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Housing affordability analysis in Kazakhstan based on D-HAQ model

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Abstract. Housing affordability is an acute socio-economic problem in many countries, and Kazakhstan is no exception. The purpose of the article is to assess the affordability of purchasing houses in the regions of Kazakhstan, taking into account dynamic changes in household income and expenditures. The analysis used data from 17 regions of Kazakhstan for 2021, which were collected from the Bureau of National Statistics, Statistical Bulletin of the National Bank, and analytical web portal. Based on the data, three indicators – down payment affordability (*DPA*), monthly repayment affordability (*MRA*), and dynamic indicator *TAM*, which is the time to achieve adequate *MRA* – were calculated. Then the Housing Affordability Quadrant was built. The results of the analysis showed that all regions of Kazakhstan are located in the third quadrant. This means that households in these regions have difficulty making both down and monthly payments. Full housing affordability in any part of the country is not observed. Then the affordability of housing under the preferential mortgage lending program was assessed, and as a result, housing affordability improved only slightly. The authors concluded that the lower the solvency of monthly payments, the less effective the effect of increasing affordability by lowering the

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interest rate on mortgage loans. Instead, it is recommended to take state control of prices in the real estate market in each region of Kazakhstan.

Keywords: housing affordability, D-HAQ model, mortgage, down payment affordability, monthly repayment affordability, regions.

JEL Classification: O18, R21, R31

1. INTRODUCTION

In recent years, state policy in world practice is most often evaluated from the point of view of protecting citizens. The main characteristic of this issue is the satisfaction of the vital needs of the country's population, the key point of which is the provision of housing for the people.

Providing the population with affordable housing is currently especially important in Kazakhstan. According to the Property Prices Index (2022), Kazakhstan is in 44th place out of 112 countries in the world, with an index of 10.48, which reflects the ratio of housing prices to income. In other words, to buy a home, Kazakhstanis need more than ten annual incomes, excluding consumption and livelihood expenditures.

Even though tens of millions of square meters of residential buildings are put into operation every year in Kazakhstan, the socio-economic problem of housing affordability persists. Moreover, (Tulegenova et al., 2021) believe that the real socio-economic state of the country is "veiled" in official statistics. Thus, according to the Bureau of National statistics of the Agency for Strategic planning and reforms of the Republic of Kazakhstan, the commissioning of residential buildings over the past ten years has increased by 2,6 times from 6531 thousand square meters in 2011 to 16910 thousand square meters in 2021. The housing affordability problem is influenced by internal factors such as growing urbanisation and population migration within the country and by external factors affecting the real estate market. Kazakhstan is a small open economy, which means it is highly exposed to changes in the global interest rate. Also, due to the country's resource dependence, fluctuations in world prices for raw materials are reflected both in the price index in Kazakhstan and the exchange rate. All this leads to changes and deterioration of the real estate market's situation and subsequently reduces citizens' ability to purchase houses.

The article aims to assess the affordability of purchasing housing in the regions of Kazakhstan using a new dynamic model. The main difference from the traditional Housing Affordability Quadrant model is the inclusion of a dynamic indicator that shows the time to achieve an adequate monthly mortgage payment. It is assumed that empirical analysis using macro data from 17 areas (3 cities of republican significance and 14 regions) will help to comprehensively compare housing affordability problems in each region and reflect their causes. Also, this model would benefit the government in implementing a precise policy regulation in providing housing to the population.

The rest of the paper is organised as follows. The second section provides a literature review that compares previously used methods to analyse housing affordability. The third section describes the methodology for applying the D-HAQ model. The fourth section provides the data used for the analysis, their full description, and sources. The fifth section directly presents the results of the empirical research and their discussion. The last section contains the conclusion and recommendation.

2. LITERATURE REVIEW

In recent decades, more and more research has been devoted to an acute socio-economic problem that takes place in many countries - the problem of housing affordability.

