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Energy News Shocks, Income and Consumption: Evidence from the Russia-China Gas Pipeline

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JEL codes: D72; O11

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1 Introduction

Resource-rich countries that export raw materials have on average been observed to perform poorly in terms of economic growth. van der Ploeg (2011) and Venables (2016) offer comprehensive surveys of this literature. Two main explanations for this poor growth performance dominate: a) the political resource curse and b) the economic resource curse. The political resource curse thesis postulates that resource exporting countries rely on extractive industries for GDP growth, and that these industries entrench extractive economic institutions in the form of expropriation of private property and disregard for contracts, which in turn harm growth. The economic resource curse thesis postulates that raw material exports appreciate the real exchange rate, which then renders non-resource tradable sectors uncompetitive, with adverse consequences for growth. Both mechanisms operate through the export side of the economy, and the empirical literature has accordingly concentrated on resource exporters.

China's position in this landscape is somewhat unique. It is a large industrialized economy with substantial spatial and time series variation in income, industrial structure, and energy use, and it is the largest economy in the world in terms of GDP measured at the purchasing power parity (PPP) exchange rate. It is also a manufacturing and agricultural goods exporter and a net energy importer.[1] The complex structure and sheer size of the Chinese economy suggest that the standard resource curse explanations, built around energy exporters, may not apply. Yet the question of whether energy shapes growth and its distribution in a large importer, and through which channel it does so, remains open. To the best of our knowledge, no comprehensive analysis of the resource curse thesis has been conducted for China. Studying the implications of energy for Chinese consumers and producers therefore offers a natural way to extend this literature to the import side of the world energy market.

Our intention is to draw a cause and effect inference in the relationship between energy and economic performance. The Russia-China gas pipeline project serves as a natural experiment and enables us to explore spatial and temporal heterogeneity in response to an exogenous shock. A unique feature of our paper is that we utilize the announcement of the pipeline project in 2014 as the news shock, as opposed to the actual delivery of natural gas from 2019 onwards. In this way we aim to capture the expectation induced effects of the project and not just the realized ones. This distinction matters for two reasons. First, prices, investment, and contracting respond to anticipated supply long before physical flows begin, so the announcement isolates a channel that the delivery date cannot. Second, the timing and route of the agreement were driven by Russia's strategic pivot eastwards rather than by the economic conditions of the Chinese provinces along the route, which allows us to treat the shock as exogenous to the outcomes we study.

[1] It is a raw materials exporter in terms of critical minerals but not energy.

The effect of energy on the economy could operate through both the demand and the supply side. On the demand side, it could directly affect consumption demand. On the supply side, it could affect industry performance and income. These channels carry different implications for where the incidence of an energy price shock should fall, which allows us to distinguish between them. In this paper we study the effect of energy on the Chinese economy systematically by taking a layered approach that follows the shock from the aggregate down to the households. First, we look at aggregate and province level effects and utilize a difference-in-differences (DID) design for causal inference. Second, we look at sector level effects by examining sectoral income across 19 sectors. Third, we analyze the effect on household consumption and income using longitudinal household data. Our baseline results are also robust to direct price treatment, placebo treatment, and alternative methods of estimation. In particular, we subject our baseline estimates to Nearest Neighbor Matching (NNM), bias-adjusted NNM, Propensity Score Matching (PSM), Entropy Balancing (EB), and Coarsened Exact Matching (CEM), which address the concern that treated and control provinces may differ systematically in ways correlated with the outcomes we study.

Our findings could be summarized as follows. First, at the aggregate national level the pipeline news shock is associated with increases in both income and consumption, suggesting that positive news about energy infrastructure generates expectation induced macroeconomic gains and associated spillovers. Province-level results, however, consistently show a post news shock decline in income and consumption in the treated regions through which the pipeline is planned to pass. Provinces on the pipeline route on average lose relative to the other provinces, by 3.8% in per capita income and 5.5% in per capita consumption. The two results are not in conflict, since the aggregate series captures the level effect of the news on the economy as a whole while the DiD estimates capture the effect on transit provinces relative to the non-transit provinces. We argue, and also demonstrate, that the relative loss is driven by an expectation induced increase in the current price of natural gas, which raises the cost of energy immediately while the benefits of additional supply arrive only after construction.

Second, we find that the overall effect of the news shock on industrial wages is negative with average wages in the treated province-industry falling by 5.3%. However, the effect varies across industries. In particular, large scale industries such as manufacturing, construction, and transport record negative but statistically insignificant wage effects whereas relatively smaller scale industries such as residential services and repairs, water, health, scientific and technical services, and IT record negative statistically significant effects. This could be associated with the scale of industrial operations and their ability to absorb costs. For instance, large scale industries such as manufacturing, construction, and transport are likely able to absorb the higher energy cost and not pass them on to wages in the form of a cut. In contrast, the relatively smaller scale industries such as

residential services and repairs, water, health, scientific and technical services, and IT appear to be managing higher energy costs by cutting wages at the margin.

Third, household level results confirm the same mechanism at the level at which it operates. Household income in treated provinces falls by 8.8%, and while the average consumption response is not statistically distinguishable from zero, this average conceals substantial heterogeneity. The effect is more prominent in the lower income quantiles, which reduce consumption far more sharply than the upper income quantiles. This could be associated with borrowing capacity constraint of the low income households who are more likely to cut consumption to meet current cost increase as opposed to borrow and smooth consumption. In contrast, high income households are much more likely to smooth consumption facing a price increase.

We contribute to the literature in four ways. First, we identify a natural experiment of significant policy relevance that allows us to test the resource curse thesis in a large net energy importer, a setting in which the standard export-driven mechanisms cannot operate. Second, we exploit the announcement rather than the delivery of the project, which isolates the expectation induced channel through which energy infrastructure affects an economy. Third, using datasets that have not been used for this purpose before, we document the effects of an energy infrastructure news shock on income and consumption not only at the aggregate national and provincial levels but also at the industry and household levels. Our industry level data cover 19 industries, which is unique in the Chinese context, and the distinction between consumption and income allows us to study the effects separately for consumers and workers. Last but not the least, to the best of our knowledge, our study is the first attempt to systematically analyze the effect of a large energy project news shock in China using a layered data driven approach.

Our paper is related to a large literature on Dutch Disease and the resource curse. Early theoretical contributions include Corden and Neary (1982) and Gregory (1976), while the empirical literature could be traced back to Sachs and Warner (2001). van der Ploeg (2011) and, more recently, Savoia and Sen (2021) review this literature. Ross (2015) presents a survey of the political strand. Early empirical work used cross-country designs, but more recent studies have focused on within country variation in natural resource shocks and their local effects. For example, Allcott and Keniston (2018) examine the effect of shale oil and gas booms on manufacturing in the United States using county level census microdata and find no evidence of a resource curse. Bjørnland and Thorsrud (2016) study Norway and Australia and find that services and non-tradable grow much faster than manufacturing. Aragón and Rud (2013) use Peruvian household survey data to estimate the effects of gold mines on household outcomes and find positive effects and Caselli and Michaels (2013) use a similar design for Brazil. Further examples focusing on the local effects of extractive industries and the associated political economy in Africa are Mamo, Bhattacharyya, and Moradi (2019), Bhattacharyya and Mamo (2021), and

Bhattacharyya and Mamo (2025). Closest to our paper is Arezki, Ramey, and Sheng (2017), who study the macroeconomic effects of oil discovery news shocks in an open economy. We differ from this body of work in two aspects: the positive energy supply shock we study is anticipated rather than realized, and it hits a net energy importer rather than an exporter.

The remainder of the paper is structured as follows: Section 2 presents a brief history of the Russia-China gas pipeline project. Section 3 presents a conceptual framework linking the pipeline news shock to income and consumption. Section 4 discusses the data and the empirical strategy. Section 5 presents evidence on the effects of the news shock on income and consumption at the province, sector, and household levels, distinguishing between short run and long run effects. Section 6 deals with robustness and Section 7 concludes.

2 Russia–China Gas Pipeline Project: A Summary

The Russia-China gas pipeline project which is also known as the Power of Siberia pipeline is the first large-scale pipeline project between Russia and China delivering Russian natural gas to China through the eastern route. The project is based on a long-term agreement signed in May 2014 between China National Petroleum Corporation (CNPC) and Gazprom. The contract runs for 30 years and is valued at approximately USD 400 billion. The pipeline transports gas from Eastern Siberian fields into North-Eastern China, entering the country at Heihe in Heilongjiang Province and then supplying major demand centres in the northern and eastern regions.

Under the agreement, annual supply is expected to reach up to 38 billion cubic meters, making it one of the largest bilateral gas contracts to date. Construction began soon after the agreement was signed, while actual gas deliveries started in December 2019. This timing creates a clear distinction between the announcement of the agreement (news shock) and its subsequent implementation.

Following the start of gas deliveries, the pipeline has continued to expand and also operational disruptions reduced. It became fully operational in 2022 with the completion of key upstream sections, marking the full integration of gas production and transmission infrastructure. During this period, the system has undergone several scheduled maintenance interruptions, which are not uncommon for large-scale energy infrastructure projects. Delivery volumes have also steadily increased reaching approximately 38 billion cubic meters annually by 2025. Furthermore in 2025, gas exports to China via this pipeline have for the first time also surpassed Russia's historical high in pipeline gas exports to Europe.

Note that the eastern route of the pipeline spans approximately 5,100 kilometers across nine provinces in China and is constructed in three segments. They are the north-

ern section (Heihe–Changling), which is operational since December 2019; the central section (Changling–Yongqing), which is operational since December 2020; and the southern section (Yongqing–Shanghai), which began construction in July 2020.

Figure 1 presents a map of the pipeline route in China. Shaded areas indicate the regions traversed by the eastern route of the Russia–China gas pipeline (Heilongjiang Province, Jilin Province, Inner Mongolia Autonomous Region, Liaoning Province, Hebei Province, Tianjin City, Shandong Province, Jiangsu Province, and Shanghai City), which we define as the treatment group, while the remaining regions serve as the control group. The map also marks key nodes along the pipeline corridor, including Heihe, Changling, Yongqing, and Shanghai, to illustrate its general spatial orientation. The exact pipeline route is not depicted in compliance with local legislations. However, the provincial classification serves as a proxy for exposure to the pipeline-related news shock. Figure 2 depicts the trend in gas supply and population coverage relative to demand over the period 2010–2022. It is apparent that demand (or gas consumption) has been growing steadily over this period and at a faster rate than local supply firmly making China a net importer of natural gas. Furthermore, population coverage of natural gas is also increasing steadily with the coverage ratio reaching 30% in 2022. From an economic perspective, the 2014 agreement can be viewed as a major policy news shock as it marked a long-term commitment in energy cooperation between China and Russia. Therefore, it is likely to have triggered expectation induced effects. Furthermore, it also marked a foreign policy shift between the two countries with significant global geopolitical implications.

Pricing has been a major sticking point between the two parties with negotiations lasting much longer than expected thereby making the prediction of precise timing and announcement of the agreement practically impossible. Therefore, it is reasonable to assume that the May 2014 announcement was a random news shock. We also discuss this further in Section 3.

3 Pipeline News Shock, Income and Consumption: A Conceptual Framework

Theoretical motivation for estimating the impact of pipeline news shock on income and consumption stems from the well-established resource curse and Dutch disease literature. The literature posits that resource curse stems from both economic and political mechanisms. In case of China, there is very little within country variation in political institutions to have meaningful effects on the outcome variables of income and consumption. Therefore, we exclusively focus on the economic mechanism here.

We also assume that the macro news shock of the new pipeline ultimately affects households and enterprises/firms at the micro level. It affects household consumption

demand through prices and it also affects house income through enterprises. We discuss them further below. However, these micro effects can also be aggregated at the industry and provincial levels. Such aggregate effects could also be heterogeneous by industry. Furthermore, the micro effects on households and enterprises could also be heterogeneous conditional on pre-existing circumstances. We discuss them further below and also address them empirically.

