VALUATION OF ENERGY COSTS IN THE RENTAL HOUSING MARKET: EVIDENCE FROM TÜRKIYE

by
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VALUATION OF ENERGY COSTS IN THE RENTAL HOUSING MARKET: EVIDENCE FROM TÜRKIYE

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ABSTRACT

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Keywords: Energy Efficiency, Energy Consumption, Market Failures
Housing Rent

This study investigates the impact of energy expenditure on housing rent in the housing market in Türkiye. We explore whether energy efficiency investments, proxied by energy costs, are capitalized into rental prices by exploiting a sample of nearly 39,000 rental dwellings from 2002 to 2019. Our results suggest that 100 TL decrease in energy bills is associated with an approximately 8 TL increase in rents, providing evidence of market failures and the role of behavioral factors in the rental housing market. We attribute market failures to informational and behavioral barriers and highlight the importance of government interventions toward eliminating these problems.

ÖZET

KİRALIK KONUT PİYASASINDA ENERJİ MALİYETLERİNİN DEĞERLENDİRİLMESİ: TÜRKİYE ÖRNEĞİ

BETÜL NUR AKBULUT

EKONOMİ YÜKSEK LİSANS TEZİ, TEMMUZ 2024

Tez Danışmanı: Dr. Öğr. Üyesi ERDAL AYDIN

Anahtar Kelimeler: Enreji Verimliliği, Enerji Harcaması, Piyasa Başarısızlığı, Ev Kirası

Bu çalışma Türkiye'de enerji harcamalarının ev kirasına olan etkisini ve enerji verimliliği yatırım maliyetlerinin ev kiralarına ne ölçüde aktarıldığını sorgulamaktadır. Bunun için 2002 ile 2019 arasındaki yaklaşık 39,000 kiralık konut verisini kullanıyoruz. Sonuçlarımız enerji faturalarındaki 100 TL azalışın ev kiralarını 8 TL arttırdığını gösteriyor. Enerji maliyetlerine dair mükemmel değerlendirmenin olmayışının, piyasadaki bilgi başarısızlıklarına ve davranışsal faktörlere atfedilebileceğine vurgu yapıyoruz. Ek olarak, piyasa başarısızlıklarımı gidermek için hükümet müdahalelerinin önemini vurguluyor ve bazı politika önerilerinde bulunuyoruz.

I would like to express my deepest gratitude and appreciation to my thesis supervisor Erdal Aydın for his endless support and insightful guidance throughout the thesis process. His expertise and encouragement have been invaluable.

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To the good people in my life

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1. INTRODUCTION

Energy efficiency in dwellings has become a significant topic of discussion among policymakers and researchers, as inefficient energy use exacerbates environmental issues by accelerating the carbonization process. Proposed solutions to counter this problem have primarily focused on the residential sector, given that this sector accounts for approximately 26% of the total energy consumption in Europe (Eurostat (2024)). In addition to environmental concerns, limitations on energy consumption have become crucial due to rising energy prices. For instance, household gas prices in Europe have risen nearly 111% from 2021 to 2022 (HEPI (2022)). This surge has prompted governments to seek solutions to limit energy consumption since rising energy prices put more economic burden on governments, especially those dependent on external energy sources and their inhabitants.

While the European Union has introduced various regulations for improving energy efficiency in dwellings, the successful implementation of these regulations is highly contingent on market constraints. The housing market faces several problems that hinder the intended effectiveness of these instruments, thereby preventing the attainment of optimal market outcomes and creating an "energy efficiency gap" (Allcott and Greenstone (2012); Gerarden, Newell, and Stavins (2017)).

There is extensive literature exploring the underlying reasons for the energy efficiency gap. Studies have generally point out various informational and behavioral barriers as drivers for market inefficiencies in the residential sector. One of the most discussed failures is asymmetrical information, which occurs when the potential tenant or home buyer is under-informed regarding costs of investments on energy efficiency incurred by the property owner. Being under-informed about the actual value of a house makes potential tenants and/or buyers unwilling to pay higher rent or price for an energy-efficient house. This reluctance, in turn, discourages the landlord from investing in energy efficiency as they face difficulties in signaling the actual value of their property (Gillingham, Newell, and Palmer (2009); Cajias, Fuerst, and Bienert (2019); Myers (2020)).

Unlike in the property market, informational failures in the rental housing market are also explained by the "split-incentive" or "principal-agent" problem, which is characterized by the unequal sharing of capital and utility cost between homeowners and tenants (Gillingham, Harding, and Rapson (2012); Olaussen, Oust, and Solstad (2017); Cajias, Fuerst, and Bienert (2019); Fuerst, Haddad, and Adan (2020); Petrov and Ryan (2021)). In other terms, while the landlord is responsible for investing in energy efficiency, the benefits of reduced bills from efficiency investments accrue for the tenants. When landlords cannot recover this investment, it results in an unwillingness to invest in energy efficiency, leading to higher energy expenditure (Myers (2020)).

The presence of split incentive and information asymmetry in the residential market is identified as the greatest obstacles to achieving the optimal efficiency level (Schleich and Gruber (2008)). To counter information asymmetries, European countries have started to implement energy certificate programs.[1] Giving information on the energy efficiency levels of properties, energy certificates aim to eliminate the asymmetry of information between homeowner-tenant and seller-buyer. Recent studies in the literature reveal that these energy efficiency campaigns indeed yield a positive impact on the property's value. Nevertheless, this positive impact is limited since the efficiency improvement costs covered by the property owner are only partially capitalized into housing prices (Olaussen, Oust, and Solstad (2017)). Hence, the energy certification programs are only partly successful in mitigating asymmetrical information, which points to other market barriers that stand in the way of achieving perfect market outcomes.

