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Natural Resources and Public Sector Wages

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Abstract

This paper studies the effects of natural resource abundance on wages for local public sector leaders in Norway. Local governments with high public revenues from the hydropower sector have fewer economic constraints compared with other local governments. High revenues might make it easier for public sector leaders to use their political power to increase leader wages relative to the wages received by other working groups. Novel data on local public sector wages, in combination with an exogenous instrument for hydropower revenues, lead to a unique empirical framework for this analysis. The instrumental variable estimates exploit the variation in geographical and topological characteristics, such as the length of rivers, river slope, water flow volume, and precipitation. Although the results indicate that public sector wages are positively affected by local government revenues, there is no evidence that the revenue effect is stronger for leader wages than for the wages of other working groups.

Keywords: public sector wages, resource curse, rent-seeking, identification, local governments, political economy.

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

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1 Introduction

Rent-seeking activity in resource-rich economies is one of the theories suggested to explain the so-called *natural resource curse.* This curse has been a topic of intense debate in the economic literature. A large number of empirical papers have investigated the potential mapping from resource abundance to poor economic performance. However, little empirical research has examined rent seeking in resource-abundant economies as a result of poor data availability on crime rates and other related statistics.

One rent-seeking opportunity for public sector workers, although not illegal, is to extract resources through higher wages. Thus, it is of interest to investigate whether revenues affect wages for public sector leaders relative to other working groups. This paper aims to extend the literature on rent-seeking activity in resource-abundant economies in two ways. First, I will test how revenues affect leader wages compared with wages in other working groups in Norwegian local governments. Second, the identification of the revenue effect is tested using an instrumental variable approach. The variation in the revenue of local governments can partly be explained by variations in hydropower revenues, which is instrumented based on geographical and topological characteristics. The instrument is thus a promising candidate for exogenous variation in the revenue variable.

In Norway, public sector revenues vary greatly among local governments, partly because of the variation in public revenues from the hydropower sector. Local governments with high revenue per capita have fewer economic constraints, which can make it easier to negotiate wages at a higher level. Leaders are closer to the decision-making process and are thus more likely to influence their own wages over time. Hence, high revenues might lead to higher leader wages relative to other working groups. This possibility can be investigated by comparing a potential revenue effect on leader wages relative to wages for other working groups. The dataset includes four public sector occupations. The first occupation is the chief executive, which is the head of the local government and represents the leader group in the analysis. The chief executive wage is locally negotiated, and the wage level varies greatly across local governments. Three other occupations are included as control groups: principals, nursing assistants and cleaners. These occupations represent working groups with high and low levels of education. Their wages are largely determined in centralized wage agreements, but there is some room for local bargaining. If high revenues lead to higher relative leader wages, then revenues are expected to have a greater positive effect on chief executive wages compared with other occupations.

To investigate the effect of resource abundance on public sector wages, it is important to measure exogenous variation in resource abundance. Norway has the highest per capita production of hydropower in the world, and approximately 98 percent of the total electricity consumption is hydropower. Among the 430 local governments, there are large differences in public sector revenues from the hydropower sector. Following Borge, Parmer and Torvik (2013), revenue is instrumented by utilizing the variation in the length and steepness of rivers, river water volume, the volume of precipitation within the nearby catchment area, and the national electricity price. Another strength of the empirical specification is that the local government dataset allow us to perform a within-country analysis. This approach reduces the likelihood of omitted variables such as amenities, culture and political differences.

This paper is organized as follows. A literature overview is presented in Section 2.

Section 3 discusses the local wage and financial system in Norway. The data are discussed in Section 4, followed by the empirical specification in Section 5. The results are presented in Section 6, with corresponding robustness tests in Section 7. Section 8 presents some alternative empirical specifications to the baseline model. Finally, concluding remarks are offered in Section 9. Appendix A through J contains more detailed information referred to in the main text.

2 Literature

Rent seeking was first defined by Tullock (1967) to explain the social welfare loss involved in the establishment of monopolies, tariffs, and subsidies. In the literature on the natural recourse curse, the rent-seeking models describe how natural resource wealth is used to increase the wealth of the elite rather than using the endowments on public goods and other investments that increase overall welfare in the economy. Fischer (2006, p.2) describes rent-seeking as "[...] the ability of individuals to capture incomes without producing output or making a productive contribution". He elaborates further on rent seeking in the public sector and discusses how public officials can intervene in the economy and appropriate or misuse public funds.

The misuse of public funds by politicians is of great importance in the literature on rent seeking and the natural recourse curse. The potential for public sector workers to influence wages has been investigated by labor economists for decades (Freeman, 1986). A recent paper by Brueckner and Neumark (2014) both models and empirically tests the hypothesis that in absence of a competitive market and in the presence of public sector unions, public sector pay reflects an element of rent extraction by government workers. The authors test whether such rent extraction can be explained by the level of local amenities as a result of a migration of taxpayers. The evidence reveals that public-sector wage differentials are indeed larger in the presence of high levels of amenities. The evidence also suggests that the effect is stronger for unionized public sector workers, who are likely to be better able to exercise political power in extracting rents. Caselli and Michaels (2013) investigate the effect of large oil windfalls in Brazilian municipalities on government behavior and find that improvements in various areas of public service provision appear small compared with the corresponding reported spending increases. These researchers suggest that incumbent mayors are able to divert the majority of oil revenues that accrue to the municipality. The diverted funds may be allocated to a combination of self-enrichment and vote buying. Another paper by Vicente (2010) uses a natural experiment framework from West Africa to investigate the effects of a potential major oil discovery on observed corruption, which is a plausible signal of rent-seeking activity. He constructs a difference-in-difference model and finds that observed corruption increased significantly in areas with potential oil wealth relative to areas without oil endowments.

Torvik (2002) uses a theoretical model to argue that natural resource abundance increases the number of entrepreneurs engaged in rent seeking and reduces the number of productive entrepreneurs. More natural resources thus lead to lower welfare. In addition, Baland and Francois (2000) formulate a theoretical model under which resource booms lead to an increase in rent-seeking activity by shifting resources away from production toward rent seeking. Lane and Tornell (1999) examine the connection between poor economic growth and weak institutions and argue that incentives for weak governments to engage in rent seeking with powerful groups in the economy increases with the windfall. The model shows that powerful groups dynamically interact via a fiscal process that effectively allows open access to the aggregate capital stock. In equilibrium, this interaction leads to slow economic growth and a "voracity effect". The model is supported by some empirical findings in Lane and Tornell (1996, 1999). In a recent work, Arezki and Brückner (2012) improve the empirical analysis by examining the effects of windfalls from international commodity price booms on net foreign assets. The key findings were that commodity price booms are followed by increases in government expenditures, increased corruption and higher expropriation risk in polarized countries, but this effect is not found in countries with less polarization. The findings are consistent with the voracity effect model.

There is an extensive body of literature on the challenging problem of measurement error and endogeneity in measuring resource wealth. Early studies, such as Sachs and Warner (1995) and Mehlum et al. (2006), use flow measures, such as the share of natural resources in exports or in GDP. As noted by many scholars, such a measure is endogenous and likely to overestimate the negative effects of resource abundance because 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, particularly Brunnschweiler and Bulte (2008a,b) and Alexeev and Conrad (2009), employs the value of subsoil assets as a measure of resource abundance, arguing that such a stock measure is more exogenous than flow measures. However, this argument is not fully satisfactory 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. This point is raised by researchers such as Collier (2010). By comparing high-GDP countries to low-GDP countries, he argues that rich and developed countries have simply had more time to discover their resources. Partly based on this background, researchers have recently directed their attention toward 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.

In earlier studies, the omitted variable problem has traditionally been addressed using panel data that allow for country fixed effects (Aslaksen, 2010; Collier and Goderis, 2008). More recent research uses within-country analysis (Borge et al., 2013; Monteiro and Ferraz, 2010; Caselli and Michaels, 2013) in addition to fixed effects to address the omitted variable problem. Within-country analysis reduces the likelihood of omitted variables across units.

3 Norwegian local governments

3.1 Administration

Norwegian 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. In this way, the local governments are partly local organizations with democratic institutions and partly agents of the central government in the provision of welfare services.

Each local government is obliged to hire a chief executive who will be the head of the administration[1]. The chief executive ensures that the issues proposed to the elected local governments bodies (i.e., the local government council and executive committee) are properly prepared and analyzed and that resolutions are conducted (Norwegian Ministry of Local Government and Regional Development, 2008).

3.2 Corruption and rent seeking in the local public sector

Corruption rates in Norway are relatively low. In 2012, the Corruption Perceptions Index ranked Norway as number seven out of 177 countries, with the top-ranked country having the least amount of corruption[2]. The index ranks countries/territories based on how corrupt their public sector is perceived to be. For the same year, OECD ranked Norway third with respect to their index of confidence in national institutions (OECD, 2014). The confidence in national institutions index is based on questions regarding confidence in the military, the judiciary and the national government.

The Norwegian Association of Local and Regional Authorities reports that surveys from 2007 and 2012 find little evidence of outright corruption in the local government sector. After 2003, 24 individuals have been convicted of corruption at the local government level. Nevertheless, hidden crimes are not easily captured by surveys or statistics, making it difficult to accurately assess the level of corruption. Thus, the most obvious way to measure local government rent seeking is by considering the higher wage levels of local public sector leaders. As mentioned in the introduction, leaders are closer to the decision-making process and are thus more likely to be able to influence their own wages.

