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Abstract

We use quasi-exogenous variation in the redistribution of natural resource tax revenues in Peru to study whether transfers to local governments can stimulate economic activity. Resource windfalls to non-extractive municipalities between 2006 and 2018 changed the size and composition of local government expenditures and had positive effects on local labor markets and household welfare. We find an increase in labor force participation, earnings, and formality in the private sector. The windfalls spur improvements in sectors that do not directly serve municipalities and especially benefit poorer rural areas, which experienced increases in household income and consumption, along with a poverty decline.

Keywords: government transfers, labor markets, rural economies, general equilibrium effects, Peru.

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1 Introduction

The effectiveness of fiscal policy in promoting economic growth has been the subject of a long-standing debate in economics since the ground-breaking work of Keynes (1936). When a local government receives an influx of resources, the literature identifies different channels that can be at work. On the one hand, transfers can generate positive multiplier effects through investments in infrastructure and demand of local inputs, leading to higher levels of formal employment, entrepreneurship, and household consumption (Corbi et al., 2018; Chodorow-Reich, 2019). On the other hand, public-sector expansion might crowd out private economic activity. Labor rationing can reduce local aggregate employment and result in an equilibrium with high unskilled wages that lowers productivity and deters entrepreneurship (Jaimovich and Rud, 2014; Albrecht et al., 2018; Cavalcanti and Santos, 2020; Girsberger and Meango, 2022; Breza et al., 2021).

In this paper, we study how plausibly exogenous transfers to local governments that affect the size and composition of municipal public expenditures affect local economies. In particular, we leverage a legal framework that allocates windfalls driven by the redistribution of natural resource tax revenues among non-extractive district in Peruvian municipalities between 2006 and 2018.[1] The stated aim of this policy was to help poorer areas in Peru to close poverty and infrastructure gaps through the fiscal redistribution of resource rents that were ring-fenced for public investment to promote local economic development.

This context offers an ideal setting to study fiscal redistribution. First, we examine a substantial fiscal shock to low-income municipalities: between 2006 and 2018, the Peruvian government redistributed USD 24 billion (2007 PPP), approximately 2% of the GDP of recipient regions annually. These windfalls represented over 20% of the median municipality's annual budget. The average recipient municipality is largely rural, poor, has limited tax and technical capacity, and operates with a small bureaucracy. Second, we exploit quasi-experimental variation in windfall intensity across time and space. Exposure to windfalls is set by a fixed rule from the central government, redistributing natural resource revenues to non-extractive district

[1] Districts are the lowest jurisdictional level in Peru. In 2005, Peru had 1830 districts across 196 provinces and 25 regions, with an average population of 23000 inhabitants per district. Municipalities are the governing bodies of districts.

municipalities (included in the analysis) within the same higher-level jurisdictional boundaries as extractive districts (excluded from the analysis). Windfall variation over time arises from shocks to commodity extraction in the same province and region, but in another district (extractive). The intensity of resource windfalls thus depends on jurisdictional rather than spatial proximity to extractive activities. Third, we construct a novel dataset to trace transaction flows within districts and economic development. We create a panel dataset spanning 2006–2018 combining administrative records for 1600 district municipalities, matched to a repeated cross-section of 700000 individuals and 200000 microenterprises interviewed in the national household survey.

We first show that nearly all windfalls convert to public expenditures, with spending shifting toward capital investment (USD 0.80 per dollar transferred), aligning with the ring-fencing of funds for this purpose. These windfalls also appear to strengthen municipal capacity, as we observe a positive impact on tax revenues and loans.

We use the resource windfalls in non-extractive districts as an instrument for local public expenditures, and identify two main channels through which they flow into local economies: the local procurement of goods and services, and the employment of municipal personnel to execute public infrastructure projects. A log-point increase in predicted public expenditures (consider that a standard deviation is 0.6 log-points) translates into the start of two additional productive infrastructure projects and almost half a project to promote social capital. Additionally, municipal human resources nearly doubled, primarily driven by low-skilled workers with fixed-term contracts hired for these projects.

We next investigate how local economies absorbed such a large shock to aggregate demand. Notably, inactivity is high in this context, with only around 65% of the labor force active at the beginning of the study period. With a log-point increase in predicted public expenditures, the likelihood of being employed relative to inactivity increased by 6.0 percentage points (ppts), with similar impacts across the public and private sectors, and the likelihood of working in the informal sector decreased by 1.0 ppts. Employment increased across all sectors, including services, construction, manufacturing, and agriculture, and for different occupations (i.e., employer, wage-employed, self-employed, and unpaid worker in home business). We further estimate an earnings elasticity of 0.05, with a larger magnitude in the agricultural sector (0.3).

We also find a boost in microenterprise activity, with a revenue elasticity of 0.07 for non-agricultural businesses and 0.33 for agricultural businesses, along with a rise in labor productivity. Revenue gains are mainly driven by entrepreneurs working on their own account and by farmers reliant on domestic labor. Notably, non-agricultural enterprises became 2.0 ppts more likely to own business premises, while the elasticity of landholdings for agricultural enterprises reached 0.24.

The estimated increases in employment, earnings, and investment, primarily in industries that do not directly serve municipalities, such as agriculture, provide evidence of positive multiplier effects. These effects are real rather than nominal, as all monetary values are adjusted using regional deflators. Moreover, we find no strong evidence of inflationary pressures within districts when examining wages and food prices, except for increases in housing values that benefit landlords. Real-term increases in earnings primarily benefit entrepreneurs. We find that several positive effects persist over time, particularly those on earnings and labor productivity in non-agricultural enterprises, along with a reduction in poverty from past resource windfalls.

We also show that the redistribution policy closed spatial gaps across and within districts. Districts in the underdeveloped highlands benefited more than the relatively more affluent coastal areas. Within districts, households in rural areas reaped the greatest benefits from the influx of resources. The impact on employment stands at 26.0 ppts (compared to 6.0 ppts for all households), and the earnings elasticity rose to 0.33 (compared to 0.05). These rural households experienced real-term income and consumption gains. We estimate an income elasticity of 0.60 and a consumption elasticity of 0.12, driven by increased spending on food and rent. Notably, we observe significant reductions in rural poverty: a 1.0 log-point increase in public expenditures decreases the likelihood of falling below the local poverty line by 11.0 ppts.

In support of our identification strategy, we conduct a battery of robustness checks. We highlight three important tests here. First, we show that the effects are not driven by spillovers or aggregate technological and productivity shocks experienced by nearby extractive activities, as the results remain robust when controlling for time-varying production of the nearest extractive activity. If anything, our results are stronger in districts farther from the nearest extractive activity. Second, we also find that the results are not capturing differential trends in the economy of extractive regions and provinces.

Finally, we exploit the fact that the redistribution formula creates a discontinuity in resource windfalls received by contiguous district municipalities along a region's border. Adjacent municipalities in different regions can receive substantially different amounts of transfers depending on the commodity produced in their region and the shocks these receive. We demonstrate that the results are robust, and even greater in magnitude, to the inclusion of boundary–year fixed effects, when restricting the sample to districts adjacent to a regional boundary.

This paper contributes to three streams of the literature. First, it adds to the literature examining the impact of regional transfers and public expenditures on local economies. We bridge the macro and micro literature by using quasi-experimental variation and fine-grain data to delineate the patterns that underpin multipliers. Our study delves into individual labor market outcomes, also capturing the informal sector, where the majority of economic activity occurs in low- and middle-income countries (LMICs). Furthermore, we map the flow of transactions from municipalities into the private sector, and estimate revenue gains and investment-led responses among enterprises, and income and consumption gains among households.

Overall, our findings suggest that resource windfalls to municipalities can generate significant positive spillovers in the local economy. Adjusting for transfer persistence, we estimate that for every dollar in resource windfalls, an additional USD 2.79–3.86 is generated locally. These estimates are slightly higher than fiscal spending multipliers derived from impacts on the formal economy (see, for example, the influential paper by Nakamura and Steinsson (2014) and the review in Chodorow-Reich (2019) for the US, and the multiplier estimated in Brazil's formal labor market by Corbi et al. (2018)), and are comparable to purchase multipliers from anti-corruption spillovers (Colonnelli and Prem, 2021). A possible explanation for the large fiscal multiplier is the presence of economic slack (Lewis, 1954; Walker et al., 2024). Overall, our findings indicate that the multiplier was driven primarily by increased *employment* of idle factors of production (extensive margin) rather than greater *utilization* of factors already engaged in production (intensive margin). We end by discussing the welfare implications of resource windfalls, considering the opportunity cost of factors of production, the distributional effects favoring rural and poorer households, and behavioral impacts that influence household utility beyond output.

Second, our research complements the growing body of literature studying the general equilibrium effects of exogenous shocks to labor demand and income in LMICs. While previous studies focus on household transfers (Angelucci and De Giorgi, 2009; Gerard et al., 2021; Egger et al., 2022) and employment programs (Imbert and Papp, 2015; Banerjee et al., 2021; Muralidharan et al., 2023), our focus shifts to public investment and the characterization of indirect beneficiaries in terms of location, sector, and job characteristics. Given that public expenditures in LMICs mainly involve purchasing or producing output rather than transferring funds to individuals, our analysis of a nationwide policy that increased local public investment provides a step forward in enhancing the external validity of recent research.

Finally, while a vast body of literature documents the effects of natural resources on economic development (Aragón and Rud, 2013; Loayza and Rigolini, 2016), evidence on the public sector's role in effectively channeling these resources remains mixed. Several studies report no or only modest impacts of commodity shocks on public service provision and living conditions. Research in Brazil attributes these modest effects to resource leakages from corruption (Monteiro and Ferraz, 2012; Caselli and Michaels, 2013), while studies in Colombia (Martinez, 2023) and Peru (Murillo and Sardon, 2024) emphasize the importance of institutional capacity, particularly through taxation. In Peru, recent research has found no effects on district-level connectivity to public services, poverty, or inequality (Aragón and Winkler, 2023). However, other studies highlight positive outcomes, such as improved school performance (Agüero et al., 2021) and increased municipal efficiency with large transfers (Maldonado and Ardanaz, 2023).

Our study takes a novel approach: by matching municipal data with individual-level data over a longer period, including the commodity price boom, and isolating the effects of municipal resource windfalls from extractive activity, we are the first to look at local labor markets and microenterprise activity, uncovering significant positive impacts that are reflected in household welfare, particularly in disadvantaged rural areas. In doing so, we provide new insights into how resource windfalls can improve outcomes for indirect beneficiaries, beyond those directly exposed to extractive activities.

The paper's structure is as follows. Section 2 provides background information about municipal resources. Section 3 describes the data and the empirical approach. In Section 4, we show the main set of results. In Section 5, we discuss the implications of our results. Section 6 provides the conclusions.

2 Background

2.1 Local resource windfalls in Peru

In 2005, Peru passed a law establishing that half of the natural resource tax revenues accrued from large-scale natural resource extraction activities and collected by the central government, known as the 'canon', had to be transferred back to local governments. Beneficiaries included governments in districts without extractive activity but within the same administrative division as districts that did have extractive activities.

In this setting, the canon resources constitute a plausibly exogenous change in the size of local government budgets and in the composition of public expenditures. The law established that the canon had to be redistributed to the regional governments and local (province and district) municipalities located in the jurisdictions where natural resources are extracted.[2]

To understand the canon's redistribution rule, it is important to note that Peru is organized into four levels of government: (1) a central government; (2) 25 regional governments; (3) 196 provincial municipalities; and (4) 1830 district municipalities. The redistribution criteria were established when the law was enacted in 2005 (Congreso de la Republica del Peru, 2019) and have remained unchanged since, as follows:

1. 10% goes directly to the district of the extractive activity, that is, the municipality where the extraction takes place;
2. 25% to all district and province municipalities located in the same province as the extractive district;

[2]The area of extractive activity is defined by the administrative boundaries within which natural resources are extracted, for example, where the electric power generation plant is located, where the gas fields are exploited, where the large-scale fishing landing places are located, and where the larger forest concessions or authorizations are located. If the extraction process takes place in more than one district, the canon is distributed among these extractive districts proportionally to the corresponding sales specified by companies.

3. 40% to all district and province municipalities located in the same region as the extractive district;

4. 25% to the regional government, destined for research and universities.

As the redistribution adds up, extractive districts receive the most. We identify non-extractive districts as those in which no extractive activity took place at any point during the period of study. Given the redistribution criteria, non-extractive districts located in the same province or region as extractive districts still receive relatively large resource windfalls.

The percentages of the canon in points (2) and (3) are redistributed using a poverty index in a progressive way, with higher weight given to poorer districts, but only among non-extractive districts. The poverty index uses information from the Population Census of 2005 (population and unmet basic needs, including lack of access to water, sewerage, and electricity), the Agricultural Census of 1994, the Census of Children's Heights of 2005, the District Registry of 2005, and the district's altitude above sea level. Notably, the values of the poverty index are fixed and were set before the start of the period of analysis.

The residual canon budget that is not used by the municipality in one year can be used in the following years, hence enabling municipalities to smooth investments by carrying over unspent funds.

The largest source of the canon between 2006 and 2018 in non-extractive districts comes from mining, approximately 60%, followed by gas (more than 24%) and oil (11.5%; see Figure A1). Figure C1 shows the spatial distribution of the main extractive activities in Peru that took place in the period of study, where we can observe that these are spread throughout the national territory. Mining activity is the most common, taking place across the highlands and coast of Peru. Oil activities are concentrated in a few districts in the Amazon and north-coast area, while gas activities take place only in two districts of the highlands, adjacent to the Amazon basin. Fewer than 1% of non-extractive districts are exposed to commodities other than minerals, highlighting the importance of mining activities.

[Figure 1 here]

Transfers from the central government to municipalities increased dramatically since the mid-2000s, driven mostly by the canon. Figure 1(a) shows that between 1997 and 2005, nationwide government transfers to non-extractive municipalities were below USD 1000 million in real terms. From 2005 onward, the increase in total government transfers is accompanied by the increase in the canon in non-extractive districts.[3]

At the beginning of the study period, the canon represented an average 18% of the budget of all non-extractive district municipalities, and almost half of this share corresponded to the mining canon. The importance of the mining canon increases over time, representing over two-thirds of overall resource windfalls in the following years. In 2007, the share of the canon over the total budget reached a peak, representing over 30% on average (the mining canon was almost 25% of the budget). There is great heterogeneity in the share of the canon from the overall budget across municipalities and years. During the commodity boom years, the canon represented around 10% of the budget for the bottom 10th percentile, and more than 40% of the budget for the top 75th percentile. The median municipality received resource windfalls equivalent to 20% of their annual budget (see Figure A2b).

Figure 1(b) shows the yearly distribution of resource windfalls. We can observe that most non-extractive municipal governments receive some canon (in all years, the municipalities in the 10th percentile receive non-zero resource windfalls). Furthermore, there is substantial dispersion across non-extractive municipalities, with top recipients benefiting more in years when the nationwide canon was larger. Even during the expansionary years associated with a commodity boom, canon realizations fluctuated within municipalities year-on-year.

Figure 2 illustrates the features of the canon's allocation formula. It depicts the evolution over time of the average windfalls for extractive municipalities, non-extractive municipalities within the same province as extractive municipalities, and non-extractive municipalities outside the province boundaries but within the regional boundaries of extractive municipalities. Three important observations arise. First, as expected, extractive district municipalities receive larger levels of resource windfalls, which spiked during the commodity boom years. Second, in line with the canon's redistribution criteria, non-extractive municipalities in the same province as

[3]The ability of district municipalities to collect taxes is limited, and thus they rely heavily on transfers from the central government. In 2015, only 12.1% of the total municipal budget came from local tax revenues, while 51.7% came from transfers from the central government, and 30.7% of those corresponded to the canon (Ministerio de Economía y Finanzas, 2016).

extractive municipalities receive more windfalls over time than those located only in the same region. Finally, for non-extractive municipalities inside the same province or regional boundaries as extractive municipalities, there is no systematic difference in the levels and trends of resource windfalls depending on their proximity to the closest mine.[4] This final point highlights how exposure to resource windfalls depends on jurisdictional rather than spatial distance from where the extractive activity takes place.

[Figure 2 here]

2.2 Windfalls and municipal expenditures

The resource windfalls we study are not perfectly fungible. They are ring-fenced for public investment to foster local development and improve living standards. District municipalities must spend most of these resource windfalls on capital expenditures, including the procurement of goods and services to undertake public works. Municipalities can only use up to 20% of the resource windfalls to fund current expenditures, which include labor and operation costs of new constructions and existing public infrastructure.

As such, the expenditures composition of municipalities is very different when comparing all sources with resource windfalls from the canon. Between 2006 and 2018, while on average non-extractive municipalities allocated almost half of their total budget to current expenditures, less than 20% of resource windfalls were allocated to this category, in line with the government guidelines (see Figure A3).

There are broadly three channels through which municipal expenditures driven by these resource windfalls can affect local economies. The first channel is through the local procurement of goods and services, including inputs and services provided by private contractors, to execute public projects financed by resource windfalls from the canon. The majority of resource windfalls in non-extractive districts are primarily directed towards local procurement of goods and services. Between 2006 and 2018, approximately 60% of resource windfalls were destined to this end. The remaining percentage of resource windfalls was destined towards investments and other types of expenditures. The distribution of resources across specific types is similar overall

[4]The sample here is restricted to all districts in 23 regions that have had at least one mining activity at any point between 2005 and 2018.

when comparing those funded by all resources with those funded by resource windfalls (see Figure A4).

The second channel is through developing and completing infrastructure that supports private-sector development, such as irrigation or other agricultural projects, transport and telecommunications (TTC), housing, water, sanitation and hygiene (WASH), energy, and other physical infrastructures. In the longer run, we can also expect social capital projects in the areas of education, culture and recreation, safety and security, social protection, and health, to enable greater productivity in the public sector. The canon resources grant municipalities full discretion over investments across these sectors, as long as the projects are deemed feasible by the local offices of public investment under the Ministry of Economy and Finance.

The third channel is through hiring municipal staff. The canon funds allow municipalities to hire staff to work on public investment projects. In Peru, municipalities frequently hire engineers and blue-collar workers directly for public works (State Comptroller of Peru, 2014), meaning that resource windfalls primarily boost demand for unskilled labor. Between 2006 and 2018, around 20% of the resource windfalls in non-extractive districts were destined to this end (see Figure A4). Municipalities are an attractive employer: they pay well and offer good benefits, which makes them competitive with private-sector jobs (Table A3).[5] By 2006, an average municipality had 50 employees and employed 22% of the wage earners in an average district. Public-sector expansion can lead to labor rationing, causing employment spillovers to private-sector workers in a slack labor market or increasing low-skilled wages, which may reduce or stabilize overall employment in a tight labor market (Breza et al., 2021).

3 Data and methodology

3.1 Data

We provide a novel link of several sources of administrative data with survey data, which allows us to explore how plausibly exogenous transfers to local governments

[5]Similar patterns in terms of attractiveness and composition of public-sector jobs have been documented in other Latin American countries (Albrecht et al., 2018; Cavalcanti and Santos, 2020) and Africa (Rud and Trapeznikova, 2020)

affect the size and composition of government expenditures and how these affect local labor markets and economies. We use data from non-extractive municipalities for the analysis. Appendix B provides definitions of the variables used in this study, indicating each data source.

3.1.1 Municipal and district data

We construct a panel dataset of over 1600 non-extractive districts using annual administrative reports from 2006 to 2018. Data on municipal budgets and expenditures are sourced from the National System of Financial Administration (SIAF, in Spanish) from the Ministry of Economy and Finance, which provides details on annual canon transfers and expenditures by type (e.g., capital or current). Through string analysis, we identify specific expenditure categories such as human resources, and goods and services. All monetary values are converted to US dollars using nominal exchange rates and adjusted to 2007 prices. The canon transfers are transformed using the inverse hyperbolic sine function. For expenditure data, we apply a log transformation to focus on the intensive margin, avoiding the unit-dependence of log-like transformations of dependent variables (Mullahy and Norton, 2024; Roth and Chen, 2024). Notably, fewer than 1% of canon and expenditure variables are zero.

We identify investments in public works using data from InfObras, a system of the State Comptroller that stores all records of infrastructure projects in Peru since 2012. All public agencies developing public investment projects are charged with registering the project and updating its development in the system.[6] We have data from 63000 projects implemented in study municipalities on the inception, start and completion dates, as well as the type of project: (i) productive, including agricultural, TTC, housing, WASH, energy, and other physical infrastructure; and (ii) social capital, including education, culture and recreation, safety and security, social protection, and health. We compute the number of projects started and completed out of those active per year for the 1,600 non-extractive districts in the analysis.

We match these data to the Registry of Municipalities (RENAMU, in Spanish) in order to measure public employment. This dataset is available since 2004 and includes information on the stock of human resources by occupation (i.e. manager, professional,

[6] Norm N° 007-2013-CG/OEA.

technical worker or support, which includes administrative assistants and blue-collar workers), and type of contract (i.e. permanent or fixed-term contract).