One of the market barriers which exacerbate the impact of energy-efficiency implementations, by creating uncertainty in the market, is the fluctuation in energy prices. Gillingham, Newell, and Palmer (2009) indicates uncertainty as another informational failure. When energy prices fluctuate, it becomes more complex to estimate the monetary return of energy efficiency investments, discouraging the property owner from investing in these instruments (Ramos et al. (2015)). Along with informational problems, behavioral barriers exist in the market. Individuals are boundedly rational (Blasch et al. (2021)): even if they have energy-specific information, they may be unable to make the optimal energy-related decision due to cognitive limitations in evaluating information (Ramos et al. (2015)).

[1] Energy Performance Certificates (EPCs), designed in 2002 by the European Union and mandated for 28 member countries of the EU. The aim of this regulation is to signal the actual value of houses to potential buyers and tenants by giving information regarding the energy efficiency level of the house, thus inciting them to buy or lease efficient houses. EPCs provide information on dwellings' actual energy efficiency level via efficiency ratings from A (high-efficiency rating) to G (low-efficiency rating).

Apart from informational and behavioral problems, some structural issues in the market can reduce the impact of informational instruments, as highlighted by recent research. For example, in rental markets with a housing shortage, potential tenants face time pressure when making rental decisions, which can lead to an undervaluation of the property's energy efficiency level (Sieger and Weber (2023)). Another issue may be the insufficiency of governmental control mechanisms regarding the correct implementation of energy-efficiency regulations. The lack of auditing may damage consumers' trust in informational campaigns. For instance, Annunziata, Rizzi, and Frey (2014) demonstrate that energy audits conducted by local authorities are effective in increasing energy efficiency in public buildings.

The above-mentioned issues collectively contribute to distortions in the rental market. In this study, we will explore the Turkish residential rental market to assess whether the energy costs are perfectly reflected in housing rents. We claim that in a perfect market, the savings from energy efficiency investments would be entirely capitalized into rental prices. Therefore, in a perfect market, a one-unit decrease in energy bills would result in a one-unit increase in rental prices.

There is a vast body of literature showing the impact of energy certificates on property value. The findings usually suggest that energy efficiency implementations have a significantly positive effect on housing rental and sell prices. For instance, Fuerst et al. (2016) report price premium for greener dwellings in Wales housing market. Moreover, Cajias, Fuerst, and Bienert (2019) find a slight yet significant effect of energy efficiency ratings on housing rents in the German rental market. However, these studies have usually investigated the existence of the impact of efficiency investments on house value. Different from the previous studies, we contribute to the literature by assessing the coefficient of the main variable of interest, which indicates the impact of energy savings on rent falls within the 0-1 scale and testing the valuation of energy costs. If the coefficient of energy consumption is one, it means that savings from energy efficiency are perfectly capitalized into rents, indicating perfect valuation.

For this purpose, we use the dataset from the Household Budget Surveys provided by the Turkish Statistical Institute. We exploit energy bills as the main independent variable representing the efficiency level, with low energy bills representing efficient houses. Our data covers nearly 39.000 rental dwellings and includes information on the expenditure patterns of households for different energy sources. This comprehensive dataset allows us to control for other physical characteristics of houses as well as the demographic features of the households.

In line with the existing literature, we report evidence for the rental premium for greener houses in the Turkish rental housing market. Our findings suggest that 100 TL decrease in energy bills leads to 8 TL increase in rental prices, meaning that coefficient for energy expenditure is 0.08, which points out the absence of perfect valuation. Confirming with the relevant studies, we also demonstrate that potential tenants value more visible dwelling characteristics (presence of elevator, house size, etc.) compared to the property's energy efficiency degree, as it is not observable by the tenants.

We provide some potential explanations for the lack of perfect valuation, such as information asymmetry, split-incentive, tenants' bounded rationality, and lack of audit as the reasons behind market inefficiencies. Furthermore, we discuss two issues that might amplify the problems in the market: the recent housing shortage in Türkiye, which may limit thorough evaluation of properties, and the uncertainty around future investment costs caused by rising energy prices. We further draw attention to the significance of the energy use of heating in Turkish households, noting that energy is mainly used for heating purposes. Therefore, we highlight the need to address informational problems in this area and propose relevant policies. To our knowledge, this is the first study to investigate the perfect valuation of energy costs in the Turkish rental housing market by analyzing the impact of energy expenditure on rental prices.

The remainder of this study is constructed as follows: First, we explore previous studies investigating the impact of energy efficiency improvements on housing rents and sales prices. Later, we provide some information on residential energy consumption in Türkiye and Turkish rental market, respectively. We then introduce our data utilized in this study and provide the descriptive statistics of variables included in our model specification. In the following section, we discuss our results and make policy suggestions. In the concluding section, we summarize our findings.

