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RESEARCH ARTICLE
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Analysing the Real Estate Market in Almaty City: A System Dynamics Approach

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Abstract

The real estate market is a complex system that is influenced by a variety of factors. Understanding the dynamics of this system is crucial for investors, developers, and policymakers who want to make informed decisions. The Massachusetts Institute of Technology (MIT) has developed a powerful tool for analyzing complex systems called System Dynamics. This paper will provide an overview of System Dynamics and MIT analysis, followed by an overview of the real estate market. Finally, we will explore how System Dynamics can be used to analyze the real estate market and make predictions about its future trends. Combining these three supporting points will give us a comprehensive understanding of the real estate market and how it can be analysed using System Dynamic. This article employs the system dynamics modelling approach to shed light on the specific real estate market dynamics in Almaty city. By utilising this methodology, we aim to provide a comprehensive analysis of the real estate market in Almaty, understanding its unique characteristics and uncovering the drivers of price volatility. This article seeks to contribute to the body of knowledge on real estate market analysis by utilising system dynamics modelling to examine the dynamics of the real estate market in Almaty. By leveraging the advantages of this progressive method, we seek to uncover the specific drivers of price volatility and provide valuable insights for policymakers, investors, and other stakeholders. Through this research, we aim to enhance the understanding of the real estate market in Almaty and offer a foundation for evidence-based decision-making in the region.

Keywords: Real Estate Market, System Dynamics, Price Volatility, Demand Supply Model, Causality Effect

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1. INTRODUCTION

Today, the real estate market is an integral part of the economic growth of any country. Real estate and the level of its development are important both economically and socially since it satisfies one of the basic human needs - the need for housing. For a significant part of the population, housing is the main source of wealth, a condition for preserving the family and supporting psychological balance and confidence. Features of the current state of development of the economy, which has entered a phase of recession and is just beginning to recover, real estate market research is becoming particularly relevant.

Analysing real estate markets and understanding the factors driving price volatility is of utmost importance in today's dynamic economic landscape. Real estate markets worldwide exhibit various levels of volatility, making it crucial to conduct thorough analyses to comprehend the underlying reasons behind price fluctuations. Numerous studies have been dedicated to explaining market volatility and identifying the factors that contribute to rising prices. However, it is essential to recognize that there is no universal answer applicable to every country or region. Each locality requires its analysis to grasp the true dynamics at play.

System dynamics is an approach to understanding complex systems that emphasizes the importance of feedback loops and time delays in shaping their behaviour. This approach was pioneered by Jay Forrester, a professor at the Massachusetts Institute of Technology (MIT), who developed a series of computer models to simulate the behaviour of social and economic systems. Forrester's work on system dynamics has influenced fields ranging from business management to environmental policy. One key insight into system dynamics is the importance of looking beyond simple cause-and-effect relationships and instead focusing on the complex feedback mechanisms that can cause systems to behave in unexpected ways. Another important contribution of system dynamics is its emphasis on the role of time delays in shaping system behaviour. By modelling how actions taken today can have long-term effects, Forrester's work has helped policymakers and business leaders better understand the consequences of their decisions. Overall, the system dynamics approach and the MIT analysis developed by Forrester and his colleagues have been instrumental in advancing our understanding of complex systems and shaping policy decisions in a wide range of fields (Forrester et al., 1976; Foster, 2002; Baryla & Ztanpano, 1995; Norris & Byrne, 2018).

Many methods of real estate valuation depend on the direct ownership and management of it, as they are influenced by social, economic and institutional factors, emerging risks and the taxation system. This requires finding new ways to evaluate real estate and the ability to take a global look at many current and future processes, to see their relationship and mutual influence, as well as the ability to determine strategic directions and prospects for the development of this type of market. In addition, the real estate market refers to the resource market, then it is affected by other factors that are characteristic of the resource market. This is not only competition, the level of labour costs, demand, the level of profitability, and the state of the financial sector, but also the conditions for the functioning of this market, characteristic of the existence of a market pricing mechanism.

Various factors, including demographic trends, interest rates, and consumer confidence drive demand for real estate. Economic conditions, such as GDP growth and unemployment rates, also significantly shape the real estate market. In addition, government policies and regulations can impact the market through measures such as tax incentives and zoning laws. Overall, the real estate market is a complex system that is shaped by a range of economic, social, and political factors, and understanding these dynamics is essential for policymakers, investors, and industry professionals alike. Real estate prices have been a topic of interest for economists and investors

for decades. Thus, this paper employs the system dynamics modelling approach to shed light on the specific real estate market dynamics in Almaty city.

2. LITERATURE REVIEW

The real estate market is a crucial component of any economy, and its performance can have significant impacts on economic growth and stability, according to 1. Antolin-Diaz et al. (2017), the real estate market is affected by various factors, including supply and demand forces, the state of the overall economy, and government policies and regulations. One major market aspect is the supply of available properties, which can be influenced by factors such as the level of new construction and the rate of foreclosures and bankruptcies (Albanesi et al., 2022). One historical trend in real estate prices is the cyclical pattern of booms and busts. According to Duca et al. (2021), these cycles are often driven by changes in interest rates, economic growth, and consumer confidence. For example, during the early 2000s, interest rates were low, and the economy was strong, leading to a boom in real estate prices (Norris & Byrne, 2018). However, when the housing bubble burst in 2008, it resulted in a major recession and a significant drop in real estate prices. Another historical trend in real estate prices is the impact of location. Real estate prices in desirable locations tend to be higher than those in less desirable areas. This trend has been observed throughout history, from the early days of urbanization to modern times. Additionally, there is a strong correlation between population growth and real estate prices. As populations increase, demand for housing also increases, leading to higher prices. Overall, historical trends in real estate prices are influenced by various factors, including interest rates, economic growth, location, and population growth (Norris & Byrne, 2018).

