Local Natural Resource Curse?*

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Abstract

Utilizing an output based efficiency measure we investigate whether higher public revenues harm efficiency in the production of local public goods. Much variation in revenues among Norwegian local governments can be explained by revenues collected from hydropower production. This revenue variation, combined with good data availability, can be used to address a main concern in the resource curse literature; that public sector revenue, and in particular the revenue from natural resources, is endogenous. We obtain an exogenous measure of local revenue by instrumenting the variation in hydropower revenue, and thus total revenue, by topology, average precipitation and meters of river in steep terrain. We find support for what we term the Paradox of Plenty hypothesis - that higher local government revenue reduces the efficiency in production of public goods. We do not find support for what we term the Rentier State hypothesis - that revenue derived from natural resources should harm efficiency more than revenue derived from other sources such as taxation.

Keywords: resource curse, paradox of plenty, rentier state, identification, local government, political economy.

JEL: *D78, H11, H27, H71, H72, H75, Q2*

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1 Introduction

A number of studies within the so-called 'resource curse' literature argue that high public revenue derived from natural resources has perverse effects for economic efficiency. Several theories have been put forward to explain why this could be the case, and a large number of empirical papers investigate the potential mapping from resource abundance to poor economic performance. In this paper we aim to extend this literature in three directions. First, in contrast to much of the previous literature which investigates how the large public revenues affect economic growth, we investigate the effect on public sector efficiency directly. The availability of an output based efficiency measure for the 430 local governments in Norway, combined with the large differences in their available economic resources, allows us to investigate what we term the *"Paradox of Plenty"* hypothesis; that high public revenues retard economic efficiency. Second, we address a main unresolved concern in the resource curse literature; that public sector revenue, and in particular the revenue from natural resources, is endogenous. By using data for revenue from hydropower plants in Norwegian local governments, and by using geographical characteristics such as meters of river, steepness of terrain, and average precipitation as instruments, we arrive at a measure of public revenue which is exogenous. Third, we investigate what we term the *"Rentier State"* hypothesis; that the efficiency effect of natural resource abundance is *different* from the efficiency effect of other types of public revenue such as taxation. We find that there is support for a claim that higher revenue retards efficiency. This holds also when we use the exogenous variation in public sector revenue from hydropower plants. But we do not find support for the claim that natural resource revenue damages efficiency more than revenue derived from other sources. Thus, while our study lends support to the *"Paradox of Plenty"* hypothesis, it does not lend support to the *"Rentier State"* hypothesis.

The Paradox of Plenty hypothesis is a claim about effects of large public revenues, while the Rentier State hypothesis is a claim about effects of the composition of public revenues. A substantial theoretical literature studies how high public sector revenues may produce rent-seeking, lobbying, crowd out production with positive externalities, or weaken the incentives to undertake efficiency improving reforms. In light of this, the theoretical justifications for the Paradox of Plenty hypothesis may be argued to be well developed. It seems fair to say that the same does not hold for the Rentier State hypothesis. Despite its popularity, its theoretical foundations are weak or non-existent. The term 'Rentier State' was first used by Mahdavy (1979), and the Rentier State hypothesis asserts that when resource abundance makes public revenue less dependent on taxation, citizens monitoring of politicians becomes weaker, and policies worse. This is not entirely convincing, however, as it begs the question of why a dollar of wasted resource revenue is worse than a dollar of wasted tax revenue. Nevertheless, given that the hypothesis is often used in the more case-study oriented literature, and have survived despite its lacking theoretical foundation, it could have some interest to see if it receives empirical backing. We do not find that the hypothesis receives support in data. However, we do not have instruments for both the revenue variables. For this reason, the empirical strategy employed in the investigation of the Rentier State hypothesis is less convincing than the one we employ in the analysis of the Paradox of Plenty hypothesis. Thus, although our study can be seen as a first step in systematically investigating a variant of the Rentier State hypothesis, it can surely not be claimed to be the final step.

The empirical literature on the resource curse is an area of intense debate. Since its change in focus from case-studies such as Gelb (1988) and Karl (1997) to multi country growth regressions following Sachs and Warner (1995), main challenges have been the possibility of omitted variables as well as the endogeneity of measures of resource abundance. To address the omitted variables problem a number of papers, such as Aslaksen (2010) and Collier and Goderis (2008), have employed panel data that allows for country or local government fixed effects. The problem of endogeneity of the resource abundance measure has been more challenging. The initial literature such as Sachs and Warner (1995) and Mehlum et al. (2006) used flow measures such as share of natural resources in exports or in GDP. As pointed out by many, such a measure is endogenous, and likely to overestimate the negative effects of resource abundance. The reason for this is that countries are measured as more resource abundant when they experience a reduction in alternative exports, a lower degree of industrialization, or a reduction in physical or human capital. In short, resource intensive production may be the result of poor economic performance for reasons other than resource abundance.

One strand of recent literature, in particular Brunnschweiler and Bulte (2008a,b) and Alexeev and Conrad (2009), has on the basis of this employed the value of subsoil assets as a measure of resource abundance, arguing that such a stock measure is more exogenous than flow measures. This is not fully satisfactory, however, and may bias the result in the opposite direction from the initial literature. Countries that have long been industrialized may have discovered more of their subsoil assets, leading such successful countries to be measured as resource abundant. For instance, Collier (2010) compares the value of known subsoil assets per square kilometer in countries with high GDP to those with low GDP. In the former countries the value of known subsoil assets is four times the value in the latter. He argues that the rich and developed countries simply have had more time to discover their resources, and thus even if more has been extracted, their measured resource wealth is higher.

Partly on this background, researchers have recently increased their attention towards finding more exogenous measures of resource abundance. Tsui (2011) use initial oil endowments to instrument for oil discoveries. Monteiro and Ferraz (2010) use a geographic rule that determines the share of oil revenues that accrue to different Brazilian local governments. Caselli and Michaels (2013) use municipal oil output to instrument for municipal revenues in Brazil.

We complement these studies by extending the resource curse literature to allow for exogenous variation in local government revenue generated from hydropower production in Norway. Norway has the highest per capita production of hydropower in the world, and about 98 percent of total electricity use is hydropower. With 430 local governments, huge differences in public sector revenue from the hydropower sector, and a close mapping from geographical characteristics to these revenues, local governments in Norway should be a promising candidate in the search for true exogenous variation in total revenues and resource abundance. By utilizing variation in topology, average precipitation and meters of river in steep terrain, the revenue measure do not depend on economic decisions. Thus like the initial literature we use a flow measure of resource abundance, but we avoid the potential problems related to the endogeneity of the measure.

Our paper is also related to the growing literature that uses geographical characteristics in economic analyses. Although this literature does not investigate the resource curse, it shares with us the use of geography in constructing instruments. Duflo and Pande (2007) use the river gradient as instrumental variable to study the productivity and distributional effects of large irrigation dams in India, and investigate how dams affect welfare in affected districts. Another study by Lipscomb et al. (2013) studies development effects of electrification between 1960 and 2000 using geological placement of hydropower plants in Brazil. Electrification is most probably correlated with unobservable effects like political decisions and other demand side concerns. They address this potential problem by isolating the portion of variation in electricity grid expansions attributed to "exogenous" engineering cost considerations. Hydropower plant placement is predicted based on geological characteristics like river gradient, water flow, and distance to the Amazon. Rural electrification has also been studied by Dinkelman (2011). She estimates the impacts of electrification on employment growth in South Africa. To identify the causal effect of electrification, land gradient is used as instrumental variable for project placement, generating exogenous variation in electricity project allocation. Andersen et al. (2014) investigate the causal effect of election stakes on turnout via an instrumental variable approach. Their empirical design exploit that topography determines hydropower income by using variables capturing variations in altitude across local governments.

We have not found that previous literature studies the effect of revenue on local government efficiency, develop an similar instrument such as ours, or distinguish between the Paradox of Plenty hypothesis and the Rentier State hypothesis.

The rest of the paper is organized as follows. In Section 2 we discuss relevant institutional characteristics of the Norwegian local governments and hydropower revenue, while in Section 3 there is a short description of the efficiency measure. Section 4 discusses the empirical specification and the identification strategy for our investigation of the Paradox of Plenty hypothesis. The results and robustness checks are summarized in Subsections 4.1 and 4.2. The Rentier State hypothesis is discussed in Section 5. Concluding remarks are offered in Section 6. Appendix A through F contains more detailed information that are referred to in the main text.

