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THE EXTERNALITY OF PUBLIC HOUSING PROJECTS: THE CASE OF MEHR HOUSING PROJECT IN IRAN

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The Externality of Public Housing Projects: The Case of Mehr Housing Project in Iran

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Abstract

Public housing projects are hotly debated especially for their impact on neighboring properties. On the one hand development of housing units could enhance available amenities and increase nearby house prices. On the other hand concentration of low-income households could create negative spillovers that reduce prices. For large projects, the expansion of the housing stock could reduce prices as well. A large body of literature provides estimates for the impact of public housing projects in developed countries. Yet, to the best of our knowledge, there is no rigorous empirical analysis of the impact of such projects in developing countries. In this paper, we study a large public housing project known as the *Mehr housing project* in Iran to shed light on this question in a developing country. In 2007 the Iranian government revealed a plan to facilitate construction of 2 million affordable apartments across almost all cities in the country. We use the exact delivery time of Mehr housing units and their postal regions to set up a difference-in-differences strategy for estimation of the impact of Mehr units on existing nearby house prices. Using the universe of house transactions for 19 large cities in Iran between 2010 and mid-2019, we compare house price changes in Mehr postal regions to non-Mehr postal regions around the time of Mehr housing units delivery. Our results show that after the delivery of Mehr units, house prices in Mehr postal regions decline by around 11 percent relative to prices in non-Mehr postal regions. This effect is significant at the 5 percent level and is robust to several specification checks like the inclusion of city by time fixed effects, allowing for differential trends for suburban locations, and regions with higher initial property values. We also provide suggestive evidence on the role of disamenity effects by looking at heterogeneity of results across different house areas, cities, and over time.

JEL classification codes: H23; H43; R31; R38.

Keywords: Externality; public housing; affordable housing; Iran; Mehr housing Project.

1 Introduction

Housing costs make up a significant portion of the cost of living in various developed and developing countries. For example Roughly 12 million American households are paying more than half of their income on housing, and over 25 percent of American renters are paying over thirty percent of their incomes (Charette et al., 2015). In Iran about 10 percent of households are paying more than half of their income on housing and on average, urban Iranian households spend about 36 percent of their expenditures on housing in 2019 (Statistical center of Iran). With high housing costs, many families especially poor ones are finding it increasingly difficult to afford all their necessities such as housing, medical expenses, food, and transportation.

Governments use a variety of methods to intervene in the housing market especially to provide housing for low-income households. Two prominent examples are construction of subsidized units and allocation of free land for housing construction. One of the main categories of government interventions for low-income housing is to build, either directly or indirectly, public and affordable housing. Public housing intends to provide decent and safe housing for eligible low-income families.

While affordable housing construction benefits targeted groups, it might create significant spillovers on nearby properties. It is very important to take into account these externalities to evaluate such interventions. If public housing leads to the redevelopment of the neighborhood and improvement of amenities, positive externalities follow (Baum-Snow & Marion, 2009; Schwartz et al., 2006). However, concentration of low-income households and poor construction quality could trigger negative externalities (Diamond & McQuade, 2019; Tighe, 2010). Many studies evaluate the externality of affordable public housing on nearby property values in the United States (Baum-Snow & Marion, 2009; Diamond & McQuade, 2019; Ellen et al., 2007; Ihlanfeldt, 2019; Schwartz et al., 2006). There are also similar studies in other developed countries (Davison et al., 2017). Yet, to the best of our knowledge, there is no empirical study of such externalities in developing countries. The externality of public housing projects might be very different in developing countries like Iran due to poor government effectiveness and lack of trust from citizens. This study tries to fill this gap by providing estimates of the externality of a very large public housing project in Iran as a developing country.

At the beginning of 2007, Iran government announced a plan to subsidize construction of about 2 million housing units to slow down the sharp rise in house prices. This plan, popularized as the *Mehr housing project*, targeted apartments suitable for low and middle income households. Most of these units were built as concentrated complexes in the suburbs of cities. It was estimated that this scheme costed about 150 billion dollars (33% of GDP of Iran in 2019) and it doubled the monetary base of the economy. Furthermore it was planned to build houses in most of the cities all over the country (1135 cities out of about 1200 cities).

One of the distinguishing features of this public housing project was that it was planned to implement in mostly all of the cities of the country in a very short period. The speed of the Mehr projects varied across cities which allows us to identify its impact on neighboring properties. Three potential mechanisms shape the overall effect of public housing on neighboring property values.

The first mechanism which leads to an increase in the value of surrounding houses is the amenity effects like the removal of vacant lots and improvements in the community facilities. A counter-veiling mechanism is the dis-amenity effect. Lower construction quality, inconsistency with the architecture of the environment, concentration of low-income households, and greater congestion in the neighborhood are all potential disamenity effects which reduce the value of neighboring properties. The third mechanism is the supply effect which might be particularly important for our study due to the large number of Mehr housing units delivered. This last channel reduces prices by shifting supply outward and is basically what the government intended to happen.

To find the effect of Mehr housing units on nearby property values, we merge house transactions data in 19 large cities of Iran between 2010 and 2019 with information on completion of Mehr housing projects. House transactions data is from the Tenement Management Information System (TMIS) maintained by the Ministry of Industry, Mines and Trade which provides detailed public records on all house transactions in Iran. Mehr projects information is acquired from Ministry of Road and Urban Development. The two datasets are combined at monthly date and postal region level.

Using a difference-in-differences (DID) strategy, we compare house prices in the postal region of the Mehr project in each city before and after Mehr project completion with other prices in other postal regions. We use the exact completion time of Mehr projects in each city for identification and argue that this timing is fairly exogenous. Figure 1 shows normalized house prices in Mehr postal regions and non-Mehr postal regions. On the horizontal axis we show time relative to the time of Mehr project completion in each city. The trend of house prices in both regions is similar right until delivery of the first Mehr unit. About a year after first Mehr unit is delivered we see a divergence between the two trends. This figure confirms the idea that our control and treatment groups are similar. It also provide visual evidence on the negative impact of Mehr housing projects on their neighboring properties.

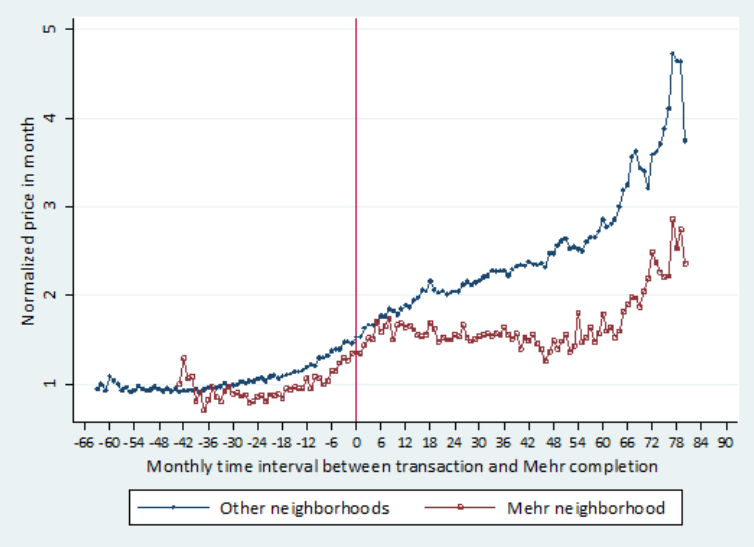


Figure 1 Normalized price trends in Mehr neighborhood with respect to other neighborhoods

Notes: Prices per square in each month of each city are averaged and divided by average housing price of that city in year 2010 and then trends of Mehr neighborhood and other neighborhoods are compared together.

Our preferred DID specification includes postal region, time, and city by time fixed effects to control for postal region time invariant characteristics and city-specific flexible time trends. Our results show that property values in Mehr neighborhoods declined by about 11 percent after the first Mehr unit is delivered. This result is consistent with supply and disamenity effects. Mehr projects created a significant supply shift in the study cities and increased the stock of housing between 1.5 to 27.5 percent in these cities. Given the scale of the projects we cannot rule out supply effects, but we provide three pieces of evidence that suggest some role for the disamenity effect.

First, the disamenity effect is expected to have a homogeneous effect on properties with different built-up areas while the supply effect is thought to be stronger for close substitutes of Mehr units. However, we do not find a significant difference between Mehr effect on housing units in a similar area band (75 -110 m^2) compared to units in other area bands. This result is more consistent with disamenity compared to supply effect.

Second, if the supply effect fully explains the negative result, we would expect a larger Mehr impact in cities with larger Mehr projects. We estimate separate regressions for each city and plot the coefficients against the scale of Mehr projects. This again does not show a clear correlation between coefficients. Therefore, the Mehr impact seems to be similar across cities with varying Mehr scales.

Third, we look at the timing of Mehr effect. We observe that the negative impact appears from the second year after the delivery of the first Mehr unit. Specifically, we do not find a significant negative impact during the first two years after project completion. The timing of the effect is more consistent with an amenity impact that materializes after Mehr residents move in gradually. The supply effect is expected to reflect sooner, either before the units are completed or upon project completion. Anecdotal evidence supports the lack of infrastructure development as Mehr projects completed. Many residents complained about unavailability of basic utilities (electricity, water, gas) as the increased congestion created a shortage. Schools, clinics and other facilities of the neighborhood did not also expand at the rate new houses were occupied. There were also reports of poor construction materials which created a low view of Mehr projects that reflected negatively on neighboring properties.

The paper proceeds as follows. Section 2 reviews the literature. Section 3 discusses a simple model and conceptual framework. Section 4 provides institutional background on Mehr housing projects and describes our data sources. Section 5 discusses our empirical strategy. Section 6 presents our results and robustness checks. A final section concludes.

2 Literature review

In common with asylum seeker reception centers (Daams et al., 2019), homeless facilities (Gibson, 2005), high-density residential buildings (Ruming et al., 2012; Searle & Filion, 2011), power plants(Davis, 2011), metro stations (Diao et al., 2017) and community gardens(Voicu & Been,

2008), affordable housing is a development type that has some externalities on host communities. This externality can be positive for the residents (Baum-Snow & Marion, 2009) but sometimes it generates conflict between development proponents and host communities (Tighe, 2010) and therefore has negative externalities on them.

Research in the United States (Tighe, 2012) has shown that while a high proportion of people support the construction of affordable housing in their towns and cities, they tend to be less supportive of its construction in their own neighborhood. Such attitudes present a challenge for the delivery of affordable housing and have seen localized opposition to planned developments characterized by many observers as self-interested "Not In My Back Yard" (NIMBYism), despite a growing literature that takes serious issue with the NIMBY concept (see (Sturzaker, 2011) for a summary of the latter).

A series of studies have found that objector concerns about planned affordable housing development tend to center on three sets of issues: the potential impacts on crime and safety, property values and other valued aspects or features of the host neighborhood; the characteristics and behaviors of prospective residents; and the physical form (bulk, style, density) of the proposed development, its ongoing maintenance and the process for planning assessment (Hogan, 1996; Iglesias, 2002; Koebel et al., 2004.; Nguyen et al., 2013; Ruming, 2014a, 2014b; Sarmiento & Sims, 2015; Scally & Tighe, 2015; Schively, 2007; Tighe, 2010).

