

Original Article

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Estimation and forecasting of revenues and financing sources of Hamedan municipalities

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Abstract

Municipalities depend on stable and predictable revenue streams to fulfill statutory obligations and implement urban development strategies. The Municipality of Hamadan, as a rapidly growing metropolitan area, faced challenges between 2009 and 2023, including construction recession, economic volatility, inflationary pressures, and declining private investment. This study aims to analyze historical revenue trends (2009–2023), evaluate the stability of revenue sources, and forecast the municipal revenue structure for 2029. This applied, descriptive–analytical study categorizes revenues into seven primary groups: General tolls, specific tolls, service charges and income of for-profit institutions, municipal funds and property, government grants and aids, donations/contributions/gifts, and revenue from the capital and financial assets disposal. Time-series regression models and ordinary least squares (OLS) were employed to assess trends. Specific taxes and service charges/income from for-profit institutions showed average annual growth rates of 34.2% and 35.9%, respectively, with substantial volatility. Municipal funds and assets exhibited the highest growth at 61.3%, whereas government grants were unstable, with an average growth of 24.2%. Capital asset disposals increased by 43.8%, primarily during fiscal constraints. OLS-based projections indicate that by 2029, the revenue structure will largely maintain its current composition, with dominant contributions from general taxes, municipal funds and assets, and capital asset disposals. Hamadan Municipality remains heavily reliant on unstable revenue sources, with a limited share of stable urban revenues. These findings underscore the need for strategic financial planning, revenue diversification, and the development of resilient municipal fiscal policies to ensure sustainable urban financial management.

Keywords

Capital assets
Hamedan Municipality
municipal revenue structure
ordinary least squares (OLS)
revenue forecasting

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1. Introduction

Municipalities, as the most important institutions of urban management and the executive arm of local government, play a fundamental role in providing public services, physical organization of the city, and supporting economic and social development (Madadi et al., 2020; Bayat et al., 2024). In the literature of urban management, municipalities are considered one of the main pillars of local governance, whose efficiency is directly dependent on financial capacity, budgetary transparency, and data-driven planning capabilities. Global experience shows that the more stable and predictable the financial structure of municipalities, the higher the rate of development plan realization, the quality of urban service delivery, and the capacity for infrastructure investment. Therefore, the stability and efficiency of the revenue system are fundamental conditions for fulfilling the legal missions of municipalities and ensuring the sustainable growth of cities (Dashti & Pakmaram, 2024).

In Iran, the financial structure of municipalities over recent decades has been affected by factors such as the instability of revenue sources, recession in the construction sector, chronic inflation, changes in financial laws, and increasing costs of city administration (Regulations on Sustainable Revenue for Municipalities and Village Administrations, 2024). Numerous studies indicate that excessive reliance on unstable revenues, particularly those derived from the sale and disposal of capital assets, has led to a significant portion of municipal budgets lacking the necessary stability for long-term planning. On the other hand, the share of sustainable revenues, such as general duties and service charges, has remained low due to the weaknesses of the urban taxation system, the absence of modern financial tools, and a lack of effective citizen participation. These challenges have led many municipalities to experience significant budget imbalances and have serious constraints in executing development projects and delivering public services (Kordestani & Shahbazi, 2025). At the research level, although studies have been conducted on the revenue structure of the country's municipalities, a significant portion of this research has either had a limited focus on one or two types of revenue, or has examined a short period, and has less frequently addressed long-term and forecast-oriented analysis. Hamedan Municipality, as one of the most important population, historical, and tourism centers of the country, has faced rising costs, increasing service

needs, and economic pressures in recent years; its revenue structure has encountered fluctuations and inadequacies of resources. However, research that comprehensively examines the revenues of Hamedan Municipality based on econometric models is very limited, indicating a research gap in the field of urban finance for this metropolis. In such a context, a comprehensive analysis of Hamedan Municipality's revenue trends and the scientific forecasting of funding sources acquires double importance. Examining long-term data and analyzing revenue behavior can provide a basis for reforming the financial structure, reducing dependence on unstable sources, increasing asset productivity, and improving the urban budgeting system.

The present study was conducted to analyze the trend in revenues and funding sources of Hamedan Municipality from 2009 to 2023 and forecast the revenues for 2029 using an ordinary least squares (OLS) econometric model. The innovation of the research lies in the comprehensiveness of the time period, the complete classification of revenue groups, the use of quantitative methods for estimating the financial future, and the focus on a city that has received less attention in urban finance studies. The findings of this research can pave the way for more accurate decision-making in financial policymaking, diversification of revenue sources, and strengthening the financial sustainability of Hamedan Municipality. The following section of the study reviews the theoretical foundations and research background, and then presents the research model and the findings.

2. Theoretical foundations and research background

Municipalities worldwide, as institutions responsible for urban service management, play a crucial role in the administration, development, and organization of citizens' lives (Nitoslawski et al., 2019). The ever-increasing urban population, the complexity of urban issues, the necessity of infrastructure modernization, and responding to the diverse needs of citizens have turned municipalities into a pillar of urban governance and sustainable development. In this regard, securing the necessary financial and credit resources to perform duties is considered one of the most important managerial and executive challenges for municipalities (Slack & Tassonyi, 2017). The concept of urban finance in economic and management literature examines how revenue is secured, resource allocation, budget structure, revenue sources, and the accounting system of urban entities. Within the theoretical framework of

public finance, three fundamental principles – financial independence, accountability, and transparency – are considered the foundations of efficiency in the municipal financial system (Shah, 2006). The realization of these principles depends on creating a coherent financial structure, diversifying revenue sources, establishing legal mechanisms for collecting local taxes and duties, and utilizing modern financing tools, including participation bonds, joint ventures, and the capital market.

One of the most important theories applicable in explaining the position of municipalities in the process of securing financial resources is the “fiscal decentralization theory.” Emphasizing the transfer of financial power and decision-making to local levels, this theory believes that local governments, including municipalities, have a more precise understanding of the needs and priorities of the local community and can allocate resources more efficiently and effectively (Tran & Nguyen, 2024; Wang et al., 2024; and Li & Li, 2024). In this view, delegating financial and revenue resources to municipalities as part of the decentralization process leads to increased productivity, transparency, and public participation in the administration of urban affairs. Comparative studies indicate that in many developed countries, municipalities enjoy relative financial independence and can create and manage diverse financial resources by applying local taxes, receiving urban service charges, revenues from the rental and sale of public properties, exploiting urban facilities, and attracting private sector investment (OECD, 2022, and World Bank, 2023). In these countries, institutional and legal structures are designed such that municipalities, while possessing legal authority in the financial sphere, are also accountable to citizens, local councils, and regulatory bodies.

On the other hand, in developing countries, the weakness of the legal system, excessive reliance on unstable sources or government aid, the inefficiency of the local tax system, and the lack of technical and institutional capacities for financial management are considered the most significant obstacles to financial independence and improving productivity in urban service delivery (Bahl & Linn, 2014). Additionally, the absence of a coherent database of urban properties, the lack of an efficient tax audit system, weakness in revenue planning, and heavy dependence on construction-related revenues make the budgeting system of municipalities fragile, unstable, and vulnerable to economic fluctuations.

Based on the United Nations theoretical framework for sustainable urban development, urban financing must be based on three key principles: Social justice (the balanced distribution of resources among urban areas and different social strata), economic efficiency (the optimal allocation of resources toward productivity and effectiveness), and environmental sustainability (securing financial resources with consideration for environmental principles and reducing damage to nature). Realizing these principles requires a shift in the traditional approach of municipalities toward revenue generation and moving toward an integrated and smart financial system. In Iran, municipalities are recognized as non-governmental public institutions that possess relative independence from the government in terms of budget and finance. However, in practice, due to insufficient attention to their financial and economic structure, they face numerous challenges regarding revenue sources. A major portion of municipal revenue is secured from unstable sources, such as the issuance of building permits and density sales, which not only threatens the financial sustainability of the city but also leads to unbalanced urban growth and the emergence of physical and environmental problems (Parliamentary Research Center, 2022; Ministry of Interior, 2023).

Furthermore, the low share of local taxes and inadequacies in the budgeting and oversight process have caused many municipalities to face chronic budget deficits and increasing reliance on government aid. In such circumstances, reforming the financial structure of municipalities, creating supportive laws to diversify revenue sources, institutionalizing financial transparency, strengthening the urban accounting system, using modern technologies to monitor and forecast revenues, and designing participatory mechanisms to attract private sector investment are among the essential measures to strengthen the financial foundations of local governments in Iran. Additionally, expanding institutional capacity, training human resources, implementing accrual accounting systems, and enhancing the level of oversight by Islamic City Councils can pave the way for improving the financial system in municipalities. A review of the theoretical foundations reveals that municipal financing is a complex, multi-layered matter linked to institutional, legal, managerial, and social dimensions. Relying solely on limited and unstable revenue sources will hinder the realization of urban development goals and effective accountability to citizens. Accordingly,

establishing a coherent, predictable, justice-oriented, and efficient revenue system within the framework of good urban governance principles is considered an undeniable necessity for the optimal management of cities. In the following, the research background and a

review of the experiences of municipalities in various countries are addressed. The research background is examined in two sections, internal and external studies, as detailed in Table 1.