3.3 Local public sector wages

Wage bargaining in the Norwegian local public sector is highly centralized and is based on strong unions. The centralized collective wage agreement set the wage frame for public sector workers, (Kommuneforlaget, 2012)[3]. The collective agreement limits variation in wages for similar workers across local governments. The collective wage agreement can be regarded as a minimum wage system in which the lowest wage schedule within a wage frame should be considered the basic wage. The actual wage schedule is decided at the

[1]Three local governments (Oslo, Bergen and Tromsø) have implemented a parliamentary government system and do not have an chief executive. Oslo, Bergen and Tromsø are respectively the first, second and seventh largest local governments in Norway based on population.

[2]See http://www.transparency.org/cpi2012/results.

[3]The collective wages agreement is between the Norwegian Association of Local and Regional Authorities and national union federations. This agreement holds for all local governments except Oslo.

local level. See Appendix A for more details and history regarding the collective wage agreement.

The collective wage agreement does not include a wage frame for local public leaders. Their wages are exclusively bargained at the local level[4]. Thus, chief executive wages vary widely across local governments. As reported in Table 1, in 2012, the highest observed monthly wage in our dataset was NOK 108,225 (USD 17,860) compared with the median wage of NOK 65,334 (USD 10,780). In the same year, the average basic wage for low-skilled labor in the local public sector, represented by cleaning services in this example, was NOK 23,831 (USD 3,930). It is clear from the table that the wage range is far greater for chief executives than for other occupations.

Table 1: Monthly salary, full-time-equivalents, in Norwegian local governments, 2012.

Occupation	**Wage** (NOK)				
	Mean	Median	S.D	Min.	Max.
Chief Executive	66984	65334	10204	39053	108225
Principal	49447	49167	4043	37032	70683
Enrolled nurse	27273	28191	2216	21840	43683
Cleaner	23831	23415	3911	15192	53809
All occupations[a]	33400	-	-	-	-
Private sector[a]	33600	-	-	-	-
Local public sector[a]	31300	-	-	-	-

a) Source: Statistics Norway. Local public sector includes: municipalities and county municipalities

A flexible wage policy is important for several reasons: first, to motivate human resource development; second, to motivate workers to work full time; third, to recruit and retain workers in the public sector; and fourth, to ensure high-quality local public sector workers. Research shows that local wage-setting policy is an important instrument to ensure the employment of qualified workers in Norwegian local governments (Egge and Moland, 2001). Fevang et al. (2008) report that the wage structure in local governments is more compressed than the wage structure in both the central government and the private sector. Using register-based wage data from Norway, they conclude that the private sector is the wage leader for those with high levels of education and/or long professional experience. However, the local government sector is the wage leader for employees with little education and/or no professional experience. The paper underlines that it is difficult for the local public sector to compete with the private sector in hiring highly educated and qualified employees.

[4]The right to local wage bargaining for the chief executive and other leaders are described in Chapter 3.4.1 in the collective wage agreement, (Kommuneforlaget, 2012). The chapter states that the wage should reflect leader qualifications, professional achievements, leadership performance, and the need to retain qualified workers.

3.4 Financing and responsibilities

In Norway as in other Scandinavian countries, local governments are important providers of welfare services[5]. Welfare services amount to 3/4 of the total budget and are regulated and based on national law. Local governments are largely financed by a combination of local taxes and central government grants, and total revenues accounted for 16 percent of GDP mainland in 2007[6]. Local governments collect revenue and wealth tax from individuals, property tax (residential and commercial property) and natural resource tax from power companies.

Subject to legal regulations, local governments have full discretion in the allocation of these revenues across service sectors. In practice, tax discretion is restricted to property tax and some other relatively small taxes. The grant system consists of earmarked grants and general purpose grants. The system of financing implies that small rural local governments with substantial tax revenue from hydroelectric power plants often have high levels of fiscal capacity. Revenues related to hydropower constitute a small share of aggregated revenues but are of substantial importance for individual local governments. As shown in Appendix B, all of the top eight local governments on the revenue ranking list have significant hydropower revenues. Common to all of these eight local governments is that the hydropower revenue accounts for approximately half or more of their total revenue. The table also shows that a local government with hydropower revenue has higher total revenue per capita on average. The average total revenue per capita among local governments with hydropower revenue was NOK 32,600 (USD 5,380) in 2007. In comparison, the figure was NOK 28,300 (USD 4,670) for all other local governments.

Table 2: Local government revenues per capita, 2007

Total revenue quartile	**Total revenue*[a]**	**Hydro revenue[b], mean**	**Hydro share of total**	**Local gov. with hydro revenue**
First	23.45 - 25.83	0.03	0 %	26 %
Second	25.83 - 28.15	0.25	1 %	51 %
Third	28.15 - 32.04	0.99	3 %	55 %
Fourth	32.04 - 108.6	7.33	15 %	68 %
95 % - 100 %	44.31 - 108.6	21.89	35 %	86 %
ALL				
Mean	30.44	2.15	5 %	50 %
Min	23.45	0	0 %	-
Max	108.59	58.47	67 %	-

All variables are ”deflated” by a cost index and corrected for payroll taxes.

a) =block grants+revenue tax+wealth tax+property tax+natural resource tax+concession revenue

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

Table 2 shows how revenues are distributed among all local governments. It is clear that local governments with a high share of hydropower revenue are in the upper total revenue per

[5]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 (primarily social assistance and child custody). Other small activities are also provided, although they represent a small share of the budget.

[6]GDP mainland: Excludes petroleum production and shipping.

capita quartile. This observation implies that revenues from hydropower production relax the economic constraints of some local governments.

Hydropower revenues are primarily collected from three sources: property tax from hydropower plants, natural resource tax, and revenues from concession power. The revenue from hydropower is distributed between the local governments affected by the production of the power. The location of the waterfall, the power plant, the reservoir, and the water transfer system determine whether a local government is entitled to hydropower revenues. In general, the local governments that are most affected by this production receive a correspondingly high share of the hydropower taxes and concession power. The number of local governments with revenues from hydropower production in the dataset varies from year to year. On average, nearly half of these governments receive revenues from the production process.

4 Data

The data cover more than 563,000 individual wage observations for local public employees from 2001 to 2012. Four occupational groups are included: chief executives, principals, nursing assistants (henceforth referred to as nurses) and cleaners. In total, 418 local governments are included in the dataset[7]. Oslo, Bergen and Tromsø are excluded because of institutional setup differences[8]. In addition, local governments that changed borders during the period of interest are excluded. For the principals, data are only available from 2004 and include observations from 411 local governments. A variable description table is given in Appendix C.

4.1 The wage variable

The individual data collected from the Norwegian Association of Local and Regional Authorities (KS) include wage data for four occupational groups. First, as explained in Section 3, the chief executive is the head of the local government administration[9]. Their wages are exclusively set at the local level. The second group is the principals at the compulsory school level[10]. Their wages are set primarily at the local level but are partly restricted by the collective wage agreement. The two remaining occupations, nurses and cleaners, have a wage structure that is primarily set by the collective wage agreement. However, as mentioned in Section 3.3, all occupation groups have some local wage negotiation opportunities. All four occupations are relatively homogeneous across local governments.

The wage variable is denoted as $\ln Wage_{kijt}$, where k is the occupation, i is the individual id, j is the local government, and t is the year. As the name indicates, it is given in a natural logarithm to facilitate comparison and interpretation of the regression results across occupations. The wage variable reports the real wage, calculated as the monthly wage excluding overtime pay and other amounts divided by the share of a full-time job. The variable is deflated by the CPI. Only data for employees who work at least 20% of a full-time position are included[11]

[7] In 2012, there were a total of 428 local governments in Norway.

[8] Oslo, Bergen and Tromsø have implemented a parliamentary government system and do not have a chief executive.

[9] In the dataset, KS defines the chief executive as the employee who earns the highest wage in the local government administration.

[10] In the dataset, KS defines a principal as an employee who is employed in the compulsory school sector, with a specific position code indicating an administration leadership position and with specific educational qualifications.

[11] Individuals who are reported to have multiple part-time positions under the same occupational code

4.2 The revenue variable

Total revenue is given by $TotalRevenue_{jt}$ and equals the sum of block grants, wealth and income tax, property tax, natural resource tax and concession power revenue. The variable is measured in NOK 10,000 per capita and is "deflated" to account for regional differentiation in the payroll tax.

4.3 Other local government characteristics

The local government controls included in the dataset are the population, the unemployment rate, and an index for political strength. First, a large population may make administration more difficult and may thus affect leader wages. Population size can also affect labor supply. Second, the local unemployment rate may affect wages. A higher unemployment rate is expected to affect wages negatively. Third, a Herfindahl index of party fragmentation in the local council is included to control for the strength of political leadership. As noted by Falch and Strøm (2006), wage outcomes in a decentralized system may be affected by politically elected representatives and their strength of political leadership relative to employee organizations and interest groups. This index is increasing with reduced party fragmentation and is expected to increase the likelihood that political leadership will affect wage setting.

