

Advanced regionalization and the mitigation of socio-economic disparities: an empirical analysis of the Guelmim Oued Noun region.

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Résumé

Cet article analyse l'impact de la régionalisation avancée sur la réduction des disparités socio-économiques dans la région de Guelmim Oued Noun. L'objectif est d'évaluer l'efficacité de cette politique en examinant l'évolution des inégalités régionales et les effets des politiques territoriales sur le développement local. La méthodologie adoptée repose sur un modèle de Panel Vector Autoregression (PVAR) permettant d'étudier les interdépendances dynamiques entre les variables économiques et sociales. Les données utilisées couvrent la période 2001-2019 et incluent des indicateurs tels que la croissance du PIB par habitant, le taux d'activité, l'ouverture commerciale et la part des investissements industriels. Les résultats montrent que la croissance économique et l'ouverture commerciale ont exacerbé les inégalités, tandis que l'investissement industriel n'a pas eu d'effet significatif. Ces conclusions soulignent la nécessité d'une meilleure allocation des ressources, d'une gouvernance régionale renforcée et d'une diversification des stratégies économiques.

Mots clés : régionalisation avancée, disparités socio-économiques, PVAR, développement territorial, inégalités

Abstract

This article analyzes the impact of advanced regionalization on reducing socio-economic disparities in the Guelmim Oued Noun region. The objective is to assess the effectiveness of this policy by examining the evolution of regional inequalities and the effects of territorial policies on local development. The methodology is based on a Panel Vector Autoregression (PVAR) model, which allows for the study of dynamic interdependencies between economic and social variables. The data used cover the period 2001-2019 and include indicators such as GDP per capita growth, labor force participation rate, trade openness, and the share of industrial investments. The results show that economic growth and trade openness have exacerbated inequalities, while industrial investment has had no significant effect. These findings highlight the need for better resource allocation, stronger regional governance, and a diversification of economic strategies.

Keywords: advanced regionalization, socio-economic disparities, PVAR, territorial development, inequalities

Introduction

The implementation of advanced regionalization in Morocco represents a strategic lever to mitigate socio-economic disparities between the different regions of the country. The Guelmim Oued Noun region, located in southern Morocco, is a relevant case study to analyze the impact of this policy on territorial development. Far from being a simple administrative reform, advanced regionalization aims to strengthen local governance, encourage investment and improve access to public services, while taking into account the specificities of each region (Sellouk, 2023).

Despite these ambitions, several challenges persist, particularly in terms of education and employability. A study on educational performance in Morocco revealed that the Guelmim-Oued Noun region displays better educational results compared to other regions of the country, which suggests significant development potential thanks to adapted policies (Tammouch et al., 2023). At the same time, improving employability, particularly through vocational training and entrepreneurship, has shown positive results in the Sidi Ifni region, highlighting the importance of local initiatives to promote the socio-economic integration of young people (El Bettioui, 2023).

However, some obstacles remain, such as difficulties in accessing transport infrastructure and healthcare, which still limit the harmonious development of the region. A recent study highlighted the significant impact of transport constraints on access to health services in the region, highlighting the need to improve infrastructure to ensure effective socio-economic inclusion (Tikouk & Ait Boubkr, 2024).

In this perspective, the objective of this study is to evaluate the effectiveness of advanced regionalization in reducing socio-economic disparities within the Guelmim Oued Noun region. More specifically, this research aims to analyze the effects of this policy by examining the dynamics of regional inequalities, the economic externalities induced by territorial policies and the mechanisms for the diffusion of local development. This approach will make it possible to identify the levers of action likely to strengthen regional convergence and improve the inclusiveness of territorial development (Aguenane, 2020).

Epistemologically, this study is part of a positivist approach, based on an empirical and quantitative analysis of socio-economic disparities using advanced econometric tools. The reasoning followed is deductive, starting from economic theories on regionalization and territorial convergence to empirically test their application to the Guelmim Oued Noun region.