2. LITERATURE REVIEW

There is a large literature investigating the impact of energy certificates and informational campaigns on housing rents or values for different countries. As one of the first studies to explore the effect of energy ratings on house prices in Netherlands, Brounen and Kok (2011) demonstrate that A-rated properties are sold at 10% more premium than D-rated ones, whereas those rated D and below are sold with discount. Subsequent studies have confirmed this finding for different countries and regions. Kahn and Kok (2014) report that properties in the Californian residential market are sold at a premium. Similarly, Deng, Li, and Quigley (2012) investigate the impact of the Green Mark program in Singapore and find a higher sales premium for green houses. On the other hand, Hyland, Lyons, and Lyons (2013) include rental housing market analysis. Investigating the impact of the Building Energy Rating program in the Irish residential market, which is the equivalent of the energy performance certificate, on property rental and sell prices, they report that A-rated houses are sold at 9% more premium than those rated D-. In addition, A-rated houses are rented at 1.8% more premium than D-rated ones. Furthermore, there is a rate discount for E, F, and G-rated houses. Hence, energy-efficient houses have a premium value in both sales and rentals.

Exploiting energy consumption as an efficiency measure, Cajias and Piazolo (2013) also find a higher price effect for owner-occupied green houses compared to rental dwellings. Zalejska-Jonsson (2014) similarly reveal a higher willingness to pay for energy-efficient houses with a 5% rental premium. Fuerst et al. (2015) also point to a price premium for houses with higher rates (A, B, C) as opposed to a price discount for those with lower rates (E, F, G) in the English residential market. Olaussen, Oust, and Solstad (2017) evaluate the Norway residential sector and discuss that the impact of efficiency improvements on transaction prices stems from the energy performances of buildings rather than labels.

Chegut et al. (2020) also find rental discounts for labels D-, E-, and F- compared to C- labeled houses. Moreover, Bian and Fabra (2020) show rental premium for energy-efficient dwellings in Spain, highlighting the importance of information asymmetries as a major driver for market inefficiency regarding energy efficiency. In line with this, Myers (2020) provides evidence for informational asymmetry proving that tenants are not well-informed regarding energy costs.

Using the Swiss Household Energy Demand Survey, Lang and Lanz (2021) investigate how tenants in Switzerland receive energy-efficiency improvements to the heating systems of the properties they occupy. They find that tenants welcome energy-efficient improvements with higher WTP as long as they are well-informed about the situation and its financial implications. This emphasizes the importance of informing households how the investments are to be capitalized into the house value. Taruttis and Weber (2022), similar to Cajias and Piazolo (2013), investigate the impact of energy consumption rather than that of energy certificates and find a rental premium for dwellings in Germany, examining the impact across regions. They find lower rental premium in urban Germany, confirming the results of Hyland, Lyons, and Lyons (2013), which also report a weaker effect in urban areas. Sieger and Weber (2023) also provide evidence for rental premiums for more energy-efficient properties in the German rental market, although this premium is small.

Compared to energy efficiency improvements, previous studies revealed that observable dwelling characteristics (such as house size) have a higher effect on the decision of the potential renter or buyer regarding renting or buying the dwelling Olaussen, Oust, and Solstad (2017). In line with this, März, Stelk, and Stelzer (2022) show that tenants have a higher willingness to pay (WTP) for observable dwelling characteristics. Therefore, we can infer that they have WTP for more energy-efficient houses, but it remains low compared to the WTP for other visible house characteristics.

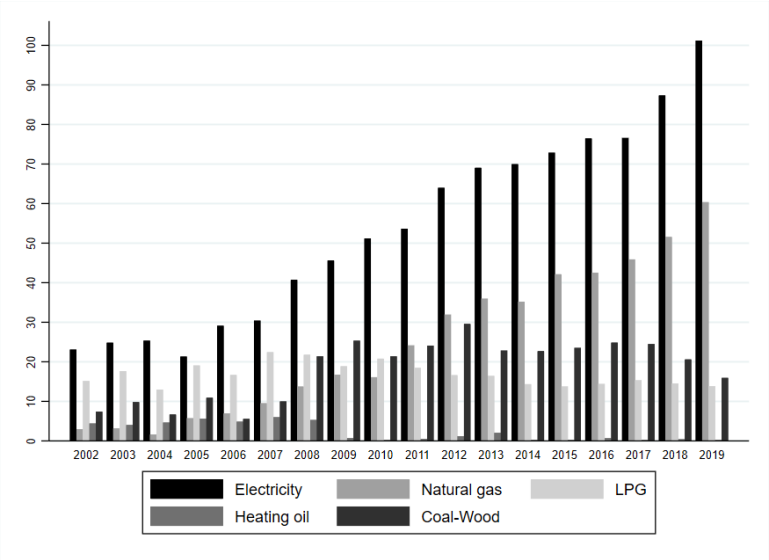
2.1 Residential Energy Consumption in Türkiye

The residential sector is one of the largest energy-consuming sectors in Türkiye. According to TUIK (2024), nearly one-third of Türkiye's total energy consumption is attributed to the residential sector in 2022. Recently, accelerating urbanization and the high rate of new building construction have led to an increase in energy demand by households. According to the statistics, residential energy demand rose 18% from 2000 to 2018 (Aydin (2024)). To mitigate environmental damages stemming from energy consumption and meet the rising energy demand, the residential sector has become the primary focus regarding energy efficiency improvements.

Another concern regarding the energy utilization of the residential sector is the rise in energy prices. According to statistics, while the electricity prices increased by 75% from 2021 to 2022, gas prices rose by 53,6% in the same period. The variation in electricity and gas prices is especially crucial as these are the most used energy sources in Turkish households, leading to the augmentation of household energy burdens. Considering that individuals in the rental segment of the residential market are economically more vulnerable than those in the property segment, alleviating energy consumption of households via energy efficiency improvements becomes more essential in terms of households' well-being, along with environmental concerns. Therefore, in this section, we investigate households' energy utilization and expenditure patterns.