The problem of housing accessibility is fundamental both from the point of view of households and a country's social policies. This is mainly due to the role of housing in meeting everyone's basic needs in life (Zakaria et al., 2020; Trojanek, 2021; Trojanek et al., 2022). Acquisition of this specific commodity, anywhere in the world, requires a financial outlay equivalent to a multiple of a household's annual income and is often unattainable without taking out a loan. For this reason, the issue of housing affordability, its interpretation and how to measure it has long been addressed in the global literature(Anacker, 2019; Ezennia & Hoskara, 2019; Haffner & Hulse, 2021; Linneman & Megbolugbe, 1992; Stone, 2006). Moreover, a literature review shows that while housing affordability was previously studied primarily in developed countries, research on this topic is often conducted in developing countries(Galster & Lee, 2021). The authors also highlight the deepening housing affordability crisis (Favilukis et al., 2019; Squires & Webber, 2019). This crisis is because, in many countries around the world, household spending on housing is increasing at a higher rate than wages. At least three factors have triggered this situation following the global financial crisis: the accelerated (re) urbanisation of capital and people, the provision of cheap credit, and the growth of inequality within society (Wetzstein, 2017). Moreover, the Covid-19 pandemic has further fueled these processes (Marona & Tomal, 2021).

An interesting study was conducted by Acolin and Green (2017). They developed a new housing affordability index for the São Paulo metropolitan region, combining housing costs with transportation costs, including the opportunity cost of commuting time. Their findings, based on data from 2007 to 2013, show that the number of households spending more than 30% of their income on housing, or 45% or more on housing and transportation costs, has been rising sharply. The metrics they developed showed that housing with limited access to jobs does not effectively raise living standards if it requires expensive and long commutes.

Özdir Sarı & Aksoy Khurami (2018) used three indicators: a subjective indicator of the housing cost burden, housing expenditure to income ratios (ETOI) and residual income to examine housing affordability in Turkey from 2006 to 2014 for NUTS level 1 and 2 regions. All of the indicators used in this study showed an improvement in housing affordability over the analysed period, varying degrees depending on the country's regions. This change results from a significant increase in the number of housing units built and a consistent rise in the GDP per capita.

The problem of housing affordability is most widely covered in China (Li et al., 2020). In the studies, the authors considered the factors that exacerbate this problem. In addition to the country's dense population, income inequality, migration, urbanisation, and wage levels are also affected (Liu et al., 2020; Cai & Lu, 2015; Lin et al., 2014; Li et al., 2017). In some regions of the country, these factors make even rental housing challenging to access. In Australia, official housing affordability is above average. Still, Saberi et al. (2017) conclude that areas that appear affordable when only housing costs are considered are not necessarily affordable when transport costs are considered. The relationship between transport and housing affordability has also been studied in different US states (Luckey, 2018; Molloy et al., 2022). The authors propose a location-based residual income approach for estimation that more fully reflects the realities faced by households by incorporating differences related to household income, composition, childcare requirements, and location.

To assess the level of housing affordability, scientists use different methods (Ucal & Kaplan, 2020). The most cited and internationally recognised indicator is the price-to-income ratio (PIR). The price-to-income ratio is the nominal house price index divided by the nominal disposable income per head and can be considered a measure of affordability (OECD Data, 2022). This indicator is easy to calculate and involves several variables. It is also used when calculating the Property Prices Index mentioned above. A new home's average price and family income are used to construct the PIR (Rizi, 2021). Since PIR has a clear advantage

in ease of calculation, it has been applied in many regions of the world over the past two decades (Lau & Li, 2006; Kim & Renaud, 2009; Zhidebekkyzy et al., 2019; Suhaida et al., 2011).

However, the disadvantages of the PIR are also apparent. Although cash income is a widely used measure, it does not measure the ability of households to pay for housing purchases. The basic cost of living covers most of the income, leaving only a small part for housing. Gan & Hill (2009) and Thalmann (2003) wrote about these shortcomings of the method.

To address these shortcomings of the PIR indicator, Stone (2006) focused on the concept of housing affordability supported by the concept of residual income. Residual income resolved the relationship between income, housing, and non-housing expenses by establishing an appropriate percentage of income for non-housing costs.

Chen & Cheng (2017) proposed a dynamic stochastic general equilibrium (DSGE) model correlated with several macroeconomic aggregates and monetary policy to predict the future of dynamic PIR.

To measure housing affordability for urban households and calculate the area of affordable housing for households with different income levels, Li & Mo (2015) applied the ELES model of the extended linear expenditure system. Based on the study results, the authors concluded that the government should find ways to increase household income and implement effective ways to control rising housing prices.