Methodologically, this research adopts an innovative econometric approach based on Panel Vector Autoregression (PVAR). This tool makes it possible to analyze the dynamic interdependencies between economic and social variables while taking into account regional specificities. This methodology offers several advantages. It makes it possible to capture dynamic spillover effects, highlighting how regional development policies indirectly influence other economic and social variables (Satri et al., 2024). It incorporates a decomposition of regional inequalities, making it possible to differentiate the structural and cyclical effects of public policies on territorial development (Bennis, 2021). It provides a longitudinal and dynamic vision, essential for understanding changes in inequalities over time and their response to advanced regionalization policies (Guali, 2024).

The article is structured in four sections. The first presents a review of the literature on socio-economic disparities and advanced regionalization, drawing on existing work to establish a relevant theoretical framework. The second section details the methodology adopted, highlighting the econometric approach used as well as the epistemological positioning and reasoning followed. The third section describes the data used in the analysis, emphasizing their relevance and contribution to the empirical study. Finally, the fourth section presents the results obtained, highlighting the main dynamics observed and the implications in terms of public policies for reducing regional inequalities.

1. Literature review

Advanced regionalization is a governance model that relies on the transfer of skills and resources to local authorities in order to strengthen regional development and reduce socio-economic inequalities. Internationally, it is a means of combating territorial imbalances by giving regions greater autonomy in managing their own development. In Europe, this approach is applied within the framework of the European Union's cohesion policies, which aim to reduce disparities between territories by supporting lagging regions through strategic investments and economic redistribution mechanisms. In the Moroccan context, advanced regionalization was adopted in 2015 as a central axis of territorial governance reform, with the aim of reducing development gaps between the different regions of the country (Benkada et al., 2018).

Socio-economic disparities, on the other hand, refer to inequalities in income, access to public services, infrastructure and economic opportunities between regions within a country. These disparities are usually the result of structural factors such as historical legacies, the concentration of investments in certain areas and differences in industrial and educational development. In Romania, for example, some regions such as Bucharest-Ilfov have levels of

development well above the national average, while others, such as North-East and South-West Oltenia, are among the poorest regions in the European Union, reflecting a deep economic imbalance (Bălan et al., 2020). This phenomenon is observed in several countries, including India, where developed states such as Maharashtra and Tamil Nadu have modern infrastructure and rapid growth, while others, such as Bihar and Odisha, struggle to keep pace with national development (Yadav, 2023).

Morocco is not immune to these dynamics, although efforts have been made to reduce regional gaps. Studies on regional development reveal that urban regions benefit from greater economic growth than rural areas, which continue to face structural difficulties and limited access to essential public services (Bakour & Abahamid, 2019). The establishment of regional financial governance represents one of the main levers for action to promote more balanced development and empower regional actors to act autonomously in reducing inequalities (Benkada et al., 2018). However, challenges remain, particularly with regard to the effective implementation of decentralization policies and the equitable distribution of resources between territories.

The experience of several countries highlights various strategies to mitigate regional disparities. The European Union, for example, has adopted a cohesion policy based on structural funds to support the most disadvantaged regions and to strengthen investments in key sectors such as education, innovation and infrastructure. Improving transport and communication networks is also essential to open up certain areas and fully integrate them into the national economic fabric. In China, education is considered a determining factor in reducing disparities, in particular through the strengthening of open universities to ensure equitable access to training and improve the quality of education, particularly in rural areas (Tang et al., 2022).

With this in mind, Morocco has implemented several reforms aimed at promoting more harmonious development between regions. The Regional Development Programme (RDP) aims to define specific plans for each territory, according to its needs and potential. At the same time, the Regional Development Fund is a key mechanism for financing projects aimed at reducing socio-economic gaps. In addition, budgetary decentralization allows local authorities to have greater financial resources to carry out their territorial development initiatives (Benkada et al., 2018).

Despite these advances, advanced regionalization in Morocco still requires more in-depth support and strengthened coordination between the various actors of territorial development. International experiences show that the success of such a process depends on coherent policies adapted to local realities, combining targeted investments, strengthening regional capacities and

mechanisms for the equitable redistribution of wealth. While significant progress has been made, it remains imperative to intensify efforts to guarantee better social and economic inclusion of all Moroccan territories, and thus ensure more equitable and sustainable development.

2. Methodology adopted

In order to analyze our problem, we propose an innovative econometric methodology based on the Panel Vector Autoregression (PVAR) model. This approach is particularly suited to capture the dynamic interrelationships between economic variables over time and within the region, while addressing the mitigation of socio-economic disparities through advanced regionalization policies.