4.4 Individual characteristics

Individual characteristics are important in wage formation. First, age is included in the regressions. To ensure that the function form is flexible, age is divided into six age groups. Second, seniority may partly be captured by the age variable. However, seniority level provides information on how long a worker has been working, regardless of age. As with age, the seniority level is also divided into 5 seniority groups. Third, educational qualifications are included. Unfortunately, the educational variable has a high rate of missing observations for some occupations. Therefore, a "missing" education variable is also included in the regressions. It is expected that higher educational levels will affect wages positively. Fourth, to investigate whether gender affects wages, a dummy for female employees is included. Fifth, the hourly wage may differ for employees working full time compared with those working part time. Given that full-time employees are the reference group, two dummies are included: one dummy for workers working between 50 and 99 percent and one dummy for workers working less than 50 percent.

5 Empirical specification and hypothesis

The aim of the analysis is to test whether high revenue levels affect public sector wages at the local level and to determine whether the revenue effect is different for public sector leaders than for other working groups. This possibility can be investigated by comparing the revenue effect on chief executive wages with the revenue effect on wages for the other included occupations. If leaders employ political power to increase their own wages, then chief executive wages should be more positively affected by revenues compared with the wages for other occupations.

The following regression is used for all four occupations in the dataset, including chief executives, principals, nurses and cleaners:

are given a new position percentage by summing the multiple part-time positions.

$$\ln \text{Wage}_{k,ijt} = \alpha + \beta \text{TotalRevenue}_{jt} + \gamma Z_{jt} + \varphi N_{ijt} + a_j + \delta_t + \epsilon_{ijt} \quad (1)$$

The wage is given by $\ln \text{Wage}_{kijt}$ for individual i working in occupation k in local government j at time t. TotalRevenue_{jt} is the total revenue level in the local government. Other local government characteristics are included by the vector of controls Z_{jt} and are discussed in Section 4.3. Individual characteristics are given by the vector N_{ijt} and are described in Section 4.4. Local government fixed effects are included with a_j. Year dummies are indicated by δ_t, and the error term is given by ϵ_{ijt}.

Given the empirical specification in equation (1), consistent with the discussion in the introduction to this section, the following hypothesis will be tested:

$$H_0^1: \qquad \beta^{chief} > 0 \quad \text{and} \qquad \beta^{chief} > \beta^{other}$$

There are three main econometric challenges in testing the hypothesis. First, omitted variables may cause biased estimated coefficients. Wages are likely to be affected by geography and local amenities. Geography is time invariant, and most amenities can also be assumed to be stable over the time period of interest. Thus, most of the omitted variable bias can be argued to be eliminated by applying local government fixed effects. One concern regarding this approach is that there is insufficient variation within the wage variable to run the FE regression. Table D.1 in Appendix D presents detailed information regarding the variation in the wage variable. The statistics show that there is much variation within the variable of interest, even after controlling for time fixed effects. For chief executives, more than 38 percent of the total variation in the wage variable remains after accounting for fixed local government and time effects. The corresponding percentage for principals, nurses and cleaners are 52, 46 and 57 percent, respectively. Thus, there should be no concerns about including local government and time fixed effects in the analysis. In addition to fixed effects, a number of time-varying control variables are included in the regressions.

Second, wages are likely to converge in areas with labor and capital mobility. It is reasonable to believe that wages in local governments within the same labor market area are correlated. As discussed above, the time-invariant variation of this spatial independence will be eliminated by applying fixed effects. In addition to fixed effects, to address concerns regarding spatial autocorrelation, all regressions are clustered at the level of the residence and employment region (RR). The RR regions define 160 regions with local governments depending on one another because of labor mobility and economic spill-overs, (Gundersen and Juvkam, 2013). In this way, the RR regions consider spatial dependence in opportunities to commute and economic spill-over potential[12].

Third, there may be reverse causality in the sense that wages affect revenues. Increased wage expenses may affect total revenue as a result of compensating block grants or other revenue transfers. Alternatively, high wages for chief executives could reflect the good leader and administrative abilities of the chief executive, making an increase in total revenues more likely. Both scenarios would lead to overestimation of the β coefficients. By contrast, unreasonably

[12] One limitation of the RR regions is that they do not cross county borders. An alternative region classification that is not restricted by county borders and that divides local governments into 46 labor market regions has been tested at the clustering level (Bhuller, 2009). Such a change in the clustering region-level does not affect the robustness of the results in the analysis.

high public sector wages can be a sign of poor economic and administrative management in the local government, which is unfavorable for local revenues. The last scenario would underestimate the β coefficients. Hence, the direction of bias in unclear. The reverse causality challenge is handled by an instrument variable approach. The identification strategy is to utilize a new instrument for hydropower revenues in Norwegian local governments developed by Borge et al. (2013).

Identification strategy and instrument

As discussed earlier, hydropower revenue is an important source of revenue variation across Norwegian local governments. Thus, variations in total revenues can partly be predicted by the variation in hydropower revenue. To ensure identification of the source of variation in the analysis, local government revenue is instrumented based on an approach newly developed by Borge et al. (2013). With a point of departure in the theory of hydropower production, the instrument utilizes the variation in the length of rivers, river slope, water flow volume and precipitation in the catchment area to predict the potential for hydropower production in Norwegian local governments. The national electricity price is also included to capture the effect of price variation on revenues. See Appendix E and Borge et al. (2013) for a detailed description of the instrument. In our analysis in Borge et al. (2013), the instrument shows promise as a strong instrument for total revenues in local governments.

For the instrument to be valid, it must satisfy two main criteria. First, it must be correlated with the variable to be instrumented (in this case, total revenue). The first criterion is likely to be met, following the discussion of the system of financing in Section 3. The strength of this correlation will be investigated as part of the econometric analysis. The first-stage regression will be as follows:

$$\text{TotalRevenue}_{jt} = \sigma + \phi Instrument_{jt} + \tau Z_{jt} + u_t + w_{jt}$$

Here, u_t is a year-specific constant term capturing common effects varying over time, Z_{jt} represents the other explanatory variables from the second-stage regression, and w_{jt} is the error term.

The second criterion for a valid instrument is that it should not be correlated with the error term in the wage equations. The instrument is not likely to be correlated with the error term in our analysis. Although wages can be correlated with geographical factors captured by the instrument, this possibility is accounted for by including local government fixed effects in all regressions. The fixed effect strategy will remove all (observed and unobserved) time-invariant factors that may affect wages. Thus, the error term will not be correlated with geographical factors that do not vary over time. The remaining elements in the instrument are precipitation and electricity price, both varying over time. Either of these elements is likely to affect wages from year to year and will most likely not be correlated with the error term.

6 Empirical Results

The empirical results from the chief executive regressions are reported in Table 3. See Appendix F for the regression results for the individual control variables. Columns 1 and 2 report simple regressions that include only the revenue variable and year dummies. Estimating the regression with fixed effects (FE) shifts the sign and makes the coefficients less statistically significant. The OLS estimation in column 1 is clearly driven by omitted variable bias, as discussed above.

In column 2, the estimated effect of one unit increase (approximately equal to one standard deviation increase) in revenues, i.e., NOK 10,000 (USD 1,650) per capita, will increase wages by approximately 1 percent. On average, that equals NOK 448 (USD 74) per month. However, the effect is not statistically significant.

Table 3: Revenue effects on wages: chief executives

ln Wage	(1) OLS	(2) FE	(3) FE	(4) FE	(5) IV/FE
Total revenues	-0.070***	0.008	0.009	0.015*	0.044*
	(0.010)	(0.010)	(0.010)	(0.009)	(0.025)
Unemployment			0.003	0.002	0.003
			(0.003)	(0.003)	(0.003)
Political strength			0.055	0.038	0.038
			(0.041)	(0.037)	(0.038)
Population				0.015***	0.017***
				(0.005)	(0.005)
Population ^{2}				-0.000	-0.000*
				(0.000)	(0.000)
Constant	10.67***	10.46***	10.44***	10.30***	
	(0.028)	(0.026)	(0.029)	(0.047)	
First stage					
Instrument					5.157 ***
					(1.115)
R-squared	0.595				
N	4795	4795	4795	4795	4782
Period	01-12	01-12	01-12	01-12	01-12
Year dummies	YES	YES	YES	YES	YES
Cluster-level	RR	RR	RR	RR	RR
Individual controls[a]	YES	YES	YES	YES	YES
Testing exogeneity of *TotalRevenue* and *TotalRevenue-lagged*					
($\chi 2(1)$-test), p-value					0.283

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

a) See Appendix F for estimation results for individual controls.

The next two columns include other control variables. The quantitative effect of revenues remains almost unchanged, but the precision of the revenue coefficients improves. In column 4, the coefficient is statistically significant at the 10 percent level. Although the results suggest a significant revenue effect, the magnitude of the effect is small. Neither unemployment rates nor political strength in the local council has a statistical significant effect on wages. This result may be caused by the low amount of time variation in the variables. The period under study covers three election periods; hence, the time series variation is limited in the political strength variable. However, population size is strongly significant. This result indicates that chief executive wages are positively affected by population increases. An increase in the population by 1,000 inhabitants is expected to increase chief executive wages by 1.5 percent, likely reflecting the increased responsibility of following a larger population. The magnitude of the population effect is large. An increase in population size by one standard deviation (i.e., 9,000 inhabitants) is expected to increase the chief executive wage by 13.5 percent. Additionally, population squared is included in the last two columns to allow the population effect to be nonlinear. The squared population term is not shown to be statistically significant in the regressions for chief executives in columns 3 and 4. However, this term is statistically significant and negative in column 5, although the size of the effect is small.

