Dynamics of development of urban housing stock and urban population

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Abstract. The development of urban housing policies needs to be correlated with the demographic development of the city. Demographic dynamics in the world, including Kyrgyzstan, is developing towards the urbanization of the population and the increase in agglomerations. Therefore, in this article, we study the degree of interdependence of urban population growth factors with the dynamics of the housing stock and the volume of commissioning of a new urban dwelling. In particular, the two largest cities of the Kyrgyz Republic were studied – the capital Bishkek and the southern city of Osh, in which more than 60% of the urban population concentrated. On the basis of the analysis, the aim is to establish a unified public housing and demographic policy for cities based on the mutual development of the urban population and urban housing stock. We have considered the historical development of these factors as well with subsequent justification of their prospective or prognostic development in the light of one housing and demographic policy for the strategic urban development plan. On the demographic side, we took indicators of the total permanent urban population and the dynamics of population growth in Bishkek and Osh; on the housing side, we took indicators of commissioning new urban housing, urban housing stock and the availability of housing per person in the city.

Keywords: city, housing stock, urban population, housing security, migration.

1 Introduction

The need to ensure a high level of comfortable accommodation of the urban population is a necessary reality in the context of the global increase in urbanization of the population. And in this context, Kyrgyzstan is no exception. The country has 31 cities of varying status in terms of importance and sharply differing population dynamics. While in many industrial cities the number of urban residents is declining, in Bishkek and Osh the number is

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increasing due to internal migration and a high birth rate among the population. This trend has led to the fact that more than 60% of the total urban population of the republic is concentrated in these cities. And the number of urban populations in the republic is 34% of the total number of citizens. At the same time, today the provision of a city dweller with 14 square meters per citizen is far from the 18 square meters planned by the state. Thus, the urban population is predominantly increasing due to the capital city of Bishkek and the southern city of Osh. They, in turn, are dramatically increasing in number and size due to migrants who move mainly from rural regions. In the process of this deliberate population movement, urban management faces quite a few problems of a social, economic and technical nature. They are exacerbated when there is a disproportionate development between the dynamics of urban population and the dynamics of urban housing stock. In this regard, we consider one of the many issues of interdependent influence of demographic changes in cities on the state of their housing stock and the provision of urban housing this population.

At the same time, the relevance of the study was to solve the problem of ensuring the housing needs of the urban population of the Kyrgyz Republic, which arose as a result of the disproportionate development in time and space of the processes of growth (decrease) in the urban population and increase (decrease) in the volume of urban housing stock.

The article highlights the trend of mutual development of the urban population and urban housing stock with the possibility of forming a unified state housing and demographic policy for regions with high demographic burden.

2 Materials and Methods

2.1 Review of references

The relevance of the matter is reflected in many publications at the international level. In the works of C. H. Mulder [1; 2; 3; 4], G.W. Evans (2000) [5], M. Braubach (2013) [6], Yu Zhang, Haiyan Jin, Yue Xiao and Yumin Gao the importance of this matter is deeply highlighted [7]. In those papers solutions are proposed with in-depth explanations of the correlation between housing sector and the demography, with consideration of health care, migration and the dynamics of households' development. Certain relevance is emphasized in the works of Grabovy P.G. and Kapustkina A.V. on urban development, taking into account environmental, energy issues and signs of the rapid development of the social and economic spheres of the city. [8; 9; 10]. It shall be noted that scientific communities of Russia and Kyrgyzstan, stressing the point on correlation between the housing sector development and demographic trends of cities [11; 12; 13; 14; 15]. In particular, issues concerning the housing construction development and the demography dynamics are considered [16].

