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The zero-rent society: Evidence from hydropower and petroleum windfalls in Norwegian local governments

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ABSTRACT

Economic theory and evidence suggest that political leaders take advantage of government revenue windfalls – particularly from natural resource exploitation – to enrich themselves. We revisit this hypothesis by combining information on massive local government hydropower and petroleum revenues in Norway with five decades of registry data on individual mayors' earnings and wealth. We find that, while the resource expansions massively boost local government revenues and spending, there is *no* evidence that mayors exploit the windfalls to enrich themselves. We attribute our precisely estimated zero-finding to characteristics of the Norwegian institutional and informational environment. First, we show that the revenue windfalls induce citizens to seek political information and raise their rates of electoral participation. Second, in the early sample period when local newspapers were more important, mayors' wage responses were negatively related to newspaper coverage. In sum, our results suggest that voter information is a key disciplining accountability mechanism, potentially explaining our zero-rent result.

1. Introduction

Economic theory suggests that political leaders may take advantage of public funds to enrich themselves, at the expense of the citizenry. Extraction of political rents may be particularly pronounced in the case of unearned government revenue windfalls, for example from natural resources or foreign aid, and there is by now considerable evidence in favor of this hypothesis.[1] In turn, the extraction of political rents is commonly considered an important mechanism in the so-called resource curse hypothesis, whereby government revenue windfalls may indeed harm rather than benefit citizens.[2]

Existing evidence on political rents mainly derives from contexts where the rent conditions are almost ideal, that is, where the political leadership enjoys a high level of political discretionary power, where there is a high level of economic rents that may be extracted, and where institutions are weak (Aidt, 2003). We contribute by focusing on a rare case where the former two conditions are clearly present – there are large economic rents to be extracted and politicians enjoy wide discretionary powers – but where the last condition is clearly *not* met: institutions are strong rather than weak, and the electorate is also exceptionally well-informed.[3] When institutions are strong and the electorate is well informed, government revenue windfalls should be expected to increase the stakes of democratic elections and mobilize voters (Andersen et al., 2014). We ask if this setting also may eliminate political rent extraction, using new panel data government revenue windfalls and a unique data on political elite outcomes for the period 1972–2019 for identification.

More specifically, we analyze the political rent effects of local government revenue windfalls in Norway due to hydropower and petroleum plant openings. While Norway is well known for

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[1] See, e.g., Caselli and Michaels (2013) and Andersen et al. (2017) on political rents and corruption related to oil windfalls, or Andersen et al. (2021) on elite diversion of foreign aid.

[2] Van der Ploeg (2011) offers a review of the so-called 'resource curse' literature, and Chen and Kung (2016) and Dhillon et al. (2020) provide more recent 'political resource curse' evidence. More comprehensive treatments of political rent mechanisms may be found in, e.g., Acemoglu et al. (2004), Besley (2005), Besley and Persson (2011), Brollo et al. (2013), Bueno de Mesquita et al. (2003), Mehlum et al. (2006), Robinson and Torvik (2005), Robinson et al. (2006), or Persson and Tabellini (2000).

[3] Armand et al. (2020) argue, and provide extensive evidence, that poorly informed citizens potentially belongs to the set of conditions for political rents and corruption.

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its large petroleum revenues, it is in fact hydropower that yields by far the highest revenue supplements to local governments, with considerable variation across municipalities and over time. Mayors and their municipal councils enjoy full discretion over the allocation of the windfalls from both sectors, suggesting a considerable economic scope for diversion that potentially may be different across the two sources of windfalls (Martinez, 2020). Yet, because Norway is well known for its quality of institutions and citizens are generally well-informed – reading more local and national newspapers than almost anywhere else in the world – we may expect political rent effects to be muted, or even eliminated. If so, an elimination of political rent effects may plausibly be ascribed to institutions and information, rather than lack of economic scope and political discretion.[4]

Merging our resource windfalls and political elite data with local government fiscal information, we first document that hydropower plant openings indeed do boost local government revenues.[5] The revenue increases are instant, accompanied by an increase in local government spending, and spread across all budget items. Simultaneously, we observe a significant expansion of local government employment (work years), and an increase in public sector wages, albeit more modest.

On this backdrop, we study how the hydropower windfalls affect the personal economic situation of the mayors, as measured by their wages, income (including non-wage incomes), and wealth (gross assets and debt). Wage compensation may be interpreted as legal payments (Di Tella and Fisman, 2004; Svaleryd and Vlachos, 2009) while business incomes and assets also potentially include illegal rents.[6] We observe the mayors' economic outcomes across their entire life cycles, allowing us to estimate effects in the period when the mayor is in office as well as in their pre- and post-office periods. Additionally, we analyze the income of the mayors' spouses, acknowledging that political rents may spill over to, or be concealed by, compensations to the political elites' close relatives, even in settings characterized by good institutions (as argued by, e.g., Folke et al., 2017).

Relying on difference-in-difference estimates – comparing different outcomes for a given mayor in a given municipality that is hit by different hydropower shocks over time at different stages of her political career – our main result is a precisely estimated zero-effect of hydropower plant openings on all mayor outcomes. For example, we show that an increase in hydropower revenue amounting to as much as 25% of average local government revenue per capita causes a statistically non-significant increase in mayor wages of no more than 1.6%, with a 95% confidence band ranging from -0.8% to 4%. We conclude that there is no indication in the data that local government revenue windfalls are systematically diverted by the political leadership. This lack of political rent effects is confirmed in our separate petroleum sector analyses, albeit with less precision due to a much smaller sample size.

Interpreting our zero-result in the Norwegian context of a long-lasting history of rule of law, strong democratic traditions, and a high degree of government transparency, we argue that the local government revenue windfalls should be expected to stimulate tighter electoral controls. When a political agent – the mayor – is granted greater scope for rents extraction, we expect the principals – citizens – to rationally respond by increasing their monitoring and electoral accountability effort. Moreover, we expect the hydropower windfalls to induce more information-seeking and political influencing activities among citizens.

Empirical analyses of data on electoral turnout, complemented by survey data on citizens' information and influencing activities, confirm that citizens indeed are mobilized by the hydropower windfalls. As in Andersen et al. (2014), we analyze the effects of hydropower windfalls on voter turnout, but now exploiting the full panel-dimension of the data. Our municipality-level panel covers nearly five decades which facilitates a triple-difference estimate on the turnout effects. We compare citizens' turnout levels before and after a hydropower windfall, in the local relative to the simultaneously held regional election, implying that we effectively difference out potentially confounding local turnout trends. We document that hydropower windfalls cause substantial increases in turnout for the local government election. Moreover, we see a significant, positive response in local newspaper consumption, as well as in the extent to which citizens contact local politicians and administration, gather information about local politics, and try to influence decisions in local government bodies. We see similar patterns for petroleum sector windfalls, albeit with a lower level of estimation precision, presumably due to the smaller sample size.

Finally, we relate the mayors' personal income responses to the information environment. Easier access to information facilitates electoral accountability, which we expect will discipline the political elite. We therefore consider how mayors' personal income responses to hydropower windfalls depend on newspaper penetration in 1972, just before our sample period begins, and document a negative information gradient. This indicates that our baseline zero-result conceals an interesting heterogeneity: Mayors appear somewhat less likely to personally benefit from hydropower rents when voters are better equipped to inform themselves. This heterogeneity supports the proposition that 'information may break the political resource curse' (Armand et al., 2020) also in the context of a democratic, developed country. Interestingly, the information gradient is steeper before 1995 – almost exactly when broadband internet penetration started expanding – and then less steep in the more recent decades. While our data does not allow us to precisely pin down the explanation for the latter pattern, a plausible interpretation is that local newspapers gradually lost its position as a primary source of information when high-speed internet entered the market.[7]

In sum, our results suggest that a larger scope for rent extraction caused by government revenue windfalls generates endogenous electoral responses. Voter mobilization and information collection appear parts of an accountability mechanism that eliminate political rents. Consistent with this interpretation, and exploiting heterogeneity in information supply across municipalities, there is indicative evidence that political leaders extract less rents when citizens are better equipped to inform themselves.

1.1. Why our zero-rent result is informative

Zero-results like ours are susceptible to several economic and methodological concerns. First, one may be concerned about the

[4] For example, Media Landscapes' expert analysis by the European Journalism Centre states that "As long as the World Association of Newspapers (WAN - IFRA) has published newspaper statistics, Norway has been close to being world leader when it comes to newspaper reading", currently just behind Japan and Switzerland. In addition, Norwegian tax records have been accessible to all from 1863. From 2001 onwards, the complete person-identifiable tax records were available as searchable information on the internet (Bø et al., 2015).

[5] The key hydropower, petroleum, fiscal, and voter data, as well as information on mayors' personal income, is available throughout the entire study period. Some of the more detailed data starts later, such as specific tax items (e.g., property taxes from 1991), and mayors' wages, assets and debt (from 1993).

[6] Bø et al. (2015) analyze the effects of public disclosure of tax filings in 2001 and find that business owners report higher incomes following the publication of income tax returns on the internet.

[7] This evolution is consistent with theories of rational inattention and that "The patterns of information that bear on the political process (who is informed and over what) are now largely determined by the individual demand for information, whereas the supply of information by the media has become less important" (Matějka and Tabellini, 2021:1900).

relevance of the economic context and the treatment. Second, failure to identify significant, causal effects could be due to weaknesses in data quality or in the empirical strategy.

Addressing these concerns one-by-one we, first, argue that the treatment and its intensity are indeed relevant and highly economically significant. In per-capita terms, Norway is the second largest hydro electricity producer in the world (after Iceland). Local government hydropower revenues are not included in the national income redistribution scheme, implying that an increase in this source of revenue does not crowd out central government grants. Moreover, while the permission to open new plants – the key driver or our hydropower revenue windfalls – is decided unilaterally by the central government, local governments are granted almost complete freedom in how to spend their hydropower revenues. Economically, hydropower producing plants are effectively eternity machines, and their openings cause a permanent, positive shift in local governments' income. Our estimates imply that a hydropower shock of one standard deviation (0.326 GWh) increases local government revenues by USD 1,440 per capita, amounting to as much as 31% of average local government revenues.[8] To ease interpretation throughout our analyses and facilitate comparison across the two sectors, we scale our hydropower and petroleum windfall variables to a unit size of about 25% of average local government revenues per capita (corresponding to exactly NOK 10,000 per capita), amounting to about USD 1,110 per capita.

Consistent with the permanent income hypothesis, we observe that hydropower and petroleum windfalls trigger large increases in local government spending, where the effects on spending amount to 85%-90% of the revenue effects, and where spending is spread across all budget items (e.g., administration, social spending, culture, etc.). Moreover, a hydropower windfall of 25% relative to average local government revenue per capita increases the local government employment rate and local government employees' average wage by about 0.8 percentage points (relative to the residential population) and 0.7%, respectively. Hence, our treatment – plant openings and their associated revenue windfalls – is associated with substantial aggregate fiscal and economic effects, potentially allowing top politicians to seize rents from a larger budget. These conditions – a high level of economic rents to be extracted, and significant discretionary power of the top-level public officials – are commonly considered two of three main prerequisites for political rents and corruption, only constrained by institutions (Aidt, 2003). Absent institutional checks, our context thus mirrors the textbook case for agency problems, rents, and corruption.

Second, our findings are unlikely to result from attenuation bias. In terms of data quality, we leverage precise information on hydropower plant openings and production capacity, the fiscal state of local government, and, importantly, unique registry data on the entire population of individual mayors' wage, income, and wealth over almost a generation – since 1972 for the broader income categories, and back to 1993 for wages and wealth. We demonstrate data quality by documenting in detail the complete life-cycle characteristics of mayors. Mayors experience significant jumps in wage and income upon entering office. For example, our broad measure of mayor income increases by about 42%, potentially reflecting a compensation for the expected effort but also suggesting a considerable scope for political rents. These estimates come with a high level of precision (where the 95% confidence band amounts to just about 19% of the estimated mayor income increase), suggesting that our rigorous specifications and high-N sample effectively absorb noise generated by observed and unobserved potential confounders.[9] In sum, our data and methods appear sufficiently fine grained to be able to detect even small wage responses to hydropower and petroleum windfalls.