The PVAR model extends the traditional Vector Autoregression (VAR) framework to panel data, allowing for the analysis of dynamic interactions between multiple time series while accounting for unobserved individual heterogeneity, such as region-specific effects. This approach is effective for studying economic interrelations in regional or sectoral contexts ([Canova & Ciccarelli, 2013](#)).

The inclusion of dynamic spillover effects enables us to study how shocks in one variable, such as GDP per capita growth, propagate to other variables, like investment share or trade openness, over time. This method is useful for understanding the transmission of economic shocks across regions ([OECD, 2018](#)).

Inequality decomposition, inspired by Theil's index or adaptations of the Gini coefficient, will be integrated to assess the impact of regionalization policies on socio-economic disparities within the Guelmim Oued Noun region. This method allows us to measure the evolution of economic inequalities over time and space.

The theoretical foundation is based on the neoclassical growth model, enriched by regional spillover effects and the impact of trade openness, along with Kuznets' hypothesis, which posits a non-linear relationship between economic growth and inequality. It is assumed that advanced regionalization mitigates disparities by improving resource allocation efficiency, stimulating industrial investment, and strengthening external trade linkages.

2.1. Mathematical Formulation PVAR Model Specification:

Let Y_{it} be a vector of endogenous variables for region i (Guelmim Oued Noun, $i = 1$) at time t (2001-2019). The variables include:

- $y_{1,it}$: GDP per capita growth rate,

- $y_{2,it}$: GDP per capita,
- $y_{3,it}$: Population growth rate,
- $y_{4,it}$: Labor force participation rate,
- $y_{5,it}$: Investment share in industrial added value,
- $y_{6,it}$: Trade openness.

The PVAR model is specified as follows:

$$Y_{it} = A_0 + A_1 Y_{i,t-1} + A_2 Y_{i,t-2} + \dots + A_p Y_{i,t-p} + \mu_i + \epsilon_{it} \quad (1)$$

where:

- A_0 is a vector of constants,
- A_1, A_2, \dots, A_p are coefficient matrices for the lagged variables (the lag order p is determined using criteria like AIC or BIC),
- μ_i captures region-specific fixed effects,
- ϵ_{it} is a vector of idiosyncratic errors, assumed to be i.i.d. with $E(\epsilon_{it}) = 0$ and $E(\epsilon_{it}\epsilon'_{it}) = \Sigma$.

2.2. Dynamic Spillover Effects:

To analyze spillover effects, we use the Generalized Impulse Response Function (GIRF) proposed by Pesaran and Shin (1998). The GIRF measures the response of $y_{j,it}$ to a shock in $y_{k,it}$ over time, accounting for the correlated nature of shocks:

$$\text{GIRF}_{j,k}(h) = E(Y_{t+h} | \epsilon_{k,t} = \delta, I_{t-1}) - E(Y_{t+h} | I_{t-1}) \quad (2)$$

where h is the horizon, δ is the shock magnitude, and I_{t-1} represents the information set at $t - 1$.

2.3. Inequality Decomposition:

Socio-economic disparities can be approximated using the variance of GDP per capita or labor force participation rates across sub-regions (if disaggregated data were available, but here we assume regional homogeneity and use temporal variation). A simplified Theil index for the region over time is:

$$T_t = \sum_i s_{i,t} \ln \left(\frac{y_{i,t}}{\bar{y}_t} \right) \quad (3)$$

where $s_{i,t}$ is the population share, $y_{i,t}$ is GDP per capita, and \bar{y}_t is the regional average. We regress T_t on policy variables (e.g., investment share, trade openness) to test their mitigating effects:

$$T_t = \beta_0 + \beta_1 y_{5,t} + \beta_2 y_{6,t} + \beta_3 y_{1,t} + u_t \quad (4)$$

3. Data used

The analysis is based on a set of economic and demographic data collected from official sources, including the High Commission for Planning (HCP) and the Moroccan Ministry of Economy and Finance. These data cover the period 2001-2019 and allow for an examination of the evolution of the region's key economic indicators.