2.1 Methodology of the study

The methodology is based on general methods of scientific approach, in particular: statistical review, comparative correlation analysis, synthesis of theoretical and practical materials. For example, the standard Corel program was used to process an array of statistical materials from 1990 to 2021 on population dynamics and urban housing stock. To build forecast indicators up to 2030, the program of long-term forecasting «trend and growth» was used. In the process of consideration of information materials, systematization

methods, classification and grouping of information were used. In addition, during the analysis of the data array, the previous studies' outcomes with convergence of disproportionate factors of development was used. [17]

3 Results

3.1 Dynamics of urban housing development and demography

At the time of the collapse of the Soviet Union and in the first years of Kyrgyzstan's independence, the pace of housing construction was quite high. Then the volume of housing construction is reduced due to the collapse, and the construction industry was in decline. The housing stock closely correlates with the development of the land fund for housing construction. Thus, the jump in the volume of urban housing stock observed in Figure 1 from 2006 to 2012 is explained by political events that occurred in 2005. After the 2005 revolution, the moratorium on the transformation of agricultural land around large cities for housing construction was lifted. In this regard, in 2010, the volume of urban housing stock reached a peak value. But unlike the chaotic dynamics of the urban housing stock, the dynamics of the urban population has a picture of constant and stable growth (Figure 1).

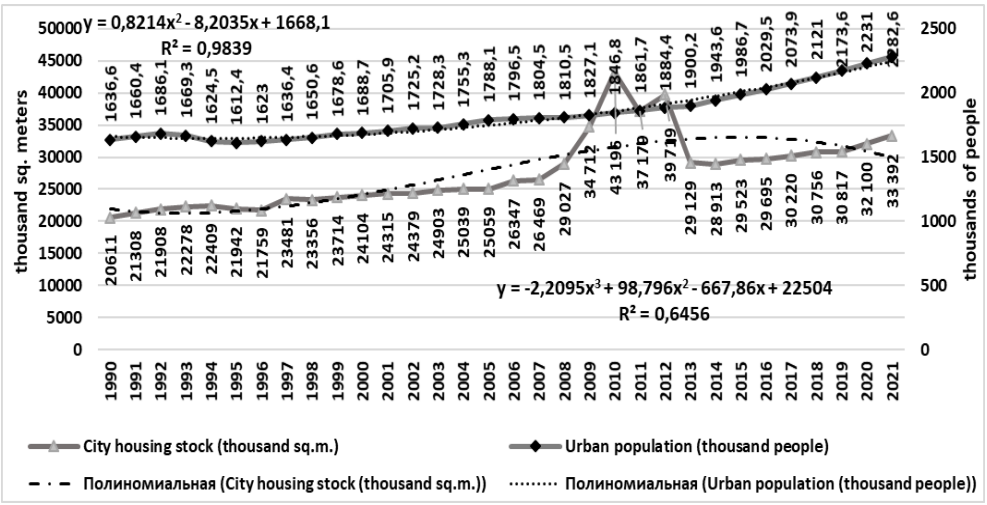

Figure 1. Dynamic picture of the urban housing stock (thousand sq.m.) and the urban population (thousand people) for the period from 1990 to 2021. Полиномиальная - Polynomial

Source: the diagram is constructed by the author according to the data of the NSC of the Kyrgyz Republic for the period from 1990 to 2021 [18]

The historical overview of urban housing stock dynamics shows a stochastic development process and therefore has a complex description function with a low approximation coefficient. The polynomial function looks like this $y = -2{,}2095x^3 + 98{,}796x^2 - 667{,}86x + 22504$, and the confidence factor is 64% or $R^2 = 0{,}6456$. From the end of 2022 to the end of 2023, a sharp increase in the volume of urban housing stock is expected due to the amnesty announced by the President of the Republic in the field of housing construction.

The resulting dynamic highlights the chaotic development of the housing stock with development prospects that are difficult to predict. In these circumstances the only factor suitable to justify this trend is the positive and stable dynamics of the urban population in the context of an unstable growth in the housing stock. The opposite dynamics is shown by the urban population factor for the entire period of independence of the Kyrgyz Republic. The chart looks quite calm with a clear picture of stable growth. The dynamics is described by a quadratic function $y = 0.8214x^2 - 8.2035x + 1668.1$ with a high degree of approximation $R^2 = 0.9839$. That is, further forecasting based on this function will be reliable for 98% of the accuracy to justify trend line development.