TUIK (2024) document that the energy sources most demanded by Turkish households were natural gas with nearly 48%, followed by electricity with 17%. and coal with 14%. The total spending made for these energy sources by households in the period from 2002 to 2019 is shown in Figure 2.1. The figure illustrates that electricity expenses have the highest share in energy bills, and rising electricity expenditure is the main driver of the increase in household energy bills. Even though gas is the most utilized energy source in quantity, it constitutes a lower share in energy bills compared to electricity. This may be due to gas prices being less costly. Besides, we observe that coal and wood expenses remain nearly stable.

Figure 2.1 : Household energy expenditure by energy source



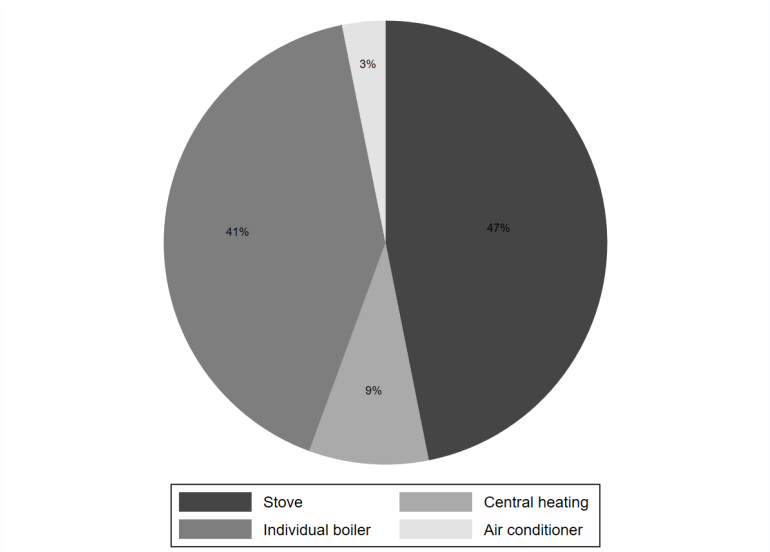
Notes: The energy expenditure (TL) is based on the Household Budget Survey provided by Turkish Statistical Institute.

Examining heating types used in Turkish dwellings, Figure 2.2 depicts that in 2019, 47% of residents utilized stove for heating which shows that stove remains a dominant heating system, although 74% of houses are built after 1980 in Türkiye (Aydin (2024)). Considering the environmental damage caused by stoves, the need to improve Turkish households' energy efficiency levels becomes even more significant. The second most used heating type after stove is the individual boiler. That is, nearly 41% of Turkish households employ individual boiler for heating.

Figure 2.3 illustrates monthly energy expenses for four different heating types. It shows that dwellings with central heating systems have higher energy bills compared to those with other heating systems, which may be explained by the payment type of central heating bills.[1] In buildings with central heating system, the total heating bill is shared equally by all households regardless of the individual energy consumption (Aydin, Eichholtz, and Yönder (2018)). This leads to an increase in energy expenditure, which explains the relatively low usage of central heating systems compared to individual boilers depicted in Figure 2.2.

[1]There are two ways of paying heating bills in the Turkish residential sector. The first one is that in buildings with central heating systems, all residents equally share the total heating cost of the building, and their share is accordingly reflected on the bill. The second one is that in dwellings with individual boilers, a consumption-based payment system is in place, that is, residents pay for the amount they consume. In both cases, making the payment is the responsibility of the resident; the landlord is not part of the energy payment process although in some countries landlords are responsible for energy expenses. The system where only the tenant is responsible for their energy consumption does not induce landlords to enhance energy efficiency at their properties as they do not directly benefit from reduced energy bills, resulting in the split-incentive problem.

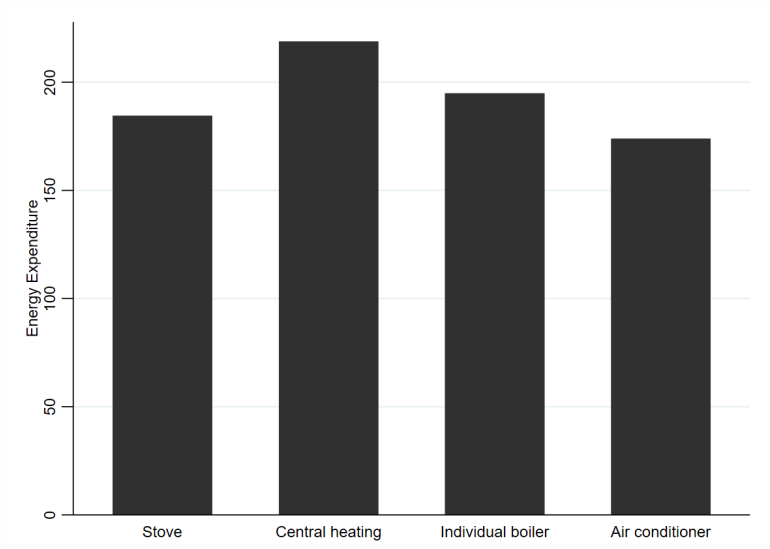
Figure 2.2 : Share of heating types in houses



Notes: This figure documents the share of heating types in Turkish households in 2019.