Figure 3 presents a schematic diagram summarizing the conceptual framework. It links the pipeline news shock to income and consumption. We argue that the pipeline news shock signals a significant increase in future gas supply and supply capacity relative to demand. Given that China is a net importer of natural gas (Figure 2), it is reasonable to expect that such a positive supply news shock will have a negative impact on the expected future price of imported natural gas. This in turn is likely to increase current price. In particular. a positive supply news shock increases demand for gas future contracts in the financial markets. This increases current international price of gas which then also increases domestic prices in net importer countries. Figure 4 plot the response of public natural gas price, industrial natural gas price, and residential natural gas price in China. We observe a significant increase in public and industrial prices following the announcement of China-Russia natural gas cooperation agreement in May 2014. Residential prices also steadily increase between the announcement of 2014 and construction in 2020 but at a much slower rate due to government subsidy. The actual increase in gas prices is likely to negatively affect current consumption by households. The effect could be heterogeneous on the basis of household income with low income households likely to be affected more than the others. Theory may predict such effects but the actual incidence is empirical in nature and therefore would need to be established empirically.

The higher industrial gas price raises input costs for firms and enterprises in China. It is expected that they will pass on a fraction of the input cost increase to the consumers both locally and internationally. This would likely lead to an increase in the relative price of exports, erosion of competitiveness, and a decline in demand in the short run. A decline in demand would likely translate into a fall in wages and income. Furthermore, a fall in wages and income could also arrive from the input cost side whereby firms could cut wages to compensate for higher energy cost. The effect on firms and enterprises are also expected to be heterogeneous by industry type. Large scale industries are likely able to absorb cost pressures from higher energy price better than relatively small scale industries. Energy intensity could also play a role. Again, these are valid empirical questions that we address in detail in Section 5.

4 Data and Empirical Strategy

We compile a dataset of income, consumption and other variables at the provincial, industry and household levels with a consistent coverage of 31 provinces in the country observed over the period 2010 to 2022.[2] This allows us to analyze the impact and transmission of energy infrastructure news shock from macro aggregate outcomes to the micro level. In addition to income and consumption, we also control for standard macroeconomic indicators such as GDP, government expenditure, urbanization, population, and others at the appropriate level of aggregation depending on the specifications. In what follows, we carefully illustrate the nature and source of our data, any adjustments to the scale and origin that we have made with respect to specific variables, and their potential coverage and variation. Note that, Appendix A1 presents detailed variable definition and source. Province and industry names are recorded in Appendix A2 and Appendix A3. We present the empirical strategy in later sections.

4.1 National Level Variables

At the national level, we use time-series data from the National Bureau of Statistics (NBS). The dependent variables are per capita disposable income and per capita consumption expenditure. The control variables are per capita GDP, per capita fixed asset investment (FAI), urbanization rate, and per capita natural gas consumption. All monetary variables are measured in nominal RMB and are expressed in a logarithmic scale for the empirical analysis.

The NBS defines disposable income as the total income available to residents for consumption and saving after deducting personal income taxes and social security contributions. It includes wage income, operating income, property income, and transfer income. Per capita disposable income is calculated as total disposable income divided by the number of permanent residents.[3]

Per capita consumption expenditure is defined as total household consumption expenditure divided by the number of permanent residents, capturing the average level of consumption. It includes spending on goods and services such as food, clothing, housing, transportation, education, and healthcare.

Per capita GDP is defined as gross domestic product divided by the total population and measures the average level of economic output per person. FAI refers to the total

[2]Sample size may vary depending on coverage of particular control variables across specifications. We discuss them in detail in each table and also clearly identify our baseline specifications.

[3]Since 2013, the NBS has implemented an integrated urban–rural household survey on income, expenditure, and living conditions, replacing the previously separate surveys conducted before 2012. Due to differences in survey scope, methodology, and indicator definitions, data for 2010–2013 were retrospectively adjusted by the NBS to ensure comparability with the new survey framework, and are reported in current prices.

monetary value of investment in the construction and acquisition of fixed assets within a given period, reflecting the scale and dynamics of capital formation. Urbanization rate is defined as the share of the urban population in the total population, calculated as the ratio of urban residents to permanent residents. Natural gas consumption is measured as the total volume of gas consumed over a given period, typically in physical units (e.g., billion cubic meters), and reflects the level of energy usage.

Unless otherwise specified, all monetary variables are expressed in current RMB and therefore capture both price changes and variations in real economic quantities.

4.2 Provincial Level Variables

At the provincial level, we construct a panel dataset of 403 observations covering 31 provinces observed over the years 2010 to 2022. The data for the construction of the provincial level variables are mainly drawn from the Provincial Statistical Yearbooks and Provincial Bureau of Statistics.

The dependent variables are per capita income and per capita consumption. Per capita income at the provincial level is defined as total disposable income divided by the number of permanent residents. It varies substantially across provinces, with the highest per capita income observed in Shanghai and Beijing, and the lowest per capita income observed in Gansu, Guizhou, and Tibet. Overall, the data reflects differences in economic development across provinces. Per capita consumption is defined as total household consumption expenditure divided by the number of permanent residents. Similar to income, consumption levels display significant regional heterogeneity and follow a broadly increasing trend over time. Shanghai and Beijing exhibit the highest levels of consumption per capita, whereas Tibet, Qinghai, and Gansu exhibit lower levels of the same.

The key explanatory variable is the interaction between the provincial level treatment indicator and the energy infrastructure policy news shock. Control variables include measures of natural gas infrastructure and usage (such as pipeline length, gas supply, number of users, and coverage rate), and standard macroeconomic indicators, including the share of the tertiary sector, general public budget expenditure, urbanization rate, population size, and the employment share of state-owned enterprises. All monetary variables are measured in nominal RMB and are expressed in logarithms in the empirical analysis. Standard macroeconomic indicators as well as gas infrastructure and usage data are sourced from the statistical yearbooks.

4.3 Industry Level Variables

At the industry level, we employ a three-dimensional panel dataset covering 31 provinces, 19 industries observed over the years 2010 to 2022. The dataset contains a total of 7,657 observations and is primarily sourced from the Economy Prediction System (EPS)

database, a widely used platform for socio-economic research in China. The database systematically compiles and harmonizes official statistics from the NBS and statistical yearbooks, ensuring consistency and comparability across regions and over time.

The outcome variable is the average wage of urban non-private sector employees, defined as total wage payments divided by the number of employees in the urban non-private sector. This measure captures formal sector earnings at the province–industry level in a consistent and well-defined manner. It exhibits substantial variation across both industries and provinces. In particular, higher wages are typically observed in capital- and skill-intensive industries, such as finance and information technology, while lower wages are found in more labor-intensive sectors, including manufacturing and traditional services. In addition, wages tend to be higher in more developed coastal provinces, such as Shanghai, Jiangsu, and Tianjin, compared to less developed inland regions, including Gansu, Guizhou, and Tibet, reflecting differences in economic structure and productivity.

The main explanatory variable is the interaction between the treatment group and the policy shock. Control variables include industry employment, measured as the total number of employees in each province–industry cell, and FAI, which captures the level of capital accumulation across regions and industries. Both variables exhibit substantial variation across provinces and industries, reflecting differences in economic scale and production structure.

4.4 Household Level Variables

At the household level, we use microdata from the China Family Panel Studies (CFPS). Our sample includes 4,603 households and 32,221 observations spanning seven survey waves over the period 2010 to 2022. The CFPS is a nationally representative longitudinal survey offering detailed information on socioeconomic conditions in China. Using CFPS, we construct household-level measures of income and consumption. Household income and consumption are defined as total annual household income and total household consumption expenditure, respectively. Both variables exhibit substantial variation across households, reflecting considerable heterogeneity in living standards.

In the data, household income ranges from zero to approximately 6.89 million RMB (or 1 million USD) per year, while household consumption ranges from zero to about 4.61 million RMB (or 684,000 USD). Approximately, the average household income corresponds to around 8,000–9,000 US dollars per year. The distribution is highly skewed, with a small number of households accounting for a disproportionate share of total income.

Control variables used in our household data analysis include household size, energy sector employment of any of the household members, home ownership status, government subsidy recipient status, and household savings. These variables account for potential

correlates of income and consumption.

Table 1, Panels A–D present descriptive statistics at the national, provincial, industry, and household levels, respectively.

4.5 Empirical Strategy

We exploit the 2014 signing of the Russia–China natural gas agreement as an exogenous news shock to identify the effect of energy infrastructure on income and consumption in China at both macro and micro levels. Note that the agreement was signed in 2014 and actual gas deliveries began in 2019. Therefore, it is appropriate to treat 2014 as a news shock and any potential effects as expectation induced.

Using this feature as a quasi-natural experiment, we adopt the DID framework. Provinces that are planned to receive the pipeline are defined as the treatment group whereas the remaining provinces are defined as control group. The years 2014 to 2022 constitute the post-treatment period and the years 2010 to 2013 are pre-treatment period.

Our country level analysis relies on time-series regressions to estimate the impact of the news shock on aggregate income and consumption. The baseline specification includes the news shock as the key explanatory variable, alongside standard macroeconomic controls such as GDP, FAI, urbanization, and natural gas consumption. To address potential endogeneity we use an instrumental variable (IV) approach with domestic natural gas prices as the instrument.

The provincial level analysis uses the DID framework as the core identification strategy and estimates the equation:

$$Y_{it} = \beta \left(\text{treatment}_i \times \text{post}_t\right) + \gamma X_{it} + \mu_i + \lambda_t + \varepsilon_{it}, \tag{1}$$

where Y_{it} is the natural log of per capita income or consumption in province i and year t. β is the coefficient of interest that captures the effect of the energy infrastructure news shock. The model is estimated using both province and year fixed effects to account for unobserved province specific time-invariant heterogeneity and time varying common shocks. Given that the treatment varies at the province–year level, we use alternative clustering schemes, including clustering by province, year, and two-way clustering in order to ensure robust statistical inference under potentially systematic spatial correlation. Furthermore, we test the parallel trends assumption using an event-study specification.

The industry level analysis uses the DID framework but incorporates an additional industry dimension in a three-way fixed effects model. In particular, this specification controls simultaneously for province, year, and industry fixed effects. Other control variables include industry-level employment and FAI. We also test robustness of the results by using clustering of standard errors at different levels. Note that the industry level analysis provides insights into the sectoral transmission channels of the news shock.

At the household level, we use survey data to estimate the impact of the news shock on household income and consumption. The specification follows the same DID structure as in the provincial and industry analysis. Additionally, it uses household level controls to account for household level heterogeneity. To further explore distributional effects of the news shock, we implement quantile regression. In particular, residuals of variables are estimated by regressing them on fixed effects and controls. The news shock effect is then estimated at different points of the outcome distribution. This approach allows for a more nuanced assessment of heterogeneous response to the news shock across households.

Note that the empirical specifications differ across levels of analysis. However, they are all grounded in the same identification strategy based on the interaction between the 2014 news shock and treatment status. Within this framework, national-level analysis captures aggregate patterns, provincial-level analysis offers main identification, industry-level analysis sheds light on sectoral transmission mechanisms, and household-level analysis reveals distributional effects at the micro level. Together, these results offer a coherent picture of how the news shock propagates through different layers of the economy.

5 Results

Table 2 presents simple time series correlations between the outcome variables of aggregate consumption and income in China and the policy announcement dummy of 2014. These correlations are estimated on a sample of 13 observations and are therefore reported as motivating evidence rather than as a causal estimate. No statistically significant correlation is observed under ordinary least squares. Using residential and public natural gas prices as instruments we find a positive and significant coefficient on aggregate income and consumption.

The national level correlations are unreliable due to small sample size and other methodologival challenges. In Table 3 we examine the relationship at the province-year level. The table presents baseline results of the news shock treatment effect after controlling for province fixed effects, time varying common shocks, tertiary industry share, general budget expenditure, natural gas coverage ratio, and state owned enterprise (SOE) employment rate. Figure 5 presents parallel trend test results and we observe parallel trends are preserved prior to treatment. We find that the treated provinces, that is, provinces through which the pipeline is planned to pass, register lower income relative to the control provinces after receiving the pipeline news shock treatment. Column 5 is our baseline specification as it uses two-way clustering by province and year. The estimated treatment coefficient is -0.039. Because the dependent variable is expressed in natural logarithms, this coefficient implies that annual per capita income in the treated provinces declined by approximately 3.8% relative to the same in the control provinces, calculated as $100 \times [\exp(-0.039) - 1]$. Assuming average annual per capita income of 40,000 RMB,

the estimated effect would translate into annual per capita income in a treated province being approximately 1,520 RMB lower than a control province. The comparable effect is about 461 international dollars using a PPP exchange rate of 3.3 RMB to 1 Geary-Khamis international dollar. To put this into perspective, for an average household size of three, the effect amounts to $461 \times 3 = 1,383$ international dollars of annual income loss, and over a five-year period this loss would accumulate to 6,915 international dollars.