An interesting method for assessing housing affordability is proposed by Mulliner et al. (2013). The authors considered that housing affordability should be assessed in terms of economic feasibility and environmental and social criteria—the COPRAS method of multi-criteria decision decision-makings used for this. The study showed that considering several social and environmental criteria can significantly influence the calculation of a district's affordability compared to focusing solely on financial characteristics. The authors also concluded that COPRAS proved an effective assessment method and could be applied in other regions or internationally. This method is intended to be used in future studies to assess housing affordability on a sustainable basis in Kazakhstan.

When considering mortgages, methodologies focus only on repayment ability, ignoring the down payment issue. Shi & Yan (2015) proposed a housing affordability quadrant (HAQ) model that assesses housing affordability in two dimensions, down payment affordability and monthly repayment affordability. However, dynamic household income and expenditure changes still need to be considered.

This study uses an improved D-HAQ model that considers down payment affordability and monthly repayment affordability, as well as dynamic changes in household income and expenditure.

3. METHODOLOGY

The HAQ model was first presented by Shi & Yan (2015). The authors analysed housing affordability in 35 Chinese cities using two metrics: down payment affordability (*DPA*) and monthly repayment affordability (*MRA*). Further, Wang & Li (2022) identified the shortcoming of the model, which is that the dynamics of indicators are not considered. Wang & Li (2022) proposed an improved D-HAQ model that considers the dynamic *TAM*, which is the time to achieve adequate *MRA*.

Down payment affordability measures the family's ability to make a down payment for housing and is calculated as follows:

$$DPA = \frac{HS}{\rho \cdot P \cdot S} \tag{1}$$

where,

HS – average household savings;

ρ – average down payment ratio;

P – average price per unit area;
S – standard residential housing area.

Monthly repayment affordability reflects a family's ability to repay a monthly mortgage (2).

$$MRA_j = \frac{RI_j/12}{(1-\rho)\cdot P\cdot S\cdot\frac{i\cdot(1+i)^{12n}}{(1+i)^{12n}-1}} \quad (2)$$

where,
i – the monthly interest rate on housing mortgage;
n – the mortgage term.

Dynamic *RI* in the *j* year after purchasing a house is calculated as (3).

$$RI_j = (I - C)(1+\beta)^j \cdot m \quad (3)$$

where,
I – average income per capita;
C – average consumption expenditure per capita;
β – average income growth rate;
m – the average number of members per household.

Based on the *DPA* and *MRA* calculations, the housing affordability quadrant is built (Figure 1). The horizontal x-axis represents *DPA,* and the vertical y-axis represents *MRA*; the intersection of the two axes occurs at point O (1; 1). The graph is then divided into four quadrants.

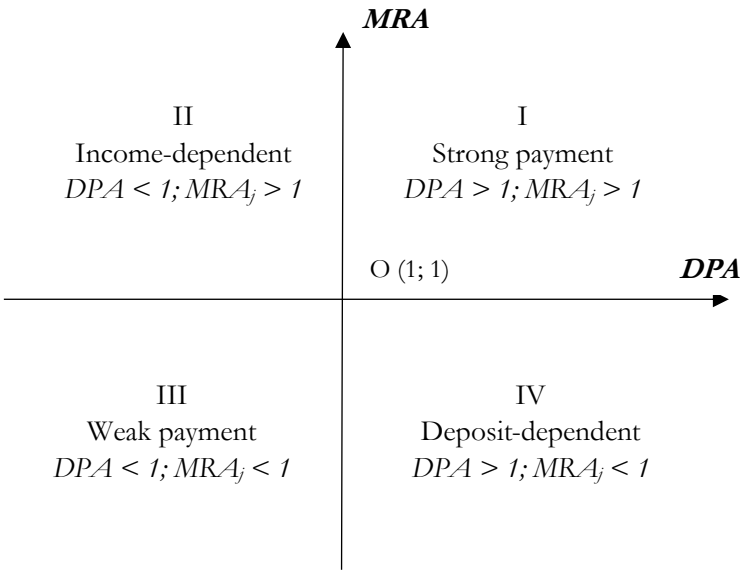

Figure 1. Housing affordability quadrant
Source: own compilation

The points in the first quadrant represent the family's ability to pay down monthly payments. The facts in the second quadrant show that the family can pay the monthly payments but is having difficulty making

the down payment for the house. The points in the third quadrant reflect the inability to purchase a house; the savings are not enough for the down payment, and the monthly income is also not enough to cover the monthly mortgage payment. The points in the fourth quadrant show that the family has enough savings for the down payment but will struggle to meet monthly mortgage payments.

