Dutch Disease, Factor Mobility Costs, and the 'Alberta Effect' – The Case of Federations

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Abstract
Do reduced costs of factor mobility mitigate 'Dutch Disease' symptoms? The case of federations provides an indication for this. By investigating 'Resource Curse' effects in all federations for which complete data is available at the regional level, and employing Sachs and Warner's methodology, it is observed that within federations resource abundance is more of a blessing than a curse (while between them the curse remains). In addition, it is also shown that federations with relatively worse institutional quality experience amplified reversed 'Resource Curse' effects within them, so that results are not driven by good institutions. A theory is then presented in an attempt to explain the difference between the cross-federal (and previous cross-country) results of the 'Resource Curse', and the intra-federal ones presented initially. It is argued that the reduced factor mobility costs within federations (compared to the costs of cross-country mobility) trigger an 'Alberta Effect' which mitigates 'Dutch Disease' symptoms, so that 'Resource Curse' effects do not apply within federations, and are even reversed. Thus, this paper demonstrates and emphasizes the significance of the mitigating role of factor mobility; also, it highlights the relative importance of 'Dutch Disease' theory (compared to the 'institutions' perspective) in explaining the 'Resource Curse' phenomenon. The paper concludes with empirical evidence for the main implications of the model, taking the United States and Canada as case studies.

Keywords: Natural Resources, Economic Growth, Factor Mobility, Dutch Disease, Resource Curse, Tax Competition, Spatial Economics

JEL *classification*: C21, O13, O18, O57, Q33

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1. INTRODUCTION

In an influential study on the relation between natural resources and economic growth, Sachs and Warner (1995) introduced the concept of the 'Resource Curse',[1] as they documented (under a comparative cross-country framework, focusing on the post 1970 era) the negative influence of resource-abundance on economic growth; specifically, showing that resource-scarce economies out-performed resource-abundant ones.[2] Thereafter, several studies followed, deepening and confirming further the existence of this phenomenon.[3]

However, the vast majority of these studies focused on cross-country comparisons whereas various, more localized, accounts tell a different story. A well-known example is that of the 19th century California gold rush in the United States, where the discovery of gold caused a large population movement to the west which (among the rest) brought significant development for San Francisco, and eventually led to the formation of the State of California, and to its admission to the union in 1850.[4] Other more recent examples are presented in several studies - Aragon and Rud (2009) show how A Peruvian goldmine increase welfare at the localized level, Michaels (2007) shows how resource abundance levers development in the long run at the county level (investigating regions in southern United States), and lastly, Michaels and Caselli (2009) show the same for Brazilian municipalities.[5]

These examples imply that the initial finding made by Sachs and Warner (1995) is not robust to more localized levels. This paper starts with a further investigation of this insight by considering the case of federations; thus, Sachs and Warner's initial hypothesis is re-examined

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[1] It should nevertheless be noted that concerns over specialization on natural resource exports have been raised previously by Raol Prebisch and Hans Singer more than half a century ago; however, these were not discussed in a similar context to the recent 'Resource Curse' literature.

[2] The meaning of 'resource abundance' should be properly defined, as it may carry some confusion with it. For an extensive discussion over the precise terminologies of natural resources see Laroui and Van der Zwaan (2002). In this paper the definition used follows that which is usually employed by economists studying the 'Dutch Disease'; thus, resource abundance refers to the amount of already exploited natural resources and reserves proven to be economically exploitable.

[3] For further discussion see Auty, 2001, Gylfason 2000, 2001, Gylfason et al. 1999, Lane and Tornell 1996, Leite and Weidmann 1999, Papyrakis and Gerlagh 2004, Rodriquez and Sachs 1999, Sachs and Warner 1999, 2001.

[4] Other historical accounts -such as 19th century gold rushes in Canada, South Africa, and Australia, or otherwise Brazil's 17th century gold rush- present similar stories.

[5] Specifically, they show that at the municipal level resource abundance had almost no effect on non-resource GDP; thus, implying for potential 'Resource Blessing' effects.

using a sample of all federations for which complete data is available at the regional level. By following Sachs and Warner's methodology, it is found that within federations resource abundance is more of a blessing than a curse (while between them the curse remains). To alleviate any concerns that this finding is driven by good institutions,[6] Mehlum et al.'s (2006) methodology is followed and the sample is divided to two groups of federations, one having relatively better institutional quality and the other relatively worse. It is found that federations in the group with the relatively worse institutions maintain the 'Resource Blessing' effects, while those in the other group do not (so that 'Resource Blessing' effects in these federations disappear).

Following that, a theory is presented in an attempt to explain the difference between the cross-federal (and previous cross-country) results of the 'Resource Curse', and the intra-federal (and previous localized) ones presented initially. It is argued that the reduced factor mobility costs within federations (compared to the costs of cross-country mobility) trigger an 'Alberta Effect',[7] which mitigates 'Dutch Disease' symptoms, so that 'Resource Curse' effects do not apply within federations, and are even reversed.[8] The mitigating role of factor mobility has received little attention in the 'Dutch Disease' literature, although (as this paper demonstrates) it potentially carries significant policy implications for resource rich economies. Thus, the contribution of this paper is two fold. Empirically, it demonstrates both the significance of the mitigating role of factor mobility (showing how under reduced mobility costs factor mobility can actually present an overshooting effect (which is independent of the level of institutional quality) to de-industrialization processes) as well as the relative importance of the 'Dutch Disease' theory

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[6] Since availability of data at the regional level, and high institutional quality, may correspond.

[7] Initially presented by Helliwell (1981) the 'Alberta Case' describes a scenario where resource rents accrue to the province which then uses them both to compete aggressively in an inter-provincial tax competition over factors of production as well as to redistribute them to the population in the form of improved public facilities. Corden (1984) further discussed this in the context of the 'Dutch Disease', describing how Alberta successfully attracted factors of production due to the above mechanics; he referred to it as the 'Alberta Effect'. In this paper I adopt this definition, and argue that its mechanics are amplified and emphasized in an environment with reduced mobility costs (such as federations, or other localized settings).

[8] Note that the suggested theory is not restrictive to federations; these are considered specifically due to the initial observation made on them. Nonetheless, as was mentioned earlier, previous studies that considered the spatial and local effects of resource abundance presented similar results, implying that the suggested mechanism may be applicable to other localized levels that present relatively lower mobility costs (especially compared to those of the cross-country cases).

(compared to the 'institutions' perspective) in explaining the 'Resource Curse' phenomenon,[9] through the case of federations. Theoretically, the paper suggests a new mechanism (the 'Alberta Effect') through which the mitigating role of factor mobility may work; to the best of my knowledge, this presents a first attempt to model the mitigating role of factor mobility through an interregional tax competition over factors of production (emphasizing the connection between the mitigating role of factor mobility and the 'Alberta Effect').[10]

That said, it is important to realize why federations present a valid case study for the mitigating role of factor mobility. To establish that, let us firstly understand how states within federations differ from sovereign countries, and secondly elaborate on the main explanations for the occurrence of the 'Resource Curse'. Starting with the former, the difference is somewhat subtle. Federal states benefit from an autonomous level that is comparable to an independent country - they have their own government, as well as their own judicial and fiscal systems; in addition, in terms of natural resources, they own all resources found in their territories, under constitutional rights. However, unlike independent countries, federal states do not have (among other things) an independent monetary system, or an army. Nevertheless, this means that federal subjects provide a comparable setting to that of previous cross-country studies when it comes to determination of fiscal policy and level of resource ownership. As for the latter, albeit still being a puzzle, the 'Resource Curse' phenomenon is given two main explanations; the first is the market mechanism theory of the 'Dutch Disease' (divided to a spending effect, and a resource movement effect),[11] and the other is the political economy perspective of 'institutions'.[12] I argue, however, that any difference in 'Resource Curse' outcomes between cross-country and intra-federal cases would be largely attributed to the resource movement effect. The intuition for this is simple –

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[9] This is concluded by showing that once 'Dutch Disease' symptoms are mitigated (so that 'Resource Curse' outcomes are reversed) then worse institutional quality only maintains the 'Resource Blessing' effect (as opposed to better institutional quality which does not) and, thus, does not change the outcome.

[10] Corden (1984), Wahba (1998), and Vermeulen (2010) consider the mitigating role of immigration and labor growth on 'Dutch Disease' symptoms, triggered by increased wage levels (caused by the resource boom). For an elaborated discussion regarding these, see Section 3.

[11] See Corden and Neary (1982). The spending effect describes the inflationary outcome of an income shock (which, in turn, causes an appreciation of the local currency), while the resource movement effect describes the movement of production factors from various sectors to the resource one. The main idea is that both effects cause a contraction of the manufacturing (tradable) sector, which in turn impedes growth.

[12] See Baland and Francois (2000), Mehlum et al. (2006).

variance in institutional quality and the spending effect remain to be a concern within federations as they are across countries, so that we are left with the resource movement effect as the main difference;[13] more specifically, if it is further assumed that it is less costly to move factors of production within federations than moving them across countries,[14] the difference in the magnitude of the resource movement effect would be driven specifically by the difference in the costs of factor mobility (as will be indicated by the model). Therefore, when looking into 'Resource Curse' effects, the case of federations provides a setting that is on the one hand comparable to previous cross-country ones (especially in terms of determination of fiscal policy and level of resource ownership) yet on the other hand narrows any differences between the two mainly to the resource movement effect, or more specifically to the costs of factor mobility. This makes federations an applicable case study for the potential mitigating role of factor mobility.

In terms of the suggested theory, the basic two-region capital tax competition model of Zodrow and Mieszkowski (1986) is adopted and extended to present the underlying mechanism (focusing on the resource movement effect) which works as follows – the introduction of a natural resource sector would bring the usual resource movement effect, as resources would move to it while neglecting the growth-enhancing manufacturing sector; however, the newly established resource sector would also increase the region's fiscal capacity so that it could undertake a more aggressive tax competition with its neighboring region. If mobility costs are low enough an 'Alberta Effect' is triggered as the region can then attract the necessary factors of production (through decreased taxes, increased wage levels, and greater public good provision) to offset the resource movement effect, and maintain the size of its manufacturing sector (or even expand it). Thus, it is shown that there exists a threshold mobility cost below which an 'Alberta Effect' is undertaken (so that the resource movement effect is mitigated, and a 'Resource Blessing' is observed) and above which an 'Alberta Effect' is not undertaken (so that the resource movement effect applies, and a 'Resource Curse' is observed). In case it is assumed that within federations

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[13] See Section 3 for an elaborated discussion over this argument.

[14] It is reasonable to assume that the movement-costs of production factors would increase with distance (as well as with other characteristics, such as language or culture, which are usually homogenous within federations but may differentiate substantially between countries), so that on average it would be less costly to move them within federations than across countries. For instance, if I am a Canadian who resides in Quebec then, *ceteris paribus*, it would be less costly for me to move to British Columbia than to Germany, although the distance between Quebec and each of them would not differentiate by much. At the same time, within Canada specifically, it would be less costly for me to move to Ontario than to British Columbia due to the distance from Quebec.

mobility costs are below that threshold while between countries they are above it, then this model explains the difference in outcomes presented initially. In addition, by following Torvik (2002) and modeling corruption as redistribution from the government to residents, the model also explains the additional initial observation of amplified 'Resource Blessing' effects in federations with worse institutional quality, as it shows that a higher national corruption-level amplifies the 'Alberta Effect' (thus, further mitigating the resource movement effect in that region) due to higher capital tax rates in the resource scarce region, and higher income in the resource rich one.