Considering the historical development of the urban housing stock and the urban population, we conducted a correlation analysis for the entire period of independence of Kyrgyzstan. The correlation showed the following dependence R(corel) = 0.63159, which indicates the presence of an average dependence of two factors. However, the correlation according to the data of the first difference or the increase in indicators, the correlation showed a value equal to R(corel) = 0.05523, which indicates the absence of a relationship between the two factors (Table 1).

Table 1. Indicators of urban housing development and urban population from 1990 to 2021.

Years	City housing stock (thousand sq.m.)	Urban population (thousand people)	Annual increase in urban housing stock	Annual urban population growth	Total living area per person in the city
1990	20611	1636,6			12,2
1991	21308	1660,4	697	23,8	12,5
1992	21908	1686,1	600	25,7	13
1993	22278	1669,3	370	-16,8	13,7
1994	22409	1624,5	131	-44,8	13,9
1995	21942	1612,4	-467	-12,1	13,5
1996	21759	1623	-183	10,6	13,3
1997	23481	1636,4	1722	13,4	14,2
1998	23356	1650,6	-125	14,2	13,9
1999	23714	1678,6	358	28	14
2000	24104	1688,7	390	10,1	14,1
2001	24315	1705,9	211	17,2	14,1
2002	24379	1725,2	64	19,3	14,1
2003	24903	1728,3	524	3,1	14,2
2004	25039	1755,3	136	27	14
2005	25059	1788,1	20	32,8	13,9
2006	26347	1796,5	1288	8,4	14,6
2007	26 469	1804,5	122	8	14,6

2008	29 027	1810,5	2558	6	15,9
2009	34 712	1827,1	5685	16,6	18,8
2010	43 196	1846,8	8484	19,7	23,2
2011	37 179	1861,7	-6017	14,9	19,7
2012	39 719	1884,4	2540	22,7	20,9
2013	29 129	1900,2	-10590	15,8	15
2014	28 913	1943,6	-216	43,4	14,6
2015	29 523	1986,7	609	43,1	14,5
2016	29 695	2029,5	172	42,8	14,3
2017	30 220	2073,9	526	44,4	14,2
2018	30 756	2121	536	47,1	14,1
2019	30 817	2173,6	61	52,6	13,8
2020	32 100	2231	1283	57,4	14
2021	33 392	2282,6	1292	51,6	14

Source: prepared by the author according to the NSC KR data [18]

3.2 Analysis of the interdependence of population growth in Bishkek and Osh with the commissioning of housing in these cities over the past 10 years

As mentioned above, the peak development of the housing stock from 2009 to 2011 was the result of revolutionary political events. As a result, most of the self-captured lands for individual housing construction around the cities of Bishkek and Osh for migrants were maximally satisfied and legalized in the republic. In this regard, for the purity of the analysis without the participation of political issues, we analyzed only market relations over the past ten years. Although it cannot be ruled out that the cause of such events is economic instability and social tension in the country.

In connection with the active migration of the population in the cities of Bishkek and Osh, it was decided to identify the role of the dynamics of the urban population on the introduction of new housing in these cities over the past ten years. For clarity, the resulting dynamics was shown in graphical form in Figure 2.

In general, population growth in capital cities is quite stable and has a pattern of stable growth. The trend line is ascending and is described by a quadratic function $y = 0.804x2 + 20.642x + 1109.8$ with a high degree of description accuracy equal to 99% or $R^2 = 0.9993$. The risk of population growth in cities in the future is more important than the decline in the population of these cities. However, the dynamics of housing commissioning is moving in the opposite direction and is moving towards a reduction in the volume of new housing commissioning. The function that can describe this trend is quite complex and is described by the following cubic equation $y = -0.0822x3 - 12.99x2 + 154.72x + 176.68$, with an average approximation $R^2 = 0.7686$. In such dynamics, it becomes obvious that there is an increase in the risk of reducing the volume of new housing construction for future periods. This, in turn, will lead to a disproportionate development of the dynamics of population growth and the dynamics of housing commissioning. Moreover, this trend hinders the

development of the indicator as the provision of living space per one city dweller. Table 1 above shows data for the entire urban area of Kyrgyzstan. The growth in the provision of urban residents with living space over a thirty-year period has grown from 12.2 sq. meters in 1990 to 14 sq. meters in 2021, which is absolutely not enough to reach the state-planned 18 sq.m. including rural residents.