However, over time and with income growth, households with $MRAj < 1$ may strengthen their ability to pay the monthly payment. The achievement of such households $MRAj > 1$ describes the third dynamic indicator *TAM* of the quadrant. *TAM* equals the value of the minimum j to make $MRAj \geq 1$ as (4).

$$TAM = \min j$$
$$s.t. \begin{cases} MRA_j = \frac{(I-C)(1+\beta)^j \cdot m/12}{(1-\rho)\cdot P \cdot S \cdot \frac{i\cdot(1+i)^{12n}}{(1+i)^{12n}-1}} \geq 1 \\ j \ni N \end{cases} \quad (4)$$

Data

To build the D-HAQ model, data from 17 regions (3 cities of republican significance and 14 regions) of Kazakhstan for 2021 were used. The indicators for calculating *DPA* and *MRA* and their sources are shown in Table 1.

Table 1

Indicators and their sources

Indicator	Description	Source
HS	Deposits in second-tier banks per capita, excluding accounts of non-residents by regions of Kazakhstan, in tenge (Figure 2)	Statistical Bulletin of the National Bank of the Republic of Kazakhstan, 2021
ϱ	average down payment ratio is calculated by the authors based on data from 10 banks of Kazakhstan, typical for all regions, in per cent (Table 2)	Analytical portal Krisha.kz
P	average price per unit area as of September 1, 2021, in each region of Kazakhstan, in tenge (Figure 3)	Analytical portal Krisha.kz
S	standard residential housing area. According to housing market analysts, the majority of residential properties in Kazakhstan are two-room apartments (1,2 million), with an average size of 50 square meters	Analytical portal Krisha.kz
i	the monthly interest rate on housing mortgages is calculated by the authors based on data from 10 banks of Kazakhstan, typical for all regions, in per cent (Table 2)	Analytical portal Krisha.kz
n	the average mortgage term is calculated by the authors based on data from 10 banks in Kazakhstan, typical for all regions, in years (Table 2)	Analytical portal Krisha.kz
I	the nominal income per capita by regions, in tenge	Bureau of National Statistics of Agency for Strategic planning and reforms of the Republic of Kazakhstan
C	expenditures of households by regions, in tenge	Bureau of National Statistics of Agency for Strategic planning and

		reforms of the Republic of Kazakhstan
β	the average income growth rate is calculated by the authors based on data from previous years in per cent	Bureau of National Statistics of Agency for Strategic planning and reforms of the Republic of Kazakhstan
m	the average size of households in both 2009 and 2019 was 3.6 people and has not changed. The size of rural households is 4.2 people, while the size of urban households is 3.2 people.	Report of the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan with the technical support of the United Nations Population Fund (UNFPA) in Kazakhstan, 2019

Source: own compilation

To make the model work, we assume that only savings, disposable income, and affordable mortgages are the source of family funds rather than borrowing from non-family relatives and friends or selling existing housing assets.

