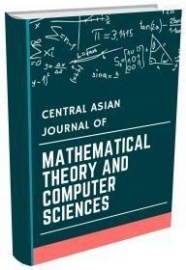

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Article

Prices of Building Materials and Their Impact on Residential Growth Trends in Iraq

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Abstract: This research discusses and applies a study on the impact of changes in the prices of building materials on residential expansion and the construction or renovation of new units in Iraq. The aim was to determine the extent of the impact of price fluctuations in building materials on urban expansion and to identify the most important materials affected by this change. The researcher relied on a descriptive analytical approach, collecting information on the study variables based on publications by the Central Statistical Organisation of Iraq, the International Monetary Fund. Some variables were adopted, represented by the dependent variable, which is the number of housing units (number of building permits granted for construction or renovation), in addition to four independent variables represented by three building materials considered essential for construction, namely bricks, cement and reinforcing steel, and a fourth variable, which is the (estimated) per capita income NGDPOPC, based on the annual publication of the International Monetary Fund. The time period ranges from 2015 to 2023. The data was analysed using a descriptive analytical approach and some statistical methods, the most important of which was the variance inflation factor (VIF) to measure the absence of linear multicollinearity . and the Pearson criterion was used to measure the correlation between the dependent variable and other variables . Finally, a regression equation was derived to predict the number of housing units according to price changes. The results indicate a strong correlation between the number of units and the prices of building materials, and that the relationship between the variables is statistically significant. Therefore, the hypothesis that there is a statistically significant level and that the four independent variables all affect the model to varying degrees is accepted, noting that the most influential material is the price of bricks, as the higher the price of bricks, the lower the number of units, and that per capita income has a direct effect on the increase in the number of units, as an increase in per capita income leads to an increase in the number of units. brick prices rise, the number of units decreases, and per capita income has a direct effect on the increase in the number of units, as an increase in per capita income leads to an increase in the number of units.

Keywords: Building Materials Prices, Residential Expansion, Estimated Per Capita Income NGDPOPC, Linear Regression

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1. Introduction

The construction sector is one of the most important sectors due to its social, political and economic significance. The construction sector is considered a major economic activity because it relies heavily on labour and the consumption of construction materials, and for these reasons it is a key driver of an important part of the economy. Its link to reducing unemployment and the consumption of building materials, as well as the development of

the construction sector, has had a significant social impact on the development of infrastructure and everything related to it. The construction sector is greatly affected by fluctuations if policies and plans are unclear. The construction sector in Iraq has recently been going through a real crisis, as before 2014, the sector was operating randomly and was unstable due to the unstable political and economic conditions. Although the years 2009-2012 saw a notable increase in construction growth, it quickly experienced a sharp decline, especially when oil prices fell in 2014 and the country was attacked by ISIS [1]. Irregular residential and urban expansion patterns have led to environmental degradation. It is therefore important to evaluate innovative construction methods and the use of renewable energy, which in turn will contribute to enhancing environmental resilience and improving housing quality [2]. It should be noted that the construction sector in general receives a large share of private and public investment, most of which is in northern Iraq, where the construction sector is the main destination for private investment. According to statistics, approximately 40% of investments are in the construction sector, and in the coming period, the construction sector is expected to recover due to the stabilisation of the security situation, the improvement of the political situation, the stabilisation of oil prices, and the reduction in military spending, which will lead to the financing of construction and housing, as well as the return of local and foreign investment and broader growth [1]. Building materials are among the most important factors that may affect the nature of residential expansion. Each region is characterised by its geographical location and the choice of building materials that are suitable for the geographical environment, which can be fundamental and important for sustainable environmental expansion in the future. Iraq is characterised by diverse terrain and environments across its geography, whether in the north, centre or south, where building materials such as cement, bricks, blocks, clay, straw, wood, reinforced steel, etc. are used. These are among the most common building materials used in construction in this region [3]. Some studies focusing on the residential sector point to problems in this sector, including regulatory structure, low productivity, and weak monitoring of competitive factors such as cost, flexibility, innovation, quality, and time, which in turn directly affect this sector [4]. Building materials have a significant impact on the quality and cost of any construction project, and therefore have a direct impact on the quality and cost of any construction project. It is therefore important for those interested in construction to understand that the prices of materials and construction have a direct impact on real estate development. Delays in construction development and delays or cancellations of real estate projects are often linked to changes in the prices of building materials. It is therefore important to explain the link between the prices of construction materials and real estate development. This is in order to avoid the problem of price differences and their impact on the delay of real estate construction resulting from constant changes in the cost of construction materials, which may contribute to the development of effective policies to monitor the risks of price changes and their impact on the delay of construction projects [5]. Therefore, it is important to propose real solutions to address such problems and move away from traditional construction methods to take advantage of advanced building materials and modern technologies to help improve construction quality and increase productivity in residential projects and buildings in general [6]. It is important to note that Iraq enjoys activities that distinguish it in terms of consumption of materials, especially construction materials such as cement, bricks, reinforcing steel, etc. Therefore, there are significant opportunities for investment in the construction sector due to the annual increase in population and the fact that young people constitute a large part of the population growth, with approximately 40% of young people under the age of 15. large areas of land owned by the country and the great need to increase the number of building units to alleviate the deficit that will arise due to population growth in the long term. Many problems have arisen as a result of economic, social and political crises, leading to the disintegration of the regular urban fabric of Iraqi cities and the spread of many informal buildings that lack the most basic elements of urban planning [7]. It is

