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Public-Private Partnership and Economic Growth in Morocco: An Empirical Analysis

Zineb Loukili
Azzouz El Hamma
National School of Business and Management,
Ibn Tofail University of Kenitra, Morocco

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Abstract

Public-private partnerships (PPPs) have emerged as an innovative investment model for infrastructure projects. Introduced in Morocco during the 1990s, PPPs have since become an important element of the country's economic development strategy, in order to stimulate economic development and address infrastructure challenges. Our paper aims to study the impact of investment in public-private partnerships on economic growth. This study serves to enrich and complement the existing work in this field, thus contributing to the advancement of knowledge and expanding the boundaries of the existing literature.The dataset was analyzed using Autoregressive Distributed Lag (ARDL). The results indicate that investment in PPPs has a positive and statistically significant impact on Morocco's economic growth in the long term, highlighting the effectiveness of this investment model in the national context.

Keywords: Public–Private Partnership; infrastructures; economic growth; multiple linear regression

Introduction

Over the last two decades, the use of the private sector through PPP arrangements has become increasingly popular as a means of acquiring, renewing and maintaining public sector infrastructure in many sectors such as

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social infrastructure, transport, public services, etc. Initiated by the United Kingdom with its Private Finance Initiative (PFI) in the early 1990s, the adoption of PPPs has now spread across the world, affecting many countries of all wealth levels and on all continents (Bettignies & Ross, 2009).

« In a general context, a PPP is a legal contract between a public entity and one or more private entities for the purpose of developing projects, or administering public services, and assigning responsibilities as well as business risks between the partners."

Public-Private Partnership (PPP) is a new practice adopted for the management and financing of public services, they are increasingly presented as the solution to the lack of financing needed to achieve the Development Goals (Loukili and Elhamma, 2024). In this article, we aim to investigate the relationship between public-private partnership and economic growth in the Moroccan context, In other words, **does the upward trend in investments in public-private partnerships have a positive impact on economic growth in Morocco?**

In order to answer our research question, we will use an econometric study based on Autoregressive Distributed Lag (ARDL) model, the data on PPPs will be collected from the World Bank database on private participation in infrastructure projects (PPI) for the period 1990 to 2020.

This work will be structured in three parts. The first part will focus on the conceptual framework, and the historical background of PPPs and offer a review of empirical literature on the effect of public-private partnerships on economic growth. The second part will present the methodology adopted and the data used. The third part, will be devoted to the estimation of the model and the presentation of the results followed by their interpretation and discussion.

Exploring the concept of public-private partnerships: definition and history

Definition of the concept

The definition of keywords in scientific work is of paramount importance, as it enables readers other than the author to gain a comprehensive understanding of the subject matter addressed in the research from various perspectives.

- According to the International Monetary Fund (IMF), PPPs are presented as an alternative to privatization. For this organization, PPP "designates arrangements through which the private sector provides infrastructure elements and services traditionally provided by the State" (IMF, 2007).
- For the European Investment Bank, PPP refers to "a wide variety of working arrangements, from the most informal to strategic

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partnerships, in the design of build-finance-and-operate contracts and mixed economy companies" (EIB, 2005).

- According to the OECD, conducting a systemic analysis requires first establishing clarity in definitions. For it, "A PPP is an agreement between the State and one or more private partners (which may possibly include operators and financiers), under which the private partners provide a service in ways that reconcile the goals. service delivery objectives pursued by the state and their own profit objectives, the effectiveness of the reconciliation depending on a sufficient transfer of risk to private partners" (OECD, 2008).
- In Morocco, PPPs are defined by Article 3 of Law No. 86-12 on public-private partnership contracts: "A public-private partnership contract is a fixed-term contract, through which a public person assigns a private with the responsibility for carrying out an overall mission. This mission may include the design, partial or total financing, construction or rehabilitation, maintenance and/or operation of equipment, infrastructure or the provision of services essential to the provision of a public service."[1]

History of Public-Private Partnerships

The emergence of PPPs in the world

The concept of public-private partnership was first used in the United States in the late 1970s and refers to the fact that local public authorities entrust private sector companies with the task of carrying out investments necessary for certain collective services, thus granting the disengagement of the federal government in the financing of urban development programs. However, the State has placed these types of contracts "under surveillance" following a certain distrust of PPP practices in the United States.

In Europe, it was in the 1990s that the United Kingdom became a favorable ground for the development of PPPs (under the name Private Finance Initiative PFI) and currently represents an inspiring tool for several countries. It is important to emphasize that this concept is not entirely a novel invention in Europe since the formula was used under the old regime in France in the form of a "concession contract", in many sectors, as a model of cooperation between the public and private sectors.

PPPs subsequently expanded, in a context of globalization that first affected the field of economy. This phenomenon then impacted the law and policy of states. The reasons that motivated the use of PPPs are the financial need to carry out public projects, whether it is energy, public services, or

[1] Dahir No. 1-14-192 of 1st Rabii I 1436 (December 24, 2014) promulgating Law No. 86-12 relating to public-private partnership contracts.

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transport infrastructure. Public-private partnerships (PPPs) were thus encouraged due to two main factors: the abundance of global financial sources and on the other hand, the expectations of governments to promote infrastructure investments, without resorting to higher tax burdens.

