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DISSERTATION THESIS

Essays on Natural Resource Richness, Economic Growth and Institutional Quality

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Abstract

This dissertation consists of three empirical papers on natural resource, economic growth and institutional quality. The first paper analyzes possible publication bias and the reason for contradictory findings in the natural resource literature, the second paper examines the effect of natural resource exports on manufacturing performance in the 15 former Soviet Union countries, and the last addresses whether similarities in country income size and at the institutional level encourage increased amounts of bilateral trade between countries. An introductory chapter puts these three papers into perspective.

In the first paper, I analyze 43 studies providing 605 different regression specifications and found that approximately 40% report a negative and statistically significant effect, another 40% report no effect, and the remaining 20% report a positive and statistically significant effect of natural resources on economic growth. The findings show that including interaction between natural resources and institutional quality, controlling for the level of investment activity, distinguishing between different types of natural resources, and differentiating between resource dependence and abundance are especially effective in explaining the differences in results across studies.

In the second paper, I examine the effect of natural resource exports on economic performance during the period from 1996 to 2010 in the 15 independent countries that formerly comprised the Soviet Union. The results suggest that natural resource exports do not crowd out the manufacturing sector only in post-Soviet countries with sufficiently high institutional quality; those with low institutional quality suffer from the natural resource curse.

In the third paper, I analyze the effects of similarities in economic size and institutional level on bilateral trade. Using panel data on the bilateral trade of Azerbaijan with 50 different countries from 1995 to 2012, the study finds that similarity of income size is necessary for increasing bilateral trade across countries. The main finding is that high quality rule of law and more control of corruption boost confidence in international trade, therefore, “reliable” countries tend to trade more with each other, and less with “unreliable” countries.

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Chapter 1

Introduction

The impact of natural resources on economic growth has been a subject of intense debate for over two decades. Little consensus exists on the effects of natural resource richness on economic growth. The literature on natural resources and growth was inspired by Sachs and Warner (1995), whose empirical analysis showed that resource-scarce economies tend to exhibit higher economic growth than resource-rich economies over the long run. This finding has inspired many economists to analyze its origins and test its robustness.

Research studies have investigated different perspectives and various approaches to the natural resource curse. There are several mechanisms by which the natural resource curse interacts with economic growth. Studies have been focused on whether natural resource curse exists, whether natural resources have direct or indirect impacts on economic growth, whether the curse is related to the type of natural resources, how countries can overcome the curse of natural resources, and the role of institutional development on natural resources and economic growth nexus.

Several studies have emphasized that natural resource richness may induce more corruption, increase political instability and the likelihood of conflicts, and hinder the functioning of democratic institutions in resource rich countries (Tella and Ades 1999; Barro 1999; Ross 2001; Jensen and Wantchekon 2004; Collier and Hoeffler 2005). There are different explanations for the natural resources and economic growth nexus. Theoretically, natural resources should promote economic growth, because the presence of natural resources can induce more investment in economic infrastructure and more rapid human capital development. However, natural resources can also lead to a shrinking of the manufacturing sector, which leads to lower economic development in the long run. Studies have investigated different reasons for failures to achieve economic development with blessed natural resource richness. These include the Dutch disease, lower institutional governance, rent-seeking conflicts, political instability, higher corruption and undermined democracy, and ineffective economic policy.

The previous literature has documented a great deal of heterogeneity in the effect of natural resources on economic growth. This dissertation investigates the natural resource and economic growth nexus from a sample of multiple countries to a one country example. It begins by collecting all published studies providing different regression specifications to find the mean effect of natural resources on economic growth, and to assess the evidence for publication selection to confirm whether the natural resource curse exists. It investigates the reasons for differing conclusions reached by different published studies. A quantitative survey of 605 estimates reported in 43 studies do not confirm overall support for the resource curse hypothesis when potential publication bias and method heterogeneity are taken into account. The differences in results across studies are related to controlling for institutional quality, or for the level of investment activity, or distinguishing between different types of natural resources, or differentiating between resource dependence and abundance.

The dissertation goes on to look at only small sample countries. It focuses on a group of countries with a common history and legal system, which faced similar social and institutional contexts, i.e., the countries that formerly comprised the Soviet Union. The previous literature on transition economies, including works studying post-Soviet countries, has yet to reach consensus regarding whether the natural resource curse exists. The sample of post-Soviet countries offers a unique opportunity to more fully examine the effects of institutions. Institutions are typically persistent and do not change significantly over short periods of time. However, the institutional frameworks have changed dramatically in several post-Soviet countries over the past two decades. This work assesses whether the presence of natural resources can lead to a shrinking of the manufacturing sector, and thus to lower economic growth. A different argument used to explain the resource curse is that natural resources have an indirect impact on economic growth because they weaken governance and economic institutions. This, in turn, leads to poor economic performance.

The dissertation uses a gravity model of international trade - the bilateral trade of Azerbaijan with 50 different countries from 1995 to 2012. It extends the literature by simply using a “similarity index” range from 0 to 1. It detects whether the similarity indices on GDP and institutional level matter for Azerbaijan’s exports. It considers whether better institutional quality in resource-rich countries encourages bilateral trade with other countries, and studies whether historical background, contiguity and distance matter for Azerbaijan as a former Soviet country.

The dissertation is organized as follows. Chapter 2 analyzes the possible publication bias and the reason for contradictory findings in the natural resource literature, Chapter 3 examines the effect of natural resource exports on manufacturing performance in the 15 former Soviet Union countries, and Chapter 4 addresses whether similarities in country income size and at the institutional level encourage increasing bilateral trade between countries in the case of Azerbaijan.

Chapter 2

Natural Resources and Economic Growth: A Meta-Analysis

Abstract

An important question in development studies is how natural resources richness affects long-term economic growth. No consensus answer, however, has yet emerged, with approximately 40% of empirical papers finding a negative effect, 40% finding no effect, and 20% finding a positive effect. Does the literature taken together imply the existence of the so-called natural resource curse? In a quantitative survey of 605 estimates reported in 43 studies, we find that overall support for the resource curse hypothesis is weak when potential publication bias and method heterogeneity are taken into account. Our results also suggest that four aspects of study design are especially effective in explaining the differences in results across studies: 1) controlling for institutional quality, 2) controlling for the level of investment activity, 3) distinguishing between different types of natural resources, and 4) differentiating between resource dependence and abundance.

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2.1 Introduction

Little consensus exists on the effect of natural resource richness on economic growth and the mechanism underlying the effect. An influential article by Sachs and Warner (1995) argues that the impact of natural resources on growth is negative, and the finding has been labeled the "natural resource curse". More specifically, this stream of literature asserts that point-source non-renewable resources, such as minerals and fuels, can hamper growth.[1] Mehlum et al. (2006) put forward that the natural resource curse only occurs in countries with low institutional quality and that with sufficient quality of institutions natural resources can foster long-term development. Other researchers emphasize that the natural resource curse is more likely to occur for certain types of natural resources (Isham et al. 2005), because point natural resources such as oil are, for economic and technical reasons, more prone to rent-seeking and conflicts (Boschini et al. 2007).

Atkinson and Hamilton (2003) and Gylfason and Zoega (2006) propose a different transmission channel and stress the role of investment. They find that natural resources crowd out physical capital and consequently have a negative effect on economic growth. Brunnschweiler and Bulte (2008) show that the quality of institutions is endogenous to natural resource richness and discriminate between natural resource dependence (flows) and natural resource abundance (stocks). They conclude that while resource dependence does not affect growth, resource abundance is growth-enhancing. Alexeev and Conrad (2009) and Cotet and Tsui (2013) also find very little evidence in support of the natural resource curse. On the contrary, examining countries with large oil endowments, they find that these countries exhibit higher income growth. In addition, Smith (2015) examines the impact of major natural resource discoveries since 1950 on GDP per capita and, applying various quasi-experimental methods such as the synthetic control method, he finds that these discoveries are associated with high growth in the long run.

According to the data we collect in this paper, the last two decades of empirical research on the effect of natural resources on economic growth have produced 43 econometric studies reporting 605 regression estimates of the effect. Approximately 40% of these estimates are negative and statistically significant, 40% are insignificant, and approximately 20% are positive and statistically significant (based on the conventional 5% significance level). Given this heterogeneity in the results, our ambition is to conduct a meta-analysis of the literature in order to shed light on two key questions: Does the natural resource curse exist in general? Can we explain why different studies come to such different conclusions? The use of meta-analysis is vital here because the method provides rigorous quantitative survey techniques

[1] Note that given our focus on the natural resource curse, we study the literature primarily examining point-source non-renewable resources—those extracted from a narrow geographic or economic base, as well as primary exports as a percentage of GDP, GNP, or total exports.

and is able to disentangle the different factors driving the estimated effect (Stanley 2001). While meta-analysis methods have been applied within economics in numerous fields, such as labor economics (Card and Krueger 1995; Card et al. 2010; Chetty et al. 2011), development economics (Askarov and Doucouliagos 2015; Benos and Zotou 2014; Doucouliagos and Paldam 2010), and international economics (Bumann et al. 2013; Havranek and Irsova 2011; Irsova and Havranek 2013; Iwasaki and Tokunaga 2014), there has been no meta-analysis examining the effect of natural resources on economic growth.

The paper is organized as follows. Section 2.2 discusses the primary studies on the resource-growth nexus. Section 2.3 describes the meta-regression framework. Section 2.4 describes the data set that we collect for this paper. Section 2.5 presents the empirical results on potential publication bias, while Section 2.6 focuses on explaining the differences in the results across studies. We provide concluding remarks in Section 2.7. Robustness checks and a list of the studies included in the meta-analysis are available in the Appendix2A.

2.2 Related Literature

In this section we briefly discuss the relevant literature that focuses on the relation between natural resources and economic growth. For more comprehensive narrative surveys we refer the interested reader to Frankel (2012) and van der Ploeg (2011).

Sachs and Warner (1995) examine the effect of natural resources on long-term economic growth and find that resource-rich countries tend to grow more slowly than resource-scarce countries. This has become known as the natural resource curse. The literature published after Sachs and Warner (1995) primarily investigates different transmission mechanisms of how natural resources affect growth, assessing whether it is possible to avoid the natural resource curse by improving the quality of institutions, or whether the existence of the natural resource curse depends on the means of measurement and the type of natural resources.

Several studies investigate the role of institutional quality and find that the natural resource curse can be avoided if institutional quality is sufficiently high (Isham et al. 2005; Mehlum et al. 2006; Arezki and van der Ploeg 2007; Boschini et al. 2007; Kolstad and Wiig 2009; Horvath and Zeynalov 2014). Most researchers examine the role of economic institutions but some studies focus on political institutions (Al-Ubaydli 2012). Brunnschweiler and Bulte (2008) make a distinction between resource dependence (the degree to which countries depend on natural resource exports) and resource abundance (a stock measure of resource wealth) and, unlike many other studies, they treat institutions as endogenous. While they fail to find a link between resource dependence and growth, they show that resource abundance is associated with better institutions and more growth. Similar evidence is also provided by Kropf

(2010). As a consequence, these results do not provide support for the existence of the natural resource curse. Alexeev and Conrad (2009; 2011) also treat institutions as endogenous and show that previously found negative effects of natural resource wealth on the quality of institutions are likely to be spurious because of the positive link between GDP and natural resources. They propose to instrument initial GDP using geographical variables to address this issue.

Sala-i-Martin and Subramanian (2013) show that new oil discoveries tend to cause real exchange rate appreciation and harm other export sectors of the economy. Gylfason (2001) and Gylfason and Zoega (2006) examine a different channel and find that natural resource richness crowds out human and physical capital, causing slower growth in the long term. The study by van der Ploeg and Poelhekke (2010) emphasizes that the volatility of output growth should be accounted for in the estimation of the resource curse. Atkinson and Hamilton (2003) and Papyrakis and Gerlagh (2006) focus on the interactions of savings and the resource curse, Baggio and Papyrakis (2010) and Hodler (2006) on the interactions of ethnic heterogeneity and the resource curse, while Anshasy and Katsaiti (2013) emphasize the role of fiscal policy. Another stream of literature examines the impact of natural resources on variables other than economic growth. Natural resource richness might induce more corruption, increase political instability and the likelihood of conflicts, and hinder the functioning of democratic institutions (Tella and Ades 1999; Barro 1999; Ross 2001; Jensen and Wantchekon 2004; Collier and Hoeffler 2005).

In our meta-analysis we examine not only real factors, such as the role of institutional quality in the occurrence of the natural resource curse, but also the role of study design in estimating the relationship. Researchers often employ cross-sectional data to investigate the long-term effect of natural resources on growth (Sachs and Warner 1995; 2001; Gylfason 1999; Leite and Weidmann 1999; Tella and Ades 1999; Lederman and Maloney 2003; Boschini et al. 2007; Papyrakis and Gerlagh 2007; Sala-i-Martin and Subramanian 2013; Ding and Field 2005; Mehlum et al. 2006; Brunnschweiler and Bulte 2008; Arezki and van der Ploeg 2007; Bruckner 2010; Brunnschweiler 2008; Kronenberg 2004; Stijns 2005). Nevertheless, van der Ploeg (2011) notes that the application of cross-sectional data in growth regressions suffers from the omitted variable bias because of the correlation between past income and the omitted initial level of productivity. Since these two variables are likely to be positively correlated, the coefficient estimate for the initial level of income is upward biased, which is associated with the overestimation of the speed of convergence in growth regressions.

Lederman and Maloney (2003) estimate cross-sectional as well as panel regressions and find that the results differ. Panel regressions provide a significantly positive effect of natural resources on economic growth, while cross-sectional regressions result in negative but insignificant estimates. Tella and Ades (1999) also use both cross-sectional and panel data and find that the impact of natural resources on economic growth becomes insignificant when using panel data. Panel data has also been applied by Jensen and Wantchekon (2004), Ilmi (2007), Zhang et al. (2008), Murshed and Serino (2011), Boschini et al. (2013), de V. Cavalcanti et al. (2011), Horvath and Zeynalov (2014), and Williams (2011). Some studies employ time series techniques (Al Rawashdeh and Maxwell 2013; Ogunleye 2008). In endogenous growth models, economic growth is determined within a model by factors such as economic institutions. Brunnschweiler and Bulte (2008) estimate a three-equation model in which endogeneity of resource dependence and institutions are controlled for. They find that resource abundance has a positive impact on institutional quality and resource dependence, and that institutional quality is negatively associated with resource dependence.

The primary studies also differ with respect to the measurement of natural resource richness and GDP growth. Sachs and Warner (1995) measure natural resource richness as the share of primary exports (agriculture, fuels, and minerals) in GDP. Boschini et al. (2007), Lederman and Maloney (2003), Isham et al. (2005), and Brunnschweiler and Bulte (2008) also apply this measure. Sachs and Warner (1999), Leite and Weidmann (1999), and Mehlum et al. (2006) use the share of exports of primary products in GNP. Sala-i-Martin and Subramanian (2013) and Jensen and Wantchekon (2004) use the percentage share of fuel, mineral, and metal exports in merchandise exports. Collier and Hoeffler (2005) employ the sum of resource rents as a percentage of GDP. Papyrakis and Gerlagh (2004) use the share of mineral production in GDP, while Gylfason and Zoega (2006) employ natural resource capital as a percentage of total capital. Finally, Neumayer (2004) examines whether natural resource curse still exists if natural and other capital depreciation is excluded from the calculation of GDP.

2.3 Methodology

Following the approach described in the guidelines for conducting meta-analyses in economics (Stanley et al. 2013), we search for potentially relevant studies in the Scopus, Google Scholar, and RePEc databases. We use the following combinations of keywords: "natural resource + economic growth," "natural resource + economic development", and "Dutch disease". We identify more than 300 journal articles and working papers, including 43 econometric studies examining the effect of natural resources on economic growth. These 43 studies report 605 different regression specifications, which enter as observations into our meta-analysis. The number of regressions reported per study ranges from one (Papyrakis and Gerlagh 2006) to 52 (Brunnschweiler and Bulte 2008), with a mean of 11. We report the full list of studies included in our meta-analysis in the Appendix2A; all data and codes we use in the paper are available in the online appendix. In this section we briefly describe the meta-analysis methods that we use in this paper, and we refer readers interested in more detailed treatment to Stanley et al. (2008).

In general, researchers interested in the effect of natural resources on economic growth estimate a variant of the following model:

$$G_{it} = \alpha + \beta NAT_{it} + \eta INS_{it} + \gamma NAT_{it} * INS_{it} + \theta X_{it} + \epsilon_{it}, \tag{2.1}$$

where i and t denote country and time subscripts; G represents a measure of economic growth; NAT represents a measure of natural resource richness; INS represents the institutional quality of a country and $NAT*INS$ is an interaction term between natural resources and institutional quality; X is a vector of control variables, such as macroeconomic conditions; and ϵ denotes an error term. Eq. (2.1) describes a general panel data setting which encompasses both cross-sectional and time-series studies, differences between which we also investigate in our meta-regression analysis. We only include studies that use economic growth as the dependent variable. Other studies investigating, for example, the effect on human capital, physical capital, democracy, institutions or GDP level, are excluded to ensure a basic level of homogeneity in our data sample.

Following several previous meta-analyses (Doucouliagos 2005; Efendic et al. 2011; Valickova et al. 2015), for the summary statistic we use the partial correlation coefficient (PCC), which can be derived as:

$$PCC_{is} = \frac{t_{is}}{\sqrt{t_{is}^2 + df_{is}}}, \tag{2.2}$$

where $i = 1, \ldots, m$ denotes primary study; $s = 1, \ldots, n$ denotes the regression specification in each primary study; t_{is} is the associated t-statistic; and df_{is} is the corresponding number of degrees of freedom. PCC_{is} represents the partial correlation coefficient between natural resources and economic growth and measures the strength and direction of the association between the two when other variables are held constant.

We have to resort to calculating the PCC because the primary studies differ in terms of proxies for natural resources and economic growth, so that standardization is necessary to make the estimated effect of resources on growth comparable across studies. It is important to note that approximately one fifth of the primary studies include the interaction effect of natural resources and institutional quality in addition to the measure of natural resources. For these studies, we consider the average marginal effect of natural resources on economic growth and use the delta method to approximate the corresponding standard error. (In principle, one could also conduct separate meta-analyses of the linear and interaction terms. In our case, however, the percentage of studies using the interaction term is relatively low and would not allow for a proper meta-analysis.)

To investigate and correct for potential publication selection bias (the preference of authors, referees, or editors for a certain type of result, which will be discussed in more detail later in the paper), we use the following simple meta-regression model and examine the effect of the standard error of PCC_{is} ($SEpcc_{is}$) on the summary statistic, PCC_{is}, itself:

$$PCC_{is} = \beta_0 + \beta_1 * SEpcc_{is} + \epsilon_{is}, \tag{2.3}$$

where $SEpcc_{is} = \frac{PCC_{is}}{TSTAT_{is}}$ and ϵ is the regression error term. This basic meta-regression model, based on Card and Krueger (1995) and Stanley (2005), has the following underlying intuition: in the absence of publication bias, the effect should be randomly distributed across studies (when, for a moment, we abstract from the use of different methodologies in different studies and only consider the sampling error as the source of heterogeneity). If authors prefer statistically significant results, they need large estimates of the effect to offset their standard errors, which gives rise to a positive coefficient β_1 whenever the underlying true effect is different from zero. Similarly, if authors prefer a certain sign of their regression results, a correlation between the estimated effect and its standard error arises. For example, suppose that authors prefer to report negative estimates - that is, those consistent with the natural resource curse hypothesis. The heteroskedasticity of the equation ensures a negative coefficient β_1, because with low standard errors (high precision) the reported estimates will be negative and modest (close to the underlying effect), while with large standard errors the reported estimates will be both modest and large, while no large positive estimates will be reported.

The meta-analysis literature has not converged to a consensus on what is the best method to estimate Eq. (2.3). Because of the heteroskedasticity and likely within-study correlation of the reported results, most meta-analysts estimate standard errors clustered at the study level, which is an approach we also adopt. Apart from the basic OLS with clustered standard errors, however, we also report fixed effects estimation (OLS with study dummies), the so-called mixed effects (study-level random effects estimated by maximum likelihood methods to take into account the unbalancedness of the data), and instrumental variable estimates, which we describe below. Each of these approaches has its pros and cons. For example, fixed effects control for unobservable study-level characteristics, but the use of fixed effects therefore does not allow us to investigate the impact of some important features of studies (such as the number of citations). Mixed effects are more flexible in this respect, but with many explanatory variables in the models the exogeneity conditions underlying mixed effects are unlikely to hold. Apart from different approaches to identification, we also use several different weighting schemes.