In column 5, the instrumental variable approach is applied. Compared with the FE regression, the IV regression reports a stronger positive revenue effect on wages. An increase of NOK 10,000 (USD 1,650) per capita in local government revenues is associated with a 4.4 percent increase in wages. On average, that equals NOK 1,972 (USD 323) per month. The IV estimate is also statistically significant at the 10 percent level. The instrument has a positive and strongly statistically significant effect on the total revenue variable. The F-value for the instrument from the first stage equals 21.4, far surpassing the Staiger and Stock (1997) rule of thumb for a good instrument. Although the estimated coefficient in column 5 is somewhat higher in value than the FE coefficient in column 4, a Hausman test does not reveal any statistical evidence of endogeneity between wages and revenues (p-value 0.28). The test indicates that the potential cost of relying on the FE estimate in terms of bias and inconsistency is small.

To determine whether similar revenue effects are present for the other occupations, the FE and IV regression results for the other occupations are presented in Table 4. Principals and cleaners are not notably affected by the total revenue level. According to Columns 3 and 4, the wages for nurses seem to be positively and significantly affected by the revenue level. The revenue effect is somewhat smaller than for the chief executive. Common to all occupations is that the IV results report a larger positive revenue effect relative to the FE regressions. The IV results and corresponding tests reveal no issues of reverse causality for chief executives and nurses. The Hausman test in columns 2 and 6 in Table 4 does, however, indicate some endogeneity issues for principals and cleaners. The FE regressions appear to underestimate the revenue effect on wages for these two occupations.

Column 2 reports that the unemployment rate has a small significant positive effect on principal wages. An increase of one percentage point in unemployment is associated with a 0.2 percent increase in principal wages. The unemployment rate is not statistically significant in the other regressions. As in the chief executive regressions, political strength is not statistically significant. Population size appears to have a positive and nonlinear effect on wages for principals. In column 2, an increase in population by 1,000 inhabitants is expected to increase principal wages by 1 percent, which likely reflects the increased responsibility at larger schools. The population effect on wages for the cleaner occupation is negative and significant. A one standard deviation increase in population size (i.e., 9,000 inhabitants) is estimated to reduce cleaners' wages by 1.8 percent. This result may reflect greater competition for unskilled jobs in larger local governments. The population effect is not linear, given the statistical significance of the squared population variable. However, the magnitude of the coefficient is small. For nurses, there is no significant population size effect on wages.

The presented magnitude of the revenue effect is somewhat small and is not strongly significant for any of the occupations. Based on the regression results, the revenue effect is larger in value and more significant for the chief executive than for the other occupations. However, a formal test of the difference of the coefficients across occupations, reveals that there is no significant difference between the chief executives and the other occupations. The test is carried out by regressing models where intercept and all slopes can be different across the chief executives and the other occupation. By including a full set om interaction terms, the null hypothesis that there is no difference in the revenue effect on wages, can be tested. If the belonging coefficient to the interaction term between the occupation dummy and the revenue variable is not statistically different from zero, there is no difference in the revenue effect for chief executives and the other occupations. The IV coefficients for TotalRevenue interacted with a dummy for occupation K are not statistically significant from zero for either of the control occupations. The p-value for the nullhypothesis is respectively equal to: 0.61 for the principals, 0.17 for the nurses, and 0.24

Table 4: Revenue effects on wages: other occupations

	Principals		Nurses		Cleaners	
	(1)	(2)	(3)	(4)	(5)	(6)
ln Wage	FE	IV/FE	FE	IV/FE	FE	IV/FE
Total revenues	-0.001	0.063	0.002*	0.008*	-0.001	0.012
	(0.005)	(0.041)	(0.001)	(0.005)	(0.002)	(0.008)
Unemployment	0.002	0.003*	-0.000	-0.000	-0.001	-0.000
	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Political strength	-0.030	-0.030	-0.008	-0.007	-0.007	-0.004
	(0.027)	(0.026)	(0.005)	(0.005)	(0.007)	(0.008)
Population	0.007***	0.010***	-0.001	-0.000	-0.002***	-0.002***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.000)	(0.001)
Population ^{2}	-0.000***	-0.000***	0.000	0.000	0.000**	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	10.320***		9.853***		9.792***	
	(0.028)		(0.012)		(0.010)	
First stage:						
Instrument		2.797**		6.182***		5.969***
		(0.769)		(0.896)		(1.217)
N	18700	18694	420286	417579	119836	118787
Period	04-12	04-12	01-12	01-12	01-12	01-12
Cluster-level	RR	RR	RR	RR	RR	RR
Year dummies	YES	YES	YES	YES	YES	YES
Individual controls[a]	YES	YES	YES	YES	YES	YES
Testing exogeneity of *TotalRevenue*						
($\chi 2(1)$-test), p-value		0.079		0.204		0.022

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

a) See Appendix F for estimation results for individual controls.

for the cleaners. Thus, the revenue effect on wages does not differ between the chief executive and other occupations.

I also present some robustness checks for the baseline regressions. In Section 8, I present some alternative empirical specifications of the model. The results of both the robustness tests and the alternative specifications support the results of the main analysis.

7 Robustness

To test the specification of the empirical model, this section present several robustness tests of the results presented in Section 6. The robustness regressions are presented in Appendix G.

First, to test whether clustering and local government fixed effects are sufficient to control for commuting opportunities and fiscal competition with other local governments, two new control variables are included. Following Falch and Strøm (2006), I calculate an index for monopsony power in the labor market and an index for fiscal competition. See Appendix C.2 for a detailed description of these indices. New data allow me to improve these indices by adding time variation. The monopsony index measures the possibility of commuting to other local governments depending on the commuting cost. The index is positively related to monopsony power. With high commuting costs, the labor supply schedule will be relatively steep, and there will accordingly be a relatively high degree of monopsony power. The monopsony index is negative and insignificant for chief executives but positive and insignificant for principals and cleaners. Thus, the regressions indicate that wages in these occupations do not depend on monopsony labor market conditions after controlling for fixed effects. However, the monopsony index is positive and significant in the regressions for nurses in Table G.3. The fiscal competition index is composed as an inverse Herfindahl index. Both of the presented indices depend on mobility possibilities across local governments, but the fiscal competition also depends on the number of competing local governments. Thus, the index accounts for both the size of the commuting out of and into the local government and the number of local governments for which there is substantial commuting. Surprisingly, the fiscal competition index is strongly significant and positive for all occupations in both the FE and IV regressions. This result is in contrast to the findings by Falch and Strøm (2006), likely because those authors are unable to consider fixed effects with their relatively time invariant index. However, including the indices does not affect any of the findings in the main analysis.

Second, it might be argued that wages reflect the industry composition in local governments. It is possible to control for industry composition by measuring each industry's employment share of total employees (both private and public sector) in the local government. Columns 3 and 4 in Table G.1 to G.4 show that industry composition is somewhat significant for principals, but the results do not alter the findings of the main analysis for any of the regressions.

Third, by restricting the sample to include only local governments with fewer than 4,400 inhabitants, the regressions are reestimated in columns 5 and 6 in the robustness tables. The cutoff level is equal to the median population size in the total sample. In this way, the sample is more homogeneous in terms of population size. Two concerns are addressed by restricting the sample to include only small local governments. First, one concern is that it is small local governments that drive the results. Local governments rich in hydropower are typically small in population size[13]. Second, the results for principals, nurses and cleaners may be driven by many observations from the large local governments. These occupations have multiple workers in each local government. Thus, large local governments will have many individual wage observations in the dataset. The results in columns 5 and 6 in the robustness regression tables show that the results are affected by the restricted sample size. First, the revenue effect on wages for chief executives and principals appears to increase. The results implies that small, rich local governments have a stronger positive revenue effect on leader wages. However, the increase in the revenue effect on principal wages is uncertain. The instrument is revealed to be weak (F-value=3.91)[14]. Hence, the coefficient must be interpreted with caution. The magnitude of the revenue effect on wages for nurses and cleaners is reduced by restricting the sample to small local governments, but the reduction is slight. This result indicates that there should be little to no concern that larger local governments may drive the results in these occupations. This concern is also ruled out in an alternative specification of the baseline model in Section 8.3. In sum, restricting the sample to local governments with fewer than 4,400 inhabitants does affect the estimated effects. However, the difference between the revenue effect for the chief executive and the other occupations is still not statistically significant. Thus, the sample restriction does not affect the main findings in the analysis, and the null hypothesis is rejected. Public revenues do not appear to affect leader wages differently than wages in other working groups.

[13]As shown in Appendix B.

[14]The poor F-value of the instrument in the principal regression relative to the other regressions is likely caused by the restricted time period. Data for principal wages are available only from 2004 to 2012. This explanation is verified by restricting the sample to include only observations from 2004 to 2012 in the IV regressions for the other occupations. In doing so, all IV regression results report weaker instrument results (chief executive F-value=6.50, nurse F-value=10.76, cleaner F-value=8.34).

Fourth and finally, it is of interest to test whether the results are driven by the size of the public revenue or by the fact that the revenues are from natural recourse abundance. The regressions are re-estimated by excluding all local governments that do not have hydropower revenues. The change in the sample does not appear to alter the findings in the main analysis. See columns 7 and 8 in the robustness regression tables. For chief executives, the revenue effect is somewhat increased in the IV regression. The fact that the revenue effect remains, may indicate that it is the size (rather than the source) of public revenue that affects local public sector wages. As in the main analysis, there is no significant difference in the revenue effect between occupations.