More technically, our identification relies on a combination of microdata on mayors' economic outcomes, a staggered treatment with plausibly exogenous local government revenue windfalls, and the inclusion of a large set of fixed effects. We control for unobserved characteristics at both the local government and the mayor level, overall and municipality-specific trends, age (seniority) effects, and even pre-office outcomes of individual mayors. Including or excluding mayor fixed effects allows us to investigate potential political selection effects (e.g., Brollo et al. 2013), and we find no evidence of this biasing our results. Our difference-in-difference strategy for the identification of windfall effects relies on the parallel-trends assumption in fiscal outcomes, which we assess by inspecting the lead-lag pattern of (changes in) local government revenues and spending around the timing of the shocks. Consistent with the parallel trend assumption, there are no clear fiscal policy trends prior to a shock, but then a sharp and permanent increase at t = 0, which reverts to around zero again after two years. Hence, the fiscal pass-through of a hydropower capacity expansion is constrained to at most two years, plausibly depending on exactly when within a fiscal year a new plant starts to operate and generate revenues for the local government, and the fiscal windfall is permanent (that is, we see no evidence of a later fiscal contraction).

1.2. Contribution to the literature

Our paper closely relates to the literature on electoral accountability and voter information, showing that informational frictions may give rise to political rents even when institutions promote accountability.[10] To our knowledge, Svaleryd and Vlachos (2009) and Folke et al. (2017) are the only papers in this literature that analyze political rents and information in a society with reputable legal and democratic institutions (Sweden), showing that information appears to reduce legal rents, and that relatives of top politicians do not seem to benefit, consistent with our findings.[11]

More narrowly, we contribute to a growing literature on the political resource curse (Brollo et al., 2013).[12] Focusing on Norway, Borge et al. (2015) show that hydropower windfalls appear to reduce efficiency in the provision of local public sector services, but they do not address potential benefits for the political elite. Furthermore, they analyze the 'Rentier State hypothesis' by estimating effects of shares of non-hydropower revenue on government efficiency, and they offer only suggestive evidence that go counter to this hypothesis.[13] Our analysis and results also shed new light on existing insights about the association between election stakes and turnout (Andersen et al., 2014), by focusing on the potential elite compensa-

[8] We present supplementary material in an online Appendix, where figures and tables are tagged with letters, i.e. Figure A. and Table B. The current calculations are based on output in Table 1 and Table B.1 (summary statistics) where nominal values are measured in NOK, and we use an exchange rate of 9 NOK/USD throughout.

[9] See Figures A.5 and A.6 for descriptive illustrations of the life-cycle characteristics of mayor wage and income.

[10] See, e.g., Ashworth, 2012, for a review of theory and evidence; Andersen and Heggedal, 2019; Besley and Burgess, 2002; Boffa et al., 2016; Bruns and Himmler, 2011; Ferraz and Finan, 2008 and 2011; Reinikka and Svensson, 2011; Snyder and Strömberg, 2010; Strömberg, 2015; Svaleryd and Vlachos, 2009.

[11] Interestingly, Mas (2017) emphasizes the importance of distinguishing between electoral accountability and wage inequality aversion. Inequality aversion is, however, not a plausible interpretation in our case since our data relates directly to the scope for rents rather than information about wage inequality.

[12] See also Arezki and Brückner (2011), Andersen et al. (2017), Andersen et al. (2020), and Caselli and Michaels (2013).

[13] The authors emphasize the limitations of their empirical strategy, see Borge et al. (2015:102, 108). See Gadenne (2017) for a paper on the same topic but from Brazil, arriving at the opposite conclusion: while tax revenues appear to promote efficiency, windfalls – in the form of grants – promote inefficiency.

tion effects of government revenue windfalls, and by showing that these effects – while zero on average – appear responsive to citizens' ability to inform themselves via local newspaper consumption, at least in the pre-broadband internet era.[14]

Finally, a different branch of the accountability literature focuses on agency problems within bureaucracies. Interestingly, while Colonnelli et al. (2020) show that political connections and patronage is a characterizing feature of local public sector hiring in Brazil – and where wage and political selection effects are driven by jobs over which mayors exert more power – Fiva et al. (2021) demonstrate that political alignment in Norwegian municipalities results in higher wages, too, but via more productive political (principal-agent) alignment rather than patronage. This contrasting evidence across Brazil and Norway fits very well with the contrast between our rent elimination result from Norway and the political resource curse in Brazil (Brollo et al., 2013; Caselli and Michaels, 2013), suggesting that key differences in the institutional and informational performance across the two countries result in widely different political and economic outcomes.

In the remainder, Section 2 explains the institutional background for our study, including the resource environment, how it affects local public finance, and the characteristics of mayor compensation. Section 3 develops our research design, while we present our main analyses and results in Section 4. Section 5 presents several extensions and robustness exercises. Finally, Section 6 concludes.

2. Background: Institutions, hydropower revenues, and mayor compensation

2.1. Institutional background

The Norwegian system of government has three levels – the central government, 19 county governments, and about 428 municipalities. The regional and local government sector – including both county and municipal authorities – accounts for about half of total government consumption, and its total spending amounts to about 20% of GDP. Local authorities are responsible for implementing national welfare policies. As in other countries with a large local public sector, the central government allocates large grants to the local levels to counteract disparities in local tax revenues and in the costs of providing government services. The local governments must produce and perform within a balanced budget.

Local government revenue consists of three main categories: Tax revenues, the general-purpose grant, and user charges. Tax revenues constitute nearly half of the municipal revenues, most of which is collected as a tax on work income and assets. The central government stipulates minimum and maximum tax rates. In the period analyzed here, all municipalities apply the maximum rates. The main government grant is the general-purpose grant. It comes with "no strings attached," allocated based on economic, social, and demographic criteria. The grant's purpose is to equalize local authorities' purchasing powers, and to stimulate settlements as part of the central government's regional policy. Importantly for our purpose – and described in more detail below – the bulk of local government revenues from natural resources, including hydropower plants and petroleum facilities, is exempted from the grant equalization scheme. User charges apply in three sectors: home-care services and nursing homes, day-care centers, and infrastructure services, particularly waste collection and treatment, water supply and sewage. However, these charges cannot exceed the cost of providing the services.

2.2. Hydropower in Norway: Plant allocation, ownership, and the energy market

Procedures for allocation of hydropower plants, as well as the energy market itself, are highly centralized. Applications for new plants include comprehensive assessments of economic feasibility, property rights and environmental impact, and the applications are centrally handled by the Norwegian Water Resources and Energy Directorate (NVE).[15] Hence, a local government has little influence over decisions about when to open a new hydropower plant, if ever, in their own municipality. Moreover, the process from application to opening is lengthy, with up to eight years of application processing time for the larger projects, in addition to the investment and construction lags. In sum, these procedures introduce significant randomness from the point of view of a local government in the spatial and temporal allocation of new plants.

The central government owns about 42% of the production capacity (defined by average, annual production in 2020, and measured in GWh), local governments 41%, regional governments own 5%, and public investment funds 1%. The private sector holds 11% of production capacity. The private sector has a larger share of ownership in the smaller power plants (>10 MW capacity).

Hydropower plants operate in an energy market that is highly integrated, and even more so over time.[16] Since 1993, the Norwegian market for electric power has been increasingly integrated also with other countries in the Nordic and the Baltic region. By 2019, pan-European trading is in place 21 countries. Electricity prices are, hence, determined in a highly centralized market for energy exchange. Regional price variation does occasionally occur due to power transmission constraints across regions, but is confined to much higher levels of aggregation than the local government level (typically, the county level, or more pronounced at the north-south regional level of the country). Electricity prices reflect the sum of production prices, distribution charges and taxes. Since the variable costs of hydropower production are very low, the owners of a power plant will generate electricity even if prices are extremely low. In the short term, taxes levied on the power plants (supply side effects) are unlikely to affect prices. Taxes affect plant profitability, which is likely to have longer-term effects through investments in new production capacity.

2.3. Local government hydropower and petroleum taxation

The essentials of the hydropower tax regime were established more than hundred years ago as the first waterfalls was developed on an industrial scale, the argument being that the local population should be compensated for the utilization of the local natural resource. In addition, some municipalities benefit from land-based facilities used to process oil and natural gas exploited on the seabed. The local governments extract natural resource revenues via a range of tax instruments. Among these, only property taxation is relevant for petroleum facilities, while all the following are relevant for hydropower plants:

[14] The interconnectedness of accountability, turnout, and information has also been the focus in other empirical papers (e.g., Bracco and Revelli, 2018), but without considering exogenous windfalls for identification and political rents as the outcome.

[15] For further documentation of licensing, see: https://www.nve.no/licensing/?ref=mainmenu.

[16] The 1991 regulatory reform introduced market competition in the Norwegian electricity sector. Corporations were split into utilities responsible for transmission and distribution and companies responsible for electricity production. In the earlier period, the hydropower corporations were integrated organizations responsible for transmission, distribution and production to their region. The regional responsibilities corresponded roughly to the counties (in 1989: 17 regional corporations). These corporations had monopoly on electricity sale, causing price dispersion across regions.

Property taxes: Property taxation is the most important source of local government revenues from natural resource-based facilities, including hydropower plants and land-based oil and natural gas facilities. Local governments can impose property taxes on residential and commercial real estate located in the municipality. Revenues from property taxes are not included in the system of revenue equalization in the general-purpose grant. Property tax rates can be set in an interval from 0.2 to 0.7 percent of taxable values per year. All local governments with substantial hydropower production and petroleum facilities apply the maximum tax-rate.

Special rules apply for defining the taxable values of hydroelectric power plants. For the larger power plants (>10 MW), the taxable value is based on a net present value calculation over an infinite period. For the smaller power plants (<10 MW), taxable values are defined as tax-deducted balance value of investments. This implies that tax revenues can be high for smaller plants. In the subsequent empirical analyses, we estimate the effects of per capita hydropower production capacity (GWh per capita), which is unrelated to (daily, seasonal, or annual) variation in energy prices.

A much smaller group of coastal municipalities benefit directly from offshore petroleum activities by hosting land-based facilities for the processing of oil and natural gas, as in the case of Brazil (Caselli and Michaels, 2013). In contrast to Brazil, however, the tax base relevant for the local government is connected to the estimated property value of these facilities (land, buildings, pipelines and machines), rather than the value of the petroleum production itself.[17] As the land-based facilities are complex structures that occupy large areas, the associated tax base and the property tax revenues can still be considerable, and this source of revenue is considered very attractive for those municipalities that benefit from it.

Licensed electricity production: Legislation requires the owners of hydropower plants to deliver a fixed amount of the power produced to the local governments where the plant is located, so-called "concessionary power production". Most local governments offer the licensed production at a market price.[18] These revenues are also *not* included as criterion for allocating the general-purpose grant, and there are no statutory restrictions on the use of these revenues.

Fees on electricity production: Owners of larger hydropower plants (producing more than 40GWh per year) pay a concession fee to local governments affected by the hydropower facilities. The fee depends on the power that the plant can provide and is calculated independently of the power plant's actual production capacity (i.e., depending on regulated water flow and fall height). Again, these revenues are *not* included in the system of revenue equalization but are earmarked for funds to be used for local business development.

