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Price Elasticity of Residential Natural Gas: Evidence from Billing Data in Iran

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Abstract

This study investigates the price elasticity of residential natural gas demand in Iran, utilizing a comprehensive nationwide database of household billing records from 2010 to 2017. To address key methodological challenges in energy demand estimation, the analysis applies instrumental variables (IV) and simulated IV techniques to account for price endogeneity caused by increasing block pricing structures and internal validity of findings. The results reveal substantial heterogeneity in price elasticity, ranging from -0.23 in winter to -0.51 in summer, irrespective of consumption tiers, and from -0.42 for the first pricing tier to -0.55 for the 12th tier over the entire year. These findings highlight the seasonal and consumption-level variability in consumer responsiveness to price signals. The results remain robust across various estimation methods, providing valuable insights into the dynamics of pricing policies and their effects on demand behavior. This study offers practical implications for policymakers aiming to balance energy provision, environmental sustainability, and economic equity in managing natural gas resources.

JEL Classification Code: D12, H23, Q31, Q41, Q48

Keywords: Price Elasticity; Energy Demand; Natural Gas; Iran

1. Introduction

Natural gas, as a source of residential heating energy, is important from several aspects. First, natural gas plays a crucial role in the transition from fossil fuels to renewable energy sources. As a cleaner-burning alternative to coal and oil, natural gas can significantly reduce greenhouse gas emissions and air pollutants when used in power generation and industrial processes. The International Energy Agency (IEA) highlights that switching from coal to natural gas has already saved around 500 Million Tons of CO_2 since 2010, which is comparable to removing 200 million cars from the road running on zero-carbon electricity (International Energy Agency [2019]). This switch helps bridge the gap as renewable energy infrastructure is developed and scaled up (International Energy Agency [2020]). Additionally, natural gas supports energy security and reliability during the transition period. Given the cyclical nature of renewable energy sources like wind and solar, natural gas-fired power plants can provide the necessary backup to maintain a stable energy supply (International Energy Agency [2022]).

Natural gas plays a more pivotal role in Iran's energy landscape than other countries because it is heavily reliant on this resource. For instance, over 80% of electricity generation is produced from natural gas (International Energy Agency [2021]). More importantly, the residential consumption of natural gas is experiencing a rapid escalation, presenting significant challenges in maintaining a balanced supply. The rapid growth of natural gas consumption in Iran has resulted in significant supply-demand imbalances, with the limited growth in supply unable to keep pace with expanding demand.

While price mechanisms are theoretically well-established tools for moderating demand and reducing consumption (Tellis [1988], Deaton and Muellbauer [1980], Mas-Colell et al. [1995], Lancaster [1966], Samuelson [1938]), the extent to which consumption responds to a price shock remains uncertain. Determining a causal estimate of the price elasticity of residential natural gas is of considerable importance, as it directly influences the effectiveness of price reforms in managing demand. The key policy question is how much such reforms in the residential sector could contribute to demand management. Understanding the price elasticity of natural gas is crucial, as many policy recommendations hinge on this parameter. For example, the effectiveness of environmental policies, such as carbon emission tax, fundamentally depends on accurate estimates of price elasticity. Also, from a welfare perspective, energy price elasticity plays a critical role in contemporary debates on taxation, social welfare, and behavioral welfare economics. Studies by Chetty [2009], Kleven [2021], Harberger [1971] highlight its significance in policymaking related to welfare changes.

Despite its significance, recent studies in energy literature face challenges in estimating price elasticity. One of the most documented issues is the problem of price endogeneity. This challenge becomes particularly pronounced under the increasing block-rate pricing, a common mechanism in utility markets. Under such a structure, the block of consumption and the corresponding price are determined simultaneously, as a household's consumption level dictates the pricing tier it falls into. This simultaneous determination leads to endogeneity concerns, as the observed price is not exogenous to the consumption behavior. Such issues complicate the identification of causal relationships and needs rigorous econometric strategies to ensure unbiased and consistent estimation of price elasticity.

Most empirical studies in the current literature using cross-sectional, survey, or country-level panel data fail to adequately address this challenge (e.g., Rehdanz [2007], Meier and Rehdanz [2010], Zeng et al. [2018], Phu [2020], Kostakis et al. [2021], Burns [2021]). Only a few of the studies have access to administrative household-level panel data, which allows for robust identification strategies and consistent estimations.

A strand of the literature that uses household panel data, employs reduced-form estimations and relies on the instrumental variable (IV) technique to address price endogeneity. For example, Hahn and Metcalfe [2021] conducted a randomized controlled trial (RCT) experiment in California to provide a reliable instrument for the price elasticity of residential electricity demand. They sent letters to eligible households encouraging them to sign up for the CARE subsidy program, using this outreach as an instrumental variable to increase the likelihood of program take-up, thereby providing exogenous variation in the price of electricity.

In the context of residential natural gas and increasing block-rate pricing, wholesale market prices at natural gas hubs often serve as a valid instrumental variable for household-level prices (e.g., Rubin and Auffhammer [2024], Favero and Grossi [2023]).

Structural demand estimation assumes that individuals do not directly consume electricity or natural gas; instead, their demand for these utilities derives from the services provided by home appliance that use the energy resource. For example, McRae [2015] models the demand for five specific appliances—refrigerator, washing machine, television, computer, and fan to estimate residential electricity demand in Colombia. By focusing on the services provided by these appliances, the model captures the underlying factors driving household electricity consumption, providing a more nuanced understanding of demand behavior.

Hewitt [1993] and Hewitt and Hanemann [1995] introduce the structural Discrete-Continuous-Choice (DCC) models from the tax literature to analyze U.S. water demand under the increasing block-rate structure. The DCC models are consistent with consumer theory by maximizing utilities subject to piecewise-linear budget constraints. Some studies have employed this approach to estimate water demand (e.g. Baerenklau et al. [2014], Miyawaki et al. [2011], Olmstead [2009a]) and electricity demand (e.g. Bolduc et al. [2008], Reiss and White [2005]).

Regarding Iran, while several studies have used aggregate, time series, or province-level panel data to estimate the price elasticity of natural gas (e.g., LotfaliPour and Baqeri [2003], Shirani et al. [2014]), there is still a lack of empirical studies for causal estimation of price elasticity based on household-level data. The existing empirical studies have not addressed the price endogeneity which leads to inconsistent estimates of parameters.

In this study we use a unique household-level administrative dataset of natural gas billing in Iran, which covers a full population of an entire country (with around 12 million residential subscribers and 26 million users) spanning 8 years (2010-2017), to estimate the price elasticity of residential natural gas.

While Makhsousi et al. [2024] employ household-level data to estimate the price elasticity of residential natural gas in Iran, their analysis is limited to a single province and relies on price variations across geographical boundaries to address endogeneity. Our study departs from Makhsousi et al. [2024] in several key ways. First, we conduct a nationwide analysis, employing a dataset that covers the entire country, and introduce alternative empirical methods, including novel instrumental variables that satisfy both the exclusion and relevance conditions. Furthermore, our dataset spans periods with both a simple two-tier pricing structure and a more complex 12-tier block-rate regime, with multiple price shocks, allowing for a more comprehensive analysis. Finally, our study explores heterogeneity in price elasticity across different consumer subgroups, providing insights into variations in demand responsiveness that remain unexamined in prior research.

Overall, our research presents several novel contributions to the literature on demand estimation under increasing block-rate pricing, particularly in the context of natural gas consumption. First, To the best of our knowledge, this is the first study that is utilizing a comprehensive billing data at the household level for an entire country, providing a uniquely granular perspective on consumer behavior. Second, Our dataset spans a period that includes both simple 2-tier pricing and 12-tier block-rate pricing regimes for natural gas, allowing us to capture the effects of a major policy transition.

Moreover, the block-rate pricing structure in our study is distinct, consisting of a 12-tier system that varies not only across different climate zones but also within the year. This feature provides substantial variation in both the width of pricing blocks and the price differentials between them, enabling a robust analysis of consumer responsiveness to price changes. Additionally, The period covered by our data also coincides with one of the most significant energy price reforms in Iran, during which natural gas prices underwent substantial exogenous shocks. This setting offers a unique opportunity to explore the impacts of policy-induced price changes.

Unlike other contexts where market dynamics may complicate identification, Iran's natural gas market is entirely government-controlled, from upstream production to downstream residential retail distribution. This centralized structure allows us to exploit exogenous price variations driven by non-market forces, effectively addressing endogeneity concerns.

Our study employs Instrumental Variables (IV) and Simulated IV, to accurately estimate the price elasticity. Additionally, our comprehensive billing data allows us to analyze heterogeneous price elasticities based on season, consumption level, and demographic factors, providing insight into demand responsiveness.

These distinct features of our study not only contribute to the existing literature by filling several important gaps but also provide robust empirical evidence on the price elasticity of natural gas demand under a complex, government-regulated block-rate pricing system. Our preliminary findings show that price elasticity varies with the regions, season and pricing blocks. The estimated value in winter is -0.23, while it amounts to -0.51 for the warm months of the year. The results indicate the elasticity of price for the first pricing block is -0.42, while it is -0.55 for the 12th block of consumers.