Table 1. Literature review

Authors	Statistical population	Independent Variables	Results
Laufs et al. (2020)	-	New smart security technology	New security technologies have a significant impact on creating security, urban management, and providing the financial resources of cities.
Altecz & Behnich (2017)	German Municipality	Tax payment system	The tax payment system is a key foundation for financing local administrations in this country. According to their findings, in states where municipalities receive a smaller share of tax revenues (especially those located in eastern Germany), the annual budget of these municipalities is also noticeably lower. This difference suggests that taxation still plays a central and decisive role in shaping the financial capacity and planning ability of municipalities, as reducing dependence on taxes or weakness in tax resources can lead to limitations in the provision of urban services, infrastructure development, and the implementation of public projects. Consequently, this study emphasizes that strengthening tax revenue bases is among the essential factors in improving the efficiency and financial sustainability of German municipalities.
Githinji et al. (2014)	kenya	Information and communication technology	Taxation is one of the sources of revenue that plays a key role in enhancing the governance of countries. The method of collecting tax revenues in most states of Kenya is relatively weak, and information and communication technology can address this weakness.
Odneyo et al. (2013)	Local Authorities of Homa Bay and Kenya	Information systems	There is a positive and significant relationship between information systems, efficiency, and effectiveness in the collection of urban revenues.
Kordestani and Shahbazi (2025)	Hamedan Municipality	-	The current revenue system of Hamedan Municipality is relatively unsustainable, relying on fees from density sales, fines for land-use changes, and penalties for removing parking spaces and infrastructure violations. Subsequently, a sustainability model emphasizing "increasing sustainable revenues and managing and improving the role of sustainable revenue sources, as well as providing modern solutions and financing methods from financial and monetary markets" is highlighted.
Mirzaei et al. (2022)	Tehran Municipality	-	The collected revenue sources of district municipalities are mainly dependent on the building boom with considerable intensity and the status of the resident population in the district (population density); the share of building permit issuance costs in northern districts out of the total housing production costs, compared with this same share in southern districts, is very small; also, there is a significant deviation in regional property prices from the corresponding market-based index.
Hajiloo et al. (2017)	Shabestar Municipality, 2004–2014	-	About 39.25% of the municipality's revenues is provided from general fees (30% share of fees on buildings and lands) and 25.36% from other sources of financing; that is, the sale of municipal properties.
Akbari and Hamidzadeh-Khiavi (2016)	Ahar Municipality	-	By quantification, the relative intra-group weight of each internal factor (strengths and weaknesses) and external factor (opportunities and threats) was determined, and each of the internal and external factors was ranked accordingly; finally, based on the internal and external factors and using the SWOT technique, the four strategies of SO, WO, ST, and WT were presented to increase the revenue sources of Ahar Municipality.

Authors	Statistical population	Independent Variables	Results
Nesari et al. (2015)	Tehran Municipality	-	A major part of the main revenues of municipalities is incompatible with the concept of sustainability and lacks continuity and desirability. Therefore, municipalities should, by studying the revenue structure based on the resistance economy, have new solutions for providing sustainable and continuous revenue sources to deliver desirable services to citizens.
Danesh-Ja'fari et al. (2014)	Tehran Municipality	Revenue sustainability	The most sustainable revenue in Tehran is the tax transferred from the government to the municipality, in the form of value-added tax or a percentage of national tax. The receipt of service charges and various local fees is also another sustainable revenue source that can be used.

Considering the research background, most existing studies have examined the revenue sources of municipalities in major Iranian cities or foreign countries, primarily limited to identifying revenue sources and general revenue management strategies. However, little research has addressed the precise estimation and forecasting of revenues and funding sources for municipalities, particularly in cities like Hamedan. Therefore, the necessity of this research arises from the fact that municipalities require accurate estimation and forecasting of revenue sources for effective planning and the design of sustainable financial policies. The innovation of this study lies in its focus on Hamedan Municipality and the use of quantitative methods to forecast revenues and funding sources, which can contribute to improving the efficiency of financial management and the sustainability of the municipality's revenue sources.

3. Research methodology

This research aims to forecast the revenues of Hamedan Municipality for the next five years (2025–2029). Each of the quantitative or qualitative techniques for forecasting has its own drawbacks. Future studies, by applying the influence of qualitative forecasting techniques to results obtained from quantitative techniques, attempt to align the forecast results more closely with reality. There has always been a difference of opinion between two groups of experts in forecasting and future studies regarding the effectiveness of quantitative methods, which rely on historical data, versus qualitative methods, which are based on judgment. A fundamental goal in estimating a regression model is to forecast changes in the dependent variable based on specific values of the independent variable. Forecasting is a process in which an objective or subjective model is used to estimate a

variable for the past or the future. Forecasting a variable can be conducted using two methods:

- Forecasting via objective models such as mathematical, statistical, and econometric models.
- Forecasting via subjective models such as Delphi methods, expert judgment, and utilizing the experience and information of experts.

In the subjective method, there is no need to present a mathematical model, and the variable in question is estimated qualitatively. However, mathematical and statistical models are typically used to perform the forecasting process for economic variables, i.e., the approximate estimation of future economic variables. In the objective method, presenting a model is essential. The best scenario for forecasting a variable is to use all methods. After forecasting, the methods can be compared using forecast measurement scales to select the best method and utilize it for forecasting. To analyze information and forecast the revenue sources of Hamedan Municipality, time series fitting models based on annual budget data and the OLS model have been used to fit the regression between independent and dependent variables, as well as to forecast dependent and independent variables in EViews software. Research limitations are the reason for choosing this econometric method for forecasting revenue.

This research faced a fundamental limitation due to the scarcity of historical data for both dependent and independent variables. Particularly, revenue and expenditure data for Hamedan Municipality were only available from 2009 onwards, and even in some years, information related to all revenue codes was not fully recorded. Therefore, using Excel software, the totals for headquarters, districts, and organizations were considered and recalculated for each revenue code for the given year. This limited volume of data eliminated the possibility of advanced lag-based econometric

models such as ARIMA or other dynamic models, as the use of lags results in the removal of more data points and the emergence of autocorrelation issues. This problem cannot be controlled with the OLS model. Furthermore, the lack of official and reliable data to forecast the future of independent variables, such as the number of building permits, vehicle production volume, and other macroeconomic indicators, limited the possibility of multi-stage forecasting for independent variables. Attempting to forecast these variables based on exogenous variables also caused problems such as heteroscedasticity and autocorrelation, which consequently reduced the significance of the coefficients. Therefore, removing a portion of the independent variables and relying on retrospective trends was inevitable. In this regard, the use of SPSS software was also not feasible, as this software is primarily designed for descriptive analysis and simple regressions and lacks the necessary capability to perform econometric analysis, time-series modeling, testing classical regression assumptions, and controlling for problems such as autocorrelation and heteroscedasticity. It is worth noting that for forecasting revenues for the next five years, other forecasting models, including scenario-building with a 10 percent increase in variables and revenues, were used. Ultimately, among all these models, the OLS model was selected as the proposed model for revenue forecasting because it provided more accurate and reliable forecasting results.

3.1 Model specification

Given the mentioned limitations for predicting the revenue sources of Hamedan Municipality, the ordinary least squares (OLS) model has been utilized. OLS analysis is recognized as the most widely used and dominant method among various linear regression techniques. In statistics, OLS is a method for estimating unknown parameters or dependent variables in a linear regression model by minimizing the difference between the observed response variables in the dataset. Investigating the most important influential factors (explanatory variables) on the dependent variable may seem simple at first glance; however, it is one of the most difficult and crucial stages of regression modeling. In other words, the statistical significance of the relationship between the unknown or dependent variable and the known or independent variable is a necessary condition for modeling using this analysis. The OLS model is also referred to as linear regression, as it is a common technique for estimating the

coefficients of linear regression equations that describe the relationship between one or more independent variables and a dependent quantity (simple or multiple linear regression).

$$Y = \beta_0 + \sum_{i=1}^p \beta_i X_i + \varepsilon \quad (1)$$

Y is the dependent quantity; β_0 is the constant coefficient; X_i is the independent quantity ($i=1$ to p); β_i is the regression coefficient of the i -th quantity; and ε is the random error with a mean of zero and variance σ^2 .

The distinguishing feature of OLS regression is that the parameters of the regression model, i.e., the β_i , are estimated in a manner that ensures the random error of the OLS regression, ε , has a mean of zero and a variance of σ^2 . The goal of the OLS method is to minimize the sum of squared differences between observed and predicted values, i.e., minimizing $\sum_{j=1}^n (y_j - \hat{y}_j)^2 = \sum_{j=1}^n e_j^2$.