Lin and Wang (2020) estimate that Chinese households spend approximately 4.6% of their income on energy. For a three person household with per capita income of 40,000 RMB, and therefore household income of 120,000 RMB, this implies an annual energy spend of 5,520 RMB. The estimated household income loss of $1,520 \times 3 = 4,560$ RMB is thus equivalent to roughly 83% of what the household spends on energy in a year. Such an expectation induced negative effect is economically substantial, and it would materially tighten the energy budget of many households in China. Undoubtedly, the incidence would be heterogeneous across households at different points of the income distribution. This is examined below using household data.

Table 4 estimates consumption loss at the province level and Figure 6 presents the corresponding parallel trends test. Parallel trends appear to be preserved prior to treatment. For our baseline specification reported in Column 5 the estimated treatment coefficient is -0.057. This corresponds to an approximately 5.5% decline in annual per capita consumption in the treated provinces relative to the control provinces, calculated as $100 \times [\exp(-0.057) - 1]$. The estimated percentage decline in per capita consumption (5.5%) exceeds that in per capita income (3.8%). This is consistent with what has been observed elsewhere, including in Europe and the UK, following an adverse energy price shock (Lavell, O'Connell, and Smith, 2025). The news shock increases the current price of energy, which reduces real purchasing power much more than it reduces income and therefore engendering a sharper fall in consumption than income. The interpretation above rests on the premise that the announcement moved current gas prices, which we have already demonstrated in Figure 4.

In Table 5 we analyze any potential effect on wage income using industry-year level data by province. We have data for 19 industries across 31 provinces over the sample period 2010 to 2022, which takes us beyond aggregate province level effects. As set out in Figure 3, the news shock is expected to affect enterprises as well as wages. Column 3 presents the baseline result for the province-industry-year level variation after controlling for province, year, and industry fixed effects. The specification also controls for industry level employment and FAI. It clusters standard errors at the province, year, and industry level. The estimated treatment coefficient is -0.054, implying that average wages in the treated province–industry cells decline by approximately 5.3% relative to the control province–industry cells, calculated as $100 \times [\exp(-0.054) - 1]$. Figure 7 presents parallel trend test results. Again, parallel trends appear to be preserved prior to treatment.

Natural gas and energy exposure vary across industries and it is likely that the wage effect across industries would be heterogeneous depending on exposure and operational scale. Figure 8 shows that there is heterogeneity across industries in terms of natural gas usage with manufacturing appearing as the single biggest user followed by construction, transport, and mining.

In Table 6, we examine potential heterogeneity of the treatment effect across industries by reporting them for all 19 industries separately. The coefficients preserve a negative sign in 18 of the 19 industries, though not all are statistically significant. Manufacturing and construction, the two largest gas users, register negative but statistically insignificant effects. This could be due to relatively large scale of these industries allowing them to absorb higher energy price and not cut wages. In contrast, statistically significant negative effects are observed in relatively small scale industries such as residential services and repairs, water, health, scientific and technical services, and IT. Again this could be reflective of relatively smaller scale of these industries rendering them less amenable to absorbing energy price increase without cutting wages.

In Tables 7 and 8 we examine the effects at a far more disaggregated household level using CFPS longitudinal household survey data. Table 7 presents results on household income and Table 8 presents results on household consumption. Column 3 presents baseline results in both tables with two-way clustering of standard errors by household and time. The specifications include province, household and time (or survey wave) fixed effects. They also control for urban dummy, family size, energy sector employment, assistance, resettlement, savings, full ownership of property, other property, and rent. Figures 9 and 10 present the respective parallel trend tests. We observe a negative treatment effect of $100 \times [\exp(-0.092) - 1] = 8.8\%$ among households located in the treated provinces. Note that, this estimate is larger than the corresponding province level effect on per capita income of 3.8%. This is likely due to the outcome variable in these two models being distinctly different with the province level outcome being per capita income and the household level outcome being household income. Furthermore, household income is only a subset of provincial income and therefore it is unsurprising that the estimated treatment effects are different.

The estimated treatment effect on household consumption reported in Table 8 is statistically insignificant.[4] The lack of a significant overall effect masks potential heterogeneity across the income distribution. In Figures 11 and 12 we examine heterogeneity by income quantile and find that the lower income quantiles are affected far more adversely by the news shock than the upper income quantiles. This is perhaps reflective of limited borrowing capacity of the low income households. Facing increase gas prices, the low income households reduce current consumption as they struggle to borrow. In contrast,

[4]Note that household consumption reported here is different from per capita consumption reported in Table 4 for our province-year level analysis.

higher income households are able to smooth consumption relatively easily.

6 Robustness

We assess robustness of our baseline results using an alternative treatment that varies in intensity with gas prices, a placebo treatment, and alternative estimators.

Our baseline estimates use a binary pipeline news shock variable. However, as shown in Figure 4 and discussed in Section 5, the effect operates through current prices. Therefore, it merits an alternative design in which treatment intensity varies with the price response itself. In Tables 9–11 we therefore interact the Treatment $\times$ Post 2014 variable with residential, industrial, and public service gas prices. Table 9 deals with province-year level aggregation for income and consumption, Table 10 deals with industry-province-year level aggregation for wage income, and Table 11 deals with household-year level aggregation for income and consumption. Our baseline results survive.

We next subject the baseline estimates to placebo tests at the two key levels of aggregation, province and household, reported in Tables 12 and 13. At the province level we use 2011, 2012, and 2013 as pseudo news shocks and find no effects. The CFPS household data impose a tighter constraint, since the waves are biennial, we observe only seven rounds, and only the 2010 and 2012 rounds precede the 2014 announcement. We therefore use 2012 as the pseudo news shock, and again find no statistically significant treatment effects.

Finally, we test robustness of our baseline results using alternative estimators including NNM with 1 and 4 nearest neighbors, bias-adjusted NNM with 1 and 4 nearest neighbors, PSM with 1 to 4 nearest neighbors, EB, and CEM, the last of which reweights the sample to make the treatment and control groups as similar as possible before the treatment effect is estimated. These methods address the concern that treated and control provinces may differ systematically in ways correlated with the outcomes we study. We find that the estimated coefficients are consistently of the same sign as our baseline and, in the overwhelming majority of cases, also statistically significant. These results are reported in the Long Appendix Tables B1 to B5.

We prefer the baseline estimates because they are parsimonious and readily interpretable, but it is reassuring that the results hold across these alternative approaches.

7 Conclusions

We investigate the effect of Russia-China gas pipeline news shock on income and consumption in China using province, industry, and household level panel data. The impact of energy shock on raw materials exporting countries has been studied extensively. In

contrast, the impact of energy news shocks on highly industrialized net energy importing country has not been studied. The pipeline announcement, together with China's position as the world's leading manufacturer and a major energy importer, offers a unique opportunity to design a natural experiment to study this question that we exploit here. A further feature of our design is that we study the announcement of the project rather than its completion, which allows us to isolate the effect of anticipated future supply form the effect of its eventual delivery. In other words, the design allows us to study potential expectation induced effects.

We find that the effect of the news shock on income and consumption in the treated provinces is unambiguously negative, and that this negative effect is driven by an expectation induced increase in the current price of natural gas. Consumption appears to fall more than income, which is consistent with price effects observed in the EU, UK, and elsewhere (Lavell et al., 2025).

The industry level results indicate a negative wage effect overall. However, we also observe heterogeneity across industries. Large scale industries such as manufacturing, construction and transport record negative but statistically insignificant effects on wages whereas relatively small scale industries such as residential services and repairs, water, health, scientific and technical services, and IT record negative and statistically significant effects on wages. We surmise that this is likely influenced by the scale of operations of a particular industry with the large scale industries absorbing higher energy cost and not choosing to cut wages.

At the household level we observe corresponding heterogeneity in incidence by income, with lower income households reducing consumption far more sharply than higher income households, consistent with a limited borrowing capacity of low income households in smoothing consumption.

These results offer insight on the important question of the effect of large-scale infrastructure projects on net energy importers. We observe immediate negative effects driven by expectation induced current price increase. However, it is unquestionable that such a large-scale project following the conclusion of construction and the delivery of supply would generate rent. Undoubtedly, the owners of capital would benefit from this additional rent. However, it remains unclear to what extent the benefits would accrue to wages of average workers and low-income households. Studying the long-term distributional consequences of such a project is beyond the scope of this study. However, it is not impossible to speculate that standard market mechanism will not ensure equity and fairness. Public policy intervention would be required in order to ensure that the long-term distributional incidence of large-scale energy infrastructure projects is fair.

Appendices

A1. Variable List

Variable	Name	Definition	Source
Panel A: National Level Variable			
Income	Per capita disposable income	Annual per capita disposable income, defined as total disposable income of residents divided by the number of permanent residents. Disposable income includes wage, operating, property, and transfer income, net of personal income taxes and social security contributions. Measured in current RMB and expressed in log scale in the regression tables.	National Bureau of Statistics (NBS)
Consumption	Per capita consumption expenditure	Annual per capita consumption expenditure, defined as total household consumption expenditure divided by the number of permanent residents. Includes spending on goods and services such as food, clothing, housing, daily necessities, medicine, transportation, education, entertainment, and other consumption. Measured in current RMB and expressed in log scale in the regression tables.	National Bureau of Statistics (NBS)
Shock	Post-2014 policy shock indicator	Indicator variable capturing the policy (news) shock associated with the 2014 China–Russia natural gas agreement. The variable equals 1 for years from 2014 onwards and 0 otherwise.	Author's calculation
GDP	Per capita GDP	Annual per capita gross domestic product, defined as total GDP divided by the total population. Measured in current RMB.	National Bureau of Statistics (NBS)
FAI	Per capita fixed asset investment	Annual per capita fixed asset investment, constructed as total fixed asset investment divided by the total population. Measured in current RMB.	National Bureau of Statistics (NBS); author's calculation
Urban	Urbanization rate	Urbanization rate, defined as the ratio of the urban population to the permanent resident population, expressed as a percentage.	National Bureau of Statistics (NBS)
NG Cons.	Per capita residential natural gas consumption	Annual per capita residential natural gas consumption, constructed as total residential natural gas consumption divided by the total population. Measured in cubic metres.	National Bureau of Statistics (NBS)

Continued on next page

Variable	Name	Definition	Source
Panel B: Province Level Variable			
Income	Per capita disposable income	Annual per capita disposable income at the provincial level, defined as total disposable income of residents divided by the number of permanent residents. Disposable income includes wage income, operating income, property income, and transfer income, net of taxes and social security contributions. Measured in nominal RMB and expressed in log scale in the regression tables.	China Statistical Yearbook
Consumption	Per capita consumption expenditure	Annual per capita consumption expenditure at the provincial level, defined as total household consumption expenditure divided by the number of permanent residents. Consumption includes expenditures on food, clothing, housing, transportation, education, medical care, and other goods and services. Measured in nominal RMB and expressed in log scale in the regression tables.	China Statistical Yearbook
Treatment	Pipeline province indicator	Indicator variable identifying provinces traversed by the China–Russia East-Route Natural Gas Pipeline. The variable equals 1 for pipeline provinces and 0 otherwise.	Author's calculation
Shock	Post-2014 policy shock indicator	Indicator variable capturing the policy shock associated with the signing of the China–Russia natural gas agreement in May 2014. The variable equals 1 for years from 2014 onwards and 0 otherwise.	Author's calculation
Treatment x Post 2014	Treatment × Shock	Difference-in-Differences treatment variable constructed as the interaction between the pipeline province indicator and the post-2014 policy shock indicator.	Author's calculation
NG Length	Urban natural gas pipeline length	Total length of urban natural gas pipeline networks within a province, measured in kilometres. This variable captures the scale of natural gas transmission and distribution infrastructure.	China Statistical Yearbook
NG Supply	Urban natural gas supply	Total annual volume of natural gas supplied through urban gas systems within a province, measured in 100 million cubic metres.	China Statistical Yearbook
NG Population	Urban natural gas users	Number of urban residents with access to natural gas services within a province, measured in units of 10,000 persons.	China Statistical Yearbook
NG Consumption	Urban natural gas consumption	Total annual urban natural gas consumption within a province, measured in 100 million cubic metres.	China Statistical Yearbook
NG Ratio	Natural gas coverage ratio	Proportion of the provincial population with access to natural gas services, calculated as the number of natural gas users divided by the total provincial population.	China Statistical Yearbook