To conduct robustness checks, we use two main data sources. To capture extractive activity near to non-extractive districts, we use data on mining production from the annual reports of the Ministry of Energy and Mining, and on international prices collected from Bloomberg. Using the reported volumes and commodity prices, we compute the monetary values of the 13 minerals produced in Peru, for every district and year. Then we convert these into US dollars using nominal exchange rates and set them to 2007 US prices in real terms. We further use spatial data on administrative boundaries and geo-coded location of extractive activities provided by the Ministry of Energy and Mining to compute the distance from each district's centroid to the closest mining extractive activity. Extractive activities are relatively distant from non-extractive districts, with the average district being 50 km away from the nearest mine. This distance is significant given the underdeveloped transportation networks outside of Peru's coastal strip (Table A2, Panel A).

To characterize districts and control for the poverty index used to redistribute the canon within non-extractive districts inside extractive provinces and regions, we use data from the 2005 Peruvian Individual and Household Census. By 2005, an average non-extractive district had roughly 14000 inhabitants, out of which more than half were living in rural areas. Population density in these districts is very low, at 90 inhabitants per km^2, compared to the national average of 363 inhabitants per km^2. Access to public services was quite limited, with an average district having only 20% of households with sewerage connectivity, and half with piped-water and electricity connectivity. Only in 20% of households have the household heads completed secondary education, and 57% have at least one unmet basic need (Table A2, Panel A).

3.1.2 Individual and household data

We use data from the Peruvian Living Standards Survey (ENAHO, in Spanish), an annual household survey collected by the National Statistics Office (INEI, in Spanish). We build a repeated cross-section of more than 700000 individuals living in roughly 1300 districts surveyed between 2006 and 2018, and a subsample panel of more than 260000 households surveyed at least twice between 2007 and 2018. We use data spanning 2003–2005 to conduct robustness checks. This survey is collected on a continuous, rolling, basis, guaranteeing that the sample is evenly distributed over the course of the calendar year.[7] The survey consists of a stratified household sample representative at the regional level, and includes unique district identifiers, enabling us to match the survey data with municipal-level data.

ENAHO collects individual-level data on labor force participation, earnings, and income sources, as well as household-level data, including consumption and poverty.

We use the labor module, collected for all household members above 14 years of age, which includes data on whether the individual was working during the previous week, has a second job, number of hours worked in the last week, the type of job, sector (i.e., public or private), and industry (including codes corresponding to the International Standard Industrial Classification (ISIC)).

Using the ISIC codes, we classify individuals by aggregate economic activities or industries: (i) agriculture, fishing and forestry (henceforth agriculture); (ii) services; and (iii) manufacturing and construction. Furthermore, we classify individuals by type of job: employer, if they own a firm or land and supervise people (e.g. agriculture, construction, mechanics, hospitality, transportation); wage-employee, if they work for a firm (e.g. permanent worker in agriculture or construction); self-employed, if they offer services as an independent contractor (e.g. farmer or household maintenance); and unpaid work, if they conduct unpaid work in their family business (e.g. agriculture or mechanics). Most wage-employed work takes place in services or manufacturing, and only 17% of those in the agricultural sector are wage-employed.

The labor module also includes information on whether individuals are working in the informal sector, defined by the INEI in three stages. In the first stage, individuals are identified as working in the informal sector if they work for a business in the household premises that is not registered with the tax authority.[8] In the second stage, all wage-employed individuals who do not enjoy working benefits in line with the national labor normative are considered informal workers. Finally, informal workers are those wage-employed individuals whose employer does not contribute to the

[7] The INEI changed the methodology used to collect the ENAHO in 2003. Prior to this, labor market outcomes were collected only during the final trimester, and the sampling was based on the outdated 1993 census.

[8] Between 2007 and 2011, for wage-employed, this information was obtained from self-reports of whether the business they work for has accounting books.

national health insurance system on their behalf.[9]

Furthermore, we use ENAHO data on earnings, income, and consumption, annualized and adjusted for spatial price variations using local deflators (by region and urban/rural area). We apply a log transformation to these variables and focus on the intensive margin. Particularly, we use data on earnings collected at the individual level, encompassing earnings from both primary and secondary occupations, including wages and profits from businesses. Income extends further to include rental income and other exceptional income sources, including bonuses, dividends, and other compensations. Both earnings and income account for the values of both cash and in-kind payments. ENAHO's household consumption module covers food (both at home and outside), rent, durables, and non-durables (e.g., clothing, healthcare, TTC, leisure, and miscellaneous expenses), regardless of acquisition method.

Additionally, we obtain data on local prices from ENAHO. Housing prices are measured through homeowners' self-reported estimates of potential monthly rental values, as nationwide data on actual land and rental prices in Peru are unavailable. For consumer goods prices, we use data from the consumption module on the quantity and value of food consumed by households in the two weeks before the survey, calculating unit prices per kilogram for 310 food items based on over 8 million household–product observations. Following Egger et al. (2022), we construct linear log-price indices for food products, weighted by household expenditures shares. Food products are classified as less tradable if they are among the top 10 food groups consumed as self-produced goods within each region. We use 2006 regional expenditures shares as weights, as ENAHO data are representative at the regional level. The final dataset includes food price indices for a repeated cross-section of over 200000 household observations.

Additionally, the survey includes data on households' poverty status, which is determined by INEI based on their ability to afford a local basic basket of goods and services. Households are classified as poor if their per capita monthly consumption falls below the cost of the local basket. Poverty status is assessed using a regional and urban/rural-specific poverty line.

By 2005, 64% of surveyed individuals were employed. Among those, 42% were

[9] This information is not available between 2007 and 2011, so we set as informal all individuals working without a formal contract.

female, 43% had at most some primary education, 38% had some secondary education, and less than 20% had tertiary education. On average, workers were 38 years old, the youngest were underage (14 years old) and the oldest were elderly (95 years old). Workers on average earned roughly 7000 soles annually (2363 in 2007 USD), but there were significant disparities, with the highest annual earnings exceeding 21000 soles (73945 in 2007 USD). Labor markets were highly informal, with 87% of workers engaged in activities in this sector. Half of the households fell below the poverty line, and almost 40% lived in rural areas (Table A2, Panel B).

The public sector is an attractive employer. In 2005, public employees earned more, on average, than those working in the private sector: a wage regression controlling for individual characteristics of the workers shows a public-sector premium of around 7% (Table A1). The educational composition of public workers is skewed towards highly educated workers, with 70% of the public labor force having attained tertiary education. In contrast, the private sector is mainly composed of workers who have attained at most secondary education. There is variation along the different types of jobs. Among employers and wage-employees, more than 20% have attained some tertiary education, while this drops to 11% for the self-employed and 7% for those in unpaid work in a household business. More than half of self-employed and unpaid workers have only attained at most primary education. While the public sector is gender-balanced, women are in the minority among employers (23%) and among wage-employees and self-employed (above 30%), whereas they are an overwhelming majority among unpaid workers (70%). The private sector suffers from high levels of informality. Almost all self-employed and unpaid workers are informal, and even among employers and wage-employees, informality reaches above 80% of the labor force (Table A3).

ENAHO also has a household panel component that contains around 30% of the full sample in overlapping four-year cycles. We use this subsample to conduct robustness checks.

3.1.3 Enterprise data

Peru's labor market is notably dependent on self-employment and the creation of microenterprises, more so than other countries in the region (World Bank, 2023). As such, we use data on microenterprise activity from the ENAHO module on businesses.

We use a repeated cross-section of approximately 140000 non-agricultural microenterprises operating across Peru between 2007 and 2018. This dataset includes information on production, retail, and service businesses, covering monthly revenues, employee counts, and business premises ownership. These data allow us to measure labor productivity and investment, adjusted to real terms using 2007 USD prices. Notably, 66% of non-agricultural microenterprises consist of self-employed individuals, and 34% own their premises, with 85% based in urban areas.

For agricultural microenterprises, we draw on data from over 67000 businesses operating in major agricultural regions (coast and highlands) over the same period. This survey collects details on crop quantities harvested over the past year and parcel sizes, enabling the construction of agricultural output, labor productivity, and investment measures. Real agricultural revenue is calculated using a Laspeyres index, weighted by the median 2007 crop price of each crop within its region. Labor inputs include both hired labor, measured by self-reported wage bills, and domestic labor, assessed through household members working in agriculture. Landholdings are determined by the total parcel area used for crops. Among agricultural microenterprises, 70% operate in rural areas, with half relying solely on domestic labor.

Additionally, we use district-level data on end-of-year formal firms, workers, and mean salary by industry from the system of electronic payrolls from the tax authorities in Peru (SUNAT, in Spanish). Since 2014, all formal firms are required to register and update employee and third-party records in this system. An important limitation of these data is that they cover only the formal sector, while, on average, 87% of the district workforce is estimated to be in the informal sector (Table A2).

3.2 Empirical strategy

3.2.1 Specification

We first estimate the effect of resource windfalls using the following specification:

$$G_{dt} = \alpha R_{dt} + \gamma_1 x'_{it} + \theta_d + \delta_t + \epsilon_{dt}, \tag{1}$$

Here, R is the amount of resource windfalls that non-extractive district d receives in year t, expressed in logs, G_{dt} is the level of public expenditures in the municipality of district d in year t, expressed in logs, and θ_d and δ_t are district and year fixed effects, respectively. Given the inclusion of district fixed effects that control for time-invariant district characteristics and year fixed effects that control for common shocks per year, the effect is identified from district-specific deviations in expenditures from the district averages.

We exploit the quasi-exogenous variation in resource windfalls in non-extractive districts as an instrument for local public expenditures. Equation (1) thus serves as the first stage. For a given district municipality, we study the effect of year-by-year variation in municipal expenditures on outcomes using a two-stage least-squares estimator (2SLS) as follows:

$$Y_{idt} = \beta \hat{G}_{dt} + \gamma_2 x\prime_{it} + \theta_d + \delta_t + \xi_{dt}, \qquad (2)$$

Here, Y_{idt} is the outcome of district d or individual i living in district d and year t, and $x\prime_{it}$ is a vector of controls included in individual-level regressions: household size, educational attainment, and indicators for whether the individual is the household head, married, and female.

Because the endogenous variable captures treatment intensity, there is more than one counterfactual scenario and, hence, more than one causal effect for a given district municipality: the effect of going from 0 to positive expenditures, and from there to further increases or decreases. Hence, there are $g_{\max}$ causal effects because g takes on values in a continuous set. The 2SLS estimates are therefore a weighted average of the unit causal response along the length of the potential causal relation. The unit causal response is estimated on the compliers: district municipalities that change public expenditures because they experienced a shock to resource windfalls.

3.2.2 Internal validity

We focus on non-extractive municipalities (i.e. those that never had any extractive activity within their boundaries during the study period) to address concerns about the direct effects of extractive activities on local economies or the potential for reverse causality in areas involved in commodity extraction where Peru is a global leader.

The quasi-exogenous variation that we exploit in resource windfalls in non-extractive districts comes from two sources: exposure and shocks to resource windfalls.

Exposure to resource windfalls follows the redistribution rule set by the central government in the canon law. As presented in Section 2, the level of exposure is determined by a district's jurisdictional relation to an extractive district, namely whether it is in the same province or region, and the number of other districts in the jurisdiction with which revenues are shared. Key to the identification strategy, this redistributing rule was defined prior to the study period and has not been modified since. Although the redistribution of the canon within provinces and regions was pro-poor, the poverty index used in this redistribution was also fixed over time, and hence it is captured by the district fixed effects and not endogenous to the labor market outcomes we study.[10]

Shocks to resource windfalls come from fluctuations in the production value of extractive districts located in the same jurisdiction as non-extractive districts. During our study period, these changes were largely driven by fluctuations in commodity prices set internationally. Figure C2 shows that the over-time dynamics of nationwide resource windfalls follows closely that of mineral prices and, although slightly less closely, that of oil prices. Resource windfalls in non-extractive districts achieve a first peak in 2008, when there is also a peak in both mineral and oil prices, and then drop down again in 2009, and increase up to 2012, around the commodity boom. They fall again until 2016 and start increasing afterwards, just like mineral prices.[11]

The validity of the exclusion restriction lies on the resource windfalls in non-extractive districts affecting local labor markets and the economy only through municipal expenditures. The variation in resource windfalls is similar to the approach of a quasi-experimental shift-share design (Borusyak et al., 2021). The canon in Peru has already been used in economics research as shocks exogenous to human capital formation (Agüero et al., 2021).

If the shocks to the values of natural extraction are as good as randomly assigned

[10] We show in Section 4 that poverty-specific trends in outcomes are not driving the results.

[11] Figure C3 shows the growth in international prices for each of the main six main minerals produced in Peru, and confirms the over-time patterns summarized in the mineral price index presented in Figure C2. This plot also demonstrates that mineral prices tend to fluctuate in unison. Table C1 presents the exposure to different commodities within provinces and regions.

to non-extractive districts across years, we expect them to not predict pre-determined outcomes. Tables D1 and D2 show that there is indeed no statistically significant effect of the changes in future resource windfalls (between 2006 and 2018) on the initial level of municipal human resources and individual labor market outcomes in non-extractive districts. Figures D3 and D4 provide evidence supporting the absence of pre-trends from future canon.

We alleviate further concerns by conducting a battery of robustness checks, presented in Tables D3 and D4. First, we rule out the possibility that the effects are driven by endogenous changes in commodity production, potentially spilling over into non-extractive districts, rather than internationally set prices. We demonstrate that the results remain robust when controlling for the time-varying value of production from the nearest extractive activity.

Secondly, we exploit the discontinuity in resource windfalls received by contiguous municipalities along a region's border, as created by the redistribution formula.[12] This variation arises because different regions are exposed to shocks to different commodities in different years. By focusing on districts adjacent to these regional boundaries, as shown in Figure C4, we demonstrate that our results remain robust to including boundary–year fixed effects. This approach allows us to compare non-extractive districts across borders that follow similar trends in unobservables and that are equidistant to extractive activities, but differ in changes to their resource windfalls. This test reduces concerns that resource windfalls simply capture aggregate technological and productivity shocks from neighboring extractive activities, as such shocks are unlikely to align with administrative boundaries.

Thirdly, we alternatively employ a shift-share instrument for *non-extractive* districts computed using data on mineral production and international prices, and adhering to the established redistribution rule, as follows:

$$z_{dt} = \sum_n s_n \frac{1}{D_n} \left(\sum_k Q_{d'kt} P_{kt} \right).$$

The exposure shares include s_n, the redistribution weight associated with either province or region n (0.25 or 0.4, respectively), and D_n, the number of districts in either province or region n. The shocks are driven by $Q_{d'kt}$, the quantity of commodity

[12] We use the regional border IDs developed by Aragón and Winkler (2023).

k produced in *extractive* district d' in year t, and P_{kt}, the international price of commodity k in year t. This shift-share instrument is highly correlated with the resource windfalls (0.72, significant at the 1% level) in mining regions. Our findings indicate that the effects on individual outcomes are stronger using this instrument, likely because it corrects for attenuation bias due to measurement error in the administrative data on resource windfalls.

Lastly, we rule out the possibility that our results are driven by region-, province-, or initial poverty-specific trends, or by oil and gas regions that might benefit directly from local extraction. For individual-level outcomes, we address unobserved household and worker heterogeneity by including household and individual fixed effects in the subsample panel data.

The stable unit treatment value assumption (SUTVA) is likely to hold in our context. Notably, district municipalities are restricted to investing in projects within their jurisdictional boundaries. Moreover, the sparse population of our study districts (91 per km^2 on average) limits mobility.[13] Limited transportation connectivity outside Peru's coastal strip makes commuting across districts difficult, especially for the predominantly rural inhabitants of the analyzed districts. While there is a concern that resource windfalls might attract workers from other districts, it is important to note that the ENAHO assigns individuals to their district of residence rather than their district of work. Thus, any feasible commuting is unlikely to drive the results. We also demonstrate that our results remain robust when excluding the most populated districts where commuting is more feasible (Tables D3 and D4). Although migration could be a remaining concern, Table D5 shows no effects on migration or selective migration based on the socio-demographics of the surveyed population.

4 Main results

4.1 Transfers and municipal outcomes

We start by showing how the resource windfalls change the size and composition of municipal public expenditures in Table 1. The dependent variables by column are: (1)

[13]For comparison, Egger et al. (2022) examined rural villages with a population density of 393 inhabitants per km^2, highlighting the relative sparsity of our districts.

total expenditures; (2) capital expenditures; (3) current expenditures; (4) any expenditures (capital or current) on human resources; and (5) any expenditures (capital or current) on goods and services. We present the estimates of Equation (1) in logs (Panel A) and levels (Panel B). For the latter, we use variables that have been winsorized at the top 10 percentile to deal with outliers.

[Table 1 here]

The public expenditures elasticity stands at 0.10, representing the first-stage result.[14] With an estimated budget elasticity of 0.09, this indicates that a significant portion of the budget increase due to the canon is utilized. In fact, each dollar of resource windfall translates to 97 cents in public expenditures. As explained in Section 2, these resource windfalls are allocated to municipal budgets, and unspent funds can be used in subsequent years, allowing for spending smoothing.

Resource windfalls primarily boost capital expenditures, with an elasticity of 0.14, compared to 0.06 for current expenditures. Each dollar of resource windfall translates to 80 cents in capital expenditures, as expected, because the canon funds are earmarked for public works. Notably, resource windfalls increase any type of spending (capital and current) on municipal human resources and local goods and services. All estimated effects are significant at the 1% level.

Furthermore, we find no evidence that resource windfalls crowd out other municipal budget sources, such as local taxes and loans. On the contrary, these windfalls enable municipalities to expand their budgets, with the elasticity of tax revenues and loans relative to resource windfalls at 0.04 and 0.10, respectively, on the intensive margin (Table C2).

We turn our focus to further understanding the channels through which resource windfalls stimulate local economic activity. Throughout this analysis, we report only the 2SLS estimates (β) using resource windfalls as an instrument, following Equation (2).

Table 2 shows the 2SLS estimates of the effect on the number of public works started (columns 1 and 2), and the rate of completion, measured as the number of infrastructure projects completed over those active (columns 3 and 4).

[14] The Sanderson–Windmeijer F-stat of excluded instruments is equal to 132, way above the Stock–Yogo weak ID F-test critical values for the 10% maximal IV–OLS size distortion (16.4).

[Table 2 here]

A log-point increase in predicted public expenditures (consider that a standard deviation is 0.6 log points), on average, translates into the start of almost two projects (1.9) for productive infrastructure and half project (0.4) to promote social capital. Compared with the initial mean, productive infrastructure projects more than tripled and social infrastructure projects almost doubled. Notably, we observe interesting dynamic effects, whereby both contemporaneous (R_t) and past resource windfalls (R_{t-k}) have a positive and significant effect on the start and completion rates of infrastructure projects (Table E1).

Next, we estimate effects on municipal human resources. Table 3 presents 2SLS estimates of the effect of public expenditure on total human resources (column 1), and on the number of managers (column 2), professionals (column 3), technicians (column 4), support workers (column 5; including administrative assistants and blue-collar workers, such as supervisors and workers on construction sites), and on the share of permanent staff rather than those hired through fixed-term contracts (column 6). It is important to note that, by the beginning of the study period, an average municipality was staffed with 51 workers, and more than half of these were support workers including administrative assistants and blue-collar workers that municipalities often hire directly to implement public works through temporary contracts.

[Table 3 here]

We find that a log-point increase in predicted public expenditures increases municipal human resources by 50.1, which means that it doubles the amount compared with the initial mean. This increase is primarily driven by support workers (38.3 additional workers, 1.5 times with respect to the initial mean), which changes the composition of human resources away from managers and in favor of these lower-skilled workers. There is also a positive effect on skilled workers, as professionals and technicians increase by 5.0 (86.9%) and 6.0 (42.6%) workers, respectively. Furthermore, public expenditures pushed by resource windfalls decreases the share of those permanently hired by the municipality (-0.25).

Dynamically, past resource windfalls have a negative impact on municipal staff, driven mainly by reductions in support workers and technicians. Many hires are temporary and tied to the duration of the public works projects (Table E1). These findings align with the observation that the canon funds are not universally fungible, as they are restricted to specific uses such as labor expenditures linked to public investment projects.

Furthermore, we find no evidence of pre-trends in overall municipal human resources (the only municipal outcome for which we have data available from 2004, before the implementation of the canon law). We observe this by plotting the coefficients of interaction terms for year dummies with districts' mean resource windfalls between 2007 and 2018, from regressions that include district and year fixed effects, with the sample period running from 2004 through to 2018, having 2006 as the reference period (see Figure D3).

In Appendix D we show how the effects on municipal-level outcomes are robust to the checks described in Section 3.2.2.

In both Tables 2 and 3, the 2SLS estimates are almost three times larger than the OLS estimates. This difference can be explained by how differently the resource windfalls are used, compared with others sources of municipal budget. Because the canon funds are designated for public investment only, these resource windfalls can stimulate local economies by increasing demand for labor and goods and services during project implementation, and once projects are completed, these can boost productivity in the private sector. Table C2, Panel A, shows the OLS and the reduced-form results for all outcomes at the municipal level.

4.2 Labor markets

In this section, we investigate effects on local labor markets. Throughout this analysis, we continue reporting only the 2SLS estimates (β) using resource windfalls as an instrument, following Equation (2). Table C2, Panel B, show the OLS and the reduced-form results for all outcomes at the individual level.