Attempts to test the impacts of affordable housing development on host areas have to date focused mainly on property value impacts. The logic here is that property values operate as a form of proxy for the bundle of characteristics and features that influence the quality of life and amenity of a neighborhood (Galster et al., 2003; Heo & Kang, 2012; Ki & Jayantha, 2010). People will be willing to pay a high price for a property in a neighborhood with low crime rates, ample parking, little traffic and an attractive appearance. Any negative impact on these desirable characteristics, however, whether due to affordable housing development or anything else, will ultimately be reflected in property values through a reduction in the value of local properties. A series of studies in the USA have found that the impacts of affordable housing development on property values can be positive, neutral, or negative, depending in large part on the specific characteristics of the development, its residents and the location ((Ellen et al., 2007; Freeman & Botein, 2002; Galster et al., 2003). Reviewing the existing literature, (Nguyen, 2005) states that affordable housing development can indeed lower property values. However, she also argues that the likelihood of negative property value impacts will depend much on project design, management and location; negative impacts are most likely where the quality, design and management of the development are poor, where it is located in a rundown and disadvantaged area, and where affordable housing residents are clustered.We can divide the effects of affordable housing on hosted communities to the amenity effect and dis-amenity effect. In studies that we see positive effects, the amenity effect is dominant and in studies that negative effect is seen, the dis-amenity effect is more important. For example, the Low Income Housing Tax Credit (LIHTC) increases nearby property values by 3.8%-6.5% in low-income neighborhoods due to housing investment and incoming middle-class households (amenity effect) (Baum-Snow & Marion, 2009; Diamond & McQuade, 2019; Ellen et al., 2007)and decreases nearby property values by 2.5% in high-income areas because it brings in

neighbors with relatively-low income (dis-amenity effect) (Diamond & McQuade, 2019). Studies examining these externalities date back to the 1960s, but there are three reasons to believe that there is not enough evidence to make a definitive statement about the nature of the relationship. First, there are a multitude of different types of affordable housing programs(Ellen et al., 2007). The nature of the program and the way in which it is implemented might have implications for the price of neighboring houses. Second, most available studies focus on small geographic areas, usually a few neighborhoods, a city, or a county and therefore, results may not be generalized to other places(Woo et al., 2016). Finally, all available studies are done in developed countries with high government effectiveness and trust(Diamond & McQuade, 2019). The externality of public housing projects might be very different in developing countries like Iran due to poor government effectiveness and lack of trust from citizens. This study tries to fill this gap by providing estimates of the externality of a very large public housing project in Iran as a developing country.

More broadly, our paper is related to a literature which examines the spillovers to neighborhoods of housing policies. (Rossi-Hansberg et al., 2010) study the impact of urban revitalization programs implemented in the Richmond, Virginia area on local land prices. (Campbell et al., 2011) examine the effects of housing foreclosure on housing prices nearby. (Ellen et al., 2013) look at how foreclosures impact local crime rates. (Autor et al., 2014) study the effect of ending rent control on nearby real estate prices and crime rates.

The lack of relevant data often prevents analysts from exploring some important issues that are directly relevant to the developing economies that are operating at a different stage of development with less mobility, urbanization and industrialization. While there has been much documentation on the formation of residential satisfaction and the evolution of housing policy in developed nations, relatively little has been written about these topics in developing nations. Externalities of affordable housing that government build, may be more negative in developing economies than its counterpart within the developed world but we don't have any research about them because of the lack of appropriate data and research in these countries. This research studies these effects in developing economies and will hopefully find parts of these externalities.

3 Conceptual Framework

Building affordable housing for low and middle-income households can affect the host neighborhood and its property values by three main mechanisms. The first mechanism can be the amenity effect. For example, in urban areas, subsidized housing often replaces abandoned, vacant lots, dis-amenities that can signal that the community is disorganized and that criminal activity will go largely unchecked. The removal of such blights can help to make a neighborhood both more attractive and safe, and thereby catalyze neighborhood revitalization.

In general, we expect that investments in housing – the rehabilitation of old housing or the construction of new housing – would have positive spillovers on the surrounding community, especially when that housing replaces an abandoned or otherwise blighted site. But those positive impacts might be tempered to some degree by poor or incongruous design, deficient management and upkeep, and/or by the perception that tenants – either because of their lower relative incomes or different ethnic compositions – will make undesirable neighbors (Ellen, 2007). There would be

other amenity mechanisms too, which include bringing infrastructures like road and utilities to the neighborhood.

A countervailing mechanism is the dis-amenity effect. As an example, the construction of a building or set of buildings may also have an independent effect, over and above the removal of the prior use. In particular, if a new subsidized project is viewed as unattractive or not fitting with the existing character of a community, or if a project is not cared for over time and has bad quality, it may detract from the appeal of a community (Ellen et al., 2007) and has a dis-amenity effect so the property values will decline. In addition, Affordable housing developments may lead to higher congestion in a poorly equipped locality and therefore use of services like schools and hospitals might become with worse quality for previous residents if new schools and public services are not constructed there. Also, the impacts of new housing may depend on who moves into it, and how their incomes and cultural conditions compare to those of existing residents. Since Mehr housing units were mostly for low and middle-income households of the city and the neighborhood became famous for this, it could have dis-amenity effect on the host neighborhood. (See (Ellen et al., 2007) for more discussion about mechanisms of amenity or dis-amenity effect).

The third type of mechanism is the supply effect. This mechanism as mentioned previously can be very strong in the case of Mehr housing project and along with the dis-amenity effect can lead to a reduction in the property values of the host community.

In Figure 2, we present how these mechanisms can shift the supply and demand curve and therefore the price and value of existing residential units.

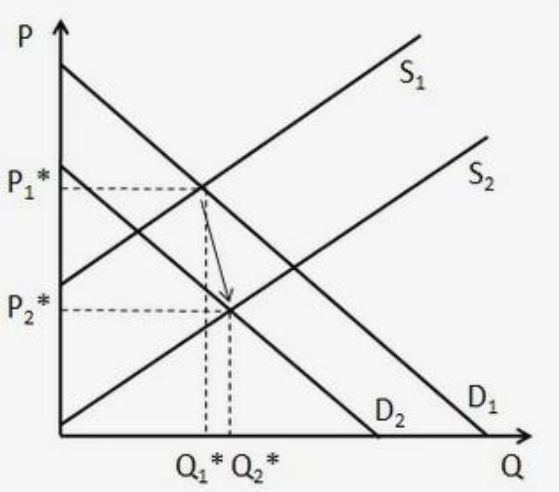


Figure 2-housing supply and demand curve in Mehr neighborhood

Suppose, before construction of Mehr housing in the hosted neighborhood, S1 and D1 are the supply and demand curve of the neighborhood, so, Q_1^* and P_1^* are equilibrium quantity and price. Amenity and dis-amenity effects shift the demand curve. Suppose dis-amenity effect is stronger in the Mehr project case. As a result, the demand curve shifts downward to D2. The supply effect shifts the supply curve downward (S2). So, the new equilibrium is Q_2^* and P_2^* which the price will certainly be lower but the effect is an aggregation of the supply and dis-amenity effects.

4 Background and Data

4.1 Mehr Housing Scheme

Real house prices in Iran has increased by an average of 23 percent between 1990 and 2019 while GDP per capita has only increased by an average of 8 percent during the same period. This pattern has created serious concerns about the ability of the poor to acquire a decent home. Iranian government started a very ambitious program in 2007 to subsidize construction of around 2 million housing units in urban areas to increase the supply of affordable housing (about 18 percent of housing stock of cities at that time) to control the surging house prices and lower the burden of housing expenditures on poor households. This plan, popularized as the Mehr housing project, planned targeted apartments suitable for low income households and facilitated construction of mostly concentrated complexes in the suburbs of cities. The construction of Mehr units started from 2007 until 2013 and their delivery dates started from 2011 until 2020[1].

Mehr project provided three form of housing subsidies. First, the government provided the project site under a long term (99 years) rental contract at subsidized prices. Second, developers received a subsidized loan which was transferred to buyers upon completion of the project. Third, developers received tax exemptions. Eligibility for the scheme was based on not owning a property[2]. The scheme covered 1135 cities out of about 1200 cities across the country. The sheer size of the project and inadequate guarantees for the loans resulted a massive budgetary burden which was mainly financed by money base expansion. The cumulative budgetary cost of the scheme is estimated in (Rahpoo Sakht corporate, 2012) to be around 1500 Thousand billion Rials (33% of GDP of Iran in that time) which resulted in a doubling of the money base.

The Mehr scheme was implemented in three different types of cities. 18 Mehr cities were established through this scheme. 858 small cities with a population of less than 25 thousand individuals, and 259 large cities with a population of more than 25 thousand individuals received varying levels of Mehr construction projects. There were three streams of Mehr construction projects. Owner-developer stream was for individuals who had their own land and had a small-scale construction plan. This stream received a government backed loan subsidy. These projects were dispersed throughout cities and there is no information of their whereabouts in our sample. The two other streams were "tripartite agreements" and "cooperative projects"[3] which were concentrated projects in selected localities of cities. These were the visible projects of the Mehr scheme and we therefore focus on them. We collect data on the timing and location of Mehr projects in 19 large cities (provincial capitals[4]). Newly established Mehr cities are not useful for studying the local externality of public housing projects. Small cities also have very few postal regions (our unit of analysis) and therefore fail our identification strategy. The selected cities for

[1] The distribution of construction and delivery date can be seen in appendix
[2] Other eligibility criteria can be find in the appendix.
[3] We discuss these streams in the appendix in more detail.
[4] There exists 31 provinces in Iran but 8 center of provinces did not have Mehr housing scheme with type of Tripartite Agreement and Cooperative projects inside the city limits so we put them aside and our data from 19 out of 23 remaining center of province cities were complete so we use these 19 cities as our selected sample which encompass most regions of the country.

our study are Arak, Gorgan, Hamedan, Orumia, Zahedan, KhorramAbad, Qom, Shahre-Kord, Kerman, Bojnurd, Semnan, Birjand, Ilam, Kermanshah, Zanjan, Sanandaj, Rasht, Yazd and Bandar-Abbas.

It is worth noting that resale of Mehr housing units was prohibited until 2013. From this date onward the government allowed resale of the units. However, the resale procedure was different from typical houses. Our house transaction data does not include any Mehr transactions prior to 2013 and might include transactions after the first resale of Mehr units after this date.