To reduce heteroskedasticity and obtain more efficient estimates, Stanley and Doucouliagos (2015) recommend using Eq. (2.3) weighted by the inverse variance of the estimated PCC_{is}, because the variance is a measure of heteroskedasticity in this case. Therefore, a weighted least squares (WLS) version of Eq. (2.3) is obtained by dividing each variable by $SEpcc_{is}$:

$$TSTAT_{is} = \beta_0 \frac{1}{SEpcc_{is}} + \beta_1 + \epsilon_{is} \frac{1}{SEpcc_{is}}, \tag{2.4}$$

where $TSTAT_{is} = \frac{PCC_{is}}{SEpcc_{is}}$ measures the statistical significance of the partial correlation coefficient. β_0 provides an estimate of the underlying effect of natural resources on economic growth corrected for any potential publication selection bias (or, alternatively, we can think of it as the effect conditional on maximum precision in the literature). The coefficient β_1 assesses the extent and direction of publication selection. As a robustness check, in the Appendix2A in Table 2.5 we also present non-weighted regressions and regressions weighted by the inverse of the number of estimates reported in each study-to give each study the same weight.

The univariate regression presented above may provide biased estimates if important moderator variables are omitted (Doucouliagos 2011). Suppose, for example, that a specific method choice made by the authors of primary studies affects both the standard error and the reported point estimate in the same direction. Then the standard error variable will be correlated with the error term, and we obtain a biased estimate of β_1 (Havranek 2015). A solution is to use an instrument for the standard error that is correlated with the standard error but not with method choices. Such an instrument can be based on the number of observations, because larger studies are, on average, more precise, and the number of observations is little correlated with method choices. We use the inverse of the square root of the number of degrees of freedom, as this number is directly proportional to the estimated standard error. An alternative is to add additional moderator variables to Eq. (2.4), after which we obtain the following model to examine the driving forces of the heterogeneity in the estimated effect of natural resource richness on economic growth:

$$TSTAT_{is} = \beta_0 \frac{1}{SEpcc_{is}} + \beta_1 + \sum_{k=1}^{N} \lambda_k * \frac{1}{SEpcc_{is}} X_{kis} + u_{is} \frac{1}{SEpcc_{is}}, \tag{2.5}$$

where k represents the number of moderator variables weighted by $(1/SEpcc_{is})$, λ_k is the coefficient on the corresponding moderator variables, and u_{is} denotes the error term.

2.4 Data

The explanatory variables used in this meta-regression analysis are listed and defined in Table 2.1. These variables represent potential sources of heterogeneity in the results of primary studies. Table 2.1 classifies the characteristics of primary studies into several categories, such as macroeconomic conditions, the choice of dependent and independent variables, and estimation methods.

Outcome characteristics: We observe that the typical estimate of the effect of natural resources on economic growth is negative (-2.39) but the standard error of this estimate is large (5.14) - since the reported estimates are not strictly comparable, however, it makes more sense to look at partial correlation coefficients. The mean PCC is -0.08, which would be classified as a small effect according to the guidelines by Doucouliagos (2011) for the interpretation of partial correlations in economics. The mean number of observations in primary studies is 198, and a typical study includes about eight explanatory variables (this number does not include dummy variables that are sometimes included, typically for the sake of fixed effects, because exact statistics on fixed effects are not always reported). The mean number of time periods is low (4.34) because most of the primary studies estimate cross-sectional regressions for a wide set of countries.

Publication characteristics: The literature on the effect of natural resources on growth is alive and well, with more and more studies published each year—the mean primary study in our sample was only published in 2007. The studies are mostly published in peer-reviewed journals (40 out of our 43 primary studies are published in a journal, and the other three are working papers from institutions such as the National Bureau for Economic Research and International Monetary Fund). The primary outlet for this literature is World Development, with seven primary studies. We also control for journal quality by including the recursive impact factor from RePEc and the number of citations from Google Scholar. We argue that these measures capture aspects of study quality not covered by method characteristics: some aspects of methodology are employed only in a single study, which does not allow us to include the corresponding control variable because it would be strongly correlated with the constant in the regression. We select the RePEc database for journal ranking because it covers virtually all journals and working paper series in economics; Google Scholar, on the other hand, is the richest database, providing citation counts for each research item.

Institutional quality: As discussed in the related literature section, several articles have demonstrated that the quality of domestic institutions is likely to be an important factor influencing the magnitude as well as the direction of the effect of natural resources on economic growth. Approximately two thirds of the primary studies control for institutional quality, and approximately one third additionally include the interaction effect of institutional quality and natural resources. Interestingly, we find that primary studies use nearly 20 different approaches to measure institutional quality. The measures of economic institutions are used more commonly than the political institutions. As regards economic institutions, primary studies use all six institutional measures from the World Bank dataset and less frequently, they also use the institutional measures reported by the International Country Risk Guide. Some studies use various averages of these measures.

Macroeconomic conditions: The primary studies typically control for several macroeconomic characteristics, such as the level of schooling, economic openness, and investment activity. It is striking that approximately one quarter of the primary studies do not control for the initial level of GDP despite the voluminous theoretical and empirical research which suggests that initial GDP is one of the key factors driving subsequent economic growth, as poorer economies take the benefit of innovations already developed in advanced countries (Durlauf et al. 2008).

The choice of the dependent variable: While the primary studies commonly employ GDP growth as the dependent variable, non-resource GDP growth (the part of output not directly influenced by the extraction of resources) is also sometimes used. In approximately two thirds of the studies these two measures are reported in the form of per capita (which is appropriate if the population growth is not high). Therefore, we examine primary studies with growth as the dependent variable but never the primary studies with the level of income as the dependent variable.

The choice of the natural resource variable: The studies differ in the proxies they employ for natural resources. The ratio of natural resource exports to GDP is often used as a measure of natural resource richness. Approximately 15% of the primary studies focus on oil and do not take into account other fuels or minerals. Approximately 15% of the primary studies use the measure of resource abundance (resource endowment exogenous to economic activity) instead of the typically used resource dependence (measures endogenous to economic activity).

Dataset type: Despite the fact that van der Ploeg (2011) emphasizes that the application of cross-sectional data in growth regressions is likely to suffer from omitted variable bias, approximately 80% of regression specifications in the primary studies on the resource-growth nexus are based on cross-sectional data. This is largely motivated by data availability. Panel structures are less common (less than 20%) and time series evidence is almost non-existent.

Estimation method: Approximately one half of the primary studies are based on OLS regressions (more specifically, any specification giving rise to possible endogeneity) and approximately one third allow for endogeneity of regressors by employing a type of instrumental variable estimator or by using lagged measures of natural resources. Other methods such as vector error correction model has been used infrequently.

Dataset time period: Finally, we create dummy variables and classify whether the data for primary studies primarily come from the 1960s, 1970s, 1980s, 1990s, or 2000s to control for potential time effects (some studies cover more than one decade in their data sets). An alternative is to include directly the mean year of the data period, but we prefer to focus on decade dummies in order to control for potential time breaks in the effect of natural resources on growth.

Table 2.1: Description and summary statistics of collected variables

Variable	Definition	Mean	St.Dev.	Min	Max
Outcome characteristics					
TSTAT	Estimated t-statistics of effect size	-0.72	2.76	-21.29	11.55
PCC	Partial correlation coefficient	-0.08	0.27	-0.94	0.77
INVSEpcc	Inverse standard error of PCC	11.41	8.22	3.34	64.72
SXP	Natural resource effect size	-2.39	7.97	-85.62	56.92
SXPSE	Standard error of effect size	5.14	24.11	0.00	367.37
DF	Logarithm of number of degrees of freedom	4.52	0.93	2.48	8.34
NO.OBS	Logarithm of number of observations	4.62	0.89	3.04	8.34
NO.EXPL.	Number of explanatory variables included	8.03	4.72	1.00	21.00
NO.COUNTRY	Logarithm of number of countries	4.14	0.81	0.69	5.04
NO.TIME	Logarithm of number of years	1.09	0.86	0.69	3.81
Publication characteristics					
YEAR	Logarithm of publication year	7.61	0.00	7.60	7.61
IMPACT	Recursive impact factor of journal from RePEc	0.15	0.24	0.00	0.87
CITATIONS	Logarithm of number of Google Scholar citations	4.22	2.00	0.00	8.09
REVIEWED	Dummy, 1 if published in peer-review journal, 0 otherwise	0.73	0.44		
Institutional quality					
INSTITUTION	Dummy, 1 if institutional variable is included, 0 otherwise	0.70	0.40		
INTERACTION	Dummy, 1 if interaction term is included, 0 otherwise	0.34	0.44		
Macroeconomic conditions					
TOT	Dummy, 1 if terms of trade are included, 0 otherwise	0.13	0.33		
OPENNESS	Dummy, 1 if trade openness is included, 0 otherwise	0.67	0.47		
INITIAL GDP	Dummy, 1 if initial GDP is included, 0 otherwise	0.79	0.41		
INVESTMENT	Dummy, 1 if investment is included, 0 otherwise	0.62	0.48		
SCHOOLING	Dummy, 1 if schooling is included, 0 otherwise	0.49	0.50		
Dependent variable choice					
GDP PER CAPITA	Dummy, 1 if dependent is measured with per capita level, 0 otherwise	0.62	0.49		
GDP GROWTH	Dummy, 1 if dependent is measured with growth, 0 otherwise	0.85	0.35		

Continued on next page

Table 2.1: Description and summary statistics of collected variables (continued)

Variable	Definition	Mean	St.Dev	Min	Max
NON-RESOURCE GDP	Dummy, 1 if dependent is measured with non-resource GDP, 0 otherwise	0.03	0.17		
Natural-resource variable choice					
RESOURCE-ABUNDANCE	Dummy, 1 if effect size is measured as resource abundance, 0 otherwise	0.16	0.36		
RESOURCE-EXPORT	Dummy, 1 if effect size is measured with exports, 0 otherwise	0.70	0.46		
OIL-RESOURCE	Dummy, 1 if effect size is measured with petroleum/fuel/oil, 0 otherwise	0.15	0.36		
Dataset type					
CROSS	Dummy, 1 if dataset type is cross-sectional, 0 otherwise	0.81	0.39		
PANEL	Dummy, 1 if dataset type is panel, 0 otherwise	0.18	0.38		
TIME.SERIES	Dummy, 1 if dataset type is time series, 0 otherwise	0.01	0.08		
REGION	Dummy, 1 if dataset includes all countries, 0 otherwise	0.86	0.35		
Estimation methods					
ENDOGENEITY	Dummy, 1 if endogeneity is controlled for, 0 otherwise	0.41	0.49		
OLS	Dummy, 1 if method type is OLS, 0 otherwise	0.52	0.49		
Dataset time period					
DUMMY60	Dummy, 1 if time period in 1960s, 0 otherwise	0.02	0.15		
DUMMY70	Dummy, 1 if time period in 1970s, 0 otherwise	0.36	0.48		
DUMMY80	Dummy, 1 if time period in 1980s, 0 otherwise	0.29	0.46		
DUMMY90	Dummy, 1 if time period in 1990s, 0 otherwise	0.26	0.44		
DUMMY00	Dummy, 1 if time period in 2000s, 0 otherwise	0.06	0.23		

Notes: Method characteristics are collected from studies estimating the effect of natural resources on economic growth. The list of studies is available in the Appendix2A; the complete data set is available in the online appendix.

Table 2.2 presents an initial analysis of the reported estimates of the natural resource curse. The arithmetic mean yields a partial correlation coefficient of -0.078 with a 95% confidence interval $[-0.099, -0.056]$. The random-effects estimator (allowing for random differences across studies) and fixed-effect estimator (weighted by the inverse variance) estimates provide a similar picture, suggesting that the effect of natural resources on growth is negative and statistically significant, although negligible to small according to the guidelines by Doucouliagos (2011). Nevertheless, these simple estimators do not account for potential publication selection and the influence of method choices, some of which may be considered misspecifications that have systematic effects on the results.

Table 2.2: Estimates of the overall partial correlation coefficient

Explanation	Estimate	Standard error	95% confidence interval	
Simple average of PCC	-0.078	0.011	-0.099	-0.056
Fixed-effect average PCC	-0.092	0.002	-0.096	-0.088
Random-effect average PCC	-0.092	0.010	-0.111	-0.073

Notes: Simple average represents the arithmetic mean. The fixed-effect estimator uses the inverse of the variance as the weight for the PCC. The random-effects specification additionally considers between-study heterogeneity.

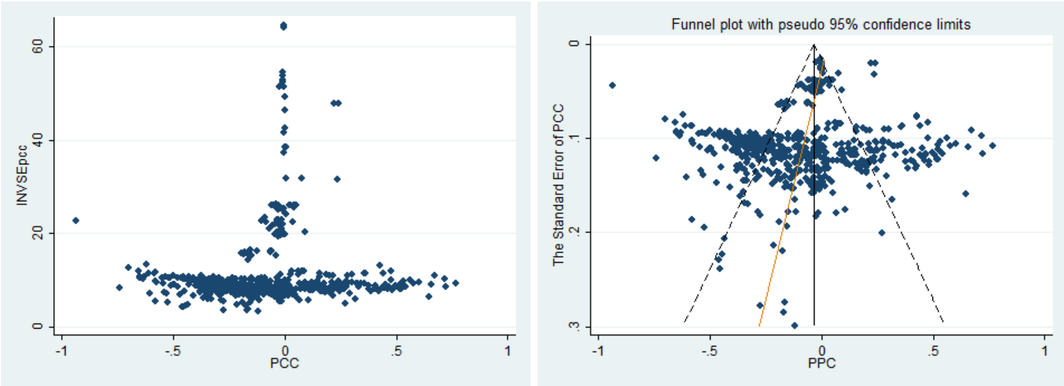
2.5 Publication Bias

Publication selection occurs when researchers, referees, or editors prefer certain types of estimates, typically statistically significant results or those that are in line with the prevailing theory (Stanley 2005). Strong publication bias was found, for example, by Havranek and Irsova (2012) in the literature on foreign direct investment spillovers, by Havranek et al. (2012) in the literature estimating the price elasticity of gasoline demand, and by Havranek and Sokolova (2016) among the studies estimating the social cost of carbon emissions. If the literature on the natural resource curse suffers from some sort of publication selection, it is important to account for it in order to uncover the underlying effect of natural resources on economic growth. For example, if negative estimates of the relationship are reported preferentially, the small negative mean effect computed in the previous section may be entirely due to publication bias.

In line with the previous meta-analysis literature (Doucouliagos and Stanley 2009), we first generate funnel plots to assess the degree of publication selection visually. The horizontal axis of the funnel plot displays the size of the effect (partial correlation coefficients) of natural resources on economic growth and the vertical axis displays precision (inverse standard errors) derived from the corresponding regression specification of a given primary study. The funnel plot is available in the left panel of Figure 2.1. In the absence of publication bias, the funnel plot should be symmetrical - the most precise estimates will be close to the underlying effect, less precise estimates will be more dispersed, and both negative and positive estimates with low precision (and thus low statistical significance) will be reported. In our case, the left-hand side of the funnel appears to be somewhat heavier than the right-hand side. This finding suggests that negative estimates, i.e., those suggesting the natural resource curse, are slightly preferred for reporting and publication.

The right panel of Figure 2.1 presents a variant of the funnel plot resembling more closely the simple meta-regression model presented earlier in this paper. The vertical line denotes an estimate of the mean effect of natural resources on economic growth derived using fixed effects. The two dashed lines that join the vertical line at the top of the funnel denote the boundaries of conventional statistical significance at the 5% level: estimates outside these boundaries are statistically significantly

Figure 2.1: Funnel plot of the effect of natural resources on economic growth



Notes: The horizontal axis of the funnel plot displays the size of the effect of natural resources on economic growth and the vertical axis displays precision (inverse standard errors).

different from the underlying effect as computed by fixed effects. These outlying estimates form, apparently, much more than 5% of the data. This could indicate publication bias in favor of statistically significant estimates, but also heterogeneity in data and methods. The remaining dashed line visualizes a regression line from our simple meta-regression model when the effect size is regressed on the standard error: the slope is negative, which suggests publication bias, and the intercept is slightly above zero, which indicates that publication bias is responsible for the mean reported negative relationship between natural resources and growth. In the next step we provide a formal test of publication selection bias.

To assess the extent of publication bias, we estimate Eq.(2.3); that is, we regress the partial correlation coefficient on its standard error using the so-called funnel asymmetry test (note the relation between these regressions and the right-hand panel of Figure 2.1). A negative coefficient attached to the standard error suggests there is some preference in the literature for results documenting the natural resource curse. The estimated constant provides the true (publication selection-free) effect of natural resources on economic growth. For example, if the constant is negative, the coefficient suggests the existence of the natural resource curse in line with Sachs and Warner (1995). We present the results in Table 2.3. We use four different econometric methods: ordinary least squares with clustered standard errors, instrumental variables estimation, fixed effects estimation, and mixed effects maximum likelihood estimation. The results vary across specifications. The estimated constant is also not robust to different econometric methods.

In Table 2.5 in the Appendix2A we present two robustness checks. In the first case, we run the specification without employing any weights. In the second case, we weight the observations by the inverse of the number of regressions reported per study to give each study the same weight. The results largely confirm our baseline results

Table 2.3: Tests of the true effect and publication selection

Panel A	**Coefficient**	**t-stat**	**p-value**	**Coefficient**	**t-stat**	**p-value**
		Clustered OLS			IV estimation	
SE	-1.016***	-5.18	0.000	-1.234***	-4.81	0.000
Constant	0.026*	1.69	0.099	0.038**	2.41	0.016
Model diagnostics						
	Number of observations = 605 F-test: F(1, 42) = 26.87 Ho: Precision = 0, $Prob > F = 0.00$ Ramsey RESET test: F(3, 600) = 4.21 Ho: No omitted variables, $Prob > F = 0.006$ R-squared = 0.04			Number of observations = 605 F-test: F(1, 42) = 23.11 Ho: Precision = 0, $Prob > F = 0.00$ Under-identification test = 1221.39 $Prob > \chi^2 = 0.000$ R-squared = 0.04		

Panel B	**Coefficient**	**t-stat**	**p-value**	**Coefficient**	**z-stat**	**p-value**
		Fixed effects			Mixed-effects ML regression	
SE	-0.011	-0.58	0.563	0.090	0.14	0.892
Constant	-0.589**	-2.64	0.011	-0.133	1.43	0.153
Model diagnostics						
	Number of observations = 605 Number of groups = 43 F(1, 32) = 0.34 $Prob > F = 0.56$ R-squared = 0.14			Number of observations = 605 Number of groups = 43 Wald test: $\chi^2(1) = 0.02$ $Prob > \chi^2 = 0.89$ R-squared = 0.11		

Notes: The dependent variable is PCC; the estimated equation is $PCC_{is} = \beta_0 + \beta_1 * SE + \epsilon_{is}$. All results are weighted by the inverse variance. SE represents “publication selection”, *constant* represents “true effect”. The standard errors of the regression parameters are clustered at the study level. Panel A, columns (2)–(4) represent OLS with cluster-robust standard errors at the study level; columns (5)–(7) represent IV estimation, where the instrumental variable is the inverse of the square root of the number of degrees of freedom. Panel B, columns (2)–(4) represent fixed-effects estimation at the study level; columns (5)–(7) represent mixed-effects ML regression. The reported t-statistics are based on heteroskedasticity cluster-robust standard errors.

discussed in the previous paragraph. We hypothesize that the instability of these bivariate regression results stems from the omission of some important moderator variables (Doucouliagos and Stanley 2009), which we address in the following section. In any case, the visual and regression analyses taken together do not provide evidence for the natural resource curse hypothesis, and also offer only limited evidence for any substantial publication bias.

2.6 Explaining the Differences in Estimates

Table 2.4 presents the results of multivariate meta-regression, for which we employ four different estimation methods to explain the heterogeneity of the estimated effects of natural resources on economic growth reported in primary studies. Our results do not suggest any evidence of publication selection bias once the characteristics of studies and estimates are taken into account. Therefore, it seems that the apparent (but slight) asymmetry of the funnel plot described in the previous section results from method heterogeneity across studies or individual estimates rather than from systematic publication selection.