[Table 4 here]

Notably, inactivity is high, with only 65% employed by 2006. Table 4, column 1, shows that a log-point increase in predicted public expenditures increases the likelihood of working, compared with being inactive, by 6.0 percentage points (ppts). The effect on employment is present in both the public (2.0 ppts) and private sector (7.0 ppts), and we find no differential effect in participating in one sector over the other. Although small in magnitude, we also find a significant decrease in the likelihood of working in the informal sector by 1.0 ppts, as opposed to in the formal sector. Among those employed, we estimate that the elasticity of earnings stands at 0.05.

We then investigate the effects on employment (columns 1–3) and earnings (columns 4–6) in different industries, as shown in Table 5. We observe impacts in industries that do not directly sell to local municipalities, consistent with multiplier effects within local economies. A one-log-point increase in predicted public expenditures increases the likelihood of employment in the service sector by 4.0 ppts, in manufacturing and construction by 2.0 ppts, and in agriculture by 10.0 ppts, compared with inactivity. We also find differential effects on participation in one industry over another (Table E2): a 4.0 ppts increase in the likelihood of working in the service sector compared with the construction and manufacturing sector, and a 2.0 ppts decrease in the likelihood of working in the service or manufacturing and construction sectors (non-agricultural) compared with the agricultural sector. When excluding unpaid workers, we find no difference in the likelihood of working in the non-agricultural compared with the agricultural sector. Furthermore, we identify a significant earnings elasticity in the manufacturing and construction sector (0.08) and the agricultural sector (0.33).

[Table 5 here]

In Table 6 we turn to effects on employment in different types of jobs in the private sector (columns 1–4). A log-point increase in predicted public expenditures increases the likelihood of working as an employer by 1.0 ppts, as wage-employed by 3.0 ppts, as self-employed by 4.0 ppts, and in unpaid work by 14.0 ppts, compared with inactivity. It is important to note that our findings reflect shifts in the composition of labor markets rather than transitions into different jobs or industries.

[Table 6 here]

Some of these estimated effects persist over time. While the effect on employment is not sustained, the positive effect on earnings remains. Additionally, both contemporaneous and past windfalls positively impact hours worked, with similar magnitudes. Notably, the drop in informality is reversed with past resource windfalls. The positive effect on unpaid work also persists over time, though past windfalls have a smaller effect compared to contemporaneous windfalls (Table E1).

We find no evidence of pre-trends when plotting the coefficients of interaction terms for year dummies with districts' mean resource windfalls between 2006 and 2018, from regressions that include district and year fixed effects, with the sample period running from 2003 to 2018, having 2005 as the reference period (see Figure D4). Interpreting the annual effects from the average canon is complex as the canon was dynamic, so we refrain from interpreting the post-event coefficients from the event study. Yet, it is important to highlight the trend break after the canon is introduced, which aligns with our main findings. In Appendix D, we demonstrate that the effects on individual-level outcomes are robust to the checks described in Section 3.2.2.

The effects are not driven by spillovers from neighboring mining activity; in fact, the point estimates are larger in districts located further from mines. We computed the distance from each municipality's centroid to the nearest operating mine during the study period and re-estimated effects for each distance quartile. Results in Figure 3 show that employment outcomes, including employment rates, wage employment, and earnings, are comparable to or greater in municipalities farther from mining activities; see panels (a)–(c). This trend is also evident in employment across different sectors (services, agriculture, manufacturing, and construction; panels (d), (e), and (f), respectively), suggesting that these industries are not significantly benefiting from increased demand due to nearby mining operations. A similar pattern is observed for municipal human resources (see Figure D1). Note that lower distance quartiles refer to districts within 20–35 km of a mine. Although the distance seems relatively close, rugged terrain and limited transportation infrastructure in the highlands can result in considerable travel times.

Beyond validating our identification strategy, Figure 3 highlights an interesting heterogeneity: labor demand shocks from municipal resource windfalls are more effective in mobilizing individuals out of inactivity and increasing earnings in non-extractive districts farther from mines. These districts were initially disadvantaged, having a higher proportion of rural populations, limited access to piped water and sewerage, inadequate housing, unmet basic needs, and overcrowding, as well as younger and less educated household heads (see Figure D2).

[Figure 3 here]

4.3 Enterprise activity and local prices

In Table 7, we find that municipal transfers contribute to growth in microenterprise activity in the private sector, for both non-agricultural firms (Panel A) and agricultural firms (Panel B). The revenue elasticity is 0.07 for non-agricultural businesses and 0.33 for agricultural businesses, respectively, both of which are significant at the 1% level (see column 1). These benefits are primarily captured by entrepreneurs working on their own account and farmers relying on domestic labor. This is consistent with earnings increasing mainly for entrepreneurs (Table E4). Furthermore, we observe improvements in labor productivity. The elasticity of revenue per worker is 0.08 for non-agricultural businesses and 0.28 for agricultural businesses (column 3).

[Table 7 here]

Notably, we find a significant investment response from firms (column 4). For non-agricultural businesses, there is an increase in capital investment, with a one-log-point rise in predicted public expenditures raising the likelihood of entrepreneurs owning their business premises by 2.0 ppts. For agricultural enterprises, we observe an increase in land ownership, with an estimated elasticity of 0.24 for landholdings relative to predicted public expenditures, statistically significant at the 1% level.

Most of these effects persist over time, as evidenced by the precisely estimated elasticity of revenues per worker in non-agricultural businesses with respect to past resource windfalls. The only exception is the effect on non-agricultural businesses owning their business premises, which is reversed with past resource windfalls (Table E1).

Furthermore, we find suggestive evidence that the number of firms are increasing in the local economy, as well as the total number of individuals employed by these formal firms (Table E3).

We next focus on the extent to which local prices are affected to explore further the possibility that our estimated effects are capturing local inflationary pressures not accounted for in the deflators we use. That is, although we use earnings and revenues in real terms, the deflators may not fully capture changes in district-level inflation as experienced by different households. To address this, we analyze data on input and output prices. When looking at inputs, we find no significant effects on earnings per hour worked in the public, non-agricultural, or agricultural sectors for wage-employed individuals working at least 20 hours per week, though in agriculture the Anderson–Rubin p-value is 0.09 (Table E4). When focusing on district-level mean wages in the formal economy, we find small point estimates and not statistically significant for the public and agricultural sectors. Only in the non-agricultural sector do we find a statistically significant positive effect on mean wages.

When looking at output prices, we find a positive elasticity on housing values, standing at 0.10 and significant at the 1% level. To look at this, we estimate a hedonic regression including as additional controls dwelling and household characteristics to account for determinants of value and for systematic biases in the self-reporting of values (Table E5, column 1). We next explore the effects on consumer goods prices relying on detailed household-level data. Columns 2–4 of Table E5 show no significant effects on food prices for all products, less-tradable products, and more-tradable products, with magnitudes below 0.001 in absolute terms. Overall, there is no strong evidence of strong inflationary pressures in local economies when analyzing prices for a range of input and output prices.

4.4 Spatial disparities and household welfare

Considering that the canon law targeted areas with high poverty and basic unmet needs and infrastructure gaps, we next investigate the extent to which deprived areas benefited from the redistribution of natural resource taxes. We focus on two aspects of spatial disparities. The first pertains to geographical regions. Peru can be broadly divided into three geographical regions: the affluent coastal region to the west, the rural highlands in the central strip spanning the Andes, and the remote Amazonian rainforest in the east. The highlands and the rainforest areas are the most remote and deprived.[15] In 2005, the average district in the coastal region had a 45% share of households with unmet basic

[15] Lima, the capital city, is situated in the central coastal region, housing almost half of Peru's population and generating half of the country's GDP. The next most affluent cities are located to the north and south of Lima, also along the coastline, connected via a main highway. The highlands are primarily linked to these larger cities via arteries of this main highway, as they lack railroad connectivity due to the rugged terrain. The rainforest is only accessible via air travel or navigating the Amazon River.

needs, compared with 62% in the highlands and 58% in the rainforest.

We find important heterogeneity by geographical region (Table E6). While the effects on municipal outcomes are similar in magnitude and precision across the three regions, the effects on individual-level outcomes mainly manifest in the highlands. For instance, the effect on employment has a magnitude of 0.13 in the highlands, while it is 0.04 in the rainforest and 0.02 in the coastal region. Likewise, the earnings elasticity is 0.16 and significant at the 1% level in the highlands, whereas it is insignificant in the rainforest and close to zero in the coastal region. Furthermore, in the highlands, the earnings elasticity in the agricultural sector is the highest, standing at 0.49 and significant at the 1% level, while it is not significant in either of the other two regions.

The second aspect of spatial disparity that we explore pertains to rurality. In half of the districts in the analysis, almost 60% of the population is rural, with the bottom percentile having no rural population and the top percentile being almost all rural population (Table A2). While fewer than 15% of households are classified as rural in the coastal region, almost half are classified as rural in the highlands and rainforest regions. At the beginning of the study (in 2005), rural households were twice as likely to have high economic dependency, defined as the number of inactive adults over the number of active adults. They were also four times more likely than urban households to have poor dwellings, live in overcrowded conditions, and have school-aged children not attending school. Additionally, they were almost ten times less likely to have access to water and sanitation services in their dwelling.

Figure 4 shows the point estimates from our main specification when the sample split households according to their location, i.e. urban, peri-urban, and rural areas. Our results show clear evidence that households located in rural areas benefited the most from the increased influx of resource windfalls into the local economy. We provide estimates stratified by area: urban (with more than 10000 households), peri-urban (with fewer than 10000 households), and rural areas.[16]

[Figure 4 here]

For each individual-level outcome, there is a noticeable gradient in the magnitude of effects, with coefficients closer to zero for urban areas and increasing coefficients for peri-urban and rural areas. For example, when considering employment compared with

[16] We follow the thresholds set by the ENAHO to classify areas.

inactivity, the effect is 0.02 for urban areas, 0.05 for peri-urban areas, and 0.26 for rural areas.

The earnings elasticity is also highest in rural areas, standing at 0.33, compared with 0.11 in peri-urban areas and an insignificant effect of 0.01 in urban areas. In rural areas, the estimated impacts on working in the private sector are statistically higher than in the public sector. Positive and statistically significant effects on employment are observed for all industries in rural areas, whereas they are close to zero and insignificant in urban areas. In rural areas, positive and significant effects are found when estimating employment by type of job (except for being an employer), with the highest magnitude seen for engagement in productive activities at home (0.60).

We discuss here alternatives, but understanding the drivers of the heterogeneous impacts by area is beyond this paper's scope. We find no correlation between resource windfalls and initial district rurality (Figure E2). Greater mobility in urban areas might cause spillovers across districts that create an attenuation bias; however, the same impact gradient appears on the predominantly urban and well-connected coast (Figure E1). Another explanation could be differences in project portfolio between urban and rural areas. Although we observe no substantial variation in sectoral composition by rurality (Figure E3), we may be missing differences in project types or the possibility of higher returns to similar projects in rural areas. A final possibility involves disparities in initial slack and reservation wages (Figure E4. While inactivity was lower in rural areas (26% vs. 41% in urban), agricultural self-employment was much higher (26% vs. 1% in urban and 9% in peri-urban), wages were significantly lower, and smaller firms were prevalent—all indicators of economic slack (Walker et al., 2024).

We next explore the extent to which these significant changes in labor market outcomes can be reflected in improved outcomes in the real economy of rural areas. In Table 8 we present our estimates of the income and consumption elasticity in real terms. The income elasticity is greater than the earnings elasticity, at 0.60 (column 1) compared with the latter standing at 0.33 (Figure 4). The consumption elasticity stands at 0.12 (column 2), driven by increased consumption in food (0.10, column 3), and rent and gas (0.18, column 4), with no statistically significant changes in durables consumption (column 5). Regarding assets, there is no effect on the likelihood of rural households owning their dwelling (column 7). Non-durables consumption shows no change (column 6), masking an increase in clothing and healthcare consumption (with elasticities at 0.23 for clothing and 0.40 for healthcare and personal care) offset by a decrease in leisure consumption (-0.16), as shown in Table E8.

[Table 8 here]

Overall, these results suggest that rural households benefited substantially from municipal resource windfalls, increasing their consumption of basic goods and services. This greater spending was likely financed primarily by higher labor earnings (though standing at 0.16, the rental income elasticity is not significant, as shown in Table E8). More than a third of the increase in earnings was destined to be spent on necessities, on average, implying that many rural households were hand-to-mouth consumers.

Notably, we find a reduction in poverty in rural areas. A log-point increase in predicted public expenditures reduces by 11.0 ppts the probability of a household to be poor, as opposed to falling above the local poverty line (column 8). Compared with the initial mean, this effects translates into a 22.9% decline in poverty. Among households falling below the poverty line, we find a negative but insignificant effect on being extremely poor (Table E10, column 1). These improvements for households in rural areas align with our findings that the agricultural sector benefited greatly, as nearly 80% of workers in this sector were located in rural areas at the start of the study period.

When examining urban areas (refer to Table E7), a different picture emerges. Compared with rural areas, the income elasticity is much lower, at 0.10. Additionally, the consumption elasticity becomes negative, standing at -0.03, coming from a decrease in food, durables, and non-durables expenditures (mostly from healthcare and leisure activities). Wage-employment opportunities often include health insurance benefits, thereby reducing out-of-pocket healthcare costs, alongside reductions in time for recreational activities. Instead, income gains appear directed towards acquiring assets, evidenced by a 3.0 ppts rise in homeownership likelihood.[17] Notably, urban areas also experience a 2.0 ppts increase in poverty rates. However, when looking at the dynamic effects, past resource windfalls reduce poverty for both rural and urban areas (Table E1).

[17] Access to mortgages and credit for house refurbishments was severely limited during the study period, with rates at 1% for rural households and 4% for urban households.

Despite the increase in food demand in rural areas, we find no evidence of strong inflationary pressures. Local food inflation decreases by 0.014% for all goods and by 0.018% for less tradable goods, and increases by 0.007% for more tradable goods (Table E5, Panel C). Although there is no increase in homeownership, we find a housing value elasticity of 0.24, which aligns with rural households——most being agricultural microenterprises—investing in land, as shown in Table 7.

5 Implications

To quantify our findings in terms of output multiplier, we conduct a a simple aggregate back-of-the-envelope exercise and estimate the effect of resource windfalls on local real GDP, relative to the amount transferred to municipalities. Due to our focus on governmental transfers, we estimate a purchase multiplier.

We use two alternative sources of district GDP. First, we impute district GDP for each year by weighting the regional GDP from the official Peruvian national accounts with the district's share of the total regional nightlight value from the harmonized global night-time light dataset developed by Li et al. (2020).[18] Second, we rely on the dataset of Seminario and Palomino (2018), the only official imputation for GDP in Peru, which in addition adjusts for population density.

The estimated effects are presented in Table E9, following Equation (1), with all monetary values in real terms (2007 USD). We adjust for transfer persistence and focus on contemporaneous effects. We first reject a negative multiplier on real GDP, an important test to alleviate concerns that local prices adjusted to offset real effects and crowding out of private output. Furthermore, we test the null hypothesis of a multiplier equal to 1, which has been the central goal of recent research on the fiscal multiplier, as otherwise it would imply no additional output generated besides the influx of resources from government expenditures. With both data sources, we find evidence of a multiplier higher than 1, particularly when dealing with outliers by winsorizing values at the top 10 percentile (as in Table 1). Using our preferred specification dealing with outliers, we find that for every dollar in resource windfalls, an additional USD 2.79–3.86 are generated in the local economy through private spending and

[18]The value of nightlights within boundaries is the sum of all the nightlight value of all pixels within a spatial polygon.

investment, assuming a closed local economy.

Our estimates are slightly larger in magnitude than fiscal spending multipliers estimated in the formal sector of Brazil (2.0) (Corbi et al., 2018) and derived from cross-sectional US policy variation from a range of studies (1.5–2.0) (Chodorow-Reich, 2019), as well as transfer multipliers in the US like that of Pennings (2021) for permanent transfers to old-age pensioners in the US (0.9–1.9). Our output multiplier is closer to Colonnelli and Prem (2021) who computes purchase multipliers in the range 1.46–4.60 from anti-corruption spillovers in Brazil. Our estimates are also closer to transfer multipliers estimated from cash transfers to households, such as the case of Egger et al. (2022) in rural Kenya (2.5–2.8) and of Gerard et al. (2021) in Brazil (1.5–2.6).

One plausible, albeit speculative, possibility is that existence of slack may help account for the large fiscal multiplier we estimate (Lewis, 1954; Walker et al., 2024). Overall, our findings indicate that the multiplier was driven by an increase in the *employment* of idle factors of production (extensive margin) rather than the deeper *utilization* of factors already engaged in production (extensive margin). The resource windfalls generated more employment (and less inactivity), rather than more hours of work, investment-led responses in the form of capital expansion of potentially underutilized resources (more business premises for entrepreneurs and houses in urban areas), and land acquisition (greater landholdings for farmers).

We next discuss welfare implications. Because output is not social welfare, multipliers need not be sufficient statistics for optimal policy. Based on the framework of Egger et al. (2022), there are two broad channels through which transfers can affect a household's utility.

First, transfers may change market outcomes that affect choices and output, and thereby showing in the fiscal multiplier. The increase in real output reflects an increase in the employment of factors of production, both with an opportunity cost. For labor, it is the value of forgone leisure, for capital it is the interest rate, and for land, it is the foregone present consumption in the case of renting the landholding, or the environmental degradation of previously unused land.

The distribution of benefits is crucial for welfare, especially if we place greater value on expanding the budget sets of poorer households. Although transfers were allocated to municipalities, general equilibrium effects show that the benefits primarily reached the poorest residents living in disadvantaged rural areas. Distributional effects could also work through prices. While there is no evidence of overall inflationary pressures, increases in housing prices mean that there was some value transferred from tenants to land owners.

Second, inter-government transfers may change behaviors that affect a household's utility without appearing in the multiplier. For this, we examine impacts on a range of indices capturing well-being. Although insignificant, we observe small improvements in female empowerment, dwelling and living quality, and sanitation practices in rural areas (Table E10).

6 Conclusion

This paper investigates how transfers affect local economies by studying Peruvian municipalities between 2006 and 2018. We leverage quasi-exogenous variations in resource windfalls in non-extractive districts, resulting from the redistribution of natural tax revenues, following a rule established by the central government, and shocks to commodities extracted within the same aggregate jurisdiction (i.e. same province or region where extractive activity takes place in another district).

In line with the resource windfalls being ring-fenced for public investment, we find an increase in public spending mainly through investments in public infrastructure, procurement of goods and services, and hiring of municipal workers, particularly low-skilled workers employed in the construction of public works.

When exploring labor markets, we observe increases in employment and earnings across various occupations and industries that do not directly serve local municipalities. Rural areas experience the most substantial benefits, resulting in increased income and consumption, as well as reduced poverty. Effects in earnings, labor productivity, and poverty are sustained over time.

We provide evidence that the extent to which transfers can generate a sizable fiscal multiplier depends on how funds are used, which types of workers are targeted by the labor demand shock from the public sector, and how much slack in factors of production exists in the local economy.

Further research is needed to better understand the potential of inter-governmental transfers to unlock economic development. First, a major infrastructure push can harm local communities during the implementation phase, particularly if municipalities halt or abandon projects mid-construction (Bancalari, 2024). Therefore, it is crucial to fully understand the constraints and incentives local policymakers face when implementing such projects. Additionally, building on the findings of Monteiro and Ferraz (2012) and Caselli and Michaels (2013), further investigation is needed to assess how corruption and limited government capacity may constrain the effectiveness of fiscal multipliers in LMICs. Finally, studies by Gadenne (2015) and Martinez (2023) highlight how reliance on transfers, rather than building taxation capacity, can impact the quality of service delivery. This underscores the need for further research into how resource windfalls shape state capacity.