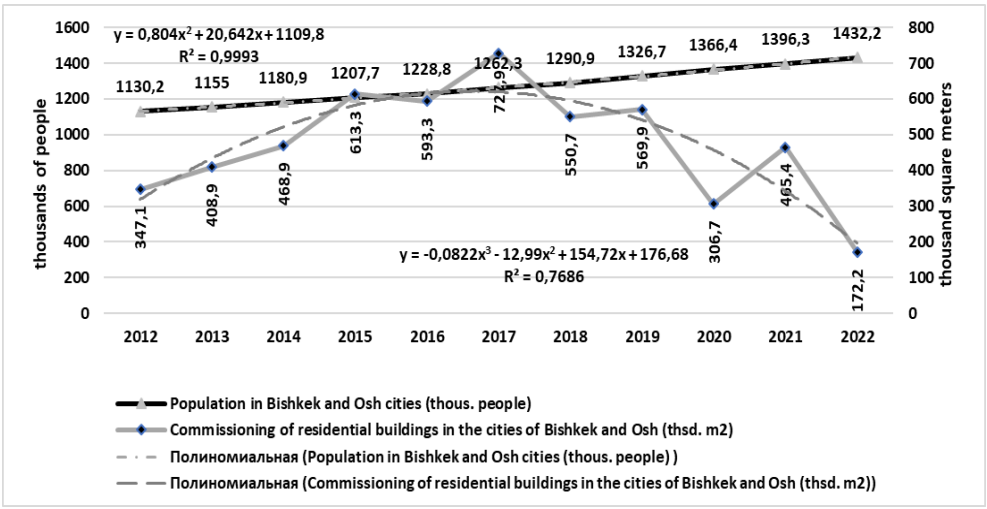

Figure 2. Dynamic picture of population growth in Bishkek and Osh and housing commissioning in Bishkek and Osh for the period from 2012-2022. Полиномиальная - Polynomial

Source: the chart was developed by the author based on data from the NSC KR for the period from 2012 to 2022 [18]

Based on dynamic data, the correlation between population growth in Bishkek and Osh with housing commissioning in these cities over the past 10 years showed an insignificant relationship equal to R(corel)=-0.30589. This confirms the validity of the previous correlation (nationally) and strengthens our findings that urban population does not affect the growth pattern of urban housing demand. So, we came to the conclusion that the growth in demand for urban residential real estate is formed by internal migrants and labor emigrants who transfer money to the country.

4 Discussion

Based on the urban population dynamic development, it can be assumed that the active growth of the urban population will continue in future periods, and the growth of the housing stock would grow as well, assuming the fact of population growth. During the period of high shortage of housing, the government, due to the lack of state building and underfunding of the housing construction industry, is trying to take measures to legitimize the spontaneous seizure of land and illegal construction. It turns out that the population provides for itself in an illegal way, but very effective for the general mass of the population, including the urban one. As an example, is the numerous migratory residential areas around the city of Bishkek, formed after the amnesty or legalized after unauthorized seizure and unauthorized development.

Therefore, the growing number of the urban population has practically no effect on the increase in the volume of the urban housing stock and the active demand in the housing market is formed not by citizens, but either by migrants or rural residents. In particular, according to the National Statistics Committee, it is known that the territory of cities over the previous 10 years has increased by 2500 hectares, due to 24 new residential areas built for migrants [19; 20]. Therefore, the assertion that the demand for housing in cities is formed by migrants is justified, since the relatively low birth rate in urban families compared to rural families and the high proportion of the wealthier urban population leaving for emigration are evident. This situation contributes to the release of a sufficiently large number of urban dwellings for future urban residents.

As a result of the study it was found that population growth could be considered as a subject of influence, and an increase in the volume of the housing stock - an object, and vice versa, when the volume of the existing housing stock can have a significant impact on the demographic dynamics in the country.