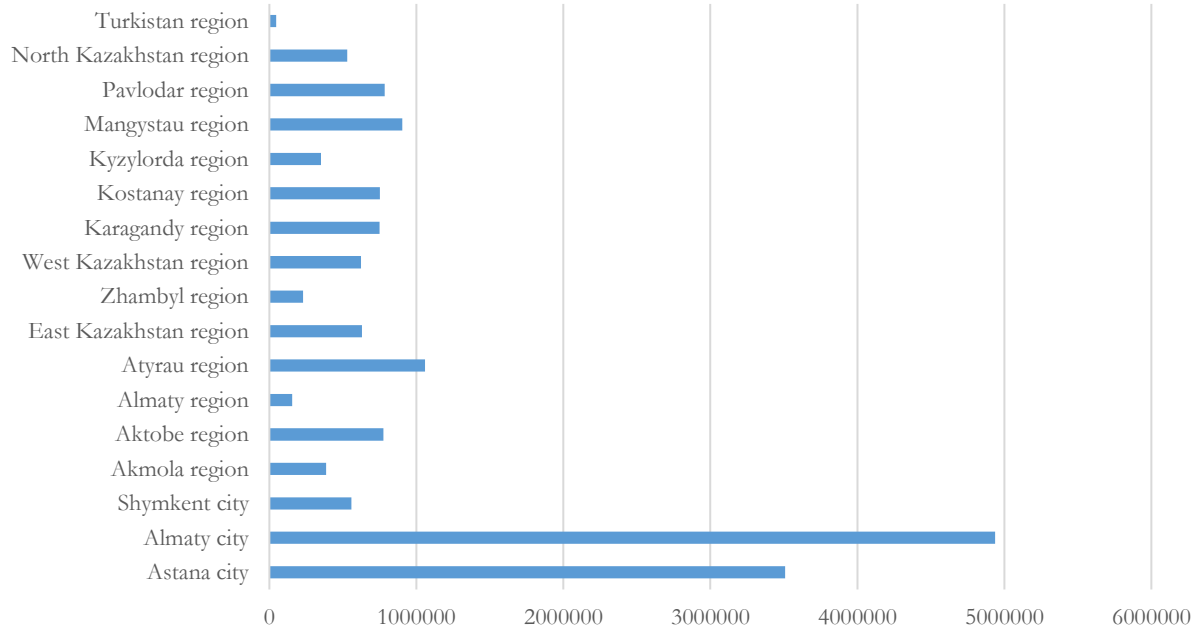

Figure 2. Deposits in second-tier banks per capita, excluding accounts of non-residents by regions of Kazakhstan, in tenge, 2021

Source: own calculation

Figure 2 shows that the two main cities of Kazakhstan – the capital (Astana city) and the financial centre of Kazakhstan (Almaty city) lead by a wide margin in terms of citizens' savings.

According to the analytical portal Krisha.kz, mortgages in Kazakhstan are issued by nine second-tier commercial banks and one with state participation – Otbasy Bank. The annual effective interest rate starts from 17.5%.

Table 2

Banks issuing mortgages in Kazakhstan and their requirements

Bank	Down payment (ϱ), %	Interest rate on housing mortgage (i), %	Mortgage term, year
Halyk Bank	20	17,5	20
Bank Center Credit	20	18	20
Bank RBK	30	22,6	20
Freedom Bank	30	17,2	20
Nurbank	20	18	20
Altyn Bank	20	18,5	20
Forte Bank	15	20	20
Bank of China in Kazakhstan	50	26,5	15
Shinhan Bank Kazakhstan	40	18,5	20
Otbasy Bank	50	5	25
Average	*29,5*	*18 (monthly 1,5)*	*20*

Source: own calculation

Table 2 data was obtained by calling call centers, through loan calculators, and in the press services of banks by analysts of the portal Krisha.kz.