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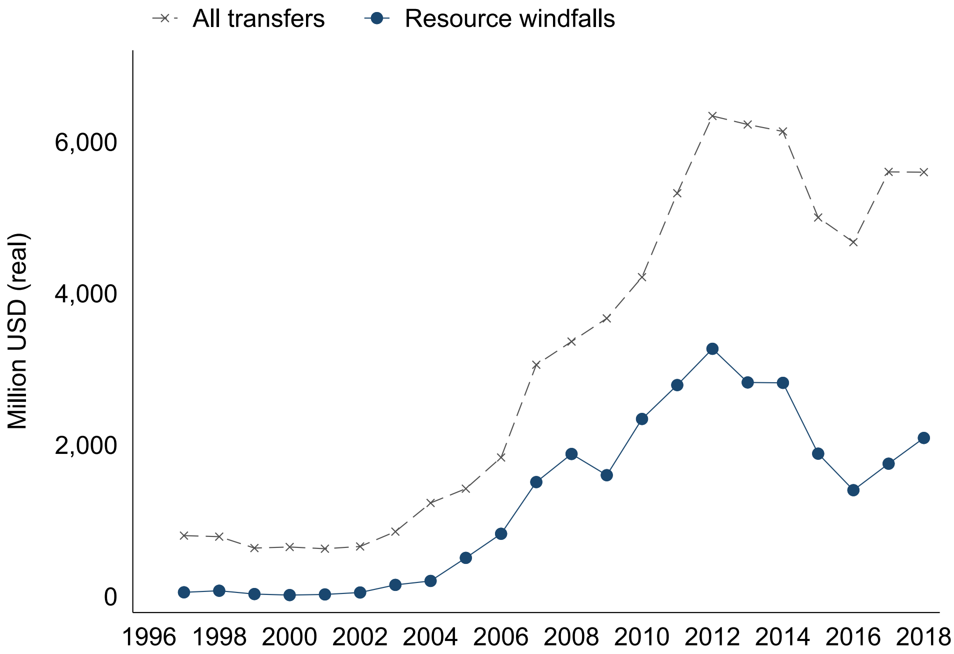
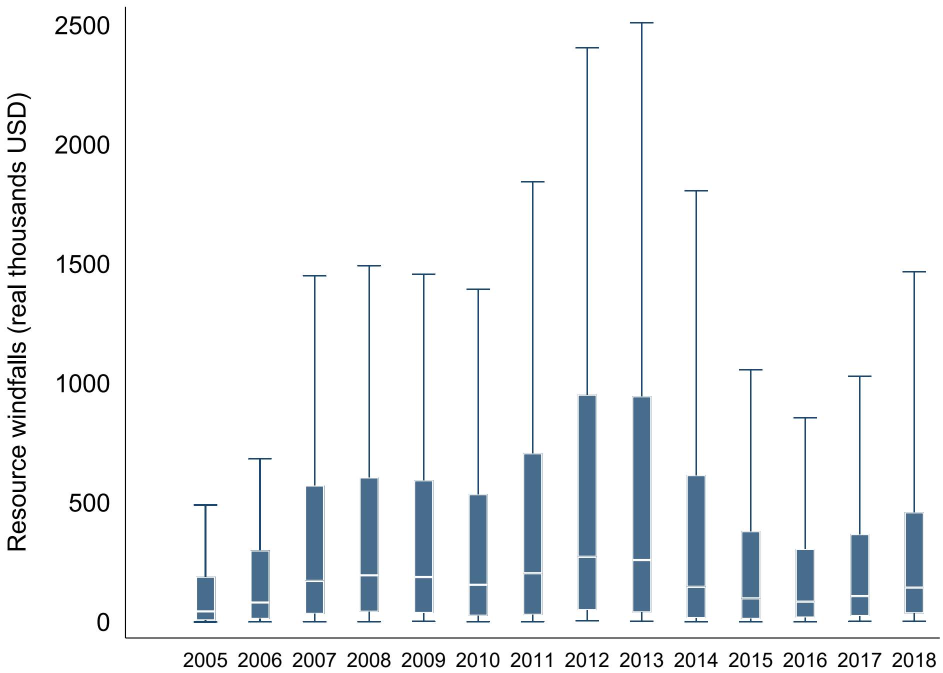
Figure 1: Variation over time in transfers among non-extractive districts

(a) Inter-governmental transfers, nationwide total

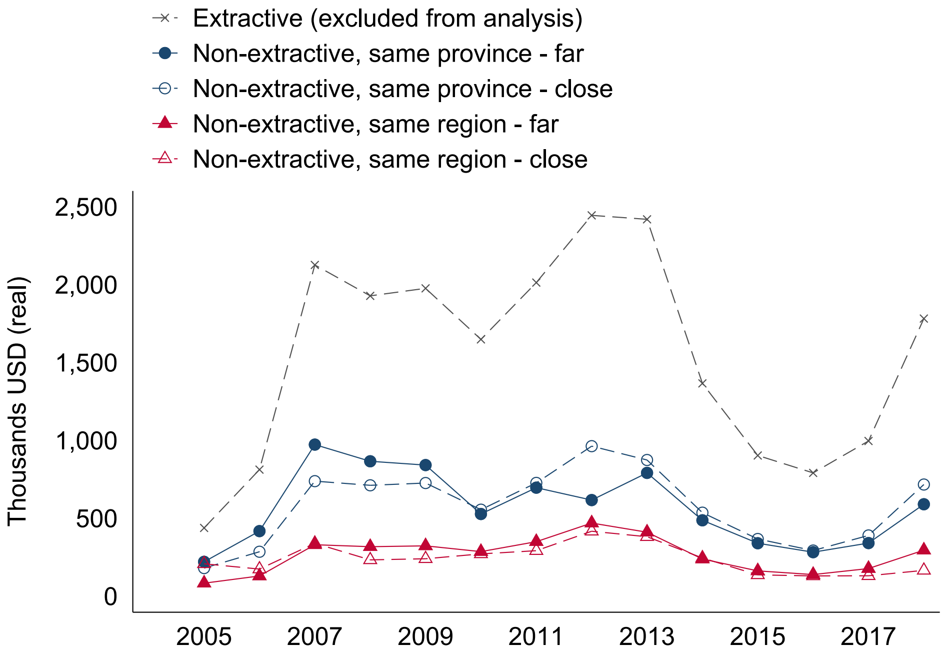


(b) Distribution of resource windfalls



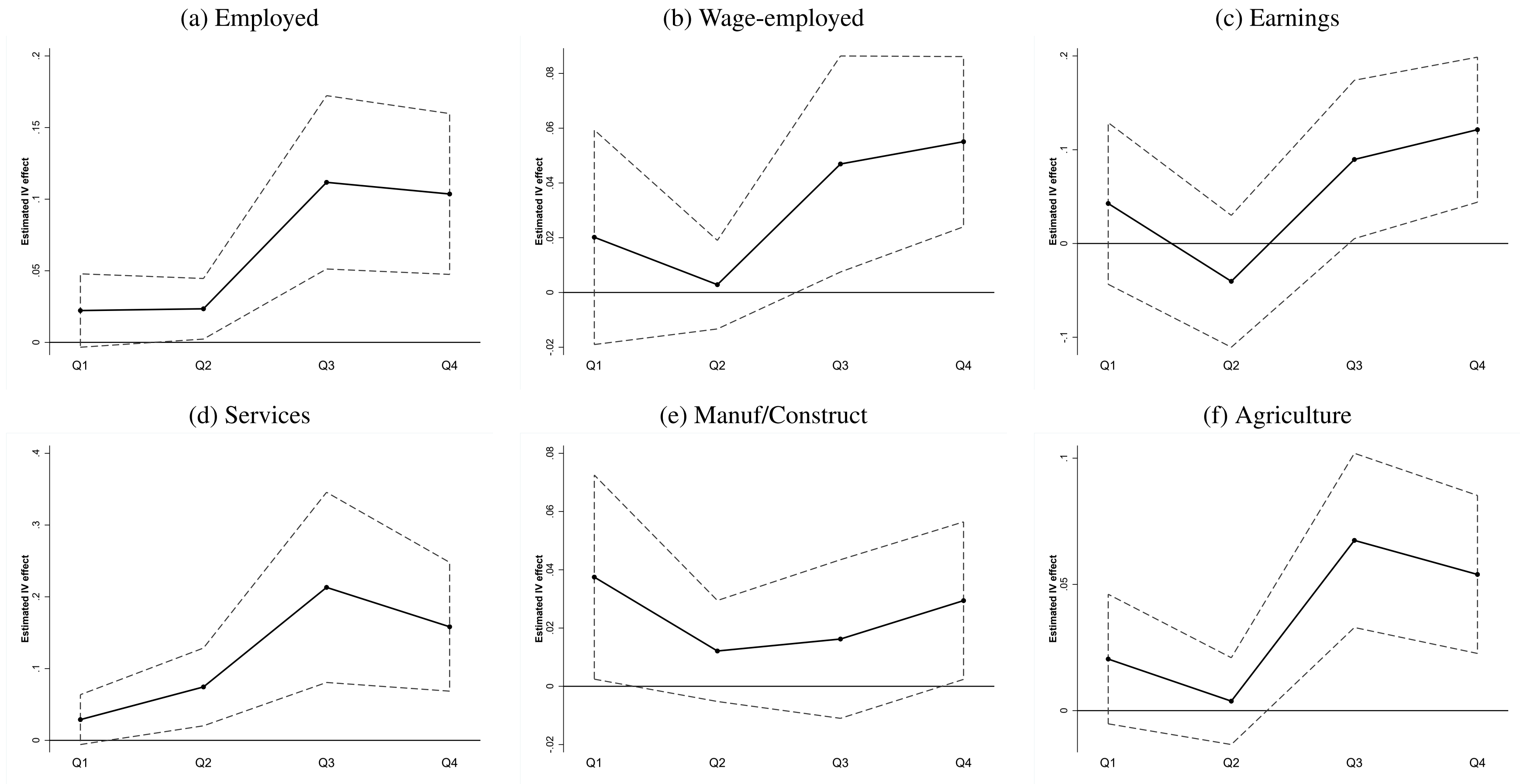
Notes. (a) Nationwide transfers measured in millions of real USD. (b) Distribution of resource windfalls, measured in thousands of real USD per year. The upper spike denotes the top 10 percentile and the lower spike denotes the bottom 10 percentile, while the upper border of the box denotes the 75th percentile and the lower the 25th percentile. The middle white line in the box denotes the median. The sample is restricted to non-extractive districts.

Figure 2: Variation over time in resource windfalls by location



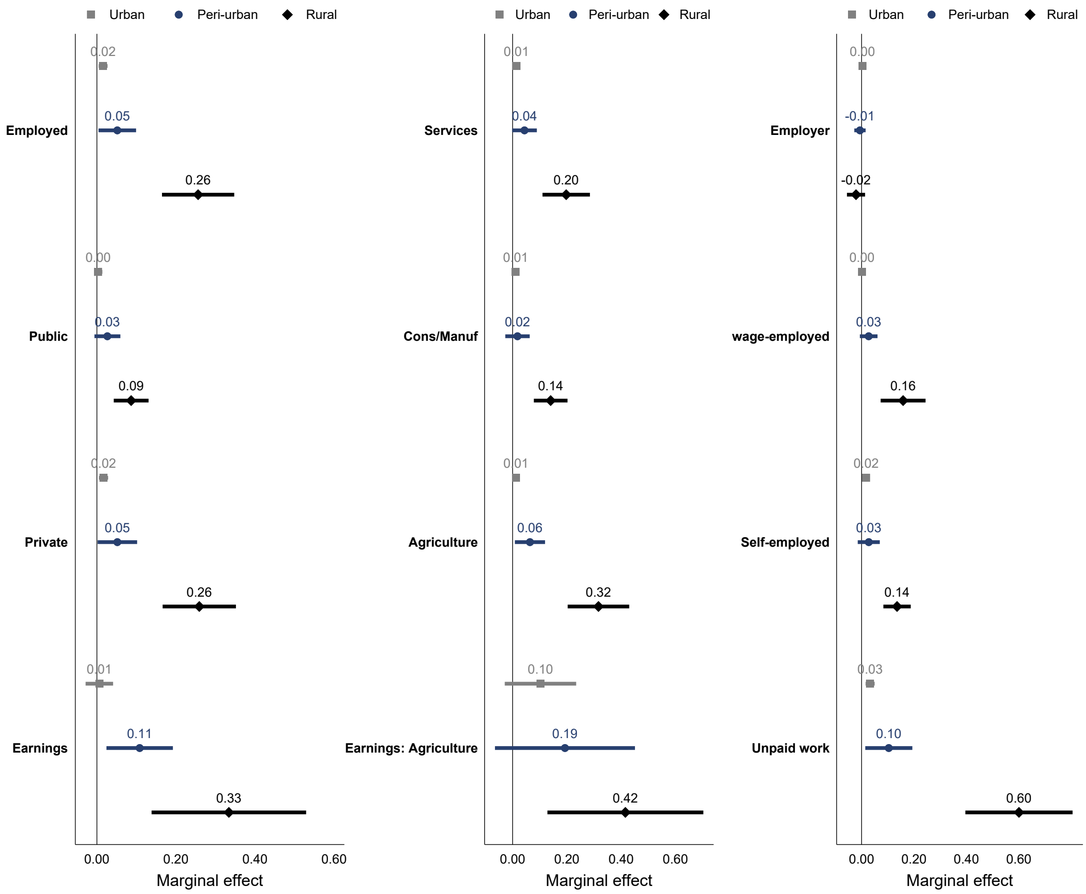
Notes. Resource windfalls over time, measured in thousands of real USD per year. Extractive districts are excluded from the analysis. In the legend, 'far' denotes districts that are located at or above the median distance to the closest mining activity, and 'close' denotes those that are located below. The sample is restricted to mining regions.

Figure 3: Heterogeneous effects (2SLS) by quartiles of distance to closest mine



Note. Spikes correspond to 95% confidence intervals. All monetary values in real terms (2007 USD) and natural logs. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditures, following Equation (2). All regressions include district and year two-way fixed effects, and control for household characteristics. Standard errors clustered at the district level. Q1 is at or below 20 km; Q2 spans {20–35] km; Q3 spans {35–65] km; and Q4 is above 65 km. The exact quartiles change slightly across outcomes due to changes in the sample of analysis.

Figure 4: Heterogeneous effects by area



Notes. Plotted coefficients correspond to 2SLS estimations of the effects of resource windfalls following Equation (2), stratifying the sample by area. All regressions include district and year two-way fixed effects, and control for household characteristics. Standard errors are clustered at the district level. Confidence intervals at 95% level.

Table 1: Effect of resource windfalls on public expenditures

	Total (1)	Capital (2)	Current (3)	HR (4)	G&S (5)
Panel A: Logs					
Resource windfalls (ln)	0.10***	0.14***	0.06***	0.04***	0.09***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Panel B: Levels					
Resource windfalls (USD 2007)	1.01***	0.81***	0.14***	0.01***	0.13***
	(0.06)	(0.04)	(0.02)	(0.00)	(0.01)
Mean (initial, millions)	0.99	0.52	0.38	0.12	0.50
District-years	18546	18546	18546	18546	18546
Districts	1608	1608	1608	1608	1608

Notes. Estimated reduced-form effects of resource windfalls on municipal expenditures by column: (1) overall expenditures; (2) capital expenditures; (3) current expenditures; (4) expenditures in human resources (HR); and (5) expenditures in goods and services (G&S). All monetary values in real terms (2007 USD). Panel A presents regressions using variables expressed in natural logs. Panel B shows regressions in levels using variables that have been winsorized at the top 10 percentile to deal with outliers. All regressions include district and year two-way fixed effects. Standard errors clustered at the district level in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2: Effects on public works

	Started		Completed/Active	
	Productive (1)	**Social capital** (2)	**Productive** (3)	**Social capital** (4)
Public expenditure (ln)	1.91***	0.44*	0.10	0.13
	(0.39)	(0.24)	(0.07)	(0.08)
AR p-values	0.00	0.06	0.18	0.14
F-stat	55.50	55.50	55.50	55.50
Mean (initial)	0.58	0.26	0.01	0.00
District-years	10910	10910	10910	10910
Districts	1608	1608	1608	1608

Notes. Estimated effects of public expenditures on the following outcomes by column: (1) number of productive projects started; (2) number of social capital projects started; (3) number of productive projects completed over active; (4) number of social capital projects completed over active. 'Productive' projects include agricultural, TTC, housing, WASH, energy, and other physical infrastructures. 'Social capital' projects include education, culture and recreation, safety and security, social protection, and health. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditures, following Equation (2). All monetary values in real terms (2007 USD) and natural logs. All regressions include district and year two-way fixed effects. Standard errors clustered at the district level in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%. AR p-values correspond to the Anderson–Rubin p-values robust to weak instrumental variable data.

Table 3: Effects on municipal human resources

	HR	**by occupation**				**by contract**
	Total	**Managers**	**Professionals**	**Technicians**	**Support**	**Permanent (share)**
	(1)	(2)	(3)	(4)	(5)	(6)
Public expenditure (ln)	50.06***	0.78	4.96***	6.02*	38.30***	-0.25***
	(9.56)	(0.65)	(1.78)	(3.21)	(8.60)	(0.04)
AR p-values	0.00	0.23	0.00	0.07	0.00	0.00
F-stat	133.67	133.67	133.67	133.67	133.67	109.45
Mean (initial)	51.12	4.08	5.81	14.59	26.64	0.33
District-years	18434	18434	18434	18434	18434	16977
Districts	1585	1585	1585	1585	1585	1585

Notes. Estimated effects of public expenditures on the following outcomes by column: (1)–(5) total number of human resources by type; column (6) is the share of human resources in permanent rather than fixed-term contracts. 'Support' includes both administrative assistants and blue-collar workers (e.g. construction workers and supervisors). All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditures, following Equation (2). All monetary values in real terms (2007 USD) and natural logs. All regressions include district and year two-way fixed effects. Standard errors clustered at the district level in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%. AR p-values correspond to the Anderson–Rubin p-values robust to weak instrumental variable data.

Table 4: Effect on local labor markets (2SLS)

	Labor market participation			**Employed**			
	Employed	**Public**	**Private**	**Hours**	**Second job**	**Informal**	**Earnings (ln)**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Public expenditure (ln)	0.06***	0.02***	0.07***	-0.13	-0.00	-0.01**	0.05***
	(0.01)	(0.01)	(0.01)	(0.40)	(0.01)	(0.00)	(0.02)
AR p-values	0.00	0.00	0.00	0.74	0.83	0.03	0.00
F-stat	91.46	102.12	89.21	83.89	84.29	84.28	83.20
Mean (initial)	0.65	0.13	0.63	38.91	0.16	0.86	8.42
Observations	720985	262605	677144	499577	501454	500856	211074
Districts	1316	1307	1316	1316	1316	1316	1294

Notes. Estimated effects of public expenditures on the following outcomes by column: (1) Employed, indicator variable equal 1 if individual had any job during the previous week, and zero otherwise; (2) Public, indicator variable equal 1 if individual had a job in the public sector during the previous week, and zero if inactive; (3) Private, indicator variable equal 1 if individual had a job in the private sector during the previous week, and zero if inactive; (4) Hours, number of hours worked by individual in the previous week, conditional on being active; (5) Second job, indicator variable equal 1 if individual has a second job, and zero if working only one job, conditional on being active; (6) Informal, indicator variable equal 1 if individual works in the informal sector, and zero otherwise, conditional on being active; and (7) Earnings, deflated earnings for those that report having earnings. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditures, following Equation (2). All monetary values in real terms (2007 USD) and natural logs. All regressions include district and year two-way fixed effects, and control for household characteristics. Standard errors clustered at the district level in parentheses. * Significant at ten percent; ** significant at five percent; *** significant at one percent. AR p-values correspond to the Anderson-Rubin p-values robust to weak instrumental variable.

Table 5: Effects on employment and earnings by industry (2SLS)

	Employed			Earnings (ln)		
	Services (1)	**Manuf/Cons** (2)	**Agriculture** (3)	**Services** (4)	**Manuf/Cons** (5)	**Agriculture** (6)
Public expenditure (ln)	0.04***	0.02***	0.10***	0.02	0.08**	0.33***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.04)	(0.10)
AR *p*-values	0.00	0.00	0.00	0.23	0.02	0.00
F-stat	98.53	97.00	76.75	88.75	70.60	26.25
Mean (initial)	0.49	0.14	0.43	8.67	8.70	7.52
Individuals	481525	263451	413306	141724	23728	44253
Districts	1315	1305	1316	1240	790	1222

Notes. Estimated effects of public expenditures on the following outcomes by columns: (1)—(3) indicator variable equal to one when being employed in the industry, as opposed to being inactive; (4)—(6) deflated earnings for people working on each industry, in logs. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditures, following Equation (2). Same notes as Table 4.

Table 6: Effects on private employment by occupation (2SLS)

	Employer (1)	**Wage-employed** (2)	**Self-employed** (3)	**Unpaid work** (4)
Public expenditure (ln)	0.01*	0.03***	0.04***	0.14***
	(0.00)	(0.01)	(0.01)	(0.02)
AR *p*-values	0.09	0.00	0.00	0.00
F-stat	97.14	89.98	98.22	90.57
Mean (initial)	0.10	0.37	0.42	0.24
Individuals	245592	375852	413524	302552
Districts	1308	1313	1316	1315

Notes. Estimated effects of public expenditures on an indicator variable equal to one when being employed in the following occupations, by column, as opposed to being inactive: (1) employer; (2) wage-employee; (3) self-employed, and (4) unpaid work in family business. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditures, following Equation (2). Same notes as Table 4.

Table 7: Microenterprise activity (2SLS)

	Revenues (ln)		Productivity (ln)	Investment
	(1)	(2)	(3)	(4)
Panel A: Non-agricultural	**All**	**Own account**	**Revenues per worker**	**Owns business premise**
Public expenditure (ln)	0.07**	0.10***	0.08***	0.02**
	(0.03)	(0.03)	(0.03)	(0.01)
AR *p*-values	0.01	0.00	0.00	0.03
F-stat	81.85	72.10	81.85	81.85
Mean (initial)	4.54	4.21	4.20	0.34
Individuals	139996	92437	139995	139996
Districts	1206	1153	1206	1206
Panel B: Agricultural	**All**	**Only domestic labor**	**Revenues per worker**	**Owned land (ha, ln)**
Public expenditure (ln)	0.33***	0.37***	0.28***	0.24***
	(0.11)	(0.12)	(0.09)	(0.09)
AR *p*-values	0.00	0.00	0.00	0.00
F-stat	60.41	44.68	60.41	52.79
Mean (initial)	7.08	6.58	6.22	-0.14
Individuals	67553	35982	67550	55030
Districts	975	951	975	962

Notes. Estimated effects of public expenditures on the following outcomes by column. Revenues (columns 1 and 2): value of production sold, for entrepreneurs working on their own account (Panel A) and farmers relying exclusively on domestic labor (Panel B). Productivity (column 3): labor productivity, measured as revenues per worker. Business premise ownership (column 4, Panel A): an indicator equal to one if the entrepreneur owns their business premise. Land ownership (column 4, Panel B): hectares of land owned by the farmer. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditures, as outlined in Equation (2). All monetary values in real terms (USD 2007) and natural logs.

