“Local public investment drivers in Morocco: A panel data analysis”

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LOCAL PUBLIC INVESTMENT DRIVERS IN MOROCCO: A PANEL DATA ANALYSIS

Abstract

This paper investigates the determinants of local public investment in Morocco, a country undergoing decentralization and facing persistent regional disparities. The study aims to identify the key factors driving capital expenditure across Morocco's 12 regions and their local governments, including regional, provincial, and municipal councils, from 2017 to 2024. A dynamic panel of 96 observations is constructed, and a generalized method of moments (GMM) estimator is applied to address endogeneity, control for regional fixed effects, and account for the temporal persistence of investment. The choice of GMM is supported by prior descriptive analysis and the absence of spatial autocorrelation, confirmed by Moran's I test. The results show that financial resources play a central role in shaping regional investment levels. Specifically, both own-source revenues and central government transfers have a positive and statistically significant effect on investment, with elasticities of 0.43 and 1.35, respectively. Public debt also contributes positively (0.21%), suggesting its potential as a complementary financing tool. In contrast, personnel expenditure exerts a crowding-out effect (−0.48%), reducing the fiscal space available for investment. Other operating expenditures and regional population show no significant impact. The model is robust ($R^2 = 0.757$) and satisfies the Hansen test ($p = 0.095$). Overall, the findings highlight the decisive role of financial autonomy and the effectiveness of intergovernmental transfers in enhancing the investment capacity of local governments. The results also call for better management of operating expenses to avoid limiting capital investment potential.

Keywords local governments, public investment, capital expenditures, panel data, generalized method of moments, local public finance

JEL Classification H54, H71, H72

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INTRODUCTION

Local public investment is increasingly recognized as a key instrument for supporting regional development and addressing the specific needs of local governments (Boex et al., 2022). Beyond its role in improving infrastructure, it enables local collectivities to adapt public services more effectively to local realities, thereby fostering inclusive growth and long-term resilience. The importance of local public investment is clearly illustrated in OECD countries, where local governments are responsible for a considerable share of national public expenditure (OECD, 2019), highlighting a broader shift toward decentralization and locally driven development policies.

Morocco, as a unitary state whose development model is founded on decentralization, embarked in 2005 on a new strategic era aimed at strengthening the role of regions and municipalities. This reform process has involved the progressive transfer of exclusive, shared, and delegated powers from the central government (Constitute, 2011). However, the successful realization of this vision depends largely on stimulating public investment led by subnational governments, particularly regional councils and municipalities. Comparing Morocco

to OECD countries reveals a significant gap. In OECD nations, local and regional governments are responsible for nearly 57% of total public investment (OECD, 2019). By contrast, territorial collectivities in Morocco did not exceed 15% of national public investment as of 2019. This significant gap underscores the considerable potential for Moroccan subnational governments to play a larger role in driving regional investment and development, especially with the upcoming opportunity presented by hosting the 2030 FIFA World Cup.

Morocco underwent a comprehensive administrative and territorial reform in 2015, establishing a new structure consisting of 12 regions, 75 provinces, and 1,503 municipalities. These three tiers of local governments are financed through a mix of own-source revenues, transfers from the central government, and borrowed funds. However, a persistent challenge lies in the heavy reliance on state transfers, coupled with a relatively moderate level of spending by local governments, both of which call for increased attention to the capacity and financial empowerment of territorial collectivities.

1. LITERATURE REVIEW AND HYPOTHESES

Research on local public investment has evolved significantly, moving from essential theoretical approaches to more detailed empirical analyses, integrating economic, institutional, and political dimensions. The classic approach, based on the economic theory of public goods (Samuelson, 1954), defines local public investment as essential to the successful supply of collective goods that meet local needs. This perspective is complemented by an analysis of the structuring role of local infrastructure funding (R. Musgrave & P. Musgrave, 1989), which highlights the importance of long-term support for local development. In addition, Oates (1973) highlights the need for fiscal decentralization and appropriate local governance, making it possible to guide investment decisions according to specific territorial characteristics.

Nevertheless, these theoretical foundations are no longer sufficient to fully explain the current dynamics of local investment, which are affected by complex contextual variables. Recent research emphasizes the importance of local governments' own resources, financial transfers from central governments, and debt capacity, while taking account of spatial and political factors.

The literature shows that own-source revenue is a fundamental lever for local investment. Indeed, Mulyana et al. (2022) demonstrate, through a study of 34 Indonesian territories, that own-source revenues have a positive influence on both the volume of capital expenditure and regional economic growth. This relationship is corroborated in different geographical configurations, notably in Latin America, where Capello and Caullo (2024) establish that own-source revenue and staff costs are major factors in local public investment. Rochmatullah et al. (2016) also emphasize this point, stressing that local financial autonomy fosters sustainable development, particularly through local taxation. This capacity for financial autonomy, a source of increased local resources, is also highlighted in studies on the Balkans, where Brahimi et al. (2025) and Elezi et al. (2024) show how municipalities, thanks to their financial independence, can allocate more funds to infrastructure.