Natural resource taxes: Starting in 1997, municipalities collect so-called natural resource taxes. The taxable values are calculated on power plants with capacities exceeding 10 MW. The tax rate is NOK 0.01 per KWh, calculated based on average hydropower production over the last six years. Hence, also these revenues are insulated from annual fluctuations in electricity prices. The natural resource taxes, however, *are* included in the general taxes on income and assets and are therefore part of the revenue equalization scheme.

Yield from the hydropower sector: Central, regional, and local governments are dominant owners in the hydropower sector, and many local governments receive dividends.

2.4. Hydropower production, petroleum, and local government revenues

We exploit data from the NVE who estimates annual energy production of hydropower plants using a 30 year series of hydrological data. These estimates form the basis for the net present value calculations in the tax system, and for property taxation which is by far the most important source of local government hydropower revenues. The data on municipal hydropower production capacity – the foundation for local government revenues – is therefore fixed until a new power plant is opened or existing plants are significantly upgraded (see Figure A.2a). There has been a steady development of new hydropower over our entire sample period, from 1972 to 2019, in which the share of municipalities with hydropower plants increased from about 45% to just above 70%.[19]

Every addition of a hydropower plant in a municipality increases local government revenues, translating into the steep positive cross-sectional correlation in 2019 (Fig. 1, left panel) between the level of hydropower production in a municipality (horizontal axis) and local government revenues (vertical axis). As can be seen, hydropower rich local governments enjoy in the most extreme cases more than three times higher per capita revenues relative to hydropower poor municipalities. Notice that it is the changes in hydropower capacity *within* municipalities introduced by new plants that we will use for empirical identification, rather than the accumulated capacity differences across municipalities (as shown in Fig. 1).

Municipalities with land-based petroleum facilities (eight in total; black triangles in Fig. 1, right panel) also enjoy high local government revenues, albeit slightly less than the hydropower rich municipalities (blue names). As can be seen, these petroleum facilities are more important for local government revenues than having a large petroleum-based sector per se, as measured by the share of the work force associated with this industry (horizontal axis in the figure). For reference, the most petroleum intensive municipalities in terms of work force (green triangles) – of which all are in the southwestern coastal region of Norway, around the "oil capital", Stavanger – have significantly lower local government revenues per capita than those municipalities that have land-based facilities. This illustrates that it is property taxation rather than more generalized spillovers that mainly matters for the allocation of petroleum revenues to local governments.[20]

[17] Norway has extensive offshore production of oil and natural gas. However, it is the central government that collects all revenues from the petroleum taxation, royalties, and dividends from the state-owned corporates (*Equinor* and *Petoro*). With the exception of local property taxes on land-based facilities, local governments therefore only indirectly benefit from the petroleum activities, via economic spillovers from the sector and receiving general government grants.

[18] Designated shares of production must be made available to the local authority at a regulated price, which is significantly lower than the market price. The amount of power allocated to local government is defined by the municipalities' demand for electricity for households etc. (larger industrial plants not included).

[19] Figure A.1 plots the cumulative growth in total hydropower production over the sample period. Figure A.2a shows a break-down of this pattern for six selected municipalities, illustrating how hydropower production in a municipality tends to increase in sharp steps with the arrival of new plants, where the height of each step indicates the size of the new plant. Finally, Figure A.3 breaks down the total hydropower additions per year into small (<0.1 GWh per capita), medium-sized (0.0–0.3 GWh per capita), and large (>0.3 GWh per capita) hydropower additions, illustrating that all types of additions are relevant throughout the sample, but that larger shocks are relatively more frequent in the early part of the sample, while smaller sized shocks are relatively more frequent in the later part of the sample. Summary statistics may be found in Tables B.1, B2a and B.2b.

[20] Figure A.2b displays the developments in per capita property tax revenues and petroleum-related employment rates for the eight municipalities over the period 1991–2019, the period for which we have petroleum plant variation. Note that the Kårstø and Mongstad processing plant covers two municipalities. The Mongstad facility was initially opened in 1975 (not included in our data), and it has been upgraded in several steps, including a new processing plant in 1999 and an electricity plant based on natural gas in 2009, both of which we cover.

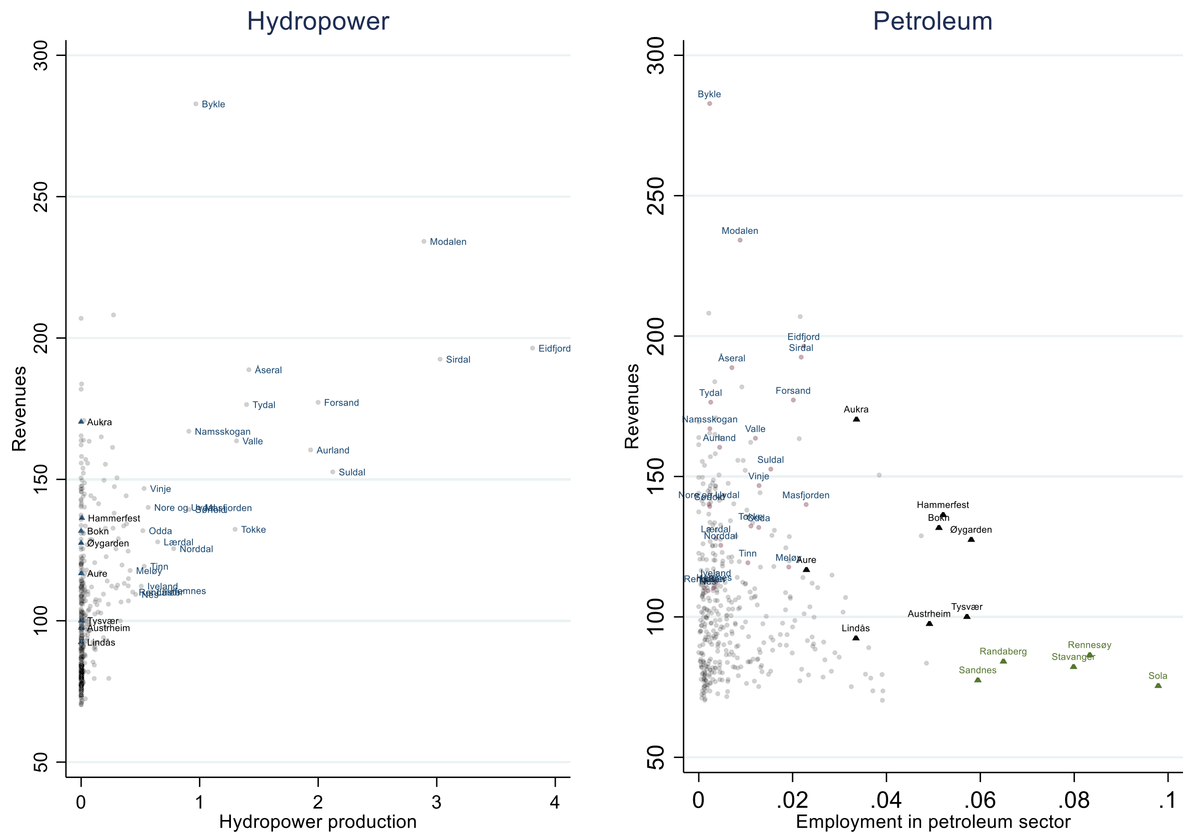

Fig. 1. Hydropower production and local government revenues.
Notes. The left panel displays 2018 municipality-level data on hydropower production (measured by GWh per capita) and local government revenues (per capita). The right panel shows the share of employees working in the petroleum (oil and natural gas) sector. We show the names of municipalities with a hydropower production exceeding 0.5 GWh per capita (in blue) and the names of the 8 municipalities with petroleum-processing facilities (in black, with triangles). For reference, the right panel also shows municipalities with a high petroleum sector employment share but without significant land-based petroleum facilities (in green, with triangles).

2.5. Mayors, CMOs, and their compensations

Our focus is on mayor compensation. Mayors are members of the municipal councils, and they are elected in the first local council meeting following the fixed-date local elections. The mayor chairs the council meetings and is the formal representative of the municipality. A local government can define the mayoral position as a full-time or part-time occupation, and the local council decides on the mayor's wage compensation.[21] Starting in the 1970 s, an increasing share of local governments have mayors in full-time positions.[22] The local councils set the mayors' wages using majority voting at the start of each four-year election period. In contrast, other members in the local council are "leisure politicians" that commonly keep a full-time work position outside political life. They use their spare time to prepare for council meetings and receive a modest compensation and travel reimbursements when participating in council meetings.

In Fig. 2, for illustration, we plot mayor income (when in office) in 2018, against local government revenues. A first observation is that there is no indication that mayor income correlates with municipal wealth. Moreover, when we classify mayors by local hydropower production level there is no clear-cut tendency for the most hydropower-wealthy municipalities (triangles) to have the better compensated mayors, and the same is true for our in total eight petroleum-wealthy municipalities (circles). For reference, we also highlight the largest population centers (squares), where mayor compensation is slightly above average. In sum, this is a first clue suggesting that hydropower and petroleum windfalls do not necessarily inflate mayoral earnings – but this interpretation disregards the potential leverage of correlated variables or trends which we will address much more rigorously using our complete panel of all individual mayors' outcomes from 1972 (or, for some outcomes from 1993) to 2019.[23]

Political rents may be diverted through different channels and at different levels of government. For this reason, we also consider proceeds to the mayors' closest relatives – their spouses. In addition, we consider the income of the chief municipal officials (CMOs). The CMOs are the top bureaucrats in the local governments and exert considerable influence via their overall responsibility for budget preparations, legal issues and as the leader of the administration. Some CMOs are members or chairs in boards of corporations or institutions fully or partly owned by local gov-

[21] The existing (2019) Local Government Act stipulates that elected members of local councils are entitled to compensation for their work, and that the remuneration can be defined as an annual basis, per meeting, or in any other way determined by the local council. Current legislation offers no guidelines on levels of compensation. Neither did the Local Government Act of 1992 (which was binding until 2019). The Proposition to the Storting on the 1992 Act contained a vague formulation saying that remuneration should be "... kept within the limits of reasonableness" (Ot. Prp No. 42 (1991–1992)). Finally, the earlier legislation did not comprise provisions relating to the type of compensation (i.e., annual, per meeting, etc.) nor regulation on levels of compensation to elected politicians (see Ot. Prp. No. 42 (1991–1992), page 142).

[22] For example, a survey conducted in 1995 found that 75% of the mayors were employed in full-time positions as mayors. Only municipalities with very small populations had part-time mayors.

[23] Our individual mayor data is from the "Local candidate dataset" (Fiva, Sørensen and Vøllo, 2021: https://www.jon.fiva.no/data.htm), including a complete register of 2,119 unique mayors over the period 1972–2019.