Table 8: Rural economies (2SLS)

	Income (ln)	Consumption (ln)					Assets	Poverty
		Total	**Food**	**Rent**	**Durables**	**Non-dur**	**House**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Public expenditure (ln)	0.60***	0.12**	0.10*	0.18***	-0.02	0.12	-0.01	-0.11***
	(0.21)	(0.05)	(0.05)	(0.07)	(0.07)	(0.07)	(0.02)	(0.04)
AR p-values	0.00	0.01	0.03	0.00	0.74	0.08	0.65	0.00
F-stat	19.22	33.07	33.22	33.07	32.92	32.84	33.07	33.07
Mean (initial)	4.64	5.51	5.07	2.81	2.09	3.77	0.86	0.73
Individuals	80162	85155	84999	85155	84790	84794	85155	85155
Districts	1013	1028	1028	1028	1028	1028	1028	1028
Level of analysis	IND	HH	HH	HH	HH	HH	HH	HH

Notes. Estimated effects of public expenditures on the following outcomes by columns. Income (column 1): deflated income for individuals reporting receiving income in natural logs. Consumption (columns 2–6): deflated household consumption per equivalent adult in natural logs, per category. Consumption in non-durables includes clothing, healthcare and personal care, transport and telecommunications, leisure and others. House (column 7): indicator variable equal to one if owns the dwelling, and zero if not. Poverty (column 8): indicator variable equal to one if the household's consumption of basic goods falls below the local poverty line, and zero if not. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditures, following Equation (2). All regressions include district and year two-way fixed effects, and control for household characteristics. Coefficients in columns 1 and 2 correspond to monetary values in real terms. Sample restricted to rural areas.

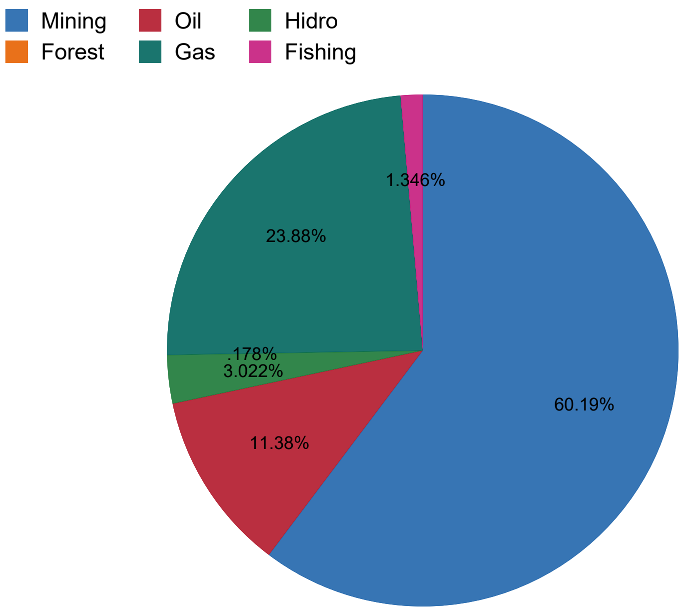
APPENDIX

Resource windfalls, public expenditure, and local economies

Antonella Bancalari and Juan Pablo Rud

A Background

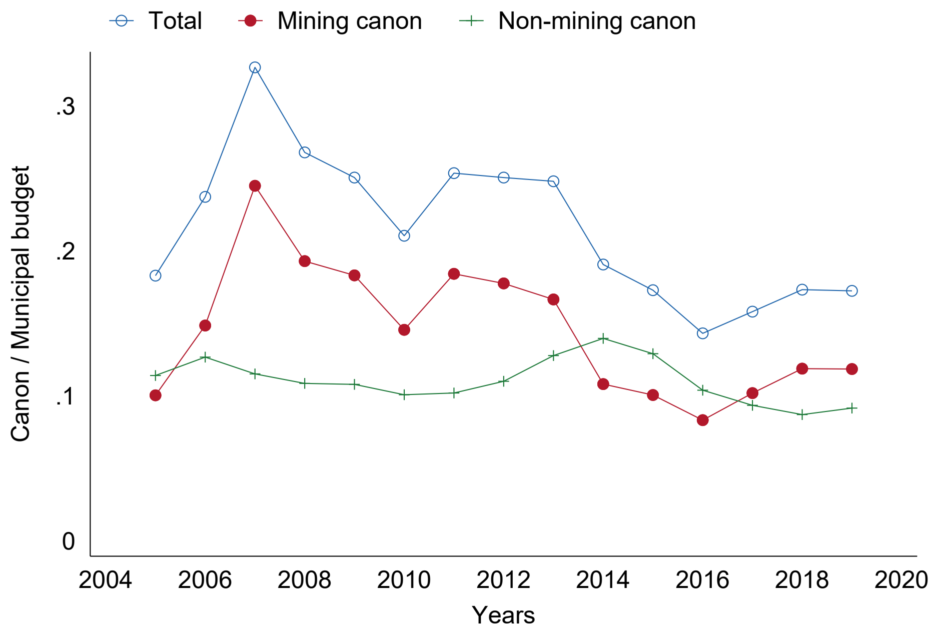
Figure A1: Resource windfalls, by type of activity (2006–2018)



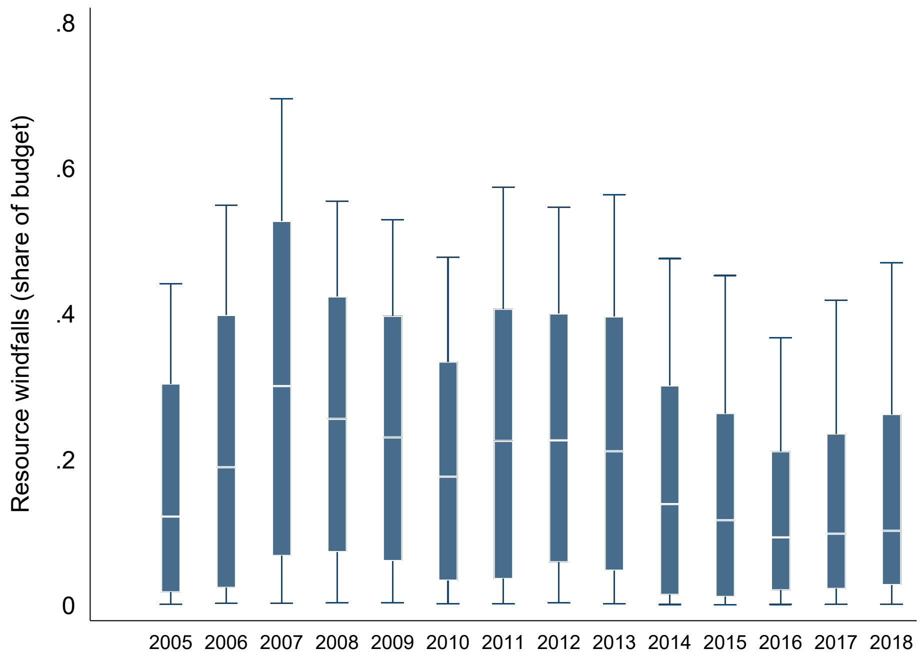
Source: Authors' own calculation using data on transfers to local governments and municipal budgets from the Ministry of Economy and Finance in Peru (SIAF). Distribution of total resource windfalls received by non-extractive municipalities by type between 2006 and 2018.

Figure A2: Share of resource windfalls over total budget

(a) Mean share, by type of canon

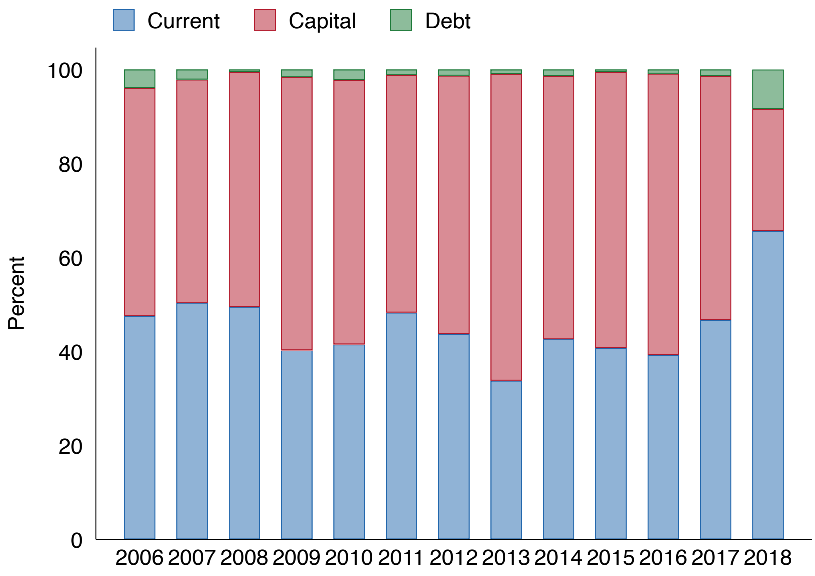


(b) Distribution of the share

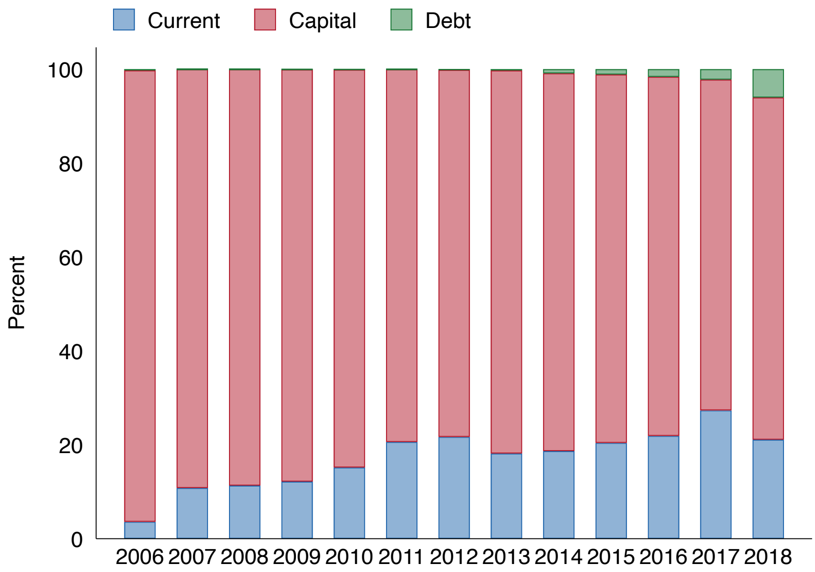


Notes. Authors' own calculation using data on municipal budgets from the Ministry of Economy and Finance in Peru (SIAF). Sample restricted to non-extractive districts. In Panel (b), the upper spike denotes the top 10 percentile and the lower spike is the bottom 10 percentile, while the upper border of the box denotes the 75th percentile and the lower border the 25th percentile. The middle white line in the box denotes the median.

Figure A3: Municipal expenditures by general categories



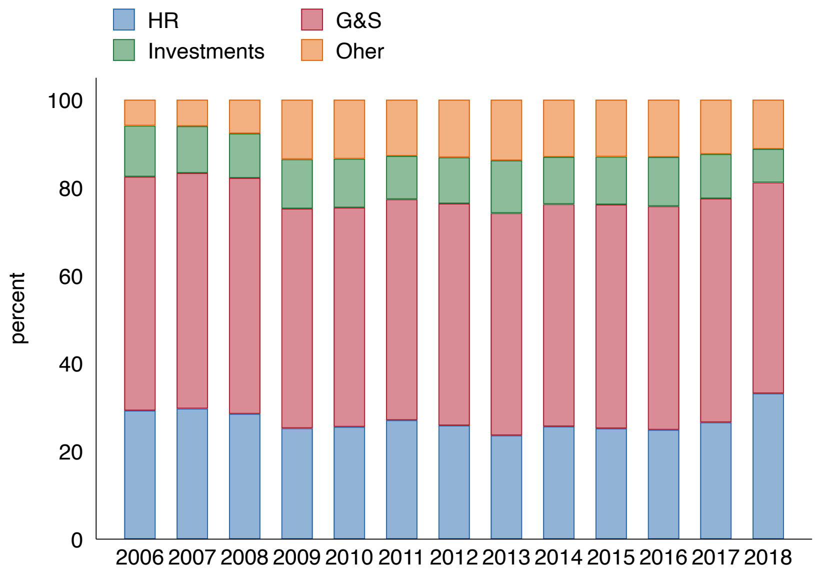
(a) All sources



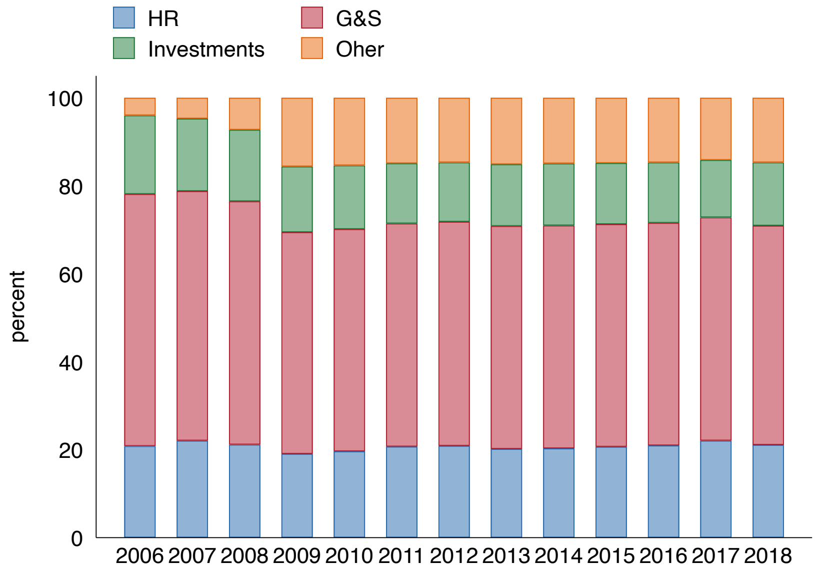
(b) Resource windfalls from the canon

Notes. Authors' own calculation using data on municipal budgets from the Ministry of Economy and Finance in Peru (SIAF). Sample restricted to non-extractive districts.

Figure A4: Municipal expenditures by specific categories



(a) All sources



(b) Resource windfalls from the canon

Notes. Authors' own calculation using data on municipal budgets from the Ministry of Economy and Finance in Peru (SIAF). Sample restricted to non-extractive districts.

Table A1: Wage premium in public sector

	Earnings (1)
Public employment	0.66***
	(0.02)
Education: some secondary	0.36***
	(0.01)
Education: some superior	0.81***
	(0.01)
Female	-0.34***
	(0.01)
Married	0.22***
	(0.01)
Is HH head	0.18***
	(0.01)
HH size	0.04***
	(0.00)
Observations	211074

Notes. All regressions include district and year two-way fixed effects, and control for household characteristics. Standard errors clustered at the district level in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Table A2: Description of socio-demographics and labor markets by 2005

	Mean (1)	SD (2)	Median (3)	Min (4)	Max (5)
Panel A: District level					
Population density per sq km	91.31	522.49	18.72	0.09	4423.03
Population	14838.90	44735.23	4164.00	88.00	812656.00
Rural population	0.53	0.31	0.59	0.00	0.99
Sewerage connectivity	0.20	0.24	0.11	0.00	1.00
Piped water connectivity	0.54	0.28	0.60	0.00	1.00
Head with secondary education	0.20	0.14	0.16	0.01	0.80
Electricity connectivity	0.55	0.25	0.58	0.00	1.00
Unmet basic needs	0.57	0.24	0.59	0.01	1.00
Panel B: Individual level					
Employed	0.64	0.48	1.00	0.00	1.00
Female	0.42	0.49	0.00	0.00	1.00
Educational attainment:					
Below or completed primary	0.43	0.49	0.00	0.00	1.00
Below or completed secondary	0.38	0.49	0.00	0.00	1.00
Tertiary	0.19	0.39	0.00	0.00	1.00
Age	38.37	16.03	37.00	14.00	95.00
Earnings, annualized, deflated	6973.99	9511.85	4674.26	24.37	218279.13
Informal	0.87	0.34	1.00	0.00	1.00
Poor	0.52	0.50	1.00	0.00	1.00
Rural area	0.39	0.49	0.00	0.00	1.00
Observations	59725				

Notes. In Panel A, the sample is restricted to non-extractive districts with SIAF data that are identified in the 2005 Census. All characteristics from the second row onwards are measured as the share of households in the district. In Panel B, the first row includes all individuals surveyed, while the rest is focused on those actively working.

Table A3: Description of local labor markets by 2005

	Employed	Public	Private			
			Employer	Wage-employed	Self-employed	Unpaid work
	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.42	0.45	0.23	0.33	0.39	0.69
	(0.49)	(0.50)	(0.42)	(0.47)	(0.49)	(0.46)
Educational attainment:						
Below or completed primary	0.43	0.07	0.44	0.26	0.57	0.57
	(0.50)	(0.26)	(0.50)	(0.44)	(0.50)	(0.50)
Below or completed secondary	0.38	0.22	0.37	0.50	0.33	0.37
	(0.49)	(0.41)	(0.48)	(0.50)	(0.47)	(0.48)
Tertiary	0.19	0.71	0.20	0.24	0.10	0.06
	(0.39)	(0.45)	(0.40)	(0.43)	(0.31)	(0.24)
Age	38.44	39.60	47.17	32.14	44.59	32.01
	(16.01)	(10.53)	(14.90)	(13.02)	(15.42)	(17.31)
Earnings, annualized, deflated	6973.99	12137.09	2795.09	6113.38	1607.65	–
	(9511.85)	(10114.48)	(4008.97)	(9220.67)	(2101.06)	(–)
Informal	0.87	0.00	0.88	0.85	0.99	1.00
	(0.34)	(0.00)	(0.33)	(0.35)	(0.11)	(0.00)
Poor	0.55	0.22	0.36	0.47	0.62	0.77
	(0.50)	(0.41)	(0.48)	(0.50)	(0.49)	(0.42)
Rural area	0.41	0.15	0.38	0.25	0.46	0.69
	(0.49)	(0.35)	(0.49)	(0.43)	(0.50)	(0.46)

Notes. Sample restricted to individuals surveyed in non-extractive districts.

