)]$ for all $\kappa < 1$. First note that it holds as an equality when $\kappa = 1$. Now note that the derivative of the left-hand side with respect to κ is $\gamma(1-\alpha)-\alpha A$ which is positive by assumption (1). □

Proposition 3 complements proposition 1 by showing that it is not only the realization of a natural resource windfall that can generate a Dutch disease effect but it is also the distribution of the resource rents. It provides a possible answer as to why some countries suffer a worse disease after finding a natural resource. Proposition 3 is limited, however, in that it only considers the initial period and only compares equal to unequal distributions. To more fully see the effect of the natural resource distribution on manufacturing and service production we now consider the marginal effect of distribution after any history.

Proposition 4. *(i) If* $\frac{AM_t}{AM_t+(A+\gamma)(1-\alpha)M_t^*} > \frac{\theta}{\theta+\theta^*}\frac{\alpha}{1-\alpha}\frac{1-\alpha-\beta}{\alpha+\beta}$ *and* $\frac{M_t^*}{M_t+M_t^*} > \frac{\theta^*}{\theta+\theta^*}\frac{\alpha}{1-\alpha}\frac{1-\alpha-\beta}{\alpha+\beta}$*, then both countries produce manufactured goods for all* $\kappa \in [0,1]$*. (ii) If the condition in part (i) holds and, if* $\theta \geq \theta^*$*, then a worsening of the resource distribution reduces the output of manufactured goods in the home country and increases their production in the foreign country.*

Proof. To see part (i) we solve for when ℓ and $\ell^*$are strictly positive. First note that $\ell > 0$ if

$$\frac{[(A+\gamma)(1-\alpha)+\gamma(1-\alpha)\kappa]M_t}{AM_t(1-\kappa)+(A+\gamma)(1-\alpha)(M_t\kappa+M_t^*)} > \frac{\theta}{\theta+\theta^*}\frac{\alpha}{1-\alpha}\frac{1-\alpha-\beta}{\alpha+\beta}.$$

From assumption (1) the left-hand side of the above inequality is strictly increasing in κ, therefore if it holds when $\kappa = 0$ it must hold for all κ. Substituting $\kappa = 0$ into the above expression gives us the first sufficient condition in part (i). The condition for $\ell^* > 0$ can be written as

$$\frac{[(A+\gamma)(1-\alpha)]M_t^*}{AM_t(1-\kappa)+(A+\gamma)(1-\alpha)(M_t\kappa+M_t^*)} > \frac{\theta^*}{\theta+\theta^*}\frac{\alpha}{1-\alpha}\frac{1-\alpha-\beta}{\alpha+\beta}.$$

Again using assumption 1 we have that the left-hand side of the above inequality is strictly decreasing in κ, therefore if it holds when $\kappa = 1$ it must hold for all κ. Substituting $\kappa = 1$ into the above expression gives us the second sufficient condition in part (i).

To prove part (ii) we take the partial derivative of the home and foreign country labor supply in manufacturing in any time period t with respect to the index of home resource distribution, while holding the total home endowment constant.

$$\frac{\partial \ell_t}{\partial \kappa} = \frac{-\alpha A+\gamma(1-\alpha)}{A}\left(1-\frac{\theta}{\theta+\theta^*}\frac{\alpha}{1-\alpha}\frac{1-\alpha-\beta}{\alpha+\beta}\right) > 0$$

$$\frac{\partial \ell_t^*}{\partial \kappa} = -\frac{\alpha\theta^*}{M^*}\frac{M[\gamma(1-\alpha)-\alpha A][1-\alpha-\beta]}{A(\alpha+\beta)(\theta+\theta^*)(1-\alpha)} < 0. \tag{20}$$

In signing the above derivative we again use assumption (1). In addition, in signing the first derivative we use that α <1 and that $\theta \geq \theta^*$. □

Proposition 4 extends proposition 3 by showing that a worsening of the distribution of the oil endowment causes a deterioration of the home manufacturing base and improves that in foreign. This result holds irregardless of the previous history and irregardless of the manufacturing productivity in period t. In fact, the reduction in home manufacturing is independent of the home manufacturing technology. Greater relative home technology ($\frac{M}{M^*}$) does, however, reduce the foreign manufacturing growth that results from worse home resource rent distribution. In addition, note that $\theta \geq \theta^*$ is not necessary for the result, therefore, the result could obtain even if $\theta < \theta^*$. Finally note that the effect is stronger when services are more of a luxury item (γ is larger). We state these extensions as a corollary of proposition 4.