Public-private partnerships in the Moroccan context

The objective of this research is to assess the impact of Public-Private Partnerships (PPPs) on economic growth in a developing country, specifically Morocco. Morocco is located in North Africa. Historically, the country was under Spanish and French protectorates, which influenced Moroccan companies to adopt numerous management practices based on the French system (Elhamma and Moalla, 2015). However, in recent years, Moroccan businesses have progressively adopted modern tools, including international accounting standards (Elhamma, 2023, 2024, 2025), advanced management control techniques (Elhamma, 2012, 2023; Snoussi, and Elhamma, 2024), and new sources of financing, such as participative finance (Bennani and Elhamma, 2015).

The origins of Public Private Partnerships in Morocco date back to the beginning of the 20th century, but it is in recent years that this phenomenon has developed. This new means of financing has become preferred for major structuring projects in several sectors, including public infrastructure projects.

According to a report by the United Nations Conference on Trade and Development (UNCTAD) in July 2016, "Morocco is the 2nd African country in terms of PPPs for infrastructure with a total amount of 27.5 billion dollars, behind Nigeria (37.9 billion dollars), and ahead of South Africa (25.6 billion dollars)" (UNCTAD, 2016).

PPPs appeared in Morocco in the form of concession contracts according to the Economic, Social and Environmental Council (CESE) in its opinion on Law 86-12, it was from 1914 that concessions contracts were granted in the fields of production and distribution of drinking water, railway, and port infrastructure. After the country's independence in 1956, the concessions were bought back and the activities of the concessionary companies, as well as the corresponding infrastructure, were entrusted to national authorities.

During the 1990s, the use of private operators for the operation of public services reappeared, but it is especially in recent years that this method of financing has become known with the construction of large-scale projects, such as the Tangier Med port, the Noor solar power plant, etc. The rise of PPPs on a national scale can be justified by the combination of at least three factors: the fragility of public finances, the questioning of the State's technocratic model, and the growing dissatisfaction of citizens with the quality of public services.

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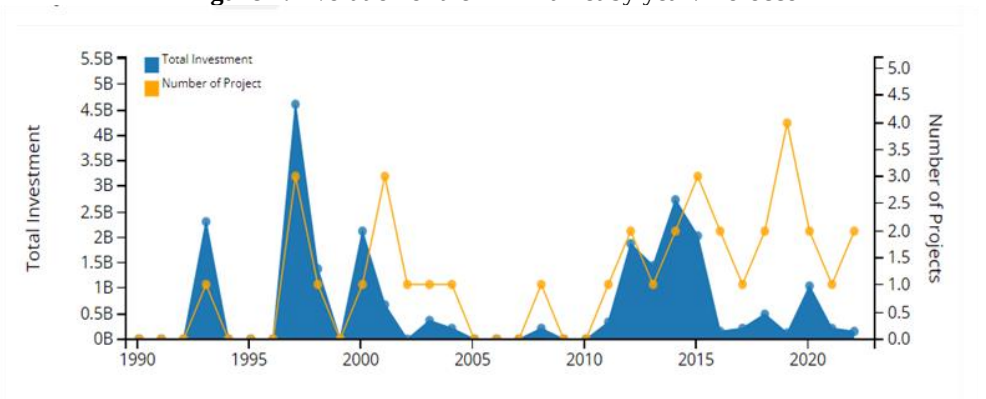
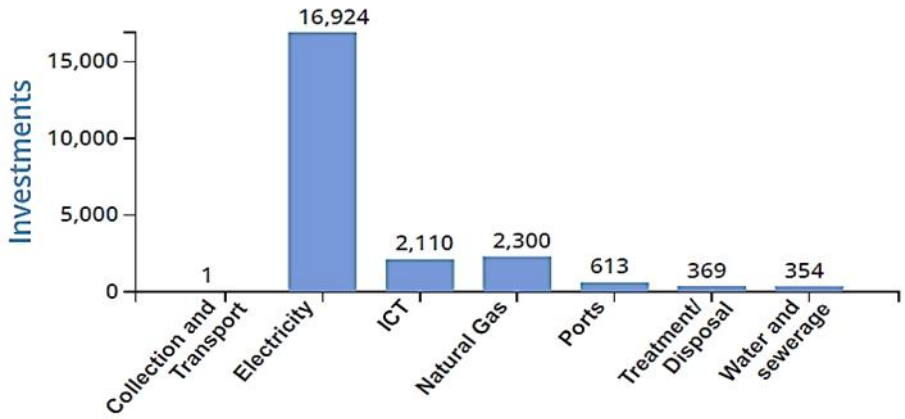
Figure 1: Evolution of the PPP market by year /Morocco



Source: PPI Visualization Dashboard - The World Bank & PPIAF

Figure 2 : Distribution of PPP projects /Morocco



Source: PPI Visualization Dashboard - The World Bank & PPIAF

The legal framework governing Public-Private Partnerships (PPPs) in Morocco was initially defined by local government texts or sectoral laws, which remained in force until the adoption of Law No. 86-12. Until 2014, the regulations lacked a comprehensive framework specifically tailored to PPPs. The introduction of Law No. 86-12 aimed to standardize and streamline the legal framework for PPP agreements, thereby ensuring greater clarity, consistency, and effectiveness in promoting infrastructure development and economic growth through these partnerships. The laws and regulations governing PPPs in Morocco are:

- Law 54-05 of 2006 relating to the delegated management of public services;
- Sectoral laws providing for concessions/PPPs (water, energy, ports, railways);

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- Law No. 86-12 relating to public-private partnership contracts (Dahir No. 1-14-192 of December 24, 2014) ;
- Law No. 46-18 amending and supplementing Law No. 86-12 relating to public-private partnership contracts (March 2020) ;

Literature review: Impact of public-private partnerships on economic growth

In this sub-section, we will explore the studies that have examined the impact of these PPPs. However, despite the recognized importance of PPPs for economic development, empirical research on this relationship remains relatively limited, particularly in developing countries.