2 The Norwegian local governments

2.1 Financing and responsibilities

In Norway, as in the other Scandinavian countries, local governments are important providers of welfare services. The local governments are responsible for child care, primary and lower secondary education (1st to 10th grade), care for the elderly (nursing homes and home based care), primary health care (general practitioners, health centers, and emergency ward), and social services (mainly social assistance and child custody). The welfare services amount to 3/4 of the total budget and are regulated and based on national law. Many additional activities are also provided by the local governments, although they make up a small share of the budget. They can broadly be categorized as culture (libraries, cinemas, sports facilities, etc.), infrastructure (roads, water, sewage, and garbage collection), industry, and housing. The local governments are administered by a directly elected municipal council, ruled by a mayor and an executive board. Local elections are held every fourth year. The local governments can partly be considered as local organizations with democratic institutions, and partly agents of the central government in the provision of welfare services.

The local governments are largely financed by a combination of local taxes and central government grants, and total revenues made up for 16 percent of mainland GDP in 2007.[1] During the period under study taxes amounted to approximately 45 percent of total revenues and grants amounted to about 35 percent. User charges and other revenues accounted for the rest. The local governments collect income and wealth tax from individuals, property tax (residential and commercial property), and natural resource tax from power companies. Most taxes are of the revenue sharing type where the local tax rates are determined by the central government. In practice, tax discretion is restricted to the property tax and some other relatively small taxes. The grant system consists of earmarked grants and general purpose grants. There are a large number of earmarked grants for specific purposes, but the general purpose grants are most important for the distribution of revenues. The main role of the general purpose grant scheme is to equalize the economic opportunities across local governments by tax and spending need equalization. The general purpose grant scheme also includes grants to promote regional policy goals.

The system of financing implies that three types of local governments end up with high levels of fiscal capacity; small rural local governments with substantial tax revenue from hydropower plants, small rural local governments that receive regional policy grants, and urban local governments with high levels of income and wealth taxes. We concentrate on the revenue variation due to differences in revenue from hydropower production. Revenues related to hydropower make up a small share of aggregate revenues, but is of high importance for individual local governments. As can be seen in Appendix A, the top local governments on the revenue ranking list have significant hydropower revenues. Common to these local governments is that the hydropower revenue accounts for about half or more of their total revenue. The table also shows that, on average, a local government with hydropower revenue has higher total revenue per capita. The average total revenue per capita among local governments with hydropower revenue was NOK 32,600 (USD 6,520) in 2007. In comparison the same number for all other local governments was NOK 28,300 (USD 5,430). See Appendix B for a more detailed description of the hydropower sector in the local governments.

Table 1 shows how the revenues are distributed among all the local governments. It is clear that local governments with a high share of hydropower revenue is in the upper total revenue per capita quantile. This shows that revenues from hydropower production relax the economic constraints for some of the local governments. In the following we describe the different sources of hydropower revenue.

2.2 Revenues from hydropower

Hydropower revenues are mainly collected from three sources; property tax from hydropower plants, natural resource tax and revenues from concession power. First, local governments receive property tax from power plants mainly determined by the national

[1]GDP mainland: excludes petroleum production and shipping.

Table 1: Local government revenues per capita, 2007

Total revenue quartile	**Total revenue***[a]	**Hydro revenue***[b] **(mean)**	**Share Hydro (of total)**	**Share Prop.tax (of Hydro)**	**Share Nat.tax (of Hydro)**	**Share Conc.pow (of Hydro)**	**Local gov. with hydro revenue**
First	23.5-25.8	0.03	0 %	82 %	6 %	14 %	26 %
Second	25.8-28.2	0.25	1 %	67 %	8 %	25 %	51 %
Third	28.2-32.0	0.99	3 %	64 %	10 %	26 %	55 %
Fourth	32.0-108.6	7.33	15 %	56 %	20 %	24 %	68 %
95%-100%	44.3-108.6	21.89	35 %	55 %	29 %	16 %	86 %
Mean values by type of government							
All	30.4	2.15	5 %	32 %	6 %	12 %	50 %
HydroRevenue>0	32.6	4.30	10 %	64 %	12 %	23 %	100 %
HydroRevenue=0	28.3	0	0	-	-	-	0

All variables are "deflated" by a cost index and corrected for payroll taxes. Hydro: Hydropower revenues.

*) NOK 1,000 = USD 165 , per capita.

a) Total revenue=Block grants+revenue tax+wealth tax+property tax+natural resource tax+concession power revenue

b) Hydro revenue=property tax from hydropower plants+natural resource tax+concession power revenue.

assessment system. Second, the natural resource tax equals NOK 0.11 (USD 0.018) per kWh produced. Third, local governments affected by hydropower development are entitled to buy up to 10 percent of the power generated. The yield from this concessionary power is equivalent to the difference between the market price of power and the price for the concession power including the input tax[2]. In this paper we focus on these revenues as they may be used freely by the local government. Some minor hydropower revenues (concession fees and revenues from reversions) are not included since they are earmarked for business development funds.

It is important to take into account that revenue from hydropower is distributed between neighboring local governments affected by the production. It is the location of the waterfall, the power plant, the reservoir and the water transfer system that decides if a local government is entitled to hydropower revenues or not. In general the local governments that are most affected by the production receives a correspondingly high share of the hydropower taxes and the concession power. The number of local governments with revenues from hydropower production in our sample varies from year to year. On average close to half of them receive revenues from the production process. The level of hydropower revenue varies widely. In 2007 it varied from zero to over NOK 58,500 (USD 9,750) per capita. Table 1 gives a description of how the hydropower revenues are distributed among the local governments in our dataset. It also gives a description of how the different hydropower revenue components are distributed within each total revenue quartile.

[2]Input tax: tax claimed when transporting electricity in the power grid.

3 Measuring local government efficiency

Our measure of local efficiency is a modified version of a measure developed by Borge et al. (2008), which is also applied by Bruns and Himmler (2011) and Revelli and Tovmo (2007). The point of departure for the measure is an indicator of output from the six main service sectors; care for the elderly, primary and lower secondary education, day-care, welfare benefits, child custody and primary health care. These service sectors account for about 75% of the local government budgets. The output measure captures both quantity and quality of the services delivered and is available for the period 2001-2007. We refer to Borge et al. (2008) for a more detailed description of the revenue measure.

The yearly number of observations varies between 357 and 387, representing 86% of all local governments on average. The major cause for missing observations is failure to report data on indicators required to calculate output. Small local governments are over-represented among the missing observations. However, other observable characteristics for the observations with missing efficiency measure are on average comparable to the non-missing observations.

In order to obtain an indicator of efficiency, output must be related to economic resources. While Borge et al. (2008) used per capita revenues as measure of economic resources, we will instead use per capita expenditures for the six services included in the output measure. By measuring economic resources from the expenditure side we achieve a better correspondence with the output measure. Efficiency in local government j in year t is then given as:

$$\text{Efficiency}_{jt} = \frac{\text{Output}_{jt}}{\text{Expenditures}_{jt}}$$

The expenditures are "deflated" in order to capture the real differences across local governments. As deflator we use the cost index from the spending needs equalization system and we also take into account the regional differentiation of the payroll tax rate. The cost index captures unfavorable cost conditions related to population size, settlement pattern, the age composition of the population and social factors. The importance of deflating can be illustrated through an example. Consider a small and sparsely populated local government that is unable to exploit economies of scale. It will tend to have high per capita expenditures because the unfavorable cost conditions are compensated through the grant system. However, output will not be in tandem with the expenditures. If expenditures were not deflated, this local government would be labeled inefficient simply because of the unfavorable cost conditions.

Figure 1 shows a plot between output and expenditures. Both measures are given a weighted average of 100, such that each variable can be interpreted as deviation from the means in percentage terms. On average there is a positive relationship between output and expenditures, i.e. local governments with high expenditures per capita provide more output to their citizens than local governments with low per capita expenditures. The main interest for this paper is the substantial variation in output between local governments with similar per capita expenditures. This observation indicates that there is substantial variation in efficiency across local governments.