The relevance of the results of the conducted research can be demonstrated by solving the problem of predicting for long periods the levels of housing provision of the urban population of the republic. Based on the results obtained on the interdependent dynamics of the housing stock and the population of the republic, these indicators are predicted according to the "trend and growth" program from 2020 to 2030 (Table 2).

Table 2. Dynamics of the population growth (million people), housing stock of the country (million sq.m.) and living space per person (sq.m.) for the forecast period from 2020 to 2030

	2020	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Population million people	6.24	6.32	6.40	6.48	6.56	6.64	6.73	6.81	6.90	6.99	7.08
Housing stock, mln sq.m.	86.579	88.022	89.489	90.981	92.498	94.040	95.608	97.201	98.822	100.469	102.144
Living area per person (sq.m.)	13,86	13,92	13,98	14,03	14,09	14,15	14,20	14,26	14,32	14,38	14,44

Source: prepared by the author according to the NSC KR data [18]

The results of the forecast demonstrated a certain growth dynamic in the projected period, both in terms of the population and housing stock of the country. However, the increase rate in the housing stock cannot be considered satisfactory. The growth of living space per person will be only 4% in 10 years from 2020 to 2030, from 13.86 sq.m. (86.579/6.24=13.86) up to 14.44 sq.m. (102.144/7.08=14.44) respectively. This will not meet the real needs of the country's population.

In the current housing program of the Kyrgyz Republic "My Home" for 2021-2026, the state sets the task of achieving a level of housing provision of 18 sq. m per person [21]. Provided that the achieved growth rates of housing commissioning and the volume of its disposal for various reasons are maintained, it will be impossible to achieve even by 2030 the level of provision of citizens with housing in the amount of 18.0 sq.m. per person. In order to achieve it, there's a need to increase the commissioning of housing to the level of 127,365.7 thousand square meters in a year. That is, to build more volume, at the expense of significant investments, based on a very flat forecast line for the commissioning of housing and the formation of the housing stock, taking into account population growth rates. This should entail the development of drastic measures at the country wide financial and construction-industry levels, providing a breakthrough in the construction of new and

maintaining the existing housing stock within the framework of the "My Home" housing program and its future extensions, as well as in striving for international housing benchmarks – 30 sq.m. per person.

By analogy with the forecast of the dynamics of the population and housing stock for the next 10 years, on the basis of the studies carried out, a forecast of the dynamics of the urban population and the volume of urban housing stock for the period 2020-2030 was carried out (Table 3).

Table 3. Forecast of the dynamics of the housing stock (million sq.m.), population and living space per person (sq.m.) up to 2030

Years	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
City housing stock, million sq m	31.76	31.78	31.81	31.84	31.86	31.89	31.92	31.94	31.97	31.99	32.02
Urban population, million people	2.16	2.20	2.23	2.27	2.30	2.33	2.37	2.40	2.44	2.48	2.51
Residential area per person of the city (sq.m.)	14,66	14,46	14,25	14,06	13,86	13,67	13,48	13,29	13,11	12,92	12,74

Source: prepared by the author according to the NSC KR data [18]

The predictive dynamics of urban parameters confirmed the picture of their development, revealed in the whole country. The growth rate of the housing stock of the growing urban population is clearly insufficient according to the criteria of the country's housing program. In quantitative terms, the provision of urban residents in 2030 will be only 12.7 sq.m. per person against 18.0 sq.m. per person provided for in the program.

So, we can affirmatively say that housing policy should be closely related to the practical demographic situation in the country. In this regard, housing policy must be supplemented with a demographic strategy, which will subsequently form a full-fledged housing and demographic policy of the state. Therefore, the regular implementation of these forecasts based on the proposed methodology will allow the city authorities, as well as at the level of the country, the industries and enterprises involved, to carry out effective monitoring of programs and strategies, processes and results of the housing and demographic policy implementation. On its basis, the necessary measures of a housing and demographic nature in the medium and long term can be developed.

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