The rest of the paper is organized as follows: Part Two reviews the existing literature on the topic. Part Three outlines the data structure, data cleaning strategy, and institutional background. Theoretical considerations are presented in part Four, in which the residential gas pricing structure is clarified. Part Five details the empirical identification strategy employed, which is based on instrumental variables. Parts Six and Seven are dedicated to presenting the empirical findings, and finally, Part Eight gives the concluding remarks.

2. Literature Review

The literature on identifying residential energy demand determinants is extensive, encompassing studies at national, regional, and individual levels. Although many studies concentrate on electricity, research on natural gas is relatively scarce. This gap is largely due to the lesser use of natural gas as a final energy source and the limited number of countries with extensive household pipeline networks. In most scenarios, natural gas is converted to electricity at power plants and subsequently distributed to end-users, primarily due to the relative cost-efficiency and ease of electricity grid infrastructure compared to gas pipelines.

This section reviews the underlying literature on the determinants of residential natural gas consumption, focusing on price and income. We also highlight key findings from the electricity and water sectors, noting methodological similarities, particularly in handling endogeneity in an increasing block tariff structure. The literature is categorized into two main streams: those using aggregate data at the country or regional level, and those employing individual-level data.

Aggregate Level Evidence

Erias and Iglesias [2022a] provides innovative estimation method for the daily own-price, cross-price, and income elasticities of natural gas demand by making use of daily observations on natural gas prices and aggregate consumption across 15 OECD countries from October 1, 2016, to November 30, 2020. They apply Autoregressive Distributed Lag (ARDL) methodology, which incorporate a comprehensive set of lagged variables. In their baseline model, natural gas demand is regressed on the real price of natural gas, the real industrial price index, the real price of coal as an alternative energy source, and the real price of CO2 emissions, alongside interactions with time or country-specific dummies. This framework facilitates the estimation of both short- and long-run elasticities for own- and cross-prices. Their results show elasticity estimates between 0 and -2.2, depending on the month and country. A notable seasonal effect emerges, wherein from October to February, residential demand peaks due to heating, rendering gas prices non-influential (zero price elasticity) in several EU countries. Conversely, in the off-peak month for heating demand, the short-run own-price elasticity is statistically significantly and negative in magnitude. Additionally, five countries (Poland, Portugal, Bulgaria, Luxembourg, and the United Kingdom) exhibit a distinct pattern among the EU countries, showing lower elasticity in absolute terms during the summer.

A subsequent study by Erias and Iglesias [2022b] analyzes a panel of 25 European countries to estimate the price and income elasticities of natural gas from 2005 to 2020, employing a similar ARDL model. Their findings confirm the previous study and underscore the significant impact of COVID-19 lockdowns on natural gas demand, confirming the "double-heating effect".

Malzi et al. [2020] investigate the effectiveness of environmental policies, specifically carbon taxes, on residential natural gas consumption in OECD countries. They integrate economic, demographic, and environmental variables into their analysis, drawing on annual data from 29 countries spanning 1980-2016 sourced from the OECD and World Bank. Employing a Cross-Sectional Autoregressive Distributed Lags (CS-ARDL) model, they find that while energy prices negatively affect natural gas consumption, the effect size is minimal. Demographic factors, including population, population density, and the proportion of the elderly, significantly influence long-term demand. Additionally, rising temperatures are inversely correlated with gas consumption in the long run, underscoring the primary role of heating demand.

Household Level Evidence

Meier and Rehdanz [2010] estimate price and income elasticities of fuels in Britain by analyzing annual surveys on 5,000 households over 1991 to 2005, totaling 64,000 observations. They employ a panel regression with time fixed effects and household random effects. Dividing total gas expenditure by an aggregated gas price index, they generate average consumption, which is then regressed on the survey-reported natural gas price. Despite estimating negative price elasticities between -0.34 and -0.56, they fail to address the endogeneity arising from reverse causality.

Subsidized energy provision, particularly natural gas, is widespread in many countries and tends to disproportionately benefit wealthier households with higher usage. Zeng et al. [2018] investigate the equality of natural gas demand in China using data from the 2014 CRECS survey, which encompasses household demographics, dwelling characteristics, home appliances, and energy consumption. To address endogeneity, they employ non-residential natural gas prices as an instrumental variable, given its correlation with residential prices while remaining unaffected by residential consumption. Utilizing a quantile regression, they estimate the price elasticity of approximately -0.9.

Dynamic panel models provide long-run price elasticity. For instance, Favero and Grossi [2023] implement a model with lagged dependent variables (and individual fixed effect) to reduce omitted variable endogeneity. They use the lagged differences of consumption as instruments to solve the endogeneity of the price as well as the lagged dependent variable. They also run a static model for demand function using wholesale prices as instrument to estimate price elasticity. The estimated price elasticity by dynamic model appeared larger than the static one. Favero and Grossi [2023] analyze natural gas billing data from 51,177 Italian households from January 1, 2016, to December 31, 2018, incorporating environmental factors from synoptic stations and socio-economic trends from institutional websites. To address endogeneity in block-tariff pricing, they propose three solutions: using baseline consumption prices, utilizing wholesale market prices as instrumental variables, and employing a dynamic panel model based on Blundell and Bond (1998). Their estimates range from -0.5 to -0.2 for households and -0.4 to -0.2 for non-households consumers.

Rubin and Auffhammer [2024] disaggregate the price elasticity of residential natural gas based on income and season, using 300 million natural gas bills from California utilities over 2003-2014. Their identification strategy combines regression discontinuity between utility borders with instrumental variables, using Henry Hub natural gas prices as exogenous instrument. Their robust results indicate price elasticities between -0.17 and -0.23.

The study by Zhang et al. [2017] uses the introduction of an increasing block pricing (IBP) for residential electricity in China as a natural experiment to estimate the impact of price changes on electricity consumption. Before 2012, residential households in the cities of Guangdong province were subject to a uniform electricity price. However, a policy shift in 2012 introduced a three-tier increasing block pricing structure. This shift in the pricing policy provides a quasi-experimental setting in which households falling on either side of the newly introduced price thresholds serve as treatment and control groups, allowing the authors to apply a difference-in-differences (DiD) regression. By exploiting the discontinuities created by the new pricing scheme, Zhang et al. [2017] explore the causal effect of electricity price changes on consumption behavior among urban households. Their analysis reveals a short-run local price elasticity of demand for electricity of -0.898, with a standard error of 0.377. This elasticity estimate is within the range of elasticities found by previous studies but with a slightly greater absolute value.

Discrete-continuous choice (DCC) models have been widely applied in the estimation of demand elastisities under increasing block pricing (IBP). These models effectively distinguish between the discrete choice of which pricing block a consumer falls into and the continuous decision regarding the level of consumption within that block. This approach addresses the price endogeneity that arises from the simultaneous determination of marginal price and consumption, which is a common issue in IBP settings. The DCC model was originally developed in the context of tax policy analysis by Burtless and Hausman [1978] and Hausman [1979], who laid the foundational econometric framework for handling such joint decision-making problems. Since its development, the DCC model has been applied across various fields, including studies on demand estimation. For instance, Olmstead [2009b] employed a DCC model combined with an instrumental variable (IV) to estimate residential water demand. Their findings indicate a substantial dissimuilarity between elasticity estimates obtained by the DCC and those derived using the IV method. Specifically, the DCC model yielded a price elasticity of water demand of -0.609, nearly twice as large as the elasticity estimate obtained using the IV approach, which was -0.292. This discrepancy underscores the importance of model selection in demand estimation, particularly in the presence of nonlinear pricing structures like IBP, where marginal price and consumption are endogenously determined.

Table 3.1: List of Variables in the Dataset and their Description

Variable	Description
ID	unique code for each subscription (gas meter)
City	name of the consumer's city
PostalCode	10-digit postal code of the consumer
FromDate	date of the start of the billing period (day, month, year)
ToDate	date of the end of the billing period (day, month, year)
Consumption	the amount of the consumer's natural gas consumption during the billing period
Gas Cost	total cost of the consumer's bill
Area	area of the dwelling unit
Number of Units	number of units for each subscription (gas meter)
Blackout Days	number of days with gas outage
Capacity	volumetric flow rate capacity of the gas meter ($m^3/hour$)
Consumption type	residential / commercial / industrial / ...
Urban	a dummy variable indicating if the consumer is based in urban or rural area

Note: The table shows the variables in the dataset and their definition. The Data comprises residential natural gas bills from 2010-2017.

3. Data & Institutional Context

3.1. Data

The data utilized in this study comprises natural gas billing information for more than 26 million households across Iran, spanning 8 years from 2010 to 2017. This dataset is unprecedented in its coverage, encompassing a full population of the entire country. The billing data includes detailed records of monthly gas consumption and associated total cost for each household. Additionally, we can integrate environmental data, such as temperature and rainfall, from meteorological stations across the country, and macroeconomic variables from national statistical agencies. Variables available in the dataset and their definition are presented in Table 3.1. Also, to save the space in the (Table 3.2), we only report summary statistics for two variables, including means and standard deviations for Consumption and Average Price. However, we report the descriptive statistics of other covariates in the Appendix (Table A.1).