The importance of financial autonomy is coupled with a contextual variability that also depends on the types of revenue mobilized. In Spain, for example, revenue from urban development, and more specifically from planning fees, plays a crucial role (Elezi et al., 2024). This illustrates how the nature of revenues influences local investment choices and priorities. Furthermore, Haraldsvik et al. (2024) highlight the link between local tax resources, state transfers, and revenue from public services to explain the stability and adaptation of investment to demographic changes in Norway.

Financial transfers from central governments, often targeted at specific projects, are another key element. Papcunová et al. (2020) highlight their importance for investment spending in Central European countries. However, this influence is not systematic. Andhini et al. (2023) stress that over-dependence on these transfers can hinder

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the development of effective autonomous management of local resources. Fitrianti et al. (2025) and Lestari and Utama (2019) confirm that these transfers, combined with own revenues, support local economic performance, as illustrated in the Indonesian and Balinese contexts. Conversely, Sekuła (2015) and Rahmasari et al. (2024) show that in Poland or Indonesia, the impact of transfers on capital investment can be marginal, particularly when budget priorities are turned toward social spending.

The debt issue also appears to be a major lever, although its effects vary from one context to another. In a study conducted by the OECD, Välilä (2006) highlights the importance of debt in investment decisions, particularly in relation to the economic climate. Regional studies, such as those by Al Hayek (2024) in Jordan and Ljutyj et al. (2024) in Ukraine, confirm that debt, particularly via instruments such as municipal bonds, can effectively support investment projects, especially in contexts of increased decentralization. However, Capello and Caullo (2024) point out that this leverage does not always have a significant impact, suggesting that local institutional and economic mechanisms strongly modulate the role of debt.

Spatial analysis further enhances the understanding of the determinants of local public investment. Bremer et al. (2023) illustrate how tax disparities between territories, particularly between rural and urban areas, limit the investment capacity of the weakest local governments, accentuating territorial inequalities. Steinbrunner and Bronnmann (2025) show that local investment, often based on own-source revenue or structural funds, has positive effects beyond administrative boundaries, underlining the need for inter-territorial coordination. These spatial autocorrelation phenomena are confirmed by Ouhakki et al. (2022) in Morocco, Lisjak et al. (2025) in Croatia, and Yang et al. (2022) in the context of public-private partnerships, who all highlight the dependence of local investment behavior on the dynamics of neighboring territories. In addition, Yu et al. (2011) reveal the complexity of fiscal interactions between levels of governance, where cities' investments influence each other negatively or positively depending on the administrative hierarchy, which calls for more integrated multi-level management.

Other, less frequently studied but equally important factors help complete this picture. For instance, Jia et al. (2014) find that expenditure decentralization tends to increase infrastructure investment, often at the expense of educational and administrative services. Vammalle and Bambalaite (2021) highlight the importance of management practices, fiscal discipline, and administrative capacity in mobilizing investment resources in Nordic countries. Similarly, Diem (2024) emphasizes that the quality of public governance not only enhances the effectiveness of local investments but also influences their spillover effects on neighboring territories. Aleksandrova-Zlatanska and Kalcheva (2019) draw attention to the limitations of traditional financing mechanisms and point to the untapped potential of innovative instruments such as green bonds, particularly in Eastern Europe. Finally, Jiménez et al. (2020), based on 1,796 local governments in Peru between 2010 and 2018, confirmed the central role of both own-source revenues and central government transfers in shaping local public investment. Their model also reveals that electoral cycles, financial management practices, and citizen participation significantly influence investment decisions, underscoring the role of participatory democracy in local public finance.

The impact of new environmental priorities on local investment is increasingly recognized, as shown by Thomazeau et al. (2022) in France. The diversity of funding sources is highlighted by Kii et al. (2022) in Sumatra. The plurality of financial instruments available in the Ukrainian context (Ljutyj et al., 2024) shows that local financial management is a constantly evolving field, where traditional challenges and contemporary issues are intertwined.

The literature review concludes that local public investment is shaped by a variety of interconnected factors, including own-source revenues, state transfers, debt capacity, and spatial dynamics. These elements interact within a systemic framework that reflects the complex relationships between economic, institutional, political, and geographical influences. Understanding this complexity is essential for optimizing local investment policies in diverse contexts, such as Morocco, which is the focus of this study.