4.2 Data

Our first dataset is from Tenement Management Information System (TMIS) which is owned by the Ministry of Industry, Mines and Trade. This information system provides detailed public records on housing characteristics and transactions data registered by real estate agents. We use the universe of house transaction data in 19 large cities of Iran between 2010 and 2018 and merge them with information on completion of Mehr housing projects based on time (month and year) and location (postal region)[5]. Since our transactions data include postcode, we use postal region's map of these cities to transfer postal region (the first 5 digit of postcode) to geographical coordinates. With this strategy, we assume that each transaction took place in the centroid of the postal region. Our second dataset is from the Ministry of Roads and Urban Development regarding address, type and scale of Mehr housing projects in each city. We use their address and Google Map to find their exact geographical coordinates. The third data that we need is the completion date of each unit. For this purpose, we use the starting date of repayment of bank installments for each unit. When a unit is completed, the bank gives the owner a booklet of bank installments and we get this data for units of selected cities from the bank's data. These datasets and their sources are summarized in the appendix.

The summary statistics of main parts of these data is described in Table 1. In the appendix we present more details about these data. In these 9 years(from May 2010 until April 2019) that we have data, 341,106 transactions occurred in our sample (19 cities) which about 6 percent of them were in Mehr postal region. In all of our sample, there exists transactions that occurred 63 months before delivery of mehr units in the city and also we have transactions after 102 months of delivery of Mehr unit in that city.

On average, 194 project or 11,033 Mehr units were planned to be constructed in these 19 cities which their starting date was on average in first half of 2010 but their average delivery time were first half of year 2014. It is worth noting that Mehr Housing Projects average area is about 84 m^2 but Average Area of Residential Units in these cities were about 109 m^2 which is quite larger. Also there is some heterogeneity between our sample cities. For example Ratio of Mehr housing units to housing stock in each city differs from 2 percent to 28 percent and Ratio of ownership in each city has values between 43 and 63 percent.

[5] The Data is publicly available here.

Table 1: Summary statistics

	Obs.	Mean	Std. Dev.	Min	Max
Variable name	(1)	(2)	(3)	(4)	(5)
Panel A: House transactions data					
Total house price(million Toman)	341,106	138.2	160.0	0.1	12000
Price of $1m^2$(thousand Toman)	341,106	1387.1	1132.3	1	40000
Age	341,106	7.0	6.2	0	87
Area	341,106	95.7	48.6	20	2000
Months since March 2010	341,106	50	28	1	112
Month interval after delivery of Mehr Project	341,106	14	28	-63	102
Transactions "NEAR" Mehr postal region	341,106	0.07	0.26	0	1
Transactions in Mehr Postal region(dummy)	341,106	0.06	0.23	0	1
Transactions After Mehr delivery in Mehr region(dummy)	341,106	0.04	0.21	0	1
Distance with Mehr Projects(KM)	341,106	5.12	2.67	0	14.5
Panel B: Postal regions data					
Mehr Postal region Area(KM2)	24	1.24	1.76	0.14	7.63
Postal region Area(KM^2)	694	0.4	1.23	0.005	21.3
Panel C: Mehr housing data					
Number of Mehr projects (not self-owning) in each city	19	194	127	14	520
Number of Mehr units (not self-owning) in each city	19	11,033	6,028	2,457	28,684
Year of starting construction of Mehr Projects	3,684	2010.2	1.2	2007	2019
Year of delivery of Mehr Units	207,868	2014.3	1.90	2010	2020
Mehr Housing Projects average area(m2)	3,684	84.2	10.8	70	110
Ratio of Mehr housing units to housing stock in each city	19	10%	7%	2%	28%
Panel D: City characteristics data					
Average Area of Residential Units	19	109	15	85	137
Population of cities	19	452,538	237,963	153,860	1,074,036
Share of apartments in housing stock	19	34%	16%	9%	65%
Housing stocks in each city	19	129,058	67,972	41,286	301,986
Ratio of ownership in each city	19	55%	5%	43%	63%

5 Empirical Strategy

We rely on a difference-in-differences (DID) strategy to estimate the reduced-form effect of Mehr housing units on nearby house prices. Intuitively, we compare the change in the price of housing units in the postal region of Mehr projects to the change in the price of housing units in other postal regions at the time Mehr housing units were delivered to applicants. Table 2 reports the basic DID figures. Average house prices in Mehr postal regions is 6996 thousand Rials before Mehr units are

delivered (column (1) in panel A). During the same period, average house prices for other postal regions is 8840 thousand Rials (column (2) in panel A). This suggests that Mehr postal regions include lower value properties. Panel B reports average prices after delivery of Mehr units. Since these transactions are after those in panel A we observe larger averages in panel B compared to panel A. However, the increase in non-Mehr postal regions is larger than that of Mehr postal regions. It seems delivery of Mehr units has significantly reduced average prices for nearby properties by 3715 thousand Rials.

Table 2: Prices in Mehr and other postal regions before and after project implementation

Prices in selected cities (Thousand **R**ials per m^2)	**Mehr postal regions**	non-Mehr **postal regions**	**Difference**
	(1)	(2)	(3)
Panel A: Before Mehr project delivery			
Average price	6996	8840	-1844
	(100)	(21)	(205)
Number of Transactions	2931	124208	
Panel B: After Mehr project delivery			
Average price	11854	17413	-5559
	(65)	(29)	(177)
Number of Transactions	15959	198008	
Panel C: B - A	4858	8573	-3715
	(205)	(39)	(224)

Notes: Panel A shows average transaction price of houses before Mehr project delivery in Mehr postal regions (column (1)) and other postal regions (column (2)). Columns (3) shows the difference between columns (1) and (2). Numbers in parenthesis are standard errors of the estimated mean. Last row of each panel reports the number of house transactions under each category. Panel B shows similar statistics for transactions occurring after Mehr project units completed. Panel C reports the difference of panels B and A.

We can implement the DID estimation strategy in a regression framework as follows:

$$\ln p_{ipt} = \phi Mehr_{pt} + X_{ipt}\theta + \delta_t + \gamma_p + \epsilon_{ipt} \quad (1)$$

Here $\ln p_{ipt}$ is the natural logarithm of the price for transaction i in postal region p on monthly date t. $Mehr_{pt}$ is a dummy variable that turns 1 when the transaction is occurring after delivery of Mehr units in a Mehr postal region. Since Mehr units were delivered in different years across cities, we can include period (δ_t) and postal region (γ_p) fixed effects to allow for flexible global time effects and arbitrary time invariant differences in average house prices across postal regions respectively. X_{ipt} includes the natural logarithm of built area and age of the transacted unit. Standard errors are clustered at postal region level.

In this specification, ϕ is the parameter of interest and measures the differential percent change in house prices across Mehr and non-Mehr postal regions. In order to interpret this as the causal impact of Mehr units on nearby properties we need to assume that in the absence of Mehr projects, the percent change in prices across Mehr and non-Mehr neighborhoods would have been the same. We have a rich variation in the timing and location of Mehr projects which justifies our reliance on a DID estimation strategy. The exact date of Mehr projects' completion (monthly date) could be thought as quasi-random as it is a function of many factors including the competence of the

developer, weather conditions, and disbursement of loans. However we try several additional specifications to make sure that our results are not driven by omitted factors.

First, house prices might have different trends across cities. In many cities there is only one postal region that contains Mehr projects. Therefore, for most cities there is a given date after which we assume the Mehr postal region is treated. Correlations between city specific trends and the timing of Mehr project completion might cause issues for our identification. To rule out this possibility, we add city by month fixed effects to control for flexible differential time trends in house prices across cities. In this specification, we solely rely on the differential evolution of house prices within each city to identify Mehr's impact.

Even with city by time fixed effects, we might expect a differential time trend for Mehr postal regions within a city because in majority of cities Mehr postal regions are located in the suburbs. For various reasons suburbs might have different trends compared to central regions and our estimated coefficient might be capturing just this differential trend. In order to overcome this second threat, we categorize postal regions in each city into quartiles of distance from the city's center and include quartile specific time fixed effects in our regression. Effectively, this allows for a flexible divergence of house price trends for postal regions in the four quartiles of distance.

The third concern arises because Mehr sites are government owned land. It might be that postal regions with more government owned land are of a different quality than other postal regions and therefore house prices have a different trend in such locations. We do not have information on the share of publicly owned land across postal regions. However, we calculate average property values in postal regions in the first year of our sample (2010) and include the interaction of this average price with time fixed effects as an additional control. This specification would also control for mean reversion concerns.

Mehr projects could affect properties both their own and neighboring postal regions. In specification (2) we only measure the impact on own postal regions. To measure the two effects separately, we add a dummy variable that turns on for postal regions neighboring (within 2 kilometers radial distance) Mehr postal regions ($Near_{pt}$) to the previous specification as follows:

$$\ln p_{ipt} = \phi Mehr_{pt} + \psi Near_{pt} + X_{ipt}\theta + \delta_t + \gamma_p + \epsilon_{ipt} \qquad (2)$$

ϕ and ψ capture the effect of Mehr units on house prices within the same postal region and in neighboring postal regions respectively. It is worth noting that this specification estimated a cleaner effect of Mehr units because it allows for an impact on neighboring postal regions. In the previous specification we assumed a zero effect on these regions.

We employ two additional specifications to look at the heterogeneity of Mehr effect and possibly shed light on the mechanisms. Mehr housing units followed a standard affordable housing design with an average area that is smaller than the average of the existing housing stock. 88 percent of Mehr units have an area between 75 and 110 m^2. Therefore, we expect the negative supply effect to be stronger for houses within the same area band of the project. To test this hypothesis, we include interactions of the built-up area dummies with Mehr dummy. We split transactions into

five area classes (less than 50, between 50 and 75, between 75 and 110, between 110 and 140 and more than 140 m^2).

$$\ln p_{ipt} = \phi_0 Mehr_{pt} + \Phi_1 \text{Mehr}_{pt} \times \text{Area\_Cat}_{ipt} + X_{ipt}\theta + \delta_t + \gamma_p + \epsilon_{ipt} \quad (3)$$

here Φ_1 contains a set of parameters that capture the differential impact of Mehr units on different area categories.

Finally, Mehr impact might change over time due to several reasons such as gradual occupation of units or development of local amenities. To allow for a time varying impact, we include variables that show the number of years passed since the delivery of Mehr units as follows:

$$\ln p_{ipt} = \phi_0 Mehr_{pt} + \Phi_1 \text{Mehr}_{pt} \times \text{YrsPassed}_{ipt} + X_{ipt}\theta + \delta_t + \gamma_p + \epsilon_{ipt} \quad (4)$$

6 Results

6.1 Main Results

Table 3 shows estimation results for three versions of the main specifications (1) and (2). Columns (1) and (2) include only postal region and time fixed effects. House prices in Mehr postal regions see a 6.6 percent reduction. This coefficient estimate is significant at 10 percent level. Once we control for postal regions close to Mehr postal regions, we see that the magnitude of the effect becomes larger. Based on column (2) housing prices fall by 8.4 percent in Mehr postal regions. Neighboring postal regions also see a reduction of 7.3 percent. In columns (2) and (5) we add city by year fixed effects which make the Mehr coefficient larger in magnitude and more significant. Allowing for a more flexible specification with city by time fixed effects in columns (3) and (6) we observe that house prices in Mehr postal regions fall by around 11 percent as a result of Mehr projects completion. This is our preferred specification because it allows city-specific flexible trends. For several reasons cities might experience local boom and busts that might covary with Mehr completion dates. It is worth noting that in columns (3) and (6) Mehr coefficient is similar with and without controlling for neighboring postal regions. In fact, in column (6) the Near coefficient is smaller and insignificant at conventional levels. We include house characteristics available in our data in the regressions and their coefficients are as we expect.