Our variables in the dataset show significant variation both between and within. This indicates that price and consumption variations are not uniform but exhibit diverse patterns that can be analyzed to understand the underlying mechanisms driving these differences. This characteristic offers a robust foundation for identifying price impacts. Our identification strategy leverages both between and within

Table 3.2: Overall, Between-group, and Within-group Statistics

Variable	Dimension	Mean	Std. dev.	Min	Max	Obs.
Consumption	Overall	301.7	316.9	1	2150	N = 727,653
	between		232.8	1	2146	n = 142,194
	within		240.3	-1179.8	2086.7	T-bar = 5.1
Average Price	overall	1199.3	891.1	168.8	10835	N = 729,833
	between		735.4	171.4	10835	n = 141,667
	within		710.2	-4709.3	10144.4	T-bar = 5.1

Source: Author's calculation.
Note: Summary statistics for Consumption of residential natural gas and Average Price of each bill are reported. It decomposes the variable x_{it} into a between (x_i) and within $(x_{it} - x_i + \overline{\overline{x}})$. The overall and within are calculated over N household-month-years of data. The between is calculated over n households, and the average number of months a household was observed in each year is T-bar. The minimum and maximum within number refers to the deviation from each individual's average.

variation in policy variables to effectively estimate the effects of pricing policy interventions. Consumption for the consumers varies between 1 and 2146 cubic meters, while its between standard deviation is 232.8. The within standard deviation shows a large variation of consumption over time and equals 240.3. The negative reported value -1179 for the within minimum is not implying that some household actually consume negative volumes. The within number refers to the deviation from each individual's average, and naturally, some of those deviations must be negative. T-bar shows that on average each household is observed 5 times in each year.

To better understand the price structure of residential gas in our setting, Figure (3.1) depicts marginal price for each block of monthly consumption.

The National Iranian Gas Company (NIGC) has divided all cities in Iran into five distinct Climate Zones, each subject to a 12-tiered increasing block tariff pricing structure. This pricing scheme varies between the cold and warm seasons.

Figure (3.1a) illustrates the marginal prices during the cold period (approximately winter) for the respective Climate Zones (Eghlim in Persian). Climate Zone 1 (CZ1) has the lowest marginal prices at each level of consumption, while Climate Zone 5 (CZ5) exhibits the highest. Marginal prices increase with volumetric consumption. Specifically, all Climate Zones begin with the same marginal price at the initial consumption stages, but CZ5 advances to the second tier rate more rapidly than the other zones, whereas CZ1 advances more slowly. This pattern persists throughout the consumption levels. Consequently, the initial and final marginal prices are the same across all Climate Zones[1].

Figure (3.1b) depicts marginal prices during the warm period (spring through fall). Although there are still 12 tiers of marginal prices based on consumption level, the pricing structure is identical for all Climate Zones during the warm period.

3.2. Context

Iran's economy consumed an estimated 11.6 quadrillion British thermal units of primary energy in 2021, making it the highest energy consumer in the Middle East. Natural gas and oil account for almost all of Iran's total primary energy consumption, while hydropower, coal, nuclear power, and non-hydropower renewables account for the remaining share (BP [2022]). Natural gas is the dominant source of energy in Iran, accounting for more than 70% of the total primary energy consumption share (Energy Information Administration [2022]). Figure (3.2) shows the share of primary energy consumption by the source of them in 2021. Figure (3.3) shows the electricity generation source by fuel

Iran's estimated proved natural gas reserves were 34 trillion cubic meters (Tcm) as of December 2021, second only to Russia, according to Oil & Gas Journal [2021]. Iran holds 17% of the world's proved natural gas reserves and almost half of OPEC's reserves. Figure (3.4) depicts the largest proved reserve holders of natural gas in 2021 across the world.

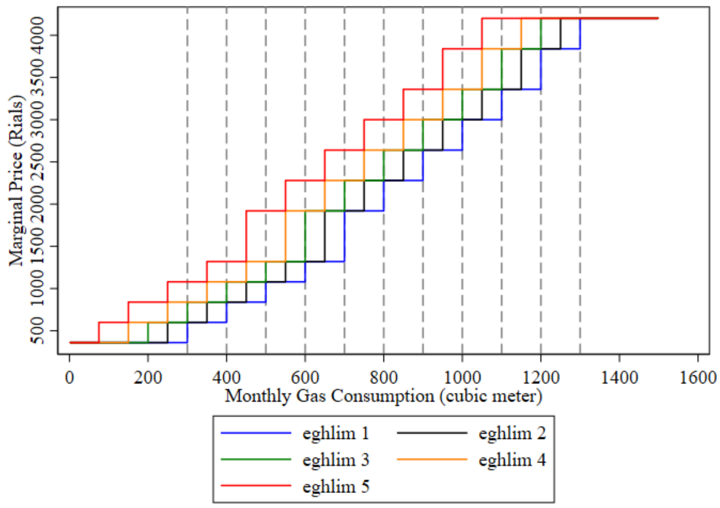
Iran was the world's third-highest dry natural gas producer after the United States and Russia in 2021 (Facts Global Energy [2021]). Despite the devastating sanctions that are restricting investment and hindering Iran's natural gas development, dry natural gas production and consumption have more than quadrupled over the past 22 years, expanding to nearly 250 Bcm per year. Figure (3.5) presents the trend history of natural gas production and consumption for 42 years. Iran's natural gas consumption growth has been faster than other developing countries, even faster than china. Natural gas consumption in China grew by 25 folds, while Iran's grew by 37 folds (Energy Information Administration [2024]).

The expansion of natural gas distribution infrastructure in Iran is remarkable compared to other oil-rich countries. Over the past three decades, Iran has devel-

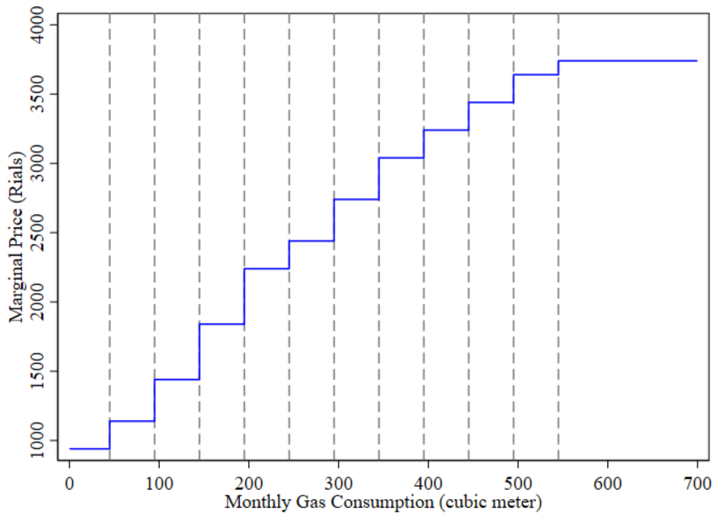
[1]See Figure (A.1) in the Appendix for two additional pricing plots for Climate Zones (1,3) and (4,5) that help illustrate with more clarity.

Figure 3.1: Residential Natural Gas Pricing Structure

(a) Marginal Price of Residential Natural Gas in Cold Period (2014)

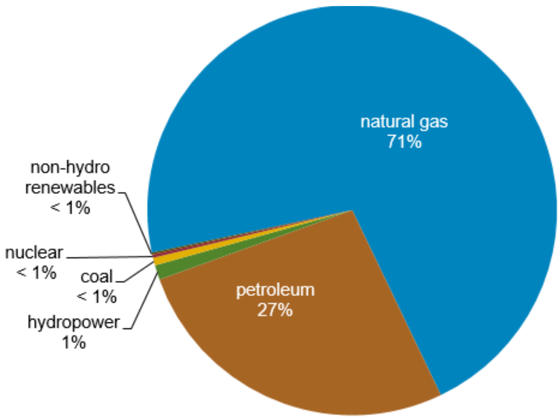


(b) Marginal Price of Residential Natural Gas in Warm Period (2014)



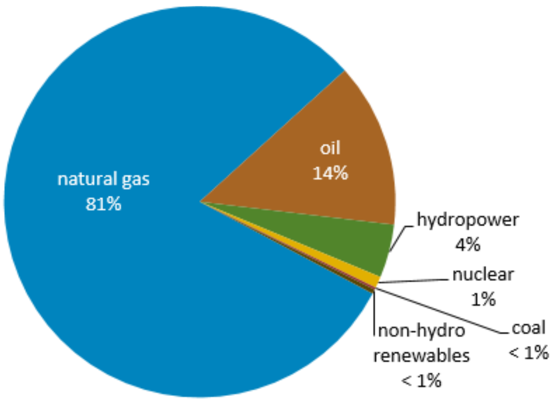
Note: Marginal prices of residential natural gas are increasing function of consumption level. Pricing structure is distinct for each geographical zone and depends on time of the year. Panel (a) shows marginal prices for each CZ (eghlim) in the cold period (from Nov. to April). Panel (b) shows marginal prices in the warm period (from April to Nov.) and is nation-wide. Marginal prices change from time to time.