Various factors, including external factors, influence real estate prices. According to Girdzijauskas et al. (2022), external factors that affect real estate prices include economic growth, interest rates, inflation, and government policies. Economic growth impacts real estate prices by increasing property demand, leading to higher prices. Interest rates have a direct effect on the affordability of mortgages, which affects the demand for properties. Low-interest rates make it easier for people to obtain a mortgage, leading to increased demand and higher prices. Inflation also affects real estate prices, reducing the purchasing power of money, and making it more expensive for people to buy properties (Sitorus et al., 2022). Finally, government policies, such as tax incentives and zoning regulations, can significantly impact real estate prices. For example, tax incentives can encourage property investment, leading to higher demand and prices, while zoning regulations can limit the supply of properties, leading to higher prices. In conclusion, external factors such as economic growth, interest rates, inflation, and government policies play a crucial role in determining real estate prices (Olamide et al., 2022; Muellbauer, 2022).

Several internal factors affect real estate prices. The first factor is location. Properties located in prime locations, such as those near the city centre or in exclusive neighbourhoods, tend to have higher prices compared to those located in less desirable areas (Ali & Chua, 2023). The second factor is the condition of the property. A well-maintained property with modern amenities such as air conditioning, a swimming pool, and a security system will have a higher value than a poorly maintained property with modern amenities. The third factor is the size of the property. More extensive properties tend to have higher prices compared to smaller properties due to the perceived value of having more space. The fourth factor is the demand and supply of properties in the area. Prices tend to increase when demand is high and supply is low. Conversely, prices tend to decrease when demand is low, and supply is high. The fifth factor is the financing options available to buyers. When financing options are readily available, and interest rates are low, buyers are more likely to purchase properties, leading to increased demand and higher prices. Overall, these internal factors play a crucial role in determining the value of real estate properties

and should be considered by buyers and sellers (Deng et al., 2022).

The real estate market is a complex system influenced by various factors such as economic conditions, demographic changes, and government policies. Analysing this market through the lens of system dynamics can provide valuable insights into its behaviour and help identify key drivers of change. System dynamics can be used to model the interactions between different components of the real estate market, such as supply and demand, prices, and investment. By analysing these interactions, researchers can identify feedback loops and other dynamic mechanisms that contribute to the overall behaviour of the market. For example, a positive feedback loop between rising prices and increasing demand can create a bubble in the market. In contrast, a negative feedback loop between falling prices and decreasing demand can lead to a market downturn. By understanding these dynamics, policymakers and investors can make more informed decisions about managing the market and mitigating potential risks. Overall, system dynamics is a powerful tool for analysing the real estate market and can provide valuable insights into its behaviour and future trends.

3. METHODS OF RESEARCH

System dynamics modelling offers several advantages for conducting research in the real estate domain. Firstly, it enables the examination of complex feedback loops and interactions among various factors influencing market dynamics. Real estate markets are highly interconnected systems, affected by factors such as supply and demand, economic conditions, government policies, and investor behaviour. System dynamics modelling allows us to capture these intricate relationships and simulate their effects over time. Secondly, system dynamics models facilitate scenario testing and sensitivity analysis. By manipulating different variables within the model, we can assess the impacts of various policy interventions, economic changes, or external shocks on the real estate market. This capability aids policymakers and stakeholders in making informed decisions and formulating effective strategies to manage volatility and ensure market stability.

Furthermore, system dynamics models can incorporate quantitative and qualitative data, allowing for a holistic market understanding. By integrating historical market data, expert opinions, and real-world observations, we can enhance the accuracy and reliability of our analysis, providing a comprehensive picture of the Almaty real estate market.

System dynamics methodology is a tool that is used to model and analyse complex systems. It is a powerful tool that helps understand complex systems' behaviour over time. System dynamics methodology is based on the concept of feedback loops and stocks and flows. Feedback loops are the processes that help regulate the system's behaviour. Stocks, on the other hand, are the accumulations of resources or materials over time. Flows represent the rate at which resources or materials move into and out of the stocks. The dynamics of a system are influenced by the interactions between feedback loops, stocks, and flows. System dynamics methodology helps identify the key feedback loops that drive the behaviour of a system (Uriona & Grobbelaar, 2019). It also helps identify the stocks and flows that are critical to the system's behaviour. System dynamics methodology is helpful in a wide range of applications, such as business strategy, public policy, and environmental management. It helps in understanding the complex interactions between different components of a system and helps in identifying the leverage points for intervention. Overall, the system dynamics methodology provides a powerful tool for understanding the behaviour of complex systems and can be used to inform decision-making in a wide range of applications.