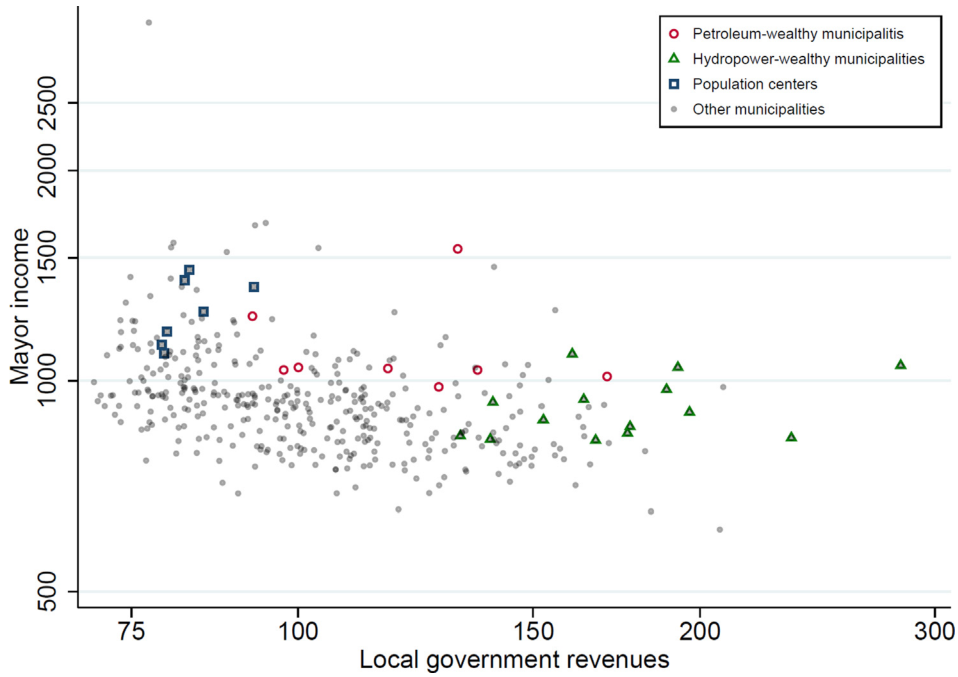

Fig. 2. Mayor earnings and local government revenues.
Notes. The plot displays 2018 mayor income conditional on total local government revenues (per capita, in NOK 1000). Triangles indicate major hydropower producers (>0.9 GWh per capita), circles refer to municipalities with facilities for petroleum processing, and squares indicate the most populous municipalities (populations larger then 80,000).

ernment. While mayors can only be elected by the council in their residential municipality and do not compete for mayoral positions in different municipalities, CMOs have careers where they apply for positions in different municipalities irrespective of their residence.[24] A rent-seeking CMO can therefore be expected to seek jobs that offer opportunities for rent extraction, possibly in hydropower- or oil-rich municipalities. Analyzing CMOs' incomes should therefore increase our chances of uncovering rent extraction – if it exists.

3. Research design

Our research design exploits that the political units are homogenous and display a high degree of institutional stability. Several local governments are subjected to (positive) revenue shocks induced by hydropower and petroleum plant openings, and the data therefore facilitate the estimation of causal effects using a difference-in-difference strategy.

3.1. Windfalls, local government revenue, and policy responses

We open our analysis by estimating the impact of hydropower and petroleum plant openings on local government revenues, spending and other aggregate policy outcomes, to verify the assumed dynamics and assess the economic significance of the hydropower and petroleum revenue windfalls on local political conditions.

Let P_{mt} represent a generic local government policy outcome in municipality m in year t. The generic $Windfall_{mt}$ variable captures the associated hydropower ($Hydropower_{mt}$) or petroleum ($Petroleum_{mt}$) capacities, sometimes entering separately and sometimes simultaneously in the regressions. We estimate a panel model with fixed effects for municipalities (γ_m) and labor market regions (subscript r) interacted with year indicators (ϑ_{rt}), in addition to the error term (ε_{mt}): [25]

$$P_{mt} = \varphi Windfall_{mt} + \gamma_m + \vartheta_{rt} + \varepsilon_{mt} \quad (1)$$

The parameter φ measures the marginal impact of a unit change in the resource capacity variable relative to the counterfactual policy change captured by the other variables in the model, and where the variation in the resource capacity variable is almost exclusively driven by new plant openings (the extensive margin). Hydropower production capacity is measured in GWh per capita, where the variation predominantly derives from the openings of new plants. Petroleum plant capacity is scaled slightly differently, using the average property tax level during the period of the plant (equal to zero before the plant opening, and equal to the new average after a second plant opening). This measurement captures that petroleum processing municipalities receive very different levels of government revenue following the plant openings (see Figure A.2b). This way of scaling directly uses that, while a local government's hydropower revenues is a straightforward function of the plants' power capacity (GWh per capita), local government tax revenue from a petroleum plant is a function of complex assessments of plant property value.[26] The municipality fixed effects imply that φ is identified exclusively from within municipality variation, while the labor market by year indicators flexibly correct for local economic trends. We are effectively asking whether a given policy outcome is

[24] In our sample, 1456 CMOs have worked in one municipality only, 265 CMOs in two municipalities, 63 in three municipalities, 14 in four municipalities and 2 in five municipalities.

[25] Note that all our analyses and results are robust to replacing the regional labor market trend (ϑ_{rt}) with a standard time trend (ϑ_t).

[26] Notice that this way of scaling petroleum plant intensity (using the average property tax revenue) might introduce a concern of mechanical correlation between the petroleum plant measure and different local government policy outcomes. We investigate the relevance of this concern by means of a placebo test, randomly assigning "ghost" petroleum plant openings to neighboring municipalities that do not have such plants.

higher than expected by a combination of the average level in that municipality as well as the trend across the neighboring municipalities that are part of the same labor market.

3.2. Windfalls and mayors' wages, income and assets

Let i represent a mayor before, during and after the years in office (where m and t are defined as before). Let Y_{imt} represent a generic mayor outcome: the mayor's wage, income, or assets, observed in years before reaching the mayoral position, when he or she is in office, and in the post-mayor period. Let *Office* equal 1 when the mayor is in office, and 0 otherwise. Similarly, *Post* is an indicator of the post-mayoral period. Hence, in the following model it is the pre-mayoral period that represents the reference category:

$$Y_{imt} = \varphi_0 Office_{imt} + \varphi_1 Post_{imt} + \varphi_2 Office_{imt} Windfall25Pct_{mt} + \varphi_3 Post_{imt} Windfall25Pct_{mt} + \varphi_4 Windfall25Pct_{mt} + \theta_i + \gamma_m + \vartheta_{rt} + A_{imt} + \varepsilon_{imt} \quad (2)$$

Ignoring the $Windfall25Pct_{mt}$ terms, the model includes individual (θ_i) and age (A_{imt}, measured in years) fixed effects, and an idiosyncratic error term (ε_{imt}), in addition to the terms capturing labor market trends and municipality fixed effects. The counterfactual outcome is therefore the individual's pre-mayor outcome in the same municipality, accounting for age and local labor market trends. Hence, φ_0 yields an estimate of the returns to office. Similarly, φ_1 captures the economic outcomes of entering the post-mayor period relative to the pre-mayor period, conditional on the fixed effects.

We now turn to our key parameter of interest, which captures the windfall effect on mayor returns to office. To the extent that plant openings have a major causal effect on local government revenue, according to estimation of Equation (1), we can interpret the estimates of hydropower and petroleum windfalls on mayor returns to office as a political resource rent effect. Our main parameter of interest is then φ_2, which captures the marginal effect of hydropower or petroleum windfalls on the mayors' returns while in office, while $\varphi_2 + \varphi_4$ is the overall windfall effect on mayoral earnings. Should mayors receive additional payments in the post-office period, it will be captured by φ_3, where the overall windfall effect amounts to $\varphi_3 + \varphi_4$.

To ease interpretation and facilitate comparison across the two sectors (hydropower and petroleum), $Windfall25Pct_{mt}$ (i.e., $Hydropower25Pct_{mt}$ and $Petroleum25Pct_{mt}$) is scaled such that, for example, φ_2 captures the marginal effect on mayor returns while in office of a 25% revenue shock relative to average local government revenues per capita. The exact scaling is based on our estimates from Equation (1), with local government revenues per capita as the policy outcome.[27]

That the model includes individual fixed effects (θ_i) implies that we estimate effects relative to the mayor's own payments before entering the top position. Removing this fixed effect from the specification implies another counterfactual; all mayor candidates in the relevant municipality (controlling for age and year). This specification offers one of several robustness tests of this critical model. Throughout the mayor-outcomes estimations, we cluster the standard errors on labor market regions to account for over-time, within-individual correlations, within-municipality correlations, and between municipality correlations (Cameron and Miller, 2015).

4. Main results: Windfalls, policy responses, and mayor (and CMO) outcomes

4.1. Windfalls and aggregate revenues, spending, and policy outcomes

In Table 1, we display estimates of hydropower and petroleum on total local government revenue, total spending, property taxes, and central government block grants, based on the regression model in Eq. (1), with and without accounting for flexible labor market region trends (region-by-year fixed effects). Recall that hydropower is measured as per capita GWh production capacity, while petroleum is measured by the corresponding per capita property tax level (average, after plant opening). According to the estimates in Column (1), a one standard deviation in the hydropower variable (0.33) yields about NOK 13,000 (USD 1,440) per capita, which amounts to as much as one third of the average revenue level across all local governments (about NOK 41,000, or USD 4,560, per capita). For petroleum plants, as expected, the correlation between the associated average property tax level (after plant opening) and local government revenue is close to one (0.92), in line with property taxation capturing the full revenue effect of petroleum windfalls.[28]

Note that it is the estimates of the hydropower and petroleum effects on local government revenues per capita in Column (1) that we use for the scaling of the windfall variables that will be used in all the remaining analyses that follow, and that these estimates are robust to the variation in model specification in Column (2). A unit change in our scaled hydropower and petroleum windfall variables (*Hydropower25Pct* and *Petroleum25Pct*, respectively) amounts to about 25% of average total local government revenues per capita (or, more precisely, NOK 10,000, or USD 1,110) which in turn is just below one standard deviation of the hydropower variable (USD 1,440).[29]

Moving to columns (3)-(4), we see that the corresponding effects on the spending level are somewhat smaller, though the differences across columns (1) and (3) are not statistically significant. Hence, our choice to scale our windfall variables according revenues rather than spending is of minor importance. Moreover, the spending effects are distributed quite evenly across all major

[27] Let $\hat{\varphi}$ denote the estimated effect of the relevant windfall indicator on local government revenues, derived from regression model (1). We use this estimate to rescale the windfall variable:$Windfall25pct_{mt} = \hat{\varphi} Windfall_{mt}/10$. The response variable in (1) is measured in 1000 NOK per capita, and we therefore divide $\hat{\varphi} Windfall_{mt}$ by 10. Replacing $Windfall_{mt}$ with $Windfall25pct_{mt}$ in (1) mechanically generates an estimated effect of 10, which represents a revenue increase of 10,000 NOK per capita. This corresponds to a local government revenue increase of about 25%, measured relative to the average revenue level of NOK 41,200 (Table B.1).

[28] A potential concern is that our use of property tax for identification might cause a mechanical effect of the petroleum treatment variable on total local government revenue. We use a Placebo-test to demonstrate that this is not the case. We identify eight coastal municipalities located in in the same counties as the municipalities with petroleum processing facilities. We define a Placebo treatment variable by assuming that the opening of these facilities was in the same years as the actual treatments. This implies that the "placebo municipality" of *Frena* gets treatment in the same year as *Aukra*, *Volda* in the same year as *Aure*, *Loppa* in the same year as *Hammerfest*, *Samnanger* in the same year as *Øygarden*, *Vindafjord* in the same year as *Tysvær*, *Sauda* in the same year as *Bokn*, *Osterøy* in the same year as *Lindås*, and *Austevoll* in the same year as *Austerheim*. The Placebo municipalities have population sizes (average population size: 5747) on par with the municipalities with petroleum facilities (average population size: 5736). Results are shown in Table B.12, where we regress total local government revenues on the indicators of hydropower and petroleum production (similar to Table 1), and Placebo indicator of petroleum production. The Placebo treatment has a negative point estimate in both model specifications and is marginally statistically significant at the 5% level in model (1) only. In sum, there is does not seem to be a general correlation between property taxation and local government revenues, suggesting that our highly statistically significant Table 1 results are informative about the true effect of new petroleum plants, as mediated by the petroleum taxation of these.

[29] The summary statistics in Table B.1a shows that the hydropower windfall variable, $Hydropower25Pct_{mt}$, has an overall mean of 0.360. The variable is quite right-skewed, partly as consequence of several municipalities having no hydropower production (see Figure A.1). The median value is therefore low, 0.002. If we exclude municipalities without hydropower production, the overall mean is 0.624 and the median 0.067.