Continued on next page

Variable	Name	Definition	Source
Tertiary	Share of tertiary industry	Value added of the tertiary (service) sector as a share of provincial GDP. This variable captures the degree of economic structural transformation toward services.	China Statistical Yearbook
General Budget Exp.	General public budget expenditure	Total expenditure under the provincial general public budget, measured in nominal RMB. This variable captures the scale of government fiscal activity.	China Statistical Yearbook
Urbanization	Urbanization rate	Proportion of the population residing in urban areas, measured as the urban population divided by the total permanent population.	China Statistical Yearbook
Population	Total population	Total permanent resident population of the province, measured in 10,000 persons.	China Statistical Yearbook
SOE Rate	State-owned enterprise employment share	Proportion of total urban employment accounted for by state-owned enterprises. This variable captures the relative importance of the state sector in the provincial economy.	China Statistical Yearbook
Panel C: Industry Level Variable			
Average Wage	Average wage of employees in urban non-private units	Annual average wage of employees working in urban non-private units within a given industry and province. Measured in nominal RMB per employee and used to capture sectoral labour income.	China Economic and Social Development Statistics Database
Treatment	Pipeline province indicator	Indicator variable identifying provinces traversed by the China–Russia East-Route Natural Gas Pipeline. The variable equals 1 for pipeline provinces and 0 otherwise.	Author's calculation
Shock	Post-2014 policy shock indicator	Indicator variable capturing the policy shock associated with the signing of the China–Russia natural gas agreement in May 2014. The variable equals 1 for years from 2014 onwards and 0 otherwise.	Author's calculation
Treatment x Post 2014	Treatment × Shock	Difference-in-Differences treatment variable constructed as the interaction between the pipeline province indicator and the post-2014 policy shock indicator.	Author's calculation
Employment	Urban employment in work units	Total number of employees working in urban work units within a given industry and province, measured in units of 10,000 persons. This variable captures the scale of sectoral employment and labour demand.	China Economic and Social Development Statistics Database
Fixed Asset Investment	Fixed asset investment (excluding households)	Total investment in fixed assets undertaken by enterprises, government agencies, and other institutional units within a given industry and province, excluding household investment. Fixed assets include construction projects, machinery, equipment, and other long-term productive assets. Measured in 100 million RMB and used to capture sectoral capital accumulation and investment activity.	China Economic and Social Development Statistics Database

Continued on next page

Variable	Name	Definition	Source
Panel D: Household Level Variable			
Income	Household income per capita	Annual household income per capita, calculated as total household income divided by the number of household members. Household income includes wage income, operate income, property income, transfer income, and welfare income. Measured in nominal RMB.	China Family Panel Studies (CFPS)
Consumption	Household consumption per capita	Annual household consumption expenditure per capita, calculated as total household consumption expenditure divided by the number of household members. Consumption includes expenditures on food, housing, transportation, education, medical care, and other goods and services. Measured in nominal RMB.	China Family Panel Studies (CFPS)
Treatment	Pipeline province indicator	Indicator variable equal to 1 if the household is located in a province traversed by the China–Russia East-Route Natural Gas Pipeline, and 0 otherwise.	Author's calculation based on CFPS household location
Shock	Post-2014 policy shock indicator	Indicator variable equal to 1 for survey years from 2014 onwards and 0 otherwise, capturing the policy shock associated with the signing of the China–Russia natural gas agreement.	Author's calculation
Treatment x Post 2014	Treatment × Shock	Difference-in-Differences treatment variable constructed as the interaction between the pipeline province indicator and the post-2014 policy shock indicator.	Author's calculation
Urban	Urban household indicator	Indicator variable equal to 1 if the household is located in an urban area and 0 if located in a rural area.	China Family Panel Studies (CFPS)
Family Size	Household size	Number of household members residing in the household. This variable captures differences in household composition and resource needs.	China Family Panel Studies (CFPS)
Energy Job	Energy sector employment indicator	Indicator variable equal to 1 if at least one household member is employed in an industry directly or indirectly related to the energy sector, including mining; electricity, gas and water production and supply; transport, storage and postal services; and scientific research, technical services and geological exploration. These sectors are closely associated with energy extraction, transmission infrastructure, distribution networks, and supporting technical services.	China Family Panel Studies (CFPS)
Full Ownership	Full home ownership indicator	Indicator variable equal to 1 if the household fully owns its primary residence and 0 otherwise.	China Family Panel Studies (CFPS)

Continued on next page

Variable	Name	Definition	Source
Other Property	Additional property ownership indicator	Indicator variable equal to 1 if the household owns one or more additional residential or commercial properties besides its primary residence and 0 otherwise.	China Family Panel Studies (CFPS)
Assistance	Government assistance indicator	Indicator variable equal to 1 if the household receives government assistance, subsidies, or social welfare support, and 0 otherwise.	China Family Panel Studies (CFPS)
Resettlement	Resettlement household indicator	Indicator variable equal to 1 if the household reports having participated in a government-sponsored relocation programme under China's Targeted Poverty Alleviation strategy (including relocation from environmentally fragile, geographically isolated, or economically disadvantaged areas), and 0 otherwise.	China Family Panel Studies (CFPS)
Rent	Rental housing indicator	Indicator variable equal to 1 if the household rents its residence and 0 otherwise.	China Family Panel Studies (CFPS)
Savings	Household savings	Total household savings, measured in nominal RMB. This variable captures the stock of household financial resources available for future consumption and investment.	China Family Panel Studies (CFPS)

A2. Provincial Coverage

Province	Province-Level Sample	Household-Level Sample (CFPS)
Beijing	√	√
Tianjin	√	√
Hebei	√	√
Shanxi	√	√
Inner Mongolia	√	√
Liaoning	√	√
Jilin	√	√
Heilongjiang	√	√
Shanghai	√	√
Jiangsu	√	√
Zhejiang	√	√
Anhui	√	√
Fujian	√	√
Jiangxi	√	√
Shandong	√	√
Henan	√	√
Hubei	√	√
Hunan	√	√
Guangdong	√	√
Guangxi	√	√
Hainan	√	
Chongqing	√	√
Sichuan	√	√
Guizhou	√	√
Yunnan	√	√
Tibet	√	
Shaanxi	√	√
Gansu	√	√
Qinghai	√	√
Ningxia	√	
Xinjiang	√	√

Notes: The province-level analysis covers all 31 provincial-level administrative regions in mainland China. The household-level analysis is based on the merged CFPS waves from 2010–2022 and covers 28 provinces. Hainan, Tibet, and Ningxia are excluded from the final household sample due to insufficient observations after data merging and sample-cleaning procedures.

A3. Industry Classification

Abbreviation	**Industry Name**
Agri	Agriculture, Forestry, Animal Husbandry and Fishery
Mining	Mining
Manuf	Manufacturing
EnergySup	Electricity, Gas and Water Production and Supply
Construct	Construction
Transport	Transportation, Storage and Postal Services
IT	Information Transmission, Computer Services and Software
Wholesale	Wholesale and Retail Trade
Accom	Accommodation and Catering Services
Finance	Finance
RealEst	Real Estate
Leasing	Leasing and Business Services
SciTech	Scientific Research, Technical Services and Geological Exploration
Water	Water Conservancy, Environment and Public Facilities Management
Resident	Resident Services and Other Services
Educ	Education
Health	Health, Social Security and Social Welfare
Culture	Culture, Sports and Entertainment
PubAdmin	Public Administration and Social Organizations

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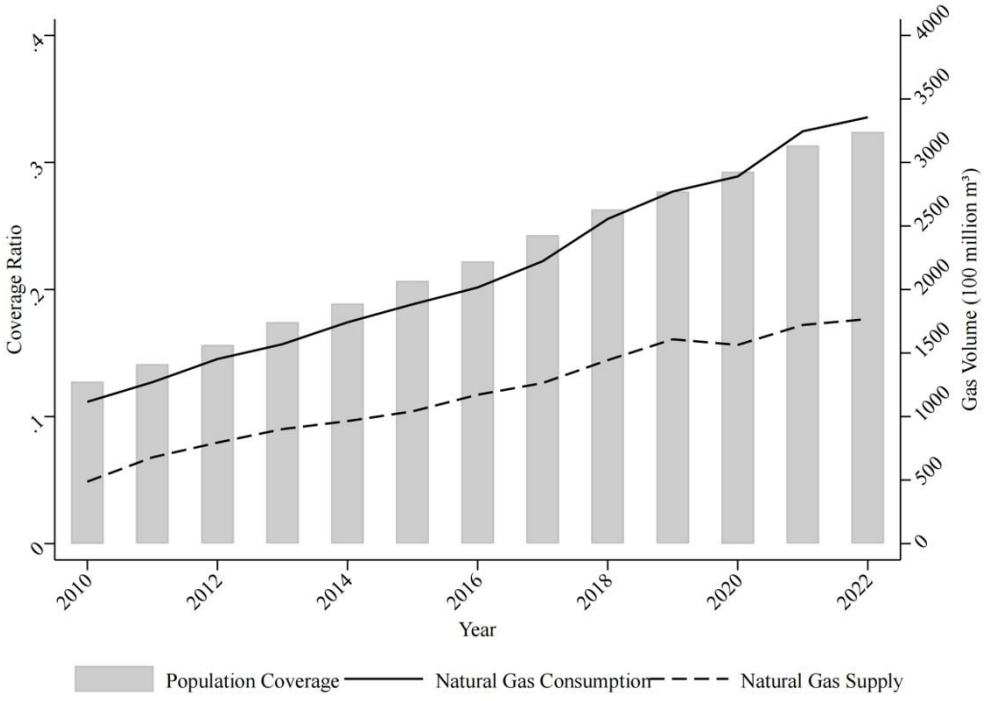
Figures

Figure 1: Spatial distribution of treatment and control provinces

Source: National Platform for Common GeoSpatial Information Services (Tianditu).

Figure 2: China Natural Gas Consumption, Supply and Coverage 2010–2022



Notes: Coverage ratio refers to the proportion of the population with access to natural gas.
Source: China Energy Statistic Yearbook.