The public-private partnership is considered as a long-term partnership between public and private actors in order to obtain mutual benefits. This type of partnership is identified as favorable not only for the partners involved but also for the overall economy. According to Sharma (2012), "PPPs offer several advantages and opportunities in terms of fiscal stabilization, flow of funds, and efficiency gains for developing countries."

According to the endogenous growth theory of Barro (1990), increasing infrastructure investment leads to significant economic growth, thus increasing infrastructure investment through PPPs is positively associated with GDP growth (Pimentel et al., 2017). The idea is that the use of PPPs allows countries to carry out infrastructure projects, especially in a context where public resources are limited, which can lead to an increase in GDP growth.

PPPs play an important role in stimulating economic growth and improving public infrastructure. Their success depends on a series of determining factors, including the quality of the institutional framework, and political and economic stability (Hammami & al., 2006). Empirical studies on Public-Private Partnerships (PPPs) show that these partnerships can have a significant impact on economic growth by improving infrastructure; this impact varies according to sectors, geographical contexts, and institutional structures.

For developing countries, empirical studies on Public-Private Partnerships and economic growth reveal significant heterogeneity in results across regions and countries. Mapule et al. (2023), show that PPPs have a positive impact on economic growth, but with variations across sectors, PPP investments in energy infrastructure have a more significant impact compared to other sectors, which promotes growth in developing economies. Aini (2024), in his study conducted within ASEAN, finds that the volume of public-private partnership projects does not seem to have a significant impact on the overall economic growth of the region. However, the effect of the value of PPP investments varies considerably across the infrastructure sectors

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concerned. This indicates that the effectiveness of PPPs is largely conditioned by the sector and the specific context of each country. Banda & Jeke (2022), in their research, studied the long-run link between PPPs and various economic indicators, including GDP. The results showed that the growth in the value of Public-Private Partnership (PPP) projects positively influenced national GDP. For other developing countries in Asia, several studies agree on the positive contribution of PPP investments to economic growth (Lee et al., 2018) (Atapattu, 2019). These studies often associate the acceleration of economic growth with the improvement of transport and telecommunications infrastructure.

On the other hand, In Turkey, Yurdaku & Kamasa (2020) initiated their study from the observation that PPP investments can boost GDP. However, the results of the study show that there is a weak relationship between PPP activities and GDP growth. Yurdaku & Kamasa, (2020) relate this result to other macroeconomic variables that affect GDP growth as a proxy for economic development.

On their part, studies conducted in developed countries have also demonstrated a great heterogeneity of results. According to the study of Jasiukevicius & Vasiliauskaite (2013), four countries in their sample, namely Belgium, Ireland, France and the United Kingdom, showed significant relationships between PPP activity and economic growth. The same goes for Bakırtaş & Aysu (2019), who also showed through their study that there is a positive and significant relationship between PPP investments and GDP per capita in the long term for 15 OECD member countries. However, contrary to previous observations, Pimentel & al. (2017), in their study on the case of Portugal showed that PPP investments would have had a negative impact on GDP growth in Portugal, unlike public and private investments which had a positive impact.

The table below summarizes the results of several research studies on the impact of PPPs on economic growth.

Table 1: Summary table of empirical research

Authors	Study area	Method of Analysis	Year of observation	Result
Jasiukevicius & Vasiliauskaite (2013)	Countries of the European Union (EU)	Calculation of correlation coefficients.	1995 - 2011	The results revealed that Belgium, Ireland, France and the United Kingdom (UK) showed strong or medium correlations between GDP growth and PPP market development.
Hamed Sallam (2015)	Egypt and the United Kingdom	Ordinary Least Squares (OLS) Regression On panel data with fixed effects model.	1992 - 2012	The results of the study indicate that PPP investments have a positive and significant influence on GDP per capita growth in Egypt and the UK.
Pimentel & al. (2017)	Portugal	VAR (Vector Autoregression) model.	1998-2013	The analysis based on a VAR estimation indicates that unlike public and private investments which have a

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				positive effect, Public-Private Partnerships seem to reduce the country's GDP.
Lee & al. (2018)	19 developing economies in Asia	Regression analysis on panel data	1985 - 2015	Empirical results show that an increase in PPP investments as a percentage of GDP is associated with higher growth in real GDP per capita.
Atapattu (2019)	19 developing economies in Asia	Regression (OLS) On panel data with fixed effects model.	1990 - 2015	The study found positive effects of PPP infrastructure stock on economic growth.
(Bakırtaş & Aysu, 2019)	15 OECD member countries	Panel Data Analysis (Dynamic Ordinary Least Squares)	1990 - 2013	The DOLS estimation results indicate a positive and significant relationship between PPP investments and long-run economic growth.
Yurdaku & Kamasa (2020)	Turkey	Vector Auto Regression (VAR)	1990 - 2014	The analysis reveals that there is only a weak association between GDP and PPPs.
Banda & Jeke (2022)	Zambia	Auto-regressive Distributed Lag (ARDL)	2000 - 2017	PPPs have a positive impact on GDP and economic development (improved household consumption and job creation).
Mapule & al. (2023)	35 developing countries	Generalized Moment Method (GMM)	1997 - 2018	PPP investment contributes positively to economic growth. PPP investment in the energy sector contributes positively to economic growth. PPP investment in the transport sector has no significant effect on economic growth.
Aini (2024)	ASEAN	Generalized Moment Method (GMM)	1990 - 2022	The number of PPP projects does not show a significant influence on economic growth in ASEAN. PPP investment in the telecommunications sector has a positive and significant influence on economic growth in ASEAN.