This study aims to empirically analyze the key determinants of local public infrastructure investment in Morocco, focusing on the financial resources and management practices of local governments. This paper empirically tests the following hypotheses:

H1: When local governments generate more of their own revenue, they are more likely to increase their capital investments.

H2: Financial transfers from the central government help boost capital spending at the local level.

H3: The ability of local governments to take on and manage debt, including interest payments, supports greater capital investment.

H4: As population size grows, local capital investment per capita may decrease due to competing demands on resources.

H5: A rise in operating expenses may limit the funds available for capital investment by local governments.

2. METHODS

This study relies on a balanced panel dataset covering Morocco's 12 regions over the period 2017–2024 (El Bakkali & Guati, 2025), yielding a total of 96 observations. To ensure the robustness and relevance of the econometric analysis, a preliminary descriptive statistical analysis was systematically conducted. This initial step served to explore the main characteristics of the variables presented in Table 1, including measures of central tendency, dispersion, and distribution, as well as interregional and temporal variations. The analysis reveals heterogeneity across regions in terms of both budgetary variables (investment expenditure, own-source revenues, intergovernmental transfers, and operating expenditure) and demographic indicators (notably population size). Moreover, the observed disparities on the regional scale justify the application of logarithmic transformations to the variables. These transformations mitigate scale-related distortions, stabilize variance, and fulfill key assumptions required for consistent and reliable model estimation.

Table 1. Explanatory variables: Definitions, source, and expected sign

Source: El Bakkali and Guati (2025).

Variable	Acronym	Definition	Unit of measurement	Data Source	Expected Sign
Local capital expenditure	Log_Invest	Capital spending by local governments in each region	Millions of dirhams	General Treasury of the Kingdom / Ministry of Economy and Finance (MEF)	?
Own Resources	Log_OR	Own-source revenues collected by local governments in each region	Millions of dirhams	General Treasury of the Kingdom / Ministry of Economy and Finance (MEF)	+
Transferred Resources	Log_TR	Resources transferred by the central government to local governments in each region	Millions of dirhams	General Treasury of the Kingdom / Ministry of Economy and Finance (MEF)	+
Interest expenses on debt	Log_interst_exp	Annual interest payments on debt incurred by local governments in each region	Millions of dirhams	General Treasury of the Kingdom / Ministry of Economy and Finance (MEF)	+
Operating expenditures	Log_OE	Expenditures related to the operating expenses of local governments in each region	Millions of dirhams	General Treasury of the Kingdom / Ministry of Economy and Finance (MEF)	–
Personnel expenses	Log_Pers_exp	Expenditures related to Personnel expenses of local governments in each region	Millions of dirhams	General Treasury of the Kingdom / Ministry of Economy and Finance (MEF)	–
Population	Log_Pop	Total population of each region	Number of inhabitants	High Commission for Planning (HCP), Morocco	+

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The econometric model chosen is a dynamic panel data model, estimated using the generalized method of moments (GMM). This methodological choice is justified by several key factors. Firstly, local public investment expenditure is highly dynamic over time, meaning that the level of investment in a region is highly dependent on its past level, which necessitates the introduction of lagged variables of the dependent variable as regressors. Secondly, certain explanatory variables, notably own or transferred financial resources, may be endogenous: they may influence investment while simultaneously being affected by it. The GMM method, therefore, allows the dynamics of the model, potential endogeneity, and unobserved heterogeneity between regions to be dealt with simultaneously. It also corrects the problems of autocorrelation and heteroscedasticity of errors often present in regional panels. The estimated dynamic model is expressed as follows:

$$\begin{aligned}\log\left(Invest_{it}\right) &= \propto \log\left(Invest_{it-1}\right)\\ &+\beta_1 \log\left(OR_{it-1}\right)+\beta_2 \log\left(TR_{it-1}\right)\\ &+\beta_3 \log\left(Interest_{Exp_{it-1}}\right)\\ &+\beta_4 \log\left(OE_{it-1}\right)+\beta_5 \log\left(PERS_{Exp_{it-1}}\right)\\ &+\beta_6 \log\left(Pop_{it-1}\right)+\varepsilon_{it},\end{aligned} \quad (1)$$

where $\log(Invest_{it})$ is the logarithm of public investment expenditure for the region i at time t; $\log(OR_{it-1})$ is the lagged logarithm of own revenues; $\log(TR_{it-1})$ is the lagged logarithm of transfers; $\log(Interest_{Exp_{it-1}})$ is the lagged logarithm of interest expenses; $\log(OE_{it-1})$ is the lagged logarithm of operating expenditures; $\log(PERS_{Exp_{it-1}})$ is the lagged logarithm of personnel expenditures; $\beta_6 \log(Pop_{it-1})$ is the lagged logarithm of population; ε_{it} is the error term.