In the empirical analysis we will mostly utilize the time series variation in the data. A possible concern is that the time series variation in efficiency is mainly driven by changes

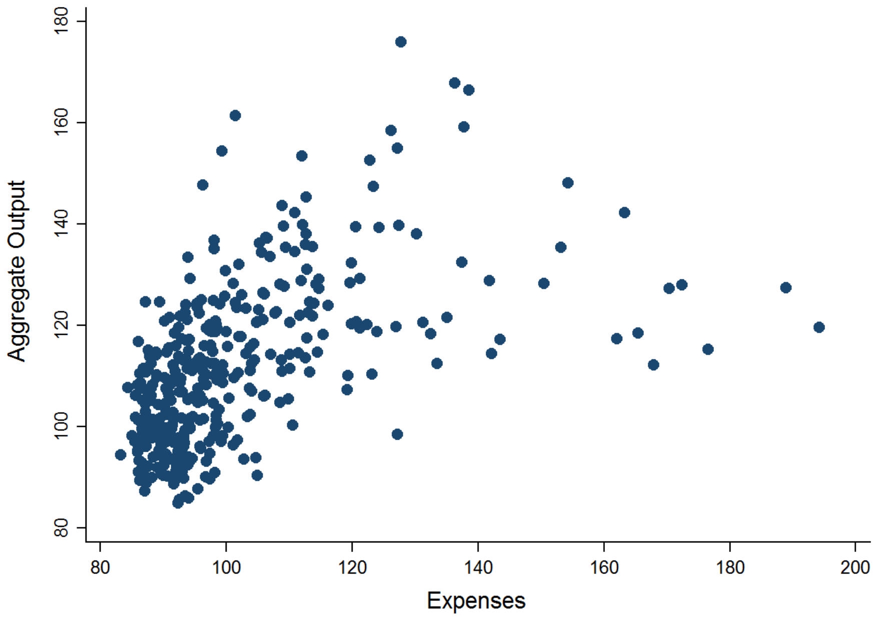

Figure 1: Aggregate output and local government expenses, 2007.
Note: Both variables are normalized such that the weighted average equal 100. In order to ease visual interpretation of the plot, three local governments with expenses above 200 are excluded from the figure.

in expenditures and to little or no extent by changes in output. We address this concern by calculating standard deviations of relative changes in output and expenditures for the 349 local governments that are in the sample in both 2006 and 2007. It appears that the standard deviation of relative output change is around 50% of the standard deviation of relative expenditure change. Although there is more time series variation in expenditures than in output, as much as 1/3 of the variation in efficiency can be attributed to changes in output. Moreover, it is first and foremost among local governments with large increases in efficiency the standard deviation of relative output change is lower than relative change in expenditures. For the vast majority of local governments the standard deviation of the relative change in output is of the same magnitude as the standard deviation of the relative change in expenditures. In the empirical analysis we will investigate whether the results are robust when we exclude observations with large increases in efficiency.

4 Testing the Paradox of Plenty hypothesis

The main hypothesis to be tested is if high local government revenue reduces the efficiency in production of public goods. As discussed in the introduction, we term it the *Paradox of Plenty* hypothesis. The empirical specification is defined as:

$$\text{Efficiency}_{jt} = \beta \text{TotalRevenue}_{jt} + \gamma Z_{jt} + \delta_t + \alpha_j + \epsilon_{jt} \quad (1)$$

where TotalRevenue_{jt} is per capita revenue, Z_{jt} is a vector of controls, δ_t is a year-specific constant term, α_j is a constant specific to each local government, and ϵ_{jt} is an error term. Given the empirical specification in equation (1), the test of the Paradox of Plenty hypothesis can be formulated as follows:

$$\begin{aligned} H_0^P &: \quad \beta = 0 \\ H_1^P &: \quad \beta < 0 \end{aligned}$$

The key variable in testing the Paradox of Plenty hypothesis is the total revenue variable, TotalRevenue_{jt}. It comprises general purpose grants, income and wealth tax from individuals, natural resource tax from power companies, property tax from individuals and companies, and concession power revenue from power companies. As for expenditures, revenues are measured per capita and "deflated" to take account for variation in spending needs and the regional differentiation of the payroll tax. Local governments with high spending needs are compensated through the grant system, and deflating is necessary to capture real revenue differences.

Several econometric challenges arise in testing the Paradox of Plenty hypothesis. First, there may be reverse causality in the sense that efficiency affects revenues. In particular, one would expect that low efficiency leads to higher revenues in order to offset the reduction in output. Increased property tax, more sale of concession power to market price, or increased (judgement) grants from the central government are possible channels in which revenues react to efficiency. This would lead to overestimation of β in absolute value. Second, the estimation of β may suffer from so-called division bias (Borjas, 1980). In our case the division bias would be more obvious if efficiency was defined as the ratio between output and revenues. Moreover, if revenues were measured with error, the division bias would also lead to overestimation of β in absolute value. Although the division bias will be less severe when efficiency is defined as the ratio between output and expenditures, measurement errors in revenues are likely to translate into measurement errors in expenditures through the local government accounts. Third, omitted variables may cause a biased estimate of β.

We handle these challenges in different ways. Most of the equations to be estimated include local government fixed effects. They will capture all time invariant differences across local governments and limit the omitted variable problem. In addition, a number of time varying variables are included as controls. These are temperature, precipitation, population size, settlement pattern, private income, and a dummy capturing whether the mayor and the deputy mayor are from different political blocks. In the following we briefly discuss the motivation for these controls.

Temperature and precipitation may have a direct negative effect on efficiency, and may be correlated with revenues related to production of hydro power. Economies of scale is to some extent handled through the deflation of expenditures, which takes into account that the cost of increasing output varies across local governments. To further control for possible scale effects, population size and settlement patterns are included as explanatory variables. Private income correlates with the revenue variable through local taxes, and may have a direct effect on output and efficiency by e.g. reducing social problems. Mayor and deputy mayor from different political blocks may reflect little political disagreement, or stronger checks and balances, that may have a direct effect on local government efficiency, as well as on tax revenues through the local business climate.

Fixed effects and controls as discussed above, are unlikely to eliminate econometric challenges related to reverse causality and division bias. Our main strategy for handling these problems is an instrument variable approach. The identification strategy is to construct an instrument using geographical characteristics like precipitation, topology and meter of rivers in steep terrain. This help us to predict hydropower revenue that is an important source of revenue variation across Norwegian local governments. The instrument is described in detail in the following subsection.

The instrument

The instrument uses different elements from the hydropower production process to predict potential production in each local government. It utilizes the steepness of the river, water volume in the river and volume of precipitation within the nearby catchment area. We refer to Appendix D and Appendix **??** for data description and sources of data. The production potential of a hydropower plant can be expressed as (NVE and Norconsult, 2003):

$$N(kW) = g \cdot \eta \cdot Q(m^3/s) \cdot H(m) \tag{2}$$

Here g equals the acceleration of gravity (9.81 m/s^2), η is the total power efficiency of the power plant, Q is the maximal usable water flow (measured in cubic meters per second), and H is the head (the total height of fall).

To construct the instrument we start out with the formula for hydropower production potential. To capture the Q and the H in equation (2) we use a dataset on water flow volume classes in Norwegian rivers[3] and a dataset on the steepness of the river in any given location. We first calculate how many meters of river in terrain above 4 degrees[4] each local government has within each water flow volume classification[5]. We term this variable $River4_{wj}$. By multiplying $River4_{wj}$ by w, i.e. multiplying the potential water volume with the length of river with water volume equal to w, we get a variable predicting the hydropower production potential within each water volume classification. Now, a river (in terrain above 4 degree) with twice the water volume of another otherwise similar river (same length), has twice the production potential. In order to construct the measure of the total hydropower production potential of each local government, we sum all these multiplicative terms. We then have a variable representing production potential of hydropower in each municipality.

Hydropower production depends on the production potential just constructed, which is constant from year to year. To which extent the production potential can be utilized from year to year depends on the yearly precipitation in the catchment area of each municipality. To capture this time variation we multiply the production potential with average yearly precipitation ($Precipitation_{jt}$). Average precipitation within the local government and

[3]Classifications (m^3/s): 1-10, 10-50, 50-100, 100-150, 150-200, 200-250, 250-300, 300-400, 400-600, 600-750.

[4]We follow NVE and Norconsult (2003) that use 4 degrees as threshold value for hydropower production. We have also tested 12 and 25 degrees, leading to the same results.