Therefore, according to the previous results of these empirical studies, our hypothesis to be tested is:

Hypothesis: Public-private partnership investments have a positive impact on economic growth in Morocco.

Methodological framework

Data Sources

To empirically analyze the impact of public-private partnerships (PPPs) on economic growth, we used the World Bank's database on private participation in infrastructure. This database represents a primary means and tool for measuring and monitoring trends in public-private partnerships (PPPs) worldwide, and more particularly in developing countries. It also provides technical advice and support to help countries to improve their regulatory

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environment and attract private investors to finance and operate infrastructure. The data collected from this database is conducted over a sample period extending from 1990 to 2020, providing a comprehensive time frame to assess trends and patterns over three decades.

Several studies conducted in the context of public-private partnerships such as Lee & al. (2018), Mapule & al. (2023), Hammami & al. (2006), Yurdaku & Kamasa (2020), have all used private participation in infrastructure projects (PPI) database.

Variable Descriptions

To verify our hypothesis, attention was given to the role of Public-Private Partnerships on growth in Morocco; the analysis was developed by introducing additional variables (control variables). Thus, we will draw inspiration from the endogenous growth model of Barro (1990, 1991, and 1996).

Control variables are included in the analysis to account for variations in macroeconomic conditions. This approach facilitates, to some extent, the isolation of the impact of sentiment from that of economic variables, thus reinforcing the robustness of the results.

Based on existing literature, the model includes investments in Public-Private Partnerships, Labor force, Money Supply, Inflation, Government Revenue and Gross Capital Formation as determinants of economic growth.

- **Dependent variable:**

GDP (Y): GDP per capita is gross domestic product divided by midyear population. it is the most widely used indicator to assess a country's production of goods and services over a year. It illustrates the importance of a country's economic activity. Macroeconomic theory suggests that an increase in PPP investments leads to significant GDP growth, so PPP activities are positively associated with GDP growth (Pimentel & al, 2017).

- **Independent variables:**

PPP variables: Represents the amount and number of public-private partnerships (PPPs) carried out in Morocco over time. It provides an aggregate measure of the scale and importance of PPPs, taking into account both the quantity (number) and the total monetary value of PPPs.

GCF: Gross Capital Formation represents the total amount of expenditure made for the purchase of capital goods such as equipment, machinery, buildings, etc. It measures investment in fixed capital and is often used as an indicator of economic activity.

Labor force: All persons who provide labor for the production of goods and services during a given period. The labor force can influence the overall demand for goods and services, which in turn can affect the level of economic output (GDP).

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Money supply: refers to the total amount of money in circulation in an economy at any given time. It typically includes currency in circulation, demand deposits, and other forms of liquid money. Changes in the money supply can impact inflation and other aspects of economic activity.

Inflation Rate: The inflation rate measures the rate of change in the prices of goods and services in an economy over time. High inflation can affect consumption, investment, and other aspects of economic activity.

Government Revenue: Government revenue consists of taxes, social contributions, grants receivable and other revenue.

Table 2 : Summary of Proposed Variable Description

Variable Name	Abbreviation	Unit of Measurement	Data Source
Dependent variable			
GDP per capita	GDP	$ US courants	World Bank's World Development Indicators database
PPP variables			
PPP investment	INV_PPP	US $	World Bank's Private Participation in Infrastructure database
Number of PPPs	NBR_PPP	Number	World Bank's Private Participation in Infrastructure database
Control Variables			
Gross Capital formation	GCF	% GDP	World Bank's World Development Indicators database
Labor force	LABOR	Labor force size	World Bank's World Development Indicators database
Broad money supply	MM	% GDP	World Bank's World Development Indicators database
Inflation	INF	% Annual	International Monetary Fund's World Economic Outlook data base
Government Revenue	REV_GOV	% GDP	International Monetary Fund's World Economic Outlook data base

Source: Authors

Econometric model

In response to our problem, we propose an estimation by **autoregressive distributed lag model (ARDL)** suggested by Pesaran et al. (2001) in order to estimate the effect of Public-Private Partnerships on economic growth in Morocco, over a period between 1990 and 2020. We will also advance our research by introducing macroeconomic performance

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indicators as control variables. Thus our model is inspired by the endogenous growth theory of **Barro (1990, 1991, and 1996)**.