The estimation is carried out using GMM in differences and systems, depending on the availability and validity of the instruments. Appropriately lagged variables are used as internal instruments to correct for endogeneity and autocorrelation biases. The robustness of the model is tested by the validity of the instruments (Hansen test) and by the absence of autocorrelation in the errors (Arellano-Bond tests for AR(1) and AR(2)).

The choice of model must also be supported by a preliminary spatial analysis to test spatial autocorrelation (Moran's index) in order to verify the existence of spatial effects in local investments. The insignificant result of this test indicates the absence of significant spatial autocorrelation, which justifies the exclusion of an explicit spatial model in the dynamic modeling.

In order to test spatial autocorrelation through the calculation of Moran's index and taking into account data from the 12 regions and the local governments within them, it is first necessary to construct a spatial contiguity-weight matrix (W). This is an essential tool for capturing the spatial relationships between the different regions where $\omega_{ij} = 1$ if i and j are neighbors, otherwise $\omega_{ij} = 0$. The neighborhood matrix (W) for the 12 regions is presented as follow:

$$W = \begin{bmatrix} 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \end{bmatrix} \quad (2)$$

The contiguity matrix is sized 12x12, with the arrangement of regions in rows and columns established in the following order: [1] Beni Mellal-khenifra, [2] Casablanca-Settat, [3] Dakhla-Oued Eddahab, [4] Daraa-Tafilalet, [5] Fez-Meknes, [6] Guelmim-Oued Noun, [7] Laayoune Sakia El Hamra, [8] Marrakech-Safi, [9] The Oriental region, [10] Rabat-Salé-Kénitra, [11] Souss-Massa, [12] Tangier-Tetouan- Al Hoceima.

The formula used to calculate the Moran index is as follows:

$$\mathrm{I} = \frac{n}{\mathrm{W}} \cdot \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}\omega_{ij}\left(x_i-\bar{x}\right)\left(x_j-\bar{x}\right)}{\sum_{i=1}^{n}\left(x_i-\bar{x}\right)^2} \quad (3)$$

where n is the number of regions (as spatial units); W is the sum of the spatial weights, i.e.,

$\sum_{i=1}^{n}\sum_{j=1}^{n}(\omega_{ij})$; ω_{ij} refers to the spatial weighting between regions i and j; x_i represents the dependent variable "Log_invest;" $\bar{x}$ is the average of the values of the variable "Log_invest."

3. RESULTS

The descriptive analysis (Table 2) of data from a balanced panel covering 12 Moroccan regions between 2017 and 2024, i.e., a total of 96 observations, highlights strong inter-regional heterogeneity in the budgetary and demographic variables studied. The dependent variable, representing local public investment (capital expenditure), shows an annual average of 1,323 million dirhams per region, with a standard deviation of 695 million, corresponding to a coefficient of variation of over 50%. This substantial dispersion suggests structural inequalities in the investment capacity of local governments, attributable to differences in financial resources, demographic pressure, and administrative efficiency.

Own resources, which reflect the fiscal autonomy of local governments, show a comparable mean (MAD 1,305 million), but a much greater relative variability (standard deviation of MAD 1,463 million, coefficient of variation of 112%). This finding reflects significant disparities in the mobilization of local revenues, justifying the hypothesis that the ability to generate own resources could significantly influence the investment effort. Conversely, the resources transferred by the state (average of MAD 2,309 million, CV of 32%) appear to be more stable and homogeneous between the regions, reflecting the existence of equalization mechanisms designed to compensate for territorial fiscal inequalities.

Operating and personnel costs, representing an average of MAD 1,026 million and MAD 1,000 million, respectively, are also highly dispersed (CVs ranging from 60% to 78%). This configuration raises the question of a potential budgetary crowding-out effect, whereby rigid operating costs limit the room for maneuver available for investment. Furthermore, interest expenditure remains low in absolute terms (87 million dirhams on average), but its relative variability is very high (CV of 77%, Max/Min ratio greater than 300), suggesting a very uneven use of debt between regions.

The demographic variable, measured by the regional population, records an average of 1.9 million inhabitants with a standard deviation of 1.5 million, reflecting pronounced differences in size between the regions (maximum/minimum ratio of 49). These disparities underscore the need to control for size effects in any econometric modeling, particularly by using per capita ratios or logarithmic transformation of variables.

In such a context, the structure of the data, combining a temporal and cross-sectional dimension, with variables potentially endogenous (such as investment or local resources), fully justifies the use of dynamic panel data modeling. In particular, the generalized panel method of moments (GMM) makes it possible to take into account:

(i) unobserved heterogeneity between regions through the introduction of fixed or specific effects;

(ii) the dynamic dependence of investment on its past values, by incorporating endogenous lags;

(iii) the presence of potential endogeneity between certain explanatory variables and investment, in particular local financial resources, which can be both a cause and a consequence of the level of investment; and

(iv) the heteroscedasticity or serial correlation of errors, often present in regional panels.