Behavioral problems may cause the higher energy expenditure in houses with central heating system, as discussed in Ramos et al. (2015). In dwellings with individual boilers, the consumers pay exactly for the amount they consume which drive households to consume less energy and potentially eliminate behavioral problems regarding energy consumption usage.

Figure 2.3 : Household energy expenditure by heating type in 2019



Notes: The energy expenditure is based on the Household Budget Survey provided by Turkish Statistical Institute.

2.2 Turkish Rental Market

In the Turkish housing market, the rental segment holds a significant share. In 2021, nearly 28% of the Turkish population resided in rental dwellings compared to 24% in 2019 (TUIK (2022)). As the rental market has a growing share in the Turkish residential market, focusing on failures in the Turkish rental market is crucial in improving energy efficiency.

One of the major problems that the Turkish rental market faces is the housing shortage in the sector. Recently, with the increasing population, urbanization, and excessive increase in sales prices, the inclination towards rental houses has increased, leading to housing shortage. Especially urban areas face limited rental dwelling supply as opposed to a vast amount of rental dwelling demand, which create competition between potential tenants when deciding to rent. Therefore, there is limited time for evaluating dwelling characteristics as there are numerous candidates. This is critical because time pressure on potential tenants leads to under-evaluation of energy efficiency levels of houses (Sieger and Weber (2023)).

Parallel to the housing shortage problem, there is an excessive increase in rents in Türkiye: In 2022, housing rents increased by nearly 84% on average (BETAM (2022)). To restrict excessive increase in housing rents, Turkish government introduced a regulation in 2022 imposing a 25% increase limit on rental prices. This regulation aimed to control housing rents, which have increased proportionally more than household income in recent years. However, inappropriate government interventions might discourage landlords from investing in energy efficiency improvements as this regulation could eliminate the possibility of receiving monetary return of improvement costs. This deterrent effect is highlighted in Ramos et al. (2015), who discuss how changing regulations leads to uncertainty regarding the return of energy efficiency investments. Given this regulation, coupled with the rising costs of energy efficiency improvements, such an atmosphere of uncertainty may further dissuade landlords from investing energy efficiency improvements leading to imperfect market. Therefore, policymakers must carefully consider the potential outcomes of such interventions before implementing them.

Another potential problem in the Turkish rental market, and the Turkish residential market in general, is the lack of energy-related literacy in households, This issue is highlighted by Brounen, Kok, and Quigley (2013), who document the presence of limited energy-related literacy in Dutch households. A lack of energy-specific literacy is significant for households as it may create biased anticipation on energy costs (Blasch et al. (2021)). For instance, anticipating that dwellings equipped with individual boilers will have lower energy bills than buildings with central heating systems, potential tenants may make dwelling choices based on the heating system of the dwelling. However, energy bills for heating are not solely related to the heating type; they also depend on house's overall energy efficiency level.

3. DATA

In this paper, we analyze the impact of energy expenditure on dwelling rents in Türkiye, leveraging the dataset based on the Household Budget Survey conducted by the Turkish Statistical Institute. Covering the period from 2002 to 2019, this dataset contains detailed micro-level information on consumption behaviors, physical characteristics, and demographic features of approximately 162,000 dwellings. Among all expenditure patterns, we focus more on energy consumption, which contains natural gas, electricity, heating oil, LPG, and coal-wood expenses. Our main variable of interest "energy bill" is the sum of these energy expenses. As we only investigate the impact on rental prices, we restrict our sample to rental dwellings by excluding owner-occupied units. The final sample consists of nearly 39.000 rental houses.

We split our sample into two based on the median value of the energy bill and identify the values below the median as "green" (low energy expenditure) and those above as "non-green" (high energy expenditure). Table 3.1 presents descriptive statistics on dwelling and household characteristics of dwellings separately for green and non-green houses. The statistics indicate that, on average, in green houses the monthly rent is 766 whereas in non-green units the monthly rent is 768. According to this simple descriptive analysis, green dwellings are rented at a discount while non-green units rented at a premium. Additionally, the statistics show that green houses are built earlier and smaller in size. Also, we observe higher income and education level in green buildings. We should note that this simple comparison of green and non-green dwellings does not control for other observable factors that affect house rents. Thus, drawing a conclusion based solely on descriptive statistics leads us to biased inferences regarding the determinants of housing rents.