The paper concludes by empirically testing the main implications of the model, taking the United States and Canada as case studies. The results validate the suggested mechanism, as it is shown that resource abundance provides a more competitive tax environment, increases per capita public good provision, increases per capita and per worker capital formation, and expands the size of the manufacturing sector and its labor share – at the provincial/territorial level.

The paper is structured as follows – Section 2 goes through the initial empirical exercise, investigating whether 'Resource Curse' occurs in federations. Section 3 discusses the results presented in the previous section and explains the motivation for the model. Section 4 presents the model, establishes its benchmark setting, and goes through the theoretical analysis. Section 5 presents the empirical testing of the model and its predictions. Section 6 concludes.

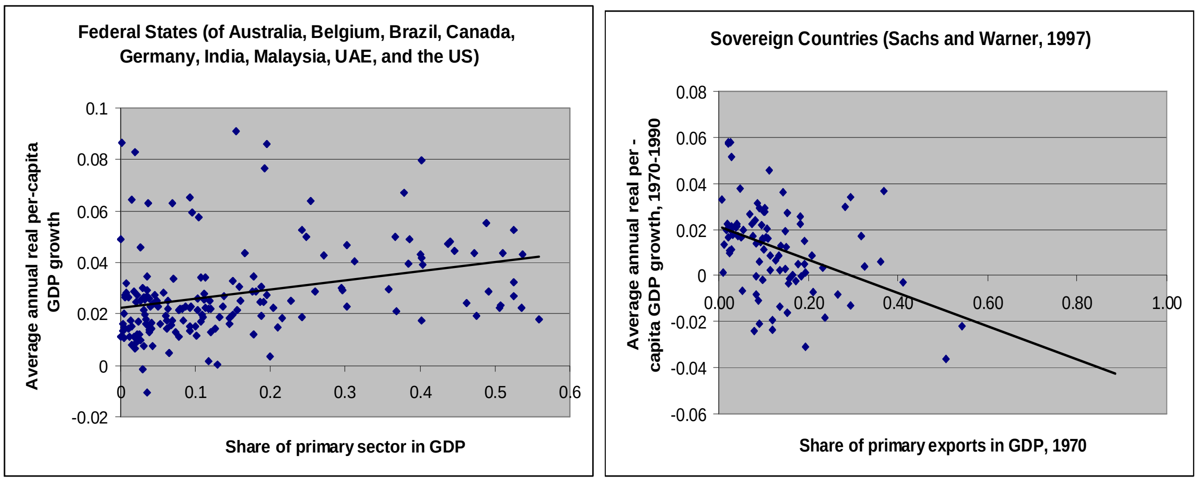
2. IS THERE A 'RESOURCE CURSE' OR 'RESOURCE BLESSING' WITHIN FEDERATIONS?

There are 25 recognized federations worldwide;[15] out of which, the minimum required state-level data is available for the following – Australia, Belgium, Brazil, Canada, Germany, India, Malaysia, Russia, United Arab Emirates, and United States.[16] The sample used for each of the federations is the maximum available; complete description of the data, sources, and periods investigated for each federation, is presented in Appendix 1. As a first take I plot in Figure 1 the average annual real per-capita growth versus resource abundance (measured at initial period) of

[15] Argentina, Australia, Austria, Belguim, Bosnia and Herzegovina, Brazil, Canada, Comoros, Ethiopia, Germany, India, Iraq, Malaysia, Mexico, Federated States of Micronesia, Nepal, Nigeria, Pakistan, Russian Federation, Saint Kitts and Nevis, Sudan, Switzerland, United Arab Emirates, United States, Venezuela.

[16] The minimum types of data required to test the given hypothesis include state-level data on real GDP per-capita, and production measures of primary sector.

federal states[17] (left figure), and of sovereign countries (right figure) as presented in Sachs and Warner (1997).[18] Additional graphs, for each of the federations separately as well as for the similar, though non-federal, cases of China, Spain and Europe, are presented in Appendix 2.[19]



G = 0.022234 + 0.035561 R
R-squared = 0.0962

G = 0.021297 - 0.0722219 R
R-squared = 0.1656

FIGURE 1. *Resource-abundance and economic growth in federal states and sovereign countries*

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[17] Note that Russia is dropped from the sample; results do not change if it is included, but variability increases so that it becomes less applicable to present results on a graph. In addition, note that samples of all federal-subjects of a common federation start at the same year, except those of Canada and India (as each has a few regions starting at later years); for detailed description see Appendix 1.

[18] In each graph, 'G' represents the average annual real per-capita GDP growth, while 'R' represents resource-abundance. The measure used for resource wealth in the sample of federal subjects is the share of primary sector in total GDP; this measurement has been commonly used in other studies of the 'Resource Curse' (see Papyrakis and Gerlagh 2004, 2007, Zhang et al. 2008) which validated the 'Resource Curse' phenomenon, and is adopted in this case as it provides both a convincing measure of resource abundance and a substantially larger sample (due to data availability limitations) compared to other measures. The measure used in Sachs and Warner's (1997) sample is the share of primary exports in total GDP.

[19] As was mentioned earlier, the case of federations is not restrictive; different regional settings (Confederations like Europe or Federations-de-facto like China and Spain) may be of interest to the given hypothesis, which is why these additional examples are provided. Nonetheless, these will not be part of the complete federations-sample, since the focus is on comparing federal states with other federal-states of equivalent status (meaning, Alberta (Canada) could arguably be compared to Texas (USA), yet it can not be similarly compared to any country in Europe (given the differences between independent countries and federal-states)). Nonetheless, note that results do not change qualitatively in case Europe, China, and Spain are included in the general sample.

This preliminary comparison implies that 'Resource Curse' mechanics affect federal-subjects and sovereign countries differently, to the extent that an opposite outcome is observed.

In their seminal work on the 'Resource Curse', Sachs and Warner (1995, 1997, 1999, 2001) applied a simple cross-section methodology, regressing average annual real per-capita growth on the logarithm of initial income and a proxy for resource-abundance (at initial year), to identify the phenomenon. Most of the papers to follow adopted a similar method. To be able to test the results against Sachs and Warner's, the same methodology will be used in this section, and applied towards the case of federations. In addition, since the model (to be presented in the following section) considers an initial symmetric case (at which the resource shock occurs), a federal-inequality measure is used to capture any inequality differences between federations, and thus create a more symmetric environment.[20] Therefore, regions for all 10 federations are put on one sample,[21] and the following model is tested:[22]

$$G^i = \alpha_0 + \alpha_1 \ln(Y_0{}^i) + \alpha_2 R^i + \alpha_3 E^i + \alpha_4 Australia + ... + \alpha_{13} US + \varepsilon^i \qquad (1)$$

Thus, three versions of equation (1) are tested. In the first, real per-capita GDP growth is regressed on a constant, resource-share proxy, and the federal-dummies, in the second the logarithm of initial income is added (as a regressor), and in the third a measure of federal-inequality is further added (as a regressor). Results are presented in Table 1.[23] It can be seen that the coefficient on the

[20] Federations present different equalization-transfer schemes, so that inequality levels within federations may be different between them. That said, the inequality-measure is computed as follows: real per-capita GDP of the initial year of each region in a given federation is divided by the real per-capita GDP of the richest region in that federation, for that year.

[21] Otherwise, each federation by itself does not provide sufficient number of observations to conclude for a significant (and thus, meaningful) result.

[22] In terms of notation: 'G' is annualized average real per-capita GDP growth,[22] 'Y_0' is per-capita real GDP in the initial year, 'R' is the proxy for resource-abundance in the initial year, 'E' is a measure of inequality in the federation in the initial year, and 'Australia' through 'US' are dummy-variables for each of the 10 federations. Since the period investigated for each federation is different, initial income is normalized for all federal states; see Appendix 1 for normalization method of initial income.

[23] Although this is not the focus of this paper, it can be seen that the coefficient on the logarithm of initial income is positive in both (2) and (3) (though non-significant in (2)), implying that the convergence theory (see Barro and Sala-i-Martin, 1992) does not apply in a regional setting. Nonetheless, there are mixed evidence regarding this; Papyrakis and Gerlagh (2007) derived an opposite result for the US (showing that convergence does apply), while Zheng et al. (2008) derived a result similar to the one presented here, for China. Premer and Walz (1994)

resource-share proxy is positive and significant in all three versions, implying that federal-states experience a 'Resource Blessing', rather than a curse (and in-contrast to previous cross-country results).

Although there is already ample evidence for cross-country versions of the above regression (observing a 'Resource Curse'), let us nevertheless analyze the cross-federal case to see whether the result is reversed between federations. To maximize the sample, all recognized federations are considered (besides Iraq, and the Federated States of Micronesia, for which the minimum required data was not available), and for each the maximum number of years (considering the availability of data) are used.[24]

TABLE 1. *Growth regressions, as in equation* (1), *for all federal-states*

Dependent variable: G^i	(1)	(2)	(3)
Constant	0.01383***	0.0178396	0.0646893**
R^i	0.034659** (0.014432)	0.042543*** (0.0129007)	0.040931** (0.014974)
LnY_0^i		0.0237472 (0.0160393)	0.0467015** (0.0207327)
E^i			-0.078801** (0.0274896)
R^2	0.4404	0.4820	0.5016
N	250	250	250

Note: Standard errors are robust, and clustered by federation. Standard deviations for independent variables appear in parentheses. Superscripts correspond to a 10, 5 and 1% level of significance.

Real per-capita GDP growth is regressed on the logarithm of initial income (and since federations are measured for different periods, the same measure of initial income is used as in the intra-federal case) and a proxy for resource-share (measured as in the previous case). Results are presented in Table 2. It is possible to see that as expected (and as was also observed in other cross-country studies) this time the coefficient on the resource-share is negative and significant (albeit

show why regional divergent is, in fact, an expected outcome. On the other hand, the coefficient on the inequality measure implies for convergence between federations (as is also observed in Table 2), since it shows that the more equal (in terms of income distribution between regions) a federation is (which is associated with better institutions, and so in turn, with higher initial income) the slower is its real per capita growth rate, on average.

[24] For complete description of data, sources, and periods investigated, see Appendix 3.

only at the 10% level, due to the relative small sample size).[25] Thus, the difference between the intra-federal and cross-federal results is observed.

To alleviate any concerns that the above result is driven by good institutions (as it can be reasonably suspected that good institutions and availability of data at the regional level correspond) let us follow Mehlum et al.'s (2006) methodology,[26] and divide the sample to two groups; the first (Australia, Belgium, Canada, Germany, and United States) presents the group of federations with the relatively better institutions, and the second (Brazil, India, Malaysia, Russia, and United Arab Emirates) presents the group of federations with the relatively worse.[27]

TABLE 2. *Growth regression, as in equation* (1), *for all federations*

Dependent variable: G^i	
Constant	0.022125***
R^i	-0.045258* (0.0260754)
LnY_0^i	-0.0072069* (0.0036346)
R^2	0.1636
N	23

Note: Standard errors are robust. Standard deviations for independent variables appear in parentheses. Superscripts correspond to a 10, 5 and 1% level of significance.

The same regressions presented in Table 1 (following equation (1)) are undertaken for each of the two groups separately (using the same variables). Results are presented in Table 3. Interestingly,

[25] Note that as opposed to the intra-federal case convergence is observed in the cross-federal setting as the coefficient on the logarithm of initial income is negative and significant (at the 10% level, due to the limited sample size).