System dynamics methodology has been applied to various real-world scenarios to analyse and understand complex systems. According to Forrester, system dynamics is a methodology for

studying and managing complex feedback systems, such as those found in business, economics, engineering, and biology (Forrester et al., 1976). System dynamics methodology has been applied in various fields such as healthcare, environmental studies, and economics. For example, a study conducted by Sterman et al. applied system dynamics methodology to the healthcare system to analyse the impact of policy changes on healthcare costs and quality (Malakoane et al., 2020). The study concluded that policy changes could positively and negatively impact the healthcare system and that using system dynamics methodology can aid in the decision-making process. Furthermore, system dynamics methodology has also been applied to environmental studies to analyse the impact of climate change on natural resources. The methodology can aid in predicting the future state of the environment and assist in developing policies and strategies to mitigate the impact of climate change. Overall, using system dynamics methodology in real-world scenarios has proven to be a valuable tool in analysing and understanding complex systems and aiding decision-making.

The System Dynamics (SD) methodology is widely used to model complex systems, such as water resource management. However, it is essential to critically analyse the limitations of this methodology to ensure its proper application. Cumbo et al. (2020) identified several limitations of the SD methodology. One of the limitations is the difficulty of calibration and validation of the models. The models are based on numerous assumptions, which can lead to incorrect predictions if the assumptions are not tested and validated. Another limitation is the lack of transparency in the modelling process. The models are often complex and challenging to understand, which can make it hard for stakeholders to participate in the decision-making process. Furthermore, the models may not incorporate all the relevant factors influencing the system behaviour, leading to an incomplete understanding of the problem. Finally, the SD methodology may not be suitable for problems that involve nonlinear and discontinuous relationships, which can be challenging to model. Overall, while the SD methodology helps model complex systems, it is important to recognize and address its limitations to ensure its proper application.

In our model, the demand is determined by considering the population of Almaty citizens, specifically potential buyers who can purchase flats in the city. Almaty is known for its high prices, resulting in a lower willingness to pay among potential buyers than other cities. To estimate potential buyers, we divided the net increase in population by 4, representing the average number of families expected to acquire flats (see Figure 1).

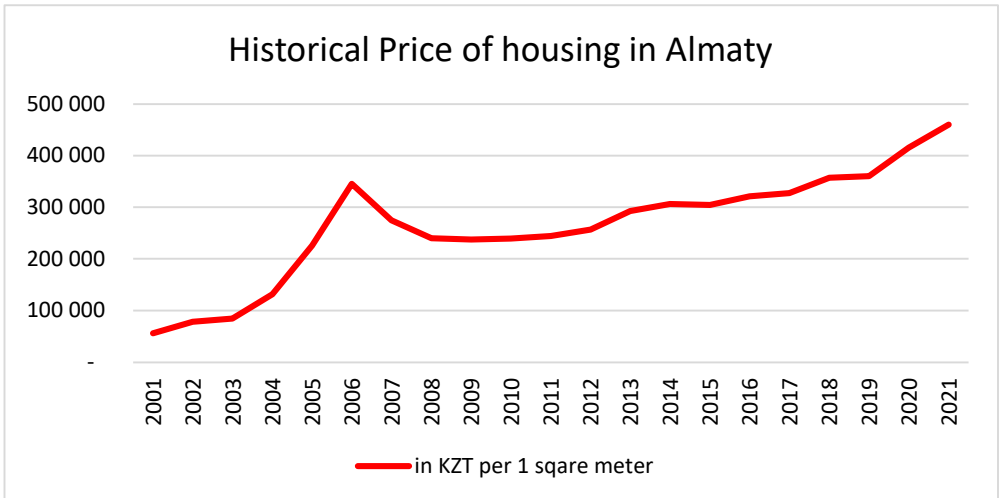

FIGURE 1. Historical price of flats in Almaty city for 2001-2022

Note: compiled by authors

On the other hand, the supply side consists of construction companies. The residential building construction market in Almaty is characterized by intense competition, which encourages innovation and provides city residents with improved housing options.

The first step is to identify the real problem and the client, which in this case is the volatility and unpredictability of pricing in Almaty, with construction companies as the client. To analyse the feedback structure of the system, we utilized Causal Loop Diagrams (CLDs). CLDs are versatile tools that visually depict the causal links between variables, indicating the cause-effect relationships through arrows. These diagrams are particularly useful for mapping the feedback structure of complex systems and capturing the mental model of the client team in the early stages of the project.

The behaviour of a system is generated by its feedback structure, which consists of fundamental patterns such as exponential growth, goal-seeking, and oscillation. Exponential growth is driven by positive feedback processes, goal-seeking by negative feedback, and oscillation by negative feedback with delays. More complex behaviour patterns, such as S-shaped growth, overshoot, and collapse, arise from the nonlinear interaction of these basic feedback structures. Understanding these patterns helps modellers discover the feedback loop structure of a system based on observed behaviour.

Positive feedback loops, also known as reinforcing loops, are denoted by a + or R, while negative loops, referred to as balancing loops, are denoted by a - or B. To determine if a loop is positive or negative, one can count the number of negative links within the loop. If the number of negative links is even, the loop is positive; if it is odd, the loop is negative. This rule works because positive loops reinforce change, while negative loops self-correct and oppose disturbances.