[5]The water flow volume classification, w, allows us to capture the usable water flow in the river. w is equal to the maximum water flow value of each water flow class; $w = \{10, 50, 100, 150, 200, 250, 300, 400, 600, 750\}$

its neighboring municipalities will affect how much of the energy potential that can be utilized from year to year. The more rain, the more of the production potential can be utilized in that year. Finally, we multiply by the national average yearly wholesale price of electricity ($Price_t$). The price variable gives information about fluctuations in the value of each unit hydropower produced over time. Price fluctuations are likely to affect hydropower revenues in the local governments because higher prices might lead to higher concession power revenues.

To transform the instrument into hydropower energy revenue potential per capita we divide it by population size lagged by 10 years. We lag the population size to limit the possibility of endogeneity between the instrument and the dependent variable. Local governments with no rivers will not gain any hydropower revenue in this instrument. The instrument is given by:

$$Instrument_{jt} = \frac{\left[\sum_{w=10}^{w=750} (w \cdot River4_{wj})\right] \cdot Precipitation_{jt} \cdot Price_t}{Population_{10jt}} \tag{3}$$

To sum up, w is water volume class in the river, $River4_{wj}$ is meter of river with water volume class w in terrain above 4 degrees in local government j, $Precipitation_{jt}$ is average precipitation in the local government j and its neighboring local governments, $Price_t$ is the real average wholesale price of electricity in Norway, and $Population_{10jt}$ is population size lagged by 10 years.

A valid instrument must satisfy two main criteria. It must be correlated with the variable to be instrumented (in our case local government revenue) and uncorrelated with the error term in the efficiency equation. The instrument is not likely to be correlated with local government revenues. This should be evident from the discussions of the system of financing in Section 2 and the discussion of the hydropower production process above. The strength of this correlation will be investigated as part of the econometric analysis.

We will also argue that the instrument is likely to be uncorrelated with the error term in the efficiency equation. The main argument is that the instrument captures geographical factors (the interaction between precipitation and steepness and length of rivers) and is specifically designed to capture hydropower production. It seems unlikely that the same geographical factors affect the conditions for producing local public services like education and care for the elderly. This is not obvious, however, as it can be argued that conditions for producing local public services are affected by geography, and that the geographical factors affecting local public services may correlate with geographical factors affecting hydropower production. Since most of the regressions will include municipal fixed effects that capture all (observed and unobserved) time invariant factors that may affect efficiency, the error term will not correlate with geographical factors that do not vary over time. The remaining issue is whether the time varying elements in the instrument correlates with the error term. Precipitation varies from year to year and may affect both hydropower revenues and the conditions for producing local public services. In particular, snow fall during winter will increase hydropower revenues and may have adverse effects on efficiency. As a consequence we may overestimate the negative effect of revenues on efficiency. We handle this potential problem by including precipitation and temperature (separate for summer and winter) as control variables. Although precipitation is included both as control and as an element in the instrument, the functional forms are different and well justified. While it is the interaction between precipitation and steepness and length of rivers that matters for hydro power production, it is the amount of precipitation (possibly with different effects for summer and winter) that is most relevant for production of local public services.

4.1 Empirical Results: The Paradox of Plenty hypothesis

The empirical results are reported in Table 2. As a starting point we report OLS and FE models with no explanatory variables beside the year dummies. In both specifications total revenues come out as statistically significant with a negative sign, consistent with the Paradox of Plenty hypothesis. However, the quantitative effect varies substantially and is largest when fixed effects are included. This indicates that revenues tend to be positively correlated with factors that are favorable to efficiency. The prediction from the fixed effects model is that an increase in revenues by NOK 1,000 (USD 165) per capita will reduce efficiency by 3.35 percentage points. In models (3)-(5) we gradually add control variables to the fixed effects specification. It turns out that most of the control variables are insignificant and that the effect of total revenues is more or less the same as in the fixed effects model without any controls. The insignificance of the controls probably reflects that most of them have limited time series variation. Consistent with our expectations, winter temperature comes out as marginally significant and with a negative sign in model (5). The coalition variable turns out positive and highly significant. The estimate suggest that if the mayor and the deputy mayor are from different political blocks the efficiency increases with 1.41 percentage points. Balance of power seems to be important for public sector efficiency. But since the estimation period only covers two election periods, the time series variation is limited and some caution is required in the interpretation of the coalition variable.

Finally, in model (6) we instrument total revenues. It is evident that the instrument has a positive and statistically significant effect on total revenues. With a corresponding F-value just above 10, the instrument passes the Staiger and Stock (1997) rule of thumb and cannot be deemed weak. The IV estimate of β is somewhat lower in absolute value than the FE estimate, which is consistent with both division bias and the hypothesis that low efficiency partly is offset by higher revenues. The IV estimate indicates that an increase in revenues by NOK 1,000 per capita will cause a reduction in efficiency by 2.61 percentage points. Although the precision is slightly reduced compared to the FE estimate, the IV estimate comes out as statistically significant at the 1% level. A Hausman test is performed to investigate the endogeneity of total revenues. The test compares the FE and IV estimates and checks whether they differ in a statistical sense. It appears that the null hypothesis of no endogeneity cannot be rejected at conventional levels of significance (p-value of 0.27), indicating that the potential cost of relying on the FE estimate in terms of bias and inconsistency is small.

Table 2: Testing the Paradox of Plenty hypothesis

	(1)	(2)	(3)	(4)	(5)	(6)
Efficiency	OLS	FE	FE	FE	FE	IV/FE[a]
Total revenue	-1.175***	-3.352***	-3.345***	-3.345***	-3.369***	-2.605***
	(0.097)	(0.509)	(0.509)	(0.509)	(0.500)	(0.670)
Temp. win.			-0.548	-0.551	-0.585*	-0.683*
			(0.349)	(0.350)	(0.353)	(0.407)
Temp. sum.			-0.225	-0.225	-0.134	-0.027
			(0.396)	(0.396)	(0.397)	(0.427)
Precip. win.			-0.007	-0.007	-0.007	-0.007
			(0.006)	(0.006)	(0.006)	(0.006)
Precip. sum.			-0.006	-0.006	-0.007	-0.008
			(0.007)	(0.007)	(0.007)	(0.007)
Population				-0.018	-0.001	0.024
				(0.133)	(0.133)	(0.149)
Pop. sparsely				-4.433	-4.105	-4.369
				(4.873)	(4.827)	(4.808)
Priv. income					0.011	0.004
					(0.012)	(0.013)
Voter turnout					0.072	0.066
					(0.046)	(0.041)
Coalition					1.409***	1.256**
					(0.516)	(0.510)
Constant	142.6***	191.1***	269.8***	272.3***	259.0***	
	(2.237)	(11.59)	(64.08)	(64.20)	(64.10)	
First stage						
Instrument						5.558***
						(1.749)
R-squared	0.242					
N	2594	2594	2587	2587	2586	2576
Estimation period	01-07	01-07	01-07	01-07	01-07	01-07
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Testing exogeneity of total revenue						
($\chi 2(1)$-test), p-value						0.270

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The standard errors in parentheses are clustered at the local government level.

4.2 Robustness checks: The Paradox of Plenty hypothesis

In this section we provide several robustness checks of our baseline estimates. Appendix E summarizes the results from the alternative specifications that will be presented below.

First we investigate if our results are sensitive to extreme observations and outliers. The motivation is that there are few observations with relatively low levels of efficiency. For example, in 2005, the minimum value of efficiency was 45, but only 1% of the observations were below 65. On the other end of the distribution, the maximum value was 135, but only 1% of the observations were above 125. We rerun the FE and IV regressions in models (5) and (6) in Table 2 excluding observations with efficiency below 80 or above 120. The FE estimate of total revenues is largely unaffected by the reduction in sample size, while the absolute value of the IV estimate increases compared to Table 2. Both estimates point out that increased revenues leads to lower efficiency.

Another concern may be that local governments with high hydropower revenue typically are small and sparsely populated. In our baseline models we control for this by including population size and settlement pattern. As an alternative we exclude larger municipalities to get a more homogeneous sample. When the models are reestimated using data only for municipalities with less than 10,000 inhabitants, the results for total revenues are more or less identical to the results reported in Table 2.