B Definition of variables

B.1 Definition of outcome variables

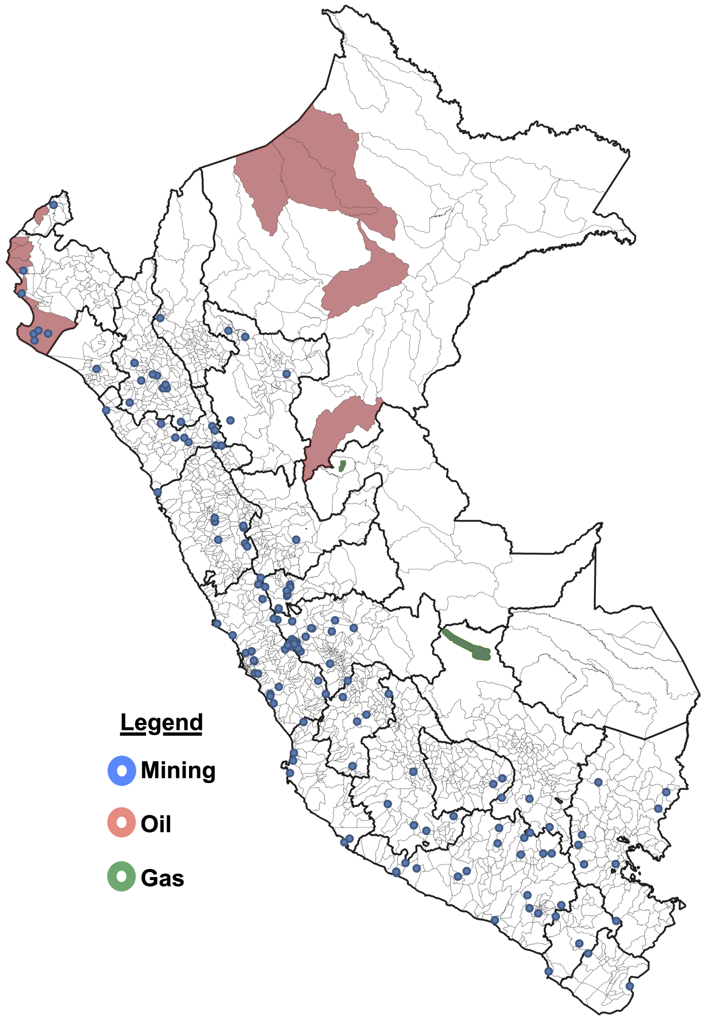
Variable	Description	Source	Years
Municipal level			
Public expenditure	Municipal expenditure in real terms (2007 USD or logs). Split by capital or current, and by human resources (HR) or goods and services (G&S)	SIAF	2006–2018
Started	Number of public projects started by the municipality. 'Productive' projects include agricultural, transport and telecommunications (TTC), housing, water, sanitation and hygiene (WASH), energy, and other physical infrastructures. 'Social capital' projects include education, culture and recreation, safety and security, social protection and health.	InfObras.	2011–2018
Completed/active	Number of public projects completed over those still actively implemented by the municipality (started but unfinished).	InfObras	2011–2018
HR	Number of municipal human resources by occupation. 'Support' includes both administrative assistants and blue-collar workers (e.g. construction workers and supervisors).	RENAMU	2004–2018
HR: permanent (share)	Share of municipal human resources in permanent rather than fixed-term contracts.	RENAMU	2004–2018
Individual level			
Employed	Indicator variable equal 1 if individual had any job during the previous week, and zero otherwise. Split in services, agriculture and construction or manufacturing (cons/manuf) sectors using ISIC codes.	ENAHO	2003–2018
Public	Indicator variable equal 1 if individual had a job in the public sector during the previous week, and zero if inactive.	ENAHO	2003–2018
Private	Indicator variable equal 1 if individual had a job in the private sector during the previous week, and zero if inactive.	ENAHO	2004–2018
Hours	Number of hours worked by individual in the previous week, conditional on being active.	ENAHO	2003–2018
Second job	Indicator variable equal 1 if individual has a second job, and zero if working only one job, conditional on being active.	ENAHO	2003–2018
Informal	Indicator variable equal 1 if individual works in the informal sector, and zero otherwise, conditional on being active.	ENAHO	2003–2018
Earnings (ln)	Deflated earnings in natural logs, for those that receive earnings. Split in services, agriculture and construction or manufacturing (cons/manuf) sectors using ISIC codes.	ENAHO	2003–2018
Employer	Indicator variable equal to one if in main occupation employs people, and zero if inactive.	ENAHO	2003–2018
Wage-employed	Indicator variable equal to one if main occupation is wage-employed, and zero if inactive.	ENAHO	2003–2018
Self-employed	Indicator variable equal to one if main occupation is self-employed, and zero if inactive.	ENAHO	2003–2018
Unpaid work	Indicator variable equal to one if main occupation is unpaid work in family business, and zero if inactive.	ENAHO	2003–2018
Revenues (ln)	Value of production sold in 2007 USD prices and natural logs	ENAHO	2007–2018
Productivity (ln)	Revenue per worker	ENAHO	2007–2018
Owns business premises	Indicator variable equal 1 if entrepreneur owns its business premises, and zero otherwise.	ENAHO	2007–2018
Owned land	Hectares of land owned by the farmer.	ENAHO	2007–2018
Income (ln)	Deflated income in natural logs for individuals reporting receiving income.	ENAHO	2006–2018

(continued on next page)

Variable	Description	Source	Years
Household level			
Consumption (ln)	Deflated consumption in natural logs per equivalent adult, total and per category: (1) food, including food consumed inside and outside the house; (2) rent, including bills; (3) durables, including any asset or housing refurbishing; and (4) non-durables, including clothing, health and personal care, TTC, leisure, and others.	ENAHO	2006–2018
Poor	Indicator variable equal to one if the household falls below the local poverty line, and zero if not poor.	ENAHO	2006–2018

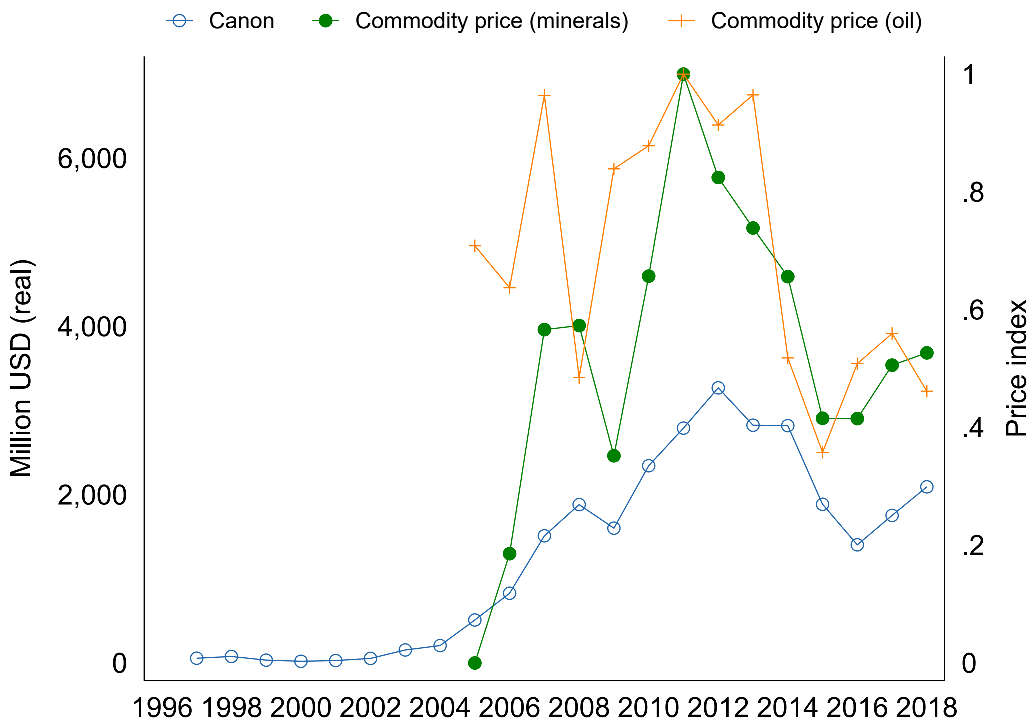
C Empirical strategy

Figure C1: Location of extractive activities



Notes. Map showing the location of the main extractive activities driving the canon resources by 2018. Blue dots correspond to mining, red areas to oil, and green areas to natural gas extraction. The coast is located in the west, the highlands in the center, and the Amazon in the east. Dark shaded borders mark regional boundaries.

Figure C2: Resource windfalls and commodity prices (2006–2018)



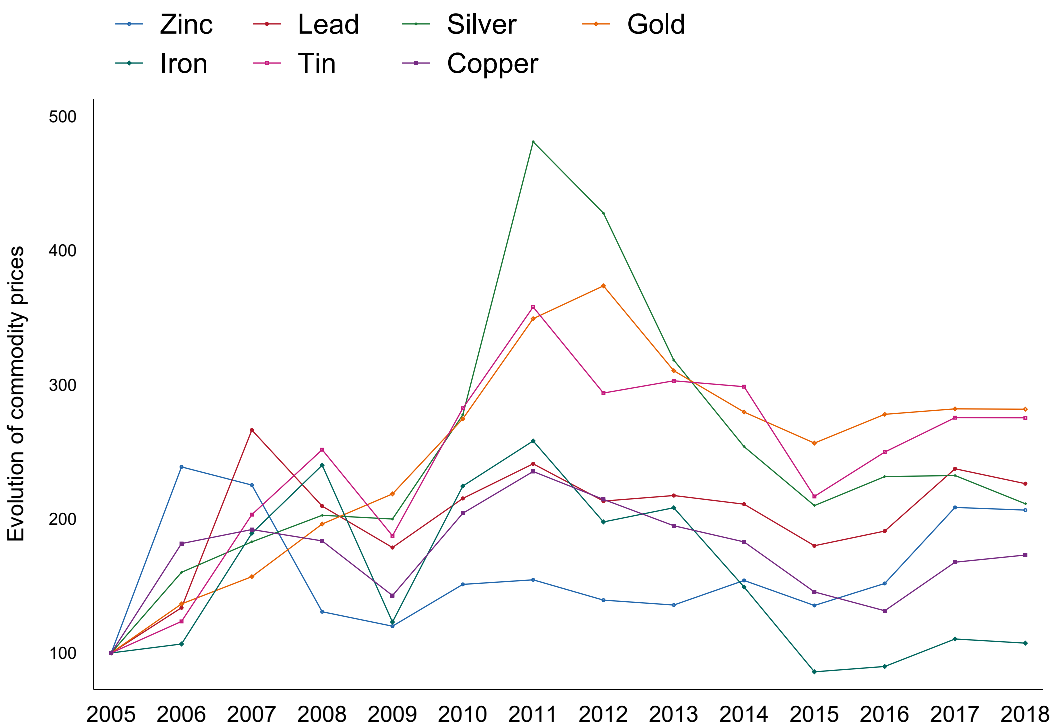
Source: Distribution of total resource windfalls received by non-extractive municipalities by type between 2006 and 2018.

Table C1: Exposure to commodities among non-extractive districts

	(1) **In province**	(2) **In region**
Minerals		
Silver	0.40	0.79
Gold	0.35	0.77
Copper	0.31	0.79
Lead	0.27	0.65
Zinc	0.26	0.65
Cadmium	0.03	0.15
Molybdenum	0.03	0.33
Arsenic	0.02	0.21
Manganese	0.01	0.22
Tin	0.01	0.08
Tungsten	0.01	0.08
Bismuth	0.00	0.10
Iron	0.00	0.02
Other		
Oil	0.01	0.07
Gas	0.01	0.06

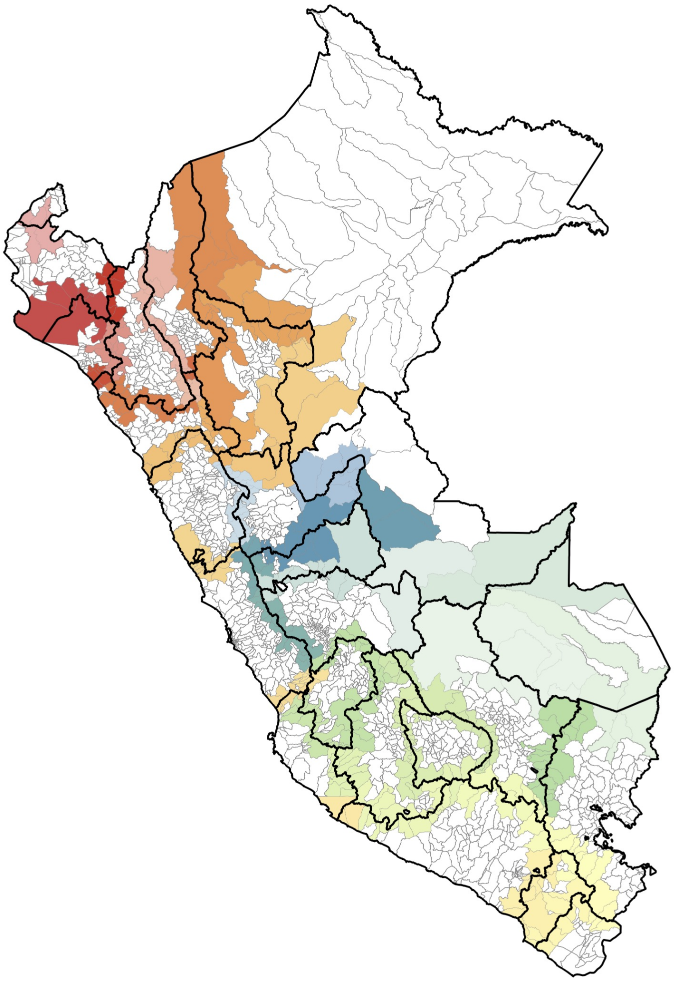
Notes. This table shows the share of non-extractive districts exposed to the extraction of these commodities at any point between 2006 and 2018 in their province (column 1) or region (column 2).

Figure C3: Growth in international prices for main minerals extracted in Peru



Source: International prices obtained from Bloomberg.

Figure C4: Bordering districts across regional boundaries



Notes. Shaded districts are those located across regional borders. Each color corresponds to a boundary group.

Table C2: OLS and reduced-form estimates

	OLS: Effects of public expenditure (ln)				**RF: Effects of resource windfalls (ln)**			
	β	se	p-value	Obs	β	se	p-value	Obs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Municipal								
Taxes (ln)	0.11	0.02	0.00	14053	0.04	0.01	0.00	14053
Loans (ln)	1.14	0.08	0.00	4369	0.10	0.05	0.07	4369
Productive: Started	0.65	0.06	0.00	10910	0.14	0.02	0.00	10910
Productive: Comp/Act	0.23	0.03	0.00	10910	0.03	0.02	0.10	10910
Social cap: Started	0.06	0.01	0.00	10910	0.01	0.01	0.22	10910
Social cap: Comp/Act	0.07	0.01	0.00	10910	0.01	0.01	0.18	10910
HR	14.65	2.23	0.00	18434	5.04	0.98	0.00	18434
HR: Managers	0.22	0.15	0.16	18434	0.08	0.06	0.25	18434
HR: Professional	2.29	0.38	0.00	18434	0.50	0.18	0.01	18434
HR: Technician	2.89	0.99	0.01	18434	0.61	0.33	0.09	18434
HR: Support	9.25	2.08	0.00	18434	3.86	0.87	0.00	18434
HR: Perm (share)	0.01	0.00	0.11	16977	-0.02	0.00	0.00	16977
Panel B: Individual								
Employed	0.01	0.00	0.00	720985	0.01	0.00	0.00	720985
Public	0.01	0.00	0.00	262605	0.00	0.00	0.01	262605
Hours	0.13	0.08	0.14	499577	-0.02	0.06	0.75	499577
Second job	-0.00	0.00	0.61	501454	-0.00	0.00	0.83	501454
Informal	-0.01	0.00	0.00	500856	-0.00	0.00	0.06	500856
Earnings (ln)	0.02	0.00	0.01	211074	0.01	0.00	0.01	211074
Employer	0.00	0.00	0.01	245592	0.00	0.00	0.11	245592
Wage-employed	-0.00	0.00	0.98	375852	0.01	0.00	0.00	375852
Self-employed	0.00	0.00	0.05	413524	0.01	0.00	0.00	413524
Unpaid work	0.02	0.00	0.00	302552	0.02	0.00	0.00	302552
Income (ln)	0.04	0.02	0.04	80162	0.04	0.01	0.00	80162
Consumption (ln)	0.01	0.01	0.40	85155	0.01	0.00	0.02	85155
Poor	-0.01	0.00	0.13	85155	-0.01	0.00	0.01	85155
Extreme poor	0.01	0.01	0.32	42159	-0.00	0.00	0.19	42159

Notes. The estimated effect of public expenditure (ln) on all outcomes presented in column 1 and of resources windfalls in column 5. Standard errors clustered at the district level presented in columns 2 and 6. The p-values are presented in columns 3 and 7. The effects on income, consumption, and poverty are restricted to rural areas. All monetary values in real terms. All regressions include district and year two-way fixed effects.

D Robustness checks

Table D1: 2006–2018 resource windfalls on 2004 municipal HR

	Total	**Managers**	**Professionals**	**Technicians**	**Support**
	(1)	(2)	(3)	(4)	(5)
Δ06-18 resource windfalls (ln)	0.05	0.01	0.02	0.04	-0.02
	(0.07)	(0.01)	(0.01)	(0.04)	(0.03)
Districts	1445	1445	1445	1445	1445

Notes. Δ06-18 denotes the mean annual growth in resource windfalls between 2006 and 2018. All specifications include province fixed effects.

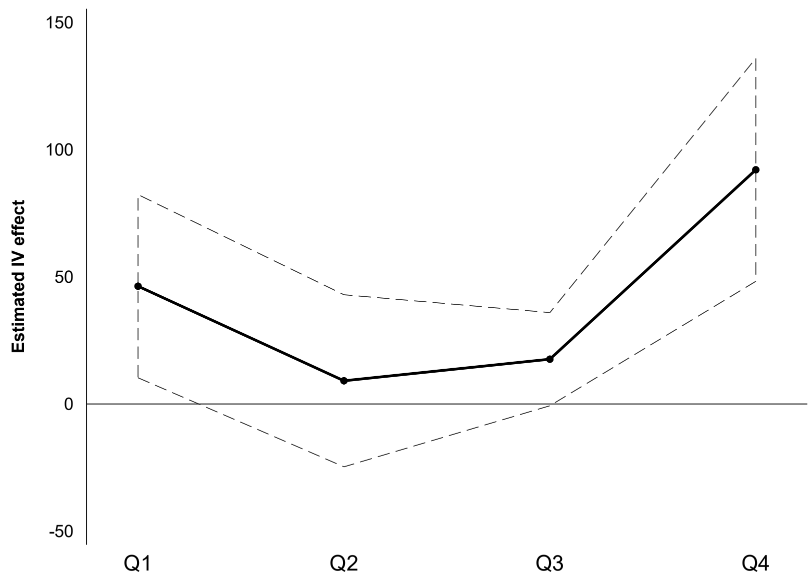
Table D2: 2006–2018 resource windfalls on 2004 individual outcomes

	Employed	**Public**	**Informal**	**Earnings (ln)**
	(1)	(2)	(3)	(4)
Δ06-18 resource windfalls (ln)	0.00	-0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Individuals	48387	19723	31179	11708

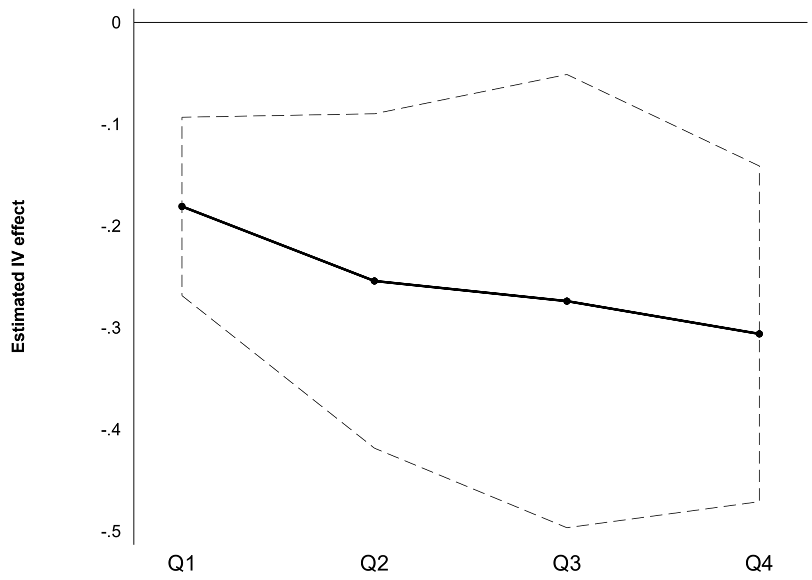
Notes. Δ06-18 denotes the mean annual growth in resource windfalls between 2006 and 2018. All specifications include province fixed effects.