In our model, we consider two types of variables: Stocks and Flows. Stocks are represented by rectangles, symbolizing containers that hold the contents of the stock. Inflows are depicted by pipes (arrows) pointing into the stock, indicating the addition to the stock. Stocks introduce delays by accumulating the difference between the inflow and outflow of a process.

By utilizing these methodologies and understanding the feedback loop structure of the system, we can gain insights into the dynamics of the real estate market in Almaty and address the pricing volatility and unpredictability issues.

4. RESULTS AND DISCUSSIONS

The model is created by inputting the stocks, flows, variables and constants (auxiliaries) into an appropriate system dynamics modelling tool – Vensim PLE was used for the simulation in this paper, however, any similar simulation software is just as viable. The model is constructed by first creating the outline by selecting all of the necessary components, and then by inputting equations for these components based on Table 4. These equations are based on assumptions outlined in previous sections of this paper. In order to launch the model, first of all, we made a Causal-Loop Diagram with six loops reflecting the demand and supply of the real estate market (see Figure 2).

For this model, demand is considering the population of Almaty citizens, exactly potential buyers who are capable of purchasing flats in this city. Almaty is famous for its high prices, subsequently, willingness to pay is less in terms of purchasing by potential buyers, in comparison to other city conditions. In order to find potential buyers, we divided the net increase of population by 4, as an average number of families.

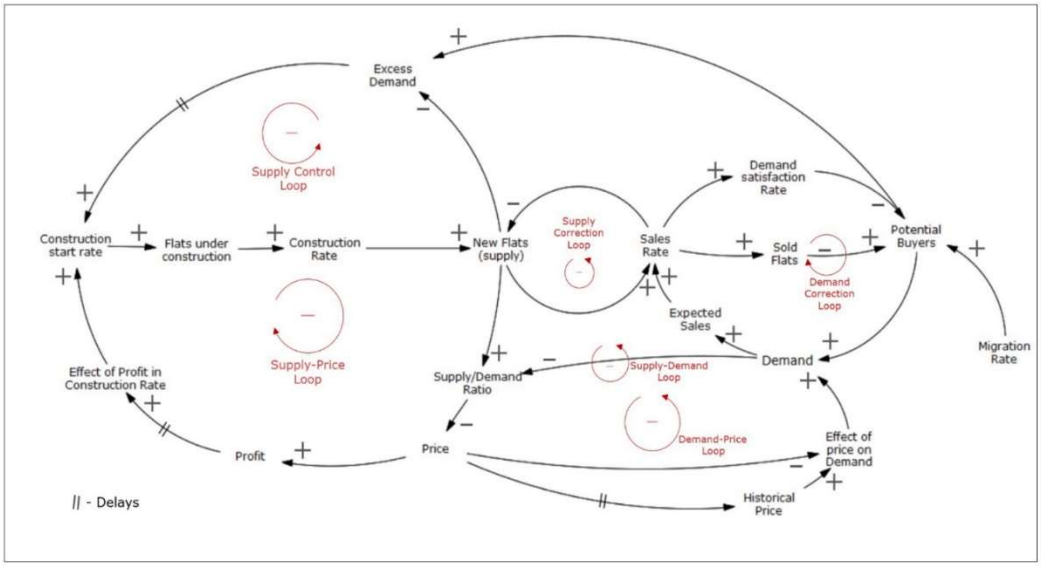

FIGURE 2. Causal and loop diagram of the real estate market in Almaty city

Note: compiled by authors

On the other hand, supply includes construction companies. Fierce competition exists in Almaty's residential building construction market, and it encourages innovation and gives city residents better homes. In this model, we identified expected cost and profit, deeply involved in understanding the mechanism of construction trends.

In our analysis, we focus on the Supply-Demand Loop, which is depicted in Figure 3.