[26] Mehlum et al. (2006) divided the sample of Sachs and Warner (1997) to two groups of countries – one with relatively better institutions, and the other with relatively worse. By following Sachs and Warner's methodology (1997) they found that 'Resource Curse' effects amplified in the group with the relatively worse institutions, while they disappeared in the group with the relatively better ones.

[27] The division was based on the average Corruption Perception Index level (published by Transparency International) for the years 1995-2010.

the results are quite the opposite than those presented by Mehlum et al. (2006).[28] As can be seen from the table, in all three versions of the regression the coefficient on the resource-share proxy (r) in 'Group 1' (composed of the federations with relatively better institutions) is non-significant, while that in 'Group 2' (composed of the federations with relatively worse institutions) remains significant as in the regressions made on the entire sample; in addition, R-squared is consistently (and significantly) lower in the regressions made on 'Group 1' (compared to those observed in the regressions made on 'Group 2'). This implies that under an environment with reduced factor mobility costs, worse institutional quality rather maintains the reversed 'Resource Curse' outcomes (contrary to the observations made in the cross-country studies), whereas better institutional quality does not.[29]

3. Discussion

Tables 1 and 2 emphasize the contrast between the intra-federal and cross-federal cases, as in the former a 'Resource Blessing' is observed, whereas in the latter it is rather a 'Resource Curse' that is observed. The question is, therefore, what is the source of this difference? The answer lies in our current understanding of the 'Resource Curse' and 'Dutch Disease' phenomena. Considering that the two main explanations for the 'Resource Curse' is the 'institutions' perspective, and the 'Dutch Disease' theory (which is further divided to a spending effect and a resource movement effect), it can be reasonably argued that the source of the above difference is largely attributed to the resource movement effect, which affects countries and federal-states in different magnitudes.

Let us reason this argument in more detail. When it comes to the 'institutions' perspective, there is some evidence that institutional quality differs (to some notable extent) at the regional

[28] Note that the focus is on the coefficient on the resource-share proxy (r); inferences regarding the coefficients on the logarithm of initial income (LnY_0) and the inequality-measure (e) remain similar to those that were observed for the unified sample.

[29] It is important to note that as much as the current sample provides some valid indication on the subject matter (due to the variability in institutional quality amongst the federations in the sample), limitations on data availability prevents us from testing the hypothesis on the federations that are consistently reported as having the relatively highest corruption levels amongst all federations (Nigeria, Venezuela, Sudan, etc.); nevertheless, based on the initial observation, the model would provide some intuition for what is expected to be observed in these federations. Thus, a further discussion over this result (providing some intuition and explanations for it) is presented in the last part of Section 4.

level. Naritomi et al. (2007) show that Brazilian municipalities that were historically associated with resource-related production are worse governed today. Bobonis (2008) provides similar evidence for regions in Puerto-Rico. Additional further evidence on Brazilizian municipalities is given by Michaels and Caselli (2009), as well as by Monteiro and Ferraz (2009). Papyrakis and Gerlagh (2007) show that resource-abundance and corruption are positively related in U.S states; they validate corruption as a transmission channel of the 'Resource Curse' within the United States;[30] similar results, on the United States and Canada, are also given by Olayele (2010). The conclusion is, therefore, that in terms of explaining the 'Resource Curse', variation in institutional quality remains a concern within federations (similar to the concern raised in the cross-country studies). When it comes to the 'Dutch Disease' theory, despite having homogenous monetary systems (so that exchange rates do not vary) the spending effect is not irrelevant within federations. Several studies have shown that there are potentially significant –and non-converging– price differentials at the regional level.[31] Cecchetti et al. (2002) estimated the half life of the price convergence rate between US states to be nine years (which is substantially slower than the rate observed between countries), and Roos (2006) estimated it to be 15 years for German cities; Culver and Papell (2006) found much less evidence of PPP with relative prices between cities within the same nation (investigating Canada, US, and Europe) than with real exchange rates between European countries. This shows that even when exchange rate concerns are eliminated, the spending effect may still be relevant (and potentially comparable to cross-country cases) given the regional price differentials (which, at the local level, may be regarded as equivalent to variations in exchange rates) and their slow convergence rate.[32] Thus, we are left with the resource movement effect as the main potential difference between intra-federal and cross-federal (or cross-country) mechanics.

More specifically, in case mobility costs are viewed as transportation costs (Krugman, 1991) or transaction costs (Coase, 1937) so that they vary with distance and are thus lower in federations than they are across countries, then it can be further argued that the source of difference lies in the

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[30] The United States makes a good example in this context, since the expectation would be that the variability in institutional quality within federations would only increase as institutional quality of federations decreases; this is also implied by Hodler (2006) who shows that greater intra-country fractionalization (which can be regarded as a consequence of bad institutions) leads to greater intra-country conflicts and weakened property rights.

[31] See McMahon 1991, Walden 1998, and Slesnick 2002.

[32] In fact, Raveh and Papyrakis (2010) show that the spending effect is quite substantial within Canada, as resource booms increase regional inflation, which in turn decreases regional exports.

costs of factor mobility which trigger the difference in the magnitude of the resource movement effect (such that if they are low enough the resource movement effect is mitigated and even reversed).

TABLE 3. *Growth regressions, as in equation* (1), *for the divided sample of federal-states*

	GROUP 1			GROUP 2		
Dependent variable: G^i	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.014436***	0.013677***	0.0371422*	0.063206***	0 .09444***	0.1656952***
R^i	0.0178911 (0.0138512)	0.0202561 (0.017441)	0.0163177 (0.0287307)	0.0411805* (0.0177149)	0.0562603** (0.0137952)	0.0543838*** (0.0124682)
LnY_0^i		-0.0040104 (0.0071971)	0.0091347 (0.013658)		0.0304921 (0.0168651)	0 .05619* (0.0217701)
E^i			-0.0342143 (0.0189574)			-0.0948181** (0.0318154)
R^2	0.1295	0.1536	0.3260	0.4148	0.4721	0.4888
N	92	92	92	158	158	158

Note: Standard errors are robust, and clustered by federation. Standard deviations for independent variables appear in parentheses. Superscripts correspond to a 10, 5 and 1% level of significance.

This can be illustrated through the case of Alberta – being extremely resource abundant (owning the second largest petroleum reserves in the world), Alberta exploits its resource wealth to compete aggressively in the competition over factors of production; indeed, it present one of the most competitive business tax environments in North America,[33] which significantly contributes to it having one of the highest investment per-capita and immigration levels in Canada for the past several decades.[34] This, in turn, leads to mitigated 'Dutch Disease' symptoms (since the attracted factors prevent the manufacturing and other growth-enhancing sectors from contracting, thus mitigating, and even reversing, any de-industrialization processes),[35] and ultimately to 'Resource Blessing' effects.[36] Nonetheless, exploiting resource rents to compete for production factors can, basically, be done by any sovereign resource rich country (so that it should not necessarily be a

[33] For instance, Alberta presents no provincial retail sales, capital, payroll, or machinery and equipment taxes.

[34] This successful factor attraction-process forms the basis for the term 'Alberta Effect'.

[35] Indeed, Alberta's manufacturing sector grew by 50% in the period of 1999-2009 (being above the growth of Alberta's total economy), contrary to common 'Dutch Disease' predictions.

[36] Alberta's real per capita growth rates have been amongst the highest in Canada, for the past 20 years.

unique mechanism to intra-federal cases in-general, nor to Alberta specifically), yet due to the relatively higher factor mobility costs between countries the factor attraction process does not materialize in the same magnitude that it does in Alberta (or in other intra-federal and localized settings which present reduced mobility costs),[37] so that 'Dutch Disease' symptoms are not mitigated, and 'Resource Curse' outcomes are observed.

Therefore, the case of Alberta serves as a main motivator for the model (presented in the following section) which, to the best of my knowledge, presents a first attempt at connecting between the costs of factor mobility and the 'Alberta Effect' to illustrate how the resource movement effect (and thus, in turn, 'Dutch Disease' symptoms) is mitigated and even reversed. The potential mitigating role of factor mobility has been brought up previously by Corden (1984) and Wahba (1998), and also more recently by Vermeulen (2010); however, each of these studies focused on the mitigating role of cross country immigration (and labor growth) triggered by the increased wage levels presented in resource rich countries. The model in this paper suggests an additional mechanism through which the mitigating role of factor mobility may work (inter-regional capital tax competition, and the 'Alberta Effect'), and emphasizes the role of reduced mobility costs in triggering it. In addition, as opposed to the previous studies, this one considers capital-intensive resource booms and capital mobility (as opposed to labor intensity and mobility) for three reasons. Firstly – looking into the mobility of capital follows the empirics of intra-federal mechanics more accurately.[38] Secondly – considering resource intensive resources corresponds better to previous studies that have noted that point-source resources (which are capital-intensive) are more significant in driving 'Resource Curse' outcomes (compared to diffuse-source resources, which are more labor intensive).[39] Thirdly – emphasizing the mobility of capital (and thus the competition over capital attraction) corresponds to the initial supposition that the resource is

[37] An indication for this is given by the United States Department of Labor reports (in its publication: "Extended Mass Layoffs in the First Quarter of 2007"), which mentions that most mass job relocations are from one U.S state to another, rather than to an overseas location.

[38] It is observed that within federations capital flows to resource abundant regions, while labor does not (the result on capital is presented in the last part of this paper, while the one on labor can be provided by the author upon request). Thus, any potential mitigating role of factor mobility should be largely driven by capital.

[39] See De Soysa 2000, 2002, Fearon 2005, Fearon and Laitin 2003, Isham et al. 2002, Leite and Weidmann 1999, Ross 2001,2003, and Sala-i-Martin and Subramanian 2003.

capital intensive.[40] Thus, in-general, it can be said that this story concerns capital more than it concerns labor (as opposed to what has been emphasized in the previous cases), which is reflected through the theory and model to follow.

4. THE MODEL

Let us consider the benchmark setting of the model, under the framework of the basic capital tax competition model of Zodrow and Mieszkowski (1986), in its simplest form.[41] There exists an economy with two symmetric regions, each having a manufacturing sector. Production in each region is undertaken by capital (K) and labor (L), employed through a constant returns to scale neoclassical production function that follows the Inada Conditions (F(K,L)); it takes place in the manufacturing sector, to produce a final good (Y) that is either consumed (X) or converted to a pure public good (G). The starting population size of each region is L_i (where $L_1 + L_2 = N$);[42] labor market is inelastic so that each resident is employed and provides one unit of labor. Thus, we have:

$$Y_i = F(K_i, L_i) = X_i + G_i \tag{2}$$

There is a fixed supply of capital in the economy (where $K_1 + K_2 = K^*$), that is equally owned by its residents (so that each owns: $K^* / N = k^*$). For starters, capital and labor are perfectly (and

[40] Since the resource is capital intensive it is the mobility of its main factor of production (capital) that influences the final outcome. Had a labor intensive resource was considered, emphasize was rather given to labor mobility (implying for the importance of factor-dependence of the resource, and factor mobility, which merits further research).

[41] Nonetheless, since I focus mainly on the resource movement effect, several concepts are also adopted from Matsuyama (1992). However, while he investigated the effects of agricultural productivity by employing a dynamic model with a learning-by-doing function in the manufacturing sector, I investigate the resource movement effect under spatial considerations and a tax competition feature. In addition, I employ a static model, with no learning-by-doing assumptions, as I am interested in the relative size of the manufacturing size.