Figure 3.2: Iran's Total Primary Energy Consumption, share by fuel, 2021



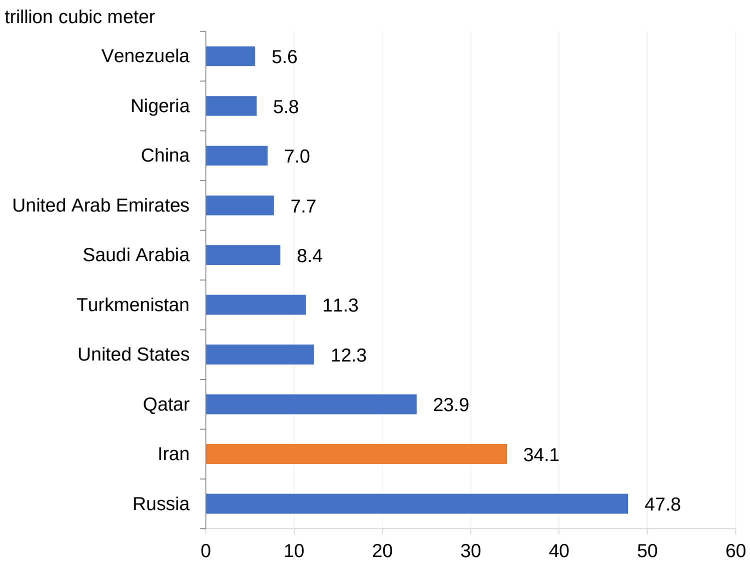
Source: U.S. EIA based on data from BP Statistical Review of World Energy 2022
Note: Chart does not include traditional biomass and waste, such as burning firewood and waste.

Figure 3.3: Iran's Electricity Generation Capacity by fuel, 2021



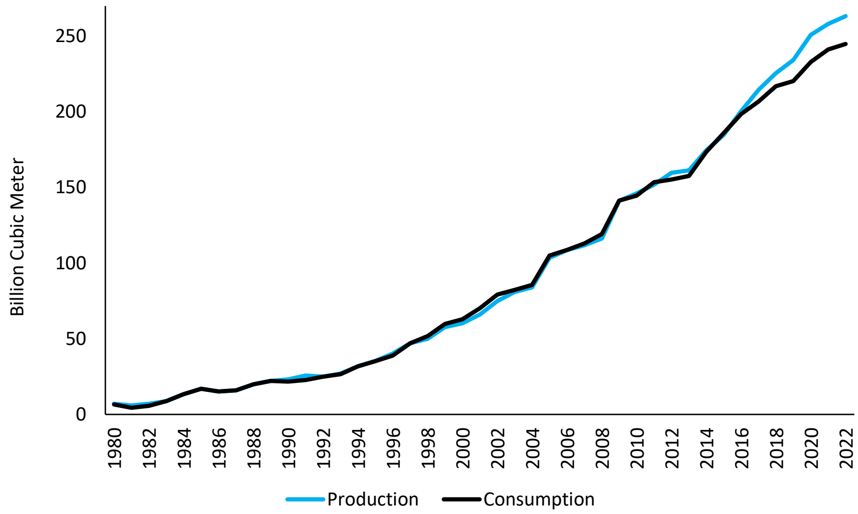
Source: U.S. EIA based on BP Statistical Review of World Energy 2022
Note: Iran generates 81% of its electricity from natural gas.

Figure 3.4: Largest proven reserve holders of natural gas, 2021



Source: Oil & Gas Journal, December 2021
Note: Iran (orange column) has the second largest proven natural gas reserve.

Figure 3.5: Natural Gas Production & Consumption in Iran, 1980-2022



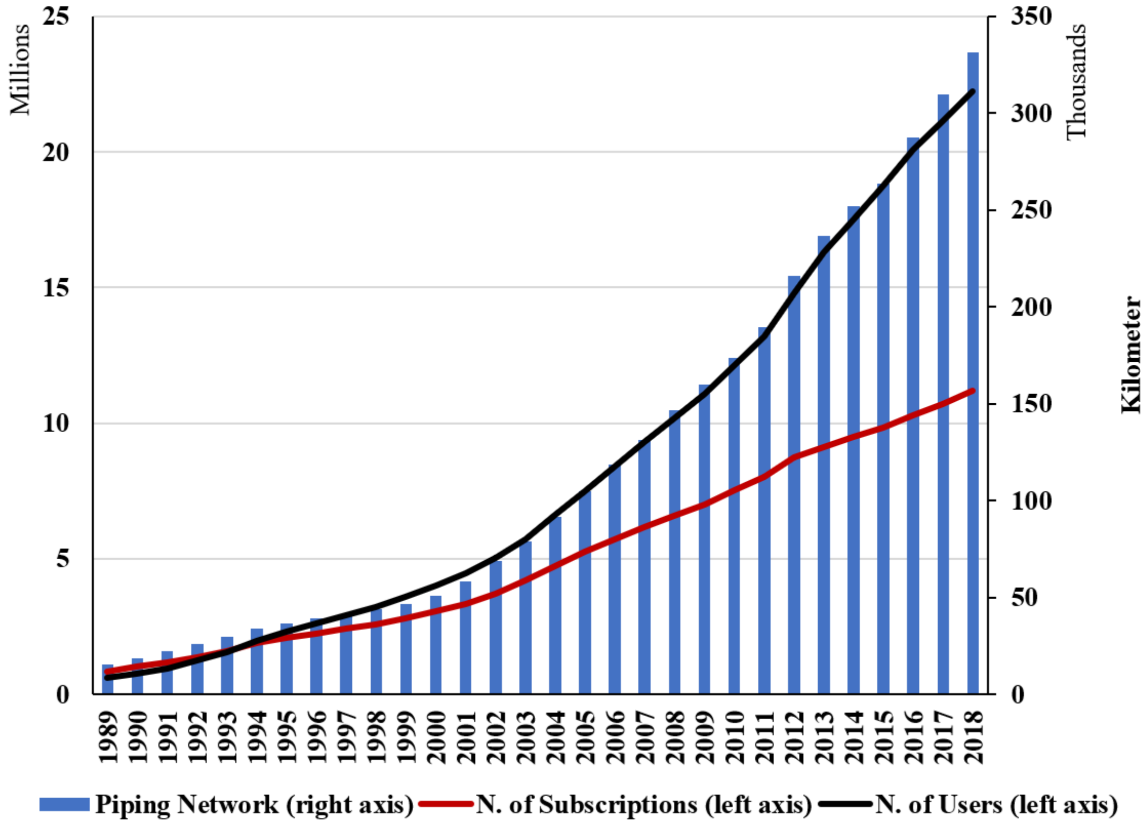
Source: U.S. Energy Information Administration, International Energy Statistics
Note: Iran's hydrocarbon yearbook is confidential since 2017. Since then figures are estimated by EIA and may slightly differ form actual. Detailed monthly production and consumption is not available publicly.

oped an extensive network of natural gas pipelines, facilitating widespread access across the country. As illustrated in Figure (3.6), there has been substantial growth in the length of the pipeline network, the number of subscribers, and the number of users from 1989 to 2018. The length of the pipeline network expanded from less than 50,000 kilometers to over 300,000 kilometers, effectively covering even rural areas.

The mismatch between demand and supply is particularly severe during certain periods of the year, prompting the government to resort to widespread gas outage as the primary policy tool to manage the crisis. This imbalance represents one of the most pressing challenges for Iran's economic development and growth prospects. These disruptions substantially impact industries that are highly dependent on natural gas as a production input, such as the petrochemical and steel sectors, which are critical sources of export revenue for Iran. The Research Center of Iran's Parliament points out that the average supply-demand imbalance during the three coldest months of 2022 was 227 million cubic meters per day, rising to 315 million cubic meters per day in the coldest months (Islamic Parliament Research Center [2024]).

The major driver of exponential demand growth for natural gas in Iran is the exceedingly low pricing policy, particularly for residential use. Figure (3.7a) illus-

Figure 3.6: Evolution of Natural Gas Distribution in Iran



Source: National Energy Statistics Yearbook 2023-2024(Ministry of Energy, Iran [2024])
Note: The figure shows expansion of natural gas pipeline across Iran from 1989-2018. Blue columns are the length of installed pipelines in each year in terms of thousand Kilometers on the right axis. Each natural gas subscription may be used by several users. Solid red and black lines are the number of subscriptions and users respectively, shown on the left axis in millions unit.

trates the evolution of natural gas prices over 1989-2018, highlighting that how low prices have persisted over time. Consumption of residential sector accounts for over 30 percent of total natural gas use. Compared to other similar countries, the price of residential natural gas in Iran remains significantly lower. Figure 3.7b provides a comparative analysis of residential natural gas prices in Iran, Turkey, and OECD countries, adjusted for Purchasing Power Parity (PPP) to ensure comparability.