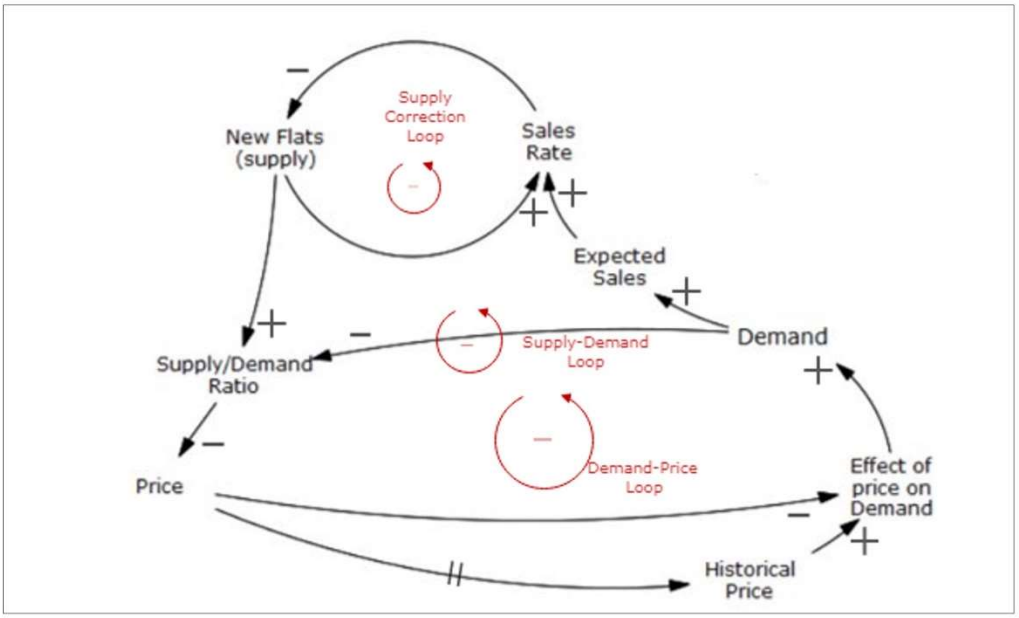

FIGURE 3. Supply-Demand Loop

Note: compiled by authors

This loop consists of several interconnected variables: Sales rate, New Flats (Supply), Supply-Demand (S/D) ratio, Price, Historical price, Effect of Price on Demand, Demand, and Expected Sales. When there is an increase in New Flats (Supply), it leads to a rise in the S/D ratio. Consequently, the increased ratio causes a decrease in Price, which, after a certain delay, impacts Historical Price. Simultaneously, Price negatively influences the Effect of Price on Demand. As a result, Demand, Expected Sales, and Sales rate are affected positively. Ultimately, the Sales rate has a negative effect on New Flats (Supply), leading to a decrease. By counting the number of negative links in this loop, we find that there are three, which is an odd number. This indicates that the loop is a balancing (negative) loop. The Supply-Demand Loop demonstrates the relationship between various factors in the real estate market. Changes in New Flats (Supply) have a cascading effect on the S/D ratio, Price, Historical Price, and other variables, ultimately influencing Demand and Sales rate. This loop plays a crucial role in maintaining a balance between supply and demand dynamics in the market.

This loop involves the variables Price, Historical Price, Demand, Effect of Price on Demand, and the Supply-Demand (S/D) ratio. In the Demand-Price Loop, there is a reverse relationship between Demand and the S/D ratio. When Demand appreciates or increases, it leads to a decrease in the S/D ratio. Additionally, this increase in Demand has a positive effect on Price and influences the Effect of Price on Demand in a favourable manner. By counting the number of negative links in this loop, we find that there is one, which is an odd number. This indicates that the loop is a balancing (negative) loop.The Demand-Price Loop demonstrates the interplay between Price, Historical price, Demand, the Effect of Price on Demand, and the S/D ratio. The loop illustrates how changes in Demand affect the S/D ratio, Price, and the relationship between Price and Demand. It plays a crucial role in maintaining a balanced dynamic between price levels and demand in the real estate market.

The next significant loop is Demand-Price Loop depicted in Figure 4.

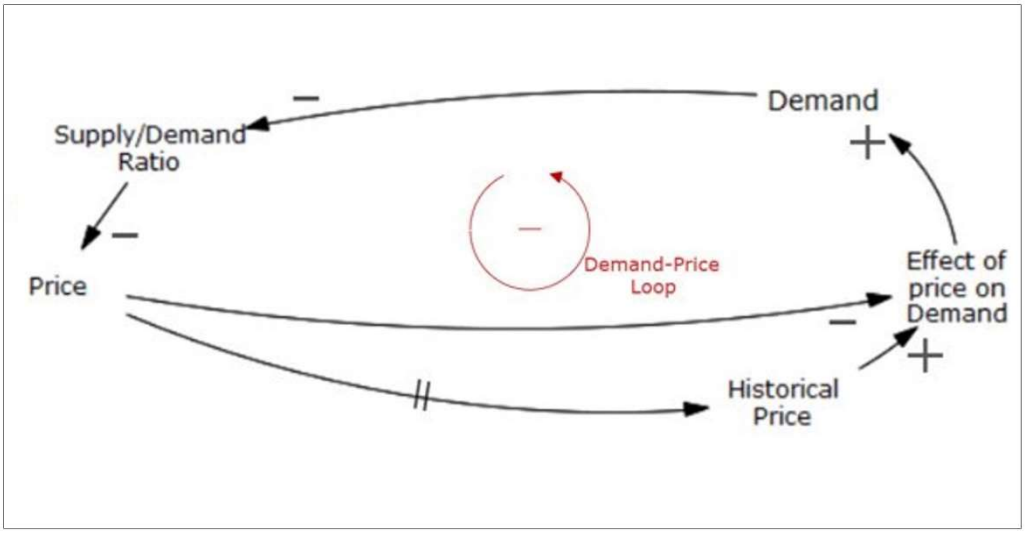

FIGURE 4. Demand Price Loop

Note: compiled by authors

The Supply-Price Loop, illustrated in Figure 5, encompasses the following variables: Construction start rate, Flats under construction, Construction rate, New flats (Supply), Supply-Demand (S/D) ratio, Price, Profit, and the Effect of Profit on Construction start rate. When there