In this study, to predict the municipality's revenue sources, information from 2009 to 2023 of Hamedan Municipality has been used, including: Realized revenue data from budget settlements (2009–2023) for six main revenue codes (from the set of revenue codes) and revenue from the disposal of capital and financial assets extracted from the statistical yearbook of Hamedan city and municipality, as well as independent variables such as inflation rate, total population, the number of building permits issued for the city of Hamedan, exchange rate, tax revenues of Hamedan city, etc., from 2009 to 2023, extracted from the Central Bank and the Statistical Center of Iran. The data on the dependent variables, which are the main revenue codes of Hamedan Municipality, have been extracted from Hamedan Municipality's budget settlement. Since the basis for predicting revenues is for the five years following 2023, and because changes occurred in the revenue codes after 2009, this entire time period has been adjusted based on correspondence with the 2023 revenue codes. All variables used in the equations, along with their abbreviations and the statistical sources of these data, are mentioned in Table 2. Additionally, the independent variables were selected based on studies by Motaghian Nasab et al. (2022), Shahrokhiyan (2021), and Gholizadeh et al. (2016), as well as the opinions of several experts and specialists of Hamedan Municipality. Furthermore, in accordance with the theoretical foundations and studies conducted by Lyytimäki et al. (2020), Nitoslowski et al. (2019), Althoff

and Bahnich (2017), Bifulco et al. (2016), Gjessing et al. (2014), Hajiloo et al. (2017), Akbari and Hamidzadeh-Khiavi (2016), and Nesari et al. (2015) on the subject, the present research has estimated the following models for predicting the revenues of Hamedan Municipality:

$$Public_t = \alpha + \beta_1 Car_t + \beta_2 licence_t + \beta_3 POP_t + \beta_4 House_t + \beta_5 Tax_t + \beta_6 Inf_t + \beta_7 GDP_t + \varepsilon_t \quad (2)$$

$$excl_t = \alpha + \beta_1 POP_t + \beta_2 Inf_t + \beta_3 GDP_t + \beta_4 income_t + \varepsilon_t \quad (3)$$

$$Service_t = \alpha + \beta_1 Car_t + \beta_2 licence_t + \beta_3 House_t + \beta_4 POP_t + \beta_5 Inf_t + \beta_6 income_t + \varepsilon_t \quad (4)$$

$$Fund_t = \alpha + \beta_1 Price_t + \beta_2 GDP_t + \beta_3 Car_t + \beta_4 POP_t + \beta_5 Exch_t + \varepsilon_t \quad (5)$$

$$Aid_t = \alpha + \beta_1 tax_t + \beta_2 Taraz_t + \beta_3 GDP_t + \beta_4 Oil_t + \beta_5 inf_t + \beta_6 Exch_t + \varepsilon_t \quad (6)$$

$$Donations_t = \alpha + \beta_1 Inf_t + \beta_2 POP_t + \beta_3 GDP_t + \beta_4 income_t + \varepsilon_t \quad (7)$$

$$Rev_t = \alpha + \beta_1 Inf_t + \beta_2 Car_t + \beta_3 licence_t + \beta_4 POP_t + \beta_5 House_t + \beta_6 Tax_t + \beta_7 GDP_t + \varepsilon_t \quad (8)$$

$$NRev_t = \alpha + \beta_1 Inf_t + \beta_2 Car_t + \beta_3 licence_t + \beta_4 POP_t + \beta_5 House_t + \beta_6 Tax_t + \beta_7 GDP_t + \varepsilon_t \quad (9)$$

$$Asset_t = \alpha + \beta_1 Loan_t + \beta_2 Price_t + \beta_3 GDP_t + \beta_4 Inf_t + \beta_5 Oil_t + \varepsilon_t \quad (10)$$

$$Fin_t = \alpha + \beta_1 Loan_t + \beta_2 Price_t + \beta_3 GDP_t + \beta_4 Inf_t + \beta_5 Oil_t + \varepsilon_t \quad (11)$$

In Table 2, the variables used in equations (2) to (11) are introduced:

Table 2. Description of variables

Variable	Unit	Abbreviation	Statistical sources
Revenue from general tolls in Hamedan Municipality in year t	Rials	Public _t	Hamedan Municipality Budget Settlement Offices
Volume of vehicle production in the country in year t	Number of machines	Car _t	Ministry of Industry and Mines Website
Number of building permits issued for the city of Hamedan in year t	Item - thousand square meters	licence _t	Hamedan Municipality Statistical Yearbooks
Total population of the country in year t	Million people	POP _t	Statistical Center of Iran
Average selling price of one square meter of residential floor area in Hamedan city in year t	Thousand Rials	House _t	Hamedan Municipality Statistical Yearbooks
Tax revenues of Hamedan province in year t	Million Rials	Tax _t	Tax Statistics Yearbooks
Annual inflation rate announced by the Central Bank in the whole country in year t	Percentage	Inf _t	Statistical Center of Iran
Gross domestic product of Hamedan province (with oil) at constant 2011 prices in year t	Million Rials	GDP _t	Statistical Center of Iran
Revenue from specific tolls in Hamedan Municipality in year t	Rials	excl _t	Statistical Yearbook of Hamadan City and Municipality
Average annual total income of an urban household in year t	Thousand Rials	income _t	Statistical Yearbooks
Revenue from service charges and income of profitable institutions in Hamedan Municipality in year t	Rials	Service _t	Hamedan Municipality Budget Settlement Offices
Revenue from municipal funds and properties in Hamedan Municipality in year t	Rials	Fund _t	Hamedan Municipality Budget Settlement Offices
Stock price index (overall stock exchange price index) in year t	Unit	Price _t	Stock Exchange Website
Average exchange rate in the free market in year t	Rials	Exch _t	Central Bank Website
Revenue from grants and aid from the government and government organizations in year t	Rials	Aid _t	Hamedan Municipality Budget Settlement Offices

Variable	Unit	Abbreviation	Statistical sources
Operational balance, operational deficit, or current budget deficit in year t	Billion Rials	$Taraz_t$	Budget Deficit Review Reports
Oil revenues of the country in year t	Billion Rials	Oil_t	Central Bank Website
Revenue from donations, gifts, and assets in year t	Rial	$Donations_t$	Hamedan Municipality Budget Settlement Offices
Total revenues of Hamedan Municipality in year t	Rial	Rev_t	Hamedan Municipality Budget Settlement Offices
Total revenues of Hamedan Municipality, excluding specific revenue in year t	Rial	$NRev_t$	Hamedan Municipality Budget Settlement Offices
Disposal of capital assets in Hamedan Municipality in year t	Rial	$Asset_t$	Hamedan Municipality Budget Settlement Offices
Disposal of financial assets in Hamedan Municipality in year t	Rial	Fin_t	Hamedan Municipality budget settlement offices
Facilities paid by Bank Maskan in year t	Billion Rials	$Loan_t$	Central Bank Website
Model error term		ϵ_t	-

4. Research data analysis

This section of the research addresses the statistical analysis of the revenue trends of Hamadan Municipality from 2009 to 2023. The information presented is extracted from comprehensive statistical tables of Hamadan Municipality revenues, and all numerical values and annual growth percentages of various revenue sources have been documented. A statistical overview is included in Table 4 to enable the observation of the change trends for each revenue

source separately and to provide a clearer understanding of the municipality's revenue structure. Therefore, before the statistical analysis, the definitions of each revenue source of Hamadan Municipality are addressed as dependent variables in Table 3. They include revenue from general tolls, specific tolls, service charges and for-profit institutions, municipal funds and property, government grants and aid, donations/contributions/gifts, capital assets disposal, and financial assets disposal.

Table 3. Main revenue sources of Iranian municipalities

1	General tolls	They include fees on passenger cars and vehicles, fees on petroleum products and cigarettes, fees on official documents, fees on building permits, etc. These fees, which provide the highest amount of municipal revenue, are mainly considered as taxes on consumption or sales of goods and are part of the municipality's recurring revenues.
2	Specific tolls	These include waste management service fees, revenue from cultural centers, revenue from other organizations affiliated with the municipality, etc. Among the revenue sources, these fees provide the lowest amount of municipal revenue.
3	Service charges and revenue from for-profit institutions	It refers to safety and firefighting service fees, expert service fees, contracting service fees, revenue from commercial advertisements and ambient advertising, etc.
4	Municipal funds and property	Revenue and rent from municipal structures, revenue from public parking lots, revenue from investments, revenue from dividends of organizations and companies, etc.
5	Government grants and aid	Grants from the government or other government organizations and institutions, and ticket subsidies.
6	Donations/contributions/gifts	Article 100 Commission fines, revenue from the sale of tender documents, citizen self-help and received gifts, etc.
7	The capital assets disposal	Sale of immovable property, sale of movable and scrapped property, sale of goodwill.
8	The financial assets disposal	Loans received from the Ministry of Interior and facilities received from banks and financial and credit institutions.

The revenue trend, as displayed in Figure 1 and Table 4, serves as the basis for subsequent analytical

interpretations, allowing for the identification of growth patterns, fluctuations, and the sustainability of each source. Based on this analysis, the changes in each of these sources are heavily influenced by macro-economic conditions, urban management decisions, and changes in financial policymaking. Their role as dependent variables in the examined relationships allows for the identification of sustainable and

vulnerable sources. This analytical framework provides a solid foundation for data interpretation and subsequent inferences. The results of the investigations show that, from 2009 to 2023, the revenues of Hamedan Municipality from various sources have had an increasing trend. However, this growth has not been uniform and has been accompanied by fluctuations.

Table 4. Revenues by main municipal code categories, Hamedan Municipality, 2009–2023 (billion Rials)

Year	Revenue from general tolls	Revenue from specific tolls	Revenue from service charges and for-profit institutions	Revenue from municipal funds and property	Revenue from government grants and aids	Revenue from donations/contributions/gifts/gifts	Revenue from capital assets disposal	Revenue from financial assets disposal
2009	229,149	14,600	18,369	3,880	25,500	162,807	65,448	6,200
2010	419,393	14,441	44,513	3,881	116,820	107,585	64,492	0
2011	530,780	53,705	30,122	7,072	1,737	131,535	88,847	23,000
2012	717,601	135,287	52,348	7,670	219,936	192,836	245,875	20,000
2013	1,173,530	201,600	34,372	11,406	1,262	358,451	170,581	50,000
2014	1,860,000	264,443	248,693	91,719	23,238	547,832	274,701	30,000
2015	1,290,000	183,871	172,920	63,774	16,158	380,916	167,020	0
2016	1,670,000	237,790	223,627	82,475	20,896	492,617	207,197	59,000
2017	1,989,750	214,084	507,535	189,688	51,272	560,275	192,956	43,700
2018	2,599,570	5,710	527,401	203,389	91,048	788,241	600,029	72,300
2019	3,158,660	128,590	811,141	345,256	219,257	1,318,360	682,521	0
2020	3,858,530	654,034	336,017	351,961	150,200	2,317,440	4,369,700	500,000
2021	5,420,200	398,402	729,684	1,013,820	151,893	3,246,580	4,026,860	35,800
2022	9,040,480	561,103	716,471	1,946,470	762,305	1,762,990	7,435,020	94,500
2023	13,700,000	902,000	1,340,000	3,160,000	528,000	3,480,000	10,600,000	300,000

Revenue from general tolls: The largest share and an average annual growth of approximately 34%; it is the main pillar of sustainable revenue. Additionally, based on the Sustainable Revenue Law of Hamadan Province Municipalities, renovation tolls have seen a 1.5% growth from 2023 onwards.