Table 3.1 : Descriptive statistics

	Low Energy Expenditure		High Energy Expenditure	
	Mean	Std	Mean	Std
House rent (TL)	766.1	430.4	768.3	488.6
House type == Detached	0.204	0.403	0.219	0.414
House type == Appartment	0.796	0.403	0.781	0.414
Heating type == Stove	0.320	0.467	0.241	0.428
Heating type == Central heating	0.106	0.307	0.144	0.351
Heating type == Individual boiler	0.537	0.499	0.484	0.500
Heating type == Air conditioner	0.057	0.231	0.046	0.209
Number of rooms	3.369	0.733	3.478	0.693
House size (m^2)	100.7	27.340	103.5	30.13
Bathroom == 1	1.007	0.086	1.010	0.099
Toilet == 1	1.019	0.137	0.984	0.084
Kitchen == 1	0.999	0.0316	1.000	0.000
Elevator == 1	0.544	0.497	0.344	0.472
Floor heating == 1	0.00801	0.0893	0.00597	0.0771
Construction period == 1981-1990	0.193	0.395	0.215	0.411
Construction period == 1991-2000	0.183	0.387	0.212	0.409
Construction period == 2001-2005	0.110	0.313	0.0895	0.285
Construction period == 2006-	0.154	0.361	0.152	0.359
Main energy source == Wood	0.0591	0.236	0.0921	0.289
Main energy source == Coal	0.0150	0.122	0.0309	0.173
Main energy source == Natural gas	0.637	0.481	0.617	0.486
Main energy source == Electricity	0.249	0.433	0.221	0.415
Primary education	0.249	0.433	0.256	0.436
High school	0.185	0.391	0.173	0.379
University	0.188	0.391	0.173	0.379
Annual household net income (TL)	56,148	38,062	60,478	40,620
Number of household members	3.590	1.452	3.562	1.420
Number of children (age < 20)	1.012	1.125	1.170	1.272
Number of elderly (age > 64)	0.479	0.796	0.590	0.916
Number of working members	1.127	1.049	1.215	1.066
Number of female members	1.486	0.797	1.502	0.796
Holiday home ownership	0.00300	0.0548	0.00985	0.0988
Length of stay	4.837	4.720	4.551	3.539
Weekly working hours	49.71	16.40	49.88	15.33
Number of Observations	999	999	1,006	1,006

Note: This table documents the descriptive statistics of the survey in 2019 for physical and demographic characteristics of the rental dwellings, separately for houses with low and high energy expenditure.

Figure 3.1 and Figure 3.2 illustrate the relationship between energy expenditure and housing rent. While in Figure 3.1, we observe a positive relationship between energy expenditure and rent, in Figure 3.2, after controlling house and household characteristics, we find a negative relationship. This highlights the importance of controlling for these other factors that influence rent.

Figure 3.1 : Relationship between energy expenditure and rent

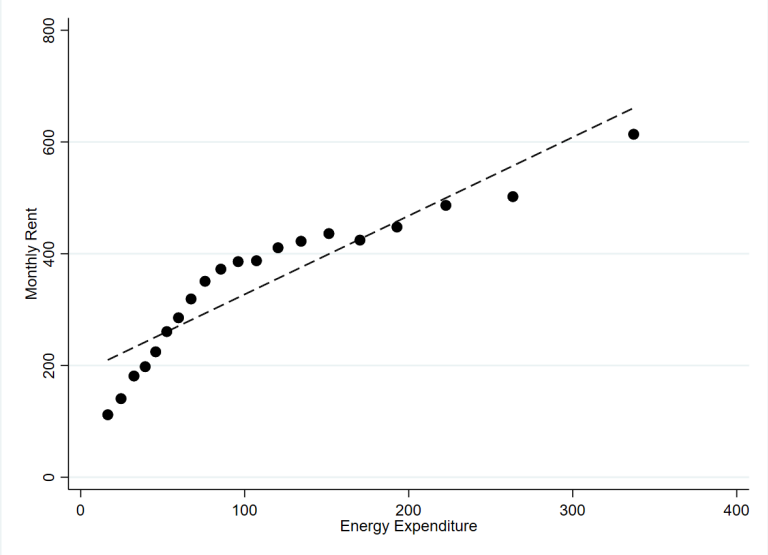
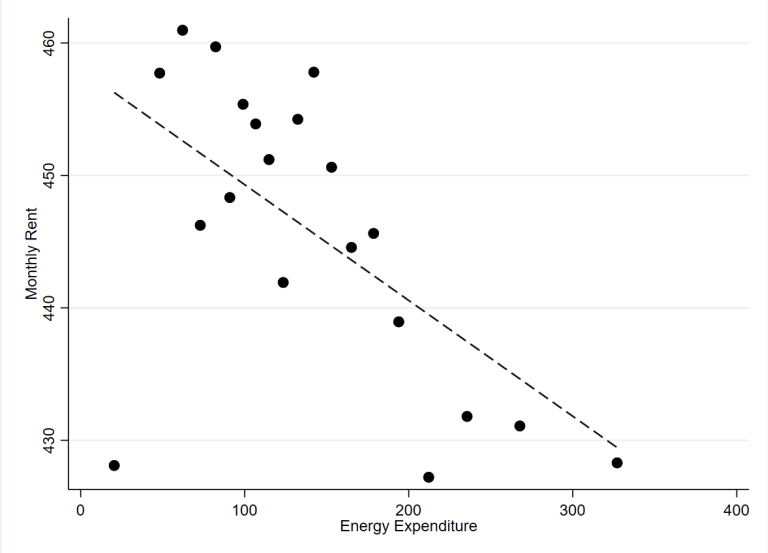


Figure 3.2 : Relationship between energy expenditure and rent controlling house and household characteristics



Notes: This figure represents the relationship between energy expenditure and rent controlling dwelling and household characteristics. Dwelling characteristics include house type, heating type, number of rooms, house size, floor type, floor heating, construction period, main energy source, presence of bathroom, toilet, kitchen and elevator. Household characteristics include education level of household head, annual household net income, number of household members, number of children, number of elderly, number of working members, number of female members, holiday home and weekly working hours.