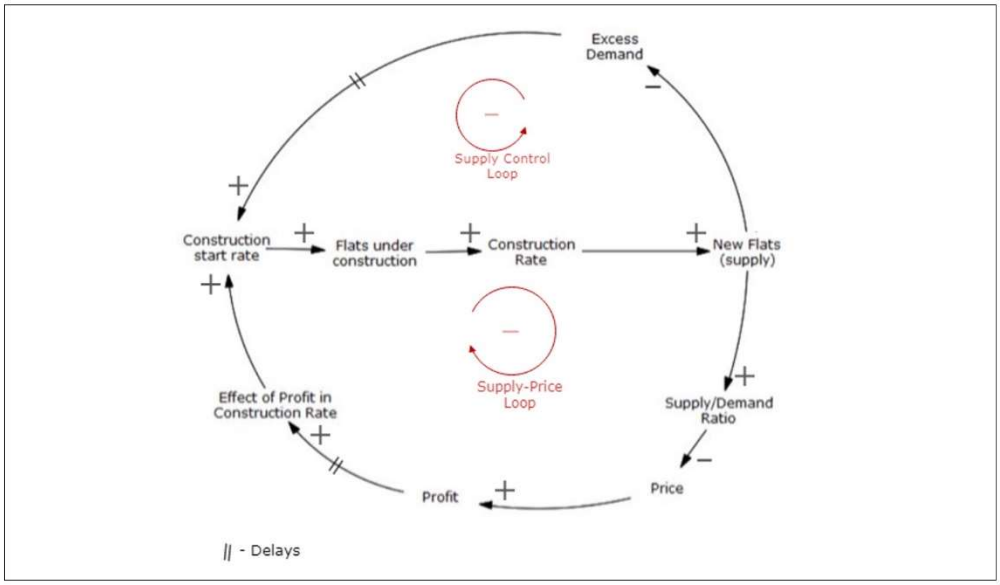

FIGURE 5. Supply Price Loop

Note: compiled by authors

is an increase in the Supply of real estate, it leads to a growth in the S/D ratio. Consequently, the increased ratio causes a decrease in Price and Profit. After a certain delay, this decrease in Profit impacts the Effect of Profit on the construction start rate. Ultimately, this effect influences the Construction start rate. In summary, the Supply-Price Loop demonstrates the relationship between various variables involved in the real estate market. An increase in Supply affects the S/D ratio, Price, and Profit, and ultimately influences the Construction start rate. This loop plays a significant role in understanding supply dynamics and its impact on price and profitability in the real estate market.

In order to quantify the flow and stocks within our model, we have identified a total of 23 variables, categorized as either stocks or flows. These variables are presented in Table 1.

TABLE 1. Flow and Stock Variables of the Model

No.	Type	Variable	Description
1	Flow	Construction preparation time	Represents the time taken for construction preparation. Measured in years. Initial value: 0.5.
2	Flow	Construction start rate	Indicates the rate at which new construction projects begin. Measured in flats per year. Equation: MAX(0, Replacement Flats + (Flats Shortage/Construction Preparation Time) * Effect of Profit on Construction Start Rate.
3	Flow	Construction time	Represents the duration of construction for each project. Measured in years. Constant value: 2.
4	Flow	Construction rate	Refers to the rate at which construction progresses. Measured in flats per year. Equation: Flats Under Construction/Construction Time.

5	Flow	Replacement flats	Represents the number of flats being demolished and replaced.
6	Stock	Flats under construction	Represents the current number of flats under construction. Calculated as Construction Start Rate minus Construction Rate. Initial value: Construction Start Rate multiplied by 3.
7	Stock	New flats	Represents the number of newly constructed flats available for sale. Calculated as Construction Rate minus Sales Rate. Initial value: 12,000.
8	Stock	Sold flats	Represents the number of flats sold per year. Calculated as Sales Rate minus Demolishing. Initial value: 5000.
9	Flow	Sales rate	Indicates the rate at which flats are sold. Measured in flats per year. Equation: New Flats divided by Sales Time.
10	Flow	Sales time	Represents the average time it takes to sell a flat. Measured in years. Constant value: 1.
11	Flow	Flat's life	Represents the expected lifespan of a flat. Measured in years. Constant value: 50.
12	Flow	Demolishing	Represents the rate at which flats are demolished. Measured in flats per year and calculated as Sold Flats divided by the Flat's Life.
13	Flow	Demand	Represents the demand for flats. Measured in the number of flats required and calculated as Increase of Population divided by 4.
14	Flow	Increase of Population	Represents the rate of population growth. Measured in the number of families. Initial value: 40,000.
15	Flow	Supply/Demand ratio (S/D ratio)	Represents the ratio of the supply of flats to the demand for flats. Measured as a unitless value and calculated as Flats Shortage divided by Demand.
16	Flow	Flats Shortage	Represents the shortage of flats in the market. Measured in the number of flats and calculated as Demand minus Sold Flats.
17	Flow	Price	Represents the price of a flat. Measured in KZT (Kazakhstani Tenge). Calculated as Cost multiplied by Accepted Profit Margin.
18	Flow	Profit margin	Represents the profit margin for each flat. Measured as a unitless value and calculated as 1.25 multiplied by the S/D ratio.
19	Flow	PROFIT	Represents the profit generated from each flat. Measured in KZT. Calculated as Price minus Cost.
20	Stock	Accepted profit margin	Represents the predetermined profit margin for each flat.
21	Flow	Cost	Represents the cost of constructing each flat. Measured in KZT. Initial value: 30,000.
22	Flow	Effect of Profit on Construction start rate	Represents the impact of profit on the rate of new construction projects. Measured as a unitless value and calculated as one divided by (Normal Profit divided by Profit).