[42] Note that throughout the paper 'i' represents the region, where $i \in (1,2)$. Also in terms of notation, subscripts represent the region, while superscripts represent the sector; in addition, capital letters represent level variables, while small ones represent per capita terms.

costlessly) mobile across the economy.[43] Each region has a government that levies a per-unit, source-based, capital tax to finance a pure public good, so that:[44]

$$G_i = T_i K_i \tag{3}$$

The after-tax rate of return on capital is ρ ; although determined endogenously (by the free capital mobility condition, which will be presented later), ρ is taken as given by each region. Following that, the pre-tax rate of return on capital would be $\rho + T_i$. There are many firms (each being a price taker) operating in each of the regions, and there is free entry to the market. Capital markets are competitive so that profit maximization by each firm yields:[45]

$$f_{k_i}(k_i) = \rho + T_i \tag{4}$$

Also, the free entry condition yields:[46]

$$w_i = f(k_i) - f_{k_i} k_i \tag{5}$$

Residents of this economy have identical preferences, represented by a strictly quasi-concave utility function, U(X,G), with the following properties: $U_X, U_G > 0, U_{XX}, U_{GG} < 0, U_{XG} > 0;$[47] in addition, they own equal shares of the firms (in their respective regions). Therefore, given that residents spend all their income on private consumption, a representative resident's budget constraint would be:

$$x_i = f(k_i) - (\rho + T_i)k_i + \rho k^* \tag{6}$$

[43] This will be modified in the stages beyond the benchmark case.

[44] Note that this model presents capital tax competition as the underlying mechanism for attracting factors of production. Nonetheless, this mechanism is not restrictive to capital and can be regarded more generally as any type of tax competition over factors of production. Even though the analysis is not presented in this paper, a similar mechanism can be modeled using income tax (through an income tax competition), and yet present identical results. The main reasons capital tax (and so, capital tax competition) is used in this model are outlined in Section 3.

[45] Profit of a representative firm in either of the regions is: $\pi_i = L_i(f(k_i) - (\rho + T_i)k_i - w_i)$ Therefore, profit would be maximized at: $d\pi_i / dk_i = 0$

[46] The free entry condition imposes $\pi = 0$, for all firms in the nation.

[47] In effect, making X and G normal goods with diminishing returns. In addition, it is assumed that marginal utilities of X and G go to infinity as each approaches zero, or otherwise go to zero as each approaches infinity (similar to the Inada Conditions of the production side).

Each region competes for the economy's capital stock, by means of tax competition (so that a capital tax competition arises, modeled along Cournot-Nash lines). This is a static, one-period model, where the order of events is as follows – each region sets its capital tax level, based on which capital is reallocated across the economy; this determines the regional wage and public goods levels, based on which labor is allocated across the economy. Indeed, the underlying mechanism is very simple; however, this presents, to the best of my knowledge, a first attempt to model the mitigating role of factor mobility through an interregional tax competition over factors of production.[48]

That said, by equation (4) each region derives $k_i(T_i)$ so that it can vary k_i by its choice of T_i. Totally differentiating equation (4) with respect to k_i and T_i, we get:

$$\frac{dk_i}{dT_i} = \frac{1}{f_{k_i k_i}} < 0 \tag{7}$$

By equation (3), we get:

$$\frac{dG_i}{dT_i} = L_i k_i + T_i L_i \frac{dk_i}{dT_i} \tag{8}$$

Also, by differentiating equation (6) with respect to T_i and substituting equation (7), we get:

$$\frac{dx_i}{dT_i} = -k_i \tag{9}$$

Each region aims to set the tax level that would maximize the welfare of its residents. Keeping this objective in mind, each region would, thus, maximize the utility of a representative resident, subject to the budget constraints of the region and the resident. Therefore, in its simplest form the problem of each of the regions would be expressed as follows:[49]

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[48] Also, it is important to mention that although I aim at presenting the simplest model possible, all components of the model represent the minimum required to be able to explain the underlying mechanism. Specifically, introducing taxes and having a utility-affecting pure public good is essential for creating a tax competition environment, and emphasizing the fiscal advantage a natural resource might present in a localized setting.

[49] Note that given the assumptions made on the utility function, as well as based on the setting of the problem, there would be an interior solution to the given problem, in each of the regions, such that $T_i, k_i, G_i, x_i > 0$. Therefore, corner solutions are not considered in this case.

$$\underset{\{T_i\}}{Max}\, U(x_i, G_i)$$

Let us denote $U_{G_i} \big/ U_{X_i}$ by $m(x_i, G_i)$; thus, we get:[50]

$$\frac{dx_i}{dT_i} + m(x_i, G_i)\frac{dG_i}{dT_i} = 0 \tag{10}$$

Substituting equations (8) and (9) to equation (10) and rearranging, we get:[51]

$$L_i m(x_i, G_i) = \frac{1}{1 + \frac{T_i}{k_i}\frac{dk_i}{dT_i}} > 1 \tag{11}$$

In equilibrium, the following capital mobility condition must hold:[52]

$$f_{k_1} - T_1 = f_{k_2} - T_2 \tag{12}$$

Therefore, in equilibrium equations (11) (for each of the regions) and (12) must hold.

Lemma 1. *Under the benchmark case, there exists a unique and symmetric Nash Equilibrium outcome, in which* $K_1 = K_2, T_1 = T_2, L_1 = L_2, G_1 = G_2$.

Proof. See Appendix 4.

Thus, we see that under the basic setting where the two regions are completely symmetric, resources will be allocated equally across the economy, and the manufacturing sectors will be of equal size.[53]

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[50] This was derived by totally differentiating $U(x_i, G_i)$ with respect to x_i and G_i.

[51] The following result replicates that which was derived by Zodrow and Mieszkowski (1986). It can be given a *Modified Samuelson Condition* (Batina 1990) interpretation, showing how the public good is undersupplied in each of the regions due to the non-cooperative behavior. To emphasize this point further a MCPF (Marginal Cost of Public Funds) interpretation can be adopted here as well (Browning, 1976), showing how in equilibrium each of the regions will face excess costs when raising an additional unit of revenue, caused by the usage of distortionary taxes and the tax competition.

[52] Capital will place where its marginal product is higher, until it is equated across regions.

[53] To keep the model simple and tractable learning-by-doing functions in the manufacturing sector are not assumed (as opposed, for instance, to Matsuyama (1992), or Sachs and Warner (1997)), and so instead of comparing growth rates, levels of capital per capita are compared directly (between the two manufacturing sectors). Adding learning-by-doing technology to the manufacturing sector would translate the comparison to growth rates, yet it would be at a cost of complicating the model while not adding any further insight (since even

4.1 The Introduction of a Resource Sector

Let us introduce a resource sector to region 2.[54] Initially, I assume this sector is capital intensive, so that, as a simplification, it only employs capital[55] (in addition to the resource endowment (Q), which is modeled as an exogenous and immobile factor of production) to produce the final good.[56] Capital in the resource sector is taxed similarly to that in the manufacturing sector (as was modeled previously); in addition, a lump-sum tax (z) is imposed on the resource rents.[57] Therefore, in this case the regional budget constraint would be:

$$G_2 = T_2{}^m K_2{}^m + T_2{}^r K_2{}^r + z \tag{13}$$

The technology used in the resource sector differs from that which is adopted by the manufacturing sector; nevertheless, production is modeled also by a constant returns to scale neoclassical production function that follows the Inada Conditions (H(K,Q)), so that:

$$Y_2 = X_2 + G_2 = F(K_2{}^m, L_2) + H(K_2{}^r, Q) \tag{14}$$

The resource is equally owned by residents of region 2 (so that: $q^* = Q / L_2$) and it provides an exogenously-determined rate of return of α. Therefore, the budget constraint of a representative resident in region 2 would be:

$$x_2 = f(k_2{}^m) - f_{k_2{}^m} k_2{}^m - z / L_2 + \rho k^* + \alpha q^* \tag{15}$$

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with learning-by-doing technology, it is basically the levels of capital per capita that would be compared between the two manufacturing sectors).

[54] More generally, this sector can be regarded as any sector that may significantly enlarge the fiscal capacity of the region; indeed, this is not restrictive to resources, but is regarded as such in the current context due to the specific observation this model aims to explain.

[55] This goes in line with point-source non-renewable resources like minerals or fuels which are capital intensive, and which (as been mentioned in an earlier note) have been identified as more influential in the ‘Dutch Disease’ and ‘Resource Curse’ phenomena due to their relatively greater potential of producing high revenues.

[56] In terms of notation, since now region 2 has two sectors (manufacturing and resource), a superscript ‘m’ refers to the manufacturing sector, while a superscript ‘r’ refers to the resource one (region 1 remains to have one sector, as before, so that this notation does not apply to it).

[57] Note that results do not change if otherwise a per-unit, source based (and thus distortionary), tax is imposed instead of the lump-sum one. Usage of lump-sum tax simplifies the analysis. This, in fact, follows the reasoning of Zodrow and Mieszkowski (1986) who used a lump sum tax as well (with the introduction of local public services) in their analysis.

Once again, the regions engage in a capital tax competition. Note that region 1 behaves according to the analysis presented previously (since nothing changed there basically); therefore, let us see how the situation changes in region 2, as its problem is analyzed as follows:[58]

$$\underset{\{T_2{}^r, T_2{}^m, z\}}{Max}\ U(x_2, G_2)$$

Substituting equations (15) and (13) to the given problem, we get the following first order conditions:

$$U_{X_2} = U_{G_2} L_2 \tag{16}$$

$$U_{X_2} \frac{dx_2}{dT_2{}^r} + U_{G_2} \frac{dG_2}{dT_2{}^r} = 0 \tag{17}$$

$$U_{X_2} \frac{dx_2}{dT_2{}^m} + U_{G_2} \frac{dG_2}{dT_2{}^m} = 0 \tag{18}$$

Note that $\frac{dx_2}{dT_2{}^r}, \frac{dG_2}{dT_2{}^r}, \frac{dx_2}{dT_2{}^m}, \frac{dG_2}{dT_2{}^m}$ are identical in computation to equations (8) and (9), only with the corresponding notation. Thus, if we substitute these to the first order conditions and solve, we get the following:

$$T_2{}^r = T_2{}^m = 0 \tag{19}$$

This means that if the lump sum tax on the resource rents is unrestricted or that otherwise the discovered resource is substantial enough (in the sense that sufficient taxes can be levied on the resource rents so that the efficient level of public good is supplied) then region 2 can, in fact, efficiently lower its capital taxes to zero, while as was seen in the previous analysis, the tax rate of region 1 remains positive.[59] This emphasizes the fiscal advantage the resource gives to the region in which it was found.

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[58] As is implied by the expression of the problem, preferences of region 2's residents stay as before (over private consumption and public goods).

[59] The cases of a restricted 'z' or a relatively small resource discovery are not analyzed, since they would present identical mechanisms (to the one presented) only in smaller magnitudes, deeming them uninteresting in terms of providing additional theoretical insights.

Lemma 2. *When factors of production are completely mobile the Nash Equilibrium outcome dictates having* $k_2^{\,m} > k_1, K_2^{\,m} > K_1, L_2 > L_1, G_1 = T_1 K_{1,} G_2 = z,$ *so that the manufacturing sector of region 2 is larger than that of region 1's (in per capita terms, as well as in absolute size).*

Proof. See Appendix 5.

Therefore, we see that in the extreme case of perfectly mobile factors, 'Dutch Disease' is mitigated in the resource abundant region, to the point where its manufacturing sector actually grows.

Let us now consider the case where labor is completely immobile between regions (yet capital is still freely mobile as before). This case illustrates how the extent to which labor is mobile does not affect the mitigation outcome.