4. Increasing Block Tariff Pricing in Residential Gas Provision

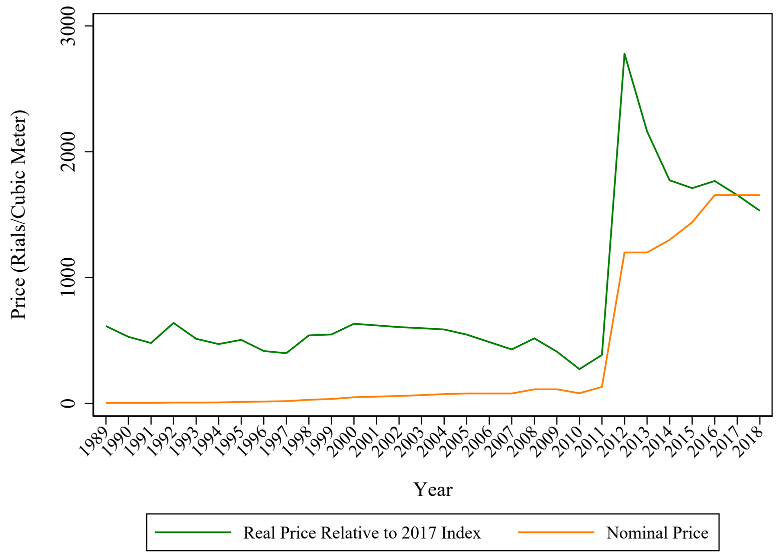
Increasing block tariff (IBT) is a pricing strategy commonly utilized by providers of natural gas, electricity, and water services. In early 2011, Iran transitioned from a two-tier pricing system applied nationwide to a 12-tier increasing block rate structure tailored to different geographic areas for natural gas pricing. This new pricing framework also comprises a fixed service fee along with applicable taxes, such as value-added tax (VAT). Multi-tier IBT pricing was implemented to regulate residential gas usage and curb excessive consumption by imposing progressively higher costs on higher consumption levels.

Increasing block tariff charges higher price for higher levels of consumption. Under this schedule, marginal price is different (ascending) for each block of quantities consumed. In a sense, natural gas provision scheme is similar to a stair moving up from left to right. Figure 4.1 depicts a two-tier pricing scheme. The real price structure in our setting is composed of 12 tiers in each of five climate zones. As it can be seen, unlike uniform price structure, average price is distinct from marginal price where the consumption is more than tier one allowance.

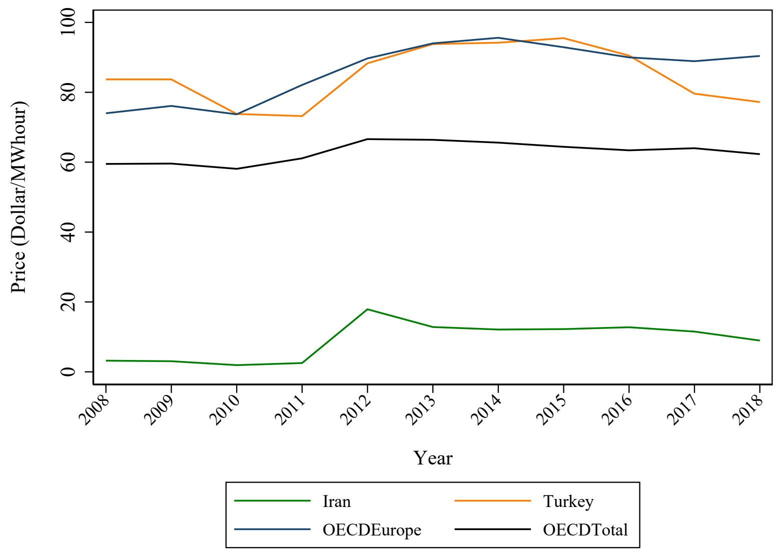
Natural gas distribution is a classic example of a natural monopoly, managed monopolistically by Iran's National Gas Company, which functions under the administration of the Ministry of Petroleum. As such, pricing is typically driven by welfare and social concerns rather than economic ones, ensuring that all households can afford the required level of gas for heating. Therefore, the 12-tire price structure is scheduled such that low levels of consumption are heavily cross subsidized by higher level consumers (mostly 11th and 12th block). This does not cover, however, the variable and fixed costs of the company, transferring net positive subsidy to the residential sector. Furthermore, opportunity cost of export is completely ignored.

Figure 3.7: Prices of Residential Natural Gas

(a) Average Nominal and Real Price of Residential Natural Gas in Iran, 1989-2018



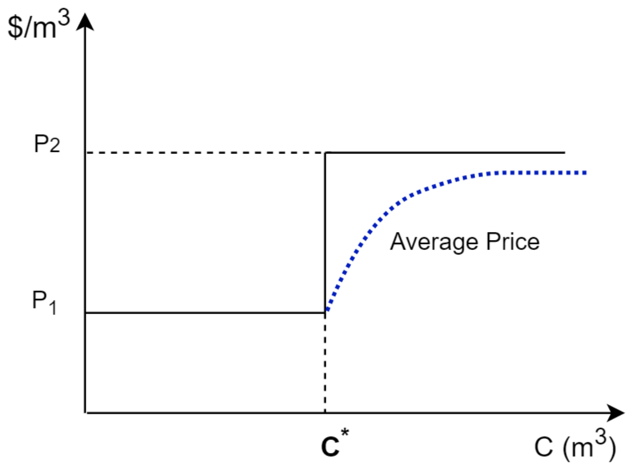
(b) Residential Natural Gas prices in PPP(USD/MWh), 2008-2018



Source: (a)National Energy Statistics Yearbook 2023-2024(Ministry of Energy, Iran [2024]). (b)Energy Prices and Taxes for OECD Countries, Statistics Report (Organisation for Economic Co-operation and Development (OECD) [2024]).

Note: Panel (a) compares average nominal price of residential natural gas (Rials per $m3$) and average real price from 1989-2018. Real prices are calculated by normalizing nominal prices to 2017 CPI index. Panel (b) compares Iran's residential natural gas prices to Turkey and OECD countries from 2008-2018. To ensure comparability, all prices are presented in PPPUSD per MWh.

Figure 4.1: Example of a Two-tier Pricing Structure



Note: This figure is hypothetical illustration of an increasing block pricing structure with only two tiers. p_1 = marginal price of natural gas in tier 1, p_2 = marginal price of natural gas in tier 2, C^* = threshold of consumption between tier 1 and 2. Blue dotted line shows average price of natural gas.

5. Empirical Identification Strategy

The baseline model to estimate the price elasticity is presented as follows:

$$log(Q_{it}) = \beta log(p_{it}) + \gamma_t + \delta_i + u_{it} \quad (1)$$

Where i and t denote household and time index, respectively, Q is the daily average consumption of each household and p stands for the average unit price. As studies suggest (e.g., Ito [2014]), consumers often do not fully understand or respond to the complexity of marginal price systems, instead, they tend to base their consumption decisions on the average cost per unit of energy consumed. Accordingly, in our regression specifications, we utilize the average unit price rather than the marginal price[2]. Since we use household-level observations, we can include household and time fixed effects to absorb the common factors that affect the demand and time-invariant household-specific characteristics.

Nevertheless, a common challenge in demand estimation is the endogeneity of price. In our context of interest, the price is determined by the consumed volume of gas by the household. Consequently, both marginal and average price of natural gas mechanically rises with increased consumption, potentially resulting in biased own-price elasticity estimate from Model (1). The reverse causality between the

[2] Average unit price is derived from dividing total cost by total consumption. AvgPrice $= \frac{\text{total cost of natural gas consumption}}{\text{total natural gas consumption}}$

demanded quantity (outcome of interest) and unit price (explanatory variable) is a well-argued issue in market analyses.

5.1. *Solutions to Endogeneity*

To account for this endogeneity, we utilize two methodologies:

- Replacing the current level of gas prices with their lagged values
- Instrumental variable estimation methods

We will now outline methods to tackle with the endogeneity challenges to obtain an unbiased estimate of own-price elasticity for natural gas, considering the block-rate pricing structure in our context.

5.1.1. *Alternative 1 : Panel Estimation with Lagged Prices*

Our First identification strategy involves substituting current natural gas price with its lagged values. Household's demand for natural gas in the current period cannot influence the lagged price values from prior period. In fact, consumers typically receive their bills at the beginning of the following month, suggesting that the most recent bill better signals users about their consumption level and cost of natural gas in their budget set. Using lagged prices instead of current price in the regression, addresses the simultaneity of current consumption and price in increasing block-rate setting. This approach has two advantages : First, it breaks the quantity-price relation because the current consumption is not a function of past prices. Second, it is more plausible that consumers respond to the lagged prices as they pay the cost after the billing cycle[3]. The following equation can be specified:

$$log(Q_{it}) = \beta log(p_{it-s}) + X_{it} + \mu_i + \gamma_t + \eta_{it} \quad ; s \geq 1 \tag{2}$$

Where, γ_t is the time and μ_i stands for household fixed effects. Also X_{it} is a vector of other exogenous variables affecting consumption, including, the interaction of city by time, number of cooling degree days, and other climatic factors.

5.1.2. *Alternative 2 : Simulated IV*

Given the presence of multiple price reforms in our setting, we employ a technique adapted from the taxation literature, as developed by Gruber and Saez [2002]

[3]For example, Rubin and Auffhammer [2024] suggest the largest price elasticity of demand corresponds to the second lag of price

and Kleven and Schultz [2014], to analyze elasticity of taxable income. The challenge posed by increasing block prices is analogous to that of marginal tax rates in a progressive tax system, where a mechanical positive correlation exists between tax rates and income levels. Similarly, in the context of block-rate pricing, consumption and prices are endogenously linked.