23	Flow	Normal profit	Represents the standard profit earned from each flat. Measured in KZT. Calculated as Cost multiplied by Profit Margin.
Note: compiled by authors			

We have ensured that sufficient historical data is available for each variable, spanning from 2000 to the present. Therefore, our analysis is based on a comprehensive time horizon of 22 years. After implementing the equations and data into the Vensim system, the model depicted in Figure 6 was generated.

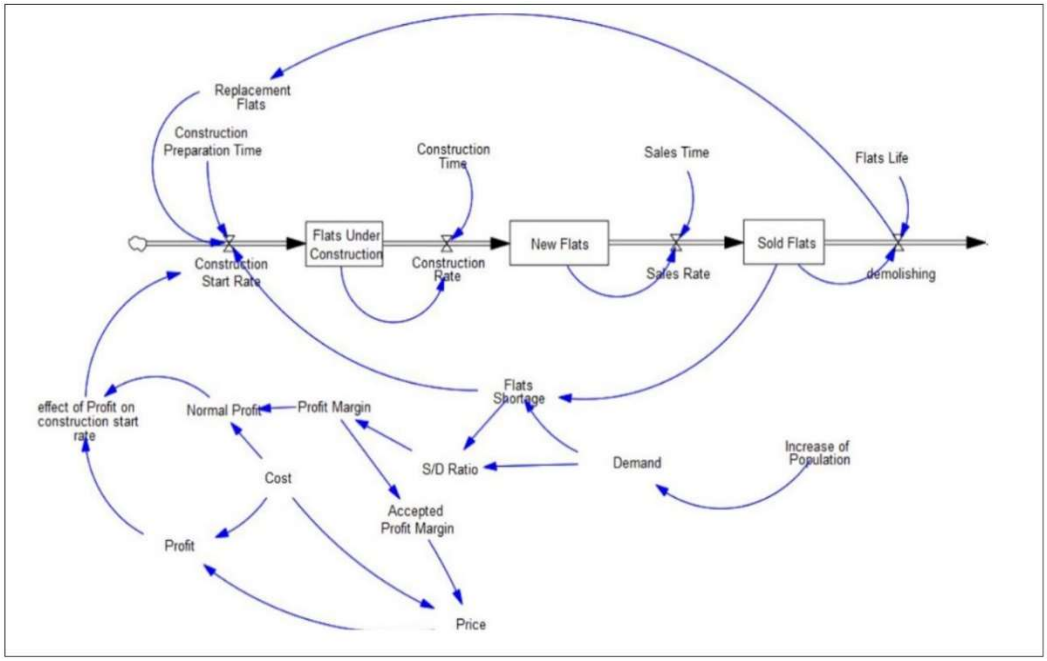

FIGURE 6. Vensim Model Visualization of Real Estate Market Dynamics

Note: compiled by authors

The Vensim program allows us to modify constant variables, such as construction time and construction preparation time, and observe the resulting impact on the entire system. This interactive platform allows us to explore different scenarios and assess their effects on the model's behaviour and outcomes, as shown in Figure 6.

The implemented model facilitated the identification of critical stocks and flows that significantly impact the real estate market, particularly in relation to the volatility of prices observed over the past 23 years. The aim was to investigate the underlying imbalance between demand and supply factors contributing to this volatility. To isolate the influence of various factors on price stability, an experiment was conducted wherein the historical price of flats per 1 square meter was removed from the model. This allowed for the observation of system behaviour and the identification of periods characterized by stable and volatile price trends.

Figure 7 illustrates the outcomes of this experiment, highlighting the fluctuations in price over time.

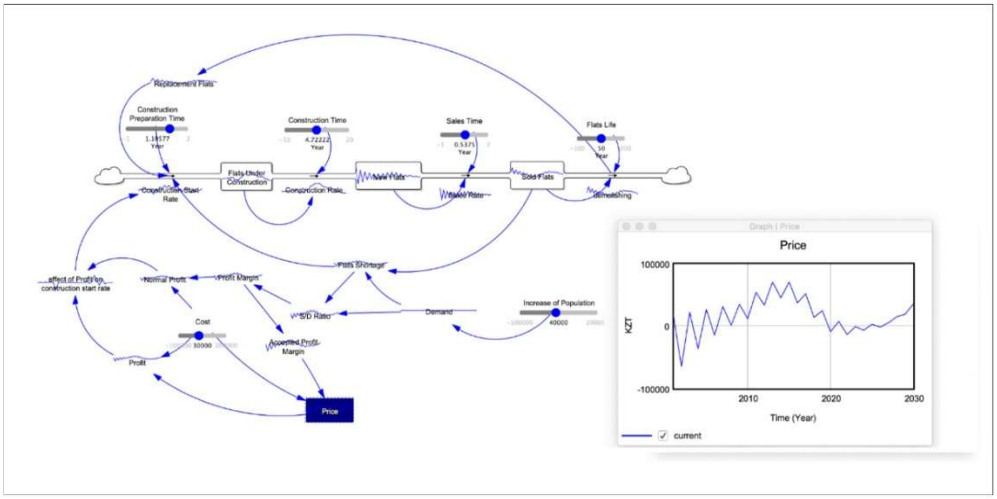

FIGURE 7. Simulation Results of Price Stability in the Real Estate Market

Note: compiled by authors

By examining the periods of stability and volatility, valuable insights were obtained regarding the dynamic interplay between demand and supply, as well as the factors that contribute to price imbalances. These findings hold significance in comprehending market conditions and devising strategies to mitigate volatility, fostering a more stable real estate market environment.