Table 1
Hydropower and petroleum windfalls, and local government revenues and spending.

	Revenues		Spending		Property tax revenues		Block grants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hydropower	40.04***	36.41***	35.81***	32.22***	12.31***	10.56***	−1.331	−2.148
	(6.822)	(5.521)	(5.825)	(4.408)	(3.115)	(2.999)	(1.118)	(1.794)
Petroleum	0.918***	0.991***	0.788***	0.873***			−0.184***	−0.163
	(0.132)	(0.164)	(0.0491)	(0.0722)			(0.0397)	(0.0907)
Observations	20,961	20,862	20,499	20,398	12,052	11,994	21,016	20,918
R-squared	0.943	0.969	0.899	0.934	0.937	0.951	0.896	0.941
Number of municipalities	531	531	530	530	510	510	531	531
Municipality FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	N	Y	N	Y	N	Y	N
Region*Year FE	N	Y	N	Y	N	Y	N	Y

Notes. The table displays the effects of hydropower production capacity on local government revenues, total current and investment spending, property tax revenues and central government block grants. Note that "Hydropower" and "Petroleum" refer to the "Windfall" variable in Eq. (1). The response variables have been measured in 1000 NOK per capita, at current prices. Hydropower production capacity is measured as annual GWh per capita. Petroleum processing has been measured as average per capita property taxes for municipality-years following the opening of the facilities. The regression models include fixed effects (FEs) for municipality and years, in addition to years interacted with labor market regions. The standard errors (in parentheses) are robust standard errors, clustered on municipalities. Significance: *** p < 0.001, ** p < 0.01, * p < 0.05.

local government budget items, where elderly care increases the most, followed by culture, administration, health and social care, education, childcare, and transport (see Table B.4 for details). As to be expected from the institutional description, we observe that hydropower production yields a considerable increase in property tax revenues (columns (5) and (6); not applicable to petroleum which, as described above, is scaled by the property tax revenues), while levels of block grants are mostly unchanged (columns (7) and (8)). In sum, the fiscal policy effects are substantial and there is no indication of systematic misallocation.

In Table 2, columns (1)-(2) and (5)-(6), we employ the revenue-scaled windfall variables (*Hydropower25Pct* and *Petroleum25Pct*) based on the results in Table 1, Column (1), to consider the windfall effects on two additional, key local aggregate policy outcomes: the average wage level (in logs) of local government employees and the local government employment rate. For reference, in columns (3)-(4) and (7)-(8), we compare the observed windfall effects to the general correlation between variation in total local government revenues per capita ("Revenues" in the table) and the same two policy outcomes.

Column (1) shows that hydropower windfalls are associated with a statistically significant increase in the local government employees' wage level – up to about 0.7% per 25% increase in average local government revenues per capita – while the effect is smaller and not statistically significant when flexibly accounting for labor market region trends, in Column (2). Columns (5) and (6) demonstrates that the employment effects are more pronounced, and statistically significant for both hydropower and petroleum windfalls. The estimated effect on local government work years per capita amounts to 0.5–0.8 percentage points for the same sized hydropower revenue windfall, and around 0.4 percentage points for a corresponding petroleum revenue windfall, amounting to an overall increase of up to around 10% of total local government employment (relative to the average of about 6.2% local government work years per capita). Finally, the results in columns (3)-(4) and (7)-(8) indicate that the estimated windfall effects are overall consistent with general tendency for local government wages and work years to correlate with variation in total local government revenues per capita. While the windfall effects (scale corresponding to NOK 10,000) are somewhat stronger than the revenue correlations (scale corresponding to NOK 1.000) in columns (3)-(4), the windfall estimates are almost identical to the work years correlations in columns (7)-(8).[30]

4.2. Mayors' baseline return to office

Before moving on to analyzing effects of the hydropower windfalls on mayor returns, we revisit the descriptive evidence on mayors' compensation in Section 2, but now viewed through the lens of our rigorous empirical framework in Eq. (2), absent the windfall terms. The regressions leverage individual-level information on mayors in the period 1972–2019.

The regression output from this exercise is summarized in Fig. 3 (see Table B.3 for regression details). As can be seen, being a mayor in Norway is indeed well-compensated. Adjusting for age, observed and unobserved fixed municipality characteristics, and labor market region specific trends, a mayor's wage level is on average about 80% (0.59 log points) higher when in office, compared to her pre-mayor wage level.[31] The estimates suggest that the elected mayors get a substantial wage raise, which mostly disappears in the post-office period. This indicates that the local councils set an in-office compensation well above the market rate, suggesting that the councils offer attractive wage contracts for most candidates. The mayor wage premium is slightly lower when measured relative to local government employees (about 60%, or 0.47 log points, higher).[32] As to be expected, the point estimate for the return to office is somewhat reduced when employing the broader income measure that

[30] The strong positive effect of windfalls on work years suggest that citizens are offered better services. This contrasts the evidence from Brazil (e.g., Caselli and Michaels, 2013; Ferraz and Monteiro, 2014), and in Section 5 we show that the windfalls generate a higher level of citizen satisfaction with public services and place to live.

[31] Cirone et al. (2021) obtain comparable returns-to-office estimate for using data on mayoral wages from the 2011 Norwegian local elections.

[32] See Tables B.2b and Table B2.c for individual-level descriptive statistics. Figure A.4 illustrates the data structure for the annual income profile of four different mayors holding office at four different periods of time within one selected municipality. Figure A.5 shows how mayor income growth tends to peak every fourth year, following the local elections, and Table B.8 shows that there is very little, if any, adjustment in mayor earnings after the first year in office. Figure A.6 plots average income growth for mayors and their spouses, 16 years before and 16 years after entering office, both in absolute (log) terms, and their wages relative to local government employee wages (+/- 12 years around entering office). Finally, Figure A.7 shows an event history analysis of mayor income, including the same fixed effects as in Fig. 3, around the year of entering office (+/- four years). The analysis in Figure A.7 excludes all post-mayor observations, hence, the counterfactual to which the estimates should be compared with are all pre-mayor years (i.e., up until the fourth year before assuming office). The graph shows that mayor income growth is statistically indistinguishable from the pre-mayor income growth until around the time of becoming mayor (t=0), where we see a sharp increase in income. The minor increase in t=-1 can be explained by mayors sometime receiving their new mayor wage in the fall, just after the election, before formally assuming office at the beginning of the next year.

Table 2
Hydropower, local government wages and employment.

	Wages (log)				Work years (%)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hydropower25Pct	0.00712**	0.00288			0.789***	0.540***		
	(0.00272)	(0.00232)			(0.155)	(0.128)		
Petroleum25Pct	0.00203	0.00190			0.448***	0.399***		
	(0.00154)	(0.00122)			(0.0370)	(0.0710)		
Revenues			0.000116*	4.78e-05			0.0529***	0.0488***
			(5.66e-05)	(7.65e-05)			(0.00308)	(0.00404)
Observations	14,737	14,660	14,655	14,577	14,738	14,661	14,656	14,578
R-squared	0.997	0.998	0.997	0.998	0.915	0.945	0.937	0.955
Number of municipalities	520	520	520	520	520	520	520	520
Municipality FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Region*Year FE	N	Y	N	Y	N	Y	N	Y

Notes. The table displays estimates on local government wages (log-scale, measured at current prices) and total number of local government work years, measured relative to the residential population (%). The hydropower and petroleum variables correspond to windfalls amounting to an estimated 25% increase in local government revenues per capita (i.e., the "Windfall25Pct" variable in Eq. (2)). The "Revenues"-variable corresponds to total local government revenues per capita (i.e., Per capita total current revenues" in Table B.1), and is measured in NOK 1,000 per capita (while the windfall variables correspond to a shock size of NOK 10,000 per capita). The data set covers the period 1986–2019. The regression models include fixed effects for municipality and years (FEs) interacted with labor market regions. The standard errors (in parentheses) are robust standard errors, clustered on municipalities.
Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

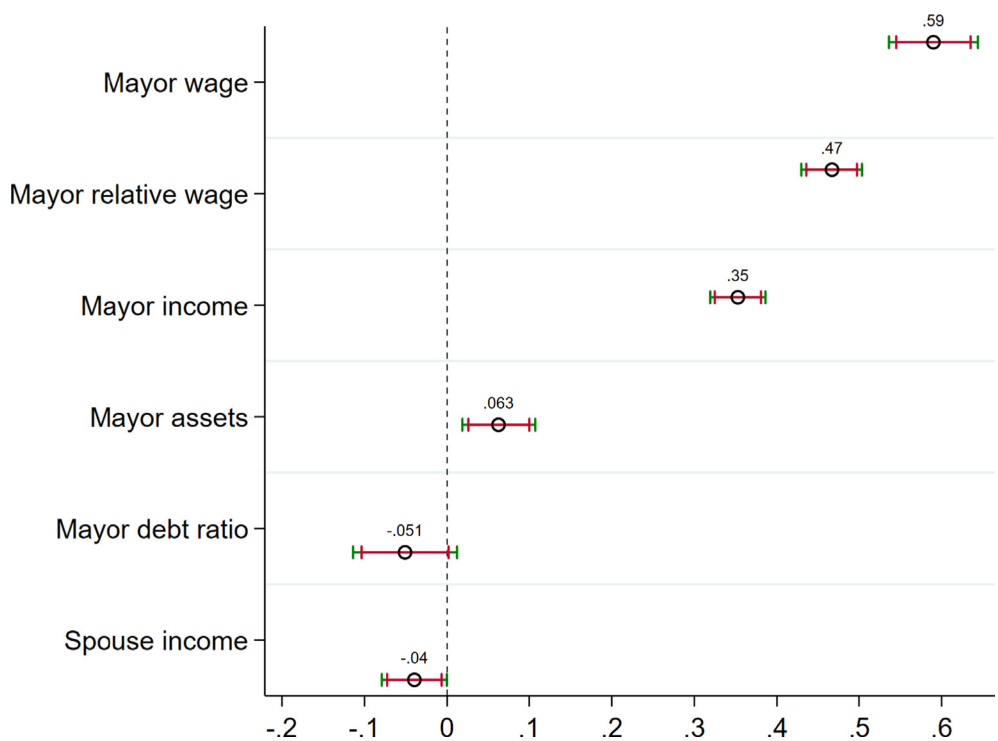

Fig. 3. The returns to office.
Notes. The diagram displays regression estimates indicating the mayors' earnings returns to office. The estimates show the effect on earnings (measured on log-scale) of a dummy variable indicating whether the mayor is in office. Mayor relative wage is measured relative to the average wage level in local government. Mayor income and spouse income includes (potential) net business revenues. The diagram shows the point estimates (indicated in numerical format) as well as 95% and 90% confidence intervals, indicated by green and red colors respectively. The standard errors are clustered on labor market regions. We present a complete set of estimates in Table B.3.

includes private business income, amounting to about 42% (0.35 log points). Consistent with the increase in income, there is some indication that the mayors accumulate assets while in office, however without significantly altering their debt-to-asset ratios. Finally, we consider the mayor's spouse's income, compared to her income before the mayor entered office. We see a small and only marginally statistically significant decline of about 4% in spouse income, perhaps reflecting a reallocation of labor market hours within the household toward the mayor.

In sum, Norwegian mayors experience large jumps in their income level when entering office. Moreover, they accumulate some assets, and their spouses' income is somewhat reduced.

4.3. Windfalls and mayors' return to office

As indicated already in Fig. 2 (Section 2), there is no evident correlation in the raw data between local government revenues in hydropower or petroleum rich municipalities and mayor income. In this section, we analyze the pattern of how mayors' return to office respond to the economic windfalls triggered by new hydropower and petroleum plant openings much more rigorously.