8 Alternative empirical specification

8.1 Asymmetric revenue effects on wages

It can be argued that wages may be less responsive to a decrease in revenues than to an increase in revenues. Wages are rarely reduced and are more likely to be positively adjusted with revenue windfalls. If this argument holds, then the revenue effect on wages will be asymmetric. Following Reiling and Strøm (2014) and Mocan and Bali (2010), this possibility can be tested by a simple change in the base model.

To test whether the revenue effect on wages differs between downturns and upturns in the revenue variable, two new revenue variables are defined:

$$TotalRevenue^{+}_{jt} = \begin{cases} TotalRevenue_{jt} & if \quad TotalRevenue_{jt} \geq TotalRevenue_{j,t-1} \\ 0 & if \quad TotalRevenue_{jt} < TotalRevenue_{j,t-1} \end{cases}$$

$$TotalRevenue^{-}_{jt} = \begin{cases} TotalRevenue_{jt} & if \quad TotalRevenue_{jt} < TotalRevenue_{j,t-1} \\ 0 & if \quad TotalRevenue_{jt} \geq TotalRevenue_{j,t-1} \end{cases}$$

Given the baseline model in Section 5, the empirical specification is now equal to equation (2). Given that the FE and IV/FE estimates are similar in the main analysis, this robustness test is only tested with FE. An IV approach is difficult to combine with the revenue definition introduced.

$$\begin{aligned} \ln \text{Wage}_{k,ijt} = \alpha + \beta_1 \text{TotalRevenue}^{+}_{jt} + \beta_2 \text{TotalRevenue}^{-}_{jt} \\ + \gamma Z_{jt} + \varphi N_{ijt} + a_j + \delta_t + \epsilon_{ijt} \end{aligned} \tag{2}$$

In this model, the conditional mean of the revenue variable is allowed to follow different paths depending on the relative change in total revenue from time *t-1* to *t*. More specifically, β_1 is the effect of a revenue increase on wages, while β_2 is the effect of a revenue reduction. If $\beta_1 = \beta_2$, then the revenue effect on wages is symmetric.

The results are presented in Appendix H. As shown, there are no signs of asymmetry in the revenue effects in either of the occupations.

8.2 Hydropower revenue effects on wages

It is possible to test whether revenue composition is relevant to the estimated wage effects. This empirical specification directly tests whether natural resource abundance affects wages in the public sector in Norwegian local governments.

To run the regression, the revenue variable is divided into hydropower revenue and other revenue. The hydropower revenue is given by $HydroRevenue_{jt}$ and equals the sum of property tax from hydropower plants, the natural resource tax and revenues from concession power. All other revenues at the local government level are represented by the variable $OtherRevenue_{jt}$, equaling the difference between total revenue and hydropower revenue. More specifically, this value is the sum of general purpose grants, revenue and wealth tax and property tax that are not from the hydropower sector.

To determine whether hydropower revenues affect wages differently than other revenues, the following regression will be estimated:

$$\begin{aligned}\ln \overline{Wage}_{jt}^{k} = \alpha &+ \beta_1 \text{HydroRevenue}_{jt} + \beta_2 \text{OtherRevenue}_{jt} \\ &+ \beta_3 Z_{jt} + a_j + \delta_t + \epsilon_{jt}\end{aligned}$$

$HydroRevenue_{jt}$ and $OtherRevenue_{jt}$ are discussed above. The other variables are described in Section 5. In the absence of an instrument for the OtherRevenue_{jt} variable, I am unable to test the identification of the estimates. As in the empirical analysis in the baseline model, the revenue variables are potentially endogenous. The presented instrument may be used as an instrument for hydropower revenues, but I have not been able to develop an instrument for other revenues. The main analysis did not reject the hypothesis that total revenues are exogenous in the wage equation for chief executives and nurses but did reject the same hypothesis for principals and cleaners. The test results may be argued to dampen endogeneity concerns in the regressions for chief executives and nurses but do not completely eliminate such concerns. Thus, the empirical results in this section lack the identification strategy presented in the baseline model, and the results should be interpreted with caution.

If the composition of revenues is relevant to rent-seeking activity as a result of higher wages for local public leaders, the revenues derived from hydropower should have a more positive effect on chief executive wages than other revenues. However, there should be no such difference in the other occupations. The hypothesis is as follows:

$$H_0^2: \qquad \beta_1^{chief} > \beta_2^{chief} \quad \text{and} \quad \beta_1^{other} = \beta_2^{other}$$

The regression results are shown in Appendix I. The results indicate that revenues from hydropower do have a stronger stimulating effect on chief executive wages than revenues from other sources do. However, a Wald test reveals that the difference between hydropower revenues and other revenues is not statistically significant (p-value 0.24). The estimated hydropower revenue effect on chief executive wages is significant at the 5 percent level. One standard deviation increase in hydropower revenue, which is NOK 4060 (USD 670) per capita, is estimated to increase chief wages by 0.8 percent or an average of NOK 358 (USD 59) per month.

There is no difference in the revenue effects for the other occupations. In total, the results do not support the H_0^2 null hypothesis that natural resource abundance affects leader wages differently than the wages of other working groups. This result supports the findings in the robustness section in Section 7 when only local governments with hydropower revenues are included in the regressions.

8.3 Local government mean wage

The main goal of the analysis is to explore the effect of public revenues on local public sector wages. One concern with estimating regressions with individual data is that the results for principals, nurses and cleaners might be driven by observations from large local governments. Large local governments have many individual workers and are likely to be overrepresented in the individual wage dataset relative to small local governments[15]. It is possible to test for this issue by aggregating the wage variable upward one level, from the individual level to the local government level. The rich dataset allows me to calculate the average wage in each local government while controlling for the personal characteristics of workers. One advantage of this approach is that it eliminates concerns about weighting for the occupations with more than one worker per local government. Next, I provide a detailed description of how the mean wage is calculated while controlling for personal characteristics.

The dataset includes individual characteristics such as gender, age, seniority, education level and full-time versus part-time positions. The first step in calculating the mean wage variable controlling for personal characteristics is to estimate the following regression separately for each occupation[16]:

$$Wage^{k}_{ijt} = \delta N_{ijt} + \alpha_j + e_{jt} + \epsilon_{ijt}$$

The vector N_{jt} represents personal characteristics, α_j is the local governments fixed effects, e_{jt} is the local governments' specific time fixed effect, and ϵ_{ijt} is the remaining error term. Next, the mean wage for occupation k in local government j, adjusted for personal characteristics, is defined as follows:

$$\overline{Wage}^{k}_{jt} = \hat{\alpha_j} + \hat{e_{jt}}$$

The baseline model is re-estimated with the mean wage variable as the dependent variable. The empirical specification is as follows:

$$\ln \overline{Wage}^{k}_{jt} = \alpha + \beta \text{TotalRevenue}_{jt} + \gamma Z_{jt} + a_j + \delta_t + \epsilon_{jt}$$

The results are reported in Appendix J.1. The change in the dependent variable does not appear to alter the findings of the main analysis. The revenue effect on wages for nurses is no longer significant, and the size of the coefficient has decreased by 0.3 percentage points. It can therefore be argued that the results for nurses in the main analysis are partly driven by observations from large local governments. This is consistent with the robustness regressions that include only local governments with fewer than 10,000 inhabitants in Section 7. However, it does not alter the main findings from Section 6. Public revenues do not appear to have a stronger positive effect on chief executive wages than on other occupations.

[15] This concern does not apply to chief executives, as there is only one chief executive in each local government.

[16] The regressions are run with the Stata command *mixed* to allow for an additional random term at the *jt* (local government and year) level.

9 Concluding remarks

This paper investigated whether resource abundance in Norwegian local governments affects wages for public sector leaders compared with other working groups. The analysis utilized individual wage data for the local government chief executive, principal, nursing assistant and cleaner positions. Variation in revenues are instrumented using the variation in topology and geography. The results suggest a small significant effect of resource abundance on chief executive wages. However, on average, the revenue effect on chief executive wages is not significantly different from the revenue effect for the other occupations included in the analysis. Thus, there is no evidence that public revenues affect public sector leader wages more positively than they affect other working groups.

The lack of rent extractions through higher wages for leaders in Norwegian local governments can partly be explained by the good institutional quality. Institutions in Norway are robust, and there is little cross-sectional variation in institutional quality. The system of centralized wage agreements for most public sector workers might also restrict the wage frames for chief executives in the local bargaining process. The results suggests that wage differences are largely explained by differences in qualifications, professional achievements, performance and the need to retain qualified workers.

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A Wage bargaining in Norwegian local governments

Historically, there has been little geographical variation in local public sector wages. Before 1990, the wage level was set within a centralized system. Even so, Strøm (1995) provides evidence, using data from 1985 to 1988, that systematic differences in wage levels across local governments did exist. He also finds that wages for low-skilled workers were affected by wages of higher skilled groups within the same local government. Also the composition of the local council affected the wage level.

After a major change in the wage-setting system in 1990, local governments gained more freedom to set their own wages. From now on, the wage was set partly at central level, and partly at local level. Falch and Strøm (2006) provide an analysis of the regime shift, and find that the wage dispersion increased across local governments after 1990. They also find that wages to some extent became more responsive to local government income after the regime shift.

The local wage bargaining system was further liberalized in the basic collective agreement in 2002. The new agreement allowed for full local wage bargaining for some occupations. Now the tariff agreement organize the wage setting regulations in three chapters, chapter 3 to 5. Chapter 3 describes the general set of rules in the tariff. Chapter 4 has a two part system and set the minimum wage for most occupations. The minimum wages is based on education and seniority. Chapter 4 also give room for some local wage bargaining. Chapter 5 includes occupations with typically high educational level. The wages for employees under Chapter 5 is set at the local level.