We discussed earlier that the mean effect of natural resources on growth is weak. Table 2.4 shows, however, that some of the method choices have a strong impact on the reported coefficient, so the underlying conclusion about the resources-growth nexus depends on what methodology one prefers. Because of the importance of the individual aspects of estimation design for the results, we discuss them in detail in the following paragraphs. It is also worth noting that the explanatory power of the regression rises significantly when the additional variables are included; compared with Table 2.3, R^2 increases by about 0.5.

Table 2.4: What drives the heterogeneity in the results?

Variable	**Clustered OLS**	**IV**	**Fixed effects**	**Mixed-effects**
NO.EXPL.VARS	-0.042	-0.043	0.046	0.054
	(0.03)	(0.04)	(0.05)	(0.06)
NO.COUNTRY	0.074***	0.052**	0.023	0.005
	(0.03)	(0.02)	(0.05)	(0.06)
NO.TIME	0.063***	0.030*	0.040	0.057*
	(0.02)	(0.02)	(0.03)	(0.03)
Publication characteristics				
YEAR	29.171***	25.574***		-18.804
	(7.40)	(7.16)		(19.305)
IMPACT.FACTOR	0.306***	0.298***		1.435***
	(0.09)	(0.10)		(0.11)
CITATIONS	0.019**	0.016*		-0.703***
	(0.01)	(0.01)		(0.22)
REVIEWED	-0.102***	-0.107***		-2.042***
	(0.04)	(0.04)		(0.73)
Institutional quality				

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Table 2.4: What drives the heterogeneity in the results? (continued)

Variable	Clustered OLS	IV	Fixed effects	Mixed-effects
INSTITUTION	0.049*	0.057**	-0.017	-0.034
	(0.03)	(0.03)	(0.03)	(0.04)
INTERACTION	0.038*	0.044*	0.016	0.019
	(0.02)	(0.02)	(0.06)	(0.07)
Macroeconomic conditions				
TOT	0.019	0.031	0.001	-0.059
	(0.03)	(0.03)	(0.06)	(0.05)
OPENNESS	0.024	0.022	-0.014	0.002
	(0.03)	(0.03)	(0.02)	(0.02)
INITIAL GDP	0.010	0.022	-0.013	0.033
	(0.04)	(0.04)	(0.03)	(0.03)
INVESTMENT	-0.062**	-0.076**	-0.199*	-0.054
	(0.03)	(0.03)	(0.10)	(0.06)
SCHOOLING	0.026	0.040	0.266	1.358*
	(0.02)	(0.03)	(0.21)	(0.71)
Dependent variable choice				
GDP PER CAPITA	-0.000	0.005	0.066	-0.039
	(0.02)	(0.02)	(0.06)	(0.05)
GDP GROWTH	0.046	0.061	0.093	-0.055
	(0.05)	(0.05)	(0.12)	(0.05)
NON-RESOURCE GDP	-0.035	-0.051	-0.004	0.005
	(0.04)	(0.04)	(0.03)	(0.04)
Natural-resource variable choice				
RES.ABUNDANCE	0.220***	0.196***	0.142**	0.123***
	(0.06)	(0.06)	(0.07)	(0.03)
NAT.RES.EXPORT	-0.048***	-0.050***	-0.017	0.001
	(0.02)	(0.02)	(0.02)	(0.02)
OIL-RESOURCE	0.181***	0.179***	0.191***	0.176***
	(0.04)	(0.04)	(0.06)	(0.06)
Dataset type				
CROSS	0.090	-0.002		0.048
	(0.20)	(0.22)		(1.24)
PANEL	0.374*	0.221		0.237
	(0.21)	(0.22)		(1.26)
REGION	-0.156***	-0.156***		-0.243
	(0.05)	(0.05)		(1.01)
Estimation methods				
OLS	0.226***	0.197***	0.159	0.326***
	(0.06)	(0.05)	(0.18)	(0.11)
ENDOGENEITY	0.202***	0.178***	0.159	0.328***
	(0.06)	(0.05)	(0.17)	(0.11)
Dataset time period				
DUMMY60	0.044	0.051	-0.071	-0.015
	(0.05)	(0.05)	(0.07)	(0.03)
DUMMY80	0.055	0.062	0.256*	0.176***
	(0.04)	(0.04)	(0.13)	(0.04)
DUMMY90	0.141***	0.160***	0.415***	0.249***
	(0.04)	(0.04)	(0.12)	(0.04)
DUMMY00	0.126**	0.145**	0.375***	0.030
	(0.06)	(0.06)	0.07)	(0.04)
SE	3.186***	1.526***	-38.087	2.458
	(0.90)	(0.58)	(75.15)	(1.86)
CONSTANT	-222.993***	-195.220***	3.186**	143.094
	(56.39)	(54.49)	(1.20)	(146.88)

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Table 2.4: What drives the heterogeneity in the results? (continued)

Variable	**Clustered OLS**	**IV**	**Fixed effects**	**Mixed-effects**
NO.OBSERVATION	605	605	605	605
F/Wald-test	45.50	47.00	14.23	123.43
R-squared	0.62	0.61	0.37	0.58

Notes: The dependent variable is PCC; the estimated equation is $PCC_{is} = \beta_0 + \beta_1 * SE + \sum_{k=1}^{N} \lambda_k * X_{kis} + \epsilon_{is}$. All results are weighted by the inverse variance. Column (2) represents OLS with cluster-robust standard errors at the study level. Column (3) represents IV estimation, where SE is instrumented with the inverse of the square root of the number of degrees of freedom. Column (4) represents fixed-effects estimation at the study level. Column (5) represents mixed-effects ML regression. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Concerning data characteristics, we find that the number of time periods in primary studies tend to be positively associated with the estimated effect of natural resources on economic growth. This result suggests that it might be worthwhile to focus on expanding the time dimension when examining the natural resource curse (we have noted that most of the primary studies are of a cross-sectional nature), as it takes some time for the effects of natural resources to become visible in GDP growth. Our results also suggest some evidence that more recent studies find the natural resource curse less often. Primary studies published in higher ranked journals are less likely to report natural resource curse.

Next, the control for institutional quality and the inclusion of an interaction term between institutional quality and natural resources has a systematic effect on the reported results. The effect is positive, which means that studies which control for institutions and the interaction tend to find a less negative impact of resources on growth. To be more specific, our findings based on the OLS meta-regression (the first column of the Table 2.4) suggest that studies controlling for institutions (holding other study and estimate characteristics fixed at the sample means and computing the predicted PCC) typically find partial correlation coefficients of about 0.25, implying a moderate positive effect according to Doucouliagos's guidelines. This result gives some support to the hypothesis that once a country exhibits a sufficient level of institutional quality, natural resources contribute positively to economic growth, which is the case, for instance, of Norway (Mehlum et al. 2006).

Concerning the measurement of natural resources, the dummy variable for oil resources is systematically positive, supporting the notion that oil is less prone to the natural resource curse than other substances, such as precious metals or diamonds. The OLS specification of our meta-regression analysis suggests that studies exploring the effect of oil tend to find partial correlation coefficients close to 0.3, which implies a moderate impact of natural resources on economic growth. Indeed, even the simple correlation coefficient between the oil dummy and the partial correlation coefficient in our sample is significantly positive with a value of 0.49. These results are in line with the literature showing that many countries with new oil discoveries exhibit higher growth for a sustained period of time (Alexeev and Conrad 2009; Smith 2015). Importantly, the result is also consistent with Boschini et al. (2007), who show that the degree of technical appropriability (i.e., that some substances, such as precious metals and diamonds, are, for economic or technical reasons, more prone to rent-seeking and conflicts) matters for the occurrence of the natural resource curse. We also find that the dummy variable for resource abundance is positive and statistically significant showing that it is important to differentiate between resource dependence and resource abundance (Brunnschweiler and Bulte 2008). The studies using the resource abundance measure are more likely to report the positive effect of natural resources on economic growth (Brunnschweiler and Bulte 2008; Alexeev and Conrad 2009; Smith 2015).

Concerning controls for macroeconomic conditions, our results suggest that the primary studies underestimate the importance of controlling for investment; approximately 40% of primary studies do not condition for investment activity, but we find that controlling for investment affects the resource-growth nexus significantly and negatively. According to our OLS meta-regression, a typical study that controls for investment finds a negative effect of natural resources on economic growth. The implied partial correlation coefficient, however, is only about −0.06, which in absolute value is less than the threshold recommended by Doucouliagos (2011) for interpretation as a small effect. In general, the result provides some support to the previous evidence showing that natural resources tend to crowd out investment activity (Gylfason and Zoega 2006).

Next, we find that the dummy variable for the data from the 1990s is statistically significant and positive. The finding indicates that the literature which primarily uses the data for the 1990s finds a less negative (or more positive) effect of natural resources on economic growth. Holding other estimate and study characteristics constant, using data for the 1990s implies partial correlations of about 0.3, suggesting a positive and moderately strong effect of resources on growth. We hypothesize that the positive effect for the 1990s stems from the fact that this period has been associated with marked substantial improvements in technology, infrastructure, education, investment allocation, and liberalization of financial markets in resource-rich (especially oil) countries.[2]

Moreover, our results suggest that articles published in journals are more likely to report positive effects of natural resources on economic growth (the difference in terms of the reported partial correlation coefficients is about 0.3), but we do not intend to overemphasize this finding given that very few of the studies in our sample are unpublished manuscripts. Moreover, our previous analysis indicates relatively little evidence for publication bias. Other moderator variables are only significant in specific regressions and therefore their effect does not seem to be systematic.

In addition, we conduct a number of robustness checks. In Table 2.6 in the Appendix2A we present the results without weighting the estimates by the inverse of their estimated variance. In these robustness checks we run the same regressions with identical moderator variables and identical econometric methods. Next, we also run the same four specifications in a setting where the weighting is based on the inverse of the number of regression specifications per primary study instead of the inverse variance of the estimates to give each study the same importance in the analysis. The results are available in Table 2.7 in the Appendix2A. The robustness checks are largely in line with our main baseline findings presented in the main text. The exception is investment, which is no longer statistically significant. Next, we also restrict our sample to the primary studies, which use the measure of mineral resources. The present the partial correlation coefficients results (in Table 2.8), funnel plot (in Figure 2.2) and meta-analysis (in Table 2.9) in the Appendix2A. Overall,

[2]We thank an anonymous referee for pointing out this interpretation.

the results suggest that the effect of natural resources on economic growth for this restricted sample is approximately zero and publication bias is not present.

We also experimented with Bayesian model averaging (for applications of the method in meta-analysis, see Havranek et al. 2015a;b; Havranek and Sokolova 2016; Havranek and Irsova 2016), because our regressions include many explanatory variables and are thus subject to model uncertainty. While we are not able to emulate the instrumental variable specification using BMA, the Bayesian analogy of our OLS specification gives results similar to our baseline.

2.7 Concluding Remarks

In this paper we take stock of two decades of empirical research examining the existence of the natural resource curse. The previous literature has documented a great deal of heterogeneity in the effect of (point-source non-renewable) natural resources on economic growth. We collect 43 studies providing 605 different regression specifications and find that approximately 40% of them report a negative and statistically significant effect, another 40% report no effect, and the remaining 20% report a positive and statistically significant effect of natural resources on economic growth.

After reviewing the apparently mixed results reported in the literature, we ask two principle questions. First, what is the mean effect of natural resources on economic growth? A lot of research work has been devoted to the topic, and the literature deserves more than a statement that the results are mixed. A quantitative synthesis of the literature can uncover economists' best guess concerning the resources-growth nexus, and support or reject the findings of Sachs and Warner (1995), the most influential study in this field, which finds evidence for the natural resource curse. Second, why do different researchers obtain such different results? Systematic literature review methods allow us to formally trace the sources of heterogeneity to the data and methods used in estimations.

To summarize the literature quantitatively, we use meta-analysis techniques (Stanley 2001) and find that the mean effect of natural resources on economic growth is negligible (negative or positive depending on the particular meta-analysis model).

In addition, we find little evidence for publication selection, i.e., that authors, referees, or editors prefer some types of findings (such as statistically significant evidence in favor of the natural resource curse) at the expense of other results. Next, our meta-regression analysis also shows that several factors are systematically important for the estimated effect of natural resources on economic growth. We find that it matters for the results whether primary studies control for the investment level, control for the quality of institutions, include an interaction term between institutional quality and natural resource richness, distinguish between different types of natural resources, and differentiate between resource dependence and resource abundance.

When primary studies explicitly consider the interaction between institutional quality and natural resources, they are less likely to find evidence consistent with the natural resource curse. Well-functioning institutions eliminate the potentially negative effect of natural resources, as they reduce the extent of rent-seeking activities often associated with point-source natural resources (Mehlum et al. 2006; Boschini et al. 2007). Next, primary studies that include investment as a control variable are more likely to find the natural resource curse. This result is broadly consistent with the available literature, which reports that natural resources crowd out physical capital (Atkinson and Hamilton 2003; Gylfason and Zoega 2006). Finally, we also find that when natural resource richness is measured solely on the basis of oil endowment (and not using other substances such as diamonds or precious metals), support for the natural resource curse is less common. This result highlights the role of the measurement of natural resource richness, as different natural resources have different degrees of "technical appropriability" (Boschini et al. 2007). Our results in this respect are consistent with several recent studies showing that large oil discoveries tend to be associated with sustained economic growth (Alexeev and Conrad 2009; Cotet and Tsui 2013; Smith 2015). Similarly, our results also suggest that the primary studies, which employ the measure of resource abundance, are more likely to find the positive effect of natural resources on economic growth (Brunnschweiler and Bulte 2008; Alexeev and Conrad 2009; Smith 2015).

In terms of policy implications, the focus on improving institutions in developing countries will not strike our readers as new, since it has been a recurring theme in development studies, and not only in relation to the effects of natural resources. Compared to individual empirical papers, though, our meta-analysis approach is more systematic and allows for robust inference based on a vast literature that lacks consensus on the importance of institutions. The approach also points to several method choices that have a strong and systematic effect on the reported results (data period under investigation, treatment of institutions, control for investment, definition of natural resources), and our recommendation to researchers is to report robustness checks with respect to these aspects of methodology.

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Appendix2A

Studies Included in the Meta-Analysis (Alphabetical Order)

1. Alexeev, M. & R. Conrad, 2009, "The Elusive Curse of Oil", The Review of Economics and Statistics, 91(3), 586-598.

2. Alexeev, M. & R. Conrad, 2011, "The Natural Resource Curse and Economic Transition", Economic Systems, 35(4), 445-461.

3. Al-Rawashdeh, R. & J. P. Maxwell, 2013, "Minerals extraction and the resource curse", Resources Policy, 38(2), 103-112.

4. Al-Ubaydli, O., 2012, "Natural Resources and the Tradeoff Between Authoritarianism and Development", Journal of Economic Behavior & Organization, 81(1), 137-152.

5. Arezki, R. & F. van der Ploeg, 2008, "Can the Natural Resource Curse Be Turned Into a Blessing? The Role of Trade Policies and Institutions", OxCarre Research Paper.

6. Atkinson, G. & K. Hamilton, 2003, "Savings, growth and the resource curse hypothesis", World Development, 31(11), 1793-1807.

7. Baggio, J. A. & E. Papyrakis, 2010, "Ethnic diversity, property rights, and natural resources", The Developing Economies, 48(4), 473-495.

8. Boschini, A. D. & J. Pettersson & J. Roine, 2007, "Resource Curse or Not: A Question of Appropriability", Scandinavian Journal of Economics, 109(3), 593-617.

9. Boschini, A. D. & J. Pettersson & J. Roine, 2013, "The Resource Curse and its Potential Reversal", World Development, 43, 19-41.

10. Bruckner, M., 2010, "Natural Resource Dependence, Non-tradables, and Economic Growth", Journal of Comparative Economics, 38(4), 461-471.

11. Brunnschweiler, C. N., 2008, "Cursing the Blessings? Natural Resource Abundance, Institutions, and Economic Growth", World Development, 36(3), 399-419.

12. Brunnschweiler, C. N. & E. H. Bulte, 2008, "The Resource Curse Revisited and Revised: A Tale of Paradoxes and Red Herrings", Journal of Environmental Economics and Management, 55(3), 248-264.

13. Cavalcanti, T. V. de V. & K. Mohaddes & M. Raissi, 2011, "Growth, Development and Natural Resources: New Evidence Using a Heterogeneous Panel Analysis", The Quarterly Review of Economics and Finance, 51(4), 305-318.

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16. Gylfason, T., 1999, "Exports, Inflation and Growth", World Development, 27(6), 1031-1057.

17. Gylfason, T., 2001, "Natural Resources, Education and Economic Development", European Economic Review, 45(4-6), 847-859.

18. Gylfason, T. & G. Zoega, 2006, "Natural Resources and Economic Growth: The Role of Investment", The World Economy 29(8), 1091-1115.

19. Hodler, R., 2006, "The Curse of Natural Resources in Fractionalized Countries", European Economic Review, 50(6), 1367-1386.

20. Isham, J. & M. Woolcock & L. Pritchett, & G. Busby, 2005, "The Varieties of Resource Experience: Natural Resource Export Structures and the Political Economy of Economic Growth", World Bank Economic Review, 19(2), 141-174.

21. Kartashov, G., 2007, “Economic Growth and Institutional Quality in Resource Oriented Countries (in Russian)”, Quantile, 2, 141-157.

22. Kolstad, I. & A. Wiig, 2009, “Is Transparency the Key to Reducing Corruption in Resource-Rich Countries?”, World Development, 37(3), 521-532.

23. Kronenberg, T., 2004, “The Curse of Natural Resources in the Transition Economies”, The Economics of Transition, 12(3), 399-426.

24. Kropf, A., 2010, “Resource Abundance Versus Resource Dependence in Cross-country Growth Regressions”, OPEC Energy Review, 34(2), 107-130.

25. Leite, C. & J. Weidmann, 1999, “Does Mother Nature Corrupt? Natural Resources, Corruption, and Economic Growth”, IMF Working Papers, 99/85, International Monetary Fund.

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27. Mobarak, A. & A. Karshenasan, 2012, “The Impact of Institutional Quality on Relation Between Resource Abundance and Economic Growth”, Iranian Economic Review, 16(32), 95-110.

28. Murshed, S. M. & L.A. Serino, 2011, “The Pattern of Specialization and Economic Growth: The Resource Curse Hypothesis Revisited,” Structural Change and Economic Dynamics, 22(2), 151-161.

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32. Ogunleye, E. K. 2008, “Natural Resource Abundance in Nigeria: From Dependence to Development”, Resources Policy, 33(3), 168-174.

33. Papyrakis, E. & R. Gerlagh, 2004, “The Resource Curse Hypothesis and Its Transmission Channels”, Journal of Comparative Economics, 32(1), 181-193.

34. Papyrakis, E. & R. Gerlagh, 2006, “Resource Windfalls, Investment, and Long-term Income”, Resources Policy, 31(2), 117-128.

35. Papyrakis, E. & R. Gerlagh, 2007, “Resource Abundance and Economic Growth in the United States”, European Economic Review, 51(4), 1011-1039.

36. van der Ploeg, F. & S. Poelhekke, 2010, “The pungent smell of “red herrings”: Subsoil assets, rents, volatility and the resource curse”, Journal of Environmental Economics and Management, 60(1), 44-55.

37. Sachs, J. D. & A. M. Warner, 1995, “Natural Resource Abundance and Economic Growth”, NBER Working Papers 5398, National Bureau of Economic Research.

38. Sachs, J. D. & A. M. Warner, 1999, “The Big Push, Natural Resource Booms and Growth”, Journal of Development Economics, 59(1), 43-76.