important to note that urbanisation is one of the most important drivers of construction material consumption, but urban expansion alone does not sufficiently explain construction material consumption. Prosperity is also a factor, but it does not explain the nature of the impact, as it is often explained that more prosperous societies need to consume more building materials than less prosperous societies, and that developed societies are the problem today. Therefore, increased prosperity and urbanisation may impose a problem of carrying capacity on developing societies in the future. important to shift from linear urbanisation models to circular urbanisation models. It is important that these models are comprehensive and specific, which will ensure effective protection of resources through the use of circular urbanisation [8]. The continuous increase in population is one of the problems facing the peoples of the world, as rapid population growth is considered a major cause of most other problems. Therefore, it is important to study the impact of urban expansion, especially in modern residential complexes, and its effect on the national electricity grid, the sewage disposal and treatment system, the capacity of the responsible authorities to collect and treat the associated waste, and the impact of collection stations on infrastructure [9]. Based on the aforementioned urgent requirements, the housing sector must begin to adopt effective and efficient strategies that lead to the development of the housing system and help it withstand economic crises and the impact of changes such as fluctuations in material prices. Housing needs are met through the development of planning strategies that help it face any challenges in the long term. It is important to note the important concept of 'housing system flexibility' and its use in solving the housing shortage as a new and innovative method. It is important to mention that comprehensive flexibility strategies have the ability to generate a dynamic and interactive housing system that helps address the problems associated with the housing system in Iraq, and thus develop housing strategies to increase the flexibility of the housing system in Iraq's provinces according to their geographical influences through quantitative analysis of the housing reality in the study areas and identifying the most important strategies that help increase the flexibility of housing systems and meet their capacity to develop future housing needs [10]. It is important to mention the issue of housing loans granted to individuals by the Housing Fund, which is one of the most important financiers of housing projects in Iraq. where the classifications of loans granted vary according to the location of the housing units. This variation is unjustified due to the lack of differences in the estimated value of real estate, especially construction costs, and the problem of not taking into account the actual ability of borrowers to repay loans, and that the increasing construction costs are often not commensurate with the amount of loans granted [11]. There are some challenges facing investors in Iraq, and it is important to identify the obstacles, including administrative, financial and legal ones, that affect the growth of investment. Some of the most important problems in this regard are the weakness of investment guarantees and incentives and the lack of a clear strategic vision on the part of those responsible for attracting investment [12]. Due to slow growth in residential expansion, Iraq is suffering from a severe housing crisis. Statistics indicate that the housing deficit is estimated at more than three million housing units, and there is a significant disparity in construction rates across the country. This disparity has contributed to the exacerbation of the housing crisis in various parts of the country. It is therefore important that the authorities adopt a new strategy to address this crisis, based on the principle of creating low-cost housing complexes that rely on multi-storey vertical construction, as this type of building has urban characteristics in addition to its economic advantages, which in turn will achieve manageable population densities and effective land economy and meet the accelerating demand for housing. This strategy could be among successful solutions that help balance the cost of building materials and the preparation of more housing [13]. Construction projects are among the activities affected by crises, including economic crises, where financial and administrative corruption are factors that affect the activities of the construction sector, in addition to delays in the implementation

of projects on schedule and the inability to determine the completion date of some projects, as well as the inability of countries to pay dues to investors. All these reasons are considered obstacles to the continuation of projects [14]. The development of the construction sector in Iraq in recent years has led to the emergence of the problem of large quantities of construction waste accumulating, which affects the health of the community on the one hand and the quality of the environment on the other. One of the important reasons for this is the lack of specific and clear standards approved by the authorities for the disposal of construction waste [15]. Urban expansion has an impact on the consumption of environmental resources, so it is important to adopt strategies that follow the circular economy model to help reduce the impact of resource consumption in cities [16]. In light of rapid development, modernisation and interest in urban sustainability, it is important to use modern technologies and artificial intelligence to improve the accuracy of selecting and classifying building materials [17].