B Total revenue linked to hydropower revenue

Table B.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.

C Data and descriptive statistics

C.1 Individual characteristics

Table C.1: Individual characteristics

Variable	Variable description (Source: KS)	Mean (S.D.)			
		Chief	Principal	Nurse	Cleaner
Wage	Real wage in NOK, calculated as the monthly wage, excess overtime pay and other amounts, divided by the share of full time job. The variable is deflated by the CPI. In the regressions it is given in natural logarithm. Source: The Norwegian Association of Local and Regional Authorities (KS)	44837 (9028)	36648 (3736)	20846 (3582)	18520 (4061)
Age 20-29	Age between 20 and 29 years.	.002 (.043)	.002 (.046)	.086 (.281)	.057 (.232)

Table C.1: Individual characteristics (continues)

Variable	Variable description (Source: KS)	Mean (S.D.)			
		Chief	Principal	Nurse	Cleaner
Age 30-39	Age between 30 and 39 years.	.051 (.220)	.093 (.290)	.184 (.387)	.182 (.386)
Age 40-49	Age between 40 and 49 years.	.289 (.453)	.219 (.414)	.306 (.461)	.282 (.450)
Age 50-59	Age between 50 and 59 years. Reference group.	.516 (.498)	.462 (.499)	.321 (.467)	.328 (.470)
Age 60	Age above 60 years.	.143 (.350)	.224 (.417)	.099 (.299)	.147 (.354)
Seniority0-3	Seniority level: 0-3 years	.057 (.231)	.015 (.123)	.037 (.188)	.048 (.214)
Seniority4-7	Seniority level: 4-7 years	.032 (.176)	.014 (.120)	.055 (.228)	.044 (.205)
Seniority8-11	Seniority level: 8-11 years	.033 (.079)	.028 (.165)	.087 (.282)	.097 (.296)
Seniority12-15	Seniority level: 12-15 years	.038 (.191)	.059 (.235)	.103 (.304)	.123 (.329)
Seniority16	Seniority level: At least 16 years. Maximum level. Reference group.	.839 (.368)	.884 (.321)	.717 (.299)	.687 (.464)
Master	Educational level equal to a master degree or higher.	.339 (.473)	.007 (.081)	.001 (.024)	.001 (.027)
Bachelor	Educational level equal to a bachelor degree.	.388 (.487)	.993 (.081)	.009 (.097)	.006 (.077)
HighSchool	Educational level equal a high school degree. Reference group.	.031 (.173)	0 (0)	.981 (.135)	.123 (.329)
Comp.School	Educational level at compulsory schooling.	.016 (.127)	0 (0)	.004 (.062)	.732 (.443)
OtherEduc.	Other education.	.048 (.214)	0 (0)	.008 (.091)	.010 (.100)
MissingEduc.	Educational level not reported	.161 (.367)	0 (0)	.004 (.064)	.125 (.331)
Woman	Dummy: Equals 1 if female	.171 (.377)	.501 (.500)	.953 (.211)	.941 (.235)
Work 49%	Works up to 50 percent.	0 (0)	.033 (.180)	.148 (.355)	.278 (.448)
Work 50-99%	Works up to 100 percent.	0 (0)	.103 (.304)	.669 (.471)	.573 (.495)
Work 100%	Works full time or up to 110 percent. Reference group.	1 (1)	.863 (.343)	.183 (.386)	.149 (.357)

C.2 Local government characteristics

Table C.2: Local government characteristics

Variable	Variable Description	Mean (S.D.)
$\overline{Wage}$	Local government specific monthly wage adjusted for personal characteristics. See Section 4.1. NOK.	
	Chief executives	44798 (8981)
	Principals	36479 (3020)
	Enrolled nurses	22097 (1991)
	Cleaners	20417 (1827)
Total revenue (NOK 10,000)	Sum of block grants, wealth and revenue tax, property tax, natural resource tax and concession power revenues. Measured in per capita, fitted prices and adjusted for payroll tax rates. *Source: Statistics Norway*	2.86 (0.93)
Hydro revenue (NOK 10,000)	Sum of property tax from power plants, natural resource tax, and concession power revenues measured in per capita, fixed prices and adjusted for payroll tax rates. Property tax: Property tax basis is collected from *Norwegian Tax Administration*. Tax rate data is only available for year 2003, 2005 and 2007-2012. Data for 2003 and 2005 is collected from *The National Federation of House Owners in Norway*. The tax rate in 2001-2004 is set equal to the tax rate in 2003, and the tax rate in 2005-2006 is set equal to the tax rate in 2005. Data for 2007-2012 is collected from *Statistics Norway*. Concession power revenue: *Statistics Norway* changed the definition in the report system after 2008. I therefor use adjusted data for concession power income reported by the *Norwegian Advisory Commission on Local Government Finances* for 2009-2012. Natural resource tax: Collected from *Statistics Norway*	0.16 (0.54)
Other revenue (NOK 10,000)	Sum of block grants, income and wealth tax, and property tax excluding power plants measured in per capita, fixed prices and adjusted for payroll tax rates. *Source: Statistics Norway*	2.70 (0.74)
Population	Population size in 1000 the 1'st of January each year. *Source: Statistics Norway*	9.03 (14.97)
Unemployment	Unemployment rate for workers of age 15-74 years. *Source: Statistics Norway*	2.66 (1.36)

Table C.2: Local government characteristics (continues)

Variable	Variable Description	Mean (S.D.)
*H*erfindahl Index-Political strength	$$\text{Herfindahl}_{jt} = \sum_{p=1}^{P}(R_{pjt}/\sum_{p=1}^{P} R_{pjt})^2$$ R_{pjt} is the number of representatives of party p in the local council in local government j at time t. *Source of data on the local council: Statistics Norway*	.264 (.100)
*M*onopsony Power	$$\text{Monopsony}_{jt} = \frac{1}{2}\left(E^r_{jkt}/\sum_{j=1}^{J} E^r_{jkt} + E^w_{jkt}/\sum_{j=1}^{J} E^w_{jkt}\right)$$ E^r_{jkt} is the number of employees residing in the local government j and working in another local government k at time t. E^w_{jkt} is the number of employees working in the local government j and residing in another local government k at time t. *Source of data on commuting patterns: Statistics Norway*	.237 (.782)
*F*iscal competition	$$\text{Fiscal}_{jt} = 2\left(\sum_{j=1}^{J}(E^r_{jkt}/\sum_{j=1}^{J} E^r_{jkt})^2 + \sum_{j=1}^{J}(E^w_{jkt}/\sum_{j=1}^{J} E^w_{jkt})^2\right)^{-1}$$ E^r_{jkt} is the number of employees residing in the local government j and working in another local government k at time t. E^w_{jkt} is the number of employees working in the local government j and residing in another local government k at time t. *Source of data on commuting patterns: Statistics Norway*	29.0 (2.32)
*I*ndustry-Structure	Share of employees working in the specified industry. *Source: Statistics Norway*	
*A*griculture	Agriculture, forestry and fishing.	.099 (.078)
*I*ndustrial	Industrial activities.	.228 (.090)
*B*usiness	Trade etc., transport, communication, financial intermediary, estate, business activities.	.266 (.089)
*P*ublicAdm.	Public administration, defense and social security.	.069 (.044)
*E*duc.Serv.	Education services.	.088 (.027)
*H*ealth	Human health and social work activities.	.215 (.055)
*U*nspec.Serv.	Unspecified services	.007 (.004)

Table C.2: Local government characteristics (continues)

Variable	Variable Description	Mean (S.D.)
Instrument	Predicts the hydropower potential in local government j. Normalized by multiplying with 10^10 See Borge et al. (2013) for details.	8.690 (21.30)

D Variation in the wage variable

Table D.1: Variation in the wage variable

Occupation	Obs.	Mean	S.D.	S.D. net of local gov. fixed effects	S.D. net of local gov. and time fixed effects	Between group variation
Chiefs	4795	44898	9008	6874	3406	5879
Principals	18700	36656	3736	2001	1949	3430
Nurses	420287	21484	2237	2227	1037	309
Cleaners	119836	19598	2190	2159	1251	501

E The instrument

The instrument is developed by Borge et al. (2013) and I refer to our paper for further details about the instrument and the hydropower sector in Norway.

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. The production potential of a hydropower plant can be expressed as:

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

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 (3) we use a dataset on water flow volume classes in Norwegian rivers[17] 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 each local government has within each water flow volume classification[18]. We term this variable $River4_{wj}$. By multiplying

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

[18]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; $w = \{10, 50, 100, 150, 200, 250, 300, 400, 600, 750\}$

$River4_{wj}$ 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 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:

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

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.