Revenue from specific tolls: Similar growth of around 34.2 percent, but high volatility due to dependence on macroeconomic conditions; a vulnerable source.

Revenue from service charges and for-profit institutions: 36% growth; there has been a significant increase since 2017 onwards, which indicates an increase in citizen participation in financing urban services.

Revenue from municipal funds and property: The highest growth (more than 61%); there is a greater focus by the municipality after 2017, but reliance on

this source can threaten financial sustainability because asset sales are not always repeatable.

Revenue from government grants and aids: Average revenue growth of 24.2%; it is unstable, highly volatile, and weak. This instability makes the municipality vulnerable in crises.

Revenue from donations/contributions/gifts: 20% growth; despite the increasing trend, there was a sharp drop in 2022, resulting from social developments and economic recession.

Revenue from capital assets disposal: High growth (44%) with spikes in 2013, 2022, and 2023, but mostly as a compensatory tool in budget deficit conditions; a temporary and unsustainable source.

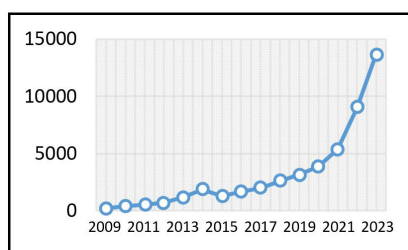
Revenue from financial assets disposal: Borrowing reached approximately 50 billion Tomans in 2020; average growth of less than 1%; an unstable source

used only periodically during crises.

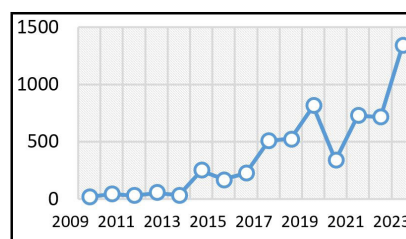
Total revenues of Hamadan Municipality: The municipality's total revenue increased from approximately 454 billion Rials in 2009 to over 23,000 billion Rials in 2023 (average annual growth of 32.4%); however, this growth has mostly relied on asset sales and unstable sources.

The research findings indicate that Hamadan Municipality, to compensate for budget deficits, particularly during crisis periods, has increasingly turned to asset sales and borrowing, which is not sustainable and may have negative impacts on the quality of urban life. Furthermore, the revenue structure of Hamadan Municipality in recent years shows that although there has been significant quantitative growth, heavy dependence on

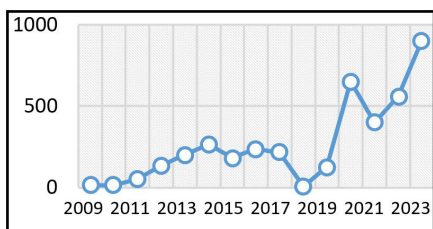
unsustainable sources such as asset sales and government grants threatens its financial stability. Macroeconomic fluctuations (inflation, construction stagnation, and exchange rates) have had a direct impact on these revenues and have reduced the municipality's financial independence. Additionally, the focus on asset sales, rather than creating value-added, has weakened the city's future capital. In contrast, general tolls and service charges have the capacity to become more sustainable and reliable sources, provided that regulations are reformed and citizen participation is attracted. Therefore, the primary challenge for the municipality is to move away from temporary sources to financial diversification, transparency, and the use of modern financing tools.



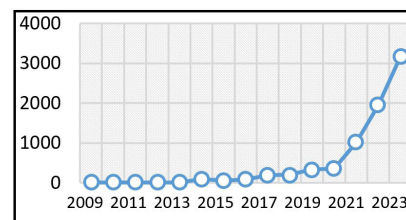
Revenue from general tools



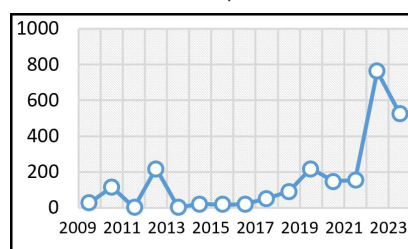
Revenue from service charges and for-profit institutions



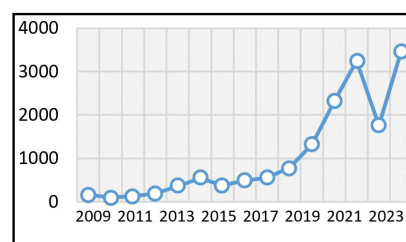
Revenue from specific tools



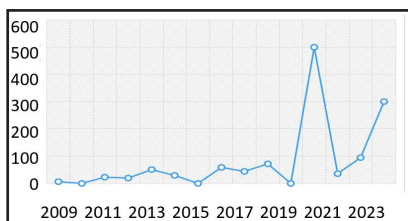
Revenue from municipal funds and property



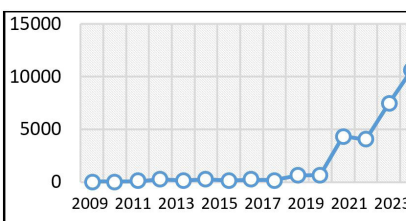
Revenue from government grants and aids



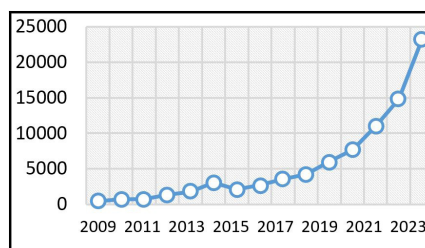
Revenue from donations/contributions/gifts



Revenue from financial asset disposal



Revenue from capital asset disposal



Overall trend of Hamadan Municipality revenues

Figure 1. Trend of Hamedan Municipality revenues during the years 2009–2023 (billion rials), (Hamedan Municipality)

*Figures are in billion rials.

5. Model estimation, analysis, and interpretation of results

Modeling, model estimation, and forecasting for the 2029 horizon

Before estimating the research models and forecasting the revenues of Hamadan Municipality, a stationarity test must be conducted on the variables to ensure that they have a long-term relationship with each other. The results of the stationarity test for the variables are presented in Table 5. As observed, most of the

variables in the research are non-stationary and become stationary with one round of differencing; these variables are technically referred to as $I(1)$ or integrated of order one. Except for the variables “revenues from specific tolls,” “revenue from capital assets disposal,” “operating balance or current budget deficit,” and “automotive production volume,” the other variables are integrated of order one and non-stationary.

Table 5. Results of variables' stationarity test

Variables	Test statistic		Critical value	Result
	At level	At first difference		
Revenues from general tolls	0.499-	3.667--	3.120-	$I(1)$
Revenues from specific tolls	3.512--	-	3.829-	$I(0)$
Service charges and revenues of for-profit institutions	2.244	4.664-	3.829-	$I(1)$
Revenues from municipal funds and property	0.131-	3.884-	-3.829	$I(1)$
Government grants and aids	2.059	5.349-	3.829-	$I(1)$
Donations/contributions/gifts	1.928	4.464-	-3.829	$I(1)$
Sum of the first six revenue codes	0.196-	4.879-	-3.829	$I(1)$
Sum of five revenue codes, excluding specific tolls and financial and capital assets disposal	-0.096	5.266-	-3.829	$I(1)$
Revenue from capital assets disposal	2.299	4.679-	-3.829	$I(1)$
Revenue from financial assets disposal	3.854-	-	-3.829	$I(0)$
Loans provided by Bank Maskan	0.045-	4.083-	-3.829	$I(1)$
Operating balance, operating balance deficit, or current budget deficit	5.039-	-	-3.829	$I(0)$
Oil revenues	1.689-	4.350-	-3.829	$I(1)$
Unofficial exchange rate	0.234-	4.452-	-3.829	$I(1)$
Stock price index	0.296-	4.025	-3.829	$I(1)$
Building permits issued for the city of Hamadan	1.589-	3.302-	-3.829	$I(1)$
Average annual total income of an urban household	2.552-	4.188-	-3.829	$I(1)$
Population	2.965-	3.943-	-3.829	$I(1)$

Variables	Test statistic		Critical value	Result
	At level	At first difference		
Average sales price of one square meter of residential floor area in the city of Hamadan	1.918-	4.441-	-3.829	I(1)
Share of provincial tax revenues in total national tax revenues	0.902-	4.987 -	-3.829	I(1)
Inflation rate	2.650-	7.482-	-3.829	I(1)
Gross domestic product (GDP) of Hamadan at constant prices	3.495-	6.586-	-3.829	I(1)
Automotive production volume	8.664-	-	-3.829	I(0)

Given the non-stationarity of the variables, a cointegration test must be performed before estimating the research models to ensure the existence of long-term equilibrium relationships. For this purpose, the Granger causality test has been utilized. The results of this test are presented in Table 6.