39. Sachs, J. D. & A. M. Warner, 2001, “The Curse of Natural Resources”, European Economic Review, 45(4-6), 827-838.

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Table 2.5: The true effect and publication selection - a robustness check

Unweighted results						
Panel A	**Coefficient**	**t-stat**	**p-value**	**Coefficient**	**t-stat**	**p-value**
	Clustered OLS			IV estimation		
SE	-0.471*	-1.72	0.095	-0.657**	-2.21	0.027
Constant	-0.026	0.80	0.426	-0.006	-0.19	0.851
Model diagnostics						
	Number of observations = 605			Number of observations = 605		
	F-test: F(1, 42) = 8.64			F-test: F(1, 42) = 4.89		
	Ho: Precision = 0, $Prob > F = 0.10$			Ho: Precision = 0, $Prob > F = 0.03$		
	Ramsey RESET test: F(3,393) = 6.29			Under-identification test = 683.24		
	Ho: No omitted variables, $Prob > F = 0.00$			$Prob > \chi^2 = 0.00$		
Panel B	**Coefficient**	**t-stat**	**p-value**	**Coefficient**	**z-stat**	**p-value**
	Fixed effects			Mixed-effects ML regression		
SE	0.422	1.36	0.175	0.398	1.33	0.183
Constant	-0.123***	-3.59	0.000	-0.160***	-3.09	0.002
Model diagnostics						
	Number of observations = 605			Number of observations = 605		
	Number of groups = 43			Number of groups = 43		
	F(1,561)=1.85			Wald test: $\chi^2(1) = 1.77$		
	$Prob > F = 0.17$			$Prob > \chi^2 = 0.18$		
Weighted by the inverse of the number of regressions per study						
Panel C	**Coefficient**	**t-stat**	**p-value**	**Coefficient**	**t-stat**	**p-value**
	Clustered OLS			IV estimation		
SE	0.773	1.16	0.247	0.308	0.41	0.684
Constant	-0.211**	-2.62	0.009	-0.157**	-1.93	0.054
Model diagnostics						
	Number of observations = 605			Number of observations = 605		
	F-test: F(1, 42) = 1.34			F-test: F(1, 42) = 0.17		
	Ho: Precision = 0, $Prob > F = 0.34$			Ho: Precision = 0, $Prob > F = 0.68$		
	Ramsey RESET test: F(3,600) = 9.49			Under-identification test = 663.54		
	Ho: No omitted variables, $Prob > F = 0.00$			$Prob > \chi^2 = 0.00$		
Panel D	**Coefficient**	**t-stat**	**p-value**	**Coefficient**	**z-stat**	**p-value**
	Fixed effects			Mixed-effects ML regression		
SE	1.197	1.07	0.289	0.773	0.71	0.476
Constant	-0.260**	-2.03	0.049	-0.211*	-1.61	0.096
Model diagnostics						
	Number of observations = 605			Number of observations = 605		
	Number of groups = 43			Number of groups = 43		
	F(1, 42) = 1.15			Wald test: $\chi^2(1) = 0.14$		
	$Prob > F = 0.28$			$Prob > \chi^2 = 0.70$		

Notes: The dependent variable is PCC. The equation $PCC_{is} = \beta_0 + \beta_1 * SE + \epsilon_{is}$ used. The standard errors of the regression parameters are clustered at the study level. SE represents "publication selection", *constant* represents "true effect". Panel (A) and Panel (B) represent unweighted results. Panel A, columns (2)–(4) represent OLS with cluster-robust standard errors at the study level; columns (5)–(7) represent IV estimation, where the instrumented variable is the inverse of the square root of the number of degrees of freedom. Panel B, columns (2)–(4) represent fixed-effects estimation at the study level; columns (5)–(7) represent mixed-effects ML regression. The reported t-statistics are based on heteroskedasticity cluster-robust standard errors. Panel (C) and Panel (D) results are weighted by the inverse of the number of regression specifications per study.

Table 2.6: What drives the heterogeneity in the results? Unweighted regressions

Variable	Clustered OLS	IV	Fixed effects	Mixed-effects
NO.EXPL.VARS	-0.034	-0.030	0.057	0.044
	(0.03)	(0.03)	(0.05)	(0.03)
NO.COUNTRY	0.040**	0.027	0.020	0.031
	(0.02)	(0.02)	(0.11)	(0.03)
NO.TIME	-0.047*	-0.063**	0.041	0.031
	(0.03)	(0.03)	(0.03)	(0.03)
Publication characteristics				
YEAR	25.009***	23.176***		51.183***
	(7.32)	(7.35)		(18.04)
IMPACT.FACTOR	0.228***	0.220***		0.224
	(0.07)	(0.07)		(0.16)
CITATIONS	0.007	0.006		0.022
	(0.01)	(0.01)		(0.02)
REVIEWED	-0.105***	-0.108***		-0.192***
	(0.03)	(0.03)		(0.07)
Institutional quality				
INSTITUTION	0.059**	0.058**	-0.040	-0.027
	(0.03)	(0.03)	(0.03)	(0.03)
INTERACTION	0.084***	0.089***	0.095	0.084***
	(0.02)	(0.02)	(0.10)	(0.02)
Macroeconomic conditions				
TOT	0.071*	0.073**	-0.026	0.002
	(0.04)	(0.04)	(0.04)	(0.04)
OPENNESS	-0.004	-0.009	0.006	0.010
	(0.03)	(0.03)	(0.02)	(0.03)
INITIAL GDP	0.013	0.020	0.038	0.029
	(0.04)	(0.04)	(0.04)	(0.04)
INVESTMENT	-0.007	-0.017	-0.059	-0.038
	(0.03)	(0.03)	(0.07)	(0.05)
SCHOOLING	0.026	0.029	0.000	-0.035
	(0.02)	(0.02)	(.)	(0.06)
Dependent variable choice				
GDP PER CAPITA	0.014	0.018	-0.015	-0.010
	(0.02)	(0.02)	(0.06)	(0.04)
GDP GROWTH	-0.014	-0.002	-0.008	-0.012
	(0.04)	(0.04)	(0.06)	(0.06)
NON-RESOURCE GDP	-0.111**	-0.120**	-0.027	-0.033
	(0.05)	(0.05)	(0.05)	(0.05)
Natural-resource choice				
RES.ABUNDANCE	0.267***	0.250***	0.117**	0.152***
	(0.04)	(0.04)	(0.05)	(0.05)
NAT.RES.EXPORT	-0.067**	-0.064**	0.001	-0.023
	(0.03)	(0.03)	(0.05)	(0.03)
OIL-RESOURCE	0.173***	0.174***	0.173**	0.176***
	(0.04)	(0.04)	(0.07)	(0.04)
Dataset type				
CROSS	-0.382***	-0.401***	-0.114	-0.042
	(0.14)	(0.15)	(0.08)	(0.20)
PANEL	-0.082	-0.118		0.126
	(0.13)	(0.13)		(0.18)
REGION	-0.049	-0.053		-0.067
	(0.04)	(0.04)		(0.09)
Estimation methods				
OLS	0.166***	0.151***	0.229**	0.219***
	(0.05)	(0.05)	(0.11)	(0.06)

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Table 2.6: What drives the heterogeneity in the results? Unweighted regressions (continued)

Variable	**Clustered OLS**	**IV**	**Fixed effects**	**Mixed-effects**
ENDOGENEITY	0.160***	0.153***	0.268**	0.250***
	(0.05)	(0.05)	(0.11)	(0.06)
Dataset time period				
DUMMY60	-0.102	-0.086	-0.008	-0.046
	(0.07)	(0.07)	(0.02)	(0.10)
DUMMY80	0.069**	0.066**	0.173***	0.064
	(0.03)	(0.03)	(0.04)	(0.05)
DUMMY90	0.088***	0.100***	0.250***	0.140***
	(0.03)	(0.03)	(0.04)	(0.05)
DUMMY00	0.072	0.081	0.031	0.052
SE	1.264***	0.583	1.169	1.466***
	(0.41)	(0.44)	(1.68)	(0.51)
CONSTANT	-190.382***	-176.274***	-2.656***	-389.939***
	(55.70)	(55.94)	(0.47)	(137.22)
NO.OBSERVATION	605	605	605	605
F/Wald-test	22.78	22.42	NA	192.36
R-squared	0.54	0.54	0.21	0.47

Notes: The dependent variable is PCC; the estimated equation is $PCC_{is} = \beta_0 + \beta_1 * SE + \sum_{k=1}^{N} \lambda_k * X_{kis} + \epsilon_{is}$. The results correspond to unweighted regressions. Column (2) represents OLS with cluster-robust standard errors at the study level. Column (3) represents IV estimation, where SE is instrumented with the inverse of the square root of the number of degrees of freedom. Column (4) represents fixed-effects estimation at the study level. Column (5) represents mixed-effects ML regression. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Table 2.7: What drives the heterogeneity in the results? Weighted by the inverse of number of regressions per study

Variable	**Clustered OLS**	**IV**	**Fixed effects**	**Mixed-effects**
NO.EXP	0.042	0.052	0.130**	0.042
	(0.05)	(0.05)	(0.05)	(0.07)
NO.COUNTRY	0.064**	0.058**	0.027	0.064
	(0.03)	(0.03)	(0.14)	(0.04)
NO.TIME	-0.130***	-0.155***	0.040	-0.130*
	(0.04)	(0.04)	(0.05)	(0.07)
Publication characteristics				
YEAR	35.775***	33.438***		35.775**
	(9.53)	(9.79)		(16.84)
IMPACT.FACTOR	0.314***	0.321***		0.314**
	(0.09)	(0.09)		(0.14)
CITATIONS	0.004	0.002		0.004
	(0.01)	(0.01)		(0.02)
REVIEWED	-0.136***	-0.138***		-0.136*
	(0.05)	(0.05)		(0.08)
Institutional quality				
INSTITUTION	0.059*	0.059*	-0.082***	0.059
	(0.03)	(0.03)	(0.03)	(0.05)
INTERACTION	0.098**	0.102**	0.203	0.098
	(0.04)	(0.04)	(0.13)	(0.08)
Macroeconomic conditions				
TOT	0.034	0.033	-0.009	0.034
	(0.04)	(0.04)	(0.05)	(0.07)
OPENNESS	0.027	0.023	0.016	0.027
	(0.04)	(0.04)	(0.03)	(0.06)
INITIAL GDP	-0.119	-0.113	0.029	-0.119
	(0.08)	(0.08)	(0.03)	(0.09)
INVESTMENT	0.008	-0.013	-0.094	0.008
	(0.04)	(0.04)	(0.07)	(0.06)
SCHOOLING	0.044	0.057		0.044
	(0.04)	(0.04)		(0.07)
Dependent variable choice				
GDP PER CAPITA	0.059	0.063*	0.193**	0.059
	(0.04)	(0.04)	(0.09)	(0.06)
GDP GROWTH	-0.030	-0.006	0.027	-0.030
	(0.06)	(0.06)	(0.06)	(0.09)
NON-RESOURCE GDP	-0.130**	-0.143**	-0.167**	-0.130*
	(0.06)	(0.06)	(0.07)	(0.08)
Natural-resource choice				
RES.ABUNDANCE	0.088	0.069	0.102**	0.088
	(0.08)	(0.08)	(0.04)	(0.10)
NAT.RES.EXPORT	-0.128***	-0.121***	0.040	-0.128**
	(0.04)	(0.04)	(0.07)	(0.06)
OIL-RESOURCE	0.136**	0.142**	0.153*	0.136**
	(0.07)	(0.06)	(0.08)	(0.07)
Dataset type				
CROSS	-0.607***	-0.663***	-0.047	-0.607**
	(0.22)	(0.21)	(0.08)	(0.29)
PANEL	-0.064	-0.120		-0.064
	(0.20)	(0.19)		(0.27)
REGION	-0.077	-0.089		-0.077
	(0.06)	(0.06)		(0.09)
Estimation methods				
OLS	0.082*	0.060	0.134	0.082

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Table 2.7: What drives the heterogeneity in the results? Weighted by the inverse of number of regressions per study (continued)

Variable	**Clustered OLS**	**IV**	**Fixed effects**	**Mixed-effects**
	(0.05)	(0.05)	(0.11)	(0.07)
ENDOGENEITY	-0.012	-0.029	0.168	-0.012
	(0.06)	(0.06)	(0.11)	(0.09)
Dataset time period				
DUMMY60	-0.259***	-0.248***	-0.021	-0.259**
	(0.08)	(0.08)	(0.02)	(0.10)
DUMMY80	-0.042	-0.047	0.205***	-0.042
	(0.04)	(0.04)	(0.05)	(0.05)
DUMMY90	0.026	0.037	0.336***	0.026
	(0.05)	(0.05)	(0.07)	(0.08)
DUMMY00	0.207**	0.234**	-0.098*	0.207*
	(0.09)	(0.09)	(0.05)	(0.11)
SE	1.558***	0.814	0.304	1.558*
	(0.49)	(0.54)	(1.95)	(0.80)
CONSTANT	-271.951***	-253.999***	-3.476***	-271.951**
	(72.54)	(74.49)	(0.52)	(128.16)
NO.OBSERVATION	605	605	605	605
F/Wald-test	34.33	31.23	NA	129.09
R-squared	0.57	0.57	0.23	0.49

Notes: The dependent variable is PCC; the estimated equation is $PCC_{is} = \beta_0 + \beta_1 * SE + \sum_{k=1}^{N} \lambda_k * X_{kis} + \epsilon_{is}$. All the regressions are weighted by the inverse number of estimates reported per study. Column (2) represents OLS with cluster-robust standard errors at the study level. Column (3) represents IV estimation, where SE is instrumented with the inverse of the square root of the number of degrees of freedom. Column (4) represents fixed-effects estimation at the study level. Column (5) represents mixed-effects ML regression. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Table 2.8: Estimates of the overall partial correlation coefficient - Mineral resource

Explanation	**Estimate**	**Standard error**	**95% confidence interval**	
Simple average of PCC	-0.024	0.017	-0.060	0.011
Fixed-effects average PCC	0.002	0.004	-0.005	0.009
Random-effects average PCC	0.002	0.018	-0.034	0.038

Notes: Simple average represents the arithmetic mean. The fixed-effects estimator uses the inverse of the variance as the weight for the PCC. The random-effects specification additionally considers between-study heterogeneity.

Figure 2.2: Funnel plot of the effect of mineral resources on economic growth

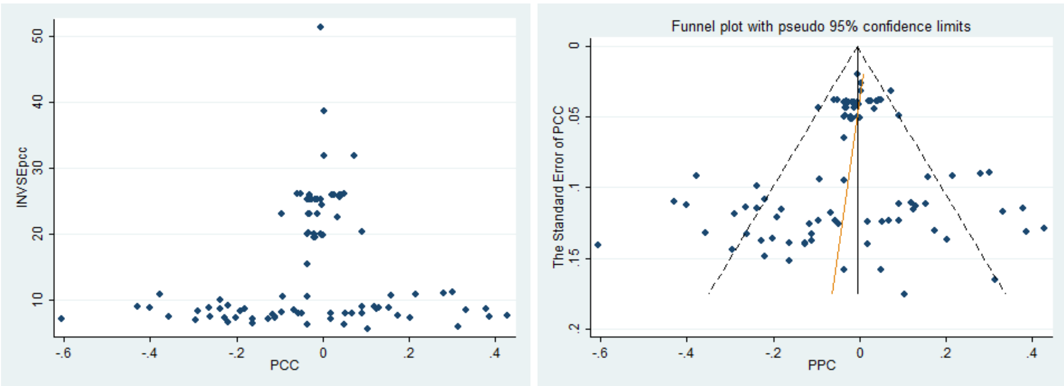

Table 2.9: Tests of the true effect and publication selection - Mineral resource

Panel A	**Coefficient**	**t-stat**	**p-value**	**Coefficient**	**t-stat**	**p-value**
	Clustered OLS			IV estimation		
SE (publication selection)	-0.462	-1.33	0.187	-0.501	-1.33	0.185
Constant (true effect)	0.016	1.09	0.277	0.018	1.13	0.262
Model diagnostics						
	Number of observations = 96			Number of observations = 96		
	F-test: F(1, 12) = 1.77			F-test: F(1, 12) = 1.78		
	Ho: Precision = 0, $Prob > F = 0.18$			Ho: Precision = 0, $Prob > F = 0.18$		
	Ramsey RESET test: F(3, 91) = 0.18			Under-identification test = 321.62		
	Ho: No omitted variables, $Prob > F = 0.576$			$Prob > \chi^2 = 0.000$		
	R-squared = 0.02			R-squared = 0.02		
Panel B	**Coefficient**	**t-stat**	**p-value**	**Coefficient**	**z-stat**	**p-value**
	Fixed effects			Mixed-effects ML regression		
SE (publication selection)	0.005	0.30	0.763	-0.033	-0.07	0.941
Constant (true effect)	-0.283	-1.15	0.276	-0.080	-0.98	0.326
Model diagnostics						
	Number of observations = 96			Number of observations = 96		
	Number of groups = 13			Number of groups = 13		
	F(1, 19) = 0.09			Wald test: $\chi^2(1) = 0.01$		
	$Prob > F = 0.76$			$Prob > \chi^2 = 0.94$		
	R-squared = 0.01			R-squared = 0.02		

Notes: The dependent variable is PCC; the estimated equation is $PCC_{is} = \beta_0 + \beta_1 * SE + \epsilon_{is}$. All results are weighted by the inverse variance. The standard errors of the regression parameters are clustered at the study level. Panel A, columns (2)–(4) represent OLS with cluster-robust standard errors at the study level; columns (5)–(7) represent IV estimation, where the instrumental variable is the inverse of the square root of the number of degrees of freedom. Panel B, columns (2)–(4) represent fixed-effects estimation at the study level; columns (5)–(7) represent mixed-effects ML regression. The reported t-statistics are based on heteroskedasticity cluster-robust standard errors.

Chapter 3

Natural Resources, Manufacturing and Institutions in Post-Soviet Countries

Abstract

We examine the effect of natural resource exports on economic performance during the 1996-2010 period in the 15 independent countries that formerly comprised the Soviet Union. After the fall of communism, these countries began to demonstrate marked differences from one another with respect to economic development and institutions, which has resulted in unique cross-sectional and time variation. Using several panel regression models that address endogeneity and clustering issues, our results suggest that natural resource exports crowd out the manufacturing sector while controlling for a wide range of economic, social and political characteristics. Nevertheless, our results indicate that the natural resources are a curse only in countries characterized by poor institutions. Therefore, the results provide a clear message to policy makers concerning the positive role that institutions play in economic performance.

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3.1 Introduction

Since Sachs and Warner (1995), many empirical studies have observed that natural resource richness does not necessarily lead to higher economic growth and that abundant natural resources are, in fact, often associated with lower economic performance. The literature has proposed several mechanisms to illuminate the so-called natural resource curse (van der Ploeg 2011; Frankel 2012), and researchers have argued that institutions are the main driving factor at the nexus of natural resources and growth (Bulte et al. 2005; Isham et al. 2005; Brunnschweiler and Bulte 2008; Hartwell 2016).

It has also been shown that the manufacturing sector is typically crucial for long-term productivity growth, as it facilitates learning by doing (Matsuyama 1992; Jones and Olken 2008; Rodrik 2008; Johnson et al. 2010), and that natural resource exports crowd out the manufacturing sector (Sachs and Warner 1999; Rajan and Subramanian 2011). Regarding the mechanism by which natural resources may crowd out the manufacturing sector, it is useful to think of the Dutch disease effect (Corden and Neary 1982). A booming sector, consider - for example - an increase in natural resource exports due to discoveries of natural resources or an increase in the price of natural resources, may crowd out the other sectors in the economy by attracting investment and labor and appreciating the domestic (real) exchange rate, thus making exports from other sectors uncompetitive.

The period following the collapse of the former Soviet Union provides what is arguably the largest natural experiment on economic reforms in recent history (Campos and Horvath 2012). The Soviet economy was over-industrialized, and prices were set by a central planning committee rather than by (non-existent) markets, leading to well-known allocation problems and price disequilibria (Egert 2009; Cheremukhin et al. 2016).

A number of large-scale market-oriented reforms were implemented in the newly independent countries that formerly comprised the Soviet Union, and these countries began to differ markedly from one another. The proximity to the west, years under socialism and prospects for EU accession (in the case of the Baltic countries) exacerbated these differences. We gather the relevant data on post-Soviet countries and examine whether the natural resource curse exists and, if so, whether institutions can lift this curse. Although the non-linear effect of natural resources on growth has been examined in several recent studies, we nevertheless believe that it is worthwhile to examine this issue and verify previous findings in this field, especially because we specifically focus on the performance of the manufacturing sector.

We believe that our analysis is valuable because we extend the previous literature in several ways. First, we focus on a group of countries that shared a common history and legal system and faced similar social and institutional contexts, i.e., the countries that formerly comprised the Soviet Union. Therefore, imposing common parameters on such a group might be more reasonable than would be the case in regressions based on countries from different continents.

Second, most of the previous research focuses on cross-sectional data. However, van der Ploeg (2011) and Rajan and Subramanian (2011) emphasize that the application of panel data is crucial because cross-sectional data suffer from omitted variable bias that arises from the correlation between initial income and the omitted initial level of productivity. We follow this suggestion and apply panel data regressions for the post-Soviet countries.