The core idea behind this instrumental variable technique is to use a household's consumption history to predict their expected consumption and corresponding average unit price in the absence of any price reform. This counterfactual price can be used as an instrument for the realized price observed in data. Consider the following first stage estimating equation:

$$P_{it}^{realized} = \alpha P_{it}^{simulated} + \mu_i + \gamma_t + \nu_{it} \tag{3}$$

Where $P^{realized}$ is the observed average unit price of natural gas after the reform, and $P^{simulated}$ is the expected average unit price for household i in time t based on the household's consumption history in the absence of price reform. To obtain $P^{simulated}$, we must first predict the consumption of household and then calucalte the average unit price according to pre-reform marginal prices. In other words $P^{simulated}$ is a function of $Q_{i,t-s}$:

$$P_{it}^{simulated} = f(Q_{i,t-s}) \tag{4}$$

Since our analysis uses monthly consumption data, the best predictor of household's consumption (and hence the average unit price) is the seasonal average of household's consumption 12 months ago. After estimating the first stage regression using simulated IV, we then run a regression of Q_{it} on $\hat{P}^{realized}$:

$$log(Q_{it}) = \beta log(\hat{P}^{realized}) + \mu_i + \gamma_t + \eta_{it} \tag{5}$$

6. Empirical Findings

The analysis reveals quite a significant heterogeneity in the price elasticity of residential natural gas demand across the seasons and pricing tiers. Using a panel estimation and simulated IV models, incorporating lagged prices and robust controls—including household and city-month-year fixed effects—we find detailed patterns in consumer responsiveness to price changes.

The results are presented in table (6.1). The panel estimation and simulated IV model include lagged price and a set of controls, including household (HHID), Month_Year, and City_Month_Year fixed effects.

As demonstrated in section 3.2, we have substantial between variations which could be exploited to estimate heterogeneous elasticities and provide more rigorous evidence for policymaking. We include the interaction term of price by each block of consumption based on average history of household consumption in the sample. The results are reported in columns (3) to (5) of Table (6.1). The findings highlight distinct differences in price elasticity across consumption tiers under the 12-tier increasing block pricing structure. Consistent with the intuition that high-consumption households respond more to price changes, for households in the lowest consumption block, the estimated elasticity is -0.42 and -0.51 in the panel and simulated IV model respectively, while for those in the highest consumption block(12th tier), it is -0.55 and -0.60. This tiered responsiveness highlights the influence of marginal pricing on consumer behavior, especially among households with high gas consumption, who experience more significant price increases. The results suggest that policies targeting these higher tiers could yield significant reductions in overall demand while maintaining affordability for lower-income households reliant on smaller volumes of natural gas. However, it is important to consider the distribution of consumption and the share of each block in total consumption for evaluating price reform effectiveness (see Figure A.2). Distribution of natural gas consumption is very right-skewed with few consumers in the top tiers of consumption, suggesting that a 10% price increase in the first block reduces the total demand by 1.4 % , while a 10% price increase in the last block reduces total demand by 0.05%.

Table 6.1: Demand Estimation of Residential Natural Gas

	Panel Lag Price				Simulated IV	
	(1) log(Q)	(2) log(Q)	(3) log(Q)	(4) Elasticity	(5) log(Q)	(6) Elasticity
$\log(p_{t-2})$	-0.246***					
	(0.008)					
$\log(p_{t-1})$		-0.430***	-0.427***	-0.427	-0.511***	-0.511
		(0.008)	(0.029)		(0.039)	
block=2$\times\log(p_{t-1})$			0.049*	-0.378	-0.008***	-0.519
			(0.029)		(0.002)	
block=3$\times\log(p_{t-1})$			-0.001	-0.428	-0.019***	-0.530
			(0.029)		(0.002)	
block=4 $\times\log(p_{t-1})$			-0.021	-0.448	-0.030***	-0.541
			(0.029)		(0.002)	
block=5$\times\log(p_{t-1})$			-0.073**	-0.499	-0.040***	-0.551
			(0.031)		(0.003)	
block=6$\times\log(p_{t-1})$			-0.099***	-0.525	-0.049***	-0.560
			(0.031)		(0.003)	
block=7$\times\log(p_{t-1})$			-0.102***	-0.528	-0.054***	-0.565
			(0.032)		(0.003)	
block=8$\times\log(p_{t-1})$			-0.142***	-0.568	-0.063***	-0.575
			(0.034)		(0.004)	
block=9$\times\log(p_{t-1})$			-0.123***	-0.549	-0.070***	-0.581
			(0.033)		(0.004)	
block=10$\times\log(p_{t-1})$			-0.171***	-0.598	-0.076***	-0.587
			(0.037)		(0.004)	
block=11$\times\log(p_{t-1})$			-0.154***	-0.580	-0.083***	-0.594
			(0.037)		(0.004)	
block=12$\times\log(p_{t-1})$			-0.133***	-0.559	-0.097***	-0.608
			(0.033)		(0.005)	
HHID	Yes	Yes	Yes		Yes	
Month_Year	Yes	Yes	Yes		Yes	
City_Month_Year	Yes	Yes	Yes		Yes	

Standard errors are reported in parentheses, * p<0.1, ** p<0.05, *** p<0.01. Q is the daily average quantity of natural gas consumed in a billing cycle. P is the average unit price of natural gas during a billing cycle, calculated from dividing billing cost by the quantity consumed. Column(1) is the regression of log(consumption) on the second lag of log(price). Column(2) is the regression of log(consumption) on the first lag of log(price). In Column(3) the consumer's block of average consumption is interacted with log(price). Column (4) reports the implied price elasticity from Column(5) for the 1st block to the 12th block. HHID is Household fixed effect, Month_Year is the interaction of month by year, and City_Month_Year is the interaction of city by month and year. In Columns (5) and (6), results are reproduced employing simulated IV. Average seasonal consumption of each household in the last 12 months is used to predict simulated average unit price after each reform.

These findings align with the broader literature on energy demand elasticity under block-rate pricing structures, such as studies by Rubin and Rubin and Auffhammer [2024] and Favero and Grossi [2023], which document comparable patterns of heterogeneity in consumer responsiveness. The observed seasonal and tiered variability in Iran's natural gas demand mirrors global trends, particularly in regions with similarly structured pricing systems and seasonal consumption peaks.

The methodological rigor of this study, particularly its use of instrumental variable techniques to address price endogeneity, enhances the reliability of these findings. By isolating exogenous variations in price, the analysis mitigates biases commonly associated with block-rate pricing, offering robust estimates of causal relationships. These results set the stage for further exploration of heterogeneity in price elasticity across demographic and geographic subgroups, promising deeper insights into the behavioral dynamics driving natural gas consumption in Iran.

7. Robustness Checks

In this section, we examine the robustness of our results and the internal validity of the analysis. Specifically, we re-estimate the model using the marginal price of natural gas instead of the average unit price. Table (7.1) reports the results of price elasticity estimates across all pricing tiers. Notably, marginal prices are set at the Climate Zone level—aggregated above the household level— by the government and are therefore independent of individual household consumption, serving as a valid source of exogenous variation. Consistent with previous findings, consumers in higher consumption tiers exhibit more elastic demand. The estimated marginal price elasticity of natural gas ranges from -0.2 to -0.296, with smaller magnitudes compared to average unit price elasticity. This aligns with existing energy literature (e.g. Ito [2014]), which documents that consumers are more responsive to the average unit cost than the marginal cost of the last unit consumed, likely due to behavioral factors.

To further evaluate internal validity, we test for heterogeneous price elasticity across warm and cold periods of the year. Intuitively, natural gas is primarily used for heating during the colder months, where substitution options are limited. As a result, we expect lower price sensitivity during this period due to the necessity-driven nature of demand. In contrast, during warmer months, natural gas is predominantly used for cooking, which can be substituted with liquefied petroleum

Table 7.1: Demand Estimation of Residential Natural Gas: Marginal Prices

	(1) log(Q)	(2) Elasticity
$\log(P_{t-1}^{margin})$	-0.200	-0.200
	(0.166)	
block=2 $\times \log(P_{t-1}^{margin})$	-0.015**	-0.215
	(0.006)	
block=3 $\times \log(P_{t-1}^{margin})$	-0.031***	-0.231
	(0.005)	
block=4 $\times \log(P_{t-1}^{margin})$	-0.040***	-0.240
	(0.004)	
block=5 $\times \log(P_{t-1}^{margin})$	-0.052***	-0.252
	(0.005)	
block=6 $\times \log(P_{t-1}^{margin})$	-0.058***	-0.258
	(0.005)	
block=7 $\times \log(P_{t-1}^{margin})$	-0.063***	-0.263
	(0.005)	
block=8 $\times \log(P_{t-1}^{margin})$	-0.071***	-0.271
	(0.004)	
block=9 $\times \log(P_{t-1}^{margin})$	-0.076***	-0.276
	(0.004)	
block=10 $\times \log(P_{t-1}^{margin})$	-0.076***	-0.276
	(0.005)	
block=11 $\times \log(P_{t-1}^{margin})$	-0.092***	-0.292
	(0.005)	
block=12 $\times \log(P_{t-1}^{margin})$	-0.096***	-0.296
	(0.006)	
HHID	Yes	
Month_Year	Yes	
City_Month	Yes	