Figure 3: Energy Shock, Income and Consumption: Conceptual Framework

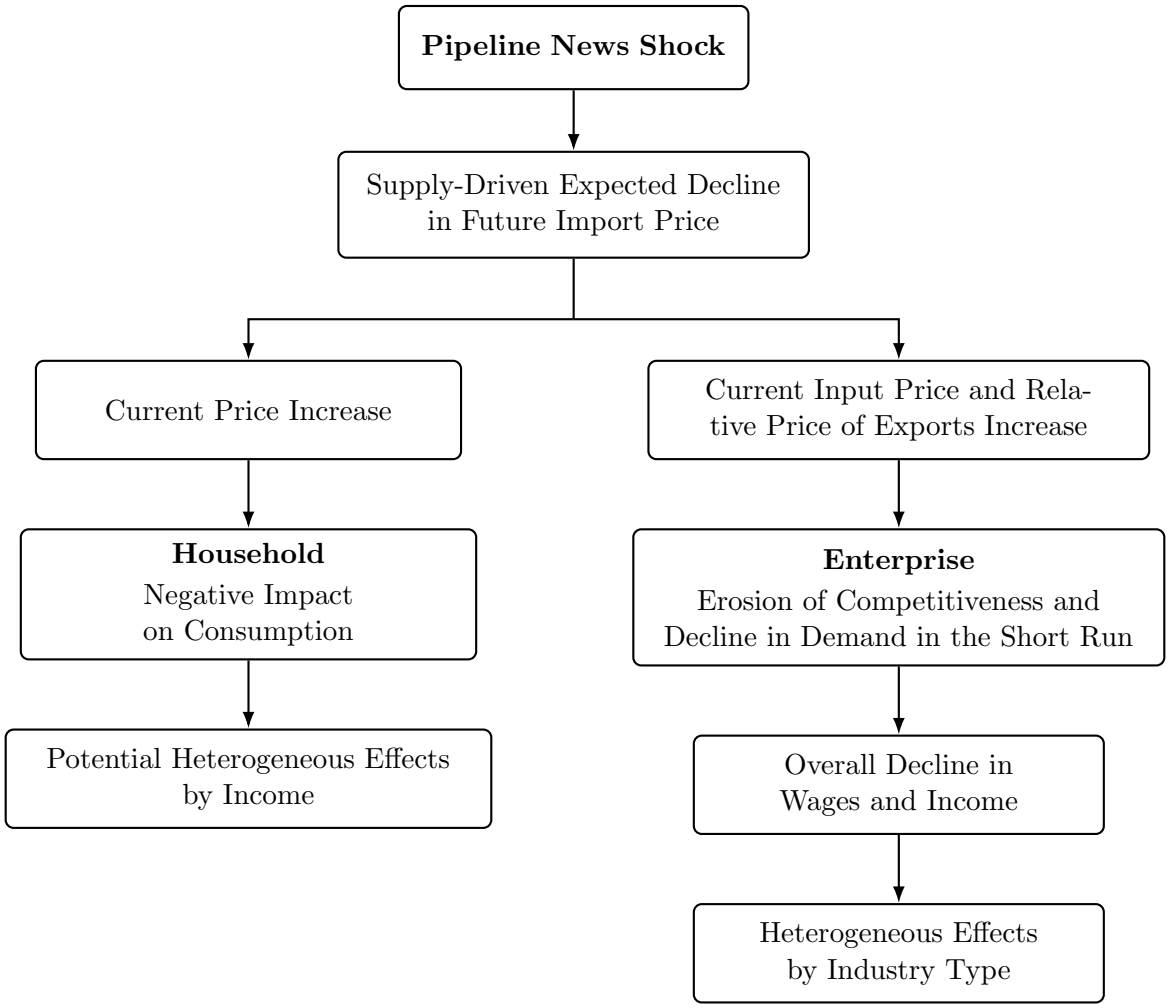
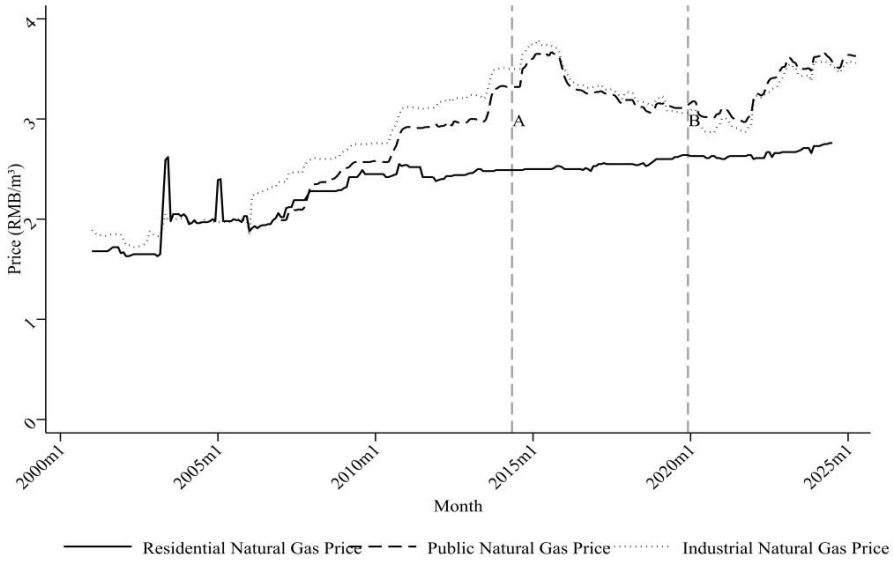


Figure 4: Pipeline News Shock and Actual Gas Price Response in China



Notes: Line A represents the formal signing of the China–Russia natural gas cooperation agreement in May 2014. Line B denotes the official launch of gas transmission through the "Eastern Route" pipeline in December 2019.
Source: Price Monitoring Center of the National Development and Reform Commission (`https://www.ceicdata.com/en`).

Figure 5: Parallel Trends Test for Income at the Provincial Level

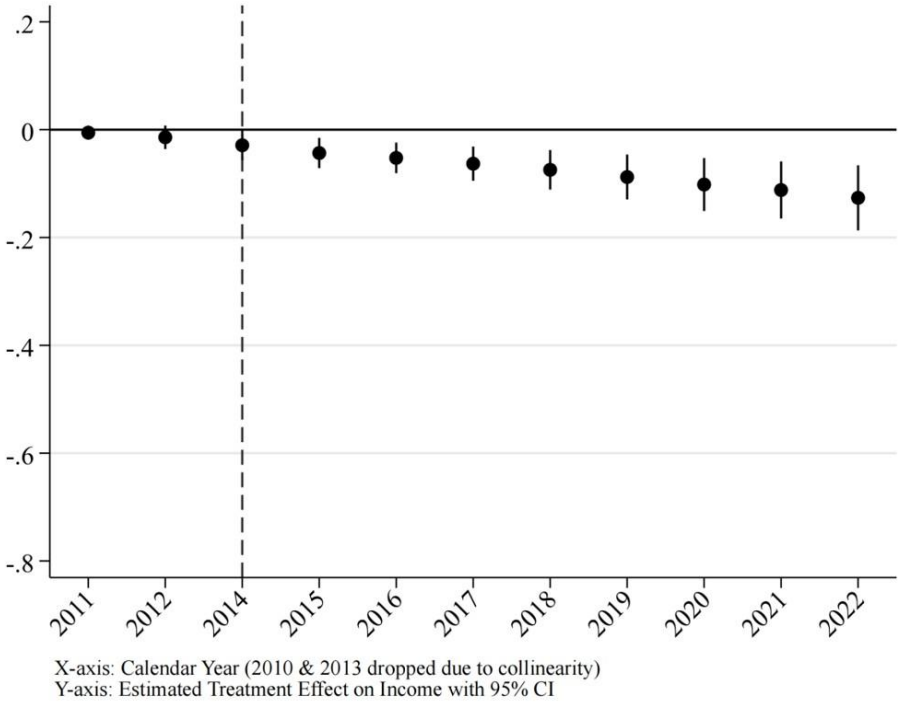
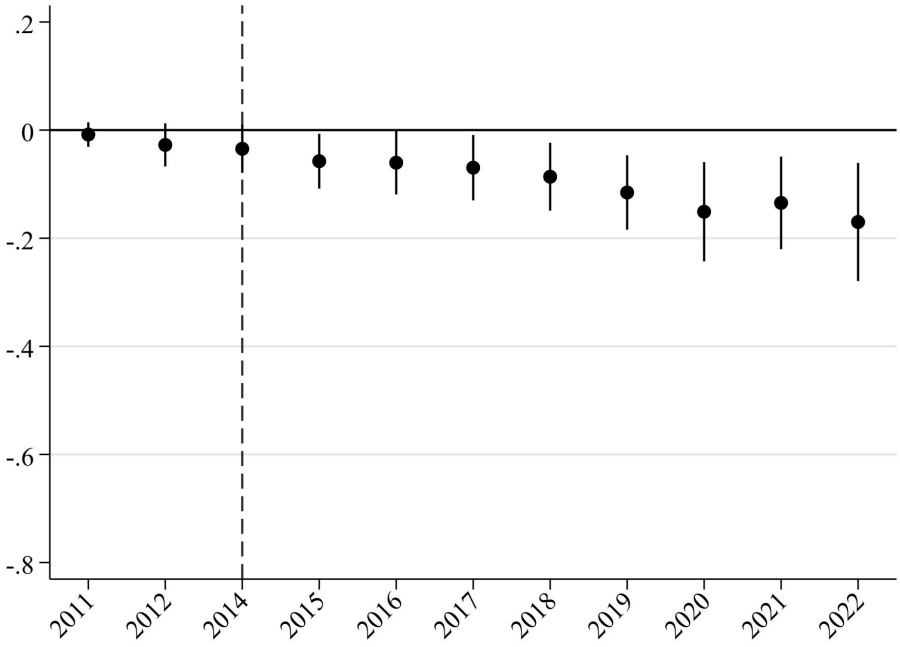
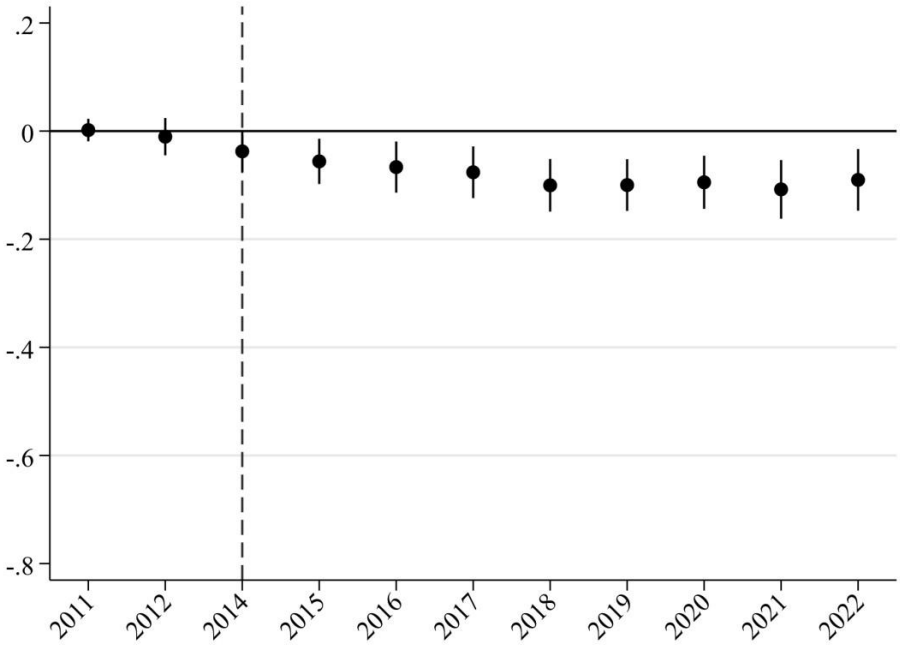


Figure 6: Parallel Trends Test for Consumption at the Provincial Level



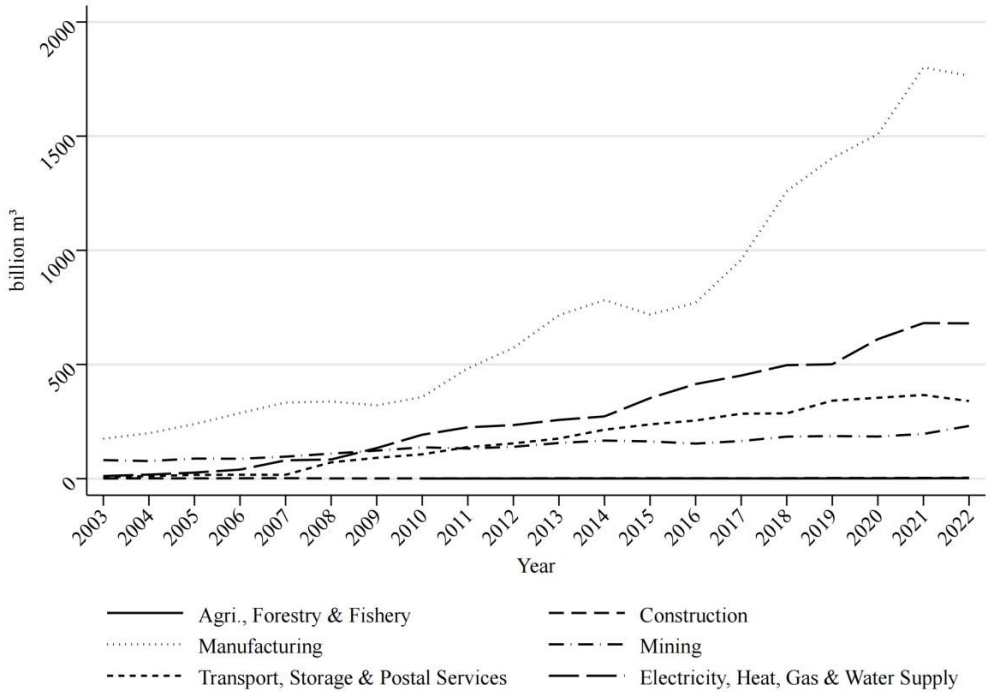
X-axis: Calendar Year (2010 & 2013 dropped due to collinearity)
Y-axis: Estimated Treatment Effect on Consumption with 95% CI