The third robustness check addresses the possible concern that changes in efficiency are driven by expenditure changes rather than output changes. As discussed in Section 3, this is first and foremost the case for local governments with large increases in efficiency from one year to the next. By excluding observations with efficiency improvements above 20%, we get a more "balanced" sample in the sense that output changes and expenditure changes are of equal importance for efficiency changes. The estimated effect of total revenues is robust to this modification of the sample. A minor change is that FE and IV estimates become more similar.

The final robustness test is to estimate a dynamic model by including lagged efficiency as an additional explanatory variable. Lagged efficiency comes out as insignificant both in the FE and IV regressions, and the estimated effects of total revenues are very similar to the estimates in Table 2.

5 The Rentier State hypothesis

The Rentier State hypothesis emphasizes that the composition of revenues may affect productivity. When a local government has high revenues from the natural resource sector, in our case from the hydropower sector, its dependence on raising revenues directly from citizens decreases, possibly making citizens less active in monitoring politicians. In turn, weaker monitoring of politicians may induce inefficiency. As we discussed in the introduction, the hypothesis is not, despite its popularity, entirely convincing from a theoretical point of view. Nevertheless, since to the best of our knowledge it has not been econometrically tested. We undertake an indicative investigation to see if it receives support in our data.

In order to test the Rentier State hypothesis, the variable $TotalRevenue_{jt}$ is split between hydropower revenue and other revenue. The econometric specification then becomes:

$$\begin{aligned}\text{Efficiency}_{jt} = {} & \beta_1 \text{HydroRevenue}_{jt} + \beta_2 \text{OtherRevenue}_{jt} \\ & + \gamma Z_{jt} + \delta_t + \alpha_j + \epsilon_{jt}\end{aligned} \tag{4}$$

Given this empirical specification, the Rentier State hypothesis can be tested as follows:

$$\begin{aligned} H_0^R &: |\beta_1| = |\beta_2| \\ H_1^R &: |\beta_1| > |\beta_2| \end{aligned}$$

Table 3: Testing the Rentier State hypothesis

	(1) OLS	(2) FE	(3) FE	(4) FE	(5) FE
Hydro revenue	-2.098***	-2.991***	-2.978***	-2.975***	-2.998***
	(0.223)	(0.416)	(0.413)	(0.411)	(0.400)
Other revenue	-0.635***	-3.885***	-3.890***	-3.892***	-3.916***
	(0.198)	(0.497)	(0.495)	(0.495)	(0.496)
Temp. win.			-0.714*	-0.719*	-0.764**
			(0.377)	(0.378)	(0.383)
Temp. sum.			-0.382	-0.389	-0.310
			(0.392)	(0.393)	(0.391)
Precip. win.			-0.010	-0.010	-0.010*
			(0.006)	(0.006)	(0.006)
Precip. sum.			-0.007	-0.007	-0.007
			(0.007)	(0.007)	(0.007)
Population				0.065	0.070
				(0.152)	(0.150)
Pop. sparsely				-5.555	-5.059
				(5.208)	(5.145)
Priv. income					0.015
					(0.012)
Voter turnout					0.005
					(0.039)
Coalition					1.387***
					(0.483)
Constant	131.3***	202.6***	314.916***	318.1***	310.2***
	(4.244)	(11.19)	(66.37)	(66.77)	(66.45)
R-squared	0.276				
N	2594	2594	2587	2587	2586
Estimation period	01-07	01-07	01-07	01-07	01-07
Year dummies	Yes	Yes	Yes	Yes	Yes
β_1=β_2(t-test),p-value	0.000	0.012	0.010	0.009	0.009

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The standard errors in parentheses are clustered at the local government level.

As in the empirical analysis of the Paradox of Plenty hypothesis, the revenue variables are potentially endogenous. The instrument developed in the previous section may be used as an instrument for hydro revenues, but we have not been able to develop an instrument for other revenues. In the analysis of the Paradox of Plenty hypothesis we could not reject the hypothesis that total revenues are exogenous in the efficiency equation. Although this result may be argued to dampen endogeneity concerns and that it is reasonable to assume that the two revenue variables in equation (4) are exogenous, it does not eliminate such concerns. Therefore, our empirical results on the Rentier State hypothesis lacks the identification strategy presented in the empirical specification of the Paradox of Plenty hypothesis. For this reason the results in this section should be seen as a preliminary extension of the resource curse literature to investigate the Rentier State hypothesis.

The estimation results are reported in Table 3, which has the same structure as Table 2. We start out by estimating models with OLS and fixed effect without any controls beside the year dummies. These models lead to very different conclusions. With OLS hydro revenues are more damaging to efficiency than other revenues, while other revenues are more damaging when fixed effects are included. In both cases the difference is statistically significant. In models (3)-(5) we gradually expand the FE model with additional controls. As in Table 2, few of the controls come out as significant and the estimated effects of the revenue variables are largely unaffected. The predictions from the FE models are that an increase in hydro revenues by NOK 1,000 per capita will reduce efficiency by 3.0 percentage points, while the same increase in other revenues will reduce efficiency by 3.9 percentage points. The FE models yield no support to the Rentier State hypothesis that natural resource revenues are more damaging to efficiency. If anything, they point in the opposite direction.

We have performed the same robustness checks as for the Paradox of Plenty hypothesis. The results are reported in Appendix F. We first exclude local governments with low or high efficiency. This reduction in sample size increases the absolute value of the estimate of other revenues. The same is the case when observations with yearly efficiency improvements above 20% are excluded. In both cases we can no longer reject the hypothesis that the two revenue components have the same effect on efficiency. On the other hand, the estimates of the revenue variables are largely unaffected by limiting the sample to municipalities with less than 10,000 inhabitants and including lagged efficiency as an additional explanatory variable.

6 Concluding remarks

We find some empirical support for the Paradox of Plenty hypothesis that higher local government revenue retards efficiency. We have instrumented public revenues with variation in resource abundance that can be argued to be truly exogenous. This implies that our result is not a consequence of public revenue being endogenous, a main concern in the existing resource curse literature. We have also investigated if the Rentier State hypothesis finds support in our data. Although it does not, this result can be argued to be less robust, since we do not have an instrument for other public revenues than those derived from natural resources. Nevertheless, the combination of weak or lacking theoretical foundation for this hypothesis, and the absence of empirical support, calls the Rentier State hypothesis into question.

It is important to keep in mind that our results for local governments in Norway need not apply in different institutional settings. Institutions in Norway are robust, and there is no cross municipal variation in institutional quality that we are able to utilize. Thus the assertion that natural resource revenues are more harmful when institutions are weak, and even that institutions in such settings may be endogenous to resource abundance, can not be investigated with our data. Also, although we are not entirely convinced about the theoretical foundations of the Rentier State hypothesis, such mechanisms may be more likely to manifest themselves in weakly institutionalized systems. Finally, local governments may not be the ideal setting to investigate the Rentier State hypothesis, as politicians at the national level may have more leeway to change laws, regulations, and institutions than the politicians at the local level. The external validity of our results should thus not be pushed too far.

We believe that future research could benefit from using similar measures as ours, or other types of exogenous variation in resource abundance, in settings where institutions are weak. Moreover, this may also shed light on the assertion that when initial institutions are fragile, they may be further eroded by resource abundance.

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A Total revenue linked to hydropower revenue

Table A.1: The 8 local governments with highest per capita revenue, 2007

Municipality	**Total revenue***^{a}	**Hydro revenue***^{b}	**Share hydro**	**Pop.**
Bykle	108,6	54,9	51 %	902
Eidfjord	93,2	58,8	63 %	915
Sirdal	77,0	51,6	67 %	1737
Modalen	75,9	42,5	56 %	356
Aurland	69,1	37,0	54 %	1715
Tydal	58,7	31,6	54 %	859
Åseral	55,9	25,2	45 %	893
Suldal	54,9	26,0	47 %	3874
Mean values for type of local government				
All (424)	30,4	2,2	5 %	10830
HydroRevenue>0 (212)	32,6	4,3	10 %	9286
HydroRevenue=0 (212)	28,3	0	-	12375

*) NOK 1,000 per capita (USD 165). "Deflated" by a cost index, and corrected for differences in payroll taxes.

a) Total revenue = block grants + income and wealth tax + property tax + natural resource tax + concession power revenue.

b) Hydro revenue = property tax from hydropower plants + natural resource tax + concession power revenue.