Lemma 3. *When capital is mobile and labor is immobile the Nash Equilibrium outcome dictates having* $k_2^{\,m} > k_1, K_2^{\,m} > K_1, L_2 = L_1, G_1 = T_1 K_{1,} G_2 = z,$ *so that the manufacturing sector of region 2 is larger than that of region 1's (in per capita terms, as well as in absolute size).*

Proof. The proof for Lemma 2 (Appendix 5) remains applicable for this case, with the slight modification of having immobile labor, which maintains the regional population sizes equal, so that the above outcome is reached. □

Let us now consider the extreme case, where both factors are completely immobile between the regions (yet are still perfectly mobile within them). Following the analysis of the benchmark case, once the resource is discovered the economy is in a symmetric equilibrium. The analysis that follows is identical to that which has been presented previously (in both regions 1 and 2), so that in equilibrium $T_2^{\,r} = T_2^{\,m} = 0$ and $T_1 > 0$; nonetheless, the main result is reversed.

Lemma 4. *When factors are completely immobile between regions (yet are mobile within them) the Nash Equilibrium outcome dictates having* $k_1 > k_2^{\,m}, K_1 > K_2^{\,m}, L_2 = L_1, G_1 = T_1 K_{1,} G_2 = z,$ *so that the manufacturing sector of region 1 is larger than that of region 2 (in both per capita and absolute terms).*

Proof. Once the resource sector is introduced, it attracts capital only from the manufacturing sector of the same region (since factors are immobile across regions), so that the above result is reached. □

Thus, when factors are immobile across regions the usual 'Dutch Disease' result is derived (specifically, the resource movement effect) in the sense that the manufacturing sector of the resource abundant region contracts.[60] The opposite results of the two extreme cases provide some intuition for the mechanics that this model tries to emphasize. When factors are immobile there is a resource movement effect towards the resource sector, and the manufacturing sector contracts, yet it stays that way because it can not attract the 'missing' factors from other regions. When factors are mobile, the same happens, only the manufacturing sector can now attract the 'missing' factors (due to the fiscal advantage that the resource provides) so that it maintains its size, or even grows. The opposite results of the two extreme cases (in conjunction with the insight that the extent to which labor is mobile does not affect the final outcome) show that there exists a threshold of capital mobility-level above which the manufacturing sector of the resource abundant contracts, while below which it does not (or even expands), by triggering an 'Alberta Effect'. Let us derive that threshold to better understand the difference observed initially between the intra-federal and cross-federal cases (and to better realize the mitigating role of factor mobility).

4.2 The Threshold Cost of Factor-Mobility

Let us now assume that capital does not flow freely between regions (yet is still completely mobile within them).[61] Specifically, there is an exogenously-determined per-unit cost (which may be regarded as a transport cost along Krugman's (1991) lines, or transaction costs following Coase (1937)) of τ for moving capital from one region to the other. This cost is higher the farther apart the two regions are (meaning higher distance presents higher τ) and is paid by firms in the region to which capital is imported to firms of the region from which capital was exported. Let us denote the total amount of capital in each region (K_i) as follows:[62]

$$K_i = K_i^* + K^{im} - K^{ex} \quad (20)$$

[60] To further emphasize how labor mobility does not affect the outcome in this case, in case labor is completely mobile in Lemma 4's setting, the manufacturing sector of region 2 would only further contract, so that not only outcome does not change, but it, in fact, amplifies.

[61] As was mentioned at an earlier point, a cost is put on mobility of capital specifically, due to the result of Lemma 3 (showing that putting such a cost on labor mobility does not affect the final outcome), which is largely driven by having a capital-dependent resource (further implying for the importance of the relation between factor-dependence of the resource, and factor mobility).

[62] Where superscript '*' denotes the initial level of capital in the region, superscript 'im' denotes the level of capital imported to the region, and superscript 'ex' denotes the level of capital exported from the region.

Having two regions means one would be a net importer, while the other a net exporter, of capital. I define β as the per-unit cost firms in the net importer region pay on all of the capital employed in that region, and γ as the per-unit sum firms in the net exporter region receive on all of the capital employed in that region; therefore, we have:[63]

$$\beta_j = \frac{\tau K^{im}}{K_i} \tag{21}$$

$$\gamma_v = \frac{\tau K^{ex}}{K_i} \tag{22}$$

This means that the rate of return on capital changes in each of the regions, so that in the net importer region it would be:

$$f_{k_i} = \rho + \beta + T_i \tag{23}$$

While in the net exporter region it would be:

$$f_{k_i} = \rho - \gamma + T_i \tag{24}$$

Note that since this is a one period model, the resource sector (once introduced) will only be attracting capital up to when capital (in that sector) earns its marginal product; furthermore, since capital still moves freely within regions it will only attract capital from the manufacturing sector of region 2 (since it is cheaper to do so), so that in effect the movement of capital occurs only between the two manufacturing sectors. That said, let us assume we are at the stage where the resource sector is introduced (so that the economy is in a symmetric equilibrium, as was shown initially in the benchmark case). As before, each region solves its maximization problem, and we get that $T_1 > 0$ and $T_2{}^r = T_2{}^m = 0$. This means that in case no capital moves between the regions then the following capital mobility condition holds:

$$f_{k_1} - T_1 = f_{k_2{}^m} = h_{k_2{}^r} \tag{25}$$

Condition (25) implies that rate of return on capital is higher in region 2 (due to the low taxes) as was seen in the previous section, so that capital will be imported there. Once that happens, the capital mobility condition changes to:

$$f_{k_1} - T_1 + \gamma_2 = f_{k_2{}^m} - \beta_1 = h_{k_2{}^r} \tag{26}$$

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[63] Subscript 'j' refers to the region to which payments are made. Subscript 'v' refers to the region from which payments were received.

At this point it is possible to derive the threshold cost (τ^*) above which the resource movement effect applies (as in Lemma 4), while below which it is mitigated (as in Lemmas 2 and 3), as an 'Alberta Effect' is triggered. From condition (26) we see that τ^* is determined by the following condition: $\gamma_2 + \beta_1 = T_1$ (since at that point rates of return are equated between the two manufacturing sectors). Therefore, by substituting equations (21), (22), and (11) to the above condition, and solving for τ^*, we get:

$$\tau^* = \frac{K_2{}^m (K_1)^2 f_{k_1k_1}}{K^{im}(K_2{}^m + K_1)U_{G_1}}(1 - L_1 m(x_1, G_1)) > 0 \qquad (27)$$

As can be seen τ^* is endogenous to the amount of relocated capital; however, since both the elasticity of substitution between private consumption and the public good and the technology employed in the manufacturing sectors are not explicitly specified it can not be determined how movement of capital between the regions affects the threshold cost. Nevertheless, it is possible to make the following inference:[64]

Lemma 5. *If $\tau > \tau^*$ then 'Dutch Disease' symptoms apply (through the resource movement effect) so that (on per capita terms) the manufacturing sector of region 2 contracts compared to that of region 1 (such that $k_1 > k_2{}^m$); otherwise, if $\tau \le \tau^*$ then 'Dutch Disease' symptoms are mitigated (by triggering an 'Alberta Effect') so that (on per capita terms) the manufacturing sector of region 2 maintains its size or expands compared to that of region 1 (such that $k_1 \le k_2{}^m$).*

Proof. When $\tau > \tau^*$ then regional rates of return dictate that it is not efficient for region 1 to export capital to the manufacturing sector of region 2 (established by condition (26)); on the other hand, for the same reason region 1 will not import from region 2 (established by condition (25)). Thus, once the resource sector is introduced in region 2 it attracts capital from the manufacturing sector of the same region, causing for its contraction; this contraction remains in equilibrium since no capital is drawn from region 1 (so that $k_1 > k_2{}^m$). However – in case $\tau \le \tau^*$ then rates of return on capital will be higher in the manufacturing sector of region 2 due to the low taxes (seen through condition (26)), and capital will flow there from region 1 (so that an 'Alberta Effect' is triggered) and its contraction (caused by the introduction of the resource sector) is mitigated and potentially even reversed (such that $k_1 \le k_2{}^m$ in equilibrium). □

Theoretically, in case it is assumed that the cost of factor mobility within federations (or other localized levels) is below the above threshold, while that across countries is above it, then the model provides an explanation to the empirical observation made initially, as it shows how due to the lowered cost of factor mobility the resource movement effect is mitigated (or even reversed) at the local level so that manufacturing sectors of resource abundant regions are not contracted and so, in turn, a 'Resource Blessing' is observed.

4.3 Cross-Federal Corruption Variability

In Section 2 it was observed that federations with relatively worse institutional quality maintain the 'Resource Blessing' effects, while those with relatively better ones do not. Let us turn to the model to explain this observation. By focusing specifically on the difference in corruption levels between federations,[65] I follow Torvik (2002) and model corruption as redistribution of fiscal budget, so that, in effect, residents get some of the government's tax revenues (specifically, a fraction θ of it). The more corrupt is a federation, the greater that redistribution would be (or in other words, the greater θ would be). Thus, under this formulation, each region would allocate only a 1-θ fraction of total tax revenue to supplying the public good, and residents would be better off by having increased income, yet would also be worse off by having decreased public good levels. Let us follow the benchmark setting (after the introduction of the resource sector), and assume that factors are completely mobile. In that case, we get:

$$G_1 = (1-\theta)T_1K_1 \tag{28}$$

$$G_2 = (1-\theta)(T_2{}^m K_2{}^m + T_2{}^r K_2{}^r + z) \tag{29}$$

$$x_1 = f(k_1) - (\rho + (1-\theta)T_1)k_1 + \rho k^* \tag{30}$$

$$x_2 = f(k_2{}^m) - (\rho + (1-\theta)T_2{}^m)k_2{}^m - (1-\theta)z / L_2 + \rho k^* + \alpha q^* + \theta T_2{}^r k_2{}^r \tag{31}$$

By following the same analysis presented in the benchmark case, solving the maximization problem of region 1 yields:

$$L_1 m(x_1, G_1) = \frac{1}{1 + \frac{T_1}{k_1}\frac{dk_1}{dT_1}} - \frac{\theta}{(1-\theta)(1 + \frac{f_{k_1k_1}k_1}{T_1})} \tag{32}$$

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[64] Since the initial empirical observations were made on per capita basis, the comparisons to follow (between the two manufacturing sectors) are also made on per capita terms.

[65] Thus, for the purposes of this analysis, the differences in corruption levels within federations are ignored or rather held constant (meaning, as an example – the focus is on differences in corruption levels between Nigeria and Canada, rather than between Alberta and Ontario).

Solving the same problem for region 2 yields (for each of the two sectors) identical expressions as (32), only having '1' on the left hand side, so that in equilibrium:

$$T_2^{\,m}, T_2^{\,r} \rightarrow 0 \tag{33}$$

Thus, given the free mobility of factors Lemma 2 applies (as before). Nevertheless, this analysis reveals various additional insights. Equations (28)-(31) show that in equilibrium public goods will decrease by the same fraction in each region, while income of residents will increase by a greater amount in region 2 (due to the resource); in addition, equations (32)-(33) show that in equilibrium tax rates in both regions would have to increase (to maintain the efficient level of public good[66]) yet would still be driven to zero in region 2 (provided a sufficiently profitable resource is introduced). Therefore, the overall equilibrium effect is two fold – firstly, more labor would be drawn to region 2 (given the higher income in region 2, yet the identical decrease in public good provision in both regions), and secondly, more capital would be drawn to region 2 (given the higher tax rates in region 1, and the corresponding change in the rate of return on capital).