Figure 7: Parallel Trends Test for Wage Income at the Industry Level



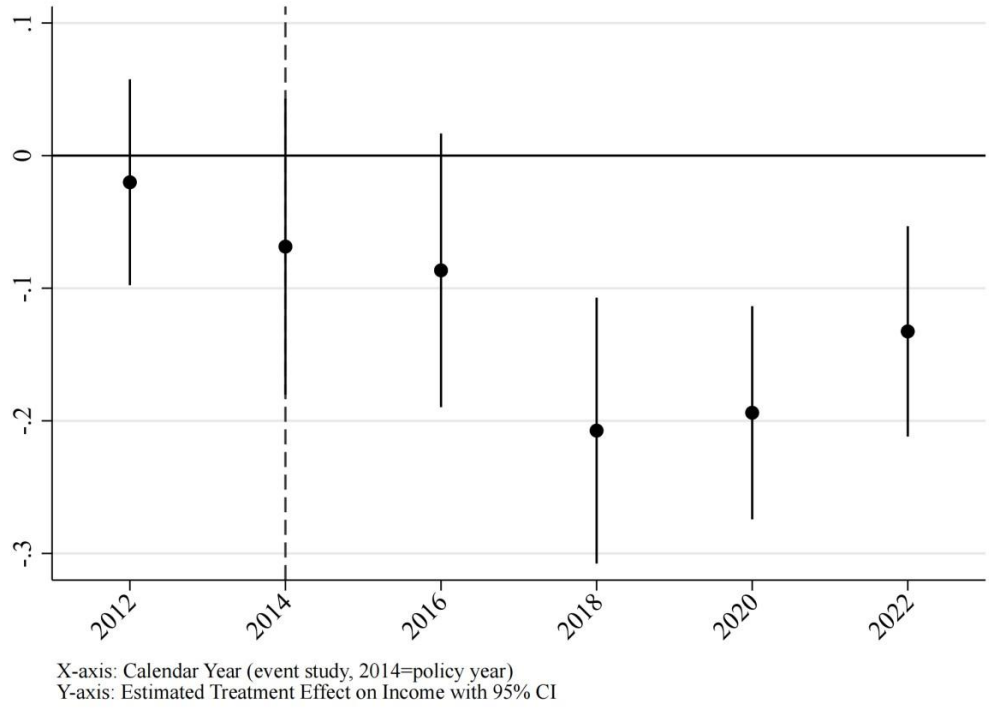
X-axis: Calendar Year (2010 & 2013 dropped due to collinearity)
Y-axis: Estimated Treatment Effect on Sector Income with 95% CI

Figure 8: Natural Gas Consumption in China by Sector



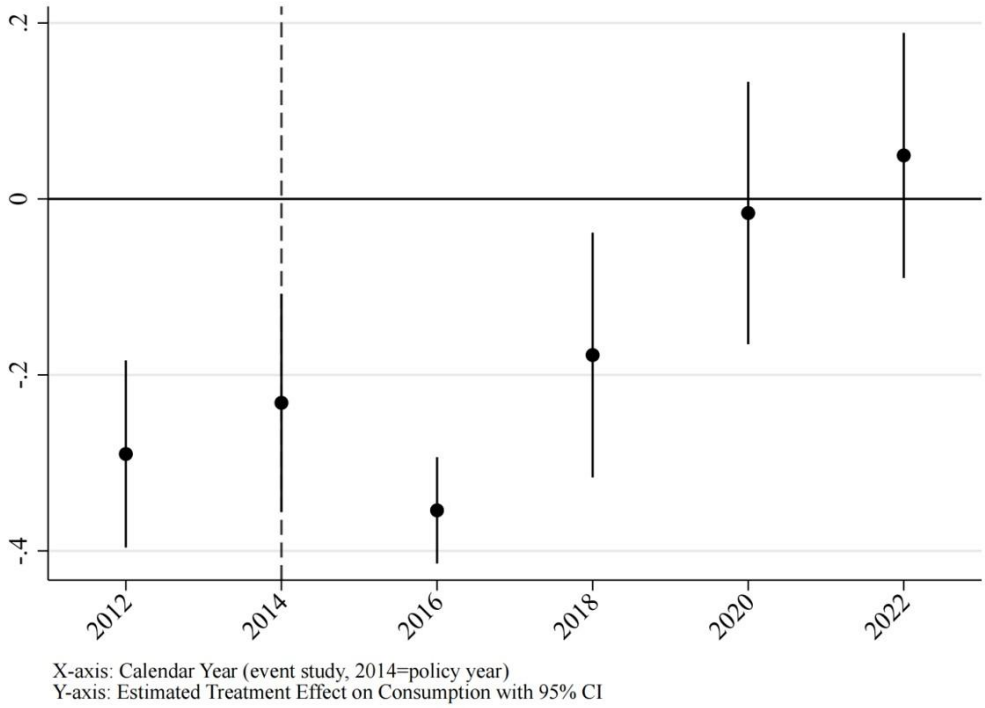
Source: China Energy Statistic Yearbook.

Figure 9: Parallel Trends Test for Income at the Household Level



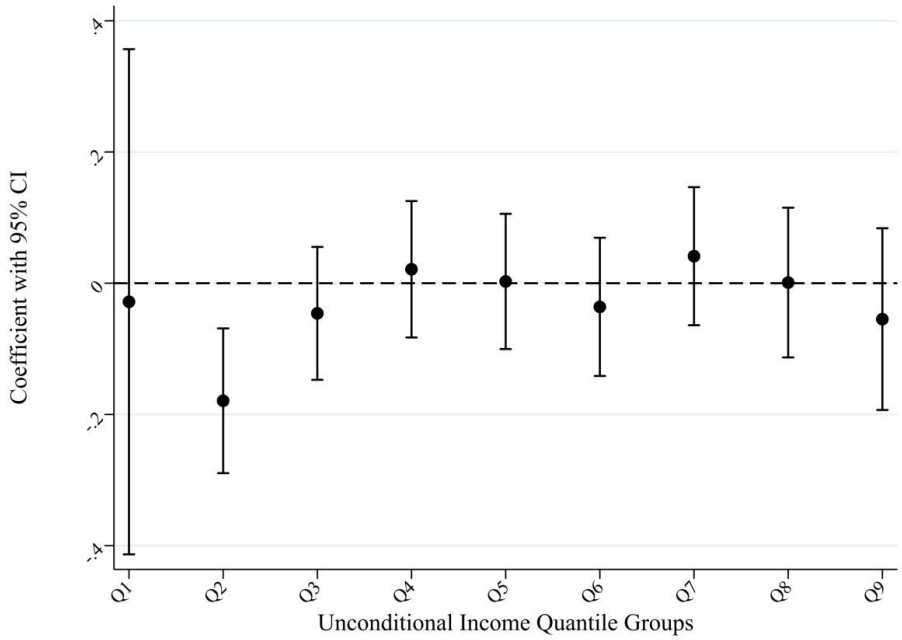
Notes: Equation controls for time and household fixed effect, standard errors are clustered at time and household level.
Source: CFPS.

Figure 10: Parallel Trends Test for Consumption at the Household Level



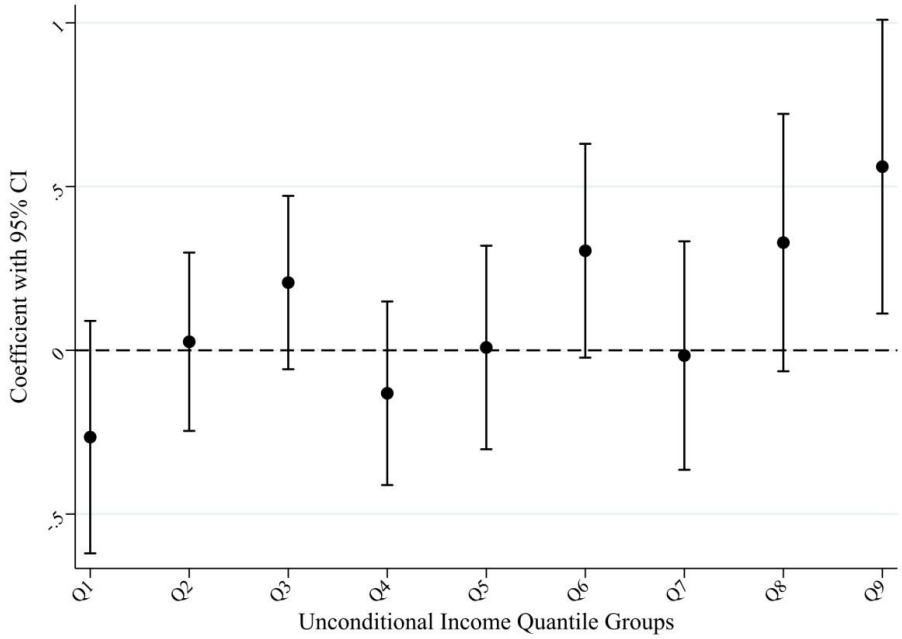
Notes: Equation controls for time and family fixed effect, standard errors are clustered at time and family level.
Source: CFPS.

Figure 11: Pipeline News Shock and Household Income by Quantile



Notes: Each point reports the OLS coefficient of the policy interaction estimated from a separate regression within an income group defined by unconditional income quantiles (Q1–Q9). Vertical bars denote 95% confidence intervals. All regressions include province, household, and year (or survey-wave) fixed effects. Standard errors are clustered at the provincial level. The horizontal dashed line indicates zero effect.

Figure 12: Pipeline News Shock and Household Consumption by Quantile



Notes: Each point reports the OLS coefficient of the policy interaction estimated from a separate regression within an income group defined by unconditional income quantiles (Q1–Q9). Vertical bars denote 95% confidence intervals. All regressions include province, household, and year (or survey-wave) fixed effects. Standard errors are clustered at the provincial level. The horizontal dashed line indicates zero effect.