To study both the relationships and the impact of PPPs on growth and economic development, the study uses the following ARDL model specification:$LogGDP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} LogGDP_{t-i} + \sum_{i=0}^{p} \alpha_{2i} GCF_{t-i} + \sum_{i=0}^{p} \alpha_{3i} INV\_PPP_{t-i} + \sum_{i=0}^{p} \alpha_{4i} NBR\_PPP_{t-i} + \sum_{i=0}^{p} \alpha_{5i} INF_{t-i} + \sum_{i=0}^{p} \alpha_{6i} MM_{t-i} + \sum_{i=0}^{p} \alpha_{7i} LogLABOR_{t-i} + \sum_{i=0}^{p} \alpha_{8i} REV\_GOV_{t-i} + \beta_1 LogPIB_{t-i} + \beta_2 GCF_{t-i} + \beta_3 INV\_PPP_{t-i} + \beta_4 NBR\_PPP_{t-i} + \beta_5 INF_{t-i} + \beta_6 MM_{t-i} + \beta_7 LogLABOR_{t-i} + \beta_8 REV\_GOV_{t-i} + \varepsilon_1$

Where **α1 … α5** represent the short-term dynamics of the model while **β1 … β5** represent the long-term relationship and ε is the white noise error term.

Result and discussion

Result of the study

Descriptive statistics

Table 3 shows the descriptive statistics of the main variables used in our study over a period of 30 years. For each variable, this table provides the mean, standard deviation and range of variation of the data. The variables examined include gross domestic product (GDP), gross capital formation (GCF), inflation (INF), investments in Public-Private Partnerships (INV_PPP), money supply (MM), number of PPPs (NBR_PPP), labor force (LABOR), government revenues (REV_GOV).

The mean for GDP stands at $75.5 billion, while the median is slightly lower at $68.9 billion, indicating a relatively balanced distribution with some outliers. For gross fixed capital formation, the mean is 26.01% of GDP, and the median is 25.79%, showing a stable trend in capital accumulation. For inflation, the average is 1.97%, with a median of 0.89%, suggesting variability in inflation rates over the period.

GDP reached a maximum of $129 billion, while the minimum was $30.2 billion, illustrating phases of marked growth but also economic challenges to overcome. PPP investments also varied, with a maximum of $2.75 billion and a minimum of zero, indicating that PPP investments have been sporadic. Money supply fluctuated between 46.15% and 128.86% of GDP, reflecting significant changes in economic liquidity.

The standard deviation of GDP is 35.5, indicating considerable variability around the mean. For GFCF, the standard deviation is 2.52, suggesting some stability in capital accumulation. Inflation has a higher standard deviation of 2.89, showing notable fluctuations. PPP investments have a standard deviation of 0.84, highlighting their irregular nature.

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Thus, descriptive statistics provide valuable insight into Morocco's economic performance. The variability of indicators such as GDP, PPP investments and inflation suggests that the country has gone through phases of growth and economic difficulties. This information can be essential to guide economic policies and development strategies, with an emphasis on the need to encourage more regular investments in infrastructure through PPPs.

Table 3: Descriptive statistics

	GDP	GCF	INV PPP	NBR PPP	INF	LABOR	MM	REV GOV
Mean	7.55E+10	26.00591	0.570399	0.967742	1.970724	10260353	83.30741	22.86753
Median	6.89E+10	25.79361	0.141000	1.000000	0.886221	10570285	83.31918	23.18125
Maximum	1.29E+11	31.26829	2.746000	4.000000	11.65717	12141859	128.8631	28.88086
Minimum	3.02E+10	21.78203	0.000000	0.000000	-1.767599	7439482.	46.15091	18.45640
Std. Dev.	3.55E+10	2.523479	0.835667	1.079626	2.885556	1483392.	25.24389	2.795813
Skewness	0.120669	0.162087	1.318985	1.033573	1.717723	-0.464725	-0.043340	0.206160
Kurtosis	1.356589	2.055847	3.311835	3.441256	5.691627	1.851656	1.494483	1.939003
Jarque-Bera	3.563765	1.287165	9.114161	5.770908	24.60255	2.819154	2.937373	1.673641
Probability	0.168321	0.525407	0.010493	0.055829	0.000005	0.244247	0.230228	0.433085
Sum	2.34E+12	806.1831	17.68237	30.00000	61.09243	3.18E+08	2582.530	708.8934
Sum Sq. Dev.	3.77E+22	191.0384	20.95016	34.96774	249.7930	6.60E+13	19117.62	234.4970
Observations	31	31	31	31	31	31	31	31

Source: Authors

Unit root tests

The unit root test is essential before estimating the model using the ARDL approach to assess the stationarity of the variables and their degrees of integration.

Table 4 : Unit Root ADF Test Results

Variables	Level		First difference		Order of integration
	ADF Test Statistics	Proba.	ADF Test Statistics	Proba.	
GDP	-0.812629	0.8010	-4.517964	0.0012	I(1)
GCF	-1.473749	0.5239	-5.448657	0.0001	I(1)
INV PPP	-4.112552	0.0033	-	-	I(0)
NBR PPP	-2.918700	0.0550	-7.312054	0.0000	I(1)
INF	-5.323935	0.0001	-	-	I(0)
MM	0.091125	0.9597	-5.207933	0.0002	I(1)
LABOR	-3.726063	0.0087	-	-	I(0)
REV_GOV	-1.282102	0.6200	-3.617467	0.0139	I(1)

Source: Authors

According to the ADF test results, it is observed that the variables INF, INV PPP and LABOR are stationary at the level (I (0)), while the variables GDP, GCF, MM, NBR PPP, REV_GOV are stationary at the order of the first difference (I (1)). Thus, no series of orders of two I(2) or more are integrated, which is essential for the application of ARDL. This result perfectly matches

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the conditions of application of the ARDL approach as presented by Pesaran et al. (2001).