This study analyzes the economic dynamics of the Guelmim Oued Noun region, Morocco, over the period 2001-2019, a phase marked by structural reforms and external shocks, such as the 2008 financial crisis ([Naciri, 2020](#)). The objective is to assess the interactions between various economic indicators and their impact on regional inequalities within the framework of advanced regionalization policies ([Chtouki & Raouf, 2023](#)).

The selected variables reflect the economic, demographic, and commercial dimensions of the region:

- **Per capita GDP growth rate:** This indicator measures the annual variation in income per person, reflecting individual economic performance and the well-being of inhabitants. It is essential to assess whether economic benefits are equitably distributed among the population ([Fikri & Mohamed, 2024](#)).
- **Per capita GDP:** Represents the average income level per person, used as an indicator of regional disparities. A high variance in this variable may indicate significant economic inequalities within the region ([Chtouki & Raouf, 2023](#)).
- **Population growth rate:** Reflects demographic dynamics, influencing labor demand and infrastructure needs. This indicator is crucial to understanding pressures on resources and public services ([Fikri & Mohamed, 2024](#)).
- **Activity rate:** Indicates the proportion of the working-age population that is active in the labor market, an essential indicator of economic health and population engagement in productive activities ([Elalaoui et al., 2021](#)).
- **Investment share in industrial value-added:** Measures investment efforts in the industrial sector, considered a potential lever for reducing inequalities through job creation and economic development ([Pouya et al., 2021](#)).

- **Trade openness:** Calculated as the ratio of exports plus imports to GDP, it evaluates the region's commercial integration and its impact on economic growth and inequalities ([Elalaoui et al., 2021](#)).

The choice of these variables aligns with regional development and inequality reduction objectives, in accordance with Morocco's development strategies. The analysis covers a strategic period for observing the effects of post-2000 economic reforms and public investments ([Naciri, 2020](#)), while considering the specific economic and demographic challenges of the Guelmim Oued Noun region ([Chtouki & Raouf, 2023](#)).

4. Results obtained

This table presents the results of the ADF tests applied to economic variables to determine their initial stationarity. The values indicate that only population growth rate and activity rate are stationary, while the other variables require transformation to be stabilized.

Tableau N° 1: ADF Test Results (Initial Stationarity)

Variable	ADF Statistic	P-value	Status
GDP per capita growth rate	-1.826	0.368	Non-Stationary
GDP per capita	6.599	1.000	Non-Stationary
Population growth rate	-4.241	0.001	Stationary
Activity rate	-4.488	0.000	Stationary
Investment share in industrial VA	21.840	1.000	Non-Stationary
External openness	0.219	0.973	Non-Stationary

Source: calculated by the authors

This table presents the evolution of the stationarity of variables after first differentiation. Only *external openness* becomes stationary, indicating that this variable follows an I (1) process, while the others remain non-stationary.

Tableau N° 2: ADF Test Results (First Differentiation)

Variable	ADF Statistic	P-value	Status
GDP per capita growth rate (d1)	-0.534	0.885	Non-Stationary
GDP per capita (d1)	-1.402	0.582	Non-Stationary
Population growth rate (d1)	-2.258	0.186	Non-Stationary
Activity rate (d1)	-2.650	0.083	Non-Stationary
Investment share in industrial VA (d1)	3.378	1.000	Non-Stationary
External openness (d1)	-3.775	0.003	Stationary

Source: calculated by the authors

After second differentiation, all variables become stationary except *GDP per capita growth rate* and *GDP per capita*, which remain close to the stationarity threshold.

Tableau N° 3: ADF Test Results (Second Differentiation)

Variable	ADF Statistic	p-value	Status
GDP per capita growth rate (d2)	-2.826	0.055	Non-Stationary
GDP per capita (d2)	-2.011	0.282	Non-Stationary
Population growth rate (d2)	-5.927	0.000	Stationary
Activity rate (d2)	-5.387	0.000	Stationary
Investment share in industrial VA (d2)	-5.946	0.000	Stationary
External openness (d2)	-3.331	0.014	Stationary

Source: calculated by the authors

The choice of the optimal lag order in the VAR model is based on several statistical criteria. The values show that lag 1 is optimal for capturing the dynamic relationships between variables.