Table 6. Results of the Engle–Granger cointegration test

Dependent variables	Test statistic	Significance level	Result
Revenues from general tolls	-58.85	0.000	Confirmation of cointegration
Revenues from specific tolls	-41.27	0.000	Confirmation of cointegration
Service charges and revenues of fro-profit institutions	-23.67	0.000	Confirmation of cointegration
Revenues from municipal funds and property	-50.11	0.000	Confirmation of cointegration
Government grants and aids	-19.134	0.034	Confirmation of cointegration
Donations/contributions/gifts	-71.47	0.000	Confirmation of cointegration
Sum of the first six revenue codes	18.99	0.000	Confirmation of cointegration
Sum of five revenue codes, excluding specific tolls and financial and capital assets disposal	23.16	0.000	Confirmation of cointegration
Revenue from capital assets disposal	-26.80	0.000	Confirmation of cointegration
Revenue from financial assets disposal	-20.11	0.006	Confirmation of cointegration

As shown in Table 6, the Granger causality test confirms cointegration in all models, indicating the existence of a long-term equilibrium relationship between the variables.

To forecast the revenues of Hamadan Municipality for the 2029 horizon, a model is proposed for each revenue code and estimated based on existing data from 2009 to 2023, and the effect of each variable on

the revenue code will be determined. All variables used in the following equations, along with their abbreviations, are mentioned in Table 2.

To forecast revenues from general duties in Hamadan Municipality, Equation (12) is used:

$$Public_t = \alpha + \beta_1 Car_t + \beta_2 licence_t + \beta_3 POP_t + \beta_4 House_t + \beta_5 Tax_t + \beta_6 Inf_t + \beta_7 GDP_t + \varepsilon_t \quad (12)$$

Table 7. General tolls model estimation results

	Variable coefficient	Significance level
α	-0.0675	0.7338
Car	-0.1648	0.0001
licence	0.0114	0.0003
POP	0.0182	0.1591
House	-0.4267	0.0000
Tax	-0.3253	0.0000
Inf	0.0438	0.0274
GDP	0.7330	0.0003

As shown in Table 7, at the 95% confidence level, all variables (except population) have a significant effect on the level of revenues from general tolls in Hamadan Municipality. Based on the estimated coefficients, the variables of inflation, number of construction permits, and gross domestic product have a positive effect, and other variables have a negative effect on the amount of revenues from the general duties of Hamadan Municipality.

The adjusted coefficient of determination for this model, estimated from 2009 to 2023, is 0.985,

indicating that the estimated model has an acceptable predictive power. Given that the country's economic condition is largely similar to that of 2013, to forecast general duties for the 2029 horizon, we assume that the model variables (except population) change based on the existing trends from 2013 to 2017. Additionally, based on population estimates obtained from the Statistical Center of Iran, the revenues from general duties in Hamadan Municipality are expected to reach 50,957.2 billion Rials for the 2029 horizon.

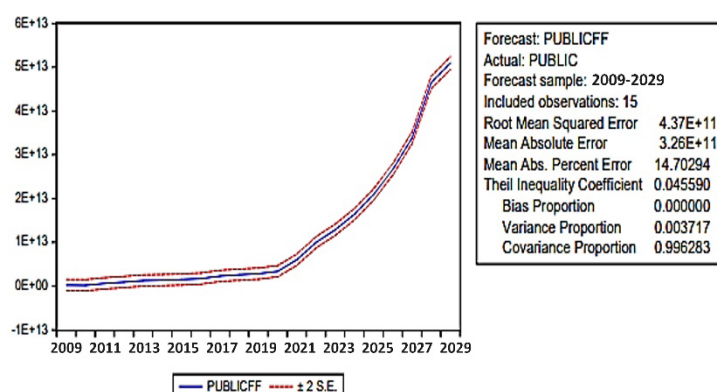


Figure 2. Forecasting revenues from general tolls in Hamadan city in the 2029 horizon

To forecast revenues from specific duties in Hamadan Municipality, Equation (13) is used:

$$excl_t = \alpha + \beta_1 POP_t + \beta_2 Inf_t + \beta_3 GDP_t + \beta_4 income_t + \varepsilon_t \quad (13)$$

Table 8. Specific tolls model estimation results

	Variable coefficient	Significance level
α	1233.3-	0000.0
Inf	0580.0	0398.0
GDP	6223.0-	0204.0
POP	3232.4-	0001.0
income	6643.0	0000.0

As shown in Table 8, at the 95% confidence level, all variables have a significant effect on the level of revenues from specific tolls in Hamadan Municipality. Based on the estimated coefficients, the variable of gross domestic product has a negative effect, and other variables have a positive effect on the amount of revenues from the specific tolls of Hamadan Municipality.

The adjusted coefficient of determination for this model, estimated during the period 2009-2023, is 0.756, indicating that the estimated model has a high predictive power.

It is forecasted that the revenues from specific tolls in Hamadan Municipality will exceed 1,435 billion Rials in the 2029 horizon.

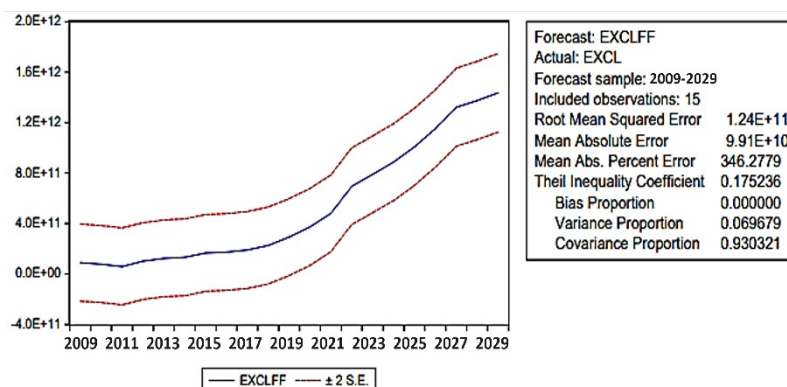


Figure 3. Forecasting revenues from specific tools in Hamadan city in the 2029 horizon

To forecast revenues from service charges and revenues of for-profit institutions in Hamadan Municipality, Equation (14) is used:

$$Service_t = \alpha + \beta_1 Car_t + \beta_2 licence_t + \beta_3 House_t + \beta_4 POP_t + \beta_5 Inf_t + \beta_6 income_t + \varepsilon_t \quad (14)$$

Table 9. Results of model estimation for revenues from service charges and for-profit institutions in Hamadan Municipality

	Variable coefficient	Significance level
α	-16.4665	0.0000
Car	0.4515	0.0007
licence	0.0521	0.0001
House	-0.7387	0.0000
POP	16.5920	0.0000
Inf	0.4281	0.0001
income	0.6813	0.0000

As shown in Table 9, at the 95% confidence level, all variables have a significant effect on the level of revenues from service charges and for-profit institutions in Hamadan Municipality. Based on the estimated coefficients, the variable of housing price has a negative effect, and other variables have a positive effect on the amount of revenues from service charges and for-profit institutions in Hamadan Municipality.

The adjusted coefficient of determination for this model, estimated during the period 2009-2023, is 0.877, indicating that the estimated model has a high predictive power.

It is forecasted that the revenues from service charges and for-profit institutions in Hamadan Municipality will exceed 1,833 billion Rials in the 2029 horizon.

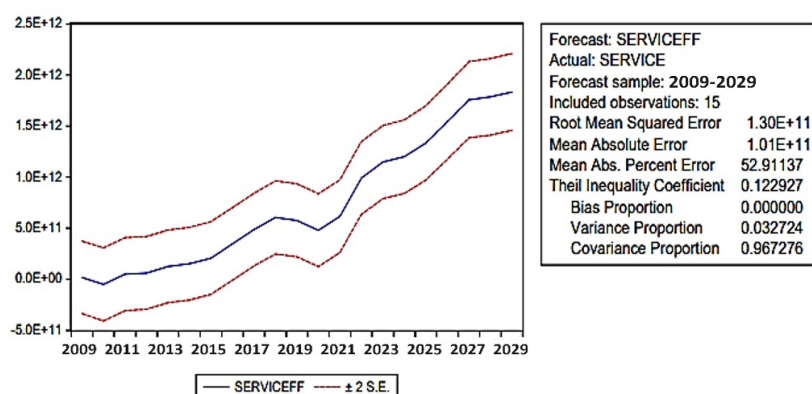


Figure 4. Forecasting revenues from service charges and for-profit institutions in Hamadan city in the 2029 horizon

To forecast revenues from funds and property in Hamadan Municipality, Equation (15) is used:

$$Fund_t = \alpha + \beta_1 Price_t + \beta_2 GDP_t + \beta_3 Car_t + \beta_4 POP_t + \beta_5 Exch_t + \varepsilon_t \quad (15)$$

Table 10. Results of model estimation for revenues from funds and property in Hamadan Municipality

	Variable coefficient	Significance level
α	3.3402	0.0000
Price	-0.2873	0.0001
GDP	0.9467	0.0002
Car	1.0734	0.0000
POP	-5.8961	0.0000
Exch	1.8231	0.0000

As shown in Table 10, at the 95% confidence level, all variables have a significant effect on the level of revenues from funds and property in Hamadan Municipality. Based on the estimated coefficients, the variables of housing price and population have a negative effect, and other variables have a positive effect on the amount of revenues from funds and property in Hamadan Municipality.

The adjusted coefficient of determination for this

model, estimated for the period 2009-2023, is 0.921, indicating that the estimated model has high predictive power and can explain more than 92 percent of the changes in revenues from funds and property in Hamadan Municipality.