F Results individual control variables

F.1 Results individual variables: Chief executives

Table F.1: Results individual variables: Chief Executive

ln Wage	(1) OLS	(2) FE	(3) FE	(4) FE	(5) IV/FE
Age 20-29	-0.149***	-0.056	-0.059	-0.065	-0.063
	(0.051)	(0.055)	(0.055)	(0.055)	(0.053)
Age 30-39	-0.041**	0.002	0.001	-0.001	0.000
	(0.016)	(0.012)	(0.012)	(0.012)	(0.012)
Age 40-49	-0.018**	0.001	0.001	0.002	0.002
	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
Age 60	-0.010	0.003	0.003	0.004	0.003
	(0.008)	(0.004)	(0.004)	(0.004)	(0.004)
Seniority0-3	0.035***	0.013	0.013	0.015*	0.015*
	(0.011)	(0.009)	(0.009)	(0.009)	(0.009)
Seniority4-7	0.034**	-0.024**	-0.024**	-0.020**	-0.020**
	(0.015)	(0.011)	(0.011)	(0.010)	(0.010)
Seniority8-11	0.019	-0.022**	-0.022**	-0.021**	-0.021**
	(0.017)	(0.009)	(0.009)	(0.009)	(0.009)
Seniority12-15	0.005	-0.018**	-0.018**	-0.018**	-0.018**
	(0.014)	(0.009)	(0.009)	(0.008)	(0.008)
Woman	-0.030***	-0.027***	-0.026***	-0.025***	-0.025***
	(0.011)	(0.007)	(0.007)	(0.007)	(0.007)
Master	0.030***	0.020**	0.020**	0.023***	0.022***
	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)
HighSchool	-0.035	-0.056***	-0.057***	-0.059***	-0.060***
	(0.024)	(0.021)	(0.021)	(0.021)	(0.021)
Comp.School	0.079	0.001	0.002	0.002	-0.007
	(0.050)	(0.026)	(0.026)	(0.026)	(0.025)
OtherEduc.	0.007	0.022	0.021	0.023	0.023
	(0.021)	(0.017)	(0.017)	(0.017)	(0.017)
MissingEduc.	0.021**	0.032***	0.033***	0.034***	0.034***
	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)
R-squared	0.595				
N	4795	4795	4795	4795	4782
Period	01-12	01-12	01-12	01-12	01-12
Year dummies	YES	YES	YES	YES	YES
Cluster-level	RR	RR	RR	RR	RR
Local gov. controls^a	YES	YES	YES	YES	YES

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

a) See Section 6 for additional estimation results.

F.2 Results individual variables: Other occupations

Table F.2: Results individual variables: Other occupations

	Principals		Nurses		Cleaners	
	(1)	(2)	(3)	(4)	(5)	(6)
ln Wage	FE	IV/FE	FE	IV/FE	FE	IV/FE
Age 20-29	-0.058***	-0.057***	-0.028***	-0.028***	-0.018***	-0.019***
	(0.012)	(0.012)	(0.001)	(0.001)	(0.002)	(0.002)
Age 30-39	-0.024***	-0.024***	-0.005***	-0.005***	-0.011***	-0.011***
	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)
Age 40-49	-0.011***	-0.011***	-0.002***	-0.002***	-0.004***	-0.004***
	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Age 60	0.002	0.002	0.001***	0.001***	0.004***	0.004***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Seniority0-3	-0.007	-0.006	-0.118***	-0.118***	-0.192***	-0.192***
	(0.005)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)
Seniority4-7	-0.024***	-0.025***	-0.105***	-0.105***	-0.167***	-0.168***
	(0.006)	(0.006)	(0.001)	(0.001)	(0.002)	(0.002)
Seniority8-11	-0.020***	-0.019***	-0.035***	-0.036***	-0.045***	-0.045***
	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)
Seniority12-15	-0.010***	-0.009***	-0.004***	-0.004***	-0.010***	-0.010***
	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)
Woman	-0.012***	-0.011***	0.000	0.001	0.002***	0.002***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Master	0.036***	0.036***	-0.006	-0.006	-0.006	-0.006
	(0.007)	(0.008)	(0.005)	(0.005)	(0.008)	(0.008)
HighSchool			-0.011***	-0.011***	0.003**	0.003**
			(0.002)	(0.002)	(0.001)	(0.001)
Comp.School			-0.014***	-0.014***	-0.004***	-0.004***
			(0.002)	(0.002)	(0.001)	(0.001)
OtherEduc.			-0.000	-0.000	-0.002	-0.002
			(0.001)	(0.001)	(0.002)	(0.002)
MissingEduc.			-0.013***	-0.012***	-0.004**	-0.004**
			(0.002)	(0.002)	(0.002)	(0.002)
Work 49%	-0.014***	-0.014***	-0.009***	-0.009***	-0.006***	-0.006***
	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)
Work 50-99%	-0.024***	-0.024***	-0.007***	-0.007***	-0.005***	-0.005***
	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)
N	18700	18694	420286	417579	119836	118787
Period	04-12	04-12	01-12	01-12	01-12	01-12
Cluster-level	RR	RR	RR	RR	RR	RR
Year dummies	YES	YES	YES	YES	YES	YES
Local gov. controls[a]	YES	YES	YES	YES	YES	YES

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

a) See Section 6 for additional estimation results.

G Robustness

G.1 Robustness: Chief executives

Table G.1: Robustness: Chief Executive

	Commute		Industry		Pop<4,400		HydroRevenue>0	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln Wage	FE	IV/FE	FE	IV/FE	FE	IV/FE	FE	IV/FE
Total revenues	0.016*	0.045*	0.015*	0.044*	0.020**	0.055*	0.000	0.056**
	(0.009)	(0.025)	(0.009)	(0.025)	(0.010)	(0.030)	(0.012)	(0.027)
Unemployment	0.001	0.002	0.002	0.003	-0.000	0.001	0.002	0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Political strength	0.035	0.035	0.038	0.038	0.017	0.015	0.008	0.010
	(0.036)	(0.037)	(0.037)	(0.037)	(0.042)	(0.042)	(0.059)	(0.059)
Population	0.019***	0.020***	0.015***	0.017***	0.101	0.113	0.008	0.014
	(0.005)	(0.005)	(0.005)	(0.005)	(0.105)	(0.103)	(0.012)	(0.013)
Population ^{2}	-0.000*	-0.000**	-0.000	-0.000*	-0.009	-0.010	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.017)	(0.017)	(0.000)	(0.000)
Monopsony Power	-0.227*	-0.221*						
	(0.123)	(0.122)						
Fiscal competition	0.050***	0.047***						
	(0.001)	(0.003)						
Unspec.Serv.			-0.006	-0.042				
			(0.569)	(0.559)				
Agriculture			0.155	0.139				
			(0.254)	(0.249)				
Industrial			0.176	0.174				
			(0.248)	(0.243)				
Business			0.085	0.079				
			(0.254)	(0.247)				
PublicAdm.Serv.			0.175	0.175				
			(0.265)	(0.259)				
Educ.Serv			0.212	0.158				
			(0.287)	(0.285)				
Healt			0.027	0.017				
			(0.250)	(0.245)				
Constant	9.107***		10.18***		10.18***		10.40***	
	(0.037)		(0.250)		(0.153)		(0.110)	
N	4795	4782	4795	4782	2369	2364	2353	2322
Estimation period	01-12	01-12	01-12	01-12	01-12	01-12	01-12	01-12
Cluster-level	RR	RR	RR	RR	RR	RR	RR	RR
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Individual controls	YES	YES	YES	YES	YES			
Instrument F-value		21.31		20.77		15.50		17.34
Testing exogeneity of *TotalRevenue*								
($\chi 2(1)$-test), p-value		0.27		0.30		0.28		0.07

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

G.2 Robustness: Principals

Table G.2: Robustness: Principals

	Commute		Industry		Pop<4,400		HydroRevenue>0	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln Wage	FE	IV/FE	FE	IV/FE	FE	IV/FE	FE	IV/FE
Total revenues	-0.001	0.064	-0.001	0.067	-0.003	0.098	-0.010	0.061
	(0.005)	(0.042)	(0.005)	(0.042)	(0.007)	(0.080)	(0.007)	(0.057)
Unemployment	0.002	0.003	0.002	0.003*	0.004**	0.005**	0.003	0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)
Political strength	-0.031	-0.032	-0.028	-0.028	-0.029	-0.037	-0.074**	-0.076**
	(0.026)	(0.025)	(0.027)	(0.026)	(0.027)	(0.026)	(0.033)	(0.030)
Population	0.007***	0.010***	0.007***	0.010***	0.181***	0.288**	0.006**	0.011***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.060)	(0.116)	(0.003)	(0.004)
Population ^{2}	-0.000***	-0.000***	-0.000***	-0.000***	-0.025***	-0.037**	-0.000*	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.009)	(0.015)	(0.000)	(0.000)
Monopsony Power	-0.021	-0.034						
	(0.028)	(0.026)						
Fiscal competition	0.052***	0.037***						
	(0.002)	(0.009)						
Unspec.Serv.			-0.580**	-0.686**				
			(0.290)	(0.327)				
Agriculture			-0.376***	-0.373***				
			(0.131)	(0.140)				
Industrial			-0.309***	-0.335**				
			(0.116)	(0.130)				
Business			-0.326**	-0.325**				
			(0.134)	(0.137)				
PublicAdm.Serv.			-0.337**	-0.322*				
			(0.160)	(0.165)				
Educ.Serv			-0.399**	-0.463***				
			(0.161)	(0.161)				
Healt			-0.351***	-0.340**				
			(0.130)	(0.141)				
Constant	8.845***		10.646***		10.111***		10.340***	
	(0.038)		(0.123)		(0.094)		(0.057)	
N	18700	18694	18700	18694	4084	4078	9937	9932
Estimation period	04-12	04-12	04-12	04-12	04-12	04-12	04-12	04-12
Cluster-level	RR	RR	RR	RR	RR	RR	RR	RR
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Individual controls	YES	YES	YES	YES	YES			
Instrument F-value		13.10		13.27		3.91		8.21
Testing exogeneity of *TotalRevenue*								
($\chi 2(1)$-test), p-value		0.08		0.07		0.05		0.14