Fig. 4 shows the estimates for the marginal effect of hydropower and petroleum windfalls, respectively, on mayors' returns to office for all our six mayor outcome variables. That is, the table displays the estimates of parameter φ_2 in Eq. (2) for different mayor outcomes Y_{imt} while, as in Fig. 3, adjusting for age, observed and unobserved fixed municipality characteristics, and labor market region specific trends.

Focusing on the left panel of Fig. 4 ("Hydropower"), a first observation is that the point estimates for hydropower on mayor outcomes (when in office) are indeed very small. For example, an increase in hydropower revenue of 25% of average local government revenues per capita (corresponding to one unit increase in the *Hydropower*25*Pct* indicator) causes a 1.6% increase in mayor wages. The larger effect is on mayors' debt ratio where the corresponding estimate amounts to about 5%. Second, zero is well within all the 90% confidence bands, with the mild exception of the debt-to-asset ratio that increases slightly (but not statistically significant at the 5% level). This stands in sharp contrast to the large returns to office estimates in Fig. 3, as well as the scope for rents provided by the substantial aggregate fiscal policy effects evidenced in Tables 1 and 2. In sum, hydropower windfalls have no significant effects on the mayors' wage levels or their wages relative to local government employees, as well as on their broader income measure that also include private business income and social security and pensions. There is no indication that hydropower windfalls affect mayors' accumulation of assets, and there are also no significant effects on the mayors' spouses' income. Finally, although the inclusion of fixed effects is potentially crucial for identification, the results are robust to excluding these, indicating that political selection effects do not seem to be relevant in this context.[33]

Turning to the petroleum estimates in the right panel of Fig. 4 ("Petroleum"), results are much less precise, as to be expected given the small sample. The results largely support the main insights from the hydropower analysis: While there is perhaps some indication that large petroleum windfalls increase mayor income somewhat, the effect on mayor wage is zero, and none of the estimates are statistically significant at the 10% level. Moreover, the income estimate decreases in size when adding municipality-fixed linear trends to the specification (Figure A.9a). At the same time, an alternative and less rigorous model specification consistent with the specification for local government wages (Table 2) suggests a 6% effect on mayor income (see Table B.11). Therefore, we cannot completely rule out a modest mayoral income gain as result of revenues generated by the petroleum sector.

[33] Brollo et al. (2013) propose that larger grants to local governments cause a drop in the quality of elected politicians. The Brazilian study offers support for this hypothesis; larger transfers induce a decline in mayors' education levels. Likewise, one might expect that revenues from hydropower production affect the pre-office earnings of Norwegian mayors. This might bias estimates in the models with mayor fixed effects. In Table B.5a, we include estimates for hydropower effects on mayor earnings in the pre-office period. These results do not indicate that hydropower revenues have important selection effects. In Figure A.9a, we display regression outputs when adding municipality-specific linear time trends and in A.9b we exclude mayor and mayor-spouse fixed effects as well as year-by-region fixed effects. Even these results correspond well to our baseline estimates.

4.4. Windfalls and CMOs' return to office

While mayors are the leaders of the political branch of local governments, the CMOs head the bureaucratic branch. In this section, we consider to what extent the mayor result of zero rent effects extends to the local government more generally by analyzing the income patterns of the CMOs. Relying on an identical regression specification as in Fig. 4, but with CMO income as the main outcome variable of interest, we find strikingly similar patterns as for the mayors (see Table B.5c for details). As for the mayors, CMOs see a considerable increase in their income when assuming office. However, there is no additional hydropower effect (with a point estimate equal to zero). If anything, we see a negative petroleum effect, but which is almost exactly counteracted by a positive petroleum effect *before* the CMO enters office. Hence, there is no evidence that CMOs, in capacity of holding office, benefit from either local government hydropower or petroleum revenue windfalls.

5. Mechanisms, extensions, and robustness

Our main results suggest that, while hydropower and petroleum windfalls have profound local economy effects, there are no effects on mayor compensation. This stands in marked contrast to existing research on resource windfalls and political rents, as discussed in the Introduction. In this section, we first show evidence that endogenous voter mobilization may be a key accountability mechanism, that the information environment appears a key mediating condition, and that mayors' income responses seem to be conditioned on the information environment. Second, we show that our zero-rent finding on mayor (and CMO) outcomes is supported by indirect evidence from surveys on citizens' satisfaction with local public services and their general perception of local government corruption. Finally, we address several potential remaining concerns with the empirical identification.

5.1. Voter turnout

Windfall revenues imply that more is at stake for the voters, which is likely to trigger voter interest and participation, as discussed and shown in Andersen et al. (2014). We therefore begin by revisiting this result with our extended panel data.

As shown in Table 3, Column (1), local turnout in the municipal council election responds significantly to hydropower windfalls. The estimate suggests that a hydropower windfall of 25% relative to the average local government revenues increases local turnout with about 1.1 percentage points, amounting to about 1.6% of average turnout (67.5%). We check robustness by differencing out local turnout effects at the regional government election, which takes place simultaneously and within the same voting booth – essentially, a triple difference specification. This exercise even more flexibly accounts for potential local voter moods that might affect turnout in both elections, but also potentially biases down the local government election estimate to the extent that hydropower windfalls stimulate turnout also in the regional election (for example because the fixed cost of voting in the regional government election is sunk). The estimated effect on turnout, reported in Column (3), is positive and highly statistically significant, although the effect is now reduced by about one half. We see a similar pattern for petroleum windfalls, with positive estimates across both specifications, but noisier in terms of both effect size and precision. In sum, our results confirm those in Andersen et al. (2014), that hydropower windfalls indeed appear to mobilize voters in the local government election.

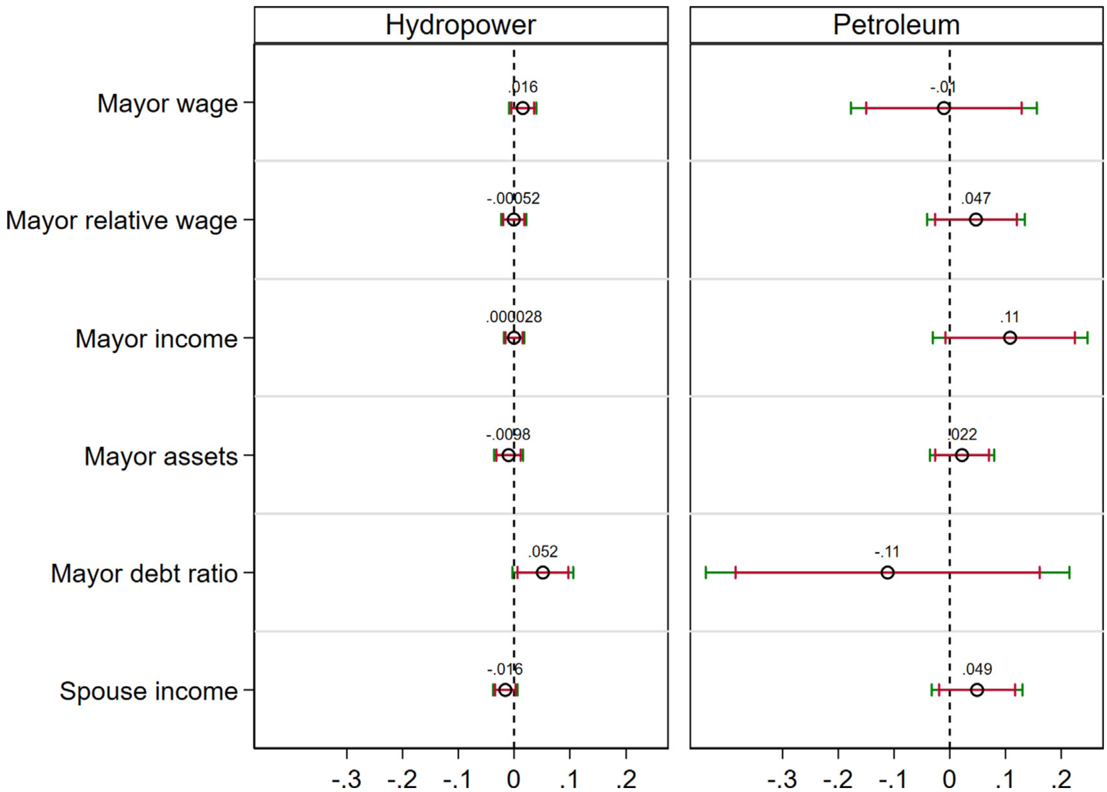

Fig. 4. Hydropower, petroleum, and the returns to office.
Notes. The diagram displays regression estimates indicating the effect of hydropower and petroleum revenue shocks on the mayors' returns to office. The estimates show the effect of a variable indicating whether the mayor is in office interacted with per capita hydropower production. The hydropower and petroleum variables correspond to windfalls amounting to an estimated 25% increase in local government revenues per capita (i.e., the "Windfall25Pct" variable in Eq. (2)). The diagram shows the point estimates (indicated in numerical format) as well as 95% and 90% confidence intervals, indicated by the green and red colors respectively. The standard errors are clustered on labor market regions. We present a complete set of estimates in Table B.5a.

Table 3
Hydropower and voter turnout.

	Voter turnout in municipal elections		Voter turnout in municipal elections less turnout in county elections	
	(1)	(2)	(3)	(4)
Hydropower25Pct	1.097**		0.484***	
	(0.394)		(0.0857)	
Petroleum25Pct	0.167		0.841**	
	(0.889)		(0.256)	
Revenues		0.103***		0.0587***
		(0.0157)		(0.0132)
Observations	5,230	5,230	4,772	4,770
R-squared	0.864	0.869	0.796	0.806
Number of mun.	479	479	476	476
Municipality FE	Y	Y	Y	Y
Region*Year FE	Y	Y	Y	Y

Notes. The table displays estimates on the effect of hydropower production on mayors' wages and income levels, measured on a log-scale. The response variables are described in Table B.1. The hydropower and petroleum variables correspond to windfalls amounting to an estimated 25% increase in local government revenues per capita (i.e., the "Windfall25Pct" variable in Eq. (2)). The table includes fixed effects (FEs) for municipalities and election years interacted with labor market regions. The standard errors (in parentheses) are robust standard errors clustered on municipalities.
Significance: *** p < 0.001, ** p < 0.01, * p < 0.05.

5.2. Information collection efforts

In the next step, we consider citizens' endogenous mobilization to inform themselves about local politics. As suggested by Andersen et al. (2014), citizens in Norwegian local elections have the incentive to pay attention to politicians' spending priorities. In addition, however, they may care about the potential for political rents. Both motives suggest that hydropower windfalls should be expected to increase citizens' influencing and information activities. The estimates in Table 4 use information on local newspaper consumption, as well as individual-level survey data on the extent to which a citizen has been in contact with local politicians or the

Table 4
Citizens' information and influencing efforts.