It is forecasted that the revenues from funds and property in Hamadan Municipality will exceed 1,171 billion Rials in the 2029 horizon.

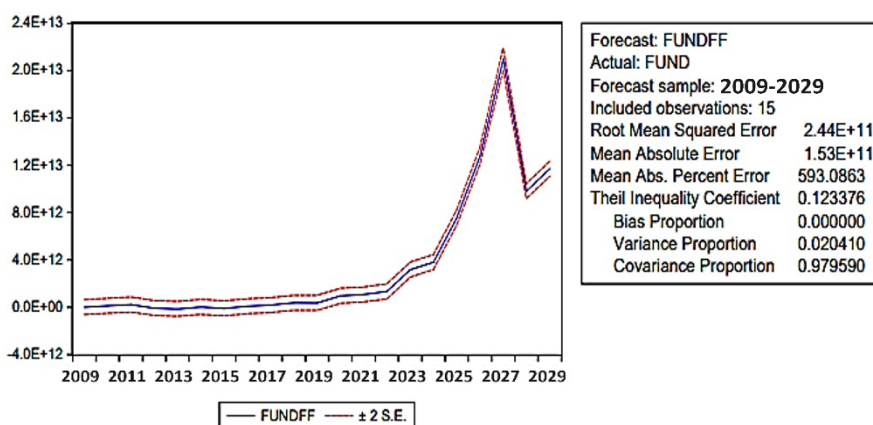


Figure 5. Forecasting revenues from funds and property of Hamadan Municipality in the 2029 horizon

To forecast revenues from government grants and government organizations in Hamadan Municipality, Equation (16) is used:

$$Aid_t = \alpha + \beta_1 tax_t + \beta_2 Taraz_t + \beta_3 GDP_t + \beta_4 Oil_t + \beta_5 inf_t + \beta_6 Exch_t + \varepsilon_t \quad (16)$$

Table 11. Results of model estimation for revenues from government grants and aids in Hamadan Municipality

	Variable coefficient	Significance level
α	0.0535	0.6619
tax	1.5295	0.0000
Taraz	0.0814	0.0000
GDP	-0.3782	0.0120
Oil	0.2784	0.0000
inf	1.0919	0.0000
Exch	-1.0997	0.0000

As shown in Table 11, at the 95% confidence level, all variables have a significant effect on the level of revenues from government grants aids in Hamadan Municipality. Based on the estimated coefficients, the variables of market exchange rate and gross domestic product have a negative effect, and other variables have a positive effect on the amount of revenues from government grants and aids in Hamadan Municipality. The adjusted coefficient of determination for this

model, estimated for the period of 2009 to 2023, is 0.919, indicating that the estimated model has a high predictive power and can explain more than 91 percent of the changes in revenues from government grants and aids in Hamadan Municipality. It is forecasted that the revenues from government grants and aids in Hamadan Municipality will exceed 2,617 billion Rials in the 2029 horizon.

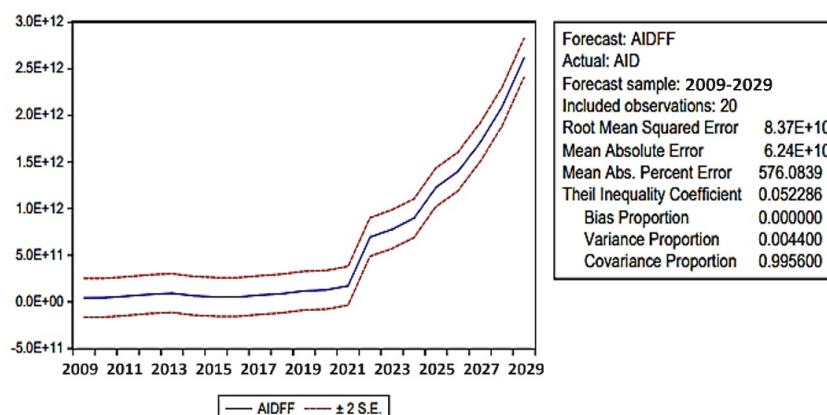


Figure 6. Forecasting revenues from government grants and aids in Hamadan Municipality in the 2029 horizon

To forecast revenues from donations/contributions/ gifts in Hamadan Municipality, Equation (17) is used:

$$Donations_t = \alpha + \beta_1 Inf_t + \beta_2 POP_t + \beta_3 GDP_t + \beta_4 income_t + \varepsilon_t \quad (17)$$

Table 12. Results of model estimation for revenues from donations/contributions/gifts in Hamadan Municipality

	Variable coefficient	Significance level
α	-9.9535	0.0000
Inf	0.5167	0.0000
POP	12.6654	0.0000
GDP	-2.6086	0.0000
income	0.3800	0.0000

As observed in Table 12, at a 95% confidence level, all variables have a significant effect on the level of revenues from donations/contributions/gifts in Hamadan Municipality. Based on the estimated coefficients, the gross domestic product (GDP) variable has a negative effect, while other variables have a positive effect on the amount of revenues from donations/contributions/gifts in Hamadan Municipality.

The adjusted coefficient of determination (R-squared)

for this model, estimated during the period 2009-2023, is 0.852, indicating that the estimated model possesses high predictive power and can explain more than 85 percent of the changes in revenues derived from donations/contributions/gifts in Hamadan Municipality.

It is forecasted that revenues from donations/contributions/gifts in Hamadan Municipality will exceed 3,851 billion Rials in the 2029 horizon.

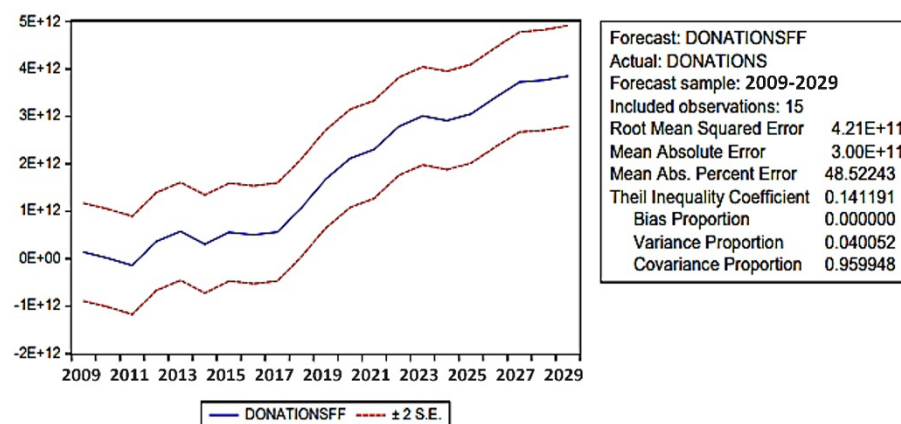


Figure 7. Forecasting revenues from donations/contributions/gifts in Hamadan Municipality in the 2029 horizon

To forecast the total revenues of Hamadan Municipality, Equation (18) is used

$$Rev_t = \alpha + \beta_1 Inf_t + \beta_2 Car_t + \beta_3 licence_t + \beta_4 POP_t + \beta_5 House_t + \beta_6 Tax_t + \beta_7 GDP_t + \varepsilon_t \quad (18)$$

Table 13. Results of total revenue estimation for Hamadan Municipality

	Variable coefficient	Significance level
α	0.6130	0.0001
Inf	-0.0827	0.0000
Car	-0.2567	0.0000
licence	0.0177	0.0000
POP	-1.4382	0.1884
House	-0.0056	0.0000
Tax	0.9756	0.0000
GDP	1.1769	0.0000

As observed in Table 13, at a 95% confidence level, all variables have a significant effect on the total revenues of Hamadan Municipality. Based on the estimated coefficients, the variables of gross domestic product (GDP) and housing price have a negative effect, while other variables have a positive effect on the total revenues of Hamadan Municipality.

The adjusted coefficient of determination (R-squared)

for this model, estimated during the period 2009-2022, is 0.990, indicating that the estimated model possesses high predictive power and can explain more than 99 percent of the changes in revenues derived from the total revenues of Hamadan Municipality.

It is forecasted that the total revenues of Hamadan Municipality will exceed 38,650 billion Rials in the 2027 horizon.

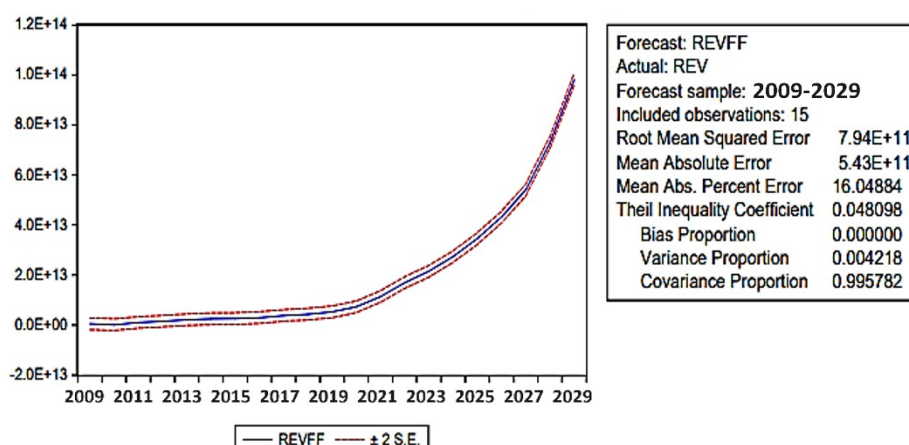


Figure 8. Forecasting the total revenues of Hamadan Municipality in the 2029 horizon

To forecast the total revenues of Hamadan Municipality, excluding specific revenues, Equation (19) is used:

$$NRev_t = \alpha + \beta_1 Inf_t + \beta_2 Car_t + \beta_3 licence_t + \beta_4 POP_t + \beta_5 House_t + \beta_6 Tax_t + \beta_7 GDP_t + \varepsilon_t \quad (19)$$

Table 14. Results of estimating the total revenues of Hamadan Municipality, excluding specific revenues

	Variable coefficient	Significance level
α	-0.2050	0.3514
Inf	-0.0070	0.6897
Car	-0.1947	0.0001
licence	0.0189	0.0001
POP	-0.4945	0.1559
House	-0.0915	0.0001
Tax	1.0124	0.0000
GDP	0.9615	0.0002

As observed in Table 14, at a 95% confidence level, all variables (except population and inflation) have a significant effect on the level of total revenues of Hamadan Municipality, excluding specific revenues. Based on the estimated coefficients, the variables of gross domestic product (GDP), housing price, and the number of produced vehicles have a negative effect, and other variables have a positive effect on the total revenues of Hamadan Municipality, excluding specific revenues.