B Developed hydropower plants in Norway

The first hydropower plant in Norway (and Europe) was built as early as in 1885. In 2010 there where in total 1275 developed hydropower plants, with a total installed capacity equal to 29,636 MW. The same year hydropower energy amounted for over 98 percent of total electricity use in Norway. Figure B maps the hydropower plants in Norway in 2008. The map illustrates that there are developed hydropower plants in all parts of Norway. Most of the production capacity enlargement was done between 1950 and 1990. During the last 25 years there have only been small new installations, owing to the fact that environment and landscape effects have been more important in the concession approval. Yet, the production capacity has increased in the same period through technological improvements on already established power plants (Erlandsen, 2006).

Local governments are involved in hydropower in two ways. First, many power companies were initially established by larger cities. The purpose was to provide a safe and cheap provision of electricity to their citizens. This role became superfluous after the deregulation of the electricity market in the early 1990s. During the last two decades

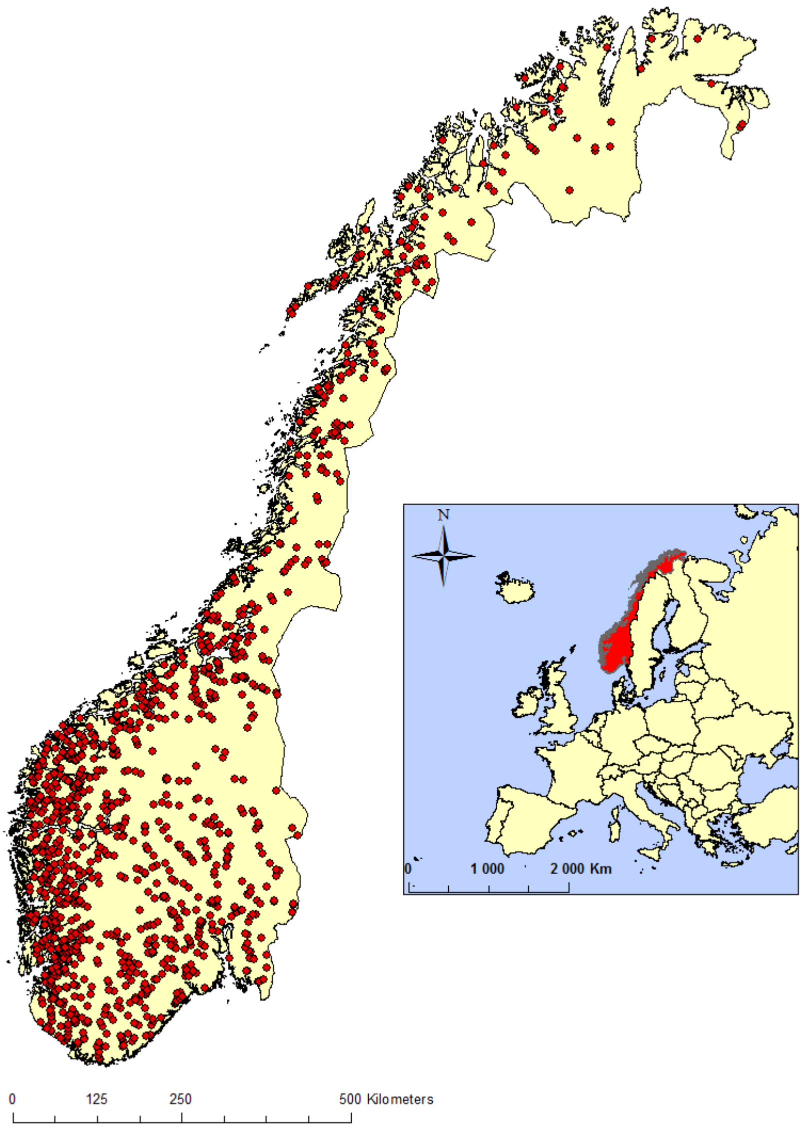


Figure B.1: Developed hydropower plants in Norway (2008).

many power companies are sold and the role of local governments as owners is reduced. Second, the local government where the power plant is located receives taxes and other revenues from the power company. These revenues are considered as compensation for environmental damages, and have been important to generate local support for projects that are profitable for the society at large. This study concentrates on the hydropower revenue received by the local governments affected by hydropower production. Geography is the main factor to decide if a local government is resource abundant or not. This exogenous variation will be used in the empirical identification strategy.

C Data

Table C.1: Variable description and descriptive statistics

Variable	Variable Description	Mean (st.dev)
Efficiency	Measures the ratio between total output in local public services and gross expenditures. *Source: The Norwegian Advisory Commission on Local Government and Statistics Norway Finances*	104.53 (11.12)
Total revenue (NOK 1,000)	Sum of revenues measured in per capita, fitted prices and adjusted for income spending needs and payroll tax. *Source: Statistics Norway*	23.15 (5.72)
Hydro revenue (NOK 1,000)	Sum of property tax from power plants, natural resource tax, and concession power revenues measured in per capita, fixed prices and adjusted for income spending needs and payroll tax. *Source: Statistics Norway and Norwegian Tax Administration*	0.805 (2.80)
Other revenue (NOK 1,000)	Sum of block grants, income and wealth tax, and property tax excluding power plants measured in per capita, fixed prices and adjusted for income spending needs and payroll tax. *Source: Statistics Norway*	22.7 (4.35)
Temperature winter	Average temperature (°C) in the Norwegian winter months (January-March, November-December). *Source: The Norwegian Meteorological Institute, calculated in ArcGIS*	-1.54 (3.29)
Temperature summer	Average temperature (°C) in the Norwegian summer months (April-October). *Source: The Norwegian Meteorological Institute, calculated in ArcGIS*	8.69 (2.54)
Precipitation winter	Average precipitation (mm) in the Norwegian winter months (January-March, November-December). *Source: The Norwegian Meteorological Institute, calculated in ArcGIS*	125.1 (75.14)
Precipitation summer	Average precipitation (mm) in the Norwegian summer months (April-October). *Source: The Norwegian Meteorological Institute, calculated in ArcGIS*	104.5 (40.71)
Population	Population size in 1000 the 1'st of January each year. *Source: Statistics Norway*	11281 (31220)
Sparsely populated	Share of population that lives in sparsely populated areas. *Source: Statistics Norway*	0.48 (0.26)
Private gross revenue	Average private gross revenue (NOK 1,000), deflated by CPI, base year 2001. *Source: Statistics Norway*	7918 (23800)
Voter turnout	Voter turnout in the local government election, i.e. the number of votes as a percentage of the number of eligible voters. *Source: Statistics Norway*	58.76 (3.70)
Coalition	A dummy variable taking the value one if the mayor is from the left-wing block while the deputy mayor is not, or if the deputy mayor is from the left-wing block while the mayor is not. *Source: Fiva et al. (2012)*	0.36 (0.48)
Instrument	See section 4 and Appendix D. The variable is normalized by 10^8.	0.067 (0.147)

Table C.1: Variable description (continued)

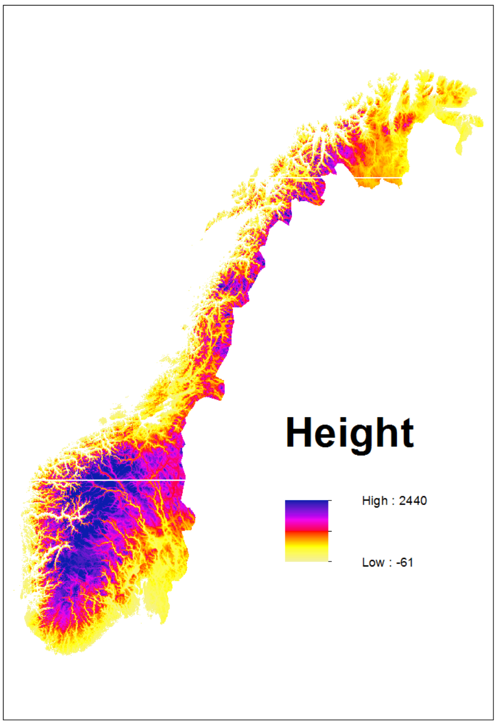
Variable	Variable Description	Mean (st.dev)
Price	The real average wholesale price of electricity in Norway, NOK 0.01/kWh. Deflated by CPI. *Source: Statistics Norway*	21.5 (4.69)
Rain	Average yearly precipitation (mm) in the area of the local government j and in the neighboring municipalities. See appendix D.2.	1434 (633)