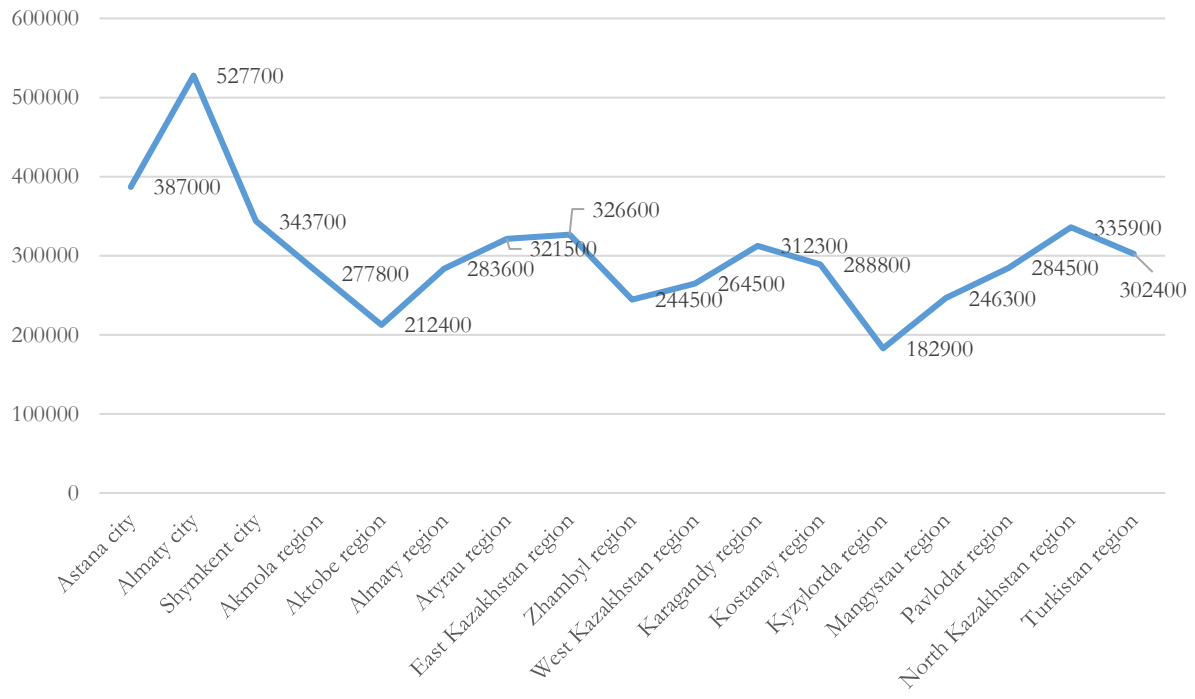

Figure 3. Cost per square meter of housing by regions of Kazakhstan, in tenge

Source: own calculation

Data on the cost of housing per square meter are taken as of September 1, 2021, for the regions of Kazakhstan. For the regions of Kazakhstan, data were collected by city-regional centres. As seen in Figure 3, the most expensive housing is in Almaty city, which is significantly higher than in other cities of republican significance. It is noteworthy that among the regions, the most increased cost of housing is in the North

Kazakhstan region, where the average wage is almost the lowest. Generally, the price per square meter of housing in Kazakhstan ranges from 182 900 tenges to 527 700 tenge, indicating a sharp price differentiation. The cost of housing in Almaty city is almost three times higher than in Kyzylorda.

Descriptive statistics of all data used to construct the D-HAQ model are presented in Table 3.

Table 3

Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
HS	17	998979,4	1268368	45222,23	4937162
P	17	302494,1	76474,57	182900	527700
ϱ	17	0,295	0	0,295	0,295
S	17	50	0	50	50
I	17	242575,5	65355,72	187501	406166
C	17	66329,65	13898	45737	93896
β	17	0,13	0	0,13	0,13
m	17	3,6	0	3,6	3,6
i	17	0,015	0	0,015	0,015
n	17	20	0	20	20

Source: own calculation

4. EMPIRICAL RESULTS AND DISCUSSION

At $j=0$, *DPA* and MRA_0 values were calculated for 17 regions of Kazakhstan for 2021. The results are presented in Table 4 and Figure 4.

Table 4

Empirical results for 17 regions of Kazakhstan in 2021

№	City/Region	*DPA*	MRA_0	*TAM*
		X-axis	Y-axis	Weight
1.	Astana city	0,615	0,375	9
2.	Almaty city	0,634	0,211	13
3.	Shymkent city	0,110	0,233	12
4.	Akmola region	0,094	0,269	11
5.	Aktobe region	0,248	0,407	8
6.	Almaty region	0,037	0,274	11
7.	Atyrau region	0,223	0,599	5
8.	East Kazakhstan region	0,131	0,249	12
9.	Zhambyl region	0,063	0,321	10
10.	West Kazakhstan region	0,160	0,354	9
11.	Karagandy region	0,162	0,273	11
12.	Kostanay region	0,177	0,256	12
13.	Kyzylorda region	0,130	0,476	7
14.	Mangystau region	0,249	0,657	4
15.	Pavlodar region	0,187	0,278	11
16.	North Kazakhstan region	0,107	0,182	14
17.	Turkistan region	0,010	0,273	11