Figure D1: Heterogeneous effects by quartiles of distance to closest mine

(a) Total HR

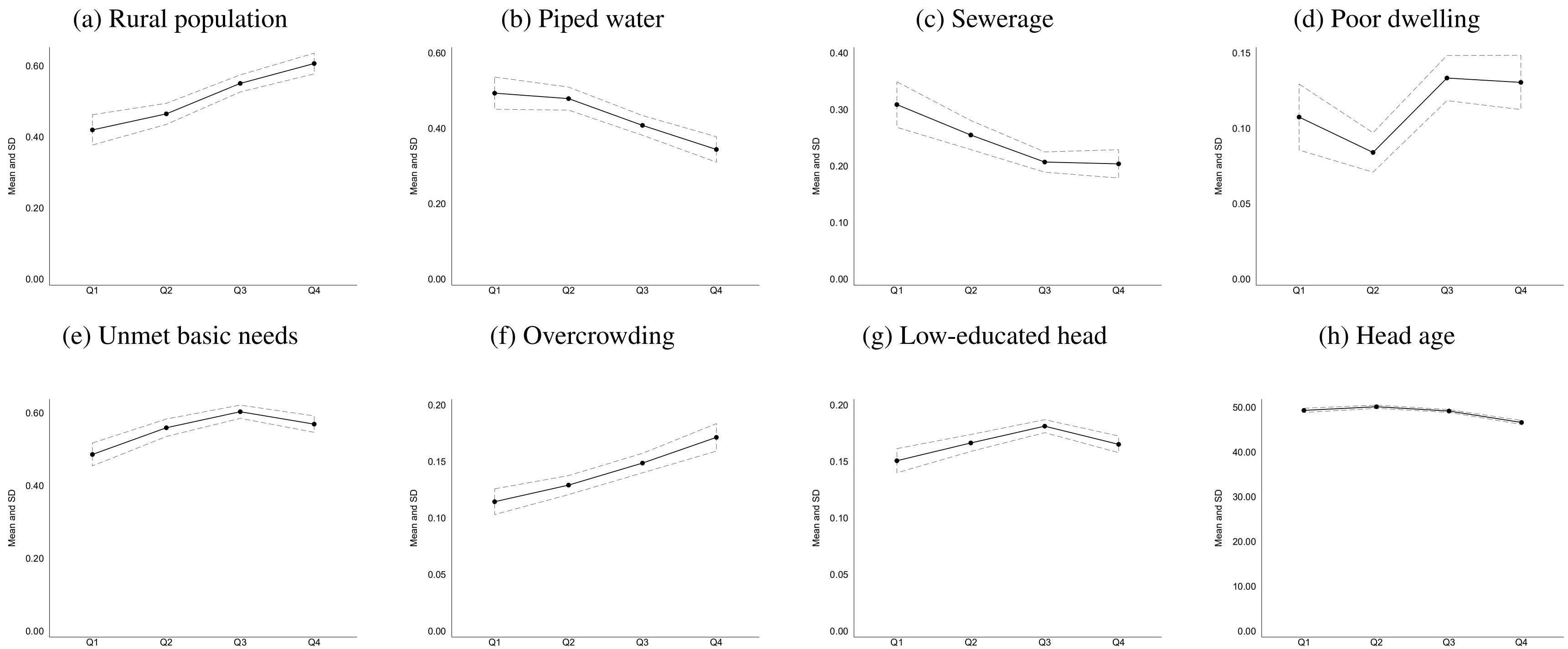


(b) % HR payroll



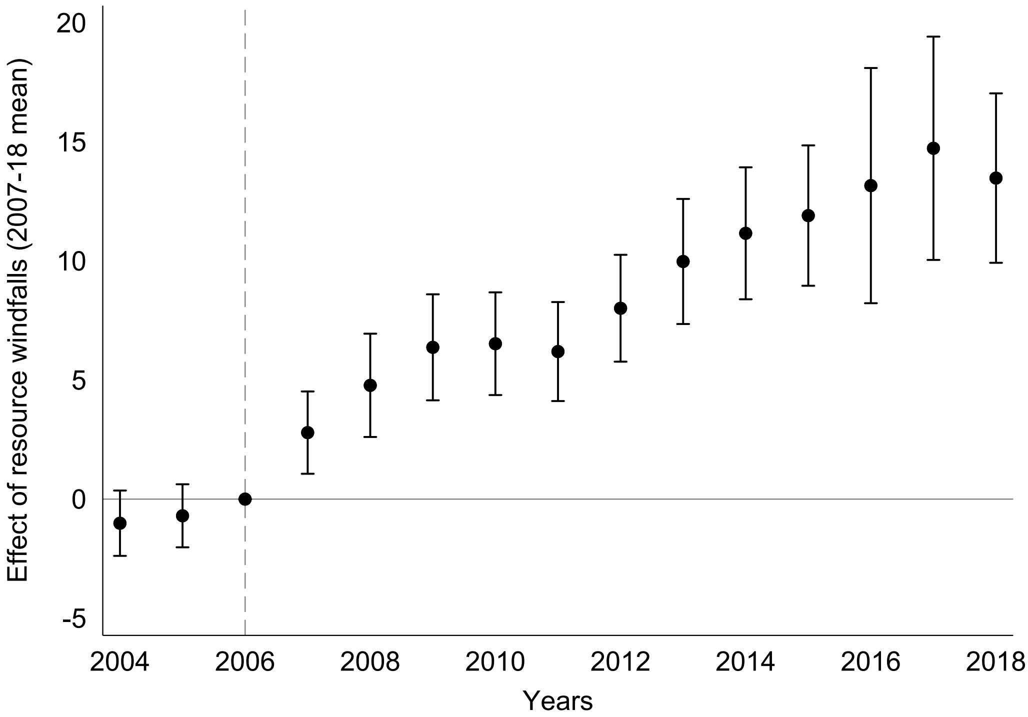
Note. Spikes correspond to 95% confidence intervals. All regressions include district and year two-way fixed effects. Standard errors clustered at the district level. Q1 is below 20 km; Q2 spans 20–30 km; Q3 spans 30–60 km; and Q4 is above 60 km. The exact quartiles change slightly across outcomes due to changes in the sample of analysis.

Figure D2: Initial district characteristics (2005 Census), by distance to closest mine



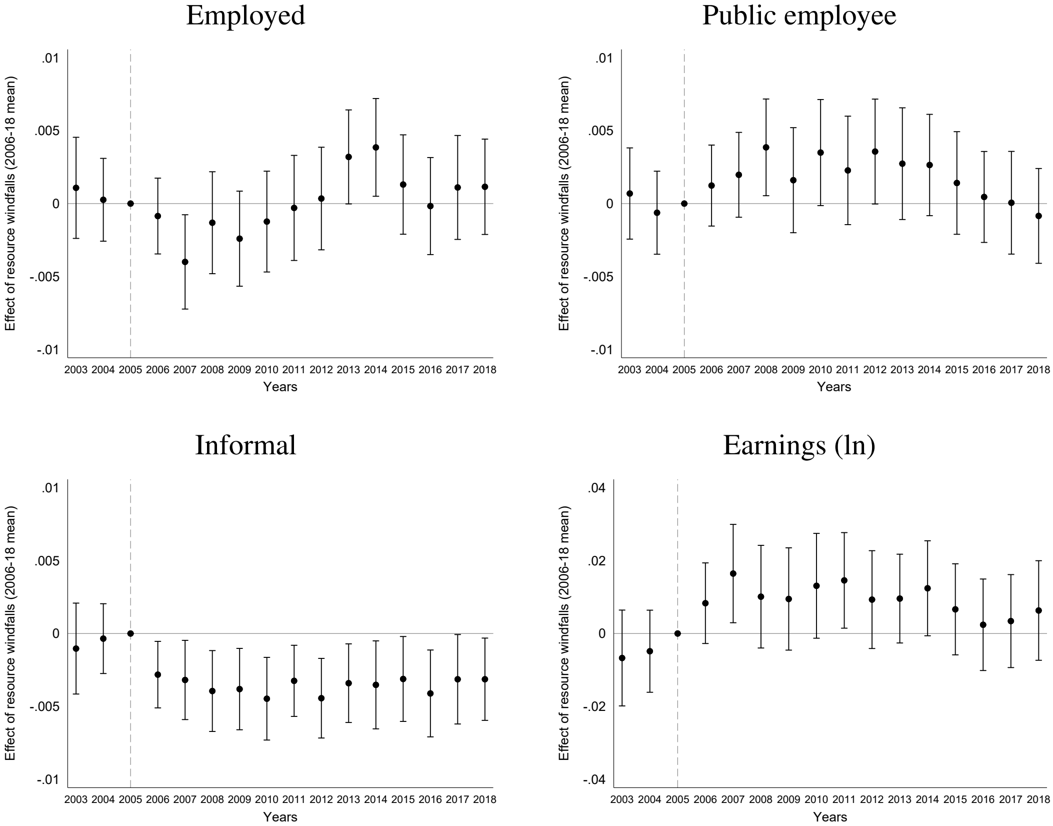
Notes. All data correspond to the 2005 Census. District characteristics are presented as the share of the population in Panel (a), as the share of households in Panels (b)–(g), and as the mean across households in Panel (h). Q1 is at or below 20 km; Q2 spans {20–35] km; Q3 spans {35–65] km; and Q4 is above 65 km.

Figure D3: Event-study: Reduced-form effects on municipal human resources



Notes. Coefficients are plotted along with 95% confidence intervals on the interactions of year dummies with district's 2007–2018 average canon (ln), with 2006 as the reference year. District and year fixed effects are included. Panel data at the municipality–year level from 2004 to 2018.

Figure D4: Event-study: Reduced-form effects on individual outcomes



Notes. Coefficients are plotted along with 95% confidence intervals on the interactions of year dummies with district's 2006–2018 average canon (ln), with 2005 as the reference year. District and year fixed effects are included.

Table D3: Robustness checks (2SLS): municipal outcomes

	Public works		Human resources		
	Productive	**Social capital**	**Total**	**Support**	**Permanent (share)**
	(1)	(2)	(3)	(4)	(5)
1. Region-year FE	1.95***	0.45*	47.07***	36.46***	-0.25***
	(0.40)	(0.24)	(9.38)	(8.56)	(0.04)
2. Province-year FE	1.93***	0.44*	45.87***	35.71***	-0.25***
	(0.39)	(0.24)	(9.42)	(8.59)	(0.04)
3. Poverty-year FE	1.92***	0.49**	55.33***	41.90***	-0.23***
	(0.39)	(0.21)	(9.54)	(8.66)	(0.04)
4. Boundary-year FE	3.61***	1.50**	19.93*	8.40	-0.23***
	(1.25)	(0.71)	(10.90)	(8.21)	(0.09)
5. Excluding large districts	2.33***	0.75**	27.41***	16.26***	-0.33***
	(0.51)	(0.34)	(4.22)	(2.73)	(0.06)
6. Excluding oil and gas regions	1.75***	0.37	41.41***	32.51***	-0.26***
	(0.40)	(0.24)	(10.18)	(9.36)	(0.04)
7. Distance to closest mine	1.91***	0.46*	48.90***	37.37***	-0.25***
	(0.39)	(0.24)	(9.56)	(8.57)	(0.04)
8. Simulated IV	0.65	0.34*	17.84***	13.83***	-0.05
	(0.46)	(0.19)	(6.44)	(5.14)	(0.05)

Notes. 'Poverty' stands for unmet basic needs, measured in the 2005 Census, and 'trends' refer to the characteristics-by-year fixed effects. 'Boundary FE' additionally includes boundary fixed effects and the specification restricts the sample to districts adjacent to a regional boundary. 'Simulated IV' corresponds to the simulated resource windfalls using mining production values and the redistribution rule of the canon law. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Table D4: Robustness checks (2SLS): individual outcomes

	Employed	**Public**	**Private**		**Earnings**
			Wage-employed	**Self-employed**	**(ln)**
	(1)	(2)	(3)	(4)	(5)
1. Region-year FE	0.06***	0.02***	0.03***	0.04***	0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
2. Province-year FE	0.06***	0.02***	0.03***	0.04***	0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
3. Poverty-year FE	0.07***	0.02***	0.03***	0.05***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
4. Boundary-year FE	0.14***	0.05***	0.07*	0.08***	0.20***
	(0.04)	(0.02)	(0.04)	(0.02)	(0.07)
5. Excluding large districts	0.19***	0.07***	0.12***	0.11***	0.24**
	(0.06)	(0.03)	(0.04)	(0.03)	(0.09)
6. Excluding oil and gas regions	0.05***	0.01**	0.02***	0.03***	0.05**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
7. Production of closest mine	0.06***	0.02***	0.03***	0.04***	0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
8. Simulated IV	0.43***	0.11***	0.14***	0.23***	0.67***
	(0.06)	(0.02)	(0.03)	(0.03)	(0.14)
9. HH FE	0.12***	0.04	0.06	0.10***	-0.02
	(0.03)	(0.03)	(0.05)	(0.04)	(0.16)
10. Individual FE	0.13***	-0.03	0.05	0.07**	-0.11
	(0.03)	(0.02)	(0.05)	(0.03)	(0.15)

Notes. Same notes as Table D3.

Table D5: Migration and selective migration (2SLS)

	Migrant (1)	**HH members** (2)	**Highly educated** (3)	**Female** (4)	**Age** (5)	**Married** (6)
Public expenditure (ln)	-0.01	0.00	-0.00	0.00	0.24	-0.00
	(0.02)	(0.01)	(0.01)	(0.00)	(0.23)	(0.01)
AR *p*-values	0.67	0.76	0.76	0.92	0.30	0.46
F-stat	67.59	91.49	91.46	91.49	91.49	91.49
Mean (initial)	0.51	0.97	0.58	0.51	37.48	0.52
Individuals	639311	722203	721583	722203	721846	722203
Districts	1295	1316	1316	1316	1316	1316

Notes. Estimated effects of public expenditure on the following outcomes by column. Migrant (column 1): indicator equal to one if the respondent was born in another district than the one in which they reside, or zero if in the same district. HH members (column 2): number of total household members. Highly educated (column 3): indicator equal to one if the respondent has attained some secondary education (above the median of the educational attainment distribution) or zero otherwise. Female (column 4): indicator equal to one if the respondent is female, or zero otherwise. Age (column 5): age of the respondent. Married (column 6): indicator equal to one if the respondent is married, or zero otherwise. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditure, following Equation (2). All regressions include district and year two-way fixed effects.

E Additional analysis

Table E1: Dynamic effects of resource windfalls (current and cumulative)

	R_t			R_{t-k}			$R_t = R_{t-k}$
	β (1)	se (2)	p-value (3)	β (4)	se (5)	p-value (6)	p-value (7)
Panel A: Municipal							
Productive: Started	0.13	0.03	0.00	0.15	0.03	0.00	0.75
Productive: Comp/Act	0.03	0.02	0.05	0.04	0.02	0.02	0.83
Social cap: Started	0.01	0.01	0.19	0.00	0.00	0.54	0.56
Social cap: Comp/Act	0.01	0.01	0.22	0.00	0.00	0.56	0.43
HR	5.20	0.95	0.00	-2.94	0.97	0.00	0.00
HR: Managers	0.16	0.07	0.03	0.08	0.07	0.25	0.46
HR: Professional	0.44	0.17	0.01	-0.19	0.17	0.28	0.01
HR: Technician	0.58	0.34	0.08	-0.57	0.29	0.05	0.02
HR: Support	4.03	0.83	0.00	-2.27	0.69	0.00	0.00
HR: Perm (share)	-0.02	0.00	0.00	0.00	0.00	0.92	0.00
Panel B: Individual/Household							
Employed	0.01	0.00	0.00	0.00	0.00	0.15	0.00
Public	0.00	0.00	0.00	-0.00	0.00	0.38	0.01
Hours	0.03	0.07	0.70	0.15	0.08	0.06	0.25
Second job	-0.00	0.00	0.59	0.00	0.00	0.47	0.35
Informal	-0.00	0.00	0.01	0.00	0.00	0.01	0.00
Earnings (ln)	0.01	0.00	0.01	0.02	0.00	0.00	0.13
Employer	0.00	0.00	0.24	-0.00	0.00	0.73	0.33
Wage-employed	0.00	0.00	0.00	0.00	0.00	0.44	0.19
Self-employed	0.01	0.00	0.00	0.00	0.00	0.62	0.00
Unpaid work	0.02	0.00	0.00	0.01	0.00	0.02	0.00
Income (ln)	0.03	0.01	0.00	0.01	0.01	0.21	0.20
Consumption (ln)	-0.00	0.00	0.08	0.00	0.01	0.34	0.13
Poor	0.00	0.00	0.12	-0.01	0.00	0.03	0.01
Extreme poor	0.00	0.00	0.60	-0.01	0.00	0.09	0.09
Panel C: Non-agricultural microenterprises							
Revenues (ln)	0.01	0.01	0.13	0.01	0.01	0.30	0.79
Revenues (ln)- Own account	0.02	0.01	0.02	0.02	0.01	0.20	0.87
Revenues per worker	0.01	0.01	0.07	0.02	0.01	0.07	0.44
Owns business premise	0.01	0.00	0.01	-0.00	0.00	0.61	0.07
Panel D: Agricultural microenterprises							
Revenues (ln)	0.03	0.01	0.01	0.03	0.02	0.12	0.98
Revenues (ln)- Only domestic	0.03	0.01	0.00	0.02	0.02	0.44	0.48
Revenues per worker	0.03	0.01	0.01	0.02	0.02	0.14	0.94
Owned land (ha,ln)	0.02	0.01	0.01	0.00	0.02	0.97	0.31

Notes. R_t denotes contemporary resource windfalls and R_{t-k} denotes cumulative resource windfalls to date, excluding the contemporary transfer.

Table E2: Effects on employment across industries (2SLS)

	Service vs. Manuf/Cons	Service vs. Agri	Manuf/Cons vs. Agri	Services and Manuf/Cons vs. Agri
	(1)	(2)	(3)	(4)
Panel A: All workers				
Public expenditure (ln)	0.04***	-0.02**	-0.10***	-0.02**
	(0.01)	(0.01)	(0.02)	(0.01)
AR p-values	0.00	0.01	0.00	0.02
F-stat	98.53	81.63	76.75	83.66
Mean (initial)	0.49	0.56	0.57	0.59
Individuals	481525	454574	413306	497904
Districts	1315	1316	1316	1316
Panel B: Excluding unpaid workers				
Public expenditure (ln)	0.03***	-0.00	-0.04***	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
AR p-values	0.00	0.74	0.00	0.99
F-stat	97.29	88.92	85.31	90.38
Mean (initial)	0.47	0.63	0.66	0.67
Individuals	467000	374882	348139	415628
Districts	1315	1316	1316	1316

Notes. Estimated effects of public expenditures on indicators capturing being employed in one industry over another. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditures, following Equation (2). Same notes as Table 5.

Table E3: Effects on firms, workers, and mean wages in the formal sector (2SLS)

	Firms	Workers	Mean wage (ln)		
			Public	Non-agriculture	Agriculture
	(1)	(2)	(3)	(4)	(5)
Public expenditure (ln)	9.28	199.46	0.09	0.47***	0.06
	(5.84)	(153.38)	(0.09)	(0.12)	(0.05)
AR p-values	0.11	0.21	0.30	0.00	0.26
F-stat	43.75	48.83	33.53	47.03	25.86
Mean (initial)	258.05	2691.70	6.02	4.65	5.31
District-years	4131	4646	671	4354	2006
Districts	1054	1164	187	1096	543

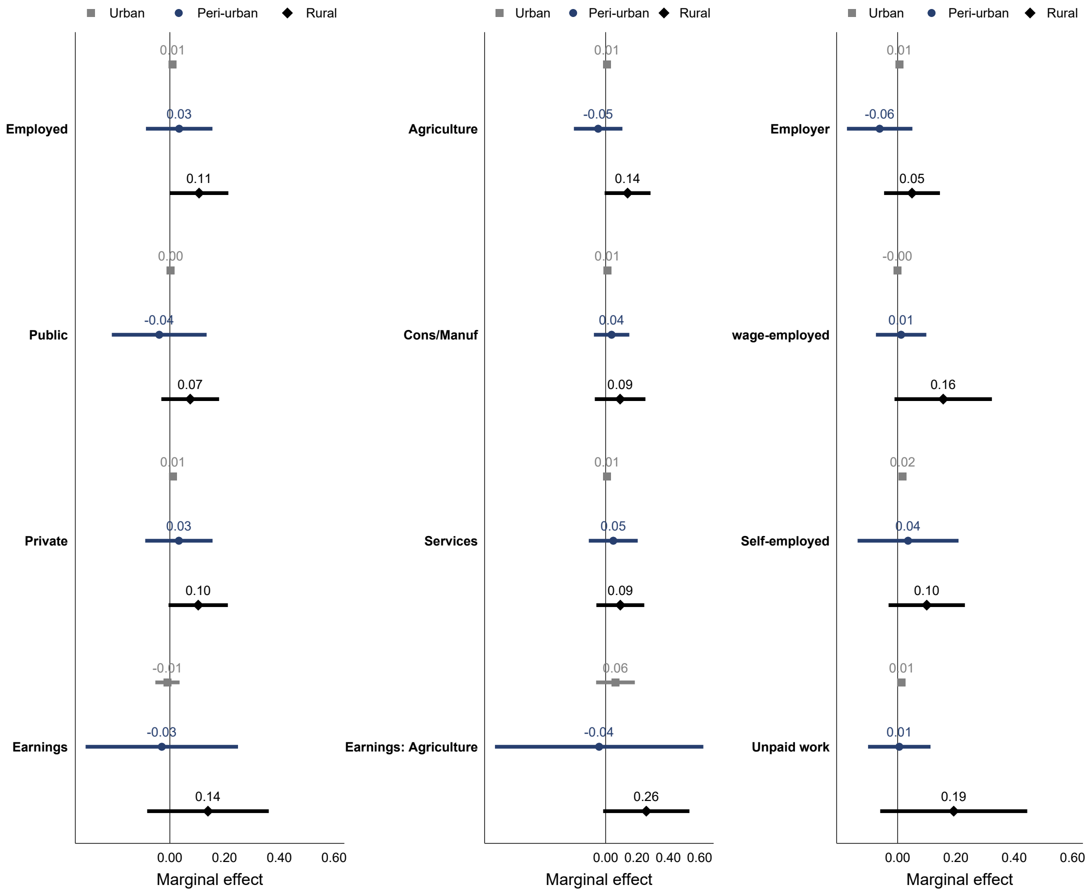
Notes. Estimated effects of public expenditure on the following outcomes at the district level by column. Firms (column 1): number of formal firms by the end of year. Workers (column 2): number of workers in formal firms by the end of year, Mean wage (columns 3–5): mean wage in the public, non-agricultural (including services, manufacturing and construction), and agricultural sectors in the formal sector. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditure, following Equation (2). All monetary values in real terms (USD 2007) and natural logs. All regressions include district and year two-way fixed effects. Standard errors clustered at the district level in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%. AR p-values correspond to the Anderson–Rubin p-values robust to weak instrumental variable.