Lag length selection

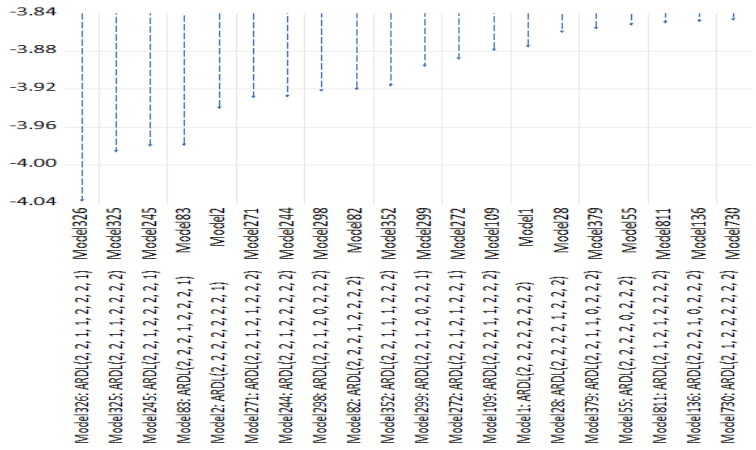
Defining the ideal number of lags to consider is an important phase in the ADRL (Auto Regressive Distributive Lags) method. To achieve this goal, several criteria are generally used, among which the most common are: the Akaike Information Criterion (AIC) and the Schwarz Information Criterion (SIC). In our study, we will use the Akaike information criterion (Kuma, 2018) to choose the best ARDL model. According to this standard, the optimal model is the one that offers statistically relevant results. According to the information criterion (AIC), the twenty best-performing models include the ARDL (2, 2, 1, 1, 2, 2, 2, 1) which is considered the ideal model and has the lowest AIC value. Figure 2 illustrates the results.

Table 5: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-269.0544	NA	0.027444	19.10720	19.48439	19.22533
1	-86.13065	252.3087*	8.91e-06	10.90556	14.30023*	11.96873
2	9.118140	78.82659	3.43e-06*	8.750473*	15.16262	10.75868*

Source: Authors

Figure 2: Akaike Information Criterion



Source: Authors

Co-integration Analysis: ARDL bounds Test

In order to confirm the presence of co-integration and to study the existence of a long-term relationship between the variables of our research, we applied the co-integration test "Bounds test".

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Table 5 : ARDL Bound test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	8.250535	10%	1.92	2.89
k	7	5%	2.17	3.21
		2.5%	2.43	3.51
		1%	2.73	3.9

Source: Authors

From Table 5 the value of Fisher statistic (F = 8.25) exceeds the lower and upper bounds for the different significance levels (1%, 2.5%, 5% and 10%). Therefore, we reject the null hypothesis and accept that there is a long-term relationship between the variables.

Study of the short and long-term relationship

Once we have verified the existence of a long-term relationship between growth and PPPs and other control variables considered in this study, we will move on to the study of the long- and short-term relationship.

Long-term relationship estimation

Table 6 provides us with the different results of the long-term equilibrium estimates between economic growth and PPPs.

Table 6: ARDL long-run coefficients

Levels Equation Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GCF	-0.003766	0.014692	-0.256314	0.8042
INV_PPP	0.029196	0.012515	2.332792	0.0480
NBR_PPP	-0.053634	0.010270	-5.222559	0.0008
INF	0.028192	0.008298	3.397296	0.0094
LOG(LABOR)	1.033919	0.415733	2.486981	0.0377
MM	0.022574	0.002752	8.202283	0.0000
REV_GOV	-0.035115	0.013828	-2.539477	0.0347
C	7.201359	6.656361	1.081876	0.3108

EC = LOG(GDP) - (-0.0038*GCF + 0.0292*INV_PPP -0.0536*NBR_PPP + 0.0282*INF + 1.0339*LOG(LABOR) + 0.0226*MM -0.0351*REV_GOV + 7.2014)

Source: Authors

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The results of the study presented in (Table 6) show that there is a significant and positive relationship between PPP investments and the increase of economic growth in Morocco over the long term. With a probability of 0.048 < 0.05. A 1% increase in public-private partnership investments leads to an average increase of 0.048% in GDP. Several studies In Asia, Africa and Europe, conducted by Mapule & al. (2023), Banda & Jeke (2022), Turan & al. (2011), Lee et al. (2018) and Hammami et al (2006), found that PPP investments have a positive effect on economic growth, because they stimulate and strengthen the development of public infrastructure, but at the same time they encourage private investment in infrastructure which leads to an increase in national production.

In this study, other variables revealed a significant impact on explaining economic growth which are LABOR, MM and INF. It is noted that the variable which has the greatest impact on long-term economic growth is the working population. Contrary to our expectations, our study found a positive impact between inflation and economic growth. This result can be interpreted as an indication that a moderate level of inflation can stimulate economic growth. During the two decades preceding 2020, Morocco benefited from moderate inflation of around 2%. This result is consistent with the results of Mallik & Chowdhury (2001) in their study, where they examined the relationship between inflation and GDP growth in a sample of 4 South Asian countries and found that inflation and economic growth are positively related.

Government revenues are negatively related to economic growth and are statistically significant at the 5% level. Government revenues are a proxy for higher tax burdens, suggesting that the higher the tax burden, the more difficult it may be for governments to raise taxes further to cover the bulk expenditures that are likely to contribute to economic growth, such as infrastructure investments (Checherita, 2009).

The estimation of the short-term relationship

We will now present the results of the estimates of the short-run relationship (Table 7).