Table 3: Main regression results

Dep.Var.: $\ln p_{ipt}$	Mehr postal region			Mehr and neighboring postal regions		
	Baseline	City×Year F.E.	City×Time F.E.	Baseline	City×Year F.E.	City×Time F.E.
	(1)	(2)	(3)	(4)	(5)	(6)
Mehr	-0.066*	-0.089**	-0.108***	-0.084**	-0.096**	-0.110***
	(0.039)	(0.043)	(0.033)	(0.039)	(0.043)	(0.029)
Near				-0.073*	-0.064***	-0.034
				(0.040)	(0.024)	(0.031)
Age	-0.014***	-0.014***	-0.022***	-0.014***	-0.013***	-0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ln(Area)	-0.137***	-0.138***	-0.327***	-0.137***	-0.312***	-0.138***
	(0.014)	(0.015)	(0.121)	(0.0147)	(0.030)	(0.0142)
Postal region F.E.	Y	Y	Y	Y	Y	Y
Time F.E.	Y	Y	Y	Y	Y	Y
City×Year F.E.	N	Y	N	N	Y	N
City×Time F.E.	N	N	Y	N	N	Y
Obs.	341,106	341,106	341,106	341,106	341,106	341,106
$\bar{R}^2$	0.321	0.341	0.353	0.321	0.343	0.353

Notes: Table shows coefficient estimates from regressions of natural logarithm of house price on covariates. Covariates include age, logarithm of area, postal region and time fixed effect in all columns. Columns (1) to (3) include Mehr which is a dummy variable that turns on for transactions in Mehr postal regions after the first Mehr unit is delivered. In addition to Mehr dummy, columns (4) to (6) include Near which is a dummy variable that turns on for transactions in postal regions neighboring Mehr postal regions after the first Mehr unit is delivered. Columns (2) and (5) include city by year fixed effects. Columns (3) and (6) include city by time fixed effects. Standard errors are corrected for clustering at the postal regions and reported in parentheses. *, **, *** represent significance of estimated coefficients respectively at 10%, 5%, and 1% level.

6.2 Robustness regressions

Table 4 reports robustness checks that try to address two concerns. First, Mehr complexes were built usually on government owned land which was located in the suburbs of cities. For various reasons houses in the suburbs might have a different price trajectory than the rest of the city. In columns (1) to (3) we control for distance from the city center first by interacting distance quartile dummies with time fixed effects and then by interacting the continuous distance variable with time fixed effects. All columns show a highly significant Mehr coefficient very close to our estimates in Table 3. Again the impact on neighboring districts is not significant. In column (4) we restrict our analysis only to peripheral postal regions on the outskirts of the cities6 to get a more comparable sample. This eliminates more than 80 percent of our observations but coefficient estimates remain remarkably stable. Column (5) performs another control group selection by removing postal regions that are too close (less than 2 km between the centers of the postal regions) to the Mehr postal regions. This selection is less stringent and does not change the coefficient estimate significantly.

[6] Transactions that their distance with Mehr postal region were the last 10 percent (last decile).

Second, house prices might show a mean-reverting behavior. It might be that relatively low prices in Mehr postal regions was a reason for locating projects. This creates an expectation for prices to increase to their usual path after some time which implies an upward bias for our estimates of Mehr coefficients. Another story stemming from mean reversion suggests that expecting an increase in amenities prior to the completion of Mehr projects prices might have increased, but after the fading of such expectations prices have returned to lower levels. This second story creates a downward bias in the estimation of Mehr coefficient. The mean reversion concern is particularly important as our data does not contain the initial years of Mehr projects and hence we cannot capture anticipation effects. In columns (6) and (7) we try to address this concern. We calculate average house prices in postal regions in the first year of our sample (2010) and interact this by time fixed effects to allow for arbitrary trends for postal regions with different levels of initial prices. Consistent with the second type of mean reversion bias we observe a 24 percent reduction in the magnitude of the Mehr coefficient. However, the coefficient is still highly significant and in the same ballpark.

Table 4: Robustness to differential trends, selection of control postal regions and mean reversion

Dep.Var.: $\ln p_{ipt}$	Trends by distance from city center			Restrict control postal regions to:		Mean reversion: Trends by quartiles of average postal price in 2010	
	Distance quartiles	Continuous distance		Farthest postal region	Postal regions beyond 2 km		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mehr	-0.114***	-0.104***	-0.106***	-0.106***	-0.104***	-0.081***	-0.084***
	(0.030)	(0.029)	(0.029)	(0.036)	(0.0281)	(0.030)	(0.028)
Near			-0.032				-0.029
			(0.031)				(0.030)
Age	-0.014***	-0.014***	-0.014***	-0.014***	-0.014***	-0.014***	-0.014***
	(0.004)	(0.001)	(0.001)	(0.002)	(0.001)	(0.004)	(0.001)
ln(Area)	-0.137***	-0.137***	-0.137***	-0.277***	-0.135***	-0.135***	-0.135***
	(0.014)	(0.014)	(0.014)	(0.026)	(0.015)	(0.014)	(0.014)
Postal region F.E.	Y	Y	Y	Y	Y	Y	Y
Time F.E.	Y	Y	Y	Y	Y	Y	Y
City×Time F.E.	Y	Y	Y	Y	Y	Y	Y
Distance to Center×Time F.E.	Y	Y	Y	N	N	N	N
Average price in 2010×Time F.E.	N	N	N	N	N	Y	Y
Obs.	341,106	341,106	341,106	63,299	315,777	334,038	334,038
$\bar{R}^2$	0.357	0.354	0.354	0.388	0.343	0.354	0.354

Notes: Table shows coefficient estimates from regressions of natural logarithm of house price on covariates. Covariates include age, logarithm of area, postal region and time fixed effect in all columns. In column (1) we divide distance between transactions and center of each city into 4 categories and allow each category to have different monthly price trend by controlling interaction of each category by time. In column (2) and (3) we use continuous measure of distance between transactions and center of city and allow different distances to have different monthly price trend by controlling interaction of each continuous distance by month. Columns (3) includes Near which is a dummy variable that turns on for transactions in postal regions neighboring Mehr postal regions after the first Mehr unit is delivered. We define the control group of each city's Mehr housing site the farthest postal regions of the city from Mehr postal region and drop other transactions in column (4). In column (5) we drop transactions that are near Mehr housing site (closer than 2km) but are not in the same postal region and make a buffer zone for the effect. In column (6) and (7) we divide postal regions to 4 categories by their average housing price in base year (2010) and

allow each category to have different monthly price trend. Columns (7) also includes Near. Standard errors are corrected for clustering at the postal regions and reported in parentheses. *, **, *** represent significance of estimated coefficients respectively at 10%, 5%, and 1% level.

Transaction of Mehr housing units could cause an issue for our estimates. Mehr units are often of lower quality. They enjoy cheap government land as well. Therefore, they are cheaper than average residential units. Our house transaction data (TMIS) should not include Mehr housing units[7] still we might have some of them by mistake. Nevertheless, we do two robustness checks in Table 5 to check the sensitivity of results. Transaction of Mehr units was legally allowed only after October 2013. Therefore, in our first test we only keep transactions prior to October 2013 in columns (1) and (2). This removes 34 percent of our transactions and eliminates interesting variation after delivery of most Mehr units. The Mehr coefficient is reduced significantly but it is still significant at 10 percent level. In columns (3) to (6) we conduct a less stringent robustness check by removing house transactions that have a similar age to the Mehr units in that postal region. Columns (3) and (4) remove such observations only within Mehr postal regions while columns (5) and (6) remove such observations in all postal regions. Both sets of columns show a highly significant Mehr coefficient that is in the same ballpark as our preferred estimate in Table 3. It is interesting to note that we never observe a significant impact of Mehr projects on neighboring postal regions.

Table 5: Robustness to Mehr housing units' transactions

Dep.Var.: $\ln p_{ipt}$	Keep obs. prior to October 2013		Drop houses with the same age as Mehr units			
			in Mehr postal regions		In all postal regions	
	(1)	(2)	(3)	(4)	(5)	(6)
Mehr	-0.0463*	-0.0485*	-0.100***	-0.102***	-0.079***	-0.0810***
	(0.0257)	(0.0256)	(0.027)	(0.027)	(0.025)	(0.0255)
Near		-0.031		-0.034		-0.0192
		(0.029)		(0.031)		(0.0268)
Age	-0.012***	-0.012***	-0.014***	-0.0141***	-0.011***	-0.0111***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000642)
log(Area)	-0.238***	-0.238***	-0.138***	-0.138***	-0.208***	-0.207***
	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)	(0.0137)
Postal region F.E.	Y	Y	Y	Y	Y	Y
Time F.E.	Y	Y	Y	Y	Y	Y
City×Time F.E.	Y	Y	Y	Y	Y	Y
Obs.	223,345	223,345	332,958	332,958	275,136	275,136
$\bar{R}^2$	0.293	0.293	0.353	0.353	0.317	0.317

Notes: Table shows coefficient estimates from regressions of natural logarithm of house price on covariates. Covariates include age, logarithm of area, postal region and time fixed effect in all columns. In the first two column we drop transactions that occur after October 2013 when transaction of Mehr housing units became legal. In columns (3) and (4) we drop transactions whose age are lower than the difference between the date of transaction and Mehr housing construction and are also located in Mehr postal region and in column (5) and (6) we drop transactions whose age are lower than the difference between the date of transaction and Mehr housing construction of the city in all postal regions. Columns (2), (4) and (6) includes Near which is a dummy variable that turns on for transactions in

[7] Registration of housing transactions in TMIS is mandatory for ordinary residential units. However, Mehr units follow a different procedure and are not registered in TMIS.

postal regions neighboring Mehr postal regions after the first Mehr unit is delivered. Standard errors are corrected for clustering at the postal regions and reported in parentheses. *, **, *** represent significance of estimated coefficients respectively at 10%, 5%, and 1% level.

Finally we conduct a placebo test to check whether spurious correlation between prices in peripheral postal region and the timing of Mehr units' delivery is responsible for the estimated impact. We assign treatment status to the postal region at the farthest distance from Mehr postal region. In other words, we define Mehr to be equal to one for the opposite suburb of the city but exactly at the time of Mehr units' delivery in that city. Table 6 reports regression results of this placebo regression. We remove Mehr postal regions from these regression. This table is formatted similar to Table 3 that shows our main results. Mehr and Near coefficient estimates are small and insignificant in all specifications. This finding is encouraging and shows secular peripheral trends are not responsible for the estimated coefficients.