4. METHODOLOGY

To identify the impact of energy expenditure on residential rents, we estimate the following empirical model:

$Rent_{\mathrm{i}} = \beta_0 + \beta_1 \text{Energy Expenditure}_{\mathrm{i}} + \beta_2 \mathrm{S_i} + \beta_3 \mathrm{R_i} + \beta_4 \mathrm{E_i} + \beta_5 \mathrm{H_i} + \beta_6 \mathrm{X_i} + \beta_7 \mathrm{Y_i} + \epsilon$

In the equation, Rent_{i} represents a household's monthly rent. The variable of interest in this model is $\text{Energy Expenditure}_{\mathrm{i}}$, which is a household's energy expenditure consisting of the sum of LPG, gas, coal, wood, and heating oil expenses, measured in TL. $\mathrm{R_i}$ is regional fixed effects which captures region-specific elements. $\mathrm{E_i}$ denotes the main energy source, while H describes the heating type used in the house. Moreover, $\mathrm{X_i}$ is a vector of quality characteristics of the house, including dwelling type, size in square meters, number of rooms, number of bathrooms, toilet, kitchen, floor heating, period of construction, elevator, and floor type. Lastly, rector $\mathrm{Y_i}$ represents household characteristics such as income, expenditure, household size, education level of the household member responsible for the household, average working hours of household members, number of elderly, children, female and working members, and holiday home ownership. ϵ is the idiosyncratic error term while S indicates survey year.

5. RESULTS

Table 5.1 : OLS estimation results

Variables	**(1)**	**(2)**	**(3)**	**(4)**
Energy expenditure (TL)	0.149***	0.084***	-0.081***	-0.206***
	(0.0160)	(0.0205)	(0.0208)	(0.0235)
Non-electricity energy expenditure (TL)				-0.206***
				(0.0235)
House size (m^2)	No	2.051***	1.300***	1.301***
		(0.0833)	(0.0903)	(0.0901)
House type == Apartment	No	55.24***	45.54***	45.16***
		(4.652)	(4.722)	(4.715)
Number of rooms	No	-20.91***	-20.44***	-20.44***
		(3.451)	(3.516)	(3.511)
Elevator ==1	No	141.4***	89.70***	89.97***
		(11.44)	(11.58)	(11.55)
Bathroom ==1	No	-4.646	-4.666	-4.659
		(4.646)	(4.666)	(4.659)
Toilet ==1	No	-27.22	-8.104	-7.450
		(21.79)	(23.59)	(23.55)
Kitchen ==1	No	30.39***	22.81*	22.89*
		(11.80)	(12.28)	(12.26)
The length of stay in the current house (years)	No	-1.500**	-2.496***	-2.507***
		(0.335)	(0.376)	(0.375)
Heating type	Yes	Yes	Yes	Yes
Main energy source type	Yes	Yes	Yes	Yes

Continued on next page

Construction period	Yes	Yes	Yes	Yes
Floor type	No	Yes	Yes	Yes
Floor heating	No	Yes	Yes	Yes
Annual household net income	No	No	0.0042***	0.0041***
			(7.502)	(7.482)
Monthly household expenditure	No	No	0.0329***	0.0330***
			(0.0106)	(0.0105)
Number of household members	No	No	-19.90***	-19.77***
			(2.983)	(2.973)
Holiday home ownership	No	No	27.06*	26.09*
			(16.32)	(16.29)
Weekly working hours	No	No	0.231**	0.231**
			(0.108)	(0.107)
Number of elderly (age>64)	No	No	3.718	3.463
			(5.103)	(5.095)
Number of children (age<20)	No	No	5.779	5.414*
			(3.075)	(3.069)
Number of working members	No	No	-18.96***	-18.84***
			(2.828)	(2.823)
Number of female members	No	No	8.081***	8.235***
			(2.285)	(2.282)
Education level	No	No	Yes	Yes
Regional fixed-effects	No	Yes	Yes	Yes
Year*month fixed-effects	No	Yes	Yes	Yes
Constant	-47,75***	-55,76***	-31,55***	-31,700**
	(535.7)	(991.0)	(1,081)	(1,054)
Observations	39,358	25,109	19,918	19,918
R-squared	0.492	0.444	0.550	0.551

Notes: Table provides the OLS estimation results. The dependent variable is housing rent. The analysis is based on the Household Expenditure Survey covering the period 2002-2019. Total energy expenditure includes natural gas, electricity, LPG and coal-wood expenditure. Non-electricity energy expenditure includes gas, LPG and coal-wood expenditure. We include region and time fixed effects to capture regional and time variations. Standard errors are given in parentheses. Data is extracted from Turkish Statistical Institute. *** p<0.01, ** p<0.05, * p<0.1.

Table 5.1 documents the estimation results for four different OLS specifications While analyzing the impact of energy expenditures on rents in columns (1), (2) and (3), in column (4), we investigate the effect of non-electricity energy expenditures on rents.

In the analysis, we include regional and year fixed effects in all specifications to control for regional and time variation. We observe that the explanatory power of the model is enhanced in column (3) as the controls related to the house and household characteristics are added. While column (2) represents the results with control variables for dwelling characteristics, column (3) additionally includes the control variables for household characteristics.

In column (2), controlling for dwelling characteristics, the coefficient for energy bills decreases from 0.15 to 0.08, which remains significant. Investigating the influence of other dwelling characteristics, our results show that the presence of elevator has a significant impact on housing rent. As expected, houses that are larger in size realize higher housing rents. In column (3), also controlling for demographic characteristics, the coefficient for energy consumption becomes negative, moving from 0.08 to -0.08. Hence, controlling for both dwelling and household characteristics, our results suggest that a 100 TL decrease in energy bills leads to nearly a 8 TL increase in rental prices. Confirming previous studies, our results imply a rental premium for energy efficient houses.