Third, our sample of post-Soviet countries offers a unique opportunity to more fully examine the effects of institutions. Institutions are typically persistent and do not change significantly over short periods of time. However, the institutional frameworks have changed dramatically in several post-Soviet countries over the past two decades (Hartwell 2013). Consider Estonia. Once part of the Soviet Union, Estonia is now fully integrated into European structures and adopted the euro in 2011. According to the widely used World Bank Governance Indicators, Estonia obtained a rule of law score close to those of Uruguay or Botswana at the beginning of our sample in 1996. Fifteen years later (at the end of our sample), Estonia received the same score as Spain and was not far from that of Japan. In addition, we propose a novel way to instrument the institutional quality in a panel setting. We use a newly developed measure of export goods "rule of law" intensity, which is constructed to be exogenous to the institutional quality at the country level (Frenscha et al. 2016).

Fourth, the previous literature on transition economies, including works studying post-Soviet countries, has yet to reach consensus regarding whether the natural resource curse exists. The findings of Esanov et al. (2001) and Kronenberg (2004) tend to support the existence of the natural resource curse, whereas Alexeev and Conrad (2009) suggest that the net effect of natural resources on growth is close to zero. Alternatively, Ahrend (2012) finds that natural endowments had a positive effect on economic growth in Russian regions at the outset of the transition.

Our results suggest that natural resource exports do not crowd out the manufacturing sector in those post-Soviet countries possessing sufficiently high institutional quality; those countries lacking such institutional quality suffer from the natural resource curse. This result is robust to different regression specifications, different instrumental variable structures and different measurements of institutions from different sources.

This paper is organized as follows. Section 3.2 discusses the related literature. Section 3.3 describes the data and introduces the econometric model. Section 3.4 presents the results. Concluding remarks are offered in section 3.5. An Appendix3A with data descriptions and additional results follows thereafter.

3.2 Literature Survey

We provide a brief literature survey in this section with a focus on those studies that examine how institutions shape the effect of natural resources on growth. We refer the reader to the surveys of van der Ploeg (2011), Frankel (2012) and Havranek et al. (2016) for a more comprehensive overview of the literature on the natural resource curse.

The literature on natural resources and growth was inspired by Sachs and Warner (1995), whose empirical analysis showed that resource-scarce economies tend to exhibit higher economic performance than resource-rich economies over the long run. This finding spurred many economists to analyze its origins and test its robustness. Some studies took an additional step and suggested that institutional quality itself might be endogenous and not invariant with respect to natural resource use in economic growth models (Brunnschweiler and Bulte 2008).

There are several mechanisms by which the natural resource curse interacts with institutions. In their theoretical model, Robinson et al. (2006) show that natural resource booms are associated with a larger of public sector, as these booms make it more desirable for incumbent political representatives to remain in power. As a result, socially inefficient over-employment in public sector may be so devastating that, despite additional revenues from natural resources, it leads to lower economic growth. It also implies underemployment in the manufacturing sector.

There are several mechanisms how the natural resource curse interacts with institutions. In their theoretical model, Robinson et al. (2006) show that natural resource booms are associated with a greater size of public sector, as these booms make it more desirable for incumbent political representatives to stay in power. As a result, a socially inefficient overemployment in public sector may be so devastating that despite additional revenues from natural resources it leads to lower economic growth. It also implies underemployment in manufacturing sector.

Several empirical studies have emphasized that the effect of natural resource richness on economic growth depends on the quality of institutions. Sala-i-Martin and Subramanian (2013) find that high levels of corruption prevented Nigeria from reaping the benefits of its natural resources and promoting growth. Others have emphasized the negative effects of natural resources on public health expenditures (Cockx and Francken 2014), democracy (Ross 2001; Jensen and Wantchekon 2004; Andersen and Ross 2013), education (Cockx and Francken 2016), and financial development (Bhattacharyya and Hodler 2014) or found that natural resources increase the incidence of civil war (Collier and Hoeffler 1998; Fearon 2005). BenYishay and Grosjean (2014) examine the reform efforts in the Central and Eastern European countries and find that natural resource endowment at the onset of the transition is beneficial unless the country (or province) was a part of Ottoman or Russian empire in the past.

According to Bulte et al. (2005) and Mehlum et al. (2006), the positive effects of natural resources on growth prevails only in countries with institutions of sufficient quality. Botswana is frequently mentioned as the example of a developing country that managed to improve its institutional framework and generate higher growth in its diamond industry (Ilmi 2007). Some studies emphasize that the natural resource curse is more concentrated in appropriable point-source resources, such as oil, diamonds or minerals, than in other resources (Auty 2004; Boschini et al. 2007; 2013). In an in-depth study of former Soviet Union countries, Luong and Weinthal (2010) emphasize that different ownership structures may be crucial for whether countries experience the natural resource curse and that fiscal regimes also matter. Hartwell (2016) emphasizes that private property, as compared to other institutions, is key to natural resources-economic growth nexus.

Nevertheless, there is also important research questioning the existence of the natural resource curse. Alexeev and Conrad (2009) examine the countries with large oil endowments and find that these countries exhibit higher incomes. Similarly, Smith (2015) investigates the effect of major natural resource discoveries in the second half of the 20th century on GDP per capita. Oil discoveries are exogenous and allow for the use of various quasi-experimental techniques such as the synthetic control method. Smith (2015) finds that the countries with oil discoveries exhibit systematically higher economic growth.

The natural resource literature has also analyzed transition countries, and the post-Soviet countries represent a large share of such countries. There are studies that focus on the effect of natural resources on growth, but they do not specifically examine how institutions influence the resource-growth nexus. Kronenberg (2004) finds that natural resources are negatively related to economic growth and argues that corruption is an obstacle to translating natural resource endowments into higher growth. Esanov et al. (2001) show that having income from natural resources reduced the incentive to reform in transition countries during the 1990s. Pomfret (2011) and Pomfret (2012) provide an extensive discussion of natural resource management in Central Asian countries and Azerbaijan and document that natural resource management is far from optimal and that the interactions among natural resources, ownership and institutional quality are complex.

The impact of oil on economic growth in transition countries (including former Soviet countries and countries from Central and Eastern Europe) is examined by Brunnschweiler (2009), and her empirical analysis reveals that oil reserves had a positive effect on economic growth over the 1996-2006 period. However, she also finds that oil reserves have a positive relationship with low democracy index scores, high levels of corruption and low human capital formation. Alexeev and Conrad (2011) analyze the relationship between point-source natural resources and economic growth in transition countries and extend the previous literature in a number of ways, finding that, overall, natural resources do not represent an obstacle to economic growth in transition countries. Alexeev and Chernyavskiy (2015) examine the taxation of natural resources, natural resource rents and economic growth in Russian regions. Their results do not suggest evidence for the natural resource curse. Oskenbayev et al. (2013) provide regional evidence for Kazakhstan and find natural resource curse only for point-source resources when institutional quality is low.

3.3 Data and Empirical Methodology

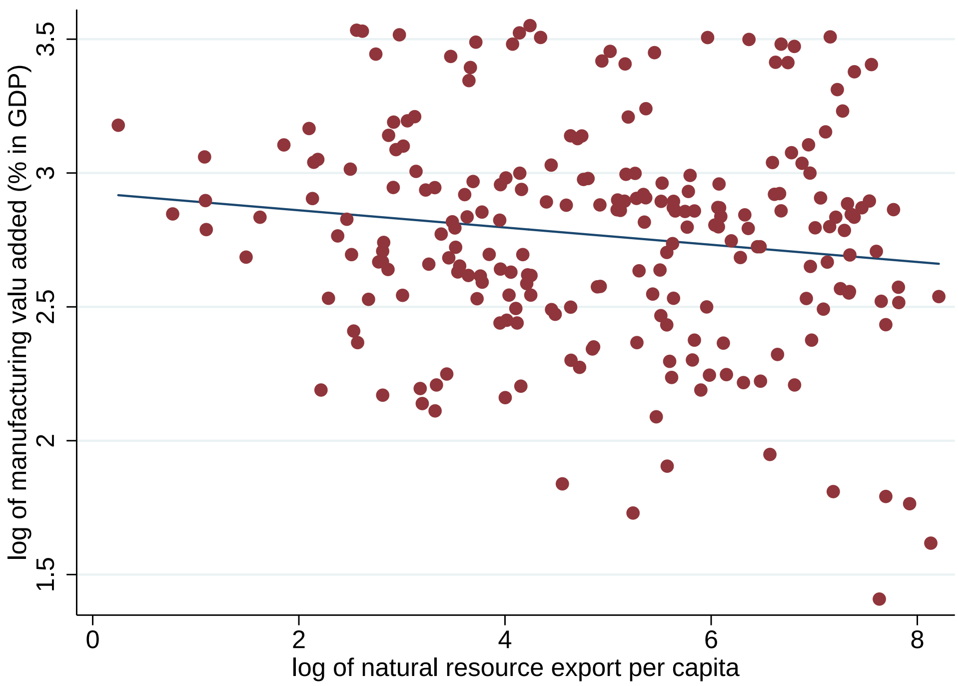
We present our data and econometric framework in this section. Our dataset consists of 15 countries during the 1996-2010 period.[1] We refer the reader to the Appendix3A, which presents data definitions, data sources and basic descriptive statistics (see Table 3.2).

Figure 3.1 shows that we observe a somewhat negative relationship between the measure of natural resource exports and manufacturing performance for the full sample, which provides some informal evidence for the natural resource curse (or, more specifically, symptoms of Dutch disease). Next, we divide our sample into two groups: countries with high-quality rule of law and countries with low-quality rule of law. We label a country's rule of law as good if the value of the rule of law indicator is greater than the 25th percentile. Clearly, placing the cut-off point at the 25th percentile is somewhat arbitrary, but this measurement illustrates our point that institutions may transform a natural resource curse into a blessing. The corresponding scatter plots are depicted in Figure 3.2. We observe a negative relationship between natural resources and growth only for countries with poor institutional frameworks.

The natural resources in the former Soviet Union countries are not distributed equally. Some countries, such as Azerbaijan, Kazakhstan and Russia, have substantial natural resources at their disposal. Some countries, such as Moldova, are rather poor in point-source natural resources. In line with previous studies (Brunnschweiler and Bulte 2008; Alexeev and Conrad 2009), we use the measure of natural resource exports per capita (fuel, metal and ore exports in millions of USD). This measure has a value of 1052 for Russia. The value of this measure is below 100 is for Moldova, Armenia, Georgia, Kyrgyzstan, Lithuania, Tajikistan and Ukraine; Belarus, Estonia, Latvia, Turkmenistan, and Uzbekistan have values in the range 100-1000; and Azerbaijan, Kazakhstan, and Russia have values above 1000. Examining a related

[1] The list of countries is as follows: Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan Republic, Latvia, Lithuania, Moldova, the Russian Federation, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. We cannot update our dataset beyond 2010 because the *rolix* data are available only up to 2010. The widely used World Bank data on institutional quality are available only from 1996. We use these data because they are highly comprehensive in terms of country coverage and their ability to capture different aspects of institutional quality. In addition, macroeconomic data before 1995 are often missing and are of varying quality.

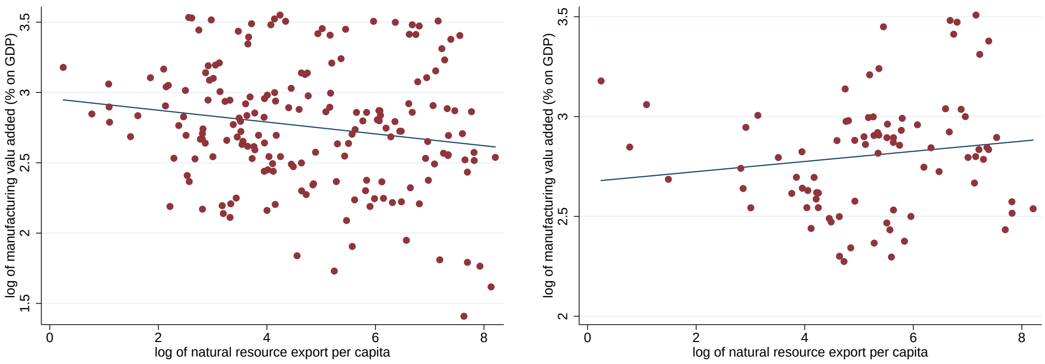
Figure 3.1: Natural Resource Exports and Manufacturing Performance



Notes: Figure shows a negative relationship between the measure of natural resource exports and manufacturing performance for the full sample. Horizontal line represents the log of manufacturing value added as a percentage of GDP, vertical line represents the natural logarithm of natural resource export (fuel, metal and ore) per capita.

measure, natural resource rents as a percentage of GDP for the period 2004-2012, we obtain a similar picture. This indicator is below 0.4% for Moldova, 1%-3% for Armenia, Belarus, Estonia, Georgia, Latvia, Lithuania and Tajikistan, 3%-10% for Kyrgyzstan and Ukraine, 27% for Russia, 35-40% for Kazakhstan and Turkmenistan and 50%-55% for Azerbaijan and Uzbekistan.[2] When we examine the variation for these countries over time, we observe the decline in the importance of the manufacturing sector after the natural resource booms, which started in the early 2000s.

Figure 3.2: Natural Resource Exports and Manufacturing Performance: Low (left) and High (right) Level of Institutions



Notes: The figure shows a negative relationship between the measure of natural resource exports and manufacturing performance for low (a) and high (b) levels of Institutions. The horizontal line represents the log of manufacturing value added as a percentage of GDP; the vertical line represents the natural logarithm of natural resource exports (fuel, metal and ore) per capita.

Our econometric framework largely follows Brunnschweiler and Bulte (2008)[3] and Isham et al. (2005), but we extend it to a panel setting. We examine the underlying factors that determine natural resource exports and institutional quality using a fixed effects model (with exogenous explanatory variables) and the determinants of economic growth using generalized two-stage least squares (2SLS). Using this framework, our ambition is to investigate the following: (1) what determines institutional quality; (2) whether institutions promote natural resource exports; (3) whether natural resource exports translate into a lower manufacturing share in post-Soviet countries, i.e., whether the natural resource curse exists; and (4) if the resource curse exists, whether sufficient institutional quality helps to alleviate the negative effects of resources on growth.

We estimate three different regression equations. Following earlier studies Isham et al. (2005); Brunnschweiler and Bulte (2008), we first analyze the determinants of institutional quality, I_{it}, using Eq. (3.1). We use six measures of institutional quality: control of corruption, rule of law, government effectiveness, regulatory quality,

[2]The rents are computed as the difference between the value of production at world prices and total costs of production. The source for the natural resource rent data is the World Bank Development Indicators.

[3] The Authors exclude the post-Soviet countries due to data unavailability.

political stability and absence of violence, and voice and accountability. These are commonly used indicators of institutional quality provided by the World Bank; see the Appendix3A for details. Brunnschweiler and Bulte (2008) use latitude as the instrument. We use longitude in absolute terms ($longitude_i$) as the instrument because it has a somewhat more straightforward interpretation for our sample, as it captures the distance to Western Europe. In addition, we use a variable measuring the years under socialism ($socialism_i$) to examine whether a longer socialist experience further erodes institutional quality. There is some time variation in this variable; for example, the Central Asian countries only become officially socialist in the mid-1920s, i.e., several years after the creation of the Soviet Union. Beck and Laeven (2006) use this instrument in their examination of the effect of institutions on economic growth in transition economies. Importantly, we use $rolix_{it}$ - a measure of export goods' rule of law intensity - as the instrument for institutional quality. This measure is constructed to be *exogenous* to the quality of institutions, and several articles demonstrate that it significantly affects the quality of institutions (Frenscha et al. 2016; Levchenko 2007; 2013). These articles show, theoretically and empirically, that the type of goods a country exports is relevant for the country's rule of law. Exporting certain goods, such as those produced using fragmented production processes, is conducive to the rule of law, while exporting goods generated by primary production is not. The main advantage of $rolix_{it}$ in a panel setting is that, unlike certain other commonly employed determinants of institutional quality, it varies across countries and over time. A higher value of $rolix_{it}$ at the country level implies that countrys' exports are more rule of law intensive.

$$I_{it} = \alpha_0 + \alpha_1 longitude_i + \alpha_2 socialism_i + \alpha_3 rolix_{it} + \epsilon_{it} \tag{3.1}$$

We expect that $\alpha_1 < 0$, because countries closer to Brussels typically have better institutions, i.e., they are more developed. α_2 is likely to be negative, as Beck and Laeven (2006) argue. Spending more time under socialism is likely to further erode the institutional framework of the country. We expect that $\alpha_3 > 0$ because countrys' exports, which are more rule of law intensive should translate into higher rule of law.

In the second step, we analyze the determinants of natural resource exports; see Eq. (3.2). Following Brunnschweiler and Bulte (2008), we use terms of trade (tot_{it}), a dummy variable for resource richness (RR_i - the dummy variable takes value one if the country is resource-rich and zero otherwise). We expect that the terms of trade and resource richness exert a positive influence on natural resource exports. We also control for some additional factors such as the population growth and the level of schooling.

$$nat_{it} = \varphi_0 + \varphi_1 tot_{it} + \varphi_2 RR_i + X_{it}\beta + \eta_{it} \tag{3.2}$$

By estimating Eq. (3.1) and Eq. (3.2), our ambition is to show, in line with Brunnschweiler and Bulte (2008), that both natural resource exports and institutions are likely to be endogenous. Finally, we examine the determinants of manufacturing performance. I and nat are instrumented using Eq. (3.1) and Eq. (3.2), respectively, because they are likely to be endogenous. We also include the interaction term of I and nat to examine the hypothesis that the natural resource curse is present only in countries that lack high-quality institutions. The interaction terms were instrumented for each type of institutional quality using the interactions of instruments. In addition, we control for some standard regressors. To better structure the analysis, the choice of regressors largely follows Ilmi (2007) and Brunnschweiler and Bulte (2008).

$$growth_{it} = \gamma_0 + \gamma_1 nat_{it} + \gamma_2 I_{it} + \gamma_3 nat_{it} I_{it} + X_{it}\beta + u_{it} \quad (3.3)$$

where $growth_{it}$ is the natural logarithm of manufacturing value added to GDP; nat_{it} is the natural logarithm of natural resource exports of fuel, metal and ore per capita; and I represents the institutional quality measure (we use six measures from the World Bank Governance Indicators because these are widely used in the literature). X_{it} represents the other control variables (lib_{it}, $open_{it}$, τ_{it}, ed_{it}, n_{it}, and $initialGDPpc_i$). lib_{it} represents EBRD trade liberalization data; $open_{it}$ denotes trade openness; τ_{it} is average tax rate; ed_{it} is external debt; n_{it} represents population growth; $initialGDPpc_i$ is the log of initial GDP in 1996; and u_{it} represents the error term. We choose these control variables in line with previous literature. Campos and Horvath (2012) find that trade liberalization and, consequently openness, is associated with higher growth in transition countries. Luong and Weinthal (2010) emphasize the importance of fiscal regimes for the natural resource curse, and therefore, we include fiscal variables such as the tax-to-GDP ratio and external debt. A number of studies show that initial GDP is a crucial variable for explaining growth performance (see, for example, Barro 1991).

The negative impact of natural resources on economic performance is typically explained using two phenomena. First, the so-called "Dutch Disease" stipulates that natural resource richness crowds out the manufacturing sector because significant natural resource exports tend to attract labor and investment from other sectors (including manufacturing sector) and appreciate the domestic currency (Corden and Neary 1982; Egert 2009). Second, the natural resource curse is explained through institutions. The discovery of point-source natural resources is often claimed to promote rent seeking and corruption. In that case, natural resources have an indirect effect on economic growth through institutions (Sachs and Warner, 2001). Given the construction of our dependent variable, our results can also be interpreted as evidence for the Dutch disease (see also Rajan and Subramanian 2011) who use the manufacturing value added to GDP as the dependent variable; Sachs and Warner (1999) and Harb (2009) use similar measures) while also acknowledging the effect of institutions.

To capture unobserved heterogeneity, we examine *pooled OLS (POLS), fixed (FEM)* and *random effect (REM)* models. The fixed effects are tested by the F test, while random effects are examined using the Lagrange multiplier (LM). We use the Hausman test to choose between the fixed and the random effect models (see Table 3.1). Generally, we use fixed effect models.

3.4 Results

This section presents our regression results. We examine the determinants of manufacturing performance in these countries and specifically analyze the significance of the interaction term between natural resource exports and institutions to address our main hypothesis, i.e., whether the natural resource curse is limited to those countries with poor institutions. Our results are provided in Table 3.1. We show six columns, each with a different measure of institutional quality. Statistical tests have been undertaken to choose the appropriate econometric method.