Table 6: Placebo regression results

Dep.Var.: $\ln p_{ipt}$	Mehr postal region			Mehr and neighboring postal regions		
	Baseline	City×Year F.E.	City×Time F.E.	Baseline	City×Year F.E.	City×Time F.E.
	(1)	(2)	(3)	(4)	(5)	(6)
Mehr	0.024	0.013	0.012	0.024	0.013	0.012
	(0.034)	(0.021)	(0.020)	(0.034)	(0.021)	(0.020)
Near				0.002	-0.001	-0.004
				(0.029)	(0.025)	(0.023)
Age	-0.014***	-0.014***	-0.014***	-0.014***	-0.014***	-0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ln(Area)	-0.141***	-0.142***	-0.141***	-0.141***	-0.142***	-0.141***
	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.014)
Postal region F.E.	Y	Y	Y	Y	Y	Y
Time F.E.	Y	Y	Y	Y	Y	Y
City×Year F.E.	N	Y	N	N	Y	N
City×Time F.E.	N	N	Y	N	N	Y
Obs.	323,376	323,376	323,376	323,376	323,376	323,376
$\bar{R}^2$	0.316	0.336	0.348	0.316	0.336	0.348

Notes: This table shows the results of the same specifications as Table 3 except that we assume that Mehr project was constructed in the farthest postal region from the real place of the city and in the same time. It shows coefficient estimates from regressions of natural logarithm of area, postal region and time fixed effect in all columns. Columns (1) to (3) include Mehr which is a dummy variable that turns on for transactions in Mehr postal regions after the first Mehr unit is delivered. In addition to Mehr dummy, columns (4) to (6) include Near which is a dummy variable that turns on for transactions in postal regions neighboring Mehr postal regions after the first Mehr unit is delivered. Columns (2) and (5) include city by year fixed effects. Columns (3) and (6) include city by time fixed effects. Standard errors are corrected for clustering at the postal regions and reported in parentheses. *, **, *** represent significance of estimated coefficients respectively at 10%, 5%, and 1% level.

6.3 Heterogeneity of Mehr effect

So far we have established a robust result that after Mehr units are delivered to applicants in a postal region, we observe around 10 percent fall in the price of nearby properties. Two categories

of mechanisms could be responsible for this negative impact: supply and disamenity. Mehr projects delivered a large number of housing units and would therefore increase housing supply which reduces prices. Figure 9 shows Mehr units as a percentage of existing housing stock in the cities in our sample. It is clear that Mehr has shifted housing supply quite radically in some cities. The second mechanism is the disamenity effect resulting from overcrowding and concentration of low income households in the Mehr postal regions which would also reduce prices. To draw policy conclusions we need to disentangle the two effects. Activating the supply channel was the main intention of the government to control prices while the disamenity effect is simply an undesirable unintended channel. Disentangling the two effects is a daunting task as more Mehr units might increase the disamenity effect as well. In order to establish that at least some of the estimated negative effect is due to the disamenity channel we look at three types of heterogeneity.

First, we note that more than 80 percent of Mehr housing units have a built area between $75m^2$ and $110m^2$ (see Figure 8 in the appendix). Therefore, assuming some degree of market segmentation, we expect a stronger supply effect for houses falling in the same area category as Mehr units. We also expect a more negative impact on smaller units as a sign of upward demand shifting to cheaper but larger Mehr units. However, there is no reason to believe that the amenity effect is different across area categories. Figure 3, shows the Mehr coefficient estimates for each area category taking the Mehr category ($75\text{-}110m^2$) as the reference. We see no significant difference between Mehr effects in different area categories[8,9]. This pattern is more consistent with the disamenity channel.

[8] We test the equality between coefficient of Category 3 with coefficient of other categories separately and in all of the tests, we cannot reject the null hypothesis that this coefficient is equal to the others at 10%. (mehrcat2=mehrcat3: F(1,699)=0.27, Prob>F =0.6033; mehrcat4=mehrcat3: F(1,699)=0.53,Prob>F=0.4675; mehrcat5=mehrcat3: F(1,699)= 0.10,Prob>F =0.7478)

[9] We expect to see the supply effect (if exist) in first and second category too, since Mehr households prefer larger housing units and maybe they prefer to live in Mehr housing units rather than smaller unit that is not Mehr unit. But we expect that this supply effect doesn's exist for categories 4 and 5 because their area are larger than Mehr units and mostly for richer households. So as more robustness check, we divide transactions to two categories and define just one Dummy variable for transactions that have area of more than 110 m^2 but again there was no significant difference between the effects in these two categories ($t<1$).

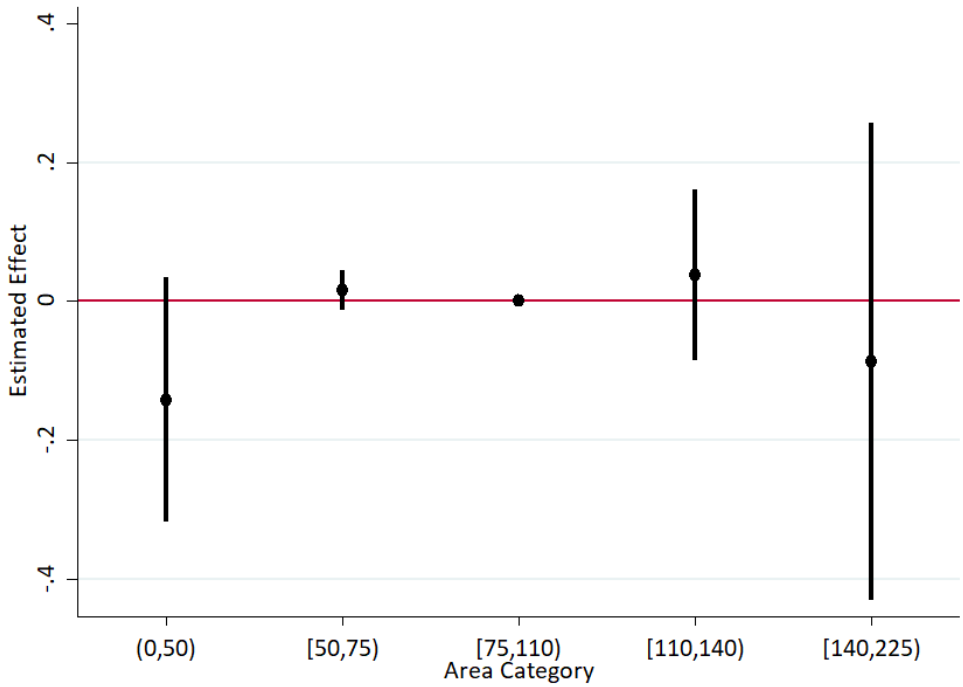


Figure 3 Heterogeneous effect in different area categories

Notes: Figure shows coefficient and standard error estimates of our intended coefficient in equation (3) of section 5 from regressions of natural logarithm of house price on covariates. Covariates include age, logarithm of area, postal region, time fixed effect and city by time fixed effect. We drop area category of between 75 and 110m^2 (which their area are the same as Mehr housing units) and the results are the effect on each area category with respect to Mehr area category.

Second, we run separate regressions for each city in our sample. Figure 4 plots coefficient estimates and 95 percent confidence intervals of Mehr effect from each regression against the scale of Mehr project in the city. We expect the supply effect to become stronger when the scale of Mehr project is larger. However, this is not what we see in the figure. Basically, there is no clear relationship between estimated coefficients and Mehr project scale. While this evidence does not rule out presence of the supply effect, it is more consistent with the disamenity effect.

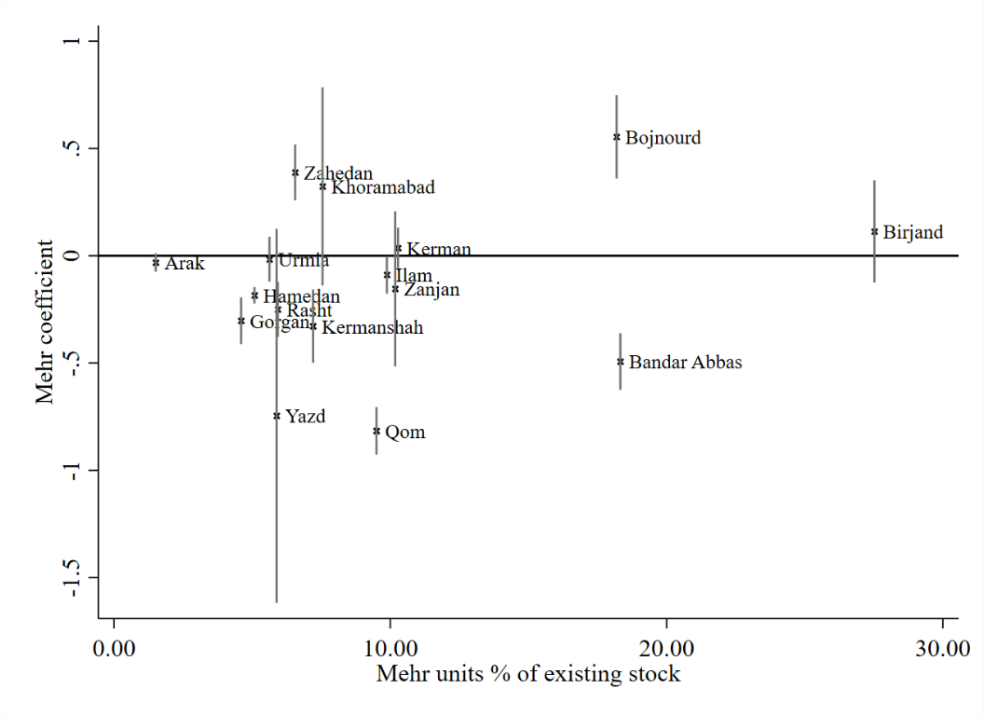


Figure 4 Relation between Mehr effect and size of Mehr projects in cities

Notes: Markers show coefficient estimate and grey lines show 95 percent confidence intervals for the coefficient from separate regressions of log house price on Mehr dummy, postal region and time fixed effects in each city. The horizontal axis shows the number of Mehr units in the given city as a fraction of existing housing stock from 1395 census of population and housing.

Finally, in Figure 5 we look at time profile of Mehr effect. As we can see from this figure, before delivery of Mehr units, property values in Mehr postal regions and other neighborhoods are similar which validates our identifying assumption. The negative effect starts two years after our reference point. Mehr housing units were delivered to their owners gradually and our reference point is the first unit delivery date in each Mehr project site. Once the delivery of units starts, we expect to see supply effects. Because households anticipate the availability of Mehr units and would withhold demand until the market supply shifts outward. But new Mehr households would take some time to move in and hence we expect the amenity effect to start later than the supply effect. This is what we observe in Figure 5 which is more consistent with disamenity type effects.