D Variables in the instrument

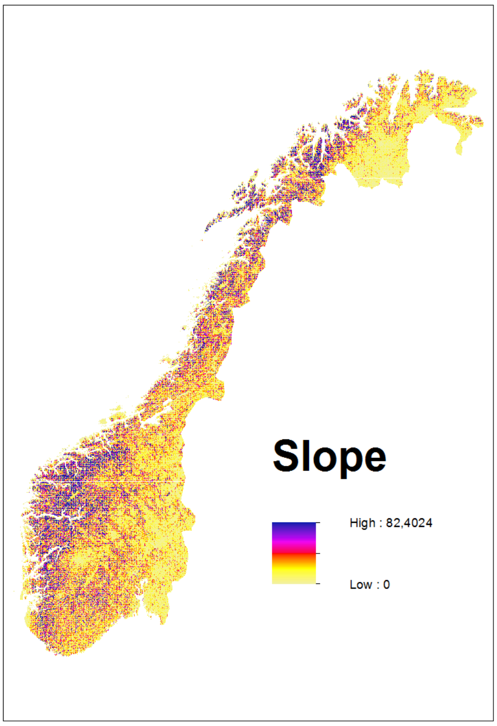
D.1 River data

Gradient data

The gradient data is calculated in ArcGIS using a terrain model collected from Norway Digital. The terrain model consists of 50x50 meter grids and has a standard deviation equal to $\pm$ 4 to 6 meter for its heights values. Using ArcGIS 10[6] the terrain model can be used to calculate the average gradient within each local government. Figure D.1 shows the terrain model of Norway, and the corresponding slope map. Both maps consist of 50x50 meter grids.



(a) Terrain model



(b) Slope

Figure D.1: Terrain and slope map of Norway

[6]ArcGIS consists of a group of geographic information system (GIS) software products produced by Esri.

Meters of river at locations with a slope above 4 degrees

Using the slope map generated in the previous section we can now calculate how many meter of river each local government has in areas with a slope above 4 degrees. This is done by coupling the gradient data with river data collected from the Norwegian Water Resources and Energy Directorate (NVE). Figure D.2 shows an example with Bykle local government, the local government with most hydro power revenue per capita. Bykle has 267.5 km. of river, in witch 84 km. are in areas with slope above 4 degrees.

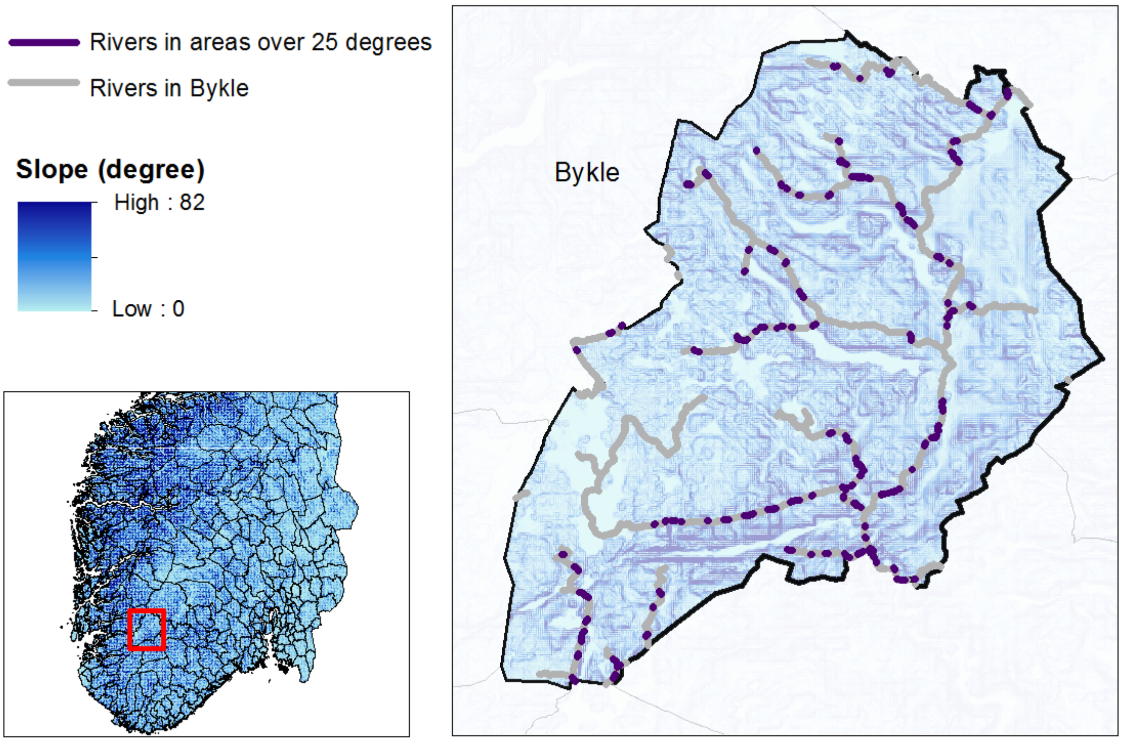


Figure D.2: Rivers in Bykle local government: Rivers (above 1 m^3/s) in areas with slope above 4 degrees.

Water flow in the rivers

River water flow data is also collected from the Norwegian Water Resources and Energy Directorate (NVE). The data reports all rivers (with water run-of above 1 m^3/s) in Norway naturally generated from lakes and rivers. NVE has classified the water run-of for all the rivers into 10 groups, as shown in figure D.3[7]. In combination with the river data calculated in last section we can now calculate how many meter of river in areas with slope above 4 degrees each local government has within each water volume classification.

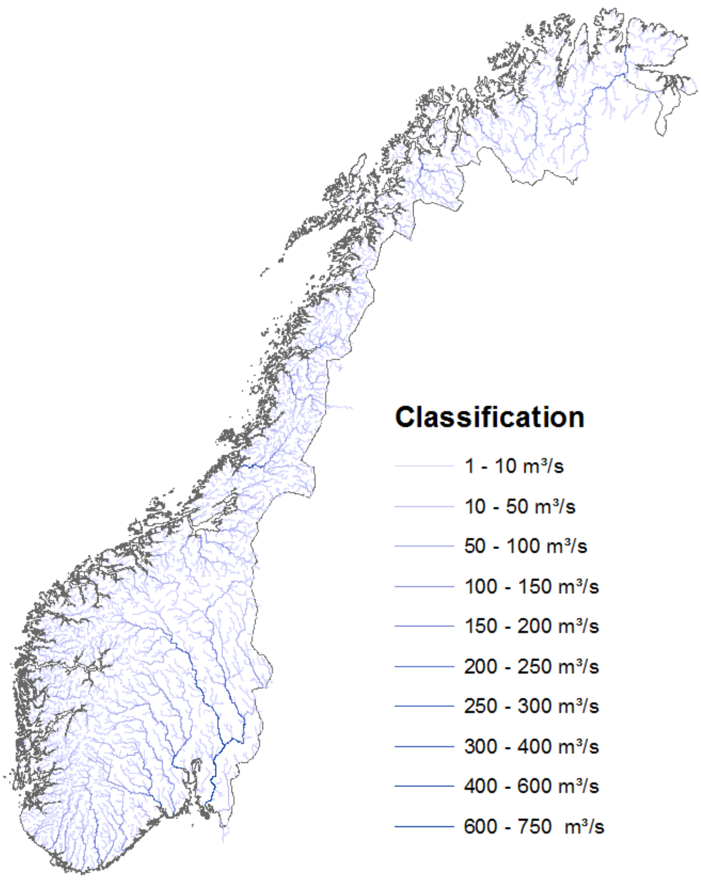


Figure D.3: River network classification. Run-off in m^3/s in the period 1960-1991

[7]Their water run-of calculations is reported in Beldring et al. (2002)

D.2 Precipitation

Precipitation data is collected from Norwegian Meteorological Institute. The data consists of 1x1 km. gridded monthly and annual precipitations values. The gridded datasets are established by a spatial interpolation method. The methodology is reported in Hanssen-Bauer et al. (2006).