Standard errors are reported in parentheses, * p<0.1, ** p<0.05, *** p<0.01.
Note: Q is the daily average quantity of natural gas consumed in a billing cycle. P^{margin} is the marginal price of the last unit of consumption of natural gas during a billing cycle, calculated according to household consumption and corresponding pricing scheme at the time. Marginal prices are set at CZ level by the government. Column(1) is the regression of log(average daily consumption) on the first lag of log(marginal price). Column (2) reports the implied price elasticity from Column(1) for the 1st block to the 12th block. HHID is household fixed effect, Month_Year is the interaction of month by year, and City_Month is the interaction of city by month.

gas (LPG) cylinders, widely available in Iran at low cost. Consequently, we anticipate higher price elasticity during the warm season. To test this hypothesis, we included an interaction term between the logarithmic form of price and a seasonal binary variable in our regression model. This approach allows us to estimate and compare the price elasticities of natural gas demand separately for the cold and warm seasons of the year, highlighting seasonal differences in consumer re-

Table 7.2: Demand Estimation of Residential Natural Gas by Cold/Warm Period: Panel Lag Prices

	(1) log(Q)	(2) log(Q)	(3) log(Q)	(4) log(Q)
$\log(P_{it-1})$	-0.430***			
	(0.008)			
$\log(P_{it-2})$		-0.246***		
		(0.008)		
$\log(P_{it-1})$			-0.518***	
			(0.009)	
Cold Period Dummy $\times$ $\log(P_{it-1})$			0.284***	
			(0.017)	
$\log(P_{it-2})$				-0.269***
				(0.008)
Cold Period Dummy$\times$ $\log(P_{it-2})$				0.078***
				(0.016)
HHID	Yes	Yes	Yes	Yes
Month_Year	Yes	Yes	Yes	Yes
City_Month_Year	Yes	Yes	Yes	Yes

Standard errors are reported in parentheses, * p<0.1, ** p<0.05, *** p<0.01. The table reports results for Panel Model with heterogeneous seasonal price elasticity. Q is the daily average quantity of natural gas consumed in a billing cycle. P is the average unit price of natural gas during a billing cycle, calculated from dividing billing cost by the quantity consumed. Each column is a separate regression. Columns (3) and (4) includes interaction of price and cold period dummy. Cold period is defined by the government from Nov. to April. HHID is Household fixed effect, Month_Year is the interaction of month by year, and City_Month_Year is the interaction of city by month and year.

sponsiveness to price changes. The results are presented in Tables (7.2) and (7.3). During winter, when heating is a dominant usage, the price elasticity is estimated at -0.24 and -0.36 in panel and simulated IV models respectively, indicating relatively inelastic demand. This reflects the necessity-driven nature of natural gas use in colder months, where households prioritize maintaining basic living conditions despite price variations. Conversely, in the summer months, the elasticity increases substantially to -0.52 and -0.62. This heightened sensitivity suggests that discretionary uses of natural gas, such as water heating or cooking, may be more adaptable to price changes, allowing households to adjust consumption patterns in response to financial incentives.

From a policy perspective, these results provide a critical empirical basis for designing targeted interventions. For example, the pronounced elasticity in upper tiers suggests that incremental price increases in these blocks could act as an

Table 7.3: Demand Estimation of Residential Natural Gas by Cold/Warm Period: Simulated IV

	(1)	(2)
	log(Q)	log(Q)
$\log(P^{sim}_{it-1})$	-0.622***	
	(0.026)	
Cold Period Dummy $\times \log(P^{sim}_{it-1})$	0.266***	
	(0.031)	
$\log(P^{sim}_{it-2})$		-0.228***
		(0.026)
Cold Period Dummy $\times \log(P^{sim}_{it-2})$		0.130***
		(0.034)
HHID	Yes	Yes
Month_Year	Yes	Yes
City_Month_Year	Yes	Yes

Standard errors are reported in parentheses, * p<0.1, ** p<0.05, *** p<0.01. The table reports results for Simulated IV Model with heterogeneous seasonal price elasticity. Q is the daily average quantity of natural gas consumed in a billing cycle. P is the average unit price of natural gas during a billing cycle, calculated from dividing billing cost by the quantity consumed. Each column is a separate regression. Columns (1) and (2) includes interaction of price and cold period dummy. Cold period is defined by the government from Nov. to April. HHID is Household fixed effect, Month_Year is the interaction of month by year, and City_Month_Year is the interaction of city by month and year. Average seasonal consumption of each household in the last 12 months is used to predict simulated average unit price after each reform.

effective demand policy tool, curbing excessive consumption without disproportionately burdening low-income households. Moreover, the stark seasonal contrast in elasticity underscores the potential value of differentiated pricing strategies that account for winter heating necessities. Such approaches could enhance both the efficiency and equity of pricing reforms, aligning with the dual objectives of energy security and social welfare optimization.

8. Conclusion

Natural gas is a cornerstone of Iran's energy sector, accounting for over 70% of primary energy consumption and serving as a critical resource for both residential and industrial use. However, rapidly increasing demand—particularly in the residential sector—has outpaced supply capacity, creating significant imbalances that need urgent policy attention. This study provides a comprehensive empirical analysis of the price elasticity of residential natural gas demand, leveraging detailed household-level billing data spanning eight years and employing advanced identification strategies to address the endogeneity challenges inherent in increasing block pricing systems.

The results highlight pronounced heterogeneity in price elasticity, both seasonally and across consumption tiers. During warmer months, higher elasticity (-0.51) indicates greater consumer responsiveness, suggesting opportunities for seasonal demand-side interventions. In contrast, the lower elasticity observed in winter (-0.23) underscores the necessity-driven nature of heating demand. Additionally, the tiered pricing structure reveals significant differences in responsiveness, with high-consumption households displaying greater sensitivity to price changes. These findings provide a strong empirical basis for designing pricing reforms that enhance efficiency while protecting low-income households from adverse welfare impacts.

This study makes important contributions to the literature on energy demand under increasing block pricing regimes by offering robust evidence derived from a uniquely granular dataset. The findings have direct implications for policy, particularly in crafting equitable and effective pricing mechanisms that balance the objectives of reducing consumption and bolstering energy security. Policymakers can adopt differentiated pricing strategies informed by observed behavioral elasticities, ensuring that reforms achieve both economic efficiency and social equity.

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Appendix A. Tables and Figures

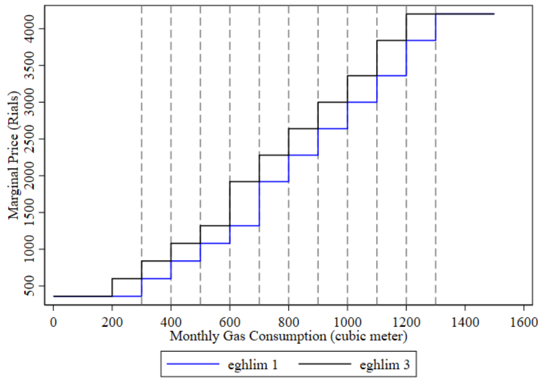
Table A.1: Summary Statistics of Variables

	Mean	SD	Min	Max
Consumption(m^3)	308	321	1	2,149
AveragePrice(Rials)	1,320	995	169	10,835
NumberofDays	42	7	15	60
Area(m^2)	120	147	1	12,915
BlackoutDays	0	0.2	0	54
GasCost(Rials)	284,271	304,288	1,567	2,257,678
NumberOfUnits	1.2	1.2	1.0	96
Urban(dummy)	0.8	0.4	0.0	1
Observations	3,428,130			

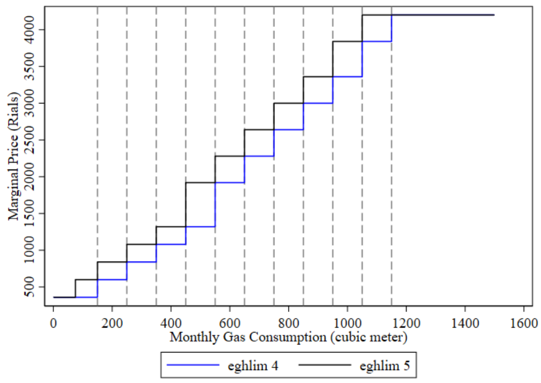
Summary statistics of key variables in the data are reported. Consumption and Average (unit) Price have diverse variation. NumberofDays for each billing cycle is limited to between 15 and 60, since other bills are outliers. Definition of all variables are presented in Table 3.1.