This result provides an explanation to the previous empirical observation, and accounts for the difference in the intra-federal and cross-country differences. The intuition is straight forward – under a more corrupted environment regional imbalance will increase, and so increased rent-seeking behavior will attract more factors of production to the resource-abundant region (so that rents be maximized), implying that an 'Alberta Effect' would only intensify as federal corruption-level increases (consequently, amplifying the reversed 'Resource Curse' effects). It is important to note that this result is largely driven by reduced mobility costs (which explains why we observe the opposite results of amplified 'Resource Blessing' effects in more corrupted federations (as presented in Table 3) and amplified 'Resource Curse' effects in more corrupted countries (Mehlum et al. (2006))). Indeed, if the setting of the model is slightly modified so that costs of factor mobility are higher than τ^* and the two regions are regarded as two separate and independent countries (having an higher θ in the more corrupted country) then Torvik's (2002) results are replicated and amplified 'Dutch Disease' symptoms are observed between the two

[66] Note that it is implicitly assumed that governments would still aim at supplying the efficient level of public goods despite the higher corruption. This acts as a mere simplifying assumption. A more realistic view on this would make public good provision endogenous to corruption levels (so that more corrupted governments would not necessarily aim at providing the efficient level of public goods), yet once intra-federal corruption-levels are held constant (so that only variability in corruption-levels at the cross-federal level are examined) then this would not change the qualitative results derived under the current setting.

countries (as under this setting the resource movement effect is amplified rather than mitigated, due to the higher costs of factor mobility). Thus, this analysis emphasizes further the relative importance of the 'Dutch Disease' explanation (compared to that of the 'institutions' explanation) for the occurrence of the 'Resource Curse', since we see that once the resource movement effect is mitigated (so that 'Dutch Disease' symptoms are reversed) then worse institutional quality only amplifies the 'Resource Blessing' effect.[67]

This result also helps to explain the empirical observation made by Michaels and Caselli (2009), who investigated the welfare effects of oil endowments on municipalities in Brazil. They found that municipalities did not decrease taxes with increases in oil endowments (contrary to the initial prediction of the model). Accounting for corruption levels (as per the addition made to the model in this section) explains this result, as it shows that having higher corruption levels leads regions to set higher tax rates (to maintain an efficient level of public goods, as mentioned earlier). Thus, the relatively higher corruption levels in Brazil (discussed by Michaels and Caselli (2009) who present a 'missing money' mechanism at the municipal level) may account for the abovementioned observation over tax rates in oil abundant Brazilian municipalities.

5. EMPIRICAL TESTING

Four investigations are undertaken to test each of the main implications of the model. Namely, I test for the relation between resource abundance and tax rates (Section 5.1), per capita public good provision (Section 5.2), and per capita, as well as per worker, capital formation (Section 5.3); lastly, to test whether 'Dutch Disease' is indeed mitigated growth rates of manufacturing sectors are compared to those of total GDP, and growth rates of manufacturing labor-share are compared to those of total labor-force (Section 5.4). In cases one, two, and four, the United States is used as

[67] This last point could perhaps be explained better through a model with endogenous corruption level, which would show that more corrupted federations would have higher variability of corruption-level within them (meaning, between the regions). This would bear closer resemblance to the cross-country scenario which would better emphasize the relative importance of 'Dutch Disease' theory in explaining the 'Resource Curse' (compared to the relative importance of the 'institutions' explanation). Nevertheless, even in this model, where variability in corruption-levels at the intra-federal level is held constant (and is not endogenous) this inference can be made, since the above can be reasonably assumed (i.e. more corrupted federations would present higher variability of corruption-levels within them, as regional imbalance increases) as is implied in previous studies (See Hodler 2006), and is demonstrated by others (See Desai et al. 2003).

a case study; due to limitations on data availability (regarding capital formation data at the state level), Canada is used as a case study in the third test.[68]

5.1 Resource Abundance and Tax Rates

Let us test the following model:

$$Tax^i = \alpha_0 + \alpha_1 R^i + \alpha_2 E^i + \varepsilon^i \qquad (34)$$

Where 'Tax' is the average of the 'State Business Tax Climate Index' for 2006-2011,[69] and the remaining variables are the same as in previous settings (with the exception of having 2006 as the initial year). Equation (34) is tested twice; in the first case the general 'State Business Tax Climate Index' is used, and in the second the corporate-tax 'State Business Tax Climate Index' is employed (due to its relevancy to the model, which discusses capital taxes).

Results are presented in Table 4. The relationship between resource abundance and the tax environment is depicted clearly, as the coefficient on the resource share proxy is positive and significant in all regressions; thus, as expected resource abundant states present a more competitive tax environment compared to the resource scarce states. This validates the basic underlying mechanism of model that connects between the resource movement effect and tax competition.

5.2 Resource Abundance and Public Good Provision

Let us test the following model:

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[68] Note that both the United States and Canada present relevant case studies, given the relatively large intra-federal variability in resource abundance that they possess. Also, since earlier discussion suggests that federations with relatively worse institutional quality would experience amplified effects through the presented mechanism, then validating the model for Canada and the United States (which possess relatively high institutional quality) implies that the suggested mechanism should also be validated in other federations. Note that the first test employs the U.S specifically as a case study due to the unique state-level tax index that is only available for U.S states; in tests two and four the U.S is employed due to the relatively higher available sample size (although results do not change if Canada is included or examined by itself).

[69] The 'State Business Tax Climate Index' is an index, published annually (since 2006) by the United States Tax Foundation, that ranks US states by their "tax-friendliness" to business. The Index is a number from 1 to 10, where 1 is least friendly, and 10 is friendliest. The general ranking is based on an average of five 'Business Tax Climate Indices' for each of five tax groups; namely – unemployment insurance tax, corporate tax, sales tax, income tax, and property tax.

TABLE 4. Resource abundance and taxes - testing equation (34) for US states

	General Tax Index		Corporate Tax Index	
Dependent variable: Tax^i	(1)	(2)	(1)	(2)
Constant	4.937713***	3.836928***	4.966694***	3.679275***
R^i	5.591071*** (1.325627)	5.658133*** (1.058146)	6.152002** (2.489794)	6.113112** (2.407309)
E^i		2.404681*** (0.7349554)		2.852142** (1.367684)
R^2	0.2213	0.3536	0.1128	0.1880
N	51	51	51	51

Note: Standard errors are robust. Standard deviations for independent variables appear in parentheses. Superscripts correspond to a 10, 5 and 1% level of significance.

$$g^i = \alpha_0 + \alpha_1 R^i + \alpha_2 E^i + \varepsilon^i \tag{35}$$

Where 'g' is the average per capita government expenditure for 1977-2008,[70] and the remaining variables remain the same as in previous settings (adopting 1977 as the initial year).[71]

Results are presented in Table 5. The coefficient on the resource share proxy is positive and significant in both regressions, implying for the fiscal advantage that resource abundant states experience (so that despite presenting more competitive tax environments, as the previous section showed, these states are still able to offer higher per capita public goods).[72] The level of per capita public good is not a direct prediction of the model; however, this test nevertheless contributes to the general argument that resource abundance affects fiscal federalism, increases regional imbalance, and thus plays a key role in the national competition over factors of production.

5.3 Resource Abundance and Capital Formation

Let us test the capability of resource rich regions to attract factors of production. Given the result of Lemma 3, and since the majority of Canada's resources are largely capital intensive, I test specifically for the attraction of physical capital. Therefore, let us consider the following model:

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[70] All data was retrieved from the US Bureau of Economic Analysis. All data on government expenditure is expressed in millions of US$, 2000 prices.

[71] Note that the District of Columbia is not included in the sample, due to limitations in data availability.

TABLE 5. *Resource abundance and public good provision – testing equation (35) for US states*

Dependent variable: g^i	(1)	(2)
Constant	3623.171***	2997.397***
R^i	9772.285*** (2623.702)	9700.187*** (2622.199)
E^i		1392.868 (1335.091)
R^2	0.2242	0.2418
N	50	50

Note: Standard errors are robust. Standard deviations for independent variables appear in parentheses. Superscripts correspond to a 10, 5 and 1% level of significance.

$$Cap^i = \alpha_0 + \alpha_1 R^i + \alpha_2 E^i + \varepsilon^i \tag{36}$$

Where 'Cap' is capital-formation and the remaining variables are the same as in previous settings.[73] Two versions of equation (36) are tested; in the first per capita capital formation is used, and in the second per worker capital formation is employed.

TABLE 6. Resource abundance capital formation - testing equation (36) for Canadian regions

	Per Capita Terms		Per Worker Terms	
Dependent variable: Cap^i	(1)	(2)	(1)	(2)
Constant	4282.076**	1549.276	10644.22***	693.4898
R^i	33207.85** (15605.6)	29608.64* (15215.9)	55952.58** (25258.8)	42847.04* (24007.21)
E^i		5230.44 (10100.46)		19045.19 (17038.15)
R^2	0.3482	0.3637	0.3290	0.3974
N	14	14	14	14

Note: Standard errors are robust. Standard deviations for independent variables appear in parentheses. Superscripts correspond to a 10, 5 and 1% level of significance.

[72] Similar results are also documented by Aragon and Rud (2009), Michaels (2007), Michaels and Caselli (2009), and Musacchio and Martinez (2010).

[73] All data was retrieved from Statistics Canada. For periods investigated, please see Appendix 1. All data on capital formation is expressed in millions of CDN$, 2002 prices.

Results are presented in Table 6. It can be seen that the coefficient on the resource share proxy is positive and significant in all regressions,[74] which validates Lemmas 2, 3 and 5; also, the results of the per-worker based regressions imply that capital indeed presents higher rate of returns in resource abundant regions.[75] It is important to note that while capital formation provides good indication for the amount of physical capital that was formatted, or otherwise imported, by a certain region, it does not provide any indication for the source of the capital in case it was indeed imported (so that it could have, essentially, been imported to the region from other intra-federal sources as much as from other countries); nevertheless, the basic underlying assumption of the model (having a positive link between distance and costs of capital mobility) follows in this empirical testing as well, so that it is assumed the magnitude of imported capital decreases with distance and increases with proximity.

5.4 The Mitigation of 'Dutch Disease'

'Dutch Disease' theory predicts that a resource boom would contract the manufacturing sector. Therefore, to test whether 'Dutch Disease' symptoms are mitigated in an environment with reduced mobility costs, let us observe whether manufacturing sectors of resource abundant states in the United States maintain their size (or expand). The following model is tested:

$$Man^i = \alpha_0 + \alpha_1 \ln(Man_0{}^i) + \alpha_2 R^i + \varepsilon^i \quad (37)$$

Where 'Man' is the average annual growth rate of either the share of manufacturing in GDP, or the share of manufacturing-labor in total labor, $\ln(Man_0{}^i)$ is the initial level of either (to account for any convergence phenomena), and R^i is the resource share proxy (measured as in the previous settings).[76]

Results are presented in Table 7. It can be seen that the coefficient on the resource share proxy is positive and significant in all regressions. This means that during the investigated period resource abundant states were not only able to maintain the relative size of their manufacturing sector (both in terms of GDP share, and labor share), but also had it expand beyond the expansion of total GDP (in the GDP-share scenario) or that of total labor force (in the labor-share scenario).

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[74] Albeit only at the 10% level when the inequality-measure is added; nonetheless, this is largely a consequence of the relatively small sample size.

[75] Musacchio and Martinez (2010) present similar results for Brazilian states in the period of 1890-1930.