Literature Review

A study by researchers Amjad Almusaed and Asaad Almssad entitled "Building materials in eco-energy houses from Iraq and Iran" examines the characteristics of local buildings in southern Iraq, focusing on the influence of building materials and environmental conditions on the construction of traditional buildings. It also examines the construction methods used in this region to erect buildings that perform specific functions, with particular attention to location and surrounding environmental conditions. The study covered the geographical area between Iraq and Iran, focusing on three specific areas (the marshes of southern Iraq, some desert areas, and the city of Basra), where the study assumed that building materials were the most important factor in shaping the local architectural style in these areas. The study focused on the role of environmental factors and energy efficiency in the creation of traditional residential environments, in addition to identifying appropriate building systems and materials, as a fundamental pillar towards the development of sustainable and environmentally friendly construction processes in the future of architecture. Through the application of the study, it became clear that the most commonly used materials in construction in this region are reeds, straw, mud, wood and bricks. The results showed that these materials have a clear environmental impact, making them central to understanding the relationship between construction and the environment. Researchers conducted a study entitled "Assessment of the Relationship Between Cost of Building Materials and Property Development in Abia State, Nigeria: Evidence from Trends in Cost of Building Materials and Property Development" The researchers studied the relationship between building materials and their role in determining the quality and cost of any construction project, and the need for those involved in the construction sector to pay attention to the impact of rising building material prices and their direct repercussions on property development. This could lead to poor performance in the construction industry, particularly in terms of project delays or stoppages, as a result of the continuous rise in building material prices. The aim of the study was to examine the relationship between the cost of building materials and its impact on real estate development in the Nigerian state of Abia, coinciding with the shortage of housing units, as reported. The study was conducted using a quantitative approach through a questionnaire distributed to a group of specialists in the construction sector and building material traders. The results showed that there is a statistically significant positive relationship between the cost of building materials and real estate development, which indicates that the rise in building materials prices has a direct impact on real estate development. The study recommended paying attention to the factors affecting the prices of building materials and establishing and activating effective regulatory bodies whose task is to monitor prices. A study by researchers entitled "Relationship between urban construction land expansion and population/economic growth in Liaoning Province, China" indicated that rapid expansion of urban land could lead to a disconnect between urban growth on the one hand, and economic and population growth on the other. On the

other hand, other studies have shown a long-term bidirectional causal relationship between urban land expansion and population and economic growth. In order to understand the nature of this relationship, remote sensing data was applied in addition to statistical data, and multiple analytical indicators were used, including: the centre of gravity index, the coordination degree model, the Theil index, and the Tapio index for flexible decoupling. The results of the study showed that the urban land of the province is characterised by expansion and clear geographical features, and that it falls into three patterns. The per capita urban land area (PCCLA) has grown rapidly, and by 2015, 13 cities (excluding Benxi) exceeded the national standard for per capita urban land area (120 square metres). Three of these cities (Yingkou, Dalian, and Huludao) exceeded the standard by more than 100%. The lack of coordination between population urbanisation and spatial urbanisation has spread from coastal areas to central and western areas and then to the entire province. The most important finding of the study is that the rapid growth in urban land is related to relative economic decline. The results showed that current economic growth patterns may not be able to sustain the expansion of urban land. Therefore, it is important to review the strategies followed and control the allocation of new land [18]. Research study Entitled "Impact of urbanisation on construction material consumption" the study examined urbanisation and its relationship to the consumption of construction materials. The study focused on the concept that the relationship between urbanisation and resource consumption is often studied only in terms of how or what type, without providing accurate quantities or information. Therefore, the main objective of this study is to measure the relationship between urbanisation and the quantities of mineral and non-mineral resources consumed at the country level, based on statistical analytical methods, relying on quantitative data and using descriptive and inferential statistical analysis methods. by constructing stepwise regression models and presenting them in the form of path diagrams to understand causal relationships and interactions. The most important findings of the study were that urbanisation alone is not sufficient to explain the relationship with the consumption of building materials. The most important recommendation of the study was the need to shift from linear models to circular urbanisation models, whose mission is to manage resources more sustainably through integrated and specific systems that ensure efficiency in resource provision and achieve a balance between consumption and urban growth . The researcher's study entitled "Urban expansion in Baghdad governorate and its impact on increasing pollution Under constancy the stability of the Infrastructure" states that the continuous increase in population is one of the most important challenges facing the world, as rapid population growth is the main cause of many problems, especially in urban contexts. Therefore, the researcher aimed through this study to measure the impact of urbanisation and its developments, especially in modern residential complexes, on a set of components of the national infrastructure in Iraq. The study was based on official statistical data collected over three years, which was approved by official bodies represented by the Central Statistical Organisation, the Ministry of Construction and Housing, and the Baghdad Secretariat. The most important topics addressed in the study were the impact of modern residential complexes on the national electricity grid and the excessive pressure on daily energy demand, as well as the impact of urbanisation on sewage and water treatment networks. The study concluded that the relative stability of some infrastructure indicators during the period covered by the study did not mean that these systems were capable of to respond to rapid growth, but rather that there is an accumulation of pressure on existing resources and systems, which requires the development of long-term strategies to keep pace with urbanisation and infrastructure. A study by researchers entitled "Consensus-based urban sustainability framework for Iraqi cities: A case study in Baghdad" : A case This study focused on a comprehensive framework for sustainability, particularly urban development projects in hot and dry regions in developing countries, given the lack of awareness and knowledge of these details in most of these regions, represented by: population growth, traffic