The adjusted coefficient of determination (R-squared) for this model, estimated during the period 2009-2023, is 0.983, indicating that the estimated model possesses high predictive power and can explain more than 98.3 percent of the changes in total revenues of Hamadan Municipality, excluding specific revenues. It is forecasted that the total revenues of Hamadan Municipality, excluding specific revenues, will exceed 70,966 billion Rials in the 2029 horizon.

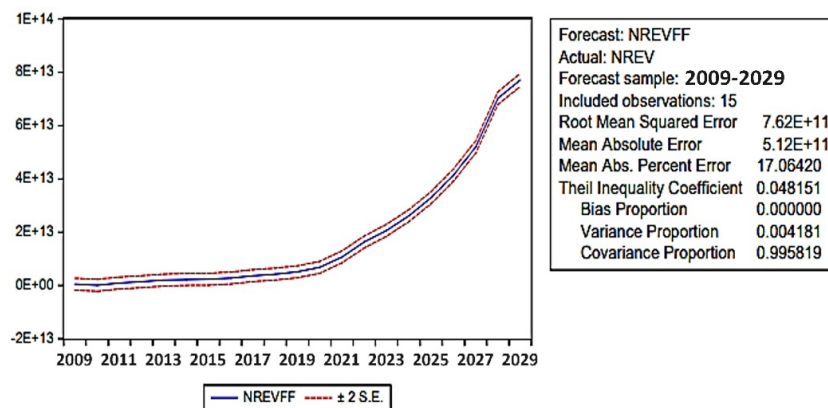


Figure 9. Forecasting the total revenues of Hamadan Municipality, excluding specific revenues, in the 2029 horizon

To forecast the financing of Hamadan Municipality through capital assets disposal, Equation (20) is used:

$$Asset_t = \alpha + \beta_1 Loan_t + \beta_2 Price_t + \beta_3 GDP_t + \beta_4 Inf_t + \beta_5 Oil_t + \varepsilon_t \quad (20)$$

Table 15. Results of estimation for financing through capital asset disposal in Hamadan Municipality

	Variable coefficient	Significance level
α	0.6048	0.0000
Loan	0.7472	0.0000
Price	0.7409	0.0000
GDP	-0.9623	0.0000
Inf	-0.2111	0.0000
Oil	0.0805	0.0000

As observed in Table 15, at a 95 percent confidence level, all variables have a significant effect on the level of financing through capital asset disposal in Hamadan Municipality. Based on the estimated coefficients, the variables of gross domestic product (GDP) and inflation rate have a negative effect, and the variables of facilities paid by Bank Maskan, oil revenue, and stock price index have a positive effect on financing through capital assets disposal in Hamadan Municipality.

The adjusted coefficient of determination for this model, estimated for the period 2009-2023, is 0.975, indicating that the estimated model possesses high predictive power and can explain more than 97 percent of the changes in financing from capital asset disposal in Hamadan Municipality. It is forecasted that the total financing from capital asset disposal in Hamadan Municipality will exceed 33,757 billion Rials in the 2029 horizon.

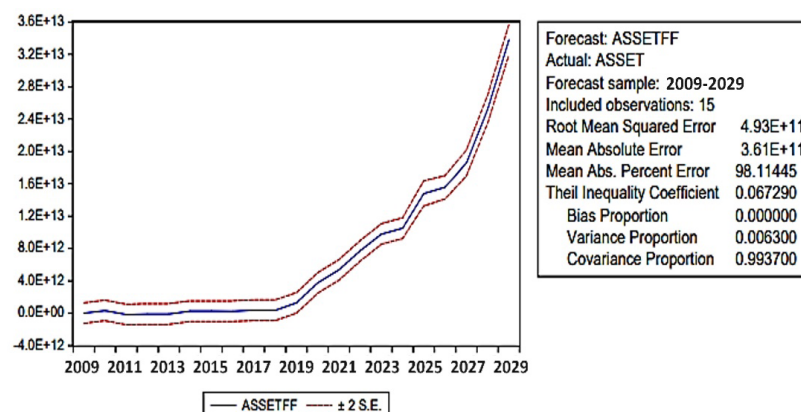


Figure10. Forecasting financing through capital asset disposal in Hamadan Municipality in the 2029 horizon

To forecast the financing of Hamadan Municipality through capital asset disposal, Equation (21) is used:

$$Fin_t = \alpha + \beta_1 Loan_t + \beta_2 Price_t + \beta_3 GDP_t + \beta_4 Inf_t + \beta_5 Oil_t + \varepsilon_t \quad (21)$$

Table 16. Results of estimation for financing through financial asset disposal in Hamadan Municipality

	Variable coefficient	Significance level
α	-1.4645	0.0000
Loan	-0.9596	0.0000
Price	1.7246	0.0000
GDP	2.674	0.0000
Inf	-0.1939	0.0000
Oil	-0.3947	0.0000

As shown in Table 16, at a 95% confidence level, all variables have a significant effect on the level of financing through financial asset disposal in Hamedan Municipality. Based on the estimated coefficients, the variables of Bank Maskan loans, inflation rate, and oil revenue have a negative effect, while the variables of Hamedan city's GDP and the overall stock price index have a positive effect on financing through financial asset disposal in Hamedan Municipality.

The adjusted coefficient of determination for this model, estimated for the period 2009-2023, is 0.596, indicating that the estimated model possesses moderate predictive power and can explain more than 59 percent of the changes in financing through financial asset disposal in Hamedan Municipality. It is predicted that the total financing through financial asset disposal in Hamedan Municipality will exceed 2,492 billion Rials by the 2029 horizon.

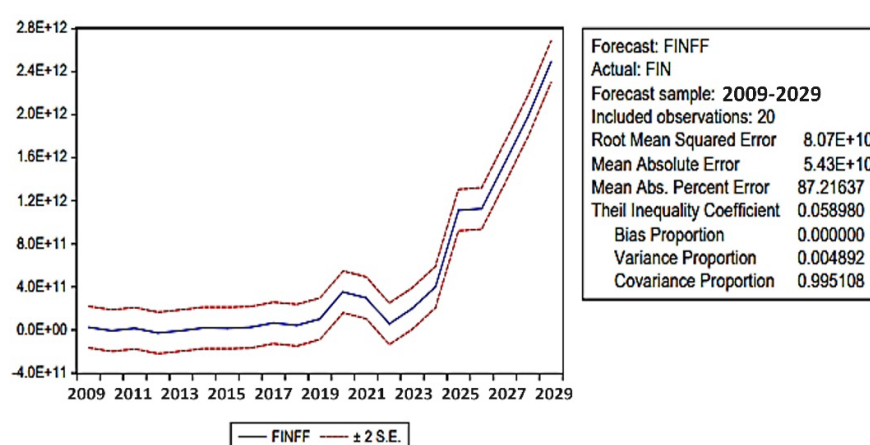


Figure 11. Forecast of financing from the disposal of financial assets in Hamedan Municipality for the 2029 horizon

The final results obtained from forecasting each revenue code for Hamedan Municipality's revenues for the next five years are presented in Table 13 for managers' decision-making and policy-making. Given that the efforts of the Municipality's revenue unit are also effective in budget realization, time series data of budget settlement from 2009 to 2023 for Hamedan Municipality have been used for these forecasts. According to the results obtained, the Municipality's revenues have followed a growing trend. The revenue codes for taxes derived from general revenues, revenues from capital assets disposal, and revenues from municipal properties and funds have accounted

for the highest amounts in these five forecast years. For the year 2025, the amounts for these revenue codes are predicted to reach 20,926, 14,789, and 7,533 billion Rials, respectively. Following that, the codes for donations/contributions/gifts, service charges and revenues from for-profit institutions, government grants and aids, revenues from financial assets disposal, and revenues from specific tolls have accounted for the highest predicted revenue amounts for these years, with minor fluctuations. Therefore, considering the results obtained from these forecasts in Table 13 and Figure 11, in the 2025 to 2029 horizon, it is clear that the highest revenues earned by the

municipality are from general tolls, but the codes for general tolls, capital assets disposal, and municipal funds and properties will still be the three main sources of revenue for Hamedan Municipality. This suggests that the Municipality's financial structure still relies on unsustainable sources, as a significant part of these revenues either depends on macroeconomic changes and the housing market (such as municipal funds and properties) or is inherently non-repeatable (such as the sale of capital assets). While the exponential growth of the forecast figures is a sign of potential capacity, if the municipality settles for this same pattern, in the long run, it will face a reduction in productive assets, an increase in financial risk, and a threat to the sustainability of urban services. On the other hand, the lower share of resources, such as service charges and revenue from for-profit institutions or specific tolls, indicates that public capacities and sustainable urban revenue generation have not yet been well activated. Global experiences suggest that the greater the weight of these resources in the budget, the more the municipality's financial independence increases, and the ability to withstand economic fluctuations rises.