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Table 7: ECM model estimation (short term)

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(GDP(-1))	0.227284	0.068859	3.300709	0.0108
D(GCF)	-0.014582	0.004256	-3.426085	0.0090
D(GCF(-1))	0.022436	0.004227	5.308109	0.0007
D(INV_PPP)	0.005926	0.005336	1.110541	0.2990
D(NBR_PPP)	-0.033321	0.005066	-6.576747	0.0002
D(INF)	0.013513	0.001785	7.571914	0.0001
D(INF(-1))	-0.011077	0.002394	-4.627829	0.0017
DLOG(LABOR)	4.386331	0.495716	8.848468	0.0000
DLOG(LABOR(-1))	3.558832	0.683406	5.207496	0.0008
D(MM)	0.004468	0.001496	2.986180	0.0174
D(MM(-1))	-0.013589	0.002753	-4.935619	0.0011
D(REV_GOV)	-0.001465	0.005655	-0.259041	0.8021
CointEq(-1)*	-1.358154	0.111448	-12.18645	0.0000

R-squared	0.960237	Mean dependent var	0.045658
Adjusted R-squared	0.930414	S.D. dependent var	0.079531
S.E. of regression	0.020980	Akaike info criterion	-4.588682
Sum squared resid	0.007042	Schwarz criterion	-3.975756
Log likelihood	79.53589	Hannan-Quinn criter.	-4.396721
Durbin-Watson stat	2.600420		

Source: Authors

CointEq (-1) corresponds to the lagged residual from the long-term equilibrium equation. According to the results in Table 6, the coefficient of CointEq (-1) is negative and highly significant, confirming the existence of a short-term adjustment mechanism to reach equilibrium is significant. This term is estimated at -1.35 for our ARDL model, reflecting a rapid adjustment to the long-term target.

Regarding the short-term relationship between the independent variables and the dependent variable, we find a positive relationship between the GFC if we consider the lagged value and economic growth, unlike PPP investment which shows a positive and insignificant impact on economic growth economic growth with a probability of 0.2990 > 0.05. This is explained by the fact that in the short term, it can be difficult for PPP investments to reveal their effects on growth in a relatively short period of time. This may be due to the project preparation, design, and financing phase, as well as the time required for the infrastructure to be operational and begin producing tangible results. In addition, administrative processes and coordination between the public and private sectors can cause delays, limiting the immediate effects of investments. However, once projects are completed, PPPs contribute significantly to economic growth, improved public services, and long-term productivity.

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Validity of the model

In this model validation step, we will check if the residuals of the model obtained follow a normal distribution, this depends on the value of the Jarque-Bera normality test, whether we have a value greater than 5%, the same for the autocorrelation tests (Breusch-Godfrey) and homoscedasticity (Breusch-PaganGodfrey), the p-value values associated with the two Breusch-Godfrey tests and the Breusch-Pagan Godfrey test, are greater than 5%.

Table 3 : Validity test results

Hypothesis	***Test applied***	***Test result***
Normality	*Jarque-Bera*	*J-B= 3.955730 (p-value=0.1383)*
Autocorrelation	*Breusch-Godfrey*	*F= 2.353116 (p-value =0.1760)*
Heteroscedasticity	*Breusch-Pagan- Godfrey*	*F= 0.925950 (p-value =0.5846)*

The results of the statistical tests for the ADRL model indicate that the residuals follow a normal distribution, which ensures the validity of the estimates. The absence of a significant correlation of the residuals with their past values also reinforces the robustness of the model, confirming that the forecast errors are independent. In addition, the heteroscedasticity analysis reveals that the residuals do not present significant variability depending on the explanatory variables, thus reinforcing the credibility of the model. Overall, these results ensure the reliability of economic analyses and the decisions that result from them.

Model stability test

We are now at the last two diagnostic tests of our model, which are also the most crucial: the CUSUM and CUSUMSQ stability tests. These two tests are applied to the residuals from the equation of our model. As for the CUSUM test, it is illustrated by a curve of the cumulative sum of the residuals with a significance threshold of 5% and under the null hypothesis: the stability of the model parameters if the curve is located in the critical zone between the two lines representing the limits of the interval. On the other hand, according to the alternative hypothesis, they would be considered unstable if the curve is outside this critical zone. As for the CUSUMQ test based on the sum of squares of the residuals, the same CUSUM procedure is applied to perform it. The graph shows the results of the CUSUM test (Figure 3). The stable position of the CUSUM line within the limits indicates that our regression model is stable over time. This means that the coefficients of the model have not undergone significant changes, suggesting that the relationships between the explanatory variables and Moroccan GDP are constant. This stability is essential for economic decision-making, as it ensures that the forecasts based on the model are reliable and that the conclusions drawn from the analysis are valid over the period studied.

Similarly, the CUSUM of Squares line remaining within the bounds

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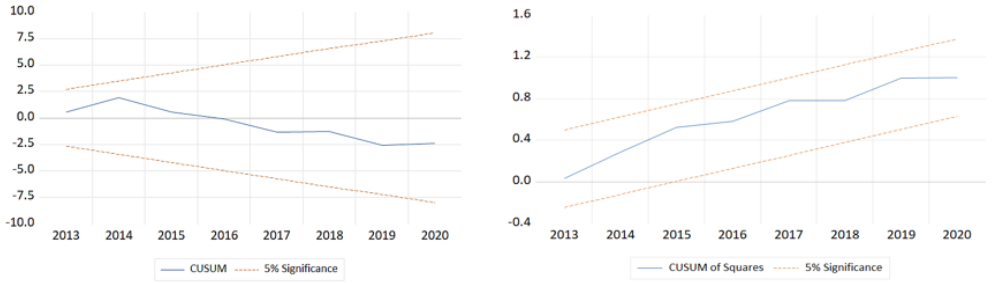
confirms that the model error variance is constant over time. This indicates that there is no heteroscedasticity in the residuals, which is crucial for the validity of the estimates. A constant error variance ensures that the predictions are not influenced by unpredictable fluctuations, thus enhancing the credibility of the results.