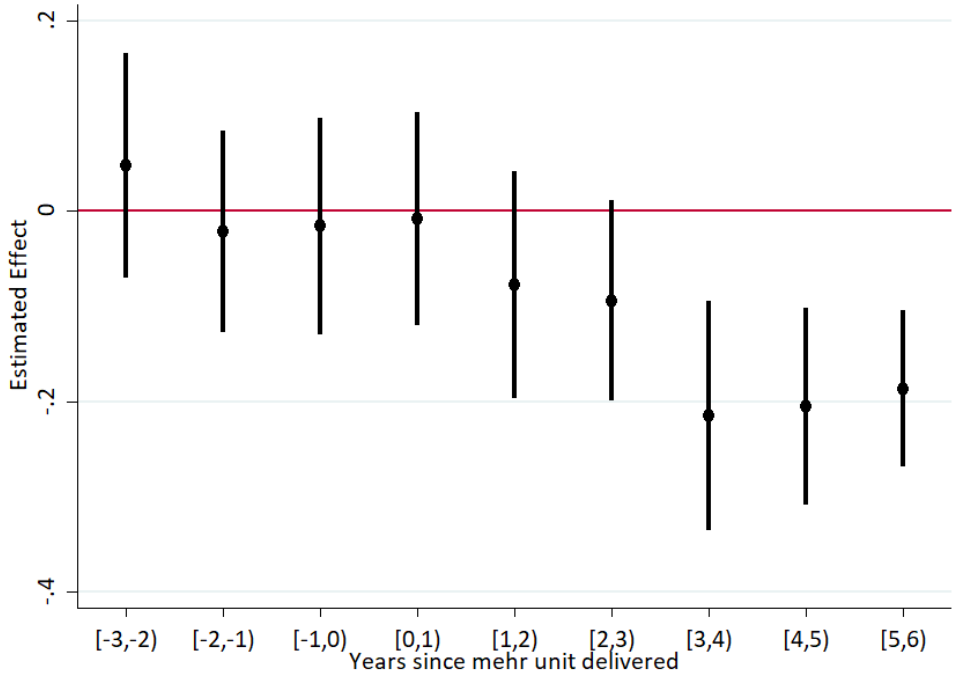


Figure 5 effect of Mehr housing delivery in different years after and before delivery of the first unit of the site

Notes: Figure shows coefficient and standard error estimates of our intended coefficient in equation (4) of section 5 from regressions of natural logarithm of house price on covariates. Covariates include age, logarithm of area, postal region, time fixed effect and city by time fixed effect. Our reference time is the first unit of Mehr housing delivery date in each Mehr project site and the coefficients are for interaction of Mehr variable and number of years passed since the delivery of Mehr units. We have data for 5 years before delivery until 7 years after delivery but we show coefficients just for before 3 years until after 6 years since the sample becomes small at the beginning and end of the range.

One of the main amenities that can have effect on housing price of each region is number and quality of schools in the region. We have data on number of schools in selected cities and also number of schools that were built in Mehr housing sites of that city. By estimating population of Mehr housing site, we calculate the ratio of population to the number of schools in each city and also in Mehr housing sites of each city. These ratios can be seen in Figure 6. As it is evident from this figure, number of schools in Mehr housing sites were lower than other parts of the city with respect to its population. This shortage of school as an amenity will other schools in the neighborhood of Mehr housing sites more crowded and will result in declining property values of Mehr postal region because of disamenity effect. Unfortunately, we do not have postal region level data on various amenities like schools, per capita police staff, and other variables to more directly test for the reduction in such amenities.

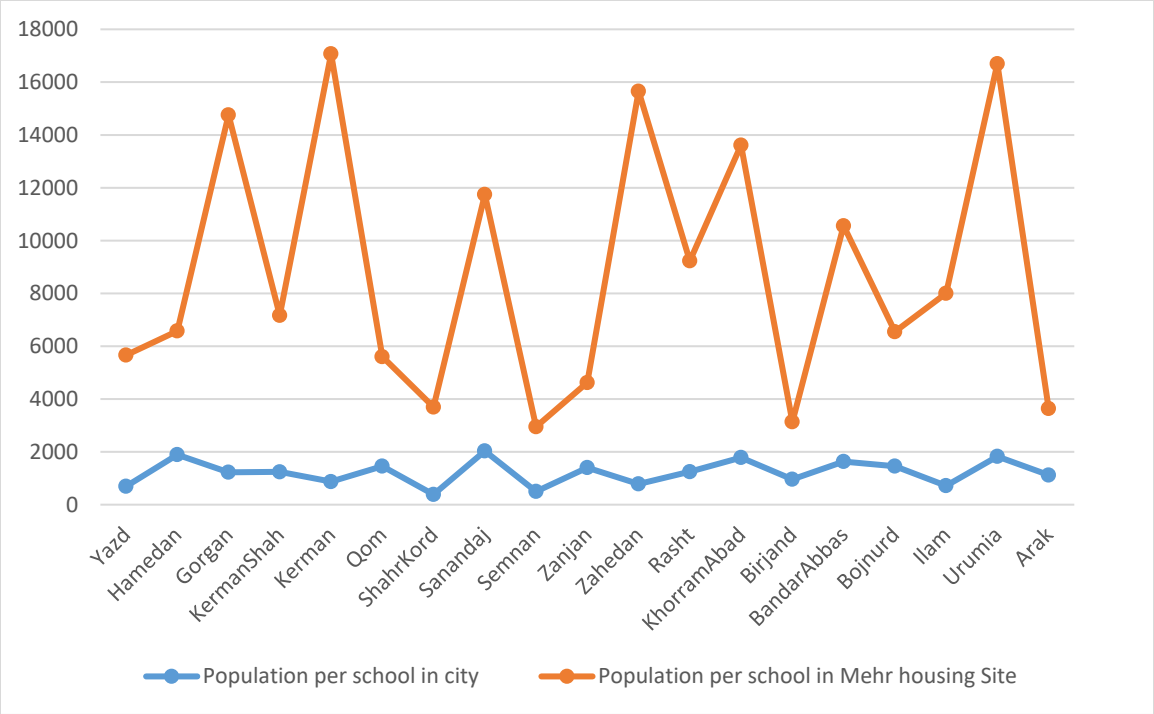


Figure 6 Comparison between population per number of school in the cities and Mehr housing site of the cities

Notes: Figure shows ratio of population to the number of schools in selected cities in blue and ratio of population to the number of schools in Mehr housing sites of the selected cities Orange.

7 Conclusion

Whether affordable housing projects negatively impacts existing properties in their neighborhood has received a lot of attention in developed countries. However, the externality of public housing projects might be very different in developing countries due to poor government effectiveness and lack of trust from citizens. This study tries to fill this gap by providing estimates of the externality of a very large public housing project in a developing country. Our results show large significant negative effects. House prices fall by around 11 percent after delivery of Mehr housing units. This result is incredibly robust to a large number of specification tests. However, the effect is concentrated in the postal region of the project and neighboring postal regions do not receive a significant impact.

Two main mechanisms could explain our results: supply and dis-amenity effects. While Mehr housing projects are very large, three pieces of evidence suggest that the dis-amenity effect is present in our case. First, we show that units with similar built-up area as Mehr units receive a similar impact compared to other units. Second, we observe that the scale of Mehr projects is not correlated with Mehr impact across cities. Finally, we notice that the Mehr impact kicks in two years after the delivery of the first unit. This suggests that gradual occupation of units is causing the decline in the value of nearby properties which is more consistent with the disamenity effect. Several potential disamenity effects might exist. General view about Mehr units was that they are of lower quality. Concentration of low-income households and higher congestion in an already low amenity neighborhood are other potential disamenity mechanisms. The caveat in our study is

that we could not provide direct evidence on these amenities because we do not have access to such data at postal region level. Anecdotal evidence and news pieces support the disamenity effect. Most Mehr residents were not satisfied with their neighborhood due to a lack of infrastructures like schools, clinics and police stations which leads to congestion in existing facilities.

The magnitude of our estimated effect is larger than previous studies in developed countries. For example (Diamond & McQuade, 2019) show that affordable housing decreases nearby property values by 2.5 percent in high-income areas in the United States because it brings in neighbors with relatively-low incomes. The higher magnitude of our results might be due to weaker government performance and lower trust by citizens in Iran which is a fixture of developing country governments.

Our results pour cold water on the idea that rapid construction of concentrated affordable housing is a good solution to rising house prices. Precisely because it is very hard to supply the infrastructure required for keeping the amenities at the pre-existing levels. Alternative ideas is to gradually expand the stock of affordable houses in order to allow for the neighborhood infrastructure to adjust. Also concentration of affordable housing units in a given area might be detrimental to the welfare of existing and new residents in the neighborhood.

8 Appendix: Further Data Description

8.1 Types of Mehr project

Mehr Project scheme can be divided by two dimensions: type of projects and type of cities. There were 3 types of cities that Mehr Projects built on and the authority for each type and procedure of that were different from the others. There were also three streams of Mehr construction projects. Owner-developer stream consists about 45 percent of Mehr housing units (about 910 thousand units) and was for individuals who had their own land and had a small-scale construction plan (on average 3 units in each project). This stream received a government backed loan subsidy. These projects were dispersed throughout cities and there is no information of their whereabouts in our sample. The two other streams were "tripartite agreements" and "cooperative projects" which were concentrated projects in selected localities of cities. These were the visible projects of the Mehr scheme and we therefore focus on them. In cooperative projects, members of a cooperation in each city register for getting land and loan from the government and manage the project. In tripartite agreements, there were there sides in the contract: government, bank and developer. The bank give the loan to the developer which will be transferred to the Mehr applicants by the subsidy of government and government select developer and give free land to the developer and mostly these projects were large-scale. Table7 presents a detailed number of planned units in each city and project type.

Table7 number of Mehr units by city type and project type

City type	Owner-developer units		Tripartite Agreement units		Cooperative units		total
	Share(percent)	Units	Share(percent)	units	Share(percent)	units	
More than 25k	67	608875	44	239798	65	390199	**1238872**
Less than 25k	29	267941	0	20	23	134732	**402693**
New cities	4	33797	56	305189	12	74297	**413283**
total	100	910613	100	545007	100	599228	**2054848**

Note: This figure shows division of Mehr housing units by their type of project and type of cities. There exists three type of cities: cities with more than 25 thousand population that were managed by ministry of housing, cities with less than 25 thousand population which were managed by National Land and Housing Organization and New cities which were under control of New Towns development CO. Three streams of Mehr construction projects were in practice. Owner-developer stream was for individuals who had their own land and had a small-scale construction. The two other streams were "tripartite agreements" and "cooperative projects" which were concentrated projects in selected localities of cities.

8.2 Targeted Population of Mehr Project

The targeted population were low-income households who were almost from the four bottom deciles. Since the buyer should bring some cash at the beginning of the plan and be able to easily pay the installments after getting the home, very poor households can't afford to register in this plan, but also middle and high income households can't register in this plan because of the registration conditions. Registration conditions for this plan were: 1) should be married and head of household; 2) none of his family members should have ownership of land or a housing unit since 2005; 3) should not have used government facilities or land since the revolution (1979) ;and 4) should have lived in the registered city since at least 5 years before registration. Furthermore, about 4 percent of houses were given to very poor households that were covered by supportive

institutions like the State Welfare Organization of Iran. This means that most of the target population were low and middle-income households of that city which didn't have house ownership although they were not necessarily very poor people.

8.3 Data source

We get our data from 5 different sources which their details can be find in Table8 .