congestion, environmental pollution, water shortages, and high energy consumption. Iraq is one of these countries, characterised by a hot and dry climate. The aim of this study was to develop a sustainable development framework based on input from specialists. The most important conclusion of the study is that the responsible authorities should apply sustainable urban development factors aimed at improving the quality of services. The results were based on interviews with approximately 15 specialists from various institutions. The results concluded that 12 of them expressed strong support for the study's findings, emphasising their understanding of them, their applicability, future challenges, and their positive impact on improving quality of life [19]. The study by researchers entitled "The Impact Of High Cost Of Building Materials On Housing Projects" aimed to determine the effects of differences and increases in the cost of building materials on housing projects in Lagos State, Nigeria. It also examined the impact of government policies aimed at controlling changes in the cost of building materials. In order to effectively implement the study, the researchers conducted a market study and compared building prices in previous years with current prices. A group of building material specialists were also interviewed in person, which helped to identify key points relevant to the study. The researchers reached a number of conclusions, the most important of which is that the policies pursued by the government are insufficient. The study identified the effects of the rising cost of building materials on housing provision and concluded that these effects may have a negative impact on the country's gross domestic product [20]. Researchers conducted a study entitled "Growing demand for housing and the productivity challenges in developing housing projects in Iraq." In this study, the researchers addressed the housing sector in Iraq and examined the most important challenges that contribute to the growing demand for housing units. Low productivity in construction operations remains one of the most significant obstacles to effective implementation and meeting the demand for housing projects, particularly horizontal projects, which represent an important solution to the accumulated housing crisis. The study focused on the impact of critical factors on construction productivity in this type of project, concentrating mainly on what is known as basic structural work, represented by wall foundations and concrete roof pouring, which are considered the most important pillars of quality and efficiency of completion. The study was conducted using a methodology based on gathering the opinions of experts through a series of questionnaires, and the results were analysed using the weighted relative importance index (RII), taking into account the degrees of experience of the respondents to obtain more accurate information. The results showed that there are five factors that have a significant impact, namely planning, the executive team, the volume of brick construction work, the stages of continuous supervision, and the dimensions of residential units. This study may help provide researchers and work teams involved in these projects with a realistic quantitative vision in the field of strategic improvement [21].

Problem description

Changes in the prices of building materials are a problem that directly affects residential expansion and leads to the obstruction of construction projects and their development, and may lead to their suspension or long delays as a result of the difference between the actual implementation prices and the estimated costs of constructing residential units due to continuous changes in the prices of materials and labour costs. As a result of these potential risks, it may become more difficult for low-income individuals to obtain suitable housing within their means, which poses a real challenge for government agencies to develop strategies to address these risks and provide suitable alternatives to reduce the complexity and difficulty of constructing On this basis, a statistical method will be applied to help determine the extent of the impact of changes and differences in the prices of building materials on the construction of housing units, the extent of this impact, which materials are most affected by price changes, and the relationship between the building materials themselves.

2. Materials and Methods

Research area and time period

The study will be implemented within the Republic of Iraq, where most of the provinces are affected by any change in the prices of construction materials and where construction costs are high, especially in areas with high population density and increasing residential expansion. Most densely populated areas place significant pressure on construction services and are often characterised by high demand for housing and widespread investment activity. housing demand and widespread investment activity. In addition, there are areas that were damaged as a result of the ISIS attacks in 2014, such as Nineveh, Diyala, Salah al-Din and Anbar, and the emergence of reconstruction requirements afterwards, amid rising construction costs and lack of funding.

The time frame will be set within the period 2015-2023, which is characterised by clearer information than other periods due to the availability of estimated data and the expansion of reconstruction requirements, especially after the terrorist events of 2014, which caused the collapse of the population infrastructure in western Iraq. This period also includes other crises such as the coronavirus pandemic, which affected the prices of most materials, followed by oil price fluctuations, especially after the start of the Russian-Ukrainian conflict.