These results provide an indication that 'Dutch Disease' is indeed mitigated in an environment with reduced mobility costs (to the point where reversed 'Dutch Disease' and eventually reversed 'Resource Curse' effects are observed), and thus validate the main implication of the model.[77]

TABLE 7. Mitigation of 'Dutch Disease' - testing equation (37) for US states

	Share out of total GDP		Share out of total labor	
Dependent variable: Man^i	(1)	(2)	(1)	(2)
Constant	-0.01035***	-0.01982***	-0.03241***	-0.03150***
R^i	0.126983*** (0.032958)	0.102367*** (0 .0323361)	0.099373*** (0.0278937)	0 .101477** (0 .0426408)
$\ln(Man_0^i)$		-0.006513* (0.0037935)		0 .0005561 (0 .0063697)
R^2	0.2737	0.3157	0.3404	0.3410
N	51	51	51	51

Note: Standard errors are robust. Standard deviations for independent variables appear in parentheses. Superscripts correspond to a 10, 5 and 1% level of significance.

6. CONCLUSION

This paper adopts the case of federations to show that reduced mobility costs mitigate 'Dutch Disease' symptoms, to the extent that they are actually reversed. By investigating 'Resource Curse' effects in all federations for which complete data is available at the state level, it is found that within federations resource abundance is more of a blessing than a curse, while between them it is rather the opposite (similar to previous cross-country studies); in addition, it is shown that federations with relatively worse institutional quality maintain the 'Resource Blessing' effects within them, while those with relatively better institutional quality do not, so that initial results are not driven by good institutions. It is argued that this difference in intra-federal and cross-federal (and previous cross-country) outcomes stems from the difference in the magnitude of the resource movement effect which is triggered by the difference in the costs of factor mobility. In case these costs are assumed to vary with distance, then it can be reasonably argued that they are lower

[76] All data was retrieved from the Bureau of Economic Analysis. The period investigated is 1977-2008. The average annual growth rates were computed as in earlier regressions of Table 1.

within federations compared to between them (or between countries in-general); once they are low enough an ‘Alberta Effect’ is triggered, so that a resource abundant region can attract the necessary factors of production to maintain (or even expand) the size of its manufacturing sector. By employing and extending the basic capital tax competition model of Zodrow and Misezkowski (1986) a first attempt is made at connecting the costs of factor mobility and the ‘Alberta Effect’ to account for the mitigating role of factor mobility; in addition, by adding variation in cross-federal corruption levels, the model explains why the initial empirical observation is, in fact, independent of institutional quality, as it shows that a higher federal corruption-level amplifies the ‘Alberta Effect’. In short, results show (both at the empirical and theoretical levels) that reduced mobility costs can act as an immune to ‘Dutch Disease’ symptoms, so that resource abundance can be a blessing. Thus, this paper emphasizes significance of the mitigating role of factor mobility, and by showing that results are not driven by good institutions, this paper also emphasizes the relative importance of ‘Dutch Disease’ theory (compared to the ‘institutions’ perspective) in explaining the ‘Resource Curse’ phenomenon.

These insights may carry certain policy implications for resource rich economies, especially for those with multiple neighboring regions that can act as potential factor exporters. Nonetheless, due to the limited sample size, it is important to realize that results may be sensitive to the specific periods or federations investigated. Future research may test the presented hypothesis for extended periods of time and additional federations.

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[77] Note that similar results are also observed by Michaels (2007) for counties in Southern United States, as well as by Michaels and Caselli (2009) for Brazilian states.

Appendix 1 – Data sources and periods observed: Federal-states

Note: the three types of data collected for all federal-states are annual real per capita GDP (used to calculate growth), nominal per capita GDP in initial year (used to calculate the converted and normalized initial income), and primary share in GDP in initial year (used the calculate the resource-share measure). All basic (non-transformed) figures are in millions of local currency.

Australia – The period investigated is 1990-2009, for all 8 regions. All data was retrieved from the Australian Bureau of Statistics.

Belgium – The period investigated is 1999-2007, for all 3 regions. All data was retrieved from the Institute of National Accounts of Belgium.

Brazil – The period investigated is 1995-2007, for all 27 regions. All data was retrieved from the Statistical Institute of Brazil.

Canada – The period investigated is 1984-2008 for the 10 provinces, and Yukon. Nunavut and Northwest Territories are sampled separately from 1999-2008, whereas from 1984-1999 they are considered a single territory (under the name 'Nunanut and Northwest Territories'). All data was retrieved from Statistics Canada.

Germany – The period investigated is 1991-2009, for all 16 Landers. All data was retrieved from the Federal Statistics Office of Germany.

India – The period investigated is 1980-2008, for 27 states. Jharkhand, Chattisgarh, Uttarakhand, and Chandigarh are sampled from 1993-2008; also, Mizoram is sampled for 1999-2008. All data was retrieved from the Ministry of Statistics of India.

Malaysia - The period investigated is 2005-2008, for all 15 states. All data was retrieved from the Department of Statistics of Malaysia.

Russia – The period investigated is 2004-2008 for 77 federal subjects. Due to limitations of data availability the following federal subjects were not included in the sample: Nenets Autonomous District, Chechen Republic, Moscow, St. Petersburg, Khanty-Mansi Autonomous Okrug-Ugra, and Yamalo-Nenets District. All data was retrieved from the Federal Statistics Service of Russia.

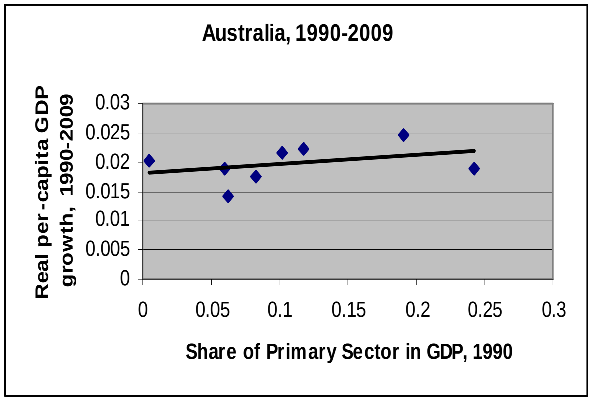
United Arab Emirates – The period investigated is 2000-2007, for all 7 states. All data was retrieved from the Ministry of Economy of the United Arab Emirates.

United States – The period investigated is 1977-2008, for all 51 states. All data was retrieved from the US Bureau of Economic Analysis.

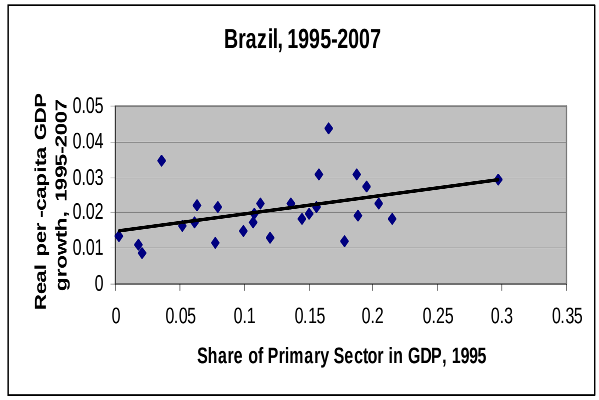
Initial income in each federal state was computed as follows – for each region nominal per-capita GDP is taken and divided by the corresponding PPP measure that converts it to US$ (1996 prices);[78] thereafter, to normalize the figures (since each correspond to a different year) this measure is further divided by the corresponding real per-capita GDP of the US (such that if the PPP converted income measure is from 1990, then it is divided by the real per-capita GDP of the US in 1990). This converted and normalized measurement is used as initial income (and can be compared across federations and across years)

[78] PPP measures were taken from version 6.3 of the Penn World Tables.

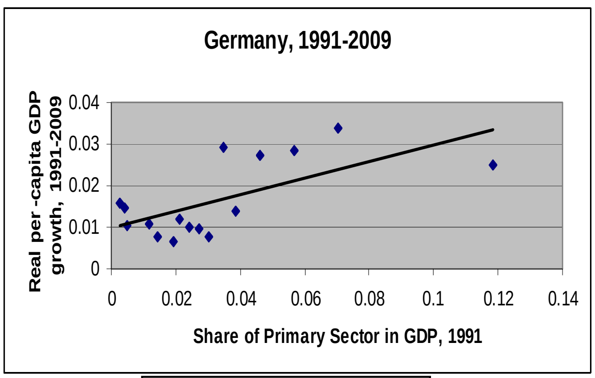
Appendix 2 – Graphs for the separate federations as well as for additional similar cases



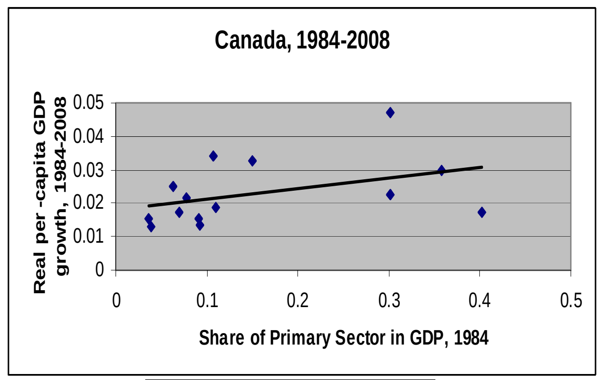
G = .0182085 + .0148108 R
R-squared = 0.1289



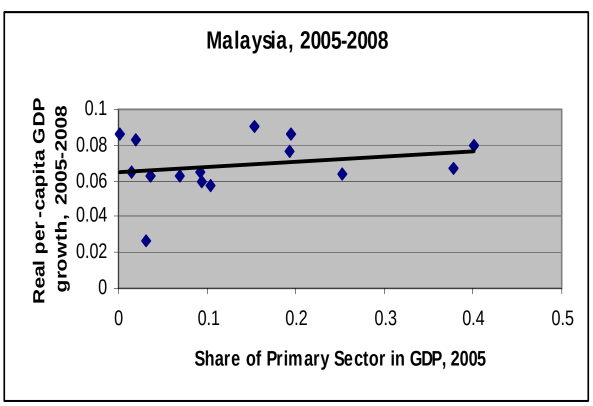
G = .0147159 + .0486238 R
R-squared = 0.1836



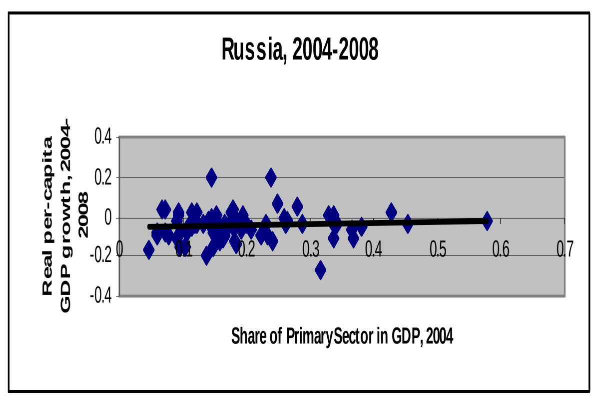
G = .009888 + .1999782 R
R-squared = 0.4291



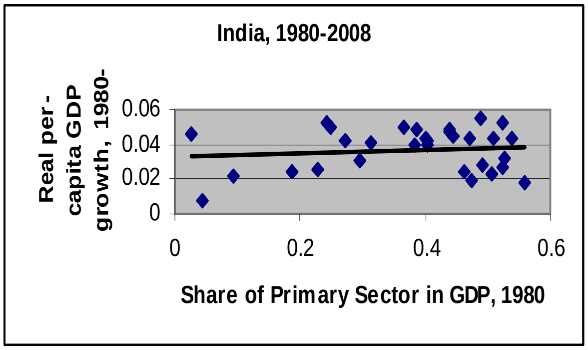
G = .0181087 + .0317517 R
R-squared = 0.1687