Source: own calculation

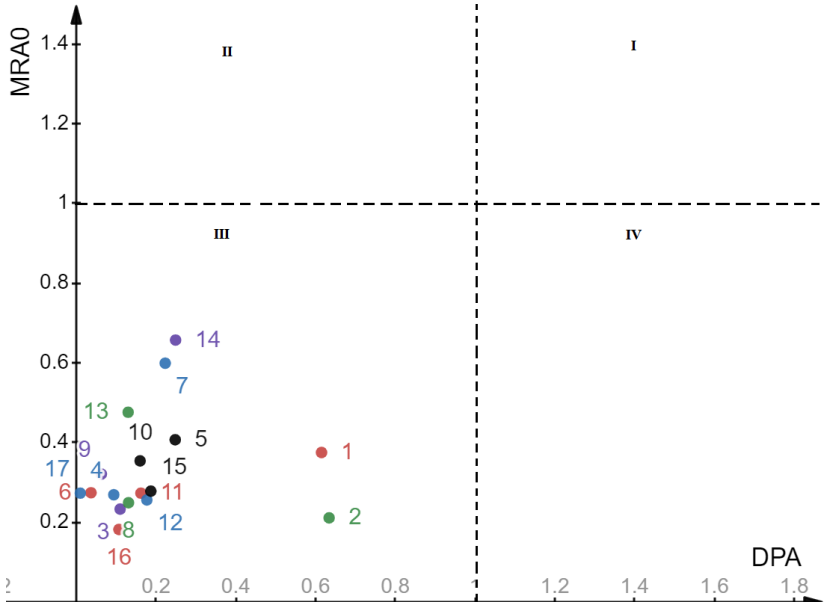

Figure 4. Empirical HAQ results for 17 regions of Kazakhstan in 2021 at *j=0*

Source: own calculation

As seen from Table 4 and Figure 4, all regions of Kazakhstan are in the third quadrant. This means that residents of all areas are experiencing difficulties with both the down payment and the monthly payments. The worst situation is observed in the regions located in the lower left corner, namely in the North Kazakhstan region, the East Kazakhstan region, and Shymkent city. Here, the lowest rates of both *DPA* and MRA_0 are observed. In Astana and Almaty, although DPA is higher compared to other regions, MRA_0, that is, the ability to pay a monthly payment, is also low. The areas of Turkistan, Almaty, Zhambyl, and Akmola experience the most significant problems with the down payment for housing; here, $DPA < 0.1$.

A feature of the D-HAQ model is the inclusion of a dynamic indicator *TAM*, which displays how many years the ability to pay a monthly payment (*MRA*) will rise above one and move to the second or first quadrant. As seen from Table 4, it will take a minimum of 4 years in the Mangystau region and a maximum of 14 years in the North Kazakhstan region. The average income explains such indicators in these regions; for example, the average salary in the Mangystau region is 349 503 tenge, and in the North Kazakhstan region – 187 501 tenge. At the same time, the cost per square meter of housing in the North Kazakhstan region is higher than in Mangystau and almost equal to housing prices in the capital. The reasons for a large *TAM* may be different. For example, β and residual income per capita in Almaty city is high, but housing prices in Almaty city are also too high. In this regard, households in economically developed cities have weaker monthly solvency.

Observing the result of the quadrant model in Figure 4, it becomes evident that the housing affordability problem in Kazakhstan is severe and has strong regional characteristics. There is no one region with full affordability. Even with high-income residents, consumption and housing prices are also high in many regions. It isn't easy to accumulate savings deposits and down payments on high house prices.

Since 2018, a social program for citizens of the Republic of Kazakhstan "7-20-25" has been operating in Kazakhstan, which provides new opportunities to improve living conditions. The "7-20-25" program is a profitable mortgage program with a low-interest rate on loans – 7%, the down payment is set at 20% of the cost of housing, and the loan repayment period is 25 years. However, this program is designed

exclusively for the primary market, there are restrictions on the maximum cost of housing, and not all banks issue loans under this program.

Table 5 and Figure 5 present the empirical results of the D-HAQ model if all Kazakhstanis could purchase housing under the "7-20-25" social program. The difference with the previous model is in the following indicators: i = 7% (or 0.583% monthly), ϱ = 20%, n = 25 years.

Table 5

Empirical results for 17 regions of Kazakhstan under the program "7-20-25"

№	City/Region	*DPA*	MRA_0	*TAM*
		X-axis	Y-axis	Weight
1.	Astana city	0,907	0,721	3
2.	Almaty city	0,936	0,406	8
3.	Shymkent city	0,163	0,449	7
4.	Akmola region	0,139	0,517	6
5.	Aktobe region	0,366	0,783	3
6.	Almaty region	0,055	0,528	6
7.	Atyrau region	0,329	1,152	-
8.	East Kazakhstan region	0,193	0,480	7
9.	Zhambyl region	0,093	0,618	4
10.	West Kazakhstan region	0,236	0,681	4
11.	Karagandy region	0,240	0,525	6
12.	Kostanay region	0,261	0,493	6
13.	Kyzylorda region	0,192	0,916	1
14.	Mangystau region	0,367	1,265	-
15.	Pavlodar region	0,275	0,535	6
16.	North Kazakhstan region	0,158	0,350	9
17.	Turkistan region	0,015	0,525	6