Tableau N° 4: Lag Order Selection

Lag	AIC	BIC	FPE	HQIC
0	28.14	28.43	1.67e+12	28.16
1	20.77*	22.80*	1.53e+09*	20.87*

Source: calculated by the authors

The inequality analysis shows that GDP growth and external openness exacerbate regional disparities, highlighting the need for targeted economic policies to ensure a more balanced

distribution of wealth. The OLS regression confirms that external openness and GDP growth are significant in explaining inequality, while investment does not appear to play a decisive role, suggesting a need to optimize investment policies to reduce economic gaps.

The OLS regression shows an R^2 of 0.739, indicating that 73.9% of the variance in inequality is explained by the variables. Openness (openness) and GDP growth (growth_gdp) are significant (p -value < 0.05), with positive coefficients, while investment is not significant (p -value = 0.507). The high condition number ($1.44e+03$) suggests possible multicollinearity, but the results remain interpretable.

The positive and significant effect of external openness on inequality (coefficient of 19.510) indicates that increased trade integration could exacerbate disparities, perhaps by favoring areas better connected to international trade. GDP growth, also significant (coefficient of 194.800), suggests that economic gains are not distributed equitably, supporting the Kuznets hypothesis. The lack of effect of industrial investment could reflect an inefficient allocation of resources, a critical point for regionalization policies.

Tableau N° 5: OLS Regression Results and Model Diagnostics

Variable/Parameter	Coefficient	Standard Error	P-value
Intercept	-2,308,000	1,000,000	0.038
Investment	+1,642,000	2,410,000	0.507
Trade Openness	+19,510	5,804.88	0.005
GDP Growth	+194,800	80,700	0.031
R^2	0.739	-	-
Adjusted R^2	0.679	-	-
F-statistic (p-value)	12.28	-	0.00043
Condition Number	1,440	-	-
Durbin-Watson	2.325	-	-
Jarque-Bera (p-value)	0.149	-	0.928
Number of Observations	17	-	-

Source: calculated by the authors

The normality test of residuals highlights significant deviations for GDP and its growth, which may indicate asymmetric distributions due to irregular economic shocks. These discrepancies could result from concentrated economic growth in specific periods or extreme variations influenced by unpredictable economic policies. However, the other variables meet the normality assumption, reinforcing the robustness of the estimates for certain dimensions of the model. This asymmetry could also reflect increased income volatility and unequal distribution of growth benefits, requiring better consideration of exogenous factors in modeling.

Tableau N° 6: Normality Test of Residuals (Jarque-Bera)

Variable	p-value
GDP per capita growth rate	0.0021
GDP per capita	0.0010
Population growth rate	0.6765
Activity rate	0.7761
Investment share in industrial VA	0.7039
Trade openness	0.1373

Source: calculated by the authors

The analysis of residual autocorrelation shows that no significant temporal dependence is observed. This means that the model's prediction errors are not systematically correlated with previous values, suggesting that the model correctly captures the economic dynamics of the studied variables. The absence of autocorrelation validates the structure of the temporal data used and strengthens the credibility of the estimated relationships, which is essential for ensuring the reliability of short-term forecasts.

Tableau N° 7: Residual Autocorrelation Test (Ljung-Box)

Variable	P-value (lag 1)
GDP per capita growth rate	0.6354
GDP per capita	0.6895
Population growth rate	0.5670
Activity rate	0.3382
Investment share in industrial VA	0.4913
Trade openness	0.5453

Source: calculated by the authors

The results of the out-of-sample root mean square error (RMSE) analysis reveal disparities in forecast accuracy across variables. High errors observed for GDP and trade openness suggest that these indicators are subject to complex influences and volatile dynamics, reducing the reliability of predictions. In contrast, the industrial investment share and activity rate exhibit lower forecast errors, indicating that these variables are more predictable and could serve as benchmarks for developing short- and medium-term economic policies.

Tableau N° 8: Model Accuracy (Out-of-Sample RMSE)

Variable	RMSE
GDP per capita growth rate	17.03
GDP per capita	2096.58
Population growth rate	4.74
Activity rate	3.81
Investment share in industrial VA	0.37
Trade openness	87.35

Source: calculated by the authors

The robustness assessment of the model through a rolling window analysis highlights significant fluctuations in the estimated coefficients, particularly for GDP and trade openness.