Using ArcGIS we calculate the average precipitation values within each local government and its neighboring local governments for each year. A visual map is shown in Figure D.4. The highlighted area show Vinje local government (the center local government in this example) and its neighbors.

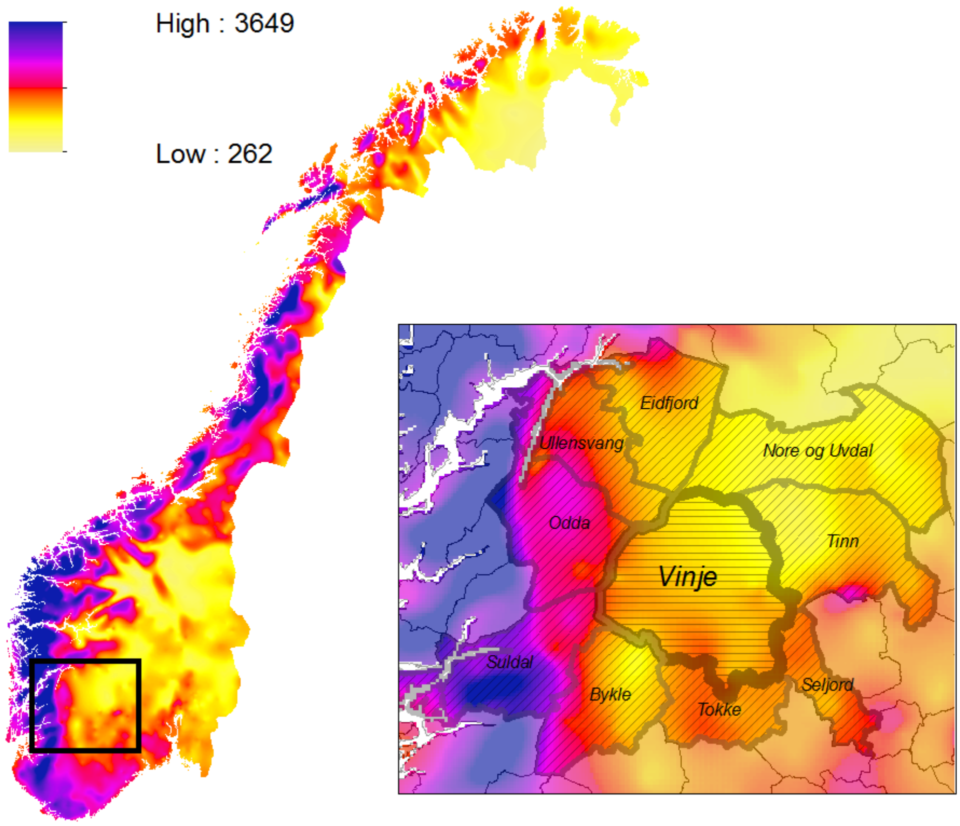


Figure D.4: Average precipitation (mm.) in Norway, year 2001

E Robustness checks: The Paradox of Plenty hypothesis

Table E.1: Robustness checks: The Paradox of Plenty hypothesis

	$80 \leq Eff. \leq 120$		Pop<10,000		$\frac{\Delta Eff.}{Eff.} < 20\%$		Lagged eff.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Efficiency	FE	FE/IV[a]	FE	FE/IV[a]	FE	FE/IV	FE	FE/IV[a]
Total revenue	-3.340***	-3.099**	-3.284***	-2.421***	-3.227***	-3.209***	-2.928***	-2.409***
	(0.134)	(1.218)	(0.515)	(0.733)	(0.240)	(0.704)	(0.316)	(0.569)
Temp. win.	0.169	0.133	-0.720	-0.866	-0.531*	-0.528*	-0.491	-0.524
	(0.275)	(0.315)	(0.450)	(0.530)	(0.296)	(0.302)	(0.340)	(0.353)
Temp. sum.	0.337	0.357	-0.397	-0.337	-0.356	-0.352	-0.592	-0.516
	(0.395)	(0.437)	(0.457)	(0.482)	(0.491)	(0.513)	(0.476)	(0.485)
Precip. win.	0.002	0.002	-0.010	-0.010	-0.014**	-0.014**	-0.012*	-0.012
	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Precip. sum.	-0.001	-0.001	-0.004	-0.005	-0.006	-0.006	-0.016**	-0.017**
	(0.006)	(0.006)	(0.008)	(0.008)	(0.006)	(0.007)	(0.007)	(0.008)
Population	0.029	0.060	3.716	5.026*	0.051	0.052	-0.026	-0.018
	(0.272)	(0.274)	(2.434)	(2.576)	(0.123)	(0.124)	(0.105)	(0.112)
Pop. sparsely	-6.759	-6.454	-3.411	-2.749	-3.474	-3.415	-5.294	-3.873
	(5.001)	(5.187)	(4.932)	(4.877)	(5.671)	(5.822)	(5.306)	(5.571)
Priv. income	0.014	0.012	0.010	-0.001	0.020*	0.020	0.008	0.001
	(0.011)	(0.012)	(0.013)	(0.014)	(0.012)	(0.014)	(0.013)	(0.014)
Voter turnout	0.018	0.017	0.052	0.051	0.025	0.026	0.054	0.049
	(0.037)	(0.036)	(0.059)	(0.051)	(0.034)	(0.035)	(0.047)	(0.044)
Coalition	0.760*	0.747*	1.789***	1.574**	1.341***	1.338***	1.625***	1.528***
	(0.401)	(0.418)	(0.632)	(0.626)	(0.487)	(0.478)	(0.528)	(0.525)
Lagged eff.							0.003	0.003
							(0.009)	(0.009)
Constant	180.1***		177.6***		185.9***		185.4***	
	(7.553)		(18.79)		(9.952)		(11.95)	
First stage								
Instrument		2.828***		5.244***		4.526***		4.518***
		(0.914)		(1.756)		(1.300)		(1.470)
N	1905	1881	1923	1919	2041	2032	1938	1931
Period	01-07	01-07	01-07	01-07	02-07	02-07	02-07	02-07
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Testing exogeneity of total revenue ($\chi 2(1)$-test), p-value		0.845		0.259		0.979		0.349

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
The standard errors in parentheses are clustered at the local government level.

F Robustness checks: The Rentier State hypothesis

Table F.1: Robustness checks: The Rentier State hypothesis

	$80 \leq Eff. \leq 120$	Pop<10,000	$\frac{\Delta Eff.}{Eff.} < 20\%$	Lagged eff.
	(1)	(2)	(3)	(4)
Efficiency	FE	FE	FE	FE
Hydro revenue	-3.269***	-2.928***	-3.061***	-2.781***
	(0.169)	(0.401)	(0.235)	(0.287)
Other revenue	-3.383***	-3.851***	-3.399***	-3.534***
	(0.154)	(0.527)	(0.268)	(0.263)
Temp. win.	0.172	-0.990**	-0.552*	-0.471
	(0.275)	(0.499)	(0.295)	(0.335)
Temp. sum.	0.328	-0.604	-0.425	-1.155**
	(0.395)	(0.448)	(0.489)	(0.492)
Precip. win.	0.002	-0.014**	-0.015**	-0.017**
	(0.005)	(0.007)	(0.006)	(0.007)
Precip. sum.	-0.001	-0.004	-0.007	-0.010
	(0.006)	(0.008)	(0.006)	(0.007)
Population	0.042	4.387*	0.084	0.087
	(0.274)	(2.508)	(0.129)	(0.124)
Pop. sparsely	-6.955	-3.786	-4.254	-9.844
	(5.034)	(5.208)	(5.737)	(5.977)
Priv. income	0.014	0.014	0.022*	0.009
	(0.011)	(0.013)	(0.012)	(0.017)
Voter turnout	0.014	-0.024	0.010	0.003
	(0.038)	(0.048)	(0.034)	(0.040)
Coalition	0.761*	1.768***	1.310***	1.627***
	(0.401)	(0.595)	(0.477)	(0.529)
Lagged eff.				0.005
				(0.008)
Constant	181.2***	192.1***	190.8***	203.2***
	(7.868)	(18.48)	(10.36)	(10.31)
N	1905	1923	2041	1920
Estimation period	01-07	01-07	02-07	02-07
Year dummies	Yes	Yes	Yes	Yes
β_1=β_2(t-test),p-value	0.529	0.010	0.062	0.001

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
The standard errors in parentheses are clustered at the local government level.