Table E4: Effects on wages and earnings by occupation and industry (2SLS)

	Earnings for entrepreneurs (ln)			Wages (ln)		
	Total	Non-agriculture	Agriculture	Public	Non-agriculture	Agriculture
	(1)	(2)	(3)	(4)	(5)	(6)
Public expenditure (ln)	0.18*	0.16	0.23	-0.02	-0.00	0.11
	(0.11)	(0.11)	(0.17)	(0.02)	(0.02)	(0.07)
AR p-values	0.10	0.14	0.19	0.35	0.80	0.09
F-stat	31.68	57.41	15.06	96.02	74.66	29.39
Mean (initial)	6.97	7.36	6.85	5.70	4.69	4.28
Individuals	18356	3733	14296	37939	106667	22948
Districts	1154	415	1031	1031	1156	1035

Notes. Estimated effects of public expenditure on the following outcomes at the individual-level by columns: (1)–(3) Earnings for entrepreneurs: earnings for all self-employed and employers, and for those in the non-agricultural and agricultural sectors; (4)–(6): Wages: earnings per hour worked for wage-employed reporting at least 20 hours of work during the previous week, for the public, non-agricultural and agricultural sector. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditure, following Equation (2). Monetary values in real terms (USD 2007) and natural logs. All regressions include district and year two-way fixed effects, and control for household characteristics. Standard errors clustered at the district level in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%. AR p-values correspond to the Anderson–Rubin p-values robust to weak instrumental variable.

Figure E1: Heterogeneous effects by area in the coastal region



Notes. Same notes as Figure 4. Sample restricted to households in the coastal region.

Table E5: Local prices (2SLS)

	Housing (ln)	Food price index (ln)		
	imputed	Overall	Less tradable	More tradable
	(1)	(2)	(3)	(4)
Panel A: All				
Public expenditure (ln)	0.106***	-0.001	-0.002	0.003
	(0.024)	(0.002)	(0.002)	(0.002)
AR p-values	0.000	0.472	0.281	0.203
F-stat	90.290	79.112	79.112	79.112
Mean (initial)	4.074	0.087	0.098	0.030
Individuals	220253	211391	211391	211391
Districts	1316	1270	1270	1270
Panel B: Urban				
Public expenditure (ln)	0.037*	0.003	0.003*	0.001
	(0.019)	(0.002)	(0.002)	(0.003)
AR p-values	0.061	0.131	0.118	0.626
F-stat	94.601	86.454	86.454	86.454
Mean (initial)	4.748	0.105	0.116	0.043
Individuals	139274	130047	130047	130047
Districts	902	856	856	856
Panel C: Rural				
Public expenditure (ln)	0.244***	-0.014***	-0.018***	0.007***
	(0.069)	(0.005)	(0.006)	(0.003)
AR p-values	0.000	0.002	0.000	0.001
F-stat	31.897	33.196	33.196	33.196
Mean (initial)	3.036	0.064	0.073	0.014
Individuals	80979	81344	81344	81344
Districts	1028	1028	1028	1028

Notes. Estimated effects of public expenditure on the following outcomes by column. Housing prices (column 1): Imputed housing prices derived from homeowners' reports on how much they would be able to rent out their property. Food price index (columns 2–4): broken down into three categories, 'overall' (encompassing all food products), 'less tradable' (limited to the top 10 food products predominantly acquired through self-consumption within each region), and 'more tradable' (covering all remaining food products). In column 1, we additionally control for dwelling characteristics including type of dwelling, wall, roof and floor materials, number of rooms, and access to utilities (piped water, sewage, electricity, and Internet). Sample restricted to rural areas. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Table E6: Heterogeneous effects by geographical region

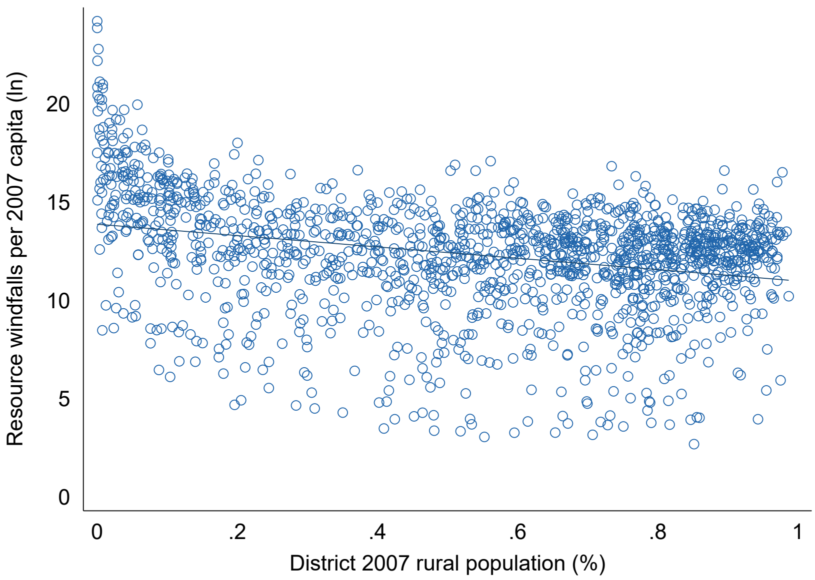
	Coast				Highlands				Rainforest			
	β	se	p-value	Obs	β	se	p-value	Obs	β	se	p-value	Obs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Municipal												
Productive: Started	1.94	0.84	0.05	2775	1.11	0.37	0.02	6863	1.24	0.94	0.23	1267
Productive: Comp/Act	0.83	0.33	0.04	2775	0.30	0.21	0.20	6863	-0.51	0.99	0.62	1267
Social cap: Started	0.25	0.11	0.05	2775	-0.02	0.06	0.71	6863	0.16	0.24	0.52	1267
Social cap: Comp/Act	0.09	0.10	0.38	2775	0.09	0.06	0.20	6863	0.61	0.49	0.25	1267
HR	50.27	19.26	0.02	5011	26.17	5.97	0.00	11086	67.05	22.27	0.01	2334
HR: Managers	-0.08	1.14	0.94	5011	1.04	0.73	0.18	11086	0.07	1.88	0.97	2334
HR: Professional	-2.87	4.56	0.54	5011	4.41	1.31	0.01	11086	9.17	3.32	0.02	2334
HR: Technician	6.58	8.63	0.46	5011	3.80	1.72	0.05	11086	18.13	9.08	0.07	2334
HR: Support	46.64	19.98	0.04	5011	16.93	4.76	0.00	11086	39.69	15.22	0.02	2334
HR: Perm (share)	-0.25	0.05	0.00	4579	-0.06	0.03	0.06	10272	-0.33	0.16	0.07	2124
Panel B: Individual												
Employed	0.02	0.01	0.01	297564	0.13	0.03	0.00	291696	0.04	0.02	0.04	131725
Public	0.00	0.01	0.55	127965	0.04	0.01	0.00	93825	0.03	0.01	0.04	40815
Private	0.03	0.01	0.01	279872	0.14	0.03	0.00	273496	0.05	0.02	0.04	123776
Hours	0.82	0.64	0.22	186216	-0.66	0.51	0.22	214919	-1.91	1.23	0.15	98442
Second job	0.00	0.01	0.76	187450	0.01	0.01	0.63	215510	-0.01	0.02	0.66	98494
Earnings (ln)	-0.01	0.02	0.58	104969	0.16	0.04	0.00	72629	0.11	0.07	0.15	33476
Employer	0.01	0.01	0.25	120297	0.01	0.01	0.11	86159	0.01	0.02	0.48	39136
Wage-employed	0.01	0.01	0.22	197783	0.07	0.02	0.00	122090	0.06	0.03	0.08	55979
Home production	0.04	0.01	0.01	120598	0.31	0.06	0.00	126449	0.06	0.04	0.16	55505
Self-employed	0.03	0.01	0.01	172884	0.08	0.02	0.00	167725	0.03	0.02	0.10	72915
Informal	0.00	0.01	0.63	187000	-0.01	0.01	0.02	215384	-0.01	0.01	0.17	98472
Services	0.01	0.01	0.07	246372	0.08	0.02	0.00	159796	0.06	0.02	0.01	75357
Agricultural	0.04	0.02	0.02	136398	0.21	0.04	0.00	193034	0.03	0.03	0.42	83874
Manuf/Cons	0.01	0.01	0.08	133966	0.04	0.01	0.02	91291	0.05	0.02	0.06	38194
Earnings - Serv	-0.01	0.02	0.50	76113	0.08	0.03	0.01	45479	0.03	0.05	0.58	20132
Earnings - Agri	0.09	0.10	0.38	12433	0.49	0.16	0.01	20990	0.32	0.24	0.21	10830
Earnings - Manuf/Cons	0.05	0.04	0.27	15452	0.24	0.08	0.01	5922	0.13	0.16	0.42	2354
Income (ln)	0.05	0.06	0.42	52167	0.13	0.07	0.07	44531	0.30	0.16	0.09	18643
Income rent, annualised, deflated (logs)	0.09	0.12	0.50	4894	0.09	0.08	0.31	6221	0.32	0.33	0.35	2242
Consumption (ln)	-0.05	0.02	0.03	99909	0.01	0.02	0.44	106709	0.07	0.06	0.25	44938

Notes. Estimates are based on 2SLS estimations using Equation (2) for each outcome measured from ENAHO. The p-values are presented in columns 3, 7, and 11. Standard errors are clustered at district level in columns 2, 6, and 10. The dependent variables are indicated in the rows.

Figure E2: Mean resource windfalls (2006–2018) and share of rural population (2007)

(a) Resource windfalls

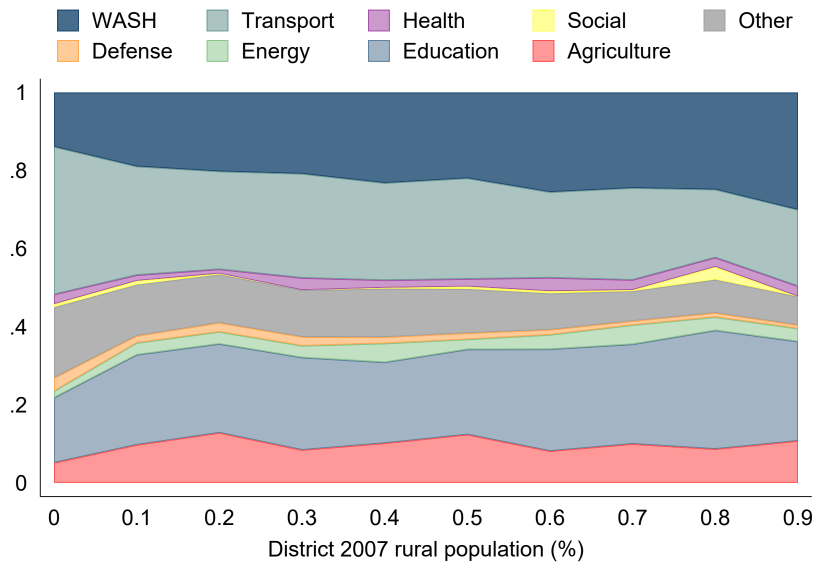
(b) Resource windfalls per capita



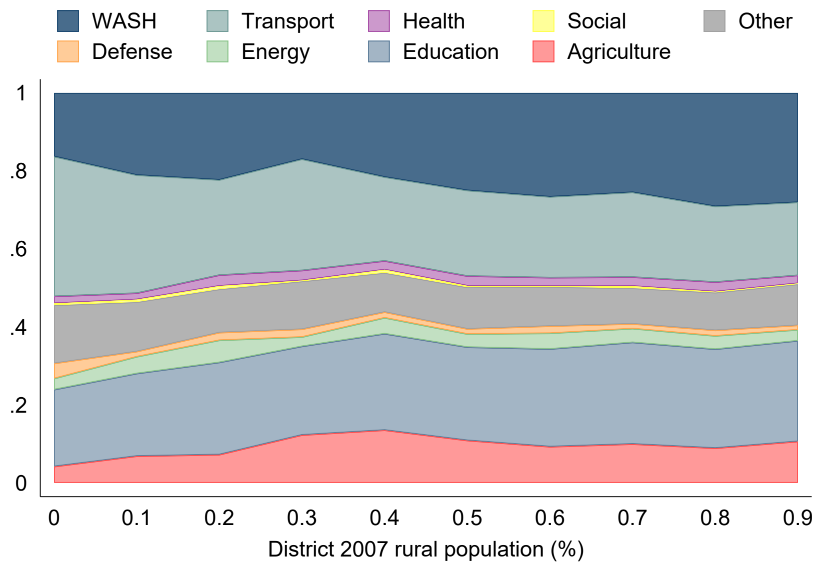
Notes. Share of rural population at the district level based on the 2007 Census. Sample restricted to non-extractive districts in the analysis.

Figure E3: Share of projects by type (2006–2018) and district share of rural population (2007)

(a) Low resource windfalls

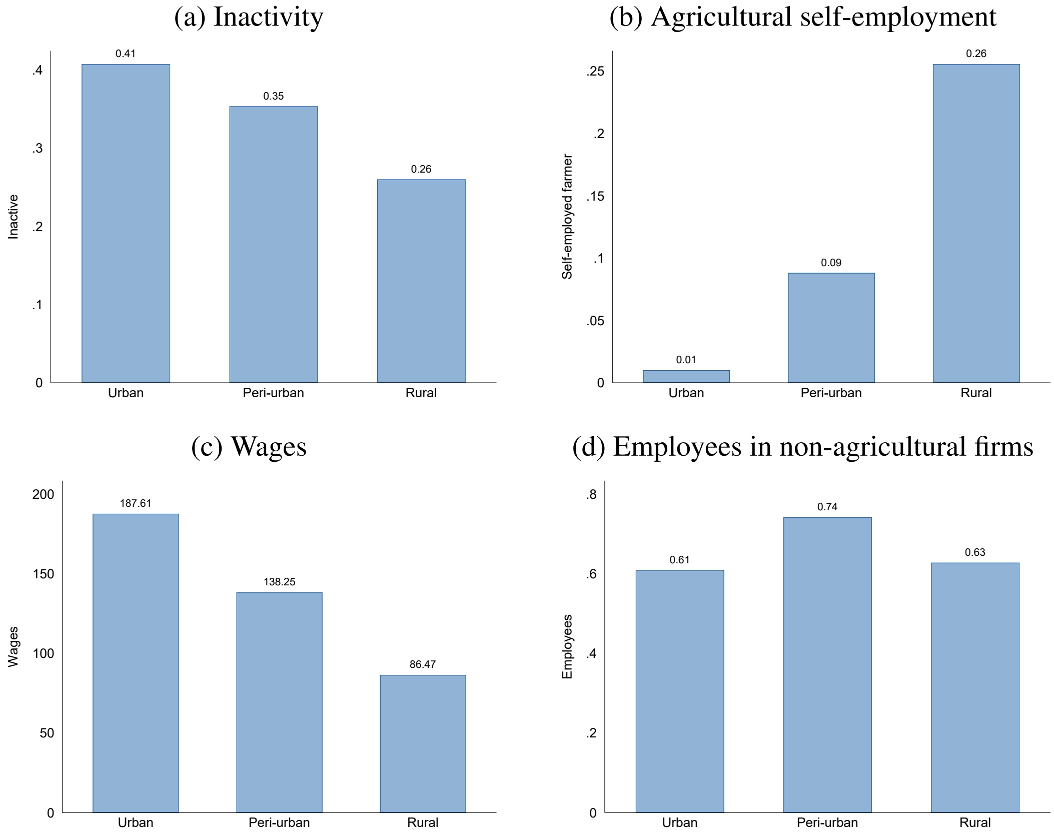


(b) High resource windfalls



Notes. Share of projects by type calculated from the total of projects started between 2006–2018. Share of rural population at the district level based on the 2007 Census. Sample restricted to non-extractive districts in the analysis. 'Low' resource windfalls are districts falling below the median of the total resource windfalls received between 2006 and 2018; and 'High' is for districts falling at or above the median.

Figure E4: Labor markets by area (initial)



Notes. Panel (a) shows the share of individuals that are inactive, Panel (b) the share of individuals working in agricultural self-employment, Panel (c) the mean wage of for wage-employed, and Panel (d) the number of employees reported by non-agricultural firms. Panels (a)–(c) are from individual-level data for 2006 and Panel (d) from firm-level data for 2007.

Table E7: Urban and peri-urban economies (2SLS)

	Income	**Consumption**					**Assets**	**Poor**
		Total	**Food**	**Rent**	**Durables**	**Non-dur**	**House**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Public expenditure (ln)	0.10**	-0.03**	-0.03**	0.01	-0.10***	-0.06***	0.03***	0.02***
	(0.04)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)
AR *p*-values	0.01	0.01	0.02	0.40	0.00	0.00	0.00	0.00
F-stat	85.08	93.14	93.03	93.14	92.98	93.09	93.14	93.14
Mean (initial)	5.67	6.37	5.61	4.48	2.80	5.03	0.67	0.32
Individuals	240368	166401	166184	166401	163706	166253	166401	166401
Districts	899	902	902	902	902	902	902	902

Notes. Estimated effects of public expenditure on the following outcomes by column. Income (column 1): deflated income for individuals reporting receiving income in logs. Consumption (columns 2–6): deflated household consumption per equivalent adult in logs, per category. Consumption in non-durables include clothing, healthcare and personal care, TTC, leisure, and others; House (column 7): indicator variable equal to one if the respondent owns the dwelling, and zero if not. Poor (column 8): indicator variable equal to one if the household is poor, and zero if not. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditure, following Equation (2). All regressions include district and year two-way fixed effects, and control for household characteristics. Coefficients in columns 1 and 2 correspond to monetary values in real terms. Sample restricted to urban areas. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Table E8: Rental income and consumption categories in rural economies (2SLS)

	Rental	Non-durable consumption				
	income	**Clothing**	**Healthcare**	**TTC**	**Leisure**	**Other**
	(1)	(2)	(3)	(4)	(5)	(6)
Public expenditure (ln)	0.07	0.23***	0.40**	0.07	-0.16*	-0.02
	(0.08)	(0.09)	(0.18)	(0.09)	(0.09)	(0.09)
AR p-values	0.36	0.00	0.01	0.45	0.06	0.82
F-stat	6.20	30.61	28.83	31.44	30.97	31.53
Mean (initial)	1.77	2.14	2.13	2.58	1.69	1.71
Individuals	6757	75448	57619	71777	77663	81823
Districts	745	1028	979	1024	1028	1027

Notes. Estimated effects of public expenditures on deflated and annualized rental income in column (1) and household consumption on non-durables per equivalent adult in natural logs for different category by colum: (2) clothing, (3) healthcare and personal care, (4) transport and telecommunications, (5) leisure and (6) others. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditures, following Equation (2). All regressions include district and year two-way fixed effects, and control for household characteristics. Sample restricted to rural areas.

Table E9: Output multiplier using district GDP

	Nightlights		Seminario and Palomino (2018)	
	All	**Winsorized**	**All**	**Winsorized**
	(1)	(2)	(3)	(4)
Resource windfalls (USD 2007)	2.58	3.89	1.85	4.84
	(1.10)	(1.46)	(0.66)	(0.68)
	[0.02]	[0.01]	[0.01]	[0.00]
p-value ($\alpha = 1$)	0.15	0.05	0.20	0.00
Mean (initial)	4.41e+07	2.41e+07	7.78e+07	2.03e+07
District-years	18518	18518	20000	20000
Districts	1566	1566	1566	1566

Notes. Estimated reduced-form effects of resource windfalls on GDP. District GDP in columns 1 and 2 corresponds to regional GDP redistributed at the district level using the share of harmonized global night-time light dataset developed by Li et al. (2020) as weights. GDP in columns 3 and 4 corresponds to the estimations of Seminario and Palomino (2018). All monetary values in real terms (2007 USD). Columns 1 and 3 present regressions in levels and columns 2 and 4 use variables that have been winsorized at the top 10 percentile to deal with outliers. All regressions include district and year two-way fixed effects, and control for cumulative resource windfalls until $t - 1$. Standard errors clustered at the district level in parentheses.

Table E10: Household welfare (2SLS)

	Extreme poor	**Female head**	**Poor dwelling**	**Overcrowded**	**Open defecation**
	(1)	(2)	(3)	(4)	(5)
Panel A: Rural					
Public expenditure (ln)	-0.06	0.02	-0.03	-0.00	-0.04
	(0.05)	(0.02)	(0.03)	(0.02)	(0.03)
AR *p*-values	0.16	0.15	0.33	0.83	0.27
F-stat	26.76	33.07	33.07	33.07	33.07
Mean (initial)	0.44	0.16	0.20	0.18	0.47
Individuals	42159	85155	85155	85155	85155
Districts	985	1028	1028	1028	1028
Panel B: Urban					
Public expenditure (ln)	0.04*	-0.00	0.01	-0.00	0.01
	(0.02)	(0.01)	(0.00)	(0.00)	(0.01)
AR *p*-values	0.07	0.44	0.23	0.85	0.36
F-stat	98.00	93.14	93.14	93.14	93.14
Mean (initial)	0.13	0.25	0.07	0.06	0.09
Individuals	27949	166401	166390	166387	166401
Districts	832	902	902	902	902

Notes. Estimated effects of public expenditure on the following outcomes by column. Extreme poor (column 1): indicator variable equal to one if the household is extremely poor, and zero if poor. Poor dwelling (column 2): dwelling has walls from rudimentary materials and natural floor. Overcrowded (column 3): more than four household members per room (excluding kitchen, bathroom, and garage). Open defecation (column 5): indicator variable equal to one if the house has no toilet, and zero if it does. All coefficients correspond to 2SLS estimates using resource windfalls as an instrument for public expenditure, following Equation (2). All regressions include district and year two-way fixed effects, and control for household characteristics. Sample restricted to households in rural areas. * Significant at 10%; ** significant at 5%; *** significant at 1%.