Tables

Table 1: Descriptive Statistics

Variable	N	Mean	SD	Min	Max	Skewness	Kurtosis
Panel A: National Level							
Income	13	24383.069	7908.289	12519.505	36883.284	0.099	1.801
Consumption	13	17105.307	4987.351	9378.000	24538.000	0.011	1.786
Time Shock	13	0.692	0.480	0	1	-0.833	1.694
GDP	13	56830.708	17422.274	30807.933	85309.820	0.183	1.839
FAI	13	357404.693	97911.038	205036.400	495966.400	-0.231	1.758
Urban	13	0.584	0.051	0.499	0.652	-0.188	1.733
NG Cons.	13	29.436	8.421	16.962	41.900	0.210	1.774
Panel B: Provincial Level							
Income	403	24307.233	12600.426	6647.420	79609.770	1.712	6.891
Consumption	403	17114.608	7854.638	4809.000	48879.300	1.331	5.154
Interaction	403	0.179	0.384	0	1	1.678	3.815
Treatment	403	0.290	0.454	0	1	0.924	1.854
Time Shock	403	0.615	0.487	0	1	-0.474	1.225
NG Length	403	18907.201	18289.850	0.000	114704.370	1.955	7.914
NG Supply	403	38.233	39.890	0.000	199.109	1.803	6.255
NG Population	403	1011.084	788.783	0.000	4165.330	1.231	4.707
NG Consumption	403	69.710	60.514	0.000	305.340	1.559	5.478
NG Ratio	403	0.249	0.168	0.000	0.904	1.458	5.347
GDP per capita	403	55978.033	30432.279	12882.000	189988.000	1.675	6.431
Tertiary	403	0.493	0.092	0.325	0.839	1.377	6.270
General Budget Exp.	403	5073.958	3106.861	551.036	18533.080	1.360	5.646
Urbanization	403	0.585	0.133	0.227	0.896	0.335	3.334
Population	403	4463.328	2898.080	300.000	12684.000	0.748	2.924
SOE Rate	403	0.438	0.158	0.132	0.961	0.303	2.939
Proximity to Russia	403	0.129	0.336	0	1	2.213	5.898
Panel C: Industry Level							
Average Wage	7657	68861.897	37520.271	10040.000	437183.000	1.955	10.189
Employment	7657	28.452	56.055	0.000	1020.249	7.978	101.722
Fixed Asset Investment	7657	948.887	2311.108	0.000	32794.497	5.629	45.197
Panel D: Household Level							
Income	32221	60988.476	110246.440	0.000	6886000.000	23.903	1068.495
Consumption	32221	45382.794	63850.681	0.000	4608220.000	15.716	857.022
Treatment	32221	0.378	0.485	0	1	0.504	1.254
Time Shock	32221	0.571	0.495	0	1	-0.289	1.083
Interaction	32221	0.216	0.411	0	1	1.381	2.907
Urban	32221	0.434	0.496	0	1	0.266	1.071
Family Size	32221	3.990	1.816	1.000	16.000	0.931	4.639
Energy Job	32221	0.406	0.491	0	1	0.384	1.148
Full Ownership	32221	0.883	0.321	0	1	-2.385	6.686
Other Property	32221	0.183	0.387	0	1	1.641	3.694
Assistance	32221	0.451	0.498	0	1	0.197	1.039
Resettlement	32221	0.021	0.144	0	1	6.669	45.475
Rent	32221	0.056	0.231	0	1	3.846	15.793

Continued on next page

Table 1 continued

Variable	N	Mean	SD	Min	Max	Skewness	Kurtosis
Savings	32221	48314.178	157167.135	0.000	10000000.000	17.280	687.615

Notes: At National level, all monetary variables are in nominal RMB. Urbanization and Time Shock are proportions. Data based on 13 time series observations only. At Provincial level, variables such as Income, Consumption, GDP per capita, and General Budget Expenditure are measured in nominal RMB. Variables including Interaction, Treatment, Shock, Tertiary Industry Share, Urbanization and SOE Rate are expressed as proportions. Provincial level variables are sourced from China Statistical Yearbook. At Industry level, average Wage and Fixed Asset Investment are measured in nominal RMB. The Energy Related Sector Dummy and Proximity to Russia are binary variables. Industry level variables are sourced from China Statistical Yearbook and also Authors' Calculation. At Household level, income, consumption and savings are measured in nominal RMB. Household level variables are sourced from China Family Panel Study (CFPS). Skewness and Kurtosis in all panels characterize the asymmetry and peakedness of the distributions.

Table 2: Pipeline News, Income and Consumption: National Level Correlation

	(1) log Income (OLS)	(2) log Income (IV1)	(3) log Income (IV2)	(4) log Consumption (OLS)	(5) log Consumption (IV1)	(6) log Consumption (IV2)
Policy	0.018	0.110***	0.098***	0.026	0.086**	0.075*
	(0.024)	(0.026)	(0.028)	(0.034)	(0.031)	(0.031)
GDP	0.540**	0.550***	0.549***	0.799**	0.805***	0.804***
	(0.141)	(0.142)	(0.130)	(0.199)	(0.152)	(0.148)
FAI	0.181	-0.061	-0.029	0.147	-0.012	0.016
	(0.091)	(0.161)	(0.150)	(0.121)	(0.133)	(0.127)
Urban	1.309	0.556	0.656	1.162	0.667	0.754
	(1.205)	(2.646)	(2.369)	(1.650)	(2.359)	(2.131)
NG Cons.	0.165	0.388	0.359	-0.190	-0.043	-0.069
	(0.148)	(0.305)	(0.270)	(0.231)	(0.292)	(0.262)
Obs.	13	13	13	13	13	13

Notes: Models (1) and (4) are Ordinary Least Squares (OLS) regression with robust standard errors. Models (2), (3), (5), and (6) are Instrumental Variables (IV) regression estimated by two-stage least squares (2SLS) with robust standard errors. The endogenous variable Policy Announcement is instrumented by residential natural gas price in models (2) and (5), and by public natural gas price in models (3) and (6). Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Sample period 2010 to 2022.

Table 3: Pipeline News Shock and Income: Province-Year Level Effect

	(1)	(2)	(3)	(4)	(5)
Treatment × Post 2014	-0.069***	-0.039***	-0.039***	-0.039***	-0.039***
	(0.007)	(0.006)	(0.011)	(0.007)	(0.011)
Controls		Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	403	403	403	403	403
Province	31	31	31	31	31

Notes: The dependent variable is the natural logarithm of annual per capita disposable income at the provincial level. Treatment × Post 2014 captures the effect of energy infrastructure news shock. All models include province and year fixed effects (FE). Control variables are Tertiary Industry Share, General Budget Expenditure, Natural Gas Coverage Ratio, and State Owned Enterprise (SOE) employment rate. Model (1)–(2) use heteroskedasticity-robust standard errors. Model (3) clusters at the province level, Model (4) at the year level, and Model (5) uses two-way clustering by province and year. Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Sample period 2010 to 2022.

Table 4: Pipeline News Shock and Consumption: Province-Year Level Effect

	(1)	(2)	(3)	(4)	(5)
Treatment × Post 2014	-0.087***	-0.057***	-0.057**	-0.057***	-0.057**
	(0.011)	(0.010)	(0.023)	(0.011)	(0.023)
Controls		Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	403	403	403	403	403
Province	31	31	31	31	31

Notes: The dependent variable is the natural logarithm of annual per capita consumption expenditure at the provincial level. Treatment × Post 2014 captures the effect of energy infrastructure news shock. All models include province and year fixed effects (FE). Control variables are Tertiary Industry Share, General Budget Expenditure, Natural Gas Coverage Ratio, and State-Owned Enterprise (SOE) employment rate. Model (1)–(2) use heteroskedasticity-robust standard errors. Model (3) clusters at the province level, Model (4) at the year level, and Model (5) uses two-way clustering by province and year. Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Sample period 2010 to 2022.

Table 5: Pipeline News Shock and Wage Income: Industry-Year Level Effect

	(1)	(2)	(3)
Treatment × Post 2014	-0.074***	-0.054***	-0.054**
	(0.010)	(0.010)	(0.016)
Controls	No	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Observations	7657	7573	7573
Province	31	31	31
Industry	19	19	19

Notes: The dependent variable is the natural logarithm of average wage at the province–industry level. All models include province, year and industry fixed effects. Control variables are Industry Level Employment, and Fixed Asset Investment (FAI). Model (1)–(2) use heteroskedasticity robust standard errors. Model (3) cluster at province, year and industry level. Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Sample period 2010 to 2022.

Table 6: Pipeline News Shock and Wage Income by Industry

Sector	Wage Income
Agri	-0.027 (0.052)
Mining	-0.009 (0.049)
Manuf	-0.010 (0.021)
EnergySup	-0.020 (0.030)
Construct	-0.023 (0.025)
Transport	-0.053 (0.045)
IT	-0.123*** (0.040)
Wholesale	-0.012 (0.039)
Accom	-0.002 (0.049)
Finance	-0.075** (0.031)
RealEst	-0.079 (0.048)
Leasing	0.006 (0.035)
SciTech	-0.150*** (0.030)
Water	-0.116*** (0.036)
Resident	-0.156*** (0.048)
Educ	-0.058 (0.035)
Health	-0.085*** (0.030)
Culture	-0.021 (0.028)
PubAdmin	-0.097*** (0.033)

Notes: The dependent variable is the natural logarithm of average wage at the province–industry level. All models include province and year fixed effects. Standard errors are clustered at the province level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.
Sector abbreviations are defined as follows: Agri = Agriculture, Forestry, Animal Husbandry and Fishery; Mining = Mining and Quarrying; Manuf = Manufacturing; EnergySup = Electricity, Gas and Heat Supply; Construct = Construction; Transport = Transportation, Storage and Postal Services; IT = Information Transmission, Software and IT Services; Wholesale = Wholesale and Retail Trade; Accom = Accommodation and Catering Services; Finance = Financial Services; RealEst = Real Estate; Leasing = Leasing and Business Services; SciTech = Scientific Research and Technical Services; Water = Water Conservancy, Environment and Public Facilities Management; Resident = Residential Services, Repairs and Other Services; Educ = Education; Health = Health and Social Work; Culture = Culture, Sports and Entertainment; PubAdmin = Public Administration and Social Organizations. Sample period 2010 to 2022.

Table 7: Pipeline News Shock and Income: Household Level Effect

	(1)	(2)	(3)
Treatment × Post 2014	-0.125***	-0.092**	-0.092**
	(0.040)	(0.040)	(0.035)
Controls	No	Yes	Yes
Province FE	Yes	Yes	Yes
Household FE	Yes	Yes	Yes
Survey Wave FE	Yes	Yes	Yes
Observations	32219	32219	32219

Notes: The dependent variable is the natural logarithm of annual household income. All models include province, household and time (or survey wave) fixed effects. Control variables are urban dummy, family size, energy sector job, assistance, resettlement, savings, full ownership of property, other property, and rent. Models (1)–(2) use heteroskedasticity robust standard errors. Model (3) uses two-way clustering by household and time. Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Sample period 2010 to 2022.

Table 8: Pipeline News Shock and Consumption: Household Level Effect

	(1)	(2)	(3)
Treatment × Post 2014	0.047	0.108*	0.108
	(0.062)	(0.060)	(0.113)
Controls	No	Yes	Yes
Province FE	Yes	Yes	Yes
Household FE	Yes	Yes	Yes
Survey Wave FE	Yes	Yes	Yes
Observations	32219	32219	32219

Notes: The dependent variable is the natural logarithm of annual household consumption. All models include province, household and time (or survey wave) fixed effects.Control variables are urban status, family size, energy-sector employment, assistance, resettlement, household income, savings, full ownership of property, other property ownership, and rent. Models (1)–(2) use heteroskedasticity robust standard errors. Model (3) uses two-way clustering by household and time. Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Sample period 2010 to 2022.

Table 9: Pipeline News Shock, Gas Prices, and Outcomes: Province Level Effects

	(1) Income	(2) Income	(3) Income	(4) Consumption	(5) Consumption	(6) Consumption
Treatment × Post 2014 × Residential Gas Price	-0.011**			-0.016**		
	(0.004)			(0.007)		
Treatment × Post 2014 × Industrial Gas Price		-0.016***			-0.023**	
		(0.004)			(0.009)	
Treatment × Post 2014 × Public Service Gas Price			-0.011***			-0.017**
			(0.004)			(0.007)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Provinces FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	403	403	403	403	403	403
R-squared	0.997	0.997	0.997	0.989	0.990	0.989

Notes: The dependent variables are the natural logarithm of average income and consumption per capita at the provincial level. The alternative treatment variables interact the treatment-group indicator, the post-2014 indicator, and the corresponding annual natural gas price. Each specification includes one alternative treatment variable. All regressions control for the tertiary industry share, general budget expenditure, natural gas coverage ratio, and SOE rate. Province and year fixed effects are included in all specifications. Standard errors, reported in parentheses, are two-way clustered at the province and year levels. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Table 10: Pipeline News Shock, Gas Prices, and Outcomes: Sector Level Effects

	(1) Income	(2) Income	(3) Income
Treatment × Post 2014 × Residential Gas Price	-0.016***		
	(0.005)		
Treatment × Post 2014 × Industrial Gas Price		-0.021***	
		(0.006)	
Treatment × Post 2014 × Public Service Gas Price			-0.016***
			(0.005)
Controls	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Observations	7573	7573	7573
R-squared	0.885	0.885	0.885

Notes: The dependent variable is the natural logarithm of average wage at the province-industry level. The alternative treatment variables interact the treatment-group indicator, the post-2014 indicator, and the corresponding annual natural gas price. Each specification includes one alternative treatment variable. All regressions control for urban employment and fixed-asset investment. Province, year, and industry fixed effects are included in all specifications. Standard errors, reported in parentheses, are three-way clustered at the province, year, and industry levels. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Table 11: Pipeline News Shock, Gas Prices, and Outcomes: Household Level Effects