Table 2. Descriptive statistics

Variables	Obs.	Mean	Std. Dev.	CV (%)	Min	Max
Investment (Capital Exp)	96	1,323	695	53	214	3,775
Own Resources	96	1,305	1,463	112	591	7,118
Transferred Resources	96	2,309	744	32	565	4,359
Interest exp	96	87	67	77	1	327
Pop	96	1,915,070	1,545,828	81	122,930	6,087,641
Personnel exp	96	1,000	602	60	104	2,442
Operating exp	96	1,026	795	78	117	3,936

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Table 3. Distribution of local public investment expenditure by region

Region	Local public investment (in millions of dirhams)	Mean	Standard deviation	Min	Max
[BK]: Beni Mellal-Khénifra	1357	1370	180	1149	1708
[CS]: Casablanca-Settat	2738	2787	722	1832	3775
[DOE]: Dakhla Oued-Eddahab	629	589	116	364	707
[DT]: Darâa-Tafilalet	588	871	373	584	1662
[FM]: Fez-Meknes	1136	1310	177	1086	1639
[GON]: Guelmim-Oued Noun	340	394	140	214	628
[LSH]: Laayoune Sakia El Hamra	660	811	465	409	1880
[MS]: Marrakech-Safi	1833	1597	237	1403	2076
[O]: The Oriental region	1472	1289	359	828	1770
[RSK]: Rabat-Sale-Kenitra	1944	1863	327	1324	2395
[SM]: Souss-Massa	809	1519	334	809	1936
[TTH]: Tangier-Tetouan-Al Hoceima	2039	1478	310	1041	2039

The estimation method is therefore based on the use of the GMM method in differences or in systems, depending on the structure of the instruments available and the robustness of the diagnostics (instrument validity, Hansen test, Arellano-Bond autocorrelation test). This approach reliably estimates the impact of budgetary resources on local public investment, while controlling for inertia effects and simultaneity bias.

The regional distribution (Table 3 and Figure 1) confirms the concentration of capital expenditure in the major economic centers. Casablanca-Settat, Rabat-Salé-Kénitra, Marrakech-Safi, and Tangier-Tetouan-Al Hoceima show average levels above MAD 1,800 million, while Guelmim-Oued Noun, Draa-Tafilalet, and Dakhla Oued-Eddahab remain permanently below the MAD 900 million threshold.

The standard deviations also show contrasting patterns of volatility: Laayoune-Sakia El Hamra and Casablanca-Settat experience strong inter-annual fluctuations, while Fez-Meknes and Beni Mellal-Khenifra operate within narrower margins. These differences reflect the coexistence of stable investment trajectories, characteristics of regions with multi-annual programming, and uneven trajectories, often dictated by one-off projects or exceptional transfers.

In order to examine the potential presence of spatial effects, a spatial autocorrelation test based on the Moran index is conducted. To this end, a binary spatial adjacency matrix (W) was constructed, defining the proximity between the 12 regions according to the following rule: $\omega_{ij} = 1$ if regions *i* and *j* are neighbors, and 0 otherwise. This 12x12 matrix, which positions the regions in a specific order (Béni Mellal-Khenifra, Casablanca-Settat, Dakhla-Oued Eddahab, Daraa-Tafilalet, Fez-Meknes, Guelmim-Oued Noun, Marrakech-Safi, The Oriental region, Rabat-Sale-Kenitra, Souss-Massa, and Tangier-Tetouan-Al Hoceima), makes it possible to understand the direct spatial relationships between communities.