Natural resource exports and institutions are instrumented, as described above. We find that our measure of export's rule of law intensity, *rolix*, is particularly conducive to institutional quality. These results confirm the findings of Levchenko (2013) and Frenscha et al. (2016). We also find that longitude in absolute terms is typically insignificant. The results indicate that countries that spent more years under socialism often exhibit lower institutional quality, which is broadly in line with the earlier findings of Beck and Laeven (2006). Since the use of *rolix* is novel in this body of literature, we present the regression results in Table 3.3 in the Appendix3A. When we examine the determinants of natural resource exports, we find that terms of trade shocks exert a positive influence on natural resource exports. Resource richness also has a positive effect on resource exports.

Our results in Table 3.1 suggest that natural resource exports lead to a shrinking manufacturing sector, which corresponds to the previous findings of Sachs and Warner (1999), using cross-country regressions, and Rajan and Subramanian (2011), using panel regressions at the industry level. Next, we find that better institutions translate into higher manufacturing growth, which broadly corresponds to earlier findings by Beck and Beck and Laeven (2006).

The conditioning variables also present a coherent story. Greater openness is associated with better economic performance, which is consistent with previous studies on the natural resource curse such as Sachs and Warner (1997) and Papyrakis and Gerlagh (2004), in addition to being consistent with earlier empirical growth studies (Barro 1991; King and Levine 1993; Mankiw et al. 1992). We also find that higher

Table 3.1: The Determinants of Manufacturing Performance in Post-Soviet Countries: The Interactions of Natural Resources and Institutions

	(CRP)	(LAW)	(EFT)	(REG)	(STB)	(VOI)
Natural resource export	-0.418***	-0.315***	-0.355**	-0.270**	-0.380**	-0.234**
	(0.15)	(0.12)	(0.14)	(0.11)	(0.17)	(0.09)
Average tax rate	-0.918	-0.853	-0.863	-0.830	-0.839	-0.816
	(0.91)	(0.92)	(0.92)	(0.92)	(0.93)	(0.93)
Trade liberaliaztion	-0.041	-0.039	-0.038	-0.038	-0.037	-0.037
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
External debt	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Population growth	0.005	0.008	-0.003	0.001	-0.006	0.002
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Trade openness	0.199**	0.197*	0.194*	0.194*	0.191*	0.193*
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Schooling	1.061	1.087	1.247	1.227	1.342	1.229
	(1.36)	(1.36)	(1.37)	(1.37)	(1.38)	(1.37)
initial GDP	-0.102	-0.086	-0.077	-0.072	-0.055	-0.065
	(0.40)	(0.40)	(0.40)	(0.40)	(0.40)	(0.40)
Institution	5.664**	6.227**	5.227**	4.802**	6.578**	5.521**
	(2.65)	(2.84)	(2.45)	(2.21)	(3.09)	(2.53)
INS*NAT	0.231**	0.172**	0.181**	0.131**	0.179**	0.126**
	(0.09)	(0.07)	(0.08)	(0.06)	(0.09)	(0.06)
Constant	-7.006	-8.276	-7.341	-7.001	-11.206	-7.388
	(6.36)	(6.73)	(6.41)	(6.18)	(8.05)	(6.31)
Observations	225	225	225	225	225	225
Country	15	15	15	15	15	15
Regression model	FEM	FEM	FEM	FEM	FEM	FEM
F/Wald	10.28	11.64	10.21	11.26	10.67	11.78
BP LM	52.45	40.32	72.87	47.81	85.40	42.50
Hausman test	66.48	39.02	74.94	65.55	85.05	44.78
R2 - overall	0.121	0.119	0.117	0.116	0.113	0.115

Notes: The model is estimated for six different measures of institutional quality: CRP - Control of Corruption, LAW - Rule of Law, EFT - Government Effectiveness, REG - Regulatory Quality, STB - Political Stability and Absence of Violence and VOI - Voice and Accountability. The F test determines the choice between the POLS model and the FEM. The LM test determines the choice between the POLS Model and the REM. The Hausman test determines the choice between the FEM and the REM. The null hypothesis is that REM is efficient. Mostly, we rejected the null hypothesis of Hausman test, therefore REM is inconsistent and FEM is applied. The cluster-robust standard errors are shown in parentheses. * , **, and *** indicate significance at 10, 5, and 1 percentage levels, respectively.

external debt results in lower performance, which broadly corresponds to the findings of Manzano and Rigobon (2001). Other variables, although often with expected sign, are statistically insignificant.

We include the interaction term between natural resource exports and institutional quality to examine the role of institutions in shaping the natural resource-growth nexus.[4] The effect of natural resource exports on growth remains negative, whereas institutions exert a positive effect. The interaction term for institutions is positive and statistically significant, which suggests that countries with good institutions do not suffer from the natural resource curse. This result is robust to different measures of institutions and different regression specifications and is interesting because recent empirical evidence suggests that that natural resource curse may be a "red herring" that disappears once one controls for the endogeneity of some regressors (see Brunnschweiler and Bulte 2008; Arezki and van der Ploeg 2010).

Based on the results presented in Table 3.1, we compute the threshold value for the countries to escape the natural resource curse, i.e., the level of the institutional quality above which the countries benefit from natural resources. Using the estimated coefficients from Table 3.1 and taking the first derivative of growth performance with respect to our natural resources measure and setting the resulting affine function to zero, we observe that the critical value for institutional quality is approximately two. For example, Azerbaijan, Kazakhstan and Russia, three countries heavily dependent on natural resources, exhibit values below two; i.e., according to our results, they suffer from the natural resource curse. By contrast, our results suggest that the Baltic countries do not suffer from natural resource curse.

3.5 Concluding Remarks

We examine how natural resource exports and the quality of institutions (such as the rule of law or control of corruption) influence manufacturing performance using data from a panel of post-Soviet countries over the last two decades. Specifically, we investigate whether good institutions are the way to overcome the natural resource curse. Post-Soviet countries offer a unique laboratory for this exercise, as institutions in these countries changed dramatically. Therefore, we examine the effect of institutions on the natural resource curse not only across countries but also over time.

Our results indicate the presence of a natural resource curse in post-Soviet countries. We find that natural resource exports crowd out the manufacturing sector

[4]We also examined alternative measures of institutional quality such as "law and order" and "democratic accountability" from the International Country Risk Guide data set. The drawback of this dataset is that it does not contain several countries in our sample, thus limiting the number of countries in our sample to ten. The results are largely in line with the findings that we present in the paper, but in some cases the standard errors were larger given the low number of observations.

while controlling for a wide range of economic, social and political characteristics. Therefore, our results give support to the notion of Dutch disease, whereby exporting in a booming sector (such as oil or natural gas) has a detrimental effect on the other sectors in the economy, particularly because of the appreciation of the real exchange rate (Egert 2009).

Nevertheless, our results indicate that the natural resources are a curse only in countries characterized by poor institutions (Bulte et al. 2005; Isham et al. 2005; Brunnschweiler and Bulte 2008; Hartwell 2016). Importantly, we find that this non-linear effect holds regardless of the measure of institutions that we use. Therefore, the results provide a clear message to policy makers concerning the positive role that institutions play in economic performance. According to our results, institutions not only have a positive and direct effect on the performance of the manufacturing sector, but they also indirectly support growth by helping to alleviate the natural resource curse.

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Appendix3A

Data definitions and its sources

growth: the log of manufacturing value added as a percentage of GDP. Source: World Bank, World Development Indicators.

nat: the natural logarithm of natural resource export (fuel, metal and ore) per capita. Source: World Bank, World Development Indicators.

Institutional quality defined and measured by Kaufmann, Kraay and Mastruzzi, on a scale of 0 - 5: a higher degree represents higher governance performance. Source: World Bank, World Governance Indicators.

control of corruption: the term that captures the perceptions of the extent to which public power is exercised for private gain, including both small-scale and large-scale forms of corruption, in addition to the "capture" of the state by elites and private interests.

rule of law: the term that captures the perceptions of the extent to which agents have confidence in and abide by the rules of society, and, in particular, the quality of contract enforcement, the enforcement of property rights, confidence in the police and the courts, and the likelihood of crime and violence.

government effectiveness: the term that captures the perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies

regulatory quality: the term that captures the perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

political stability and absence of violence: the term that captures the perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically motivated violence and terrorism.

voice and accountability: the term that measures the perceptions of the extent to which a country's citizens are able to participate in selecting their government, including freedom of expression, freedom of association, and a free media.

tot: terms of trade, which is measured as the ratio of the export price index to the import price index. Authors' calculation. Source of price indexes: World Bank, World Development Indicators.

longitude: the value of the longitude of a country on a scale of 0-100. Source: OpenData by Socrata.

socialism: information regarding years under socialism is collected by the authors for each country from different sources.

rolix: the institutional intensity of country's exports, Source: Frensch et al. (2016)

lib: trade liberalization, which is measured on a scale from 1 to 4.3, where 1 represents little or no change from a rigid centrally planned economy and 4.3 represents the standards of an industrialized market economy. Source: EBRD, Transition Indicators.

open: trade openness is the sum of the percentages of merchandise export and import on GDP. Source: World Bank, World Development Indicators.

τ: tax rate is measured as the percentage equal to the proportion that tax revenue is of GDP. Tax revenue refers to compulsory transfers to the central government for public purposes. Source: World Bank, World Development Indicators.

ed: external debt, which is measured as a percentage of external debt stocks to gross national income. Total external debt is debt owed to nonresidents that is repayable in currency, goods, or services, where it represents the sum of public, publicly guaranteed, and private non guaranteed long-term debt, use of IMF credit, and short-term debt. Source: World Bank, World Development Indicators.

n: population growth is the exponential rate of growth of midyear population during one year, expressed as a percentage. Source: World Bank, World Development Indicators.

initial GDP per capita of countries is based on 1996. Source: World Development Indicator.

Table 3.2: Descriptive Statistics

Variable	Mean	Std.Dev.	Min	Max
Manufacturing value added	-0.011	0.154	-0.415	0.940
Natural resource export	453.365	662.235	0.282	3673.025
Control variables				
Average tax rate	0.101	0.033	0.011	0.177
Trade liberalization	3.401	1.044	1	4.3
External debt (per capita)	154.512	358.072	4.188	3604.045
Population growth	0.171	1.02	-2.52	2.82
Trade openness	0.821	0.298	0.286	1.697
Schooling	0.107	0.03	0.004	0.177
Initial GDP	1232.607	1009.416	136.862	3527.848
Institutional quality				
Control of Corruption (CRP)	1.835	0.559	1.01	3.47
Rule of Law (LAW)	2.01	0.661	0.820	3.72
Regulatory Quality (REG)	1.855	0.704	0.810	3.67
Government Effectiveness (EFT)	2.111	0.962	0.32	3.94
Political Stability (STB)	2.161	0.746	0.26	3.51
Voice and Accountability (VOI)	1.899	0.902	0.37	3.6
Natural resource instruments				
Terms of trade	0.019	0.192	-0.537	0.766
Resource richness	0.333	0.472	0	1
Institutional quality instruments				
Rolix	14.938	14.18	1.636	51.662
Longitude	45.345	18.283	24.1	74.587
Years under Socialism	65	9.031	50	76

Table 3.3: The Determinants of Institutional Quality

Institution	CRP	LAW	EFT	REG	STB	VOI
Rolix	0.038***	0.036***	0.042***	0.046***	0.033***	0.041***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Longitude	-0.009**	-0.005	0.002	0.006	0.012	0.009
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Socialism	-0.003	-0.395***	0.092	-0.240	0.065	-0.424***
	(0.08)	(0.09)	(0.10)	(0.17)	(0.16)	(0.13)
Constant	1.698***	1.846***	1.206***	1.333***	1.059***	1.188***
	(0.17)	(0.19)	(0.21)	(0.36)	(0.35)	(0.28)
Observations	225	225	225	225	225	225
Country	15	15	15	15	15	15
F-test	272.59***	346.98***	215.49***	142.61***	67.38***	246.73***
R2 -overall	0.787	0.825	0.745	0.659	0.478	0.770

Notes: The model is estimated for six different measures of institutional quality with Random-effects GLS regression method given the time-invariance of some regressors, see top row: CRP - Control of Corruption, LAW - Rule of Law, EFT - Government Effectiveness, REG - Regulatory Quality, STB - Political Stability and Absence of Violence and VOI - Voice and Accountability. The standard errors are in parentheses. Bias-reduced linearization procedure is used to adjust the standard errors because of Moulton problem. * , **, and *** indicate significance at 10, 5, and 1 percent levels, respectively.

Chapter 4

The Gravity of Institutions in a Resource-Rich Country

Abstract

This research study analyzes the effects of similarities in economic size and institutional level on bilateral trade. It is interested in whether similarities in country size and at the institutional level encourage enlarging volumes of bilateral trade between countries. Using panel data of the bilateral trade of Azerbaijan with 50 different countries from 1995 to 2012, estimating by random and fixed effects, as well as the Poisson Pseudo Maximum Likelihood (PPML), the study finds that similarity of income size is necessary for increasing bilateral trade across countries. The main finding is that high quality rule of law and more control of corruption boost confidence in international trade, therefore, reliable countries tend to trade more between each other, and less with unreliable countries. Unreliable countries trade more with each other, and less with reliable ones. A large divergence in institutional quality performance reduces bilateral trade across countries. The results show that a long-term contract is one of the main indicator for natural resource exports; therefore distance might not have significant impact on bilateral trade relationships.

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4.1 Introduction

The gravity model is a successful way to analyze bilateral trade corresponding to economic size, distance between countries and other economic factors such as institutional levels. Inspired by Newton's law of gravity in physics, the gravity model of international trade functions for the analysis of bilateral trade relationships as a function of economic size (mostly GDP, national income) and the inverse of distance (geographical, trade cost, tariffs).

The theoretical methodology of the gravity model in economics was introduced by Tinbergen (1962), and has been performing successfully as an empirical application. Anderson and van Wincoop (2003) developed a method that consistently and efficiently estimates a theoretical gravity equation, and analyzes the comparative statics of trade frictions. They applied their method to solve the border puzzle of McCallum (1995), and found that borders reduce bilateral trade levels by 44 % between the US and Canada, and 30 % between the US and other developed countries.

The main related discussions are whether national borders reduce bilateral trade between developed countries (Anderson and van Wincoop 2001); the effects of institutional similarities on bilateral trade; and whether good institutions foster economic growth (Duc et al. 2008). With regards to institutions, primary research suggests that the institutional governance of a country has strong and positive effects on bilateral economic relationships (Milner and Kubota 2005; Lundstrom 2005; Duc et al. 2008). It is expected that higher institutional quality reduces trade costs, decreases default risks and builds credible business environments; therefore, thus fostering bilateral trade between countries. Institutional quality may indirectly effect bilateral trade by discouraging domestic investments that are the key determinant of international trade (Mauro 1995). Bojnec and Ferto (2009) examine the variation in bilateral agricultural and food trade patterns in OECD countries, focusing on the positive impact of institutional similarity and the importance of governance quality on bilateral trade relationship.

The international trade performance of former Soviet countries have large divergencies based on their bilateral trade directions and their developments over the last two decades. EU market access had a significant development effect on transition countries' exports (Damijan and Rojec 2007); Baltic countries' bilateral trade relationships were decreased with the members of the post-Soviet countries (Byers et al. 2000), these countries also diverted their foreign trades to the member countries after the breakup of the Soviet Union. The export performance of these countries has benefitted from different levels of market access since declaring their independence from the Soviet Union. As a non-member of the WTO [1], Russian exports to WTO member countries fell between 1995 and 2002 with China's accession to the WTO

[1] WTO welcomed the Russian Federation as its 156th member on 22 August 2012.

in 2001 (Lissovolik and Lissovolik 2006). Fugazza (2004) emphasized that countries have benefited from the greater integration of the world economy in the 1985-1999 period. Access to extra-regional markets has been a key factor explaining export performance during this period.

Oil producing countries have disadvantages in bilateral trade relationships. The distance elasticity of trade increases with oil prices in oil-producing countries (Vezina and von Below 2013). Higher oil price volatility has caused reverse globalisation, covering 84 countries from 1984 to 2008 (Chen and Hsu 2012); and there is significant inefficiency in the use of oil revenue funds in oil-producing countries (Azhgaliyeva 2013). Considering that most oil producing countries exports depend on the oil price, these countries experience unsustainable export performance related to higher oil price volatility. It is questionable whether Azerbaijan achieved sustainable exports despite its huge amount of oil and status as a resource-rich country.

The effective management of natural resource export and good institutions are crucial for resource-rich countries. These two tools foster trade, and they have great potential to contribute to economic and human capital development. Institutional quality plays a more important role than natural resource richness: natural resource income can be a blessing for a country with good institutions and a curse for countries with poor institutions (Mehlum et al. 2006; Horvath and Zeynalov 2014).

This study examines the gravity model of bilateral trade in several ways. First, it extends the literature by simply using a "similarity index" range from 0 to 1. Second, it detects whether the similarity indices on GDP and institutional level matter for Azerbaijan's exports. Third, it considers whether better institutional quality of resource-rich countries encourages bilateral trade with other countries. Fourth, it studies whether historical background, contiguity and distance matter for Azerbaijan as a former Soviet country. The main object of this study is to analyze intuitional similarity across countries, and to clarify whether similarity at the institutional quality level is crucial for bilateral trade relationship.

The main findings can be summarized as follows. There is a positive relationship on GDP similarities between the volume of bilateral trade between Azerbaijan and rest of the world, as a similarities to the their respective GDPs. The influence of institutions plays a pivotal role in the bilateral trade between countries. The institutional quality performance is dominant in explaining the partnerships of Azerbaijan in export. Large divergence in institutional quality reduces trade between countries. Azerbaijan developed its bilateral trade relationships with countries with which it shares a border, and has enlarged its trade partners with dissimilar historical background. A long-term contract is the main indicator for natural resource exports; therefore distance might not have significant impact on bilateral trade relationships.

The paper is organized as follows: Section 4.2 gives an overview of the performance of Azerbaijan's exports. Section 4.3 explains the methodology, data description, and robustness of the methods. Section 4.4 discusses results, while Section 4.5 provides concluding remarks.

4.2 Azerbaijan's Export Performance

Exports as bilateral trade play an important role in clarifying the performance of transition economics while building their free-market economies (Svejnar 2002). In past decades, Azerbaijan owed thanks to its oil and natural gas reserves, as well as high crude worldwide oil prices, for it's rapid economic growth. Oil and gas incomes enlarged the country's export volume, and became the main determinant of the country's income. However, Azerbaijan has challenges to reduce dependence on the oil and gas sectors: the shares of oil and gas in total exports are 87 % and 7 %, respectively. These shares will change to 60 % and 30 % if Azerbaijan is able to produce at its peak point and export it to Europe before 2020 (IMF-Report 2014). Therefore, the country experienced high export-to-GDP ratios and was highly focused on the oil sector over last decade.

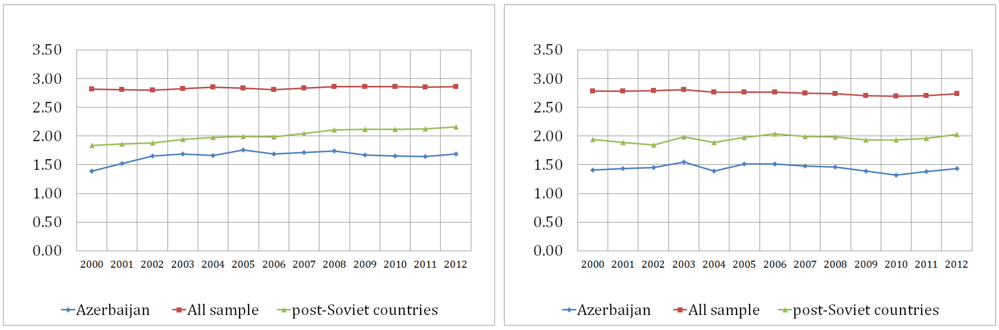
The growth of the non-oil sector was close to 10 percent in 2013. In order to decrease the share of resource-based income on GDP, the country supported non-oil growth with high public spending and rapid consumer loans (IMF-Report 2014). However, it needed to improve the efficiency of public investment and to reduce transfers from the state oil fund to the country budget. The effectiveness of consumption loans remains important as a government policy.

The exports of Azerbaijan are influenced by crude oil exports, where oil prices are the main channel connecting Azerbaijan to the rest of the world. At the begining of 2015, Azerbaijan experienced the negative consequences of a fall in the oil price. The main non-oil export partners of Azerbaijan are Russia and Turkey, where total the non-oil export is relatively small compared to the oil-export volume.