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

G.3 Robustness: Nurses

Table G.3: Robustness: Nurses

	Commute		Industry		Pop<4,400		HydroRevenue>0	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln Wage	FE	IV/FE	FE	IV/FE	FE	IV/FE	FE	IV/FE
Total revenues	0.002*	0.008*	0.002*	0.008*	0.000	0.006	0.002	0.008
	(0.001)	(0.005)	(0.001)	(0.005)	(0.001)	(0.005)	(0.001)	(0.005)
Unemployment	-0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Political strength	-0.009	-0.008	-0.009*	-0.008	0.005	0.006	-0.005	-0.005
	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)
Population	-0.001	-0.000	-0.001	-0.000	0.002	0.004	-0.002***	-0.002**
	(0.000)	(0.000)	(0.001)	(0.001)	(0.015)	(0.015)	(0.001)	(0.001)
Population ^{2}	0.000	0.000	0.000	0.000	0.000	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)
Monopsony Power	-0.006	-0.006						
	(0.021)	(0.021)						
Fiscal competition	0.039***	0.038***						
	(0.000)	(0.001)						
Unspec.Serv.			-0.057	-0.065				
			(0.077)	(0.075)				
Agriculture			-0.034	-0.027				
			(0.036)	(0.036)				
Industrial			0.008	0.011				
			(0.033)	(0.032)				
Business			-0.021	-0.016				
			(0.033)	(0.033)				
PublicAdm.Serv.			-0.019	-0.015				
			(0.028)	(0.028)				
Educ.Serv			-0.061**	-0.063**				
			(0.029)	(0.029)				
Healt			-0.020	-0.014				
			(0.038)	(0.038)				
Constant	8.917***		9.870***		9.836***		9.887***	
	(0.019)		(0.035)		(0.023)		(0.015)	
N	420286	417579	420286	417579	76045	75988	220804	219991
Estimation period	01-12	01-12	01-12	01-12	01-12	01-12	01-12	01-12
Cluster-level	RR	RR	RR	RR	RR	RR	RR	RR
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Individual controls	YES	YES	YES	YES	YES			
Instrument F-value		47.47		47.27		25.76		32.18
Testing exogeneity of *TotalRevenue*								
($\chi 2(1)$-test), p-value		0.20		0.17		0.26		0.19

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

G.4 Robustness: Cleaners

Table G.4: Robustness: Cleaners

	Commute		Industry		Pop<4,400		HydroRevenue>0	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln Wage	FE	IV/FE	FE	IV/FE	FE	IV/FE	FE	IV/FE
Total revenues	-0.001	0.011	-0.001	0.012	-0.001	0.009	-0.002	0.009
	(0.002)	(0.008)	(0.002)	(0.008)	(0.002)	(0.010)	(0.002)	(0.009)
Unemployment	-0.000	-0.000	-0.001	-0.000	-0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Political strength	-0.006	-0.003	-0.007	-0.004	-0.006	-0.004	-0.005	-0.004
	(0.007)	(0.007)	(0.007)	(0.008)	(0.009)	(0.010)	(0.008)	(0.008)
Population	-0.002***	-0.002***	-0.002***	-0.002***	-0.018	-0.014	-0.003***	-0.002**
	(0.001)	(0.001)	(0.000)	(0.000)	(0.021)	(0.021)	(0.001)	(0.001)
Population ^{2}	0.000**	0.000*	0.000**	0.000*	0.003	0.002	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.003)	(0.000)	(0.000)
Monopsony Power	0.014	0.015						
	(0.012)	(0.012)						
Fiscal competition	0.041***	0.040***						
	(0.000)	(0.001)						
Unspec.Serv.			0.059	0.030				
			(0.108)	(0.111)				
Agriculture			0.019	0.034				
			(0.038)	(0.038)				
Industrial			0.031	0.040				
			(0.035)	(0.035)				
Business			0.029	0.043				
			(0.037)	(0.037)				
PublicAdm.Serv.			0.026	0.039				
			(0.045)	(0.045)				
Educ.Serv			0.032	0.031				
			(0.055)	(0.057)				
Healt			0.055	0.066*				
			(0.040)	(0.040)				
Constant	8.807***		9.758***		9.770***		9.811***	
	(0.008)		(0.035)		(0.030)		(0.015)	
N	119836	118787	119836	118787	27661	27637	61292	60991
	56144	61292	60991					
Estimation period	01-12	01-12	01-12	01-12	01-12	01-12	01-12	01-12
Cluster-level	RR	RR	RR	RR	RR	RR	RR	RR
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Individual controls	YES	YES	YES	YES	YES			
Instrument F-value		23.84		23.66		13.08		17.23
Testing exogeneity of *TotalRevenue*								
($\chi 2(1)$-test), p-value		0.02		0.02		0.14		0.10

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

H Asymmetric revenue effects

Table H.1: Asymmetric revenue effects: All occupations, FE

ln Wage	(1) Chiefs	(2) Principals	(3) Nurses	(4) Cleaners
TotalRevenue^{+}	0.017	-0.000	0.003**	-0.000
	(0.011)	(0.005)	(0.001)	(0.001)
TotalRevenue^{-}	0.020*	-0.000	0.003**	-0.000
	(0.012)	(0.005)	(0.001)	(0.001)
Unemployment	0.001	0.002	0.000	-0.000
	(0.003)	(0.001)	(0.000)	(0.000)
Political strength	0.035	-0.030	-0.010*	-0.004
	(0.039)	(0.027)	(0.006)	(0.007)
Population	0.014***	0.007***	-0.000	-0.002***
	(0.005)	(0.001)	(0.001)	(0.000)
Population ^{2}	-0.000	-0.000***	0.000	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	10.398***	10.318***	9.932***	10.104***
	(0.053)	(0.029)	(0.015)	(0.009)
N	4795	18700	420286	119836
Period	01-12	04-12	01-12	01-12
Year dummies	YES	YES	YES	YES
Cluster level	RR	RR	RR	RR
Individual controls	YES	YES	YES	YES
$\beta_1 = \beta_2$(t-test),p-value	0.238	0.136	0.567	0.735

* p¡.10, ** p¡.05, *** p¡.01

I Hydropower revenue effects on wages

Table I.1: Hydropower revenue effects on wages: All occupations, FE

ln Wage	(1) **Chiefs**	(2) **Principals**	(3) **Nurses**	(4) **Cleaners**
Hydro revenues	0.018**	-0.006	0.002	-0.001
	(0.009)	(0.006)	(0.002)	(0.002)
Revenues ex.hydro	0.013	0.001	0.003**	-0.001
	(0.010)	(0.005)	(0.001)	(0.001)
Unemployment	0.002	0.002	-0.000	-0.001
	(0.003)	(0.001)	(0.000)	(0.000)
Political strength	0.036	-0.028	-0.008	-0.007
	(0.034)	(0.028)	(0.006)	(0.007)
Population	0.016***	0.006***	-0.001	-0.002***
	(0.005)	(0.001)	(0.001)	(0.001)
Population ^{2}	-0.000	-0.000***	0.000	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	10.31***	10.32***	9.852***	9.792***
	(0.048)	(0.031)	(0.017)	(0.013)
N	4795	18700	420286	119836
Period	01-12	04-12	01-12	01-12
Year dummies	YES	YES	YES	YES
Cluster level	RR	RR	RR	RR
Individual controls	YES	YES	YES	YES
$\beta_1 = \beta_2$(t-test),p-value	0.238	0.136	0.567	0.735

* p¡.10, ** p¡.05, *** p¡.01

J Local government specific mean wage as dependent variable

Table J.1: Revenue effects on mean wages

	Chiefs		Principals		Nurses		Cleaners	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln Wage	FE	IV/FE	FE	IV/FE	FE	IV/FE	FE	IV/FE
TotalRevenue	0.010	0.043	-0.008*	0.067*	0.001	0.005	-0.001	0.009
	(0.010)	(0.045)	(0.004)	(0.037)	(0.001)	(0.004)	(0.002)	(0.009)
Population	0.026***	0.028***	0.012***	0.017***	-0.001	-0.001	-0.003***	-0.003***
	(0.006)	(0.007)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Population^2	-0.000**	-0.000**	-0.000***	-0.000***	0.000	0.000	0.000***	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment	0.008**	0.009**	0.002	0.003*	-0.000	-0.000	-0.000	-0.000
	(0.004)	(0.004)	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Political strength	0.022	0.019	-0.009	-0.008	-0.000	0.001	-0.012*	-0.009
	(0.061)	(0.060)	(0.016)	(0.017)	(0.005)	(0.006)	(0.007)	(0.007)
Constant	10.19***		10.35***		9.857***		9.786***	
	(0.057)		(0.017)		(0.008)		(0.009)	
N	4795	4782	3355	3343	4962	4948	4911	4897
Period	01-12	01-12	04-12	04-12	01-12	01-12	01-12	01-12
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	RR	RR	RR	RR	RR	RR	RR	RR
Instrument F-value		20.79		6.720		21.16		21.17
Testing exogeneity of *TotalRevenue*:								
($\chi 2(1)$-test), p-value		0.450		0.005		0.256		0.150

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