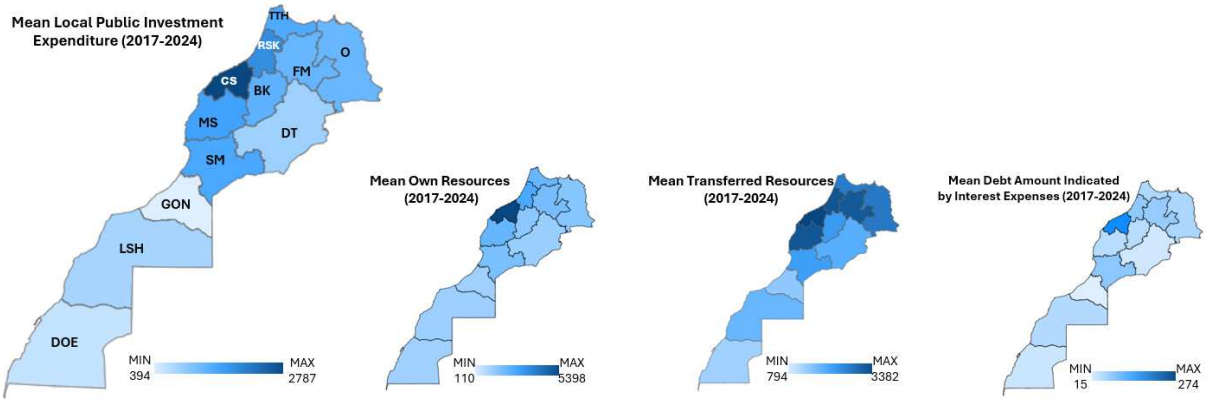

Figure 1. Distribution of local investment expenditures by region

The application of the Moran test, using the R statistical software, led to an index I equal to 0.0327 with a *p*-value of 0.5951. An index close to zero, combined with a non-significant *p*-value, indicates the absence of spatial autocorrelation of local public investment between regions. The low dispersion of the index, reflected in a standard deviation of 0.5325, confirms this tendency to accept the null hypothesis of spatial independence.

This finding is consistent with the empirical results of estimating the dynamic panel data model using the generalized method of moments (GMM). These reveal that the inter-regional disparities observed in local public investment are mainly attributable to characteristics specific to each local government, rather than to interactions or spatial dependencies between regions. Spatial analysis using the Moran test and the spatial index did not reveal any significant correlation between regions, corroborating the absence of spatial autocorrelation in the data. Consequently, the use of a dynamic GMM panel model, which takes into account individual heterogeneity, temporal dynamics, and the endogeneity of the explanatory variables, appears fully justified for the analysis of the significant determinants of local investment, without requiring the explicit integration of spatial effects in the current framework.

The estimated model, using the dynamic panel generalized method of moments (GMM) over the period 2018–2024, employs the logarithm of local public investment (LOG_INVEST) as the dependent variable. The explanatory variables include the logarithms of local own resources (LOG_OR), transfers received (LOG_TR), interest charges (LOG_INTEREST_EXP), operating expenditure (LOG_OE), personnel expenditure (LOG_PERS_EXP), and the size of the regional population (LOG_POP) (Table 4).

The coefficients show a positive and significant relationship between local own-source revenue and local public investment (coefficient = 0.429, $p < 0.01$), underlining the importance of regional financial autonomy in supporting investment. Transfers received were the strongest significant factor (coefficient = 1.354, $p < 0.001$), highlighting the crucial role of external resources in financing local projects. Interest charges, also significant (coefficient = 0.215, $p < 0.05$), may reflect productive indebtedness, where borrowing is used to increase investment capacity.

Conversely, operating expenses had a negative, albeit insignificant, effect on investment (–0.265, $p = 0.13$), while personnel expenses had a negative and significant influence (–0.475, $p < 0.01$), probably reflecting a budgetary crowding-out effect linked to the high fixed costs represented by personnel expenses. Finally, population does not appear to be a significant factor once the other variables are controlled for.

Figure 2 compares the observed values of local public investment (in logarithms) with those predicted by the GMM model, and also shows the residuals. The curves for observed values (in green) and predicted values (in orange) are very close, particularly between the 2019 and 2022 periods, which attests to the model's ability to faithfully reproduce regional investment dynamics. Most of the residuals (in blue) remain close to zero, suggesting that the model is well specified. However, relatively larger deviations appear in 2018 and 2024, reflecting a slight under- or over-estimation of investment in certain regions or years.

Each point on the graph is coded in the form 'X-YY', where X corresponds to the number of the region (from 1 to 12) and YY to the year, expressed in two digits (for example, '1-18' designates region

Table 4. GMM model estimation

Variable	Coefficient	Std. Error	t-statistic	Prob.
LOG_OR	0.429191	0.123500	3.475221	0.0008
LOG_TR	1.354249	0.317298	4.268071	0.0001
LOG_INTERST_EXP	0.214948	0.082004	2.621189	0.0105
LOG_OE	–0.265245	0.173537	–1.528462	0.1304
LOG_PERS_EXP	–0.475269	0.158528	–2.998020	0.0036
LOG_POP	–0.151790	0.185844	–0.816762	0.4166