The Central Bank of Azerbaijan Republic (CBAR) fixed 1 US dollar (USD) at 1.05 Azerbaijan manat (AZN)(It was 0.78 AZN before that day) [2]. This strategy has been thought to create incentives to diversify the national economy, to strengthen the manat's international competitiveness and export potential, and to ensure stability of the country's balance of payment. To improve the robustness of exports performances, it therefore follows that Azerbaijan should increase diversity of exported products.

[2]Azerbaijan's economy faced sharp devaluation of the manat on 21 February 2015. Even thought CBAR promised that devaluation would be 12-14%, it ended at 34%, causing panic in the society and undermining the credibility of CBAR. The main question is why CBAR did not choose gradual deprecation instead of a sharp decrease on the value of the manat against to the US dollar and Euro. Dramatic decreases in oil prices lead to a huge fiscal deficit, considering that budget revenue mostly related to oil income and crude oil exports, depreciation was the main reason for the sharp depreciation of the manat. Further, devaluation in the national currencies of Azerbaijani major trade partners (Russia, Turkey, Ukraine and Georgia) caused more difficulties on Azerbaijan export.

Figure 4.1: The institutional quality level of Azerbaijan Republic



Source: World Bank, Worldwide Governance Indicators.

The institutional quality is not well developed in Azerbaijan. The country continues to perform most poorly in dealing with change in governance (rule of law) and control of corruption compared to other post-Soviet countries (see Figure 4.1). Azerbaijan, as a resource-rich country, may not have achieved sustainable economic development due to its weaker institutions level. Poor institutional quality cannot support export diversification by promotion of reduction of the natural-resource effect on total exports.

The global financial market's volatility poses a high risk due to the weak transmission channel of Azerbaijan with international markets. Falling oil prices will cause slower growth in oil-producer emerging countries, and in Azerbaijan as well. Obviously, Azerbaijan is highly dependent on oil prices, and the economy will not perform at the same level as in previous years. The oil fund might help the government to deal with the adverse consequences of oil price declines in the short-run, however, the country needs strong fiscal policy to maintain economic growth in the long-run. Development of private investment will play a crucial role in ensuring strength of non-oil output and export diversification.

This research analyzes the similarity in the institutional quality and the economic size in the context of Azerbaijan export component, by using the gravity model of international trade.

4.3 Methodology and Data

4.3.1 Methodology

The methodology designed to take two main issues into account. The first is related to the similarity index. Following Helpman (1987), the GDP, CPI, and institutional qualities standardize to 0-1. There are many similarity indices which first appeared in Finger and Kreinin (1979). However, this study standardizes the similarity indicator with a simple method:

$$S_{ij}^{h} = \frac{2\varphi_i\varphi_j}{\varphi_i^2 + \varphi_j^2} \tag{4.1}$$

where i stands for home country (Azerbaijan), $j = 1, ..., 50$ indices for the 50 different countries. h represents three different macroeconomic indicators: GDP, CPI and institutional quality. $S_{ij} \in (0; 1)$ represents similarity index between countries. Values close to 1 show similar in country size; values closest to 0, dissimilar country size (for details, see Appendix4A, page 121).

The second issue is to determine a benchmark model for selected database. In dealing with heteroskedasticity, panel data has advantages: it is simple and it controls unobservable heterogeneity (Henderson and Millimet 2008). While most gravity models estimate by cross-sectional dataset, OLS models might be misleading in the presence of heteroskedasticity (Silva and Tenreyro 2006). This study used both fixed effect and random effect methods. A Hausman test provides a method for testing the adequacy of the random effect estimation. The main disadvantage of panel data methods are loss of information (fixed effect drops time constant variables) and elimination of zero flows. Therefore, a Poisson Pseudo Maximum Likelihood was performed, producing robust results with zero trade flows, provides unbiased estimates in the presence of heteroskedasticity and all observation weighted equally (Westerlund and Wilhelmsson 2009; Siliverstovs and Schumacher 2009; Shepherd and Wilson 2009).

The gravity equations are represented with different forms in primary studies. The choice of regressors largely follows Anderson and van Wincoop (2003) and Anderson (2011). According to the gravity theoretical concept:

$$E[x_{ijt}] = S_{ijt}^{GDP} S_{ijt}^{INS} S_{ijt}^{CPI} D_{ij}^{\theta} exp(\lambda L_{ij})\epsilon_{ijt} \tag{4.2}$$

where S_{ijt} represents the similarity index, D_{ij} is the distance between countries, and L_{ij} are represented by the vector of linkage of dummy variables for bilateral trade. The home country, host country, and year are represented by i, j and t, respectively. x_{ijt} represents exports fraction on host country's GDP (from country i to country j in year t). θ defined as distance effect, which is expected to be negative. λ represents the coefficient of linkage dummy variables of bilateral trade such as contiguity, historic background, and landlock status.

Firstly, different estimation techniques will be compared to find the "preferred" gravity model for the chosen sample country. The results will contain the estimation outcomes from Random and Fixed effect panel estimation and Poisson Pseudo Maximum Likelihood (PPML) regression.

Employing various panel data estimation techniques allows the study to control for heterogeneity among countries. As Silva and Tenreyro (2006) claim that OLS is not consistent while the empirical model is log linearized in the presence of heteroscedasticity: the estimating of model in levels is preferable than taking logarithms. This study followed panel data estimation methods.

There are several problems related with gravity estimation model which remain with a concern. Random and fixed-effects regressions are simple methods to deal with unobserved heterogeneity. However these methods also have pitfalls: dropping time invariant variables, leads to loss of information, elimination or censored to one zero flow between countries eliminating (Matyas 1998; Egger and Pfaffermayr 2003; Andrews et al. 2006; Henderson and Millimet 2008). However, PPML gives consistent parameters even when the covariance structure is misspecified. Estimating the average response over the population would enable predictions of the effect of changing one or more covariates on a given individual (Siliverstovs and Schumacher 2009; Shepherd and Wilson 2009; Westerlund and Wilhelmsson 2009). The methodology follows both two different estimation methods and different robustness checks to confirm findings.

4.3.2 Data

The sample includes data on Azerbaijan in relation to 50 different countries from 1995 to 2012 (for details and variable description see Appendix4A, page 118). The panel dataset consist of 900 observations of bilateral export flow (18 years * 50 countries). The information on bilateral exports of Azerbaijan comes from the State Statistic Committees of the Republic of Azerbaijan. These exports represent 94 % of the total export of home country (the list of countries - Appendix4A, page 119). Data on GDP and CPI come from the World Development Indicator (WDI). The data on distance (both kilometric, and latitudinal difference) and dummies indicating landlocked situation, historical background, contiguity come from Centre d'Etudes Prospectives et d'Informations Internationales (CEPII).

Measure of institutional qualities (Rule of Law and Control of Corruption) data comes from the Worldwide Governance Indicator (WGI). It scores countries from 0 to 5, with 5 representing high level institutional quality. The Rule of Law is defined as "reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence" (Kaufmann et al. 2009) and Control of Corruption defined as "capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests" (Kaufmann et al. 2009). The Rule of Law and Control of Corruption are among the main determinants of bilateral trade relationship. A low rule of law can create incentives for bribery and abuse of power (Sachs and Warner 2001; Kronenberg

2004; Ding and Field 2005). The absence of corruption seems to be unambiguously favourable to bilateral trade (Leite and Weidmann 1999; Gylfason 2001; Jensen and Wantchekon 2004; Duc et al. 2008)

As robustness checks, four additional types of WGI institutional quality have been used: Institutional qualities - Voice and Accountability, Political Stability, Government Effectiveness and Regulatory Quality (Kaufmann et al. 2009). For details and variable description, see Appendix4A and Table 4.3. The exact definition of "institutional quality" is open to debate, however a wide range of researchers agree that it refers to a country's governance quality and is key for development. I limited the set of institutional variables to those of the WGI. WGI are not used by the World Bank Group to allocate resources, which uses different individual data sources produced by a variety of survey and sources. This data has the advantages of a large survey base, very wide country coverage and relative objectivity, which makes them particularly attractive and easy for econometric analysis. Different studies have used different measurements, and a wide range of them have reached similar conclusions that institutional quality is an important driver of economic development and growth (Acemoglu et al. 2001; Boschini et al. 2007; Brunnschweiler and Bulte 2008). Law et al. (2013) found that institutional quality is higher in developed countries than in under-developed countries, regardless of whether the institution measure is proxied by ICRG or WGI. Studies suggest that country-level institutions have undergone only limited qualitative change over the last decades (Sachs and Warner 1995; Boschini et al. 2007), and changes in institutional quality are small across years.

There are 52 zero trade flows in the selected dataset. It represents trade with different countries based on beginning of dataset (1995-1998). The zero trade flow countries are Canada, Crotia, Cyprus, Indonesia, Japan, Malta, Norway, Portugal, Republic of Korea. Azerbaijan has started its bilaterat trade relationship later 90s with these countries. PPML may produce inconsistent estimates when the dependent variable has many zeros, however this dataset has only 52 zero trade flows, meaning that there is no selection bias. Different methods used to confirm robustness of preferred methods.

4.4 Results

This section aims to analyze the differences between the estimation based on panel data and PPML estimation. The results are estimated with the gravity model derived from Eq.(4.2).

Table 4.1 contains estimated outcomes from random and fixed effect models. The differences between columns relate to the choice of institutional level (Control of Corruption (CRP) or Rule of Law (LAW), the choice of distance (kilometric or longitudinal), and the choice of estimation method (random (REM) or fixed (FEM) effects models).

Columns (1)-(3) represent panel estimates using the CRP as an institutional quality variable. Columns (1) and (2) describe random effect estimates with kilometrical distance and longitudinal distance, respectively. Column (3) describes fixed effect estimates, due to time inconsistence four variable omitted while fixed effect. Columns (1) and (2) have Hausman test results comparing two different random effect estimates to fixed-effect estimates (Column (3)). Hausman test results confirms fixed model preferable to random effect estimations.

Columns (4)-(6) represent panel estimates using the LAW as an institutional quality variable. Columns (1) and (2) describe random effect estimates with kilometrical distance and longitudinal distance, respectively. Column (6) describes fixed effect estimates, due to time inconsistence four variable omitted while fixed effect. Columns (4) and (5) have Hausman test results comparing two different random effect estimates to fixed-effect estimates(Column (6)). Hausman test results confirms fixed model preferable to random effect estimations.

GDP similarity has a positive impact on bilateral trade, and is one of main determining factors in the trade volume between Azerbaijan and its trade partners. The similarity of economy size is necessary for increasing bilateral trade across countries in the case of Azerbaijan, however, the country has no trade experience with countries of dissimilar economic size.

Institutional similarity also provides a positive impact on the trade volume between countries, and its performance is widely considered a key determinant of Azerbaijan's exports. One might argue that higher dissimilarity of institutional level increases transaction costs, which has an adverse effect on bilateral trade. The quality of governance affects the informal business environment, therefore, similar countries might be familiar with each others' business processes. Further, the impact of higher perceived quality of institutions on bilateral trade is beneficial due to developed countries having a higher level of institutional quality. Countries with stronger rule of law and more control on corruption tend to trade more between each other.

For a long time, distance played a pivot role in explaining bilateral trade flow in the gravity equations. However, these results show that distance does not have a significant effect on the bilateral trade of the Azerbaijan Republic. Both kilometric and longitudinal distances were used, distance seems to have lost its importance due long term contracts in natural resource exports.

Table 4.1: The Gravity Model of Azerbaijan - Random and Fixed Effect Models

	CRP REM (1)	CRP REM (2)	CRP FEM (3)	LAW REM (4)	LAW REM (5)	LAW FEM (6)
GDP Similarity	1.452***	1.531***	2.639***	1.201**	1.278***	1.957***
	(0.325)	(0.325)	(0.384)	(0.324)	(0.324)	(0.374)
CRP Similarity	3.428***	3.438***	3.057**			
	(0.805)	(0.821)	(1.098)			
LAW Similarity				7.311***	7.417***	8.339***
				(0.800)	(0.809)	(0.924)
CPI Similarity	-0.267	-0.278	-0.411	-0.392	-0.407	-0.542
	(0.368)	(0.367)	(0.365)	(0.351)	(0.350)	(0.348)
Distance (kilometric)	-0.064			-0.020		
	(0.330)			(0.353)		
Distance (longitudinal difference)		0.043			0.177	
		(0.245)			(0.261)	
Contiguity	1.976**	2.083**		1.477**	1.702**	
	(0.550)	(0.587)		(0.596)	(0.633)	
Historic	-0.799**	-0.779**		-1.123**	-1.090**	
	(0.389)	(0.381)		(0.419)	(0.408)	
Landlock	0.219	0.230		0.757*	0.763*	
	(0.414)	(0.426)		(0.446)	(0.458)	
Constant	-0.945	-1.636	-1.324	-4.306	-5.192***	-5.397***
	(2.844)	(1.213)	(0.930)	(3.001)	(1.240)	(0.793)
N	779	779	779	779	779	779
$LM/F-test$	42.05	43.78	28.54	107.06	114.45	67.04
$Hausman-test$	51.05	98.42		43.08	85.14	

Notes: Dependent variable measured with the natural logarithm of export fraction on host country's GDP. The differences between columns relate to the choice of institutional level (Control of Corruption (CRP) or Rule of Law (LAW), the choice of distance (kilometric or longitudinal), and the choice of estimation method (Random (REM) or Fixed effect models (FEM)). ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Duran-Fernandez and Santos (2014) analyze the different types of distance measurement on a gravity model. The Authors conclude that the different distance measurements do not affect the significance of estimation models. Their results showed that a time-based distance measurements improve the significance of results compared to length-based measurements.

Sharing a border has notable weight on bilateral trade relationships. Azerbaijan shares borders with Russia, Georgia, Armenia, Turkey and Iran. Neighbour countries have significant effects on the bilateral trade of Azerbaijan Republic, except Armenia [3]. However, it seems that the Azerbajan Republic was not interested in developing bilateral trade with former Soviet countries. Russia and Georgia are former Soviet countries, and share borders with Azerbaijan. Except for these two countries, the other 13 former Soviet countries have no important influence on Azerbaijan's export performance. The historical background is adverse on bilateral trade. Therefore, Azerbaijan is interested in developing international trade with other countries rather than countries that share its historical background.

Robustness checks are performed in an attempt to deal with heteroscedasticity and selection bias problem. The PPML model has advantages to deal with heteroskedasticity and zero trade (Silva and Tenreyro 2006). Table 4.2 represents the gravity model of Azerbaijan with PPML. Column (1) & (3) represent estimations for Control of Corruption (CRP) with kilometric distance and longitudinal difference, respectively. Column (2) & (4) represent for Rule of Law (LAW) with kilometric distance and longitudinal difference, respectively.

The results are similar to he outcomes of random and fixed effects. GDP and institutional similarities maintain their significant effect on bilateral trade using PPML.

Comparing the results of PPML and panel data estimation, the following observations are in order. GDP and institutional similarities are larger under panel data estimation. The sign and significance of the estimates do not differ much and institutional similarity maintain a positive effect. The effect of CPI similarity becomes significant using rule of law as institutional quality with this model. It demonstrates that more divergence between countries‘ consumer price index simulates development of bilateral trade relationships. While common borders increase bilateral trade, historical background plays an adverse role on Azerbaijan‘a trade performance. Landlock status does not impact trade performance today. The main motivation is institutional similarity, which still has a positive impact on bilateral trade performance. The results show that the established model proves a positive impact of institutional similarity on bilateral trade.

Robustness checks for misspecification of the gravity equations using RESET test were conducted. The test results confirms that the PPML estimations pass the

[3] There are no diplomatic relations between Azerbaijan and Armenia due to conflict over the Nagorno-Karabakh region

Table 4.2: The Gravity Model of Azerbaijan - PPML Results

	CRP	LAW	CRP	LAW
GDP Similarity	0.721***	0.356**	0.717***	0.377**
	(0.159)	(0.153)	(0.155)	(0.148)
CRP Similarity	2.659***		2.671***	
	(0.494)		(0.496)	
LAW Similarity		6.043***		6.149***
		(0.573)		(0.572)
CPI Similarity	-0.130	-0.327**	-0.128	-0.334**
	(0.173)	(0.151)	(0.172)	(0.147)
Distance (kilometric)	0.0462	0.123		
	(0.176)	(0.158)		
Distance (longitudinal difference)			0.041	0.208
			(0.122)	(0.173)
Contiguity	0.637**	0.423*	0.653**	0.609**
	(0.254)	(0.244)	(0.263)	(0.256)
Historic	-0.511**	-0.707**	-0.524**	-0.746**
	(0.202)	(0.207)	(0.195)	(0.200)
Landlock	0.0714	-0.0887	0.0636	-0.174
	(0.214)	(0.259)	(0.215)	(0.266)
Constant	-2.224	-5.340**	-2.004**	-5.153***
	(1.537)	(1.373)	(0.665)	(0.684)
N	779	779	779	779
$Wald-Chi2$	92.34	78.01	91.98	61.06
$RESET-test$	0.562	0.475	0.573	0.487

Notes: Dependent variable measured with the USD dollar of export fraction on host country's GDP. The differences between columns relate to the choice of institutional level (Control of Corruption (CRP) or Rule of Law (LAW), and the choice of distance (kilometric or longitudinal). ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

RESET test. Tests represent that misspecification does not exist in the gravity model using PPML.

Different robustness estimation methods were conduced to test the validity of results. Random effects and conditional fixed-effects Poisson regressions were performed as a robustness check. The findings are quite similar to panel data and PPML estimations. Comparing the results of random effects and conditional fixed-effects poisson regression with PPML, demonstrates that GDP and institutional similarities are smaller under PPML. There is no notable difference on significance and direction between these estimations (for detail, see Table 2.4).

Dataset has 52 zero trade flows. A zero-inflated model was performed as a robustness check. There is no notable difference on significance and direction using zero-inflated model (for results, see Table 4.5). Institutional quality similarities keep their significant and positive impacts on bilateral trade relationships.

Long-term contracts play pivot role in resource-rich exporting countries. Azerbaijan also has a long-term contracts related to natural resource exports with countries. These countries include Italy, Indonesia, Germany, Israel, India, France, the US and Russia. The contract countries listed above are always on Azerbaijan's top 10 exports partner lists and account for more than 70% of total exports [4]. Controlling export path-dependence, "contract" dummy variable used: it takes 1, if Azerbaijan has a long-term contract related to natural resource exports with a country. Results show that there are a positive and significant effect of long term contracts on natural resource exports (see Table 4.6). This also is one of the main explanations of the positive insignificant effect of distance. A long-term contract is the main indicator for natural resource exports; therefore distance might not negatively (significantly) impact bilateral trade relationships.

As a robustness checks, four additional types of institutional quality used. Institutional qualities - Voice and Accountability (VOI), Political Stability (POL), Government Effectiveness (GOV) and Regulatory Quality (REG) used from the Worldwide Governance Indicator (for details and variable description, see Table 4.3). It also scores countries from 0 to 5, with 5 representing high level institutional quality. The results confirm significance and direction of previous findings (see Table 4.7). To sum up, different methods, estimations and different measurements confirm positive impacts of institutional similarities on Azerbaijan‘s bilateral trade performance.

4.5 Concluding Remarks

The aim of this paper was to consider whether GDP and institutional similarities play an important role as a determinant of the bilateral trade of Azerbaijan with other countries. Different methods and specifications were used to describe bilateral trade and analysis of the robustness of model. The most important impacts concern similarity indices of GDP and institutional quality, as well as historical background, contiguity, and landlock.

The main conclusion confirms a positive relationship between the volume of bilateral trade among Azerbaijan and rest of the world in the context of GDP similarities. Azerbaijan has developed its bilateral trade with countries that have similar GDPs rather than dissimilar ones. This indices that Azerbaijan is most interested in increasing bilateral trade with developing countries.

The influence of institutions plays a pivotal role in bilateral trade between countries. Institutional quality is dominant in explaining the partnerships of Azerbaijan in export, confirming that institutional similarity tends to increase international trade. The higher "Rule of Law" and more "Control of Corruption" give confidence to other countries in economic relationships, therefore, reliable countries tend to trade more between each other, and less with unreliable countries. It also means that less reliable countries trade more with each other, and less with reliable ones. A large divergence in institutional quality reduces trade between countries.