Data sources

The data published in the periodic bulletins of the Iraqi Central Statistical Organisation for the period 2015-2023 regarding the number of permits for the construction of residential units and renovation permits, annual construction material prices, labour costs and foreign exchange rates published by the Iraqi Central Statistical Organisation have been approved. and the estimated calculations for the period 2015-2023 for per capita income NGDPOPC according to the exchange rate of the dollar on the international scale of the International Monetary Fund and its economic publication WEO.

Methodology

Methods used

This study follows a descriptive analytical approach to examine the relationship between changes in the prices of building materials and the construction and quality of residential units in Iraq. Data for five variables were used for the period 2015-2023. The dependent variable was assumed to be (number of building or renovation permits) was assumed to be the dependent variable, represented by residential units being built or renovated, and the other variables were independent variables, namely basic building materials (bricks, cement and reinforcing steel) in addition to the variable of per capita income (estimated) NGDPOPC according to the exchange rate of the dollar on the international scale of the International Monetary Fund and its economic publication WEO. Most of the data was taken from periodic publications on the official website of the Iraqi Central Statistics Organisation, except for the annual per capita income data NGDPOPC, which was taken from IMF data, as shown in Table 1 below.

3. Results and Discussion

Table 1. Prices of building materials according to CSO reports and NGDPOPC per capita according to the IMF report for the years 2015-2023.

Year	Construction permits Renovation/number	Bricks	Cement	Rebar/tonne	Per capita income$ by exchange rate NGDPDPC
2015	22716	214	235.5	852	5044
2016	21653	214	177.5	867	4639
2017	24107	175	103.5	651	5178
2018	20676	185	102	695	5959

2019	22464	188	102	786	5945
2020	17665	195	105.5	814	4520
2021	32850	191	114	1240	5011
2022	37442	210	116	1347	6186
2023	34373	211	120.5	1126	5869

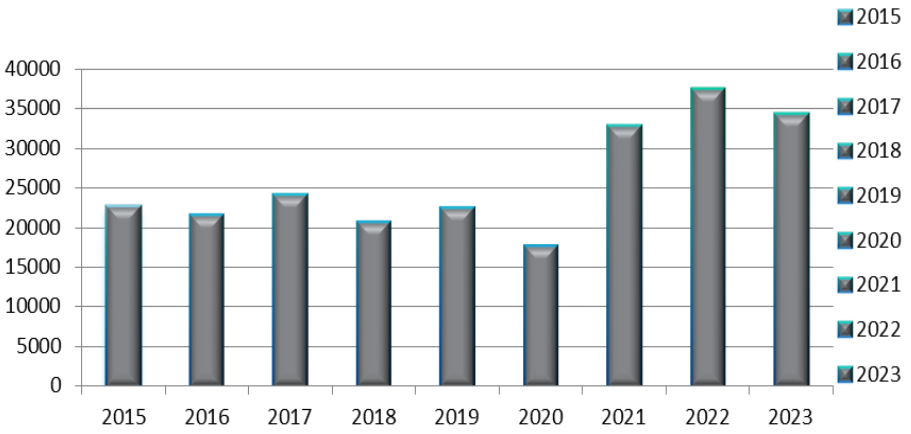

Figure 1. Shows the volume of approvals for the construction and renovation of units for the years 2015-2023.

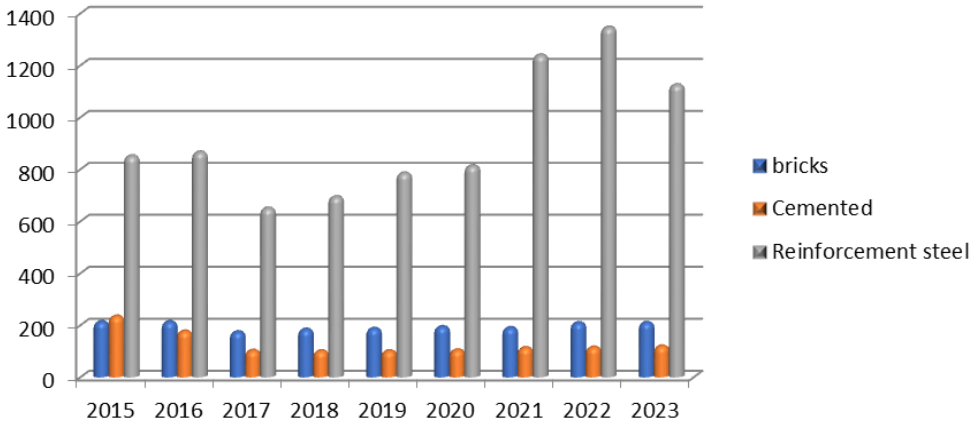

Figure 2. Shows the change in the prices of building materials over the years 2015-2023.