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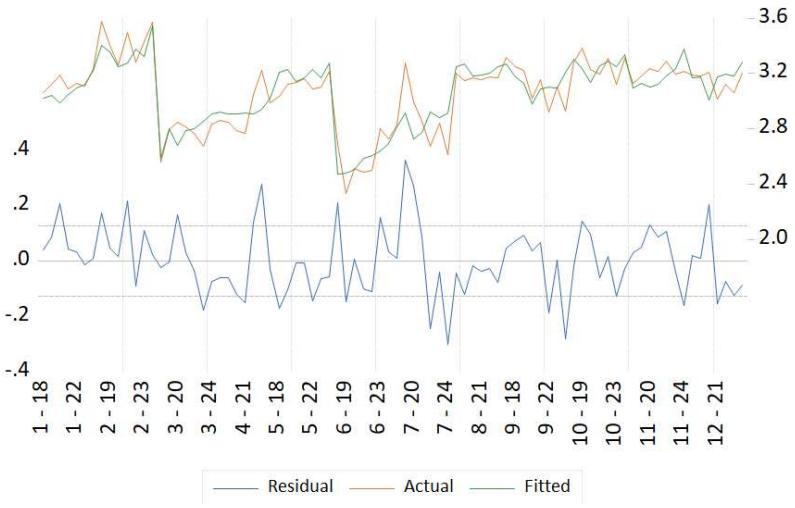

Figure 2. Residual analysis: GMM estimates of local public expenditure

1 in 2018, while '6-22' corresponds to region 6 in 2022). This representation allows both a cross-sectional reading (inter-regional comparison) and a longitudinal reading (temporal evolution) and visually confirms the explanatory capacity of the GMM model. Overall, Figure 2 supports the statistical results presented above and testifies to the robustness of the estimated model.

The estimated econometric model (Table 5) shows satisfying results overall, both in terms of the quality of the fit and the validity of the instruments. The coefficient of determination (R^2) reaches 0.757, indicating that nearly 76% of the variance in the logarithm of local public investment is explained by the variables selected. The adjusted R^2, which is slightly lower (0.742), reflects the model›s parsimony and the general relevance of the explanatory variables without over-adjustment. The accuracy of the predictions is also supported by the low root mean square error (Root MSE = 0.124) and by an almost equivalent standard error of the regression (0.129), which reflects the stability of the residuals and the good predictive capacity of the model in the context of a panel of log-transferred data.

The sum of the squares of the residuals remains moderate (1.29), and the level of dispersion of the dependent variable (standard deviation of 0.253 for a mean of 3.06) confirms the relevance of using the logarithmic transformation to attenuate the effects of bias linked to the heterogeneity of regional sizes. The Durbin-Watson statistic, equal to 1.56, indicates a possible positive autocorrelation of the residuals, moderate but not negligible, suggesting the existence of region-specific dynamics that are not totally captured by the fixed effects. However, in the context of GMM estimation, taking into account the dynamics of the model via the lagged dependent variable limits the impact of this autocorrelation.

The validity of the instruments used in the GMM is confirmed by Hansen's test on over-identification restrictions. The *J* statistic, equal to 4.698, associated with a probability *p* of 0.095, indicates that the null hypothesis of the validity of the instruments cannot be rejected at the 5% threshold. Although this value is close to the 10% threshold, it remains within an acceptable range from an econometric point of view. Nevertheless, care should be taken to avoid an excessive multiplica-

Table 5. Statistical summary and diagnostic tests of the GMM model

Root MSE	0.123920	R^2	0.757172
Mean dependent var	3.058486	Adjusted R-squared	0.741606
S.D. dependent var	0.252984	S.E. of regression	0.128598
Sum squared resid	1.289919	Durbin-Watson stat	1.559554
J-statistic	4.698311	Instrument rank	8
Prob(J-statistic)	0.095450	–	

tion of instruments, which could weaken the power of the Hansen test, especially as the rank of the instruments here is eight for a total of 12 regions observed.

All of these results corroborate the validity of using the method of generalized moments to model local public investment using regional data. The heterogeneity observed between regions, the potential dynamics of investment, and the risk of endogeneity linked to own or transferred resources fully justify the use of the GMM in a dynamic panel framework. The specification adopted makes it possible not only to control for unobserved fixed effects but also to correct for endogeneity bias while maintaining good estimation efficiency.

In summary, this empirical analysis shows that disparities in local public investment in Morocco are largely determined by factors internal to the local governments, such as the ability to mobilize own resources, the receipt of transfers, and the management of personnel costs, rather than by direct spatial effects. These results offer important implications for public policy, suggesting that improving fiscal autonomy and controlling fixed costs are essential levers for boosting local investment. The heterogeneity observed between regions, the potential dynamics of investment, as well as the risk of endogeneity linked to own or transferred resources, fully justify the use of the GMM in a dynamic panel framework. The specification adopted makes it possible not only to control for unobserved fixed effects but also to correct for endogeneity bias while maintaining good estimation efficiency.