Azerbaijan developed its bilateral trade relationship with the countries sharing its

[4] The State Statistical Committee of the Republic of Azerbaijan database

borders, and enlarged its trade with countries with dissimilar historical backgrounds. Distance did not have a significant impact on bilateral trade relationships: a long-term contract is the main indicator for natural resource exports, therefore distance might not negatively impact bilateral trade relationships. It is also not confirmed that landlock status is an obstacle to bilateral trade relationships.

The next step is to make progress in the measurement of institutional quality level, which can develop clearness of institutional similarities impact on bilateral trade. It would also be interesting to consider Azerbaijan's impost from other countries, and to take more complex data into consideration to further develop the robustness of the model.

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Appendix4A

Data definitions and its sources

Export, bilateral trade from Azerbaijan to 50 different countries, in millions US dollars. Source: World Bank, World Development Indicator, 2014.

Export per capita, export fraction on 50 different host countrys' GDPs, in US dollars. Source: World Bank, World Development Indicator, 2014.

GDP per capita, Gross Domestic Product per person for home and host countries, US dollars. Source: World Bank, World Development Indicator, 2014.

CPI, Consumer Price Index, base year 2010. Source: World Bank, World Development Indicator, 2014.

Institutional qualities:

Control of Corruption, Rule of Law, Voice and Accountability, Political Stability, Government Effectiveness and Regulatory Quality scores from 0 to 5, 5 represents high level institutional quality. Source: World Bank, World Governance Indicator, 2014.

Distance (kilometric), kilometric distance between capital city (Baku) to the capital city of host countries. Source: CEPII database, www.cepii.fr.

Longitudinal difference, longitudinal difference between capital city (Baku) to the capital city of host countries. Source: CEPII database, www.cepii.fr.

Contract, binary variable equals to 1 if countries had fixed long-term oil export contracts with Azerbaijan. Source: The State Statistical Committee of the Republic of Azerbaijan database, http://www.stat.gov.az/menu/7/indexen.php.

Contiguity, binary variable equals to 1 if countries share same border with Azerbaijan. Source: CEPII database, www.cepii.fr.

Historic, binary variable equals to 1 if countries had same historical background (former Soviet country member). Source: Author's estimation.

Landlock, binary variable equals to 1 if countries has no access to sea. Source: CEPII database, www.cepii.fr.

The Countries of the Sample

Afghanistan	Georgia	Lithuania	Taiwan
Austria	Greece	Malta	Tajikistan
Belarus	India	Moldova	Thailand
Belgium	Indonesia	Netherlands	Tunisia
Bulgaria	Iran	Norway	Turkey
Canada	Israel	Poland	Turkmenistan
China	Italy	Portugal	Ukraine
Croatia	Japan	Republic of Korea	United Arab Emirates
Cyprus	Kazakhstan	Romania	UK
Czech Republic	Kyrgyzstan	Russia Federation	USA
Egypt	Latvia	Singapore	Uzbekistan
Estonia	Lebanon	Spain	Vietnam
France		Switzerland	

Table 4.3: Data Descriptions

Variable	Obs	Mean	Std. Dev.	Min	Max
Export (mln)	900	175.17	872.37	0	19220
Export per capita	894	24.11	102.66	0	2334.265
GDP pc - Azerbaijan	900	1680.72	973.43	650.77	3126.72
GDP pc - Host countries	893	15489.44	16055.66	205.61	67804.55
CPI - Azerbaijan	900	110.43	36.58	69.78	178.58
CPI - Host countries	823	98.56	34.89	0.57	395.63
Institutional variables					
CRP - Azerbaijan	850	1.41	0.07	1.25	1.55
CRP - Host countries	850	2.76	1.08	0.59	4.92
LAW - Azerbaijan	850	1.59	0.14	1.34	1.76
LAW - Host countries	850	2.83	1.04	0.54	4.49
VOI - Azerbaijan	850	1.38	0.05	1.23	1.48
VOI - Host countries	850	2.56	1.11	0.52	4.74
POL - Azerbaijan	850	1.89	0.25	1.42	2.25
POL - Host countries	850	2.91	1.44	0.48	4.87
GOV - Azerbaijan	850	1.67	0.11	1.51	1.93
GOV - Host countries	850	2.56	1.12	0.79	4.83
REG - Azerbaijan	850	1.77	0.15	1.47	2.13
REG - Host countries	850	2.91	1.23	0.59	4.95
Similarity variables					
GDP Similarity	893	0.32	0.34	0.001	0.999
CPI Similarity	823	0.85	0.14	0.02	1
CRP Similarity	850	0.81	0.15	0.49	1
LAW Similarity	850	0.83	0.13	0.56	1
VOI Similarity	850	0.78	0.11	0.42	0.98
POL Similarity	850	0.87	0.14	0.59	1
GOV Similarity	850	0.82	0.17	0.56	0.99
REG Similarity	850	0.79	0.12	0.51	0.99
Distance measurement					
Distance (kilometric)	900	3250.52	2040.91	507	9047
Longitudinal difference	900	36.57	25.56	1.77	124.93
Binary Variables					
Contract	900	0.16	0.38	0	1
Contiguity	900	0.12	0.33	0	1
Historic	900	0.28	0.45	0	1
Landlock	900	0.18	0.38	0	1

Notes: The choice of institutional level Control of Corruption (CRP) or Rule of Law (LAW)(Voice and Accountability (VOI), Political Stability (POL), Government Effectiveness (GOV) and Regulatory Quality (REG)).

The Standardisation of Similarity Index

$(\varphi_i - \varphi_j)^2 \geq 0$ for $\varphi > 0$

$\varphi_i^2 - 2\varphi_i\varphi_j + \varphi_j^2 \geq 0$

$\varphi_i^2 + \varphi_j^2 \geq 2\varphi_i\varphi_j$

$1 \geq \frac{2\varphi_i\varphi_j}{\varphi_i^2+\varphi_j^2}$

consider that $\varphi > 0$

$1 \geq \frac{2\varphi_i\varphi_j}{\varphi_i^2+\varphi_j^2} \geq 0$

Therefore similarity index:

$S_{ij} = \frac{2\varphi_i\varphi_j}{\varphi_i^2+\varphi_j^2}$

Index ranges:

if $\varphi_i = \varphi_j + C$, C is positive value, which represents difference between

two parameters. Then,

$S_{ij} = \frac{2(\varphi_j+C)\varphi_j}{(\varphi_j+C)^2+\varphi_j^2} = \frac{2\varphi j^2+C*\varphi_j}{2\varphi_j^2+2*C*\varphi_j+C^2} = 1 - \frac{C^2}{2\varphi_j^2+2*C*\varphi_j+C^2}$

if $C = 0$, then, $S_{ij} = 1 - 0 = 1$

as we observe, when C increases S_{ij} converge to the zero.

Table 4.4: The Gravity Model of Azerbaijan - Poisson regressions

	Random-effects Poisson regression				Conditional fixed-effects Poisson regression			
	CRP	LAW	CRP	LAW	CRP	LAW	CRP	LAW
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP Similarity	1.011**	0.792**	1.025**	0.830**	1.699***	1.232***	1.699***	1.232***
	(0.284)	(0.270)	(0.281)	(0.266)	(0.299)	(0.304)	(0.299)	(0.304)
CRP Similarity	2.704***		2.738***		1.899**		1.899**	
	(0.689)		(0.696)		(0.902)		(0.902)	
LAW Similarity		6.192***		6.267***		6.892***		0.892***
		(0.753)		(0.760)		(0.894)		(0.894)
CPI Similarity	-0.148	-0.380	-0.149	-0.387	-0.239	-0.479**	-0.239	-0.479**
	(0.236)	(0.236)	(0.236)	(0.236)	(0.237)	(0.238)	(0.237)	(0.238)
Distance (kilometric)	0.00512	-0.00186						
	(0.274)	(0.286)						
Distance (longitudinal)			0.0671	0.158				
			(0.204)	(0.219)				
Contiguity	0.854*	0.586	0.928*	0.773				
	(0.453)	(0.481)	(0.476)	(0.506)				
Historic	-0.540	-1.109**	-0.524	-1.064**				
	(0.353)	(0.360)	(0.331)	(0.336)				
Landlock	0.0322	0.545	0.0394	0.590				
	(0.373)	(0.367)	(0.372)	(0.366)				
Constant	-2.025	-4.522*	-2.255**	-5.176***				
	(2.358)	(2.472)	(1.014)	(1.081)				
N	779	779	779	779	779	779	779	779
$LM/F-test$	53.23	57.64	45.34	74.34	54.62	34.03	53.54	34.26

Notes: Dependent variable measured with the export fraction on host country's GDP. The differences between columns relate to the choice of institutional level (Control of Corruption (CRP) or Rule of Law (LAW), the choice of distance (kilometric or longitudinal), and the choice of GEE estimation methods (Random or Fixed Poisson Regressions). ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Table 4.5: The Gravity Model of Azerbaijan - Zero-Inflated Results

	CRP	LAW	CRP	LAW
GDP Similarity	0.436**	0.494***	0.267**	0.301**
	(0.116)	(0.118)	(0.111)	(0.112)
CPI Similarity	0.248	0.093	0.181	0.034
	(0.217)	(0.216)	(0.218)	(0.217)
CRP Similarity	3.193***		3.463***	
	(0.514)		(0.694)	
LAW Similarity		4.190***		4.025***
		(0.309)		(0.308)
Distance (kilometric)	0.400	0.431		
	(0.672)	(0.470)		
Distance (longitudinal difference)			0.128	0.128
			(0.145)	(0.144)
Contiguity	0.327**	0.193**	0.479***	0.375**
	(0.095)	(0.096)	(0.099)	(0.098)
Historic	-0.297**	-0.388***	-0.177**	-0.244**
	(0.077)	(0.079)	(0.075)	(0.077)
Landlock	-0.092	0.200	-0.079	0.190
	(0.084)	(0.865)	(0.085)	(0.187)
Constant	0.657	0.316	-2.050***	-2.578***
	(0.671)	(0.662)	(0.372)	(0.385)
N	779	779	779	779
$Wald-Chi2$	121.34	153.32	122.32	153.34
$RESET-test$	0.542	0.435	0.553	0.492

Notes: Dependent variable measured with the USD dollar of export fraction on host country's GDP. The differences between columns relate to the choice of institutional level (Control of Corruption (CRP) or Rule of Law (LAW), and the choice of distance (kilometric or longitudinal). ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Table 4.6: The Gravity Model of Azerbaijan - PPML Results with *contract*

	CRP	LAW	CRP	LAW
GDP Similarity	0.894***	0.620**	0.971***	0.695***
	(0.183)	(0.178)	(0.179)	(0.171)
CPI Similarity	-0.155	-0.337*	-0.170	-0.361**
	(0.193)	(0.173)	(0.190)	(0.163)
CRP Similarity	2.738***		2.673***	
	(0.497)		(0.503)	
LAW Similarity		5.663***		5.795***
		(0.568)		(0.566)
Distance (kilometric)	-0.224	-0.188		
	(0.164)	(0.155)		
Distance (longitudinal difference)			-0.076	0.081
			(0.120)	(0.115)
Contract	1.198***	1.159***	1.196***	1.115***
	(0.186)	(0.175)	(0.191)	(0.176)
Contiguity	0.476**	0.259	0.527**	0.479*
	(0.238)	(0.233)	(0.260)	(0.260)
Historic	-0.583**	-0.818***	-0.540**	-0.787**
	(0.190)	(0.199)	(0.193)	(0.205)
Landlock	0.376*	0.420*	0.385*	0.263
	(0.202)	(0.233)	(0.212)	(0.255)
Constant	-0.486	-2.936**	-1.972**	-4.805***
	(1.399)	(1.312)	(0.653)	(0.673)
N	779	779	779	779
$Wald-Chi2$	105.71	169.67	101.55	177.68
$RESET-test$	0.564	0.412	0.583	0.392

Notes: Dependent variable measured with the USD dollar of export fraction on host country's GDP. The differences between columns relate to the choice of institutional level (Control of Corruption (CRP) or Rule of Law (LAW), and the choice of distance (kilometric or longitudinal). ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Table 4.7: The Gravity Model of Azerbaijan - PPML Results: Robustness Check

	VOI	POL	GOV	REG
GDP Similarity	0.645***	0.534**	0.622***	0.677***
	(0.132)	(0.230)	(0.112)	(0.153)
CPI Similarity	-0.223**	-0.247**	-0.182**	-0.272**
	(0.103)	(0.114)	(0.086)	(0.125)
VOI Similarity	4.436***			
	(0.932)			
POL Similarity		5.231***		
		(0.624)		
GOV Similarity			3.864***	
			(0.734)	
REG Similarity				6.012***
				(0.532)
Distance	0.032	0.087	0.076	0.056
	(0.187)	(0.196)	(0.199)	(0.201)
Contract	1.452***	1.271***	1.101***	1.823***
	(0.175)	(0.182)	(0.166)	(0.542)
Contiguity	0.516**	0.435***	0.586**	0.432*
	(0.235)	(0.112)	(0.271)	(0.249)
Historic	-0.632**	-0.546*	-0.723***	-0.495**
	(0.293)	(0.315)	(0.195)	(0.229)
Landlock	-0.054	-0.078	-0.121	-0.187
	(0.265)	(0.187)	(0.115)	(0.243)
Constant	-5.321**	-4.893**	-5.044**	-5.563**
	(2.462)	(2.265)	(2.336)	(2.575)
N	779	779	779	779
$Wald-Chi2$	124.12	135.23	147.23	112.12
$RESET-test$	0.667	0.534	0.613	0.498

Notes: Dependent variable measured with the USD dollar of export fraction on host country's GDP. The differences between columns relate to the choice of institutional level (Voice and Accountability (VOI), Political Stability (POL), Government Effectiveness (GOV) and Regulatory Quality (REG)). ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Response to Reviewers

for the Dissertation Defense

19th April, 2017

on the manuscript

"Essays on Natural Resource Richness, Economic Growth and Institutional Quality"
by Ayaz Zeynalov

I thank all reviewers for their insightful comments on the pre-defense version of my dissertation. Since the reviewers suggest that the dissertation can be submitted without major changes, I respond to the comments below:

Response to Comments from Karel Janda:
I am grateful to Prof.Janda for his very kind comments on my dissertation. I am happy that he has recommended the thesis for defense without substantial changes.

Response to Comments from Christopher A. Hartwell:
As Prof.Hartwell emphasized, the introductory chapter had been missed out. I have added an introduction chapter in order to tie together the three chapters. It was crucial in the "essay" format pursued by this dissertation. The chapters have been through language editing as well.

Response to Comments from Richard Frensch:
I appreciate Prof.Frensch's his valuable comments and remarks. I respond to his comments below (the comments are in italics):

In this chapter, potential publication bias is controlled for by relating the size effect (partial correlation coefficients) of natural resources on economic growth to precision (inverse standard errors). Another or additional straightforward possibility would be to include more primary studies not formally published. Why is this not done here?

We preferred to include only published papers in order to control the quality of our research with few exceptions. It is not easy to evaluate the quality of unpublished manuscripts, therefore we aimed to differentiate wheat from chaff. The main advantages of a published paper is that before they appear in a journal, they undergo peer review, one of the most important processes in scientific research. Some working papers are also adjusted before publication; however, we wanted to ensure peer-reviewed journal quality.

It is unclear whether in equation (3.2) resource exports are measured in nominal or in real terms. If the former, does this imply that rising resource prices may affect resource exports and terms of trade simultaneously, so that terms of trade may not exogenously affect exports?

Brunnschweiler and Bulte's (2008) methodology has been followed. The control variables have been chosen with reference to Isham et al. (2005) and Brunnschweiler and Bulte (2008). Oil prices are exogenous for sample countries; these countries have no overall control on oil prices. Despite being the second-largest producer on the oil market (Russia), none of this country is a member of OPEC. Moreover, they are not able to act as a swing producer in the oil market. For such capability, they would need to be able to adjust their production swiftly and without much cost. Therefore, the sample countries are price takers rather than price makers in the oil market.

The dependent variable in (3.3) is the share of manufacturing in GDP. As the share of manufacturing in GDP would be lowered by any increase in resource sector activity, even with manufacturing activity remaining unchanged: why is this specification a valid test of whether natural resources crowd out manufacturing?

The main motivation behind the choice of dependent variable is when an economy experiences a resource boom, the manufacturing sector tends to shrink (Sachs and Warner, 1995; Gylfason, 2001, Auty 2001). This has been called Dutch disease. The share of manufacturing in GDP has changed dramatically in resource-rich post-Soviet countries over last two decades. As an example, Russia was last measured at 5.89 *in 2015, while it was* 17.2 *in 2001.*

The authors use initial gdp in their growth regression (equation (3.3) rather than the initial manufacturing share of gdp, thus missing the chance to estimate speed of convergence. Why?

The main motivation behind the choice of initial income was to assess the association between manufacturing and initial income. It is expected that as countries' initial income level is high, the share of manufacturing expected to grow more rapidly.

With this way, we wanted to control level of development.

Could the author discuss his choice of estimators against the results in Hauk and Wacziarg (2009) which the between estimator (OLS applied to a single cross-section averaged over time) performs best in terms of overall bias?

The between estimator will not perform best for my sample countries, because we have only 15 countries in our sample dataset. We have addressed endogeneity of natural resource and institutions using 2 SLS FE. The fixed effects model is crucial because cross-sectional data suffers from omitted variable bias that arises from the correlation between initial income and the omitted initial level of productivity. Using a between estimator would dramatically reduce the degree of freedom, therefore we would not be able to find significant results.

In his introductory discussion of gravity, the author regularly refers to theoretical models (e.g., page 89, second para). However, the most important developments in this respect, i.e., the identification and decomposition of trade costs within structural gravity approaches, compatible with new and new new theories of trade (as, e.g., described in Anderson, 2011), are not mentioned. Perhaps there are two possibilities: either to tone down the theory discussion or extend it.

Thanks for remind Anderson's research. Indeed, this chapter has taken advantage of Anderson (2011)'s research. The methodology is based on Anderson and Wincoop (2003) and Anderson (2011). Both articles have been added as a citation for the choice of methodology. The choices of explanatory variable follow from Anderson (2011).

While the interpretation of results is always in terms of trade flows, the basic gravity equation (4.2) is formulated not in terms of trade flows but in terms of openness measures (other countries' imports from Azerbaijan as fraction of their GDP), at the same time omitting mass variables (exporter and importer GDP) from the list of explanatory variables - why?

Exporter's and importer's GDPs have been included as a similarity index of GDP which is estimated as a fraction of exporter and importer GDP (similarity index of GDP has been explained in Appendix 4 A, page 100 - The Standardisation of Similarity Index).

The author draws on Helpman (1987) to motivate GDP similarity as a driver of trade. In Helpman (1987), however, for GDP similarity to play a role presupposes the existence of substantial intra-industry trade. How does this motivation relate to the facts of Azerbaijani trade?

Given the size of the economy, bilateral trade will be lower between countries of *dissimilar size when compared with countries of equal size. The main motivation behind GDP similarity was that countries that are similar in size engage in two-way trade of differentiated goods and hence trade more.*

The (trade) data are probably in nominal terms. Are there period (time) effects, to account for price variations over time, as recommended, e.g., in Baldwin and Taglioni (2006)?

I have controlled consumer price index as a controlling variable. Consumer price indexes CPIi and CPIj are "multilateral resistance" terms. They summarize the average trade resistances between a country and all its trading partners.

Why didn't the author use all Azerbaijani trade, i.e. exports from Azerbaijan plus all partner countries' exports to Azerbaijan? Could the author discuss his treatment of MTR across his different specifications against the recommendations of the relevant literature under the specific conditions of his systematically unbalanced panel data?

The main motivation was to assess the export performance of a resource-rich country. Natural resources exports undoubtedly play a more important role in the economy of Azerbaijan than import performance. The quality of institutions of Azerbaijan is very important for countries those importing from Azerbaijan. Therefore, I concentrated on assessment of the determinant of exports. Regarding the methodology, while most gravity models estimate by cross-sectional dataset, OLS models might be misleading in the presence of heteroskedasticity (Silva and Tenreyro 2006). This study used both fixed effect and random effect methods. A Hausman test provides a method for testing the adequacy of the random effect estimation. The main disadvantages of panel data methods are loss of information (fixed effect drops time constant variables) and elimination of zero flows. Therefore, a Poisson Pseudo Maximum Likelihood was performed, producing robust results with zero trade flows, providing unbiased estimates in the presence of heteroskedasticity and all observations weighted equally

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