In column (4), we investigate the impact of non-electricity energy expenditure on rents. Here, we exclude electricity expenditure from total energy expenditure. Because, the other energy sources (LPG, natural gas and coal/wood) are used for heating systems, however, electricity is utilized for lighting or home appliances, which might lead to measurement error in the energy expenditure variable. When we exclude electricity expenses, in the fourth column we observe that 100 TL decrease in energy expenditure leads to nearly 20 TL increase in rents, which is closer to the perfect valuation case.

Comparing dwelling characteristics, we document that most of the visible physical characteristics (such as house size and elevator) have a higher impact on housing rents compared to energy expenditure level of the house. Especially the presence of elevator is essential in the decision-making process of renting a home.

6. DISCUSSION AND SUGGESTION

So far, studies have investigated the impact of energy efficiency ratings on housing value regarding to what extent efficiency savings are reflected in the value of a house. In this study, we exploited a different approach to test the valuation of energy costs by examining the impact of energy bills on rents. We claim that in a perfect market, a decrease in energy bills would be reflected entirely in higher willingness to pay for greener houses, meaning that, 1 TL decrease in energy bills would associate with 1 TL increase in housing value which points out perfect valuation of energy costs. However, our results suggest that 100 TL decrease in energy bill leads to nearly 8 TL increase in rental prices. Hence conforming with the existing literature, we report that the savings from energy efficiency improvements are not entirely reflected in house rents in Turkish residential market. The absence of perfect valuation of energy costs may stem from informational and behavioral failures, as generally agreed upon in the literature.

In line with Brounen, Kok, and Quigley (2013) and März, Stelk, and Stelzer (2022), we found that consumers are more likely to prioritize visible house characteristics over energy-related characteristics when making a rental decision. The tenant might be under-informed on energy costs and the potential reduction in bills that residing in an efficient house would create, leading to biased evaluations when deciding to rent.

Recently, policymakers have introduced several regulations to reduce these informational problems. However, compared to previous studies, the relatively low capitalization rate in the Turkish residential rental market may indicate the existence of inefficient control mechanisms that mitigate the effectiveness of efficiency regulations and informational campaigns. This low capitalization rate may also suggest lower efficiency standards compared to the standards the EU has imposed. The lack of audits is also related to trust environment. As mentioned in previous studies, the lack of trust, meaning consumers' lack of confidence in the available information, is a driver of market failure.

For example, Bian and Fabra (2020) noted that property owners may hide the energy efficiency level of their dwellings. Additionally, Ramos et al. (2015) showed that consumers struggle to assess the reliability of the information provided about energy efficiency practices. The lack of audits can increase distrust, leading to situations that reduce the effectiveness of informational instruments.

Additionally, we reported that energy is mainly used for heating systems, which emphasizes the importance of promoting energy-related literacy and awareness, especially regarding heating costs and energy consumption for heating in Turkish households. Lastly, as discussed in Section 2, the recent housing shortage problem in urban areas of Türkiye may lessen the effectiveness of energy implementations. Eliminating this problem via various residential policies could be beneficial in enhancing energy efficiency in the Turkish residential rental market. Taruttis and Weber (2022) confirm our inference, documenting that in the German rental housing market, the effect of energy efficiency improvements on housing prices gets stronger as housing supply increases. This evidence highlights the importance of mitigating housing shortage in improving energy efficiency in rental market of Türkiye.

Further studies could investigate the extent of the housing shortage issue in Türkiye's rental market, particularly in urban areas, and examine its impact on energy efficiency implementations. Comparative analyses of the effect of energy consumption on rents in urban versus rural regions could also provide valuable insights. Similarly, future studies could compare capitalization rates between owner-occupied and rental homes in Türkiye to gain insights into the extent of the split incentive problem in the Turkish rental market. This comparison could help develop more appropriate policy recommendations, such as providing financial support to landlords for their investment costs. Offering monetary support to landlords can reduce the split incentive problem.

7. CONCLUSION

There is a unanimity across various academic debates on the idea that energy efficiency measures are crucial for not only mitigating environmental problems but also improving the economic well-being of households. Given environmental concerns and current economic challenges, policymakers increasingly emphasize the importance of energy efficiency improvements through policy instruments. However, informational and behavioral factors hinder the effectiveness of these efficiency improvements.

In this study, we investigate tenants' willingness to pay for an energy-efficient house to test the existence of perfect valuation of energy costs in the rental housing market. For this purpose, we employ a cross-sectional dataset covering the period from 2002 to 2019, which includes 39,000 rental units. Our results suggest that a rental premium for more energy efficient residences corresponds to a 8 TL rental rise when energy bills is reduced by 100 TL. Confirming previous studies, we found a rental premium for greener dwellings, though a small one.

Consistent with the literature, we report the absence of perfect valuation regarding energy costs, indicating that efficiency investments made by landlords are not perfectly passed through to rental prices The lack of perfect valuation may potentially explained by the existence of informational and behavioral failures in the market. Tenants might be unable to fairly evaluate the actual value of a dwelling since, as per our findings, they value the observable characteristics of a house more than its energy efficiency rating, which may suggest that government oversight of informational regulations in Turkiye is insufficient. Increasing awareness and energy literacy, particularly regarding heating energy consumption in Turkiye, where the majority of energy demand is for heating, would be a significant step in reducing inefficiencies in the rental market. As in European countries, greater emphasis on energy certificates, raising public awareness, and increasing government audits of energy certificate regulations may be beneficial to approach the perfect valuation of energy costs.

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