	(1a) Newspaper consumption (1972, 2000–2018)	(1b) Newspaper consumption (2000–2018)	(2) Politicians	(3) Administration	(4) Information	(5) Decision
Estimates:						
Hydropower25Pct	0.0503**	0.119	0.0358***	0.0271***	0.0179**	0.0277***
	(0.0175)	(0.0630)	(0.00544)	(0.00631)	(0.00637)	(0.00533)
Petroleum25Pct	0.0280*	0.0157	0.0221	0.0336	0.0225	0.0374**
	(0.0113)	(0.00971)	(0.0250)	(0.0227)	(0.0116)	(0.0135)
Observations	8,545	8,144	35,333	35,333	34,976	34,693
R-squared	0.786	0.812	0.046	0.044	0.055	0.028
Fixed effects	Municipality	Municipality	County	County	County	County
Estimates:						
Revenues	0.00338***	0.00333***	0.00393***	0.00294***	0.00159***	0.00258***
	(0.000526)	(0.000858)	(0.000372)	(0.000320)	(0.000286)	(0.000260)
Observations	8,466	8,065	34,528	34,529	34,184	33,893
R-squared	0.792	0.817	0.055	0.047	0.056	0.032
Fixed effects	Municipality	Municipality	County	County	County	County
Response variables:						
Mean	1.160	1.167	0.189	0.373	0.376	0.159
Standard dev.	0.345	0.345	0.391	0.484	0.484	0.366

Notes. The upper panel shows the estimated effects of hydropower and petroleum windfalls on citizens' newspaper consumption, information collection and influencing efforts. The hydropower and petroleum variables correspond to windfalls amounting to an estimated 25% increase in local government revenues per capita (i.e., the "Windfall25Pct" variable in Eq. (2)). The lower panel displays the estimated effects of local government revenues per capita (measured in 1000 NOK per capita, in current prices). Column (1) displays estimates on newspaper consumption, measured as average number of newspapers sold per household in each municipality. The models in (1) and (2) include fixed effects (FEs) for election years interacted with labor market region as well as municipality fixed effects. The analyses displayed in column (1a) exploit annual data for 1972 and each year in the period 2000–2018, while the sample in (1b) is restricted to the 2000–2018 period. Most of the data on newspaper circulation derive from The Norwegian Media Businesses' Association (*Mediebedriftenes Landsforening*, MBL), available from http://www.mediekatalogen.no/jsf/home/index.jsf. Additional data has been collected by The National Association of Local Newspapers (*Landslaget for lokalaviser*, LLA). The 1972 data on newspaper circulation is due to Høst (2005).
Columns (2) – (5) exploit individual-level survey data on contacts with politicians, administration; attempts to get information and to influence local government decisions. The survey questions were coded as 0 (no) and 1(yes), and were expressed as follows: **Politicians**: *Have you had contact with a politician in local government on issues of interest?* (In Norwegian: Hatt kontakt med en politiker i kommunen om saker som har opptatt deg?) **Administration:** *Have you had contact with a local government employee on issues of interest?* (In Norwegian: Hatt kontakt med en ansatt i kommunen om saker som har opptatt deg?) **Information**: *Have you attempted to get information from local government on issues of interest?* (In Norwegian: Prøvd å få tak i informasjon fra kommunen om saker som har opptatt deg?) **Decision:** *Have you tried to influence a decision in local government bodies?* (In Norwegian: Gjort noe for å påvirke en avgjørelse i kommunens styringsorganer?).
The survey data was collected by the *Agency for Public Management and eGovernment (Difi)*, and derive from four surveys conducted in 2010, 2013, 2015 and 2017. The regression models in (2)-(5) are linear probability models and include fixed effects for survey years and counties (N = 19). The models include additional individual level controls: education level (4 levels), civil status (4 levels), age (continuous) and gender. (The standard errors are robust standard errors clustered on labor market regions (in parentheses). The lower panel displays summary statistics for the response variables. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$.

local government administration, and whether she has attempted to get information on, or influenced, local government decisions.

Columns (1a) and (1b) – the difference being that the first column includes data both from 1972 and the period 2000–2018, while the latter only includes the most recent period – shows that hydropower windfalls indeed stimulate local newspaper consumption, albeit not statistically significant when excluding the 1972-observations. Specifically, according to the estimate in Column (1a), a hydropower windfall of 25% relative to average local government revenues per capita increases newspaper consumption per household by about 0.05 newspapers, amounting to an increase of almost 5% relative to the mean. The estimates on citizens' political influencing and information activity in columns (2)-(5) suggest that the propensity to engage in any of these activities increase by between 2% and 4%. Again, the estimates are qualitatively similar for petroleum windfalls: all positive and of similar size, but noisier and less precisely estimated (with statistical significance in two out of the six regressions). In sum, the estimates in Table 4 strongly suggest that government revenue windfalls significantly increase the overall amount of information sources that citizens pay attention to, via boosting local newspaper consumption. Moreover, citizens also increase the intensity by which they directly engage with local politicians and the political administration.

5.3. Mayors' conditional income responses

The evidence so far suggests that hydropower and petroleum windfalls increase citizens overall political activity and their information seeking efforts, but it remains unclear how, and to what extent, this in turn influences politicians' behavior. Focusing on political rents and accountability we therefore, in a final step, consider how the mayors' returns to office respond to the information environment. We focus on hydropower windfalls, as our petroleum sample is too small for informative heterogeneity analyses.

Our measure of the information environment is local newspaper consumption. Since about 1995, broadband internet has become increasingly available as an information technology. While local newspapers provided by a free and competitive press are commonly thought to be informative, the impact of the internet on the distribution of information is more contested (e.g., Matêjka and Tabellini, 2020). Hence, we split our analysis into separate pre-1995 and a post-1995 regressions, to consider whether the role of newspapers in mediating the effects of hydropower windfalls on mayors' return to office has changed with the changing information environment.

The results visualized in Fig. 5 focus on the pre-1995 period when newspapers were citizens' main source of media information about local politics. The graph displays the estimated marginal

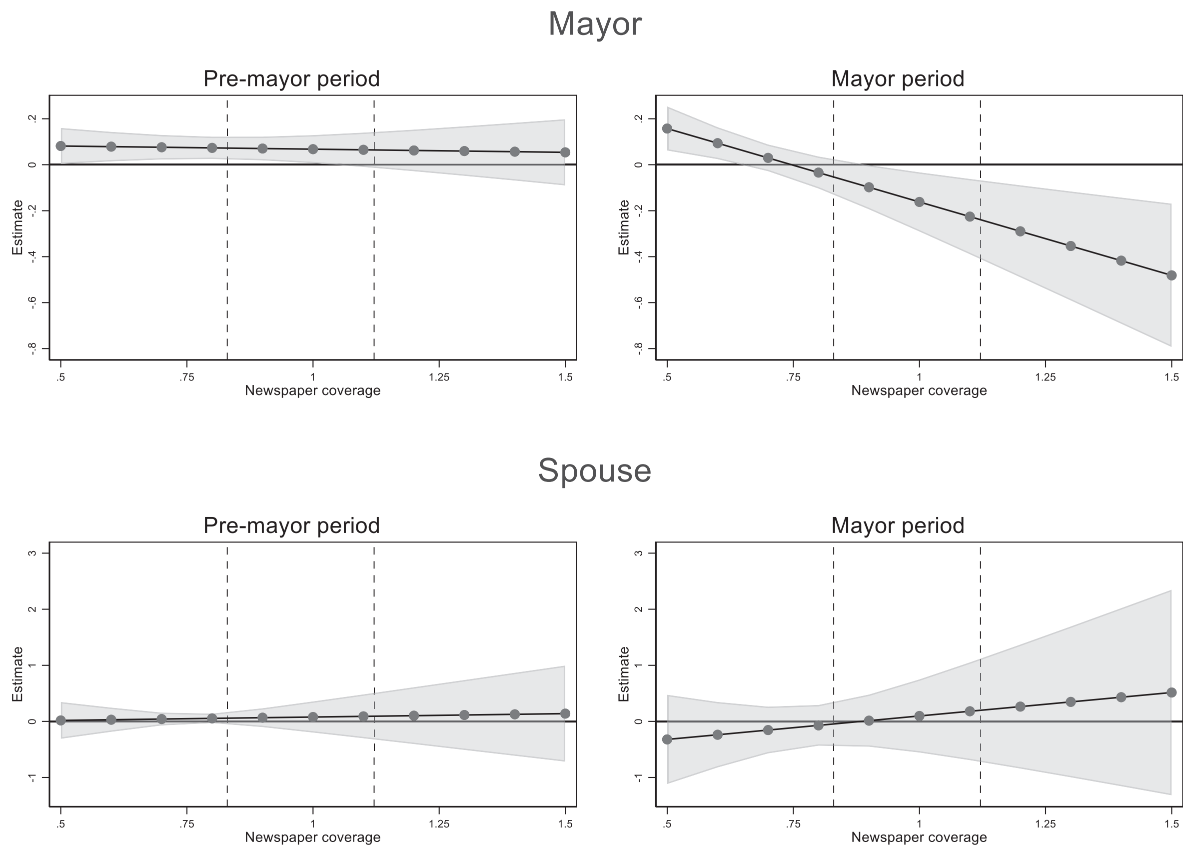

Fig. 5. Hydropower, newspaper coverage and mayor income
Notes. The diagrams display the marginal effects of hydropower production on personal income levels (1972–1995), conditional on newspaper coverage. The hydropower variable corresponds to windfalls amounting to an estimated 25% increase in local government revenues per capita (i.e., the "Windfall25Pct" variable in Eq. (2)). Newspaper coverage has been measured as number of newspaper subscriptions per household in 1972. The upper panel displays effects on mayors' incomes and the lower shows effects on the spouses' income levels, and we estimate the marginal effects for years before the mayor enters office and when she is in office. The estimates derive from regression models with fixed effects for labor market regions*year, and mayors' age. The dashed vertical lines indicate the 25% and 75% fractiles of 1972 newspaper coverage. The standard errors are clustered on municipalities, and the diagram shows point estimates and 95% confidence intervals. We display supplementary statistics in Table B.6b.

effect of hydropower production on overall income, primarily consisting of wage and private business income. We use newspaper consumption in 1972 as a fixed municipality characteristic, to condition mayor income responses on the level of local newspaper penetration in a way that is not endogenous to contemporaneous (throughout our sample period) hydropower windfalls. As before, the mayor income estimates are, on average, not statistically different from zero but less precisely estimated because we zoom in on heterogeneity within a smaller part of our sample (i.e., pre 1995). More interestingly, however, the graph suggests a clear negative local information gradient in the mayors' income responses to hydropower windfalls, also within the 25%-75% fractiles band of newspaper coverage (indicated by the vertical dashed lines), statistically significant at the 1% level.[34] As expected, this pattern is only evident for the periods when the respective mayors hold office (upper right panel), not in the years before they enter office (upper left panel), and it also only holds for the mayors' income, not for that of their spouses (bottom panels). The results in Fig. 5 are consistent with the interpretation that mayor wage formation in relation to hydropower windfalls may respond to citizens' (expected) information level, as suggested by, for example, Sandbu (2006) and Paler (2013). The more likely citizens are to be informed via local newspaper reading, the more moderate is the marginal effect of hydropower windfalls on mayor income. The negative information gradient disappears in the post-1995 period (see Figure A.10 and the accompanying Table B.6b) – the gradient is still negative, but much less steep and not statistically significant. This result is consistent with local newspapers losing its informational leverage in local politics with the rise of broadband internet use. Indeed, for the most recent and relatively short period of year 2000 to 2018, in which we have information on both local newspaper and broadband internet penetration, the steady increase in broadband coverage has been accompanied by a simultaneous steady decline in local newspaper circulation (see Figure A.11).

5.4. Indirect evidence on rents and corruption

Several studies from Brazil suggest that while resource booms in the form of oil windfalls boost local government budgets, there is indication that local public service provision deteriorates (e.g., Caselli and Michaels, 2013; Ferraz and Monteiro, 2014). This may be indicative of leakage, potentially suggesting substantial political rents and corruption. Because such leakage may be broadly

[34] All regression details may be found in Table B.6a, where the gradient in Fig. 5 is identified by the estimate for the interaction term in Column (2). Notice that the mayor income estimates in Fig. 5 and Table B.6a are robust to including additional interaction terms of the hydropower windfalls with citizens' average 1972 (pre-tax) personal income level as well as the 1972 population (results available upon request), suggesting that it is information rather than income and population size that is the key driver of the observed heterogeneity.

Table 5
Service satisfaction and corruption perceptions.