	(1) Income	(2) Income	(3) Income	(4) Consumption	(5) Consumption	(6) Consumption
Treatment × Post 2014 × Residential Gas Price	-0.027*			0.019		
	(0.011)			(0.036)		
Treatment × Post 2014 × Industrial Gas Price		-0.036**			0.030	
		(0.013)			(0.042)	
Treatment × Post 2014 × Public Service Gas Price			-0.028**			0.021
			(0.011)			(0.035)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Survey Wave FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32219	32219	32219	32219	32219	32219
R-squared	0.399	0.399	0.399	0.235	0.235	0.235

Notes: The dependent variables are the natural logarithm of household income and consumption. The alternative treatment variables interact the treatment-group indicator, the post-2014 indicator, and the corresponding annual natural gas price. Each specification includes one alternative treatment variable. All regressions control for urban status, family size, energy-sector employment, assistance, resettlement, savings, full homeownership, other property ownership, and rent. Province, household, and survey-wave fixed effects are included in all specifications. Standard errors, reported in parentheses, are two-way clustered at the household and survey-wave levels. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Table 12: Placebo Treatment at the Province Level

	(1) Income	(2) Income	(3) Income	(4) Consumption	(5) Consumption	(6) Consumption
Treatment × Post 2011	-0.011			-0.015		
	(0.011)			(0.011)		
Treatment × Post 2012		-0.013			-0.017	
		(0.009)			(0.011)	
Treatment × Post 2013			-0.012			-0.007
			(0.007)			(0.010)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	124	124	124	124	124	124
R-squared	0.999	0.999	0.999	0.997	0.997	0.997

Notes: The dependent variables are the natural logarithm of average income and consumption per capita at the provincial level. The estimation sample is restricted to the pre-treatment period, 2010–2013. The placebo post-treatment indicators take the value of one from 2011, 2012, and 2013 onwards, respectively. All regressions control for the tertiary industry share, general budget expenditure, natural gas coverage ratio, and SOE rate, and include province and year fixed effects. Standard errors, reported in parentheses, are clustered at only province level because treatment is assigned at the province level and the limited number of pre-treatment years makes clustering by year less reliable. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Table 13: Placebo Treatment at the Household Level

	(1) Income	(2) Consumption
Treatment × Post 2012	-0.035	-0.236
	(0.135)	(0.243)
Controls	Yes	Yes
Province FE	Yes	Yes
Household FE	Yes	Yes
Survey Wave FE	Yes	Yes
Observations	9206	9206
R-squared	0.582	0.555

Notes: The dependent variables are the natural logarithm of household income and consumption. The estimation sample is restricted to the two pre-treatment survey waves, 2010 and 2012. The placebo post-treatment indicator takes the value of one in the 2012 survey wave. All regressions control for urban status, family size, energy-sector employment, assistance, resettlement, savings, full homeownership, other property ownership, and rent. Province, household, and survey-wave fixed effects are included in all specifications. Standard errors, reported in parentheses, are clustered at the province level because treatment is assigned at the province level and the placebo sample contains only two survey waves. Given the limited number of pre-treatment waves, the household-level placebo estimates should be interpreted with caution. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Long Appendix – Not for Publication

Tables below report robustness tests with matching estimators. In all Tables B1 to B5 NNM denotes nearest-neighbour matching based on Mahalanobis distance. Bias-adjusted NNM applies a linear bias correction to the nearest-neighbour estimates. PSM denotes logit-based propensity-score matching. EB denotes entropy balancing. CEM denotes coarsened exact matching.

B1. Average Treatment Effects on the Treated: Impact of the Russia–China Gas Pipeline Agreement on Provincial Income Using Pre-treatment Covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Baseline	NNM (nn=1)	NNM (nn=4)	Bias-adj. NNM (nn=1)	Bias-adj. NNM (nn=4)	PSM (nn=1)	PSM (nn=2)	PSM (nn=3)	PSM (nn=4)	EB	CEM
Treatment effect	-0.039^{***}	-0.049^{***}	-0.052^{***}	-0.047^{***}	-0.041^{***}	-0.048^{***}	-0.045^{***}	-0.045^{***}	-0.046^{***}	-0.043^{***}	-0.020
	(0.011)	(0.016)	(0.012)	(0.014)	(0.013)	(0.017)	(0.017)	(0.016)	(0.016)	(0.014)	(0.013)
Units retained	31	31	31	31	31	15	18	18	18	31	19
Observations	403	31	31	31	31	15	18	18	18	31	247

Notes: The dependent variable is the natural logarithm of annual per capita disposable income at the provincial level. Column (1) reports the baseline province–year fixed-effects difference-in-differences estimate using the full 2010–2022 panel. Columns (2)–(10) report ATET estimates based on one pre–post income-change observation per province. The matching covariates are the 2010–2013 average income level, the pre-treatment income trend, and the average tertiary-industry share. Post-treatment income is averaged over 2015–2022, and 2014 is excluded from the construction of the pre–post change. Column (11) applies CEM using median cut-points for the same pre-treatment covariates, merges the CEM weights back into the full panel, and re-estimates the baseline model with the same controls and fixed effects. Standard errors in Columns (1) and (11) are two-way clustered by province and year. Standard errors are reported in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

B2. Average Treatment Effects on the Treated: Impact of the Russia–China Gas Pipeline Agreement on Provincial Consumption Using Pre-treatment Covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Baseline	NNM (nn=1)	NNM (nn=4)	Bias-adj. NNM (nn=1)	Bias-adj. NNM (nn=4)	PSM (nn=1)	PSM (nn=2)	PSM (nn=3)	PSM (nn=4)	EB	CEM
Treatment effect	-0.057^{**}	-0.060^{**}	-0.083^{***}	-0.068^{***}	-0.062^{***}	-0.061	-0.056^{*}	-0.057^{*}	-0.064^{**}	-0.038	-0.052^{**}
	(0.023)	(0.026)	(0.020)	(0.025)	(0.018)	(0.038)	(0.034)	(0.031)	(0.029)	(0.025)	(0.023)
Units retained	31	31	31	31	31	15	17	19	21	31	19
Observations	403	31	31	31	31	15	17	19	21	31	247

Notes: The dependent variable is the natural logarithm of annual per capita consumption at the provincial level. Column (1) reports the baseline province–year fixed-effects difference-in-differences estimate using the full 2010–2022 panel. Columns (2)–(10) report ATET estimates based on one pre–post consumption-change observation per province. The matching covariates are the 2010–2013 average consumption level, the pre-treatment consumption trend, and the average tertiary-industry share. Post-treatment consumption is averaged over 2015–2022, and 2014 is excluded from the construction of the pre–post change. Column (11) applies CEM using median cut-points for the same pre-treatment covariates, merges the CEM weights back into the full panel, and re-estimates the baseline model with the same controls and fixed effects. Standard errors in Columns (1) and (11) are two-way clustered by province and year. Standard errors are reported in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

B3. Average Treatment Effects on the Treated: Impact of the Russia–China Gas Pipeline Agreement on Province–Industry Wages Using Pre-treatment Covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Baseline	NNM (nn=1)	NNM (nn=4)	Bias-adj. NNM (nn=1)	Bias-adj. NNM (nn=4)	PSM (nn=1)	PSM (nn=2)	PSM (nn=3)	PSM (nn=4)	EB	CEM
Treatment effect	-0.054^{***}	-0.078^{***}	-0.069^{***}	-0.070^{***}	-0.057^{***}	-0.069^{***}	-0.077^{***}	-0.071^{***}	-0.075^{***}	-0.072^{***}	-0.053^{***}
	(0.016)	(0.011)	(0.009)	(0.010)	(0.009)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.017)
Units retained	589	589	589	589	589	273	348	396	430	589	461
Observations	7573	589	589	589	589	273	348	396	430	589	5929

Notes: The dependent variable is the natural logarithm of average wage at the province–industry level. Column (1) reports the baseline province–industry–year fixed-effects difference-in-differences estimate using the full 2010–2022 panel. Columns (2)–(10) report ATET estimates based on one pre–post wage-change observation per province–industry cell. The matching covariates are the 2010–2013 average wage level, the pre-treatment wage trend, and average pre-treatment industry employment. Post-treatment wages are averaged over 2015–2022, and 2014 is excluded from the construction of the pre–post change. Column (11) conducts CEM separately within each industry using industry-specific median cut-points for the same pre-treatment covariates, merges the CEM weights back into the full panel, and re-estimates the baseline model with the same controls and fixed effects. Standard errors in Columns (1) and (11) are multi-way clustered by province, year, and industry. Standard errors are reported in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

B4. Average Treatment Effects on the Treated: Impact of the Russia–China Gas Pipeline Agreement on Household Income Using Pre-treatment Covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Baseline	NNM (nn=1)	NNM (nn=4)	Bias-adj. NNM (nn=1)	Bias-adj. NNM (nn=4)	PSM (nn=1)	PSM (nn=2)	PSM (nn=3)	PSM (nn=4)	EB	CEM
Treatment effect	-0.092^{***}	-0.065^{*}	-0.073^{**}	-0.065^{*}	-0.080^{**}	-0.113	-0.083	-0.077	-0.080	-0.056	-0.076
	(0.035)	(0.038)	(0.033)	(0.038)	(0.032)	(0.069)	(0.061)	(0.057)	(0.056)	(0.102)	(0.055)
Units retained	4603	4603	4603	4603	4603	2781	3367	3717	3930	4603	3955
Observations	32219	4603	4603	4603	4603	2781	3367	3717	3930	4603	27683

Notes: The dependent variable is the natural logarithm of annual per capita household income. Column (1) reports the baseline household–wave fixed-effects difference-in-differences estimate using the full panel. Columns (2)–(10) report ATET estimates based on one pre–post income-change observation per household. Pre-treatment covariates are constructed from the 2010 and 2012 CFPS waves and include the household income level and trend, urban status, family size, energy-sector employment status, and household savings. Post-treatment income is averaged over the 2016, 2018, 2020, and 2022 waves, while the 2014 wave is excluded from the construction of the pre–post change. Column (11) applies CEM to households with stable treatment status. Income, the income trend, and savings are coarsened using median cut-points, while urban status, family size, and energy-sector employment status are matched exactly. The CEM weights are merged back into the household–wave panel, and the baseline model is re-estimated with the same controls and fixed effects. Standard errors in Columns (1) and (11) are two-way clustered by household and survey wave. Standard errors are reported in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

B5. Average Treatment Effects on the Treated: Impact of the Russia–China Gas Pipeline Agreement on Household Consumption Using Pre-treatment Covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Baseline	NNM (nn=1)	NNM (nn=4)	Bias-adj. NNM (nn=1)	Bias-adj. NNM (nn=4)	PSM (nn=1)	PSM (nn=2)	PSM (nn=3)	PSM (nn=4)	EB	CEM
Treatment effect	0.108	0.161**	0.144**	0.152**	0.127**	0.190*	0.118	0.105	0.101	0.148	0.179
	(0.113)	(0.066)	(0.056)	(0.066)	(0.056)	(0.109)	(0.097)	(0.093)	(0.092)	(0.124)	(0.119)
Units retained	4603	4603	4603	4603	4603	2796	3373	3711	3922	4603	3577
Observations	32219	4603	4603	4603	4603	2796	3373	3711	3922	4603	25037

Notes: The dependent variable is the natural logarithm of annual per capita household consumption expenditure. Column (1) reports the baseline household–wave fixed-effects difference-in-differences estimate using the full panel. Columns (2)–(10) report ATET estimates based on one pre–post consumption-change observation per household. Pre-treatment covariates are constructed from the 2010 and 2012 CFPS waves and include the household consumption level and trend, household income, urban status, family size, energy-sector employment status, and household savings. Post-treatment consumption is averaged over the 2016, 2018, 2020, and 2022 waves, while the 2014 wave is excluded from the construction of the pre–post change. Column (11) applies CEM to households with stable treatment status. Consumption, the consumption trend, income, and savings are coarsened using median cut-points, while urban status, family size, and energy-sector employment status are matched exactly. The CEM weights are merged back into the household–wave panel, and the baseline model is re-estimated with the same controls and fixed effects. Standard errors in Columns (1) and (11) are two-way clustered by household and survey wave. Standard errors are reported in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.