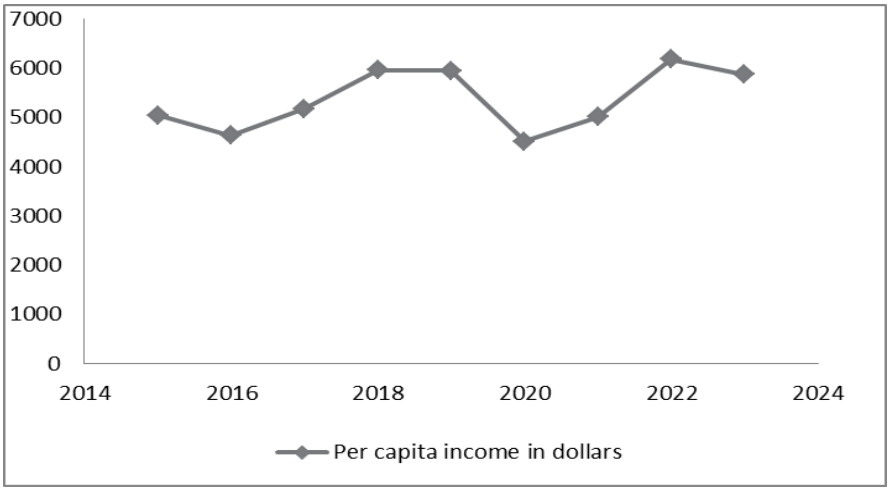

Figure 3. Shows the average per capita income according to the International Monetary Fund (IMF) report.

Some statistical measures will be adopted using the SPSS programme, and the most important measures to be adopted are the variance inflation factor (VIF) to help ensure that there is no multicollinearity problem.(Fig 1) This measure will be extracted for the presence of several independent variables in addition to the dependent variable. The correlation between the variables will be studied using Pearson's correlation coefficient to study the relationship between the dependent variable and each of the independent variables, and to measure the overall correlation R between the dependent variable and all variables in the model.(Fig 2) and (Fig 3) The value of R2 Adjusted will be extracted, as it is preferable to use this value instead of R2, especially in multivariate models, because it takes into account any variable that is added and attempts to exclude it if it is unnecessary, thus helping to build effective and simple models [22].

Finally, a multiple linear regression model will be constructed to predict the size of residential units based on changes in the prices of building materials. It will be as follows:

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Finally, a multiple linear regression model will be constructed to predict the size of residential units based on changes in the prices of building materials. It will be as follows:

$$y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4$$

Where y is the number of housing units, x_1 is bricks, x_2 is cement, x_3 is reinforcing steel, x_4 is per capita income (estimated) NGDPOPC, and bj is the slope and regression coefficients .

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The mathematical application

According to the bulletin published on the dollar exchange rate in Iraq by the Central Statistical Organisation, as shown in Table 2 below, the values of the variables were standardised at the real market rate of the dollar in Iraq, as shown in Table 3 below.

Table 2. Dollar exchange rates in Iraq according to the bulletin of the Central Statistical Organization.

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Dollar price	1251	1281	1256	1211	1202	1204	1471	1482	1581

Table 3. Prices of building materials according to CSO reports and NGDPDPC according to the IMF report for the years 2015-2023 after standardizing their prices in dollars.

Year	Construction and renovation permits/number	Bricks/ $	Cement	Rebar/ $	Per capita income$ by exchange rate NGDPDPC
2015	22716	171.063	188.25	681.06	5044
2016	21653	167.057	138.56	676.81	4639
2017	24107	139.331	82.40	518.31	5178
2018	20676	152.766	84.23	573.91	5959
2019	22464	156.406	84.86	653.91	5945
2020	17665	161.96	87.62	676.08	4520
2021	32850	129.844	77.50	842.96	5011
2022	37442	141.7	78.27	908.91	6186
2023	34373	133.46	76.22	712.21	5869

After performing statistical analysis using SPSS, the results were as follows: The absence of multicollinearity was tested using the VIF value, with the results in Table 4 showing that all values for this measure of the variables are less than 5, proving that there is no multicollinearity. This helps us to validate the results and their reliability and interpretability.

Table 4. Results of the Variance Inflation Factor (VIF).