	(1)	(2)	(3)	(4)	(5)	(6)
	Satisfaction:			Corruption:		
	Place to live	Services	Difference: (2) – (1)	Central government	Local government	Difference: (5) – (4)
Estimates:						
Hydropower25Pct	0.415**	0.775***	0.380*	0.131	0.276	0.100
	(0.139)	(0.168)	(0.169)	(0.332)	(0.471)	(0.261)
Petroleum25Pct	0.925	0.755	0.0465	0.425	0.560	−0.466
	(0.628)	(0.741)	(0.393)	(0.756)	(0.675)	(0.786)
Summary statistics:						
Mean	81.2	68.8	−12.5	58.3	60.0	1.8
Std. dev.:	18.6	17.3	17.2	28.1	27.5	16.4
Observations	36,537	36,597	36,227	20,181	17,713	16,826
R-squared	0.029	0.054	0.017	0.026	0.016	0.022

Notes. The table displays regression estimates on satisfaction with the municipality "as a place to live" (1) and local government services (2; average score of satisfaction with: child care, pre-school services, primary schools, regular physicians, emergency health services, pedagogical-psychological services, child protection services, nursing institutions, nursing homes, social services, tax collection, planning- and construction services, fire department, public transportation and library). The response variables are measured on a 7-point scale from 0 (very deficient) to 100 (very good). In column (3), the response variable is measured as the difference between the service satisfaction and "place to live". As in Table 4, the survey data was collected by *Difi*. The questions on user satisfaction were included in the waves in 2010, 2013, 2015 and 2017. The response variables in columns (4) and (5) tap the perception of corruption in central and local government respectively. (Separate survey question for the central and local levels: "To what extent do you think that types of corruption, such as bribes and favoritism of friends and family, occur in the Norwegian public sector?") The responses were coded on a 7-point scale from 0 (very small degree) to 100 (very large degree). In column (6) the response variable is measured as the difference between corruptions perceptions in the local vs. central government levels. The questions on corruption perceptions were included in 2013, 2015 and 2017. The hydropower and petroleum variables correspond to windfalls amounting to an estimated 25% increase in local government revenues per capita (i.e., the "Windfall25Pct" variable in Eq. (2)). The regression model includes controls for respondents' gender, age, civil status, education levels, and fixed effects for survey years and counties. The table displays summary statistics for the response variables. The standard errors are robust standard errors clustered on labor-market regions (in parentheses). Significance: *** p < 0.001, ** p < 0.01, * p < 0.05.

distributed (via patronage and clientelistic spending and transfers, as suggested by, e.g., Robinson et al., 2006) and hence difficult to measure directly, indirect evidence on the quality of local government services may be informative. In our Norwegian setting, we have already shown that the revenue windfalls increase local government spending (Table 1) and work years (Table 2), as well as spending across all the major service sectors (Table B.4).

Despite these clear patterns, there could be a decline in the quality of public services, as perceived by the local populations. Exploiting the same large survey data that we used to produce Table 4 allows us to address this question directly, by regressing citizens' level of satisfaction with local government services on our hydropower and petroleum windfall variables. In Table 5, we first consider, in Column (1), survey responses on satisfaction with the municipality "as a place to live", and then, in Column (2), a variable capturing satisfaction with local government services. We see a clear positive correlation for both indicators, highly statistically significant for hydropower windfalls and non-significant for petroleum windfalls, and the effect is stronger for local public services. We then, in Column (3), take the difference between the two response variables to eliminate the potential leverage of local characteristics that may be related to hydropower and petroleum windfalls, but are unrelated to service quality. The difference-in-difference estimates suggest that hydropower and petroleum windfalls generate, if anything, a positive effect on satisfaction with local government services, conditional on the respondents' general satisfaction with the "place to live". Hence, our estimates diverge markedly from the evidence from Brazil, and we conclude that there is no indication that Norwegian citizens do not benefit from local government revenue windfalls, consistent with our zero-rents interpretation.

Finally, we consider citizens' perception of corruption in the central and local government, respectively. Consistent with our baseline results, the evidence in Table 5, columns (4) and (5), shows no indication that hydropower or petroleum windfalls make citizens more prone to perceive politicians as more (or less) corrupt. As all citizens across all municipalities face the same central government, variation across municipalities in how citizens perceive central government corruption may be interpreted as capturing differences in citizens' general tendency to perceive politicians as corrupt, independent of level of government and local government revenue windfalls (which indeed does not affect the central government budgets). Hence, in Column (6), we take the difference between local and central government corruption perception, to capture local government corruption perception over and above the general tendency of perceiving politicians as corrupt. Again, there is no significant tendency in the data that hydropower or petroleum windfalls imply that local politicians are seen as more (or less) corrupt.[35]

5.5. Additional robustness and remaining concerns

Our key identifying assumption is that the timing of the hydropower windfalls is unrelated to local economic and political trends affecting local government revenue. Flexibly controlling for regional trends – that is, the inclusion of fixed effects for labor-market regions interacted with years in our regressions – addresses the influence of any observed and unobserved trends within these regions, but not potentially unobserved and omitted trends that

[35] In an additional robustness exercise, we test for non-linear effects by including a linear as well as a quadratic hydropower windfall variable. This allows us to inspect whether: (1) reported satisfaction complies with standard economic theory of diminishing returns to scale and decreasing marginal benefit of public funds; (2) corruption is perceived as especially prevalent in municipalities collecting large or extreme levels of hydropower revenue. While consistent with economic theory of diminishing marginal utility (of public funds) we see clear evidence of the former (see Figure A.12), there is no evidence of the latter (i.e., both the linear and quadratic terms in the corruption specifications are close to zero and far from statistically significant).

are specific to a municipality. We therefore address remaining concerns with the identifying assumption in three ways. [36]

First, we conduct a lead-lag analysis where changes in local government hydropower revenues are regressed against leads and lags of hydropower capacity expansions so large that they plausibly can be ascribed to plant openings (see Figure A.8, left panel, for the resulting graph of lead-lag estimates and confidence bands, and the associated figure notes for further details). We see no evidence of systematic changes or trends in revenues before the timing of the hydropower shock, while we see substantial revenue increases in the first- and second year following the plant openings, before the revenues again stabilize at the new level (i.e., the changes in revenues revert to around zero after two periods). Notice that we see an almost identical pattern for changes in local government spending (Figure A.8, right panel), as to be expected given the balanced-budget requirements embedded in the institutional framework. [37]In sum, the observed pattern suggest parallel pre-trends prior to the shocks, the fiscal pass-through is limited to two years, and the revenue increase is permanent (that is, there is no evidence of a delayed fiscal contraction).

Second, one may worry that the timing of hydropower plant openings could be sensitive to political affiliations between local politicians that benefit from the plants and politicians and parties in the central government that have the political power to influence power plant decisions. We therefore analyze whether the timing of plant openings are related to partisan alliances between the local mayor and relevant cabinet ministers in central government. We identify municipality-years where mayors are politically matched with the energy minister or the prime minister and show that production startup is unrelated to these alliances (see Table B.7).

Finally, we exploit data on the production potential of protected waterfalls. Starting in 1973, the Parliament adopted a first protection plan for watercourses (‘‘*Verneplan for vassdrag*”), which was amended in in 1980, 1986, 1993, 2005 and 2009. The plan covers 389 watercourses, where both the level and growth of protected waterfalls are similar as we see for actual hydropower production (Figure A.13, left diagram). Importantly, the municipalities that experience that their watercourses are being protected are presumably very similar to those municipalities with the highest propensity of new hydropower plant additions. If we see a relationship between the protected watercourses and local government revenues similar to the relationship we see for the developed watercourses (our windfalls), this would be a threat to our empirical identification. We therefore, first, regress the 2019 revenue level against actual hydropower production and fixed effects for labor market regions and, second, plot the residuals from this regression against the production potential (measured on the same scale) in protected waterfalls. We see no indication of a correlation between the potential production from the protected resources and levels of local government revenue (Figure A.13, right diagram). This supports our identifying assumption that it is the hydropower development that raises local government revenue levels, rather than underlying local characteristics that are related to the potential for hydropower development.

6. Conclusions

Government revenue windfalls from natural resource extraction, foreign aid, intergovernmental grants, or elsewhere allow incumbents to both cater to the public and at the same time extract political rents for themselves. This is the core of a theoretical argument that has received substantial support in empirical studies. Political rents appear an inescapable cost of such windfalls.

We offer evidence to the contrary by showing that windfall revenues do not *necessarily* induce rent extraction by the local political elites. This finding is surprising, given that the Norwegian local government hydropower and petroleum windfalls do indeed trigger substantial increases in local government revenues and spending and that politicians enjoy wide discretionary powers, suggesting that the economic scope for rents is indeed large.

Our zero-rent finding should be understood in the context of deep-rooted legal and democratic institutions, including legislation that yield citizens an unusually high degree of information about politicians' incomes and public policy. For example, the Norwegian Freedom of Information Act offers the public extensive powers to claim public documents, which is particularly useful for reporters. Norway has a longstanding tradition for giving all citizens' access to the individual tax records, the country has been ranked number 1 on the ''Press Freedom Index" by *Reporters Without Borders*, and it is consistently ranked top-ten on the ''Corruption Perceptions Index" of *Transparency International*.[38]

Crucial for the interpretation of our results, information-seeking and influencing activities are endogenous to revenue windfalls. We show that citizens increase newspaper subscriptions following hydropower plant openings, and residents display greater propensity to contact and influence local politicians. These effects to not appear particular to the hydropower sector: Patterns are similar for petroleum windfalls, though less precisely estimated due to a substantially smaller sample size. Finally, exploiting geographical heterogeneity in newspaper circulation, we show that the better-informed local electorates tend to have mayors that benefit less in terms of own compensation from hydropower windfalls, particularly in the early period of our sample when newspapers were the most important source of information about local politics and the economy. Overall, our findings imply that a zero-rent society is feasible: Natural resource revenues do not necessarily inflate politicians' earnings or wealth.

Acknowledgements

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[36] Additionally, note that the mayor income results in Fig. 4 – for which we have the longest time series – are robust to a much simpler Eq. (1), Table 2-type of local government-level regression without mayor fixed effects, with a somewhat larger but still non-significant point estimate for the hydropower windfalls and a smaller point estimate for the petroleum windfalls (see Table B.11). Moreover, the results are robust to controlling for municipality-specific linear trends (Figure A.9a), removing fixed effects (Figure A.9b), excluding potential outliers in terms of very large per capita hydropower production (Figure A.9c), and clustering standard errors on mayors rather than labor market regions (Figure A.9d). Also notice that this type of difference-in-difference regressions with staggered treatments are vulnerable to estimation bias (e.g., Callaway and Sant'Anna, 2021; Jakiela, 2021). In our setting, this is more of a concern with the hydropower windfalls than with the petroleum windfalls (the latter taking place at a much lower frequency, resulting in a small sample of geographically disbursed shocks). We show evidence in Table B.9 that our main results are robust to restricting the analyses to subsamples where we observe only one individual mayor per municipality and excluding the post-treatment period to ensure that municipality-mayors remain exposed to hydropower treatment in all years following hydropower plant openings (''staggered treatment"). Moreover, in Table B.10, we show robustness to excluding the ''always treated" and the ''late observations" (post-2006), or both. We conclude that staggered treatment and heterogeneous effects do not appear to significantly bias are baseline estimates in Fig. 4.

[37] The parallel-trend assumption is often addressed by plotting trends before ''treatment" (plant openings). In our case, however, many municipalities have opened hydropower production prior to the observational period (1972-), and many are subjected to multiple revenue shocks, making it difficult to plot perfectly clean pre-trends.

[38] See https://rsf.org/en/ranking and https://www.transparency.org/en/cpi/2020/index/nor. Additional sources may be found in Footnote 4.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpubeco.2022.104650.

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