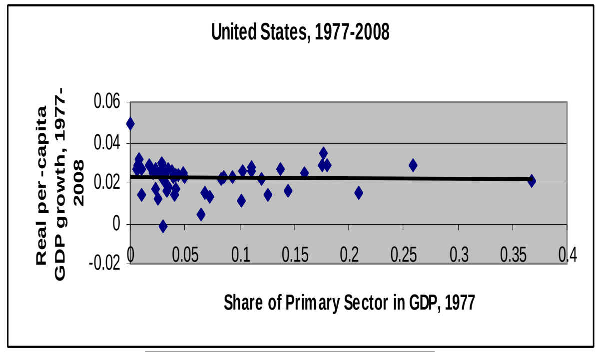
G = .0649196 + .0285786 R
R-squared = 0.0511



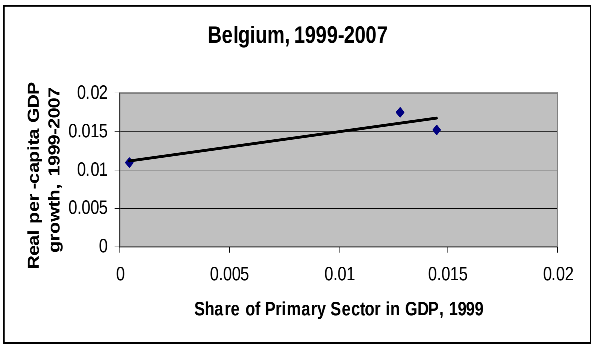
G = -.0586538 + .0699227 R
R-squared = 0.01



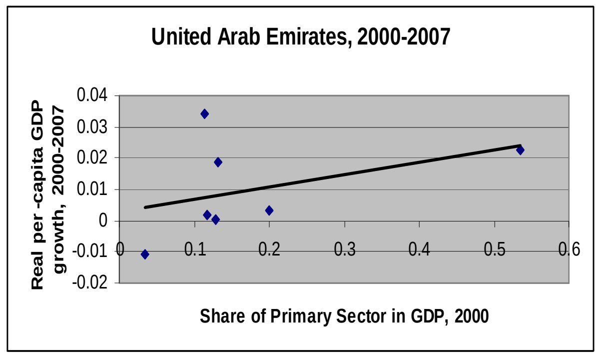
G = .0327424 + .0105524 R
R-squared = 0.0198



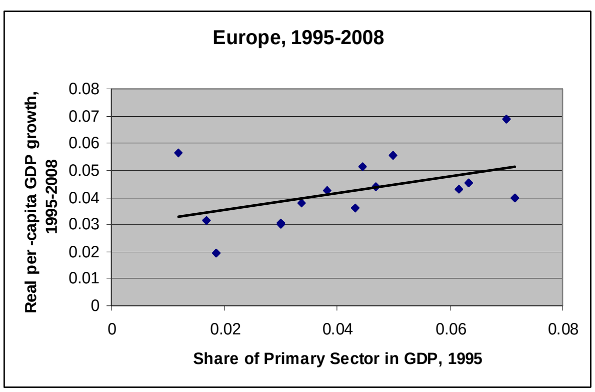
G = .0226639 - .0012689 R
R-squared = 0.00



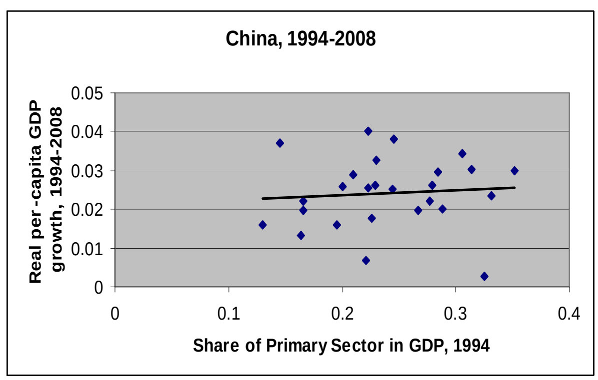
G = .0109821 + .3913342 R
R-squared = 0.8015



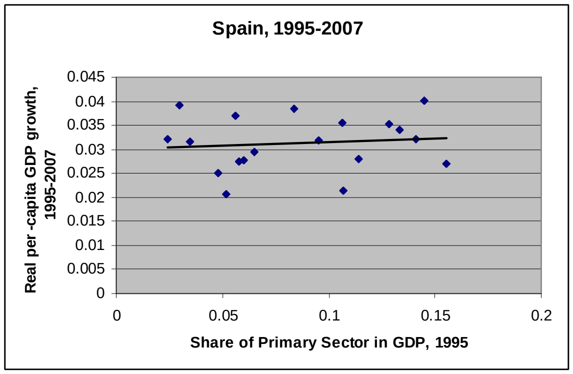
G = .0030653+ .0387144 R
R-squared = 0.1671



G = .0290523 + .3118108 R
R-squared = 0.2252



G = .0213926 + .0117045 R
R-squared = 0.006



G = .0299281 + .0154119 R
R-squared = 0.0132

As can be seen, a few of the federations (Australia, Brazil, Germany, Canada, Belgium, UAE) present positive relationship between resource abundance and growth, while the rest present no observed relationship; however – interestingly (and perhaps more importantly), none of them show any indication for an occurrence of a resource curse. [79]

Graphs for China, Spain, and Europe, depict a similar picture to the one observed in federations. Europe shows some indication for a resource blessing, while Spain and China show no relation between resource abundance and growth (this follows the results on Zhang et al (2008) who looked into 'Resource Curse' effects in China); meaning, no resource curse is observed in none of the cases, implying that the suggested mechanism may be relevant for other regional regimes (besides federations) that may still present lower costs for factor mobility (compared to cross-country scenarios).

Data sources and periods observed: Non-federal subjects
(Note: all basic (non-transformed) figures are in millions of local currency).
Spain – Data (annual real per-capita GDP, production of primary sector in initial year) on all 19 Spanish regions covers the period of 1995-2007. All data was retrieved from the National Statistics Institute of Spain.
Europe – Data (annual real per-capita GDP, production of primary sector in initial year) on all 15 European-Union members (as of 1995) covers the period of 1995-2008. Note that the result does not change if members that were added to the Union at a later are included. All data was retrieved from Euro-stat (Central Statistics Institute of the European-Union).

[79] Papyrakis and Gerlagh (2007) show that the 'Resource Curse' applies within the United States, employing a methodology that is similar to the one used in this paper.; conversely, the result derived here shows there exists a weak, non-significant, relation between resource abundance and growth within the United States. The different outcomes can be a consequence of the different periods investigated; Papyrakis and Gerlagh look into the period of 1986-2000, while here the period of 1977-2008 is analyzed (in addition, they drop the District of Columbia and Delaware from their sample, whereas both are included in this current case; nonetheless, results do not change if the two are dropped from this sample). This implies that results may be sensitive to the period investigated.

China – Data (annual real per-capita GDP, production of primary sector in initial year) on all 26 Chinese provinces covers the period of 1994-2008 (note that the sample starts in 1994 due to the price liberalization scheme in the resource sector that went into action in 1994 (see Zhang et al. (2008)); prior to 1994 prices in the resource sector were heavily regulated by the federal regime, which decreases the relevance of investigating that period, given the context of the hypothesis). All data was retrieved from the National Bureau of Statistics of China.

Appendix 3 – Data sources and periods observed: Federations

The sample used for the regressions presented in Table 2 includes 23 federations; namely – Argentina, Australia, Austria, Belguim, Bosnia and Herzegovina, Brazil, Canada, Comoros, Ethiopia, Germany, India, Malaysia, Mexico, Nepal, Nigeria, Pakistan, Russian Federation, Saint Kitts and Nevis, Sudan, Switzerland, United Arab Emirates, United States, Venezuela (basically all recognized federations except Iraq, and the Federated States of Micronesia).

Data was retrieved on annual real per-capita GDP and the share of primary sector in GDP (in the initial year). All data on real pert-capita GDP was retrieved from World Bank Databases; data on share of primary sector in GDP was retrieved from each federation's individual central statistical bureau.

The time period investigated for each federations, is as follows:
Argentina: 1980-2008 , Australia: 1985-2008 , Austria: 1976-2008 , Belgium: 1995-2008 , Bosnia and Herzegovina: 1999-2008 , Brazil: 1995-2007 , Canada: 1961-2008 , Comoros: 1980-2008 , Ethiopia: 1981-2008 , Germany: 1991-2008 , India: 1980-2008 , Malaysia: 1970-2008 , Mexico: 1993-2008 , Nepal: 1964-2008 , Nigeria: 1981-2008 , Pakistan: 1999-2008 , Russia: 2002-2008 , St. Kitts and Nevis: 1977-2008 , Sudan: 1960-2008 , Switzerland: 1990-2008 , United Arab Emirates: 1996-2008 , United States: 1950-2008 , Venezuela: 1995-2008.

Appendix 4 – Proof of Lemma 1

The symmetric outcome, where the regions choose an equal tax rate (and so other indicators are equal as well) follows equations (11) and (12), and so it is a viable option. Interestingly, it is also a unique option –

- In a first scenario, let us assume that $T_1 > T_2$ and $G_2 \geq G_1$. By (12) we get that $k_2 > k_1$, which means that $x_2 > x_1$; since the level of public good in region 2 is at least as high as that in region 1, then labor will move to region 2 down to at least where $k_1 = k_2$; once that occurs (12) does not hold. Thus, rate of return of capital and the regional wage rates can not be equal at the same time, so that equilibrium does not arise. What will happen, in fact, is that capital and labor will continue to move to region 2 so that in the limit region 1 vanishes.[80]
- In a second scenario, let us assume that $T_1 > T_2$ yet also $G_1 > G_2$. The higher tax rate in region 1 means that there would be more capital in region 2, making its tax base larger than that of region 1. Taking the first scenario into account, region 2 knows that once its public good level is at least as high as that of region 1 it will make region 1 vanish in the limit; thus, given its higher tax base region 2 would be able to raise its tax to a point where

[80] Nonetheless, note that the concept of the limit in this context represents the long term, and is only mentioned here under purely theoretical terms.

it is still below that of region 1 yet it equalizes the levels of public goods between the regions (causing that which was described in the previous scenario, where region 1 vanishes in the limit).

The two above scenarios work both ways (meaning, not only when region 1 presents higher taxes, but also vice versa), which means that no region 1 can allow itself to present lower taxes than its neighbor or otherwise it will vanish in the limit. Thus, the only viable option is when tax rates are equal and a completely symmetric outcome arises. □

Appendix 5 – Proof of Lemma 2

The updated free capital mobility condition would be:

$$f_{k_2{}^m} = h_{k_2{}^r} = f_{k_1} - T_1$$

This by itself means that in equilibrium capital per capita as well as capital in absolute level will be higher in the manufacturing sector of region 2. When it comes to labor, in case $z \geq T_1 K_1$ then labor will move to region 2 so that $L_2 > L_1$ (since both wage levels and public good levels would be higher in region 2); otherwise, due to the same reasons outlined in the proof of Appendix 4, by having a larger tax base than that of region 1, region 2 would be able to at least equalize its public good provision level to that of region 1, so that even in that case labor will be drawn to region 2 and we would get $L_2 > L_1$. Thus, once taxes decrease to zero in region 2 we get the suggested equilibrium outcome, where the manufacturing sector is larger in region 2. □

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