Table8 -Data details and sources

Data title	Source	Description
Housing Transactions in cities	Tenement Management Information System (Ministry of Industry, Mine and Trade)	From 2010 to 2018 Including Postal code, age, area, transaction date and price
Mehr housing projects properties	Ministry of Roads and Urban Development	Including address, number of units, construction date
Delivery date of Mehr units	Maskan (Housing) Bank installment data	Starting date of repayment of bank installment
Location of Transactions and Mehr projects	Post Company and Google Map	Postal map of each city with its postal region's exact location
Selected cities housing stock information	Population and housing census(Statistical Center of I.R. Iran)	Census of 2011 including ownership rates, number of housing stocks, share of apartment units, average area of houses and etc. of each city

8.4 Other details about Mehr Housing

As mentioned before, we select 19 cities from the largest cities that Mehr units were built in. All of these 19 cities are the center and the most important city of the province. As can be seen in Table 9, from the 629,997 Mehr units that were built in cities with a population of more than 25 thousand (except self-owned that are scattered in the city), 209,602 units were built in the 19 cities mentioned previously (about 33 percent of total). It can be seen in the following table that the starting date of construction of these projects were mostly before 2010, but unfortunately our transaction data starts after that time. However, the first delivery date of all of the cities are after 2011, and therefore we can compare the data we have before and after the delivery date. We got the address and number of units of Mehr projects in these cities from the Ministry of Roads and Urban Development. In this dataset, the starting date of each project of each city is specified but for the delivery date of each unit, we use the starting date of repayment of bank installments from Maskan (Housing) Bank installment data for each unit of Mehr project. When a unit's construction is finished, the loan for that unit is transferred to the owner and the bank gives the installment booklet and the key of the residential unit to the owner simultaneously. Hence, we get this date for each unit and use the date of the first unit that was delivered as date of delivery to owners in the following table.

Table 9 Details of Mehr housing in selected cities

City	Number of Mehr Projects	Number of Mehr Units	Number of concentrated Projects (not self-owned)	Number of concentrated Units	Year of Starting Construction	Year and month of delivery to owners(first unit)
Bandar Abbas	470	30,496	169	20,568	2008	Jan-13
Ilam	570	7,006	56	4,078	2008	Apr-12
Yazd	645	11,996	131	9,276	2009	Apr-12
Kermanshah	3,421	32,384	48	16,396	2010	Sep-12
Rasht	980	21,226	205	12,852	2009	Sep-13
Zanjan	3,334	22,021	520	10,637	2008	Nov-11
Sanandaj	1,198	16,919	190	10,079	2009	Nov-12
Qom	1,726	37,342	234	28,684	2009	Apr-12
Orumia	1,630	14,835	431	10,060	2010	Sep-12
Zahedan	916	9,672	271	7,640	2008	May-11
Kerman	1,153	32,384	138	16,396	2008	Oct-11
Hamedan	730	11,585	136	8,135	2009	Jan-12
Arak	1,059	8,450	14	2,457	2010	Oct-12
KhorramAbad	3,760	15,268	100	6,822	2011	Oct-13
Gorgan	1,416	14,774	28	4,566	2010	Mar-13
Bojnurd	2,291	16,771	190	9,600	2009	Apr-13
Birjand	1,053	17,101	217	13,020	2009	Mar-12
ShahrKord	741	9,009	267	7,247	2010	Nov-12
Semnan	372	11,798	310	11,089	2008	Mar-12
All 19 cities	27,465	341,037	3,655	209,602	-	-
All “>25k population” cities	188,323	1,238,872	10,651	629,997	-	-
Share of selected cities	15%	28%	34%	33%	-	-

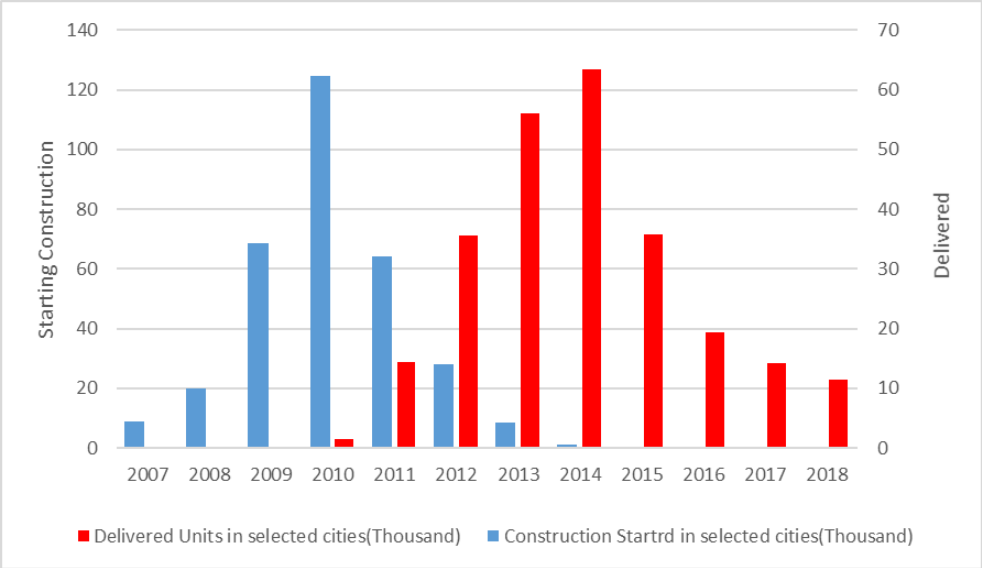


Figure 7 Starting construction date and delivery date of Mehr Units

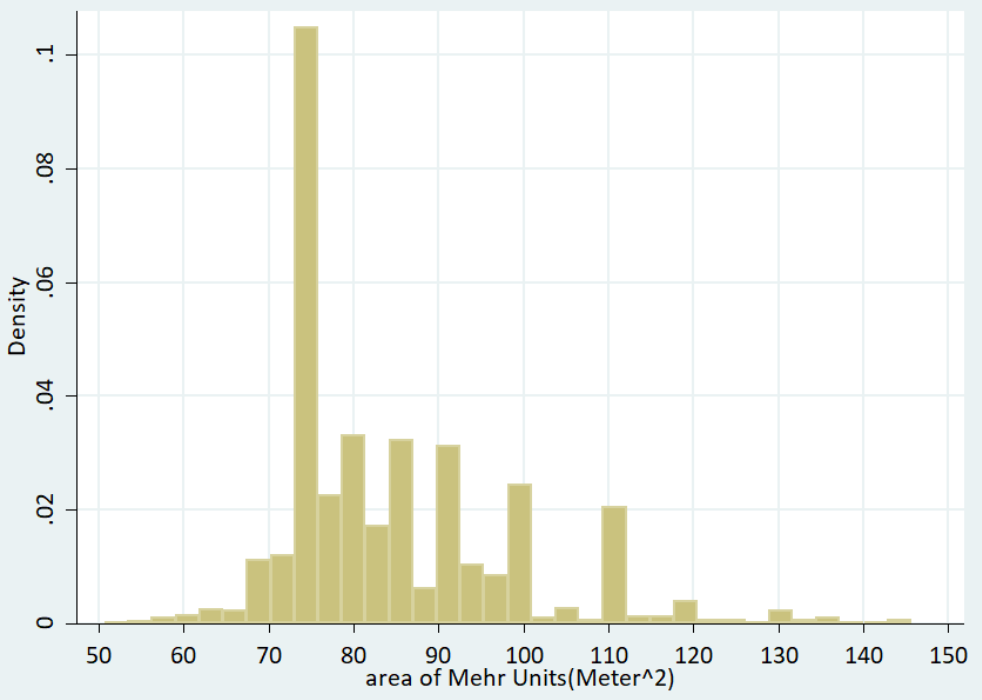


Figure 8 Distribution of Mehr housing areas is sample cities

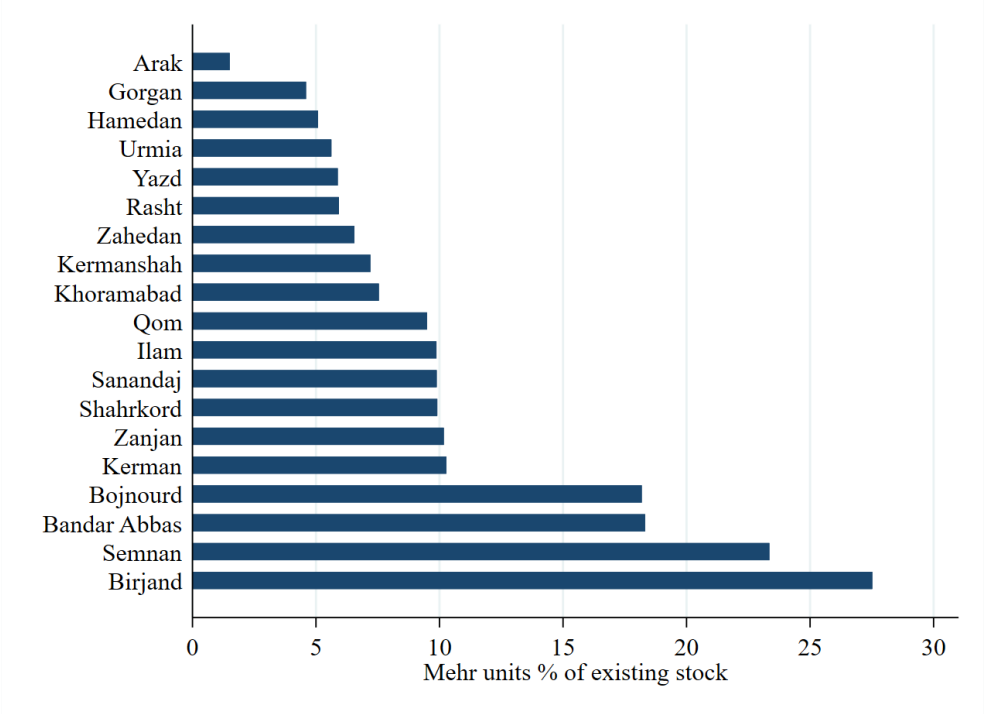


Figure 9 Mehr units as a percentage of existing housing stock in cities

8.5 Transactions

Official transactions of residential units occur in real estate consultant firms and after that are registered in the TMIS. These firms record residential unit's information including postal code, age, area, transaction date and price. This process is mandatory for residential unit's transactions for finalizing the transfer. However, this is different for Mehr Housing units. First of all, until the end of 2013, transferring Mehr units was illegal and the owner could not sell the unit. But after 2013, the buyer and seller should go to the Department of Roads and Urban Development of the city to transfer the unit and register it there. They should also transfer the loan and rent contract with the government. For this reason, registering in the TMIS was not mandatory for Mehr units, therefore the data we have contains ones other than Mehr units. This deduction is even more legible for transactions before 2013 since no units could be sold before that time.

In the following table, we present summary statistics of transactions in the selected cities for the years 2010 until 2019. 142,309 transactions are registered in these cities in this interval which is about 5 percent of all transactions registered in the country.