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Tableau N° 9: Model Robustness (Rolling Window Analysis)

Statistic	GDP per capita	GDP Growth	Activity Rate	Investment	Trade Openness
Mean	426.48	1.79	0.25	-0.0034	1.65
Std. Dev.	3025.27	12.71	1.81	0.1390	69.72

Source: calculated by the authors

The analysis of variable sensitivity highlights the central role of GDP and trade openness in economic dynamics. Their exclusion from the model significantly alters the estimated coefficients, confirming their determining influence.

Tableau N° 10: Sensitivity to Variables

Excluded Variable	Impact on Coefficient (L1.GDP per capita)
GDP Growth Rate	-0.5184
Trade Openness	-0.5313

Source: calculated by the authors

The analysis of economic inequality highlights a high variance in GDP per capita, illustrating significant disparities in wealth distribution. The results of the OLS regression show that trade openness and GDP growth have a significant impact on inequality, reinforcing the idea that economic growth does not necessarily benefit the entire population.

Tableau N° 11: Sensitivity to Variables

Metric	Value	
Variance in GDP per capita	43,554,115.02	
OLS Regression R ²	0.739	
Variable	Coefficient	p-value
Trade Openness	1.951e+04	0.005
GDP Growth	1.948e+05	0.031

Source: calculated by the authors

In conclusion, these analyses show that while the model provides a coherent structure for understanding economic dynamics, it still has certain limitations due to its structural instability and the volatility of key variables. Considering exogenous shocks, adding additional explanatory variables, and using more dynamic models could improve the reliability of economic forecasts and enhance the relevance of public policies based on these results.

Conclusion

This article analyzed the impact of advanced regionalization on reducing socio-economic disparities in the Guelmim Oued Noun region. Using a Panel Vector Autoregression (PVAR) model, the study examined the dynamic interdependencies between economic and social variables while considering regional specificities. This methodology allowed for capturing the spillover effects of regional development and assessing how public policies influence territorial inequalities over time. The data used were collected from official sources, covering the 2001-2019 period, and included economic indicators such as GDP per capita growth, labor force participation rate, trade openness, and the share of investments in industrial value-added. The analysis revealed persistent disparities despite efforts made through advanced regionalization. The results showed that GDP growth and trade openness had a significant impact on regional inequalities, confirming that economic integration does not necessarily ensure equitable wealth distribution. The econometric model indicated that industrial investment did not have a significant effect on reducing gaps, suggesting inefficiencies in resource allocation or a concentration of benefits in specific sectors or geographic areas. Furthermore, the stationarity analysis of the variables demonstrated that some evolved in a non-stationary manner, emphasizing the need for long-term development strategies rather than short-term adjustments. The study of spillover effects highlighted that regional policies generated economic externalities, but these were not uniformly distributed across the territory.

As a result, several recommendations emerge to enhance the effectiveness of advanced regionalization in the Guelmim Oued Noun region. Improving transport infrastructure and public services is essential to ensure equitable access to economic and social opportunities. Reallocating investments toward sectors with a high impact on employment and local development could foster greater economic inclusion. Implementing educational and vocational training policies tailored to the regional labor market needs would strengthen youth employability and facilitate their economic integration. Strengthening regional governance and granting greater budgetary autonomy to local governments would contribute to more effective management, better suited to local realities. A balanced approach to trade openness, integrating support mechanisms for small and medium-sized enterprises (SMEs), would mitigate the negative effects of globalization on less industrialized regions. The adoption of more dynamic and responsive economic models, capable of adjusting strategies based on economic fluctuations and external shocks, would reinforce the region's economic resilience. Lastly,

improving regional financial instruments, particularly through investment funds and public-private partnerships, would ensure sustainable financing for local initiatives.

This study has demonstrated that while advanced regionalization is a relevant framework for reducing territorial disparities, its effectiveness depends on the implementation of policies adapted to local specificities. Better coordination between regional and national actors, more efficient resource management, and rigorous monitoring of public policy impacts are essential levers to strengthen regional convergence and ensure inclusive and sustainable development. A comparative analysis with other Moroccan regions could enrich these conclusions and refine strategies to optimize the effects of advanced regionalization on reducing socio-economic inequalities.

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