Model		Unstandardized Coefficients		Collinearity Statistics	
		B	Std. Error	Tolerance	VIF
1	(Constant)	38145.878	15020.454		
	X_1	-372.728	80.244	.380	2.630
	X_2	74.908	30.571	.398	2.511
	X_3	28.512	6.616	.859	1.164
	X_4	3.099	1.329	.793	1.260
a. Dependent Variable: Y					

The correlation between the dependent variable y (number of building or renovation permits) and the independent variables (influencing factors) can be interpreted from Table 5 below, where the results indicate that the relationship between the dependent variable and the first independent variable X1 is a strong inverse relationship, represented by the value -0.755. This relationship explains that the increase in the price of bricks affects the decrease in the number of dwellings (number of building or renovation permits). The relationship with the second independent variable X2 was -0.366, indicating that the correlation is inverse but weak, as the increase in the price of cement will lead to a slight decrease in the number of housing units (building or renovation permits). renovation permits). As for the third variable X3, its effect is direct, with a result of (0.742), which explains that the increase in the price of reinforcing steel is also accompanied by an increase in the number of housing units (this indicator is not considered positive, but it explains that there are other variables that have a stronger effect than this variable). The last variable, X4, shows its correlation through the value (0.503), which is a positive

correlation, as an increase in per capita income leads to an increase in the number of housing units (number of building or renovation permits).

Table 5. Correlations between variables according to Pearson's correlation scale

Correlations						
		Y	**X1**	**X2**	**X3**	**X4**
Pearson Correlation	Y	1.000	-.755	-.366	.742	.503
	X1	-.755	1.000	.751	-.318	-.401
	X2	-.366	.751	1.000	-.120	-.431
	X3	.742	-.318	-.120	1.000	.171
	X4	.503	-.401	-.431	.171	1.000

From Table (6), the correlation can be interpreted in general based on the results of the R value, which was (0.977). This means that the correlation between the dependent variable y (number of building or renovation permits) and the other independent variables is a strong positive relationship. The adjusted R2 value explains that 91% of the change in the number of building or renovation permits can be explained by the independent variables in the model. Since there is little difference between R2 (0.955) and R2 Adjusted (0.911), this explains that all independent variables are important in the model.

Table 6. General correlation between variables

Model	**R**	**R Square**	**Adjusted R Square**	**R Square Change**
1	.977[a]	.955	.911	.955

Based on the values in the following table (7), the value of Sig=0.006 which is less than 0.05 Thus, the hypothesis is accepted that there is a statistically significant difference between the group means and the model is significant with a value of F=21.364 which means that there is a significant difference between the group means.

Table 7. ANOVA analysis of variance table

Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	374026469.053	4	93506617.263	21.364	.006[b]
	Residual	17507210.947	4	4376802.737		
	Total	391533680.000	8			

a. Dependent Variable: Y

b. Predictors: (Constant), X4, X3, X2, X1

Based on the results, the regression equation is

$$\hat{y} = 38145.878 - 372.728x_1 + 74.908x_2 + 28.512x_3 + 3.099x_4$$

The above prediction equation can be applied to know the number of permits or new housing units under construction or renovation based on the information of the independent variables (price of bricks, price of cement, price of rebar and per capita income) if the policy and economic conditions remain the same.The above prediction

equation can be applied to know the number of permits or new housing units under construction or renovation based on the information of the independent variables (price of bricks, price of cement, price of rebar and per capita income) if the policy and economic conditions remain the same.

4. Conclusion

The increase in the height of building materials directly affects the paths of residential expansion, whether in the construction of housing units or renovation and addition in units and based on the results of the study, the cost of materials has a significant impact on the number of housing units that have been authorised for construction or renovation according to the number of building permits through the results it is clear that the relationship between the prices of brick material has an inverse relationship with the expansion of the number of housing units As for the effect of cement materials, it was also inverse, the more the price of cement increases, the lower the average number of building units, but its inverse effect is not strong and less than bricks, as for the relationship of rebar material, it was a direct relationship, i.e. the increase in its prices and its difference did not affect much in the sense of even If the prices differ, their impact is less compared to the other variables, and the difference in impact may be due to the fluctuation of prices according to the years specified in the study period, where we observe a period of increase and decrease in other periods, so it was not in an increasing or decreasing manner, as for the last variable of the estimated per capita income, its impact is direct, where the increase in the estimated per capita income was if the per capita income increases, the average number of units of housing It is important to note that the study was based on four documented variables, three of which are building materials and the fourth variable is the estimated per capita income, although there are more materials involved in the construction of housing units, but the study was limited to the most important basic materials to study the relationship in general between building materials and the expansion of housing.

REFERENCES

[1] E. Sector/UNESCO, "Assessment of the Labour Market & Skills Analysis Iraq and Kurdistan Region-Iraq," United Nations Educational, Scientific and Cultural Organization, Office for Iraq UN Compound, International Zone, Baghdad, Iraq, 2019.

[2] A. Almusaed, A. Almssad, A. Alasadi, and F. Al-Asadi, "Sustainable Reimagining of urban Habitats: Navigating Iraq's housing crisis through Socio-Technological and Environmental approaches," Ain Shams Engineering Journal, vol. 16, no. 2, p. 103280, 2025.