4. DISCUSSION

Three hypotheses are validated based on the results of the dynamic panel data model estimated via the Generalized Method of Moments (GMM). The first postulates that the accumulation of own resources has a positive impact on capital expenditure commitment and disbursement rates. This logical causal relationship is supported by several empirical works, including Banaszewska (2018), Kuntari et al. (2019), and Olurankinse (2012). In general, local governments with budgetary and financial autonomy, supported by the mobilization of their own resources, are those with a dynamic economy and significant fiscal potential. These same governments tend to follow this dynamic and preserve their assets, constantly striving to meet the needs of communities subject to local taxation (described as demanding) through investment in local infrastructure.

Hypothesis 2, which states that transferred resources have a positive effect on the volume of investment expenditure, is statistically validated. This result highlights the structuring role of intergovernmental transfers in strengthening the investment capacity of local governments, particularly those with limited financial autonomy. Earmarked transfers, such as program authorizations or specific allocations (particularly in the Moroccan context), appear to be effective budgetary instruments, insofar as their purpose is explicitly geared toward financing investment projects. These observations concur with the findings of previous studies (Scala, 2008; Martinez-Vazquez et al., 2017; Papcunová et al., 2020), which highlight the importance of these financial flows in correcting territorial imbalances and stimulating local public investment.

Hypothesis 3, which posits a significant effect of interest expenses on local capital expenditure, is confirmed by the results. The statistical significance of interest payments suggests that debt plays a non-negligible role in financing local investments, likely reflecting a growing reliance on borrowing. This finding aligns with Välilä (2006), Al Hayek (2024), Ljutyj et al. (2024), and Capello and Caullo (2024), who underline the impact of debt on investment decisions at the local or regional level.

Regarding Hypothesis 4, which suggests that population size influences the volume of local capital expenditure, the estimation results do not confirm this assumption. The population variable appears statistically insignificant, indicating that, within the context of the regions and period studied, population size does not exert a measurable effect on the level of capital expenditure by local governments. This result may reflect the presence of other overriding factors, such as institutional arrangements, budgetary priorities, or intergovernmental transfers, that moderate or offset the expected impact of demographic size. Increasing

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demand for services in more populous areas does not automatically translate into higher levels of investment, possibly due to budget constraints or the prioritization of operating expenditures. This finding contrasts with Fitrianti et al. (2025) and Banaszewska (2018), who identified a negative relationship between population size and investment in the case of large municipalities.

Hypothesis 5 proposes that operating expenses may constrain local public investment. The econometric analysis partially confirms this, but with a reversal regarding the two representative variables. Personnel costs have a statistically significant negative effect on investment expenditure, with a coefficient of –0.475269, indicating that higher personnel expenses reduce the volume of capital investment. Conversely, expenses on goods and services do not show a significant impact. This finding highlights that personnel expenditures exert a notable budgetary pressure, limiting investment capacity, while other operating costs appear less influential. These results nuance the common view that only recurrent expenditures limit investment capacity. A similar dynamic is discussed by Capello and Caullo (2024).

In the case of Moroccan local governments, and in contrast to operating expenditure on goods and services, expenditure on personnel costs is more or less constant and does not change significantly from one year to the next, given the low recruitment rate observed among Moroccan local governments, which may well justify the insignificance of this explanatory variable on the volume of local public investment.

CONCLUSION

The objective of this paper was to identify, using a rigorous empirical framework, the determinants of local public investment expressed by the volume of public capital expenditure in 12 regions of Morocco over the period 2017–2024. By using the GMM-system method on a balanced dynamic panel, the analysis was able to overcome biases related to the endogeneity of explanatory variables, unobserved region-specific effects, and the inertia of capital expenditure.

Empirical results highlight three major drivers of regional investment. First, the resources mobilized by local governments have a significant and positive impact, underscoring the importance of financial autonomy in strengthening investment capacity. Second, financial transfers from the central government play an even more decisive role, with higher elasticity, reflecting their weight in the regions' budgetary structure. Finally, interest charges – an indirect indicator of controlled debt – also have a positive effect, suggesting that recourse to debt financing can effectively support investment when well managed.

Conversely, personnel expenses are a significant crowding-out factor, absorbing a rigid share of the budget and thus limiting the scope for capital expenditure. Other operating expenses have no statistically significant effect, and demographic size has no notable influence once financial variables are included in the model.

These results suggest several public policy guidelines. It is essential to strengthen the mobilization of local governments' own revenues, particularly through better tax management and a review of incentive mechanisms. At the same time, the structure of central government transfers should be reviewed to promote local investment, taking into account the different needs of regions. Rationalizing wage costs is also essential to free up resources for productive investment.

Finally, future research could complement this analysis by assessing not only the volume but also the efficiency of local public investment. The inclusion of indicators relating to institutional quality, fiscal governance, and spatial interactions between regions would broaden the understanding of the role of local finances in promoting balanced and sustainable regional development in the context of advanced regionalization in Morocco.

AUTHOR CONTRIBUTIONS

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Visualization: Rizlane Guati.
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