Figure 3: CUSUM and CUSUM of Squares Tests



Source: Authors

In conclusion, the fact that the CUSUM and CUSUM of Squares lines remain within the confidence interval limits for the Morocco GDP regression model demonstrates the robustness and stability of the model. These results strengthen confidence in economic analyses, allowing decision-makers to use these estimates to guide effective policies and informed decisions.

Interpretation and discussion of results

Data analysis through the model Autoregressive Distributed Lag (ADRL) for the case of Morocco over the period 1990-2020 highlights several key trends concerning economic growth, investments in Public-Private Partnerships (PPPs) and various economic indicators (control variables). According to our results, we find the existence of significant long-term effects and an absence of immediate short-term impact of PPPs on economic growth, requiring a certain time to generate concrete and persistent consequences.

The long-run results reveal a significant and positive relationship between PPP investment and economic growth. These results corroborate with the findings of Lee & al. (2018), Pimentel & al. (2017), Banda & Jeke (2022), Bakırtaş & Aysu (2019), Hamed Sallam (2015). This finding validates the idea that PPPs can boost economic development, which is consistent with Morocco's policy orientation and the results of current theoretical studies. In recent years, Morocco has actively implemented policies to promote the standardization and rationalization of PPPs, which has enabled it to innovate and develop in the direction of improving quality and efficiency.

Our results are also consistent with the findings of Mapule & al. (2023) who highlight that PPPs have a positive effect on growth and that PPP investments in the energy sector play a determining role in economic growth.

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Indeed, the analysis of the data for the case of Morocco (Figure 2) shows that the majority of PPP investments in Morocco are concentrated in the energy sector, which largely explains the positive impact on growth.

Regarding the impact of the number of PPP projects on economic growth, we can observe in (Figure 1) the existence of a large divergence between the amount invested and the number of projects, an increase in the number of projects does not necessarily coincide with an increase in investments or growth. The periods between 1995-2000 and 2010-2025 are periods with high investments but few projects, which explains the positive impact of investments in value on growth, unlike the other periods, and therefore the negative impact of the variable number of projects on growth. This result highlights the importance of prioritizing the quality and concentration of resources on strategic projects to stimulate economic growth rather than increasing small projects.

In the short term, we find no significant effect between PPP investments and economic growth. Estache & Garsous (2012) highlight the fact that the time factor is crucial in conducting studies on infrastructure investments, whether it is Public-Private Partnerships or traditional infrastructure investments. Research that covers long periods of time is more likely to show a positive impact of infrastructure investments on growth and output. This is because infrastructure typically has a unique cash flow profile, with high short-term costs and a slow but long-term revenue stream. Investments in the energy and transportation sectors are often built on revenue forecasts that extend over a period of more than 30 years.

This study highlights the importance of ADRL models to capture complex temporal dynamics, separating short-term effects from long-term relationships. These findings underline the need to incorporate a distinct temporal dimension in the formulation and evaluation of economic policies, for a more detailed understanding of their overall impacts. In conclusion, the lack of immediate effects should not be interpreted as inefficiency; rather, it emphasizes the significance of a long-term strategic perspective in order to guarantee substantial and long-lasting effects on economic performance.

Conclusion

Public-private partnership (PPP) investments are an innovative financing mechanism designed to facilitate projects that generate widespread economic benefits. This approach addresses the constraints posed by limited public resources, enabling the implementation of critical infrastructure projects that stimulate economic growth. By promoting investments in sectors essential to development, and contributing to improving the overall investment climate in a country.

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Our empirical analysis measures the impact of PPP investments on economic growth in Morocco for the period 1990-2020. This relationship is empirically tested using the World Bank's database on private participation in infrastructure for developing countries. This is the largest database of its kind, using a consistent methodology across countries and periods to record private investment commitments in four public infrastructure sectors: transport, energy, water and sanitation, and telecommunications.

Our results reveal a positive and significant relationship between these investments and the country's economic growth in long term. This underlines the crucial role of PPP investments, particularly in infrastructure. The sectoral allocation of these investments, with a strong focus on the energy sector, appears to be a decisive factor in maximizing their impact. Unlike the number of PPP projects that do not have a significant influence on growth, this means that investments in large-scale projects produce a greater impact than that generated by small-scale projects. In addition, the strategic selection of PPP projects is essential to ensure that resources are allocated to initiatives with the greatest potential for economic and social returns.

Although these results are significant, our analysis is not without limitations, particularly with regard to the PPI database which only covers PPPs in infrastructure, and more specifically in the transport, energy, water and sanitation, and telecommunications sectors. While infrastructure is likely to constitute the majority of PPP investments, other sectors (such as health and education, etc.) may also be of great importance in helping to alleviate fiscal constraints and supporting economic growth. Broadening the sectoral coverage could be the subject of further work, particularly if the analysis is extended to other countries.

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