Table 10-summary statistics of transactions in the selected cities

Year	Transactions	Average Price (million Rials)	Average area	Average age
2010	31,381	655	91	9
2011	41,364	703	91	8
2012	58,744	909	92	8
2013	41,821	1,190	92	7
2014	50,035	1,444	93	6
2015	47,526	1,374	94	6
2016	22,428	1,760	98	5
2017	20,591	1,971	102	6
2018	22,288	2,416	100	6
2019 (until half)	4,928	3,606	99	7
Total interval (selected cities)	341,106	1,332	94	7
Total interval (country)	3,434,854	2,398	91	7.5

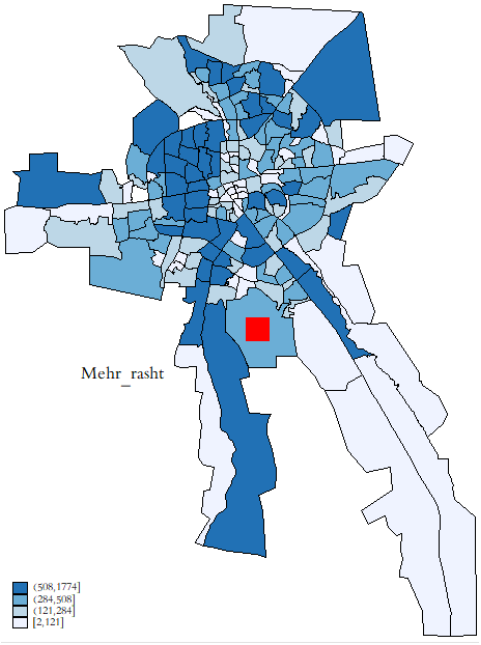
From this 341,106 transactions, just 20,976 of them belonged to Mehr housing postal regions. The table below shows the distribution of these transactions in the selected cities.

Table 11-transactions in Mehr Postal regions and other regions of each city

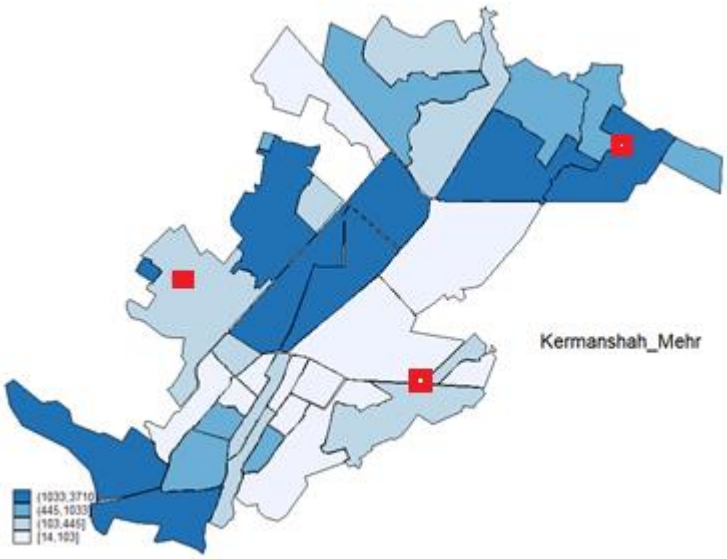
City	Total Transactions	Transactions in Mehr postal regions
Arak	**28,332**	**1,366**
Urumia	**17,613**	**773**
Ilam	**6,871**	**1,735**
Bojnurd	**7,318**	**303**
BandarAbbas	**11,361**	**1,581**
Birjand	**3,901**	**247**
KhorramAbad	**3,066**	**457**
Rasht	**67,598**	**1,063**
Zahedan	**4,636**	**1,011**
Zanjan	**12,623**	**396**
Semnan	**15,945**	**551**
Sanandaj	**13,543**	**219**
SharKord	**5,671**	**113**
Qom	**26,176**	**3,473**
Jerman	**10,255**	**782**
Hamedan	**44,375**	**5,252**
Yazd	**3,400**	**55**
Kermanshah	**26,355**	**1,025**
Gorgan	**33,058**	**574**
Total	342,097	20,976

8.6 Postal Regions Location

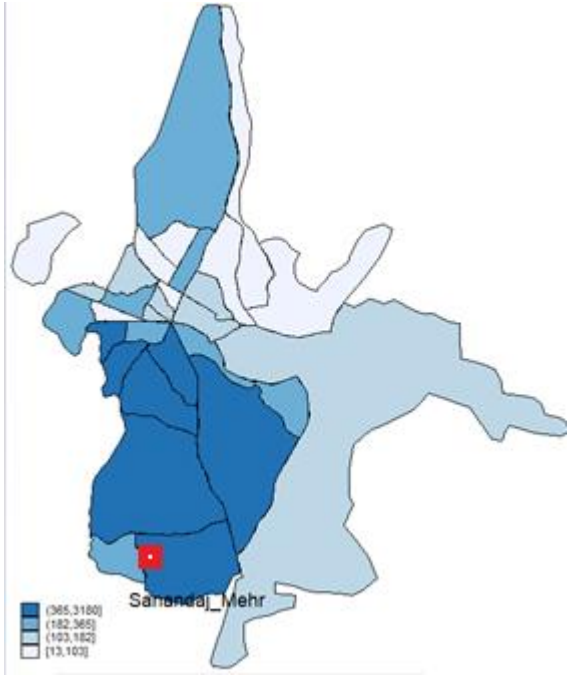
Postal regions of Rasht and their number of transactions can be seen in the figure below. Mehr projects have one main site in each city where most of the projects (except self-owned) were built. We specify the location of this site in the figure with a red square.



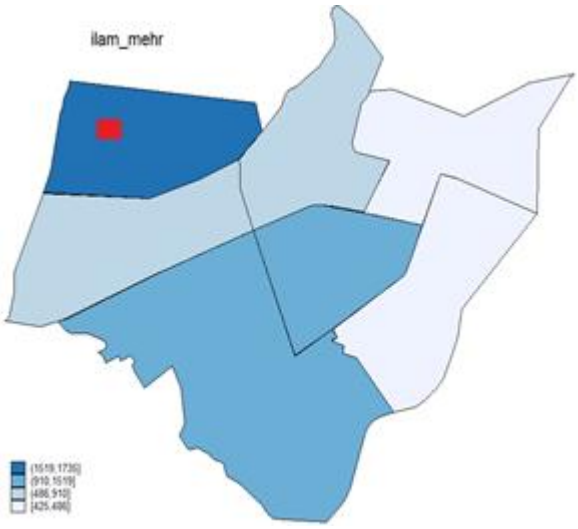
Rasht



Kermanshah



Sanandaj



Ilam

Figure 10- postal region's map in Rasht, Kermanshah, Sanandaj and Ilam (four of the selected cities) and Mehr scheme location (square)

After specifying the location of Mehr Housing main site and each city's transactions, we calculate distance between each transaction's postal region and Mehr postal region. The following figure shows the distribution of the distance.

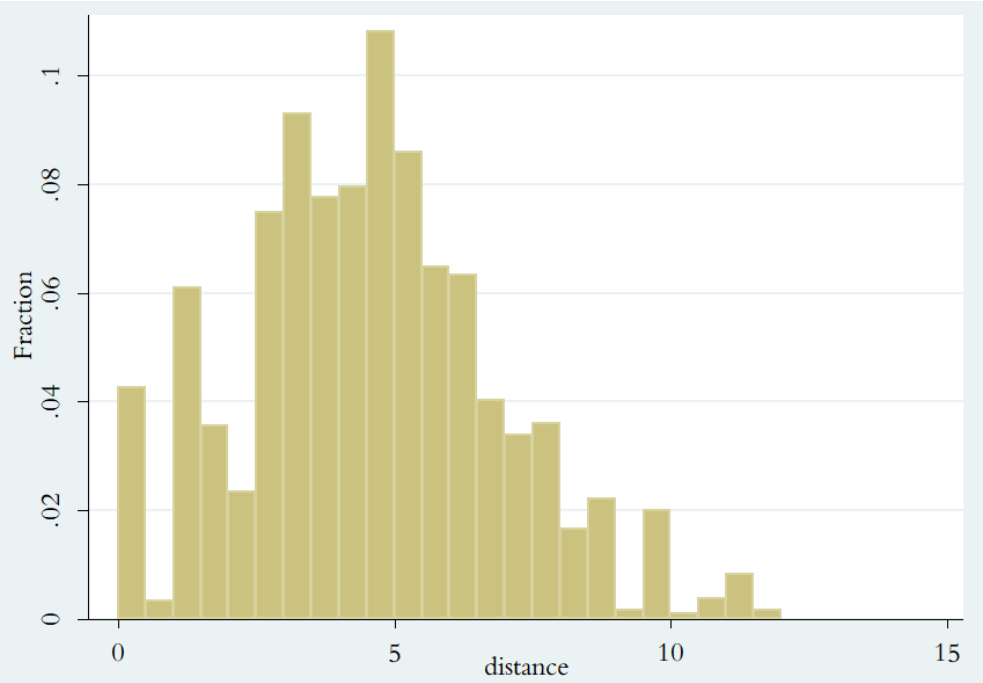


Figure 11 Distances between house transactions and Mehr site location in each city

8.7 Selected Cities Housing Stock Information

To show the heterogeneity of the selected cities, we use data of population and housing census which was done in 2011, including ownership rates, number of housing stocks, share of apartment units, average area of houses and population of each city. Summary of the information about the selected cities can be seen in the following table. As can be seen, these cities are different from each other in various aspects. For example, just 9 percent of units in Urumia are apartments but this share is about 65 percent in Arak. Also, the average area of units is 85 m^2 in Rasht, while it is 137 m^2 in ShahrKord.

Table 12 Selected Cities Housing Stock Information

City	Population	Housing stock	Share of owners	Share of Mehr units (except self-owned) to housing stock	Share of apartment units in the housing stock	Average area of residential units
Arak	484,212	162,802	56%	2%	65%	96
Urumia	667,499	178,850	63%	6%	9%	135
Ilam	172,213	41,286	60%	10%	17%	112
Bojnurd	199,791	52,776	51%	18%	35%	101
BandarAbbas	435,751	112,333	43%	18%	44%	93
Birjand	178,020	47,308	50%	28%	37%	112
KhorramAbad	384,216	90,380	52%	8%	11%	113
Rasht	639,951	216,821	60%	6%	43%	85
Zahedan	560,725	116,534	44%	7%	25%	119
Zanjan	386,851	104,515	57%	10%	30%	104
Semnan	153,860	47,479	59%	23%	54%	111
Sanandaj	373,987	101,924	53%	10%	32%	90
SharKord	159,775	73,122	60%	10%	23%	137
Qom	1,074,036	301,986	51%	9%	54%	96
Kerman	534,441	159,513	54%	10%	25%	122
Kermanshah	851,405	227,596	50%	7%	27%	101
Gorgan	329,536	99,266	56%	5%	49%	100
Hamedan	525,794	159,966	59%	5%	56%	99
Yazd	486,152	157,653	61%	6%	16%	135

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