Corollary 5. *If both countries produce manufacturing goods, then even if the home country has better initial technology in manufacturing and a smaller natural resource endowment, it can still have a comparative disadvantage in manufacturing if it has worse natural resource rents distribution.*

Finally, we show that the Dutch disease can arise solely from less equal natural resource rents distribution. Furthermore, this Dutch disease effect exists without labor shifting to the natural resource sector or without increasing the relative wage of the country with worse resource rent distribution. In fact, as a result of the reduction in manufacturing output, the relative wage will decrease in the long run.

Proposition 6. *A worsening of the home country resource rent distribution can generate manufacturing stagnation. It does so without a change in the relative home to foreign wage in the short run and with a decrease in the long run.*

Proof. From equations (10) and (11) the relative home wage is $\frac{w_t}{w_t^*} = \frac{M_t}{M_t^*}$ which does not depend on κ, θ or θ^*.

After any change in the resource rent distribution of the home country, the total adjustment in the home manufacturing labor productivity at any time t is given by

$$dM_t = \int_0^t \delta \frac{\partial Q_{M\tau}}{\partial \ell_\tau} \frac{\partial \ell_t}{\partial \kappa} d\kappa d\tau = \int_0^t \delta M_\tau \frac{\partial \ell_t}{\partial \kappa} d\kappa d\tau \tag{21}$$

which, is strictly negative as long as $d\kappa < 0$ by proposition 4, part (ii). Similarly, the total change in foreign manufacturing labor productivity is

$$dM_t^* = \int_0^t \delta \frac{\partial Q_{M\tau}^*}{\partial \ell_\tau^*} \frac{\partial \ell_t^*}{\partial \kappa} d\kappa d\tau = \int_0^t \delta M_\tau^* \frac{\partial \ell_t^*}{\partial \kappa} d\kappa d\tau < 0.$$

□

4 Conclusion

In this paper we demonstrate that the Dutch disease effect may arise solely from demand considerations without productive factors moving to the resource sector, without any wage increase, and without any currency appreciation. First, we show that it can arise solely from increased demand for non-traded services. Second, we show that this increased demand is augmented by unequal distribution of the resource rents. As services become more of a luxury item and/or the resource rents are less widely distributed, the Dutch disease is more pronounced. Our results suggest why some countries, therefore, have a greater chance of suffering the curse.

Our emphasis on the importance of resource rent distribution for Dutch disease effects resonates with recent thinking that the resource curse is generally seen as conditional on poor political governance (see for example, Elbadawi and Soto 2012 and Acemoglu and Robinson 2012). The stark political reality of resource discoveries is that rents are often contested in the context of highly unbalanced and non-inclusive power structures that privilege short-term personal enrichment over long-term collective welfare enhancement (Barma et al 2012). It is intuitive to view these features as modalities for motivating our modeling of unequal distribution of resource rents, and they will remain important policy issues in these countries for some time. As much as institutional quality

is correlated with income and natural resource rent distribution, then our model suggests that the effect may exist at a more primitive distributional level.[12] We leave further development of these ideas for future research.

Our analysis also relates to a recent debate evolving around optimal use of resource revenues in developing countries. Devarajan and Giugale (2013) make the case for universal and uniform direct payments to the population in resource rich African countries, which could lead to a reduction in poverty and enhancement in social welfare. Although we do not consider alternative mechanisms, our main result demonstrates that equality in distribution of natural resource rents could be an important factor to cope with Dutch disease dynamics. Future contributions to this discussion should explicitly consider the mechanisms through which natural resource rents are allocated.[13]

It may also be worthwhile to consider the introduction of traded services into the analysis. In particular, with learning-by-doing in tradable services, a resource rich country (or one that receives large foreign transfers) could develop a comparative advantage in the provision of luxury services.