A review of the regression results for the various revenue models of Hamedan Municipality shows that the influence of variables on revenue sources varies, and in each model, certain variables play a more prominent role than others. In the model for revenues derived from general tolls, gross domestic product (GDP) has the most positive impact, followed by taxes and inflation, which play significant roles, while housing prices, the number of vehicles, and building permits have a significant negative effect, and

population has no significant effect. In the specific tolls model, household income has the most positive effect, and population has the most negative effect, while gross domestic product also has a limited negative effect. In the model for revenues from service charges and for-profit institutions, population and the number of vehicles have the most positive effect, and housing prices have a prominent negative effect. For municipal funds and properties, financial indices and assets have a significant impact, while population and housing prices have a negative effect. In financing from capital asset disposal, bank loans and the stock price index have the most positive effect, while gross domestic product and inflation have the most negative effect. In financing from financial asset disposal, gross domestic product and the stock index show the most positive impact, while bank loans, inflation, and oil revenue have a negative effect. A general comparison of the models shows that some variables, such as gross domestic product and housing prices, have a significant impact in several models, while population and some sector-specific indices play a secondary role. This analysis shows that the direction and intensity of the impact of various variables differ for each revenue source. The significance of certain variables emphasizes the need to focus on them when planning and forecasting urban revenues.

Therefore, the data in Table 17 clarifies that Hamedan Municipality requires a serious revision of its revenue portfolio. If the focus is not placed on diversification and increasing the share of sustainable sources, such as reformed general tolls, local taxes, and urban services, even significant revenue growth will not be able to prevent financial fragility in the future.

Table 17. Forecast of Hamadan Municipality revenue codes for 1404–1408 (Rials)

Revenue forecast Year	Revenues from general tolls	Revenues from specific tolls	Revenues from service charges and for-profit institutions	Revenues from municipal property and funds	Government grants and aids	Donations/contributions/gifts	Revenue from capital asset disposal	Revenue from financial asset disposal	Total
2025	20,925,847,577,670	1,007,016,755,240	1,334,119,054,841	7,532,569,591,056	1,201,161,289,972	3,053,808,191,629	14,789,462,861,386	1,058,348,669,589	50,982,617,805,897
2026	26,653,875,208,473	1,152,739,186,799	1,541,989,054,397	12,756,390,867,301	1,452,472,571,426	3,400,075,648,432	15,563,953,429,206	1,120,705,104,905	63,642,201,070,939

Year	Revenue forecast	Revenues from general tolls	Revenues from specific tolls	Revenues from service charges and for-profit institutions	Revenues from municipal property and funds	Government grants and aids	Donations/contributions/gifts	Revenue from capital asset disposal	Revenue from financial asset disposal	Total
2027		33,816,401,554,313	1,321,022,355,987	1,756,243,558,551	20,958,755,248,266	1,749,032,205,948	3,722,428,353,935	18,560,539,667,926	1,585,875,590,378	83,470,298,535,304
2028		46,488,620,867,846	1,374,589,343,819	1,785,021,861,300	9,807,390,102,281	2,053,162,604,757	3,760,139,913,185	25,154,864,686,199	2,010,814,259,765	92,434,603,639,153
2029		50,957,235,524,452	1434996802058	1,833,522,956,228	11,706,921,408,003	2,617,310,441,276	3,850,796,218,027	33,757,325,902,020	2,492,417,163,827	108,650,526,415,889

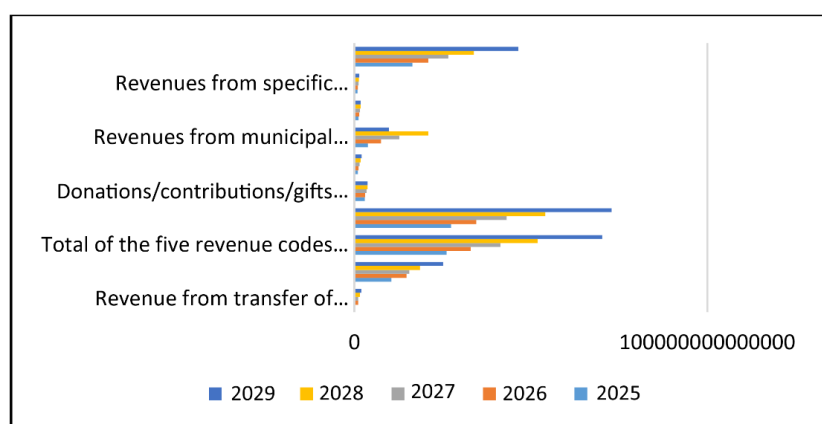


Figure 12. Forecast of Hamadan Municipality revenue codes (2025–2029)

6. Results and suggestions

Examining the financial situation of municipalities is of great importance because their financial resources influence the quality of urban services and managerial decision-making. The present study analyzed the revenue trend of Hamadan Municipality from 2009 to 2023 and, using the ordinary least squares (OLS) method, forecast revenues for the next five years up to the 2029 horizon. The results of the research show that revenues from specific tolls fluctuated more sharply than general tolls due to the impact of macroeconomic conditions, with an average growth of 34.2 percent, and revenues from service prices and for-profit institutions showed a growth of 35.9 percent.

Revenues from municipal funds and properties, which increased in all the years of the study period (except 2015), grew by 61.3%, suggesting that Hamadan Municipality has placed greater focus on municipal funds and properties for revenue creation from 2017 onward. Revenues from government grants and aid have also faced severe fluctuations. During some years (2016), there was no performance, revealing it as one of the instability factors in Hamadan Municipality's revenue, with a growth of 24.2% over the studied period. The trend of revenues from donations/contributions/gifts in Hamadan Municipality was increasing in most years; however, in 2022, it had a sharp decline compared to 2021, due to social and

economic developments. Overall, it experienced an average growth of 33% over the period under review. Furthermore, Hamedan Municipality's financing from capital asset disposal underwent severe fluctuations alongside a 43.8 percent growth over the period. This indicates that whenever the municipality's budget faces a severe squeeze, the use of this financing method increases sharply. Finally, financing from financial asset disposal in Hamedan Municipality experienced an average growth of less than one percent during the period under review, despite occasional shocks. Subsequently, to forecast the revenues of Hamedan Municipality for the 2029 horizon, after reviewing the trends of the variables and introducing a proposed model for each revenue code, the effect of each variable on each revenue code was determined. The high adjusted coefficients obtained for each revenue code indicate that the estimated models possess acceptable predictive power. Consequently, based on these models, the revenues from each revenue code were forecast for the 2029 horizon (the next 5 years). In the 2025 budget forecast for Hamedan Municipality, revenue sources are estimated at approximately 50,983 billion Rials. The major sources are provided by revenues from general tolls (41.7 percent), revenue from capital assets disposal (29 percent), and revenues from municipal funds and properties (15 percent). Donations/contributions/gifts (6 percent), service charges and revenues from for-profit institutions (2.3 percent), and government grants and aids (2.4 percent) contribute to the sourcing of this budget. Additionally, a very negligible portion (2 percent for the code) of Hamedan Municipality's public resources is provided through revenues from financial asset disposal and revenue from specific tolls (2 percent).

Executive recommendations for improving the financial sustainability of the municipality can be categorized into three time horizons. In the short-term (1 to 2 years), actions such as reforming and revising taxes and tariffs, improving revenue collection systems through digitalization and system integration, and strengthening public participation by enhancing the quality of urban services can lead to increased efficiency and the rapid realization of revenues. During this same period, pursuing immediate legal reforms is also important; specifically, allocating a fixed and sustainable share of traffic fines to municipalities can create a reliable financial source for funding equipment, maintenance, and traffic control costs. In the medium-term (3 to 5 years), focusing on

diversifying revenue sources through the development of sustainable revenues, such as local taxes, service charges, and income from for-profit institutions, along with investing in productive projects and the smart management and prioritization of assets, will help reduce the municipality's dependence on unsustainable sources. In the long-term (5 years and more), the primary goal is to create a sustainable and resilient financial structure achieved through reducing dependence on government aid and one-off revenues, developing modern financial tools, multi-year planning, strengthening debt management, and institutionalizing legal reforms related to revenue sources (including the stabilization of the municipalities' share of traffic fines), which will ultimately lead the municipality toward financial independence and sustainable urban development.

6.1 Suggestions for future research

Considering the occurrence of the 12day war in Iran and its impact on economic and financial structures, future studies can focus on examining the effect of shortterm crises on the revenue sustainability of municipalities. Revising revenue forecasting models, evaluating the financial resilience of municipalities, and analyzing shortterm revenue changes are among the key axes of future research. In addition, given that some regression coefficients in the present study were relatively unsatisfactory, the use of data mining (including timeseries analysis, clustering of revenue sources, and identification of payment patterns) can increase the accuracy of the models. Future studies may pursue topics such as "redesigning municipal revenue forecasting models under crisis conditions," "analyzing the financial resilience of urban management," and "examining the effect of the 12day war on the sustainability of urban revenues," which will provide more precise tools for financial planning.

Authors' Contributions

The authors contributed equally to this study.

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Conflict of Interest

The authors declared no conflict of interest.

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