As illustrated in Figure 8, the oscillations in prices can be explained by modifying the Construction preparation time from 6 months to 4 months and the Construction time from 1 year to 8 months.

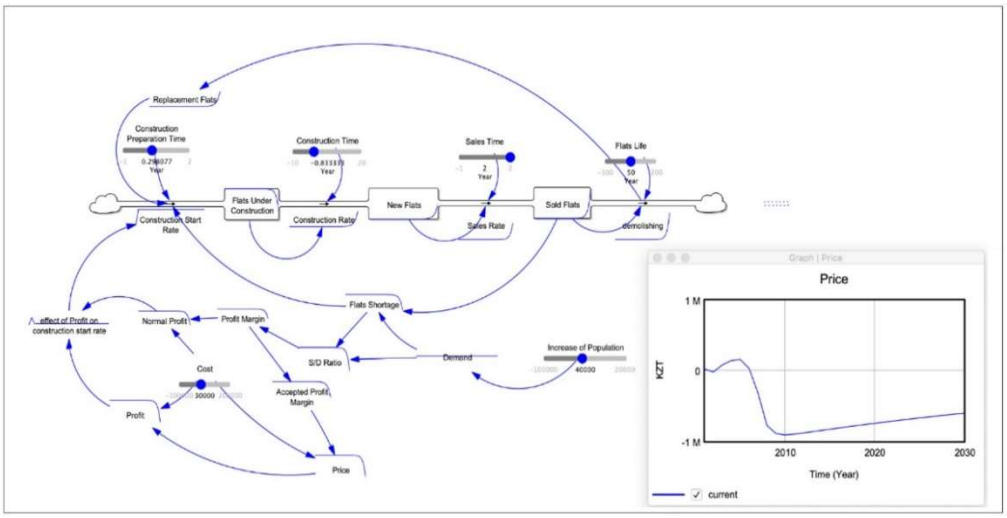

FIGURE 8. Model when the price is stable

Note: compiled by authors

Based on these observations, it can be inferred that a more balanced equilibrium between Supply and Demand can be achieved by decreasing the construction preparation time and construction time.

5. CONCLUSION

In conclusion, the system dynamics MIT analysis of the real estate market provides valuable insights into the complex interactions and feedback loops that drive this critical sector of the economy. By using advanced modelling and simulation techniques, researchers can explore how different factors, such as interest rates, supply and demand, and government policies, affect the behaviour of buyers, sellers, and investors. This analysis can inform policymakers, investors, and industry leaders as they make decisions about how to manage and develop the real estate market. Ultimately, the system dynamics MIT analysis offers a powerful tool for understanding the real estate market dynamics and developing strategies to support its sustainable growth.

The construction rate is an essential factor in the supply side of the real estate market. An increase in the construction rate leads to an increase in the supply of housing units, which, in turn, reduces real estate prices. Conversely, a decrease in the construction rate leads to a decrease in the supply of housing units, which increases the prices of real estate. This relationship is supported by the law of supply and demand, which states that an increase in the supply of a commodity leads to a decrease in its price. In contrast, a decrease in the supply of a commodity leads to an increase in its price. Therefore, a high construction rate results in a surplus of housing units, which lowers real estate prices, while a low construction rate results in a shortage of housing units, which drives up real estate prices.

Various factors, including economic growth, population dynamics, government policies, interest rates, and infrastructure development, influence the real estate market in Almaty city. The demand for housing is shaped by population growth, changing demographics, investment potential, government initiatives, and cultural factors. On the other hand, the supply of real estate is determined by builders in Almaty city, offering diverse housing options, construction quality, and competition among developers. Real estate markets exhibit cyclic behaviours, with oscillations in market conditions such as property prices, demand, and supply. These cycles are a natural part of the real estate market, often caused by imbalances between demand and supply resulting from delays in construction preparation and execution. In our Vensim program, we considered scenarios with long delays in these variables and observed price fluctuations, while shorter delays resulted in price stability.

We recommend implementing technological and managerial strategies to reduce construction delays based on our findings. By decreasing construction times by 50%, we can expect a gradual decrease in price cycles over time. Shortening the time spent on preparation activities allows for faster project completion and delivery, enabling quicker occupancy and revenue generation. Additionally, reduced preparation time provides flexibility to adapt to changing market demands or project requirements, enhancing the project's appeal and value. In a competitive real estate market, faster project delivery can give developers an advantage by attracting buyers, tenants, or investors who prioritize timely completion and occupancy, thereby improving marketability and profitability.

Furthermore, we suggest that construction companies have access to information on "Flats under construction" when initiating new projects. This data can assist in avoiding excessive supply and oscillations in the model by ensuring that only the necessary number of flats are built. By implementing these recommendations, the Almaty real estate market can experience more stable and efficient dynamics, leading to enhanced market performance and sustainable growth.

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