References

[1] Acemoglu, D., S. Johnson, and J.A. Robinson (2001). "The Colonial Origins of Comparative Development: An Empirical Investigation." American Economic Review, 91(5): 1369-1401.

[2] Acemoglu, D. and J. Robinson (2012). "Why Nations Fail: The Origins of Power, Prosperity and Poverty". New York: Crown Publishers.

[3] Barma, N.; K. Kaiser; T. M. Le and L. Viñuela (2012). "Rents to Riches? The Political Economy of Natural Resource Led Development." Washington, DC: World Bank Press.

[12] Recent research by Law et al (2014) shows that income inequality is negatively correlated with institutional quality.

[13] An important observation here is that different allocation mechanisms may not be perfect substitutes. For example, remittances or foreign aid are conventionally considered to be analogous to natural resource finds in the literature. Although all these channels denote a windfall, the channels of injection to the economy could be different. Whereas the natural resource rents may be captured by elites who already represent the upper segments of the income distribution, remittances may be associated with poor or middle-class households on the receiver ends. Our framework, therefore, shows that natural resource finds and remittances may have different Dutch disease implications.

[4] Battaile, B. and S. Mishra (forthcoming). "Benchmarking Structural Change in Non-Renewable Resource Economies (NREs)." World Bank.

[5] Brahmbhatt, M., O. Canuto, and E. Vostroknutova (2010). "Dealing with Dutch Disease," World Bank Economic Premise, June 2010, Number 16.

[6] Calfucura, E., A.M. Ortiz, C. Sanborn, and J.L. Dammert (2013). "The Good, The Bad and The Ugly," Americas Quarterly, Winter 2013.

[7] Corden W.M. (1984). "Boom Sector and Dutch Disease Economics: Survey and Consolidation." Oxford Economic Papers, 36(3): 359-380.

[8] Corden W.M. and J.P. Neary (1982). "Booming Sector and De-industrialisation in a Small Open Economy." The Economic Journal, 92 (December): 825–848.

[9] Devarajan, S. and M. Giugale (2013). "The Case for Direct Transfers of Resource Revenues in Africa." CGD Working Paper 333. Washington, DC: Center for Global Development.

[10] Elbadawi, I and R. Soto (2012). "Resource Rents, Political Institutions and Economic Growth". Working Paper 413, Institute of Economics, Pontifical Catholic University of Chile.

[11] The Economist (1977). "The Dutch Disease" (November 26, 1977). The Economist, pp. 82-83.

[12] Hunter, L. and J.R. Markusen (1988). "Per-capita Income as a Determinant of Trade." In Feenstra, R. (Ed.), Empirical Methods for International Economics. MIT Press, Cambridge, pp. 89-109.

[13] Kapiszewski, A. (2006). "Arab Versus Asian Migrant Workers in the GCC Countries." United Nations Expert Group Meeting on International Migration and Development in the Arab Region, United Nations Secretariat, May 2006.

[14] Krugman, P. (1987). "The Narrow Moving Band, the Dutch Disease, and the Competitive Consequences of Mrs. Thatcher." Journal of Development Economics, 27(1-2):41-55.

[15] Law, S.H., H.B. Tan, and W.N.W. Azman-Saini (2014) "Financial Development and Income Inequality at Different Levels of Institutional Quality." Emerging Markets Finance and Trade, 50 (2014): 21-33.

[16] Lederman D. and W.F. Maloney (2008). "In Search of the Missing Resource Curse." Policy Research Working Paper Series No: 4766, The World Bank.

[17] Markusen, J.R. (2013). "Putting Per-capita Income Back into Trade Theory." Journal of International Economics, 90(2013): 255-265.

[18] Matsuyama, K. (1992). "Agricultural Productivity, Comparative Advantage, and Economic Growth." Journal of Economic Theory, 58(2): 317-334.

[19] Sachs, J.D. and A.M. Warner (2001). "The Curse of Natural Resources." European Economic Review, 45(4-6): 827-838.

[20] Stone, J.R.N. (1954). "The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom, 1920-1938, Vol. I." Cambridge University Press, Cambridge.

[21] van der Ploeg, F. and A.J. Venables (2013). "Absorbing a Windfall of Foreign Exchange: Dutch Disease Dynamics." Journal of Development Economics, 103: 229-243.