Source: own calculation

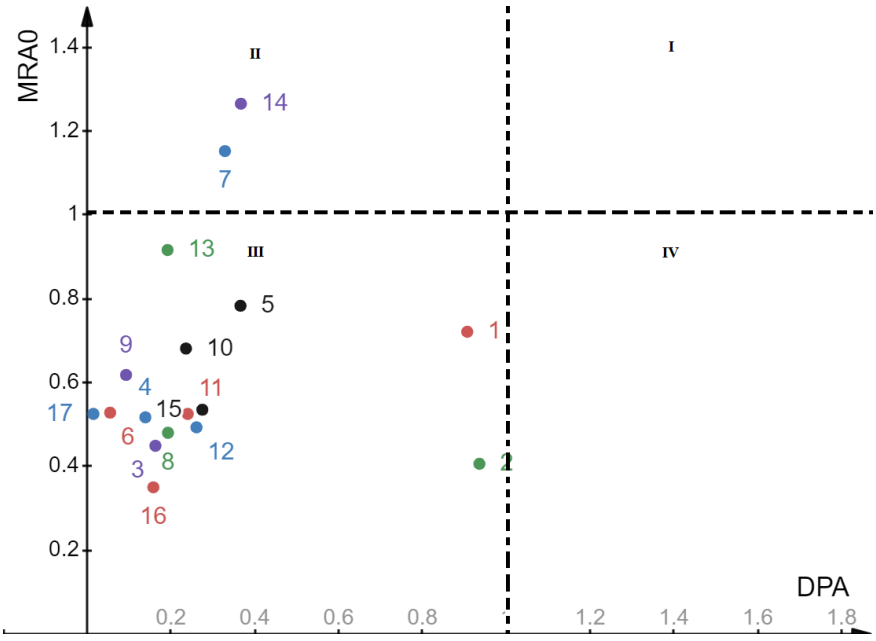

Figure 5. Empirical results for 17 regions of Kazakhstan under the program "7-20-25" at j=0

Source: own calculation

As seen in Figure 5, housing affordability in the regions is changing with preferential mortgage lending, particularly when applying a low-interest rate on mortgages, reducing the down payment, and increasing the mortgage term. In the western regions of the country - Mangystau and Atyrau regions - with high wages, residents no longer experience difficulties paying monthly payments ($MRA_0 > 1$). However, these regions are in the second income-dependent quadrant and need help to make a down payment. In the two main cities of republican significance – Almaty city and Astana city – the opposite situation is observed. Here, the points approached the fourth deposit-dependent quadrant when *DPA* is close to 1 and $MRA_0 < 1$. That is, families in these regions, due to high savings (Figure 2), can afford to make a down payment but still experience difficulties in paying monthly fees. This once again confirms that in economically developed cities, the solvency of residents is low since even with a high income, housing prices are even higher.

It should also be noted that with preferential mortgage lending under the "7-20-25" program, the required number of years to achieve $MRAj > 1$ (*TAM*) is lower than under market lending conditions.

5. CONCLUSION

This article analysed the ability of citizens to purchase housing in 17 regions of Kazakhstan, taking into account the dynamic measurement of housing affordability. In addition to *DPA* and *MRA*, *TAM* is integrated into the models to measure the time required for each region to achieve adequate monthly solvency. Based on the analysis results, the housing affordability quadrant showed that no region has complete housing affordability. On the contrary, in all regions, families experience difficulties with the down payment and the monthly payments. Further, using the same model, the affordability of housing under the program of preferential mortgage lending "7-20-25" was analysed. The results showed that lowering the interest rate and down payment and increasing the mortgage term did not change the housing affordability problem. Only two regions of Kazakhstan moved to the second quadrant, which indicates the availability of monthly payments. Other regions remained in the same third quadrant. This suggests that the smaller the MRA_0, the less effective the effect of increasing affordability by lowering the mortgage interest rate.

According to the study results, the main reason for the low affordability of housing was identified - as high prices in the real estate market, both in the primary and the secondary. Housing prices in all regions do not correspond to the incomes of citizens, this is especially noticeable in the North Kazakhstan region, where prices per square meter of housing are almost equal to the price in the capital, but the average income of residents of the region is nearly the lowest in Kazakhstan. For the precise regulation of the policy in the field of providing the population with housing, the government is recommended to control the adequacy of prices in the real estate market in each region at the state level.

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