[3] A. Almusaed and A. Almssad, "Building materials in eco-energy houses from Iraq and Iran," Case Studies in Construction Materials, vol. 2, pp. 42-54, 2015.

[4] A. M. Hameed and F. D. Kadhim, "Strategic planning for promoting competitiveness in the housing sector in Iraq," Journal of the International Society for the Study of Vernacular Settlements, vol. 10, no. 11, 2023.

[5] K. S. Ihedigbo, C. O. Mgbeahuru, M. A. Wuna, and C. E. Olughu, "Assessment of the Relationship Between Cost of Building Materials and Property Development in Abia State, Nigeria: Evidence from Trends in Cost of Building Materials and Property Development," Journal of Sustainability and Environmental Management, vol. 3, no. 2, pp. 102-110, 2024.

[6] A. M. Teen and A. M. Gramescu, "Use of Modern Technology to Develop Investment Housing Projects in Iraq," " Ovidius" University Annals Constantza. Series Civil Engineering, vol. 20, no. 20, pp. 89-96, 2018.

[7] A. Kadhim and D. Çetin, "An Evalution on Karbala City Slums and Concrete Blocks in Iraq: A Housing Unit Design Proposal," AURUM Journal of Engineering Systems and Architecture, vol. 6, no. 1, pp. 105-124, 2022.

[8] G. Schiller and J. Roscher, "Impact of urbanization on construction material consumption: A global analysis," Journal of Industrial Ecology, vol. 27, no. 3, pp. 1021-1036, 2023.

[9] N. M. Alsaffar, "Urban expansion in Baghdad governorate and its impact on increasing pollution Under constancy the stability of the infrastructure," in IOP Conference Series: Earth and Environmental Science, 2021, vol. 790, no. 1: IOP Publishing, p. 012003.

[10] Z. S. Shama and J. B. Motlak, "Resilient housing system strategies: Baghdad governorate as a model," in IOP Conference Series: Materials Science and Engineering, 2020, vol. 745, no. 1: IOP Publishing, p. 012110.

[11] M. G. Majeed and J. B. Motlak, "Analysis the Role of Housing Fund on the Construction for New Housing Case Study: Diwaniyah governorate/Iraq," Turkish Journal of Computer and Mathematics Education, vol. 12, no. 13, pp. 829-838, 2021.

[12] M. M. A. Al Mahdi and M. Z. Fisal, "The Reality of Local Investment in Iraq and Prospects for its Development: A Case Study in the Baghdad Investment Commission," International Journal of Professional Business Review: Int. J. Prof. Bus. Rev., vol. 8, no. 2, p. 6, 2023.

[13] I. K. Jumaah, S. S. Mesrop, and T. J. Mohammed, "The reasons and proposed treatments for the housing problem in Iraq," in IOP Conference Series: Materials Science and Engineering, 2020, vol. 881, no. 1: IOP Publishing, p. 012172.

[14] G. A. Fadhil and A. M. Burhan, "Investigating the effects of economic crisis on construction projects in Iraq," in E3S web of conferences, 2021, vol. 318: EDP Sciences, p. 02005.

[15] A. A. Obaid, I. A. Rahman, I. J. Idan, and S. Nagapan, "Construction waste and its distribution in Iraq: an ample review," Indian Journal of Science and Technology, vol. 12, no. 17, pp. 1-10, 2019.

[16] M. Kolkwitz, "Material stocks and flows embedded in residential buildings: A spatially explicit and temporally dynamic bottom-up study of Vantaa, Finland," Resources, Conservation and Recycling, vol. 215, p. 108157, 2025.

[17] K. Sun et al., "Urban Fabric Decoded: High-Precision Building Material Identification via Deep Learning and Remote Sensing," Environmental Science and Ecotechnology, p. 100538, 2025.

[18] Z. Li, W. Luan, Z. Zhang, and M. Su, "Relationship between urban construction land expansion and population/economic growth in Liaoning Province, China," Land Use Policy, vol. 99, p. 105022, 2020.

[19] M. M. Mohsin, T. Beach, and A. Kwan, "Consensus-based urban sustainability framework for Iraqi cities: A case study in Baghdad. Heliyon, 6 (12), e05348," ed, 2020.

[20] P. Akanni, A. Oke, and O. Omotilewa, "Implications of rising cost of building materials in Lagos State Nigeria," Sage Open, vol. 4, no. 4, p. 2158244014561213, 2014.

[21] A. Hassoon, F. E. M. Ghazali, T. Khaleel, and A. Hadi, "Growing demand for housing and the productivity challenges in developing housing projects in Iraq," Journal of Infrastructure Preservation and Resilience, vol. 6, no. 1, p. 3, 2025.

[22] J. Karch, "Improving on adjusted R-squared," Collabra: Psychology, vol. 6, no. 1, 2020.