Figure A.1: Residential Natural Gas Pricing Structure in cold season

(a) Marginal Price of Gas in Cold Season for CZ(1) v.s. CZ(3)

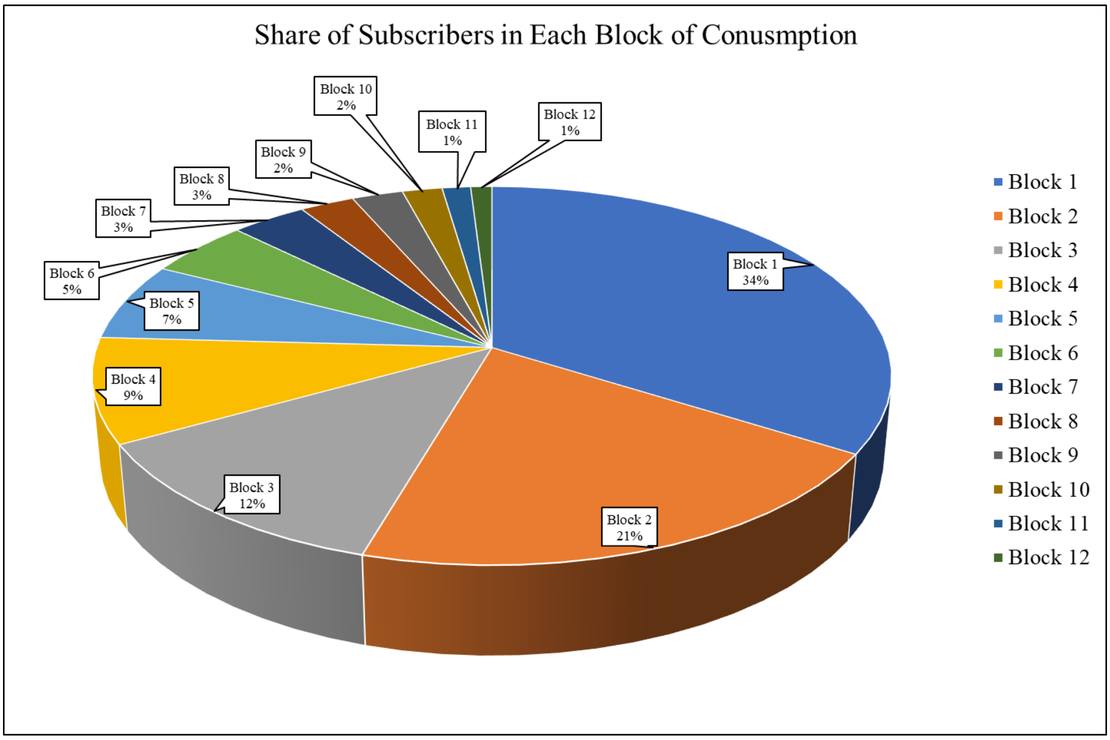


(b) Marginal Price of Gas in Cold Season for CZ(4) v.s. CZ(5)



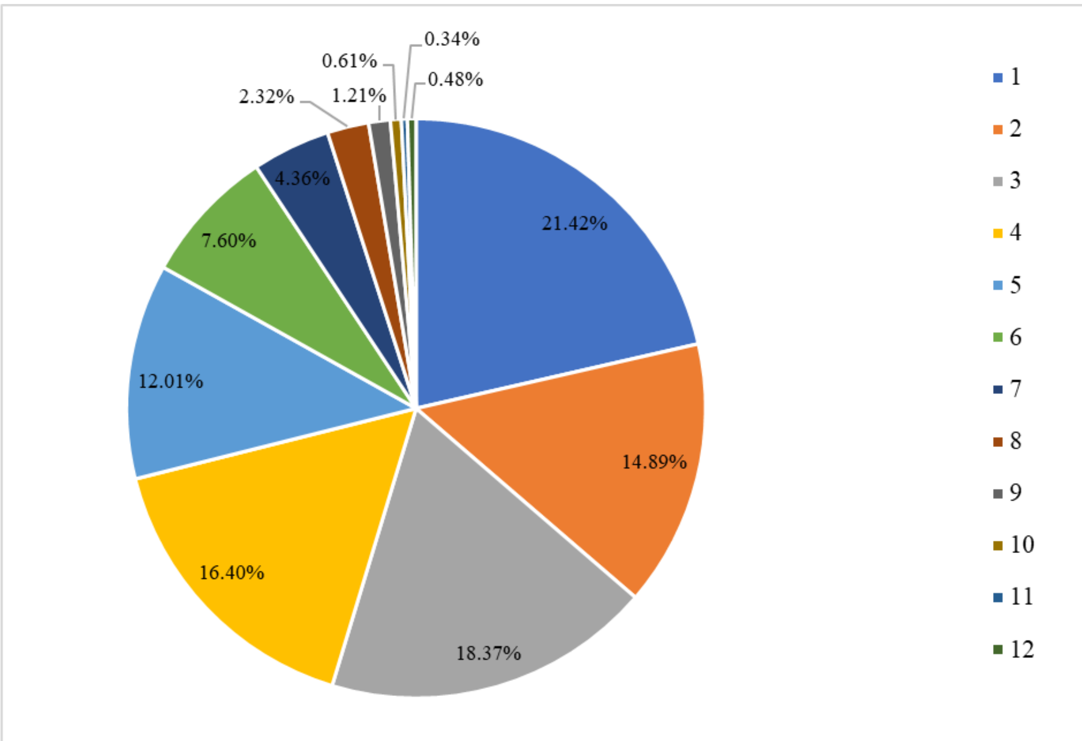
Note: Marginal prices of residential natural gas are increasing function of consumption level. Pricing structure is distinct for each geographical zone and depends on time of the year. Panel (a) shows marginal prices for CZ(1) and CZ(3) (eghlim in Persian) in the cold period (from Nov. to April). Panel (b) shows marginal prices for CZ(4) and CZ(5). Theses specific marginal prices are depicted to better illustrate the pricing structure. See Figure 3.1 for the full picture.

Figure A.2: Subscribers' Share in Each Block of Consumption



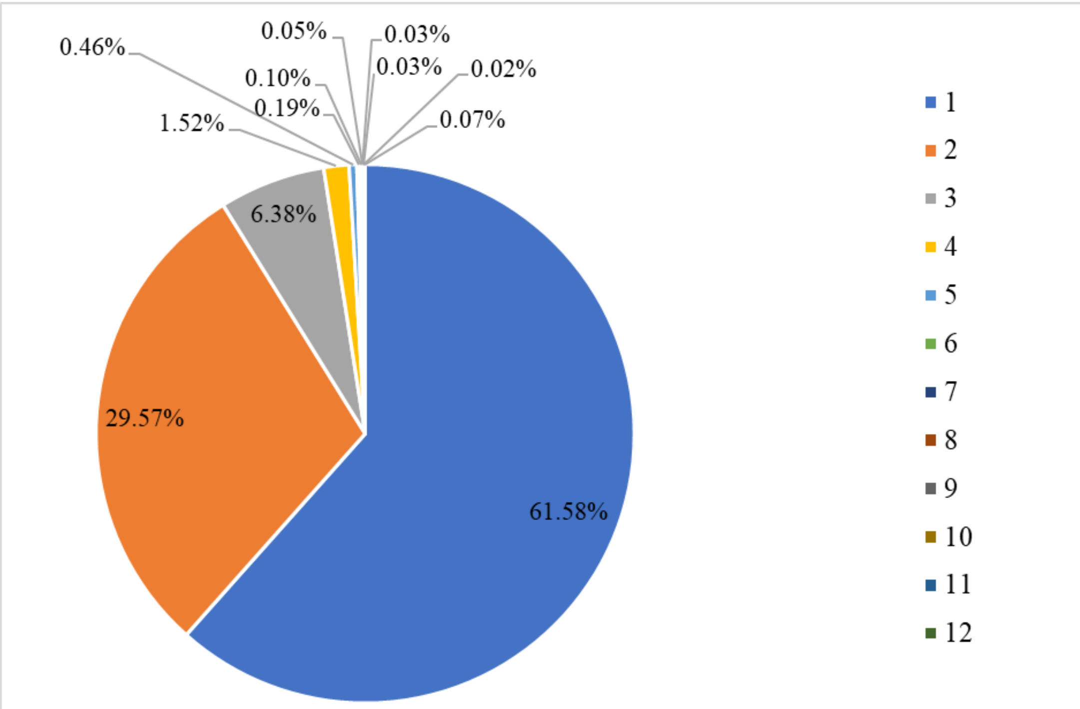
Note: The figure shows the share of subscribers in each block of consumption during the whole year. There are 12 blocks of consumption. More than 30 percent of subscribers fall within the first tier of consumption allowance. Average yearly consumption for each subscriber is considered to determine the corresponding block of consumption.

Figure A.3: Subscribers' Share in Each Block of Consumption during a Cold Month, Month = **mid Jan.-mid Feb.** (Bahman in Iran)



Note: The figure shows the share of subscribers in each block of consumption during a cold month. There are 12 blocks of consumption. Over 30 percent of subscribers fall within the first and second tier of consumption allowance. Average monthly consumption for each subscriber is considered to determine the corresponding block of consumption.

Figure A.4: Subscribers' Share in Each Block of Consumption during a Warm Month, Month = **mid June-mid July** (Tir in Iran)



Note: The figure shows the share of subscribers in each block of consumption during a warm month. There are 12 blocks of consumption. Over 60 percent of subscribers fall within the first tier of consumption allowance. Average monthly consumption for each subscriber is considered to determine the corresponding block of consumption.