Causality between Domestic Investment and Economic Growth: New Evidence from Argentina

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Abstract:

This study investigates the causal relationship between domestic investment and economic growth in Argentina over the period 1980-2022, utilizing cointegration analysis and a Vector Error Correction Model (VECM). The empirical results indicate that domestic investment has no significant long-term effect on economic growth. However, economic growth has a positive long-term impact on domestic investment, suggesting that growth stimulates investment rather than the reverse. In the short term, a bidirectional relationship exists between domestic investment and economic growth. These findings provide important policy implications for fostering sustainable economic development in Argentina.

Keywords: Domestic Investment, Economic Growth, Argentina, VECM.

JEL Classification: C32, E22, O40, O54

1. Introduction

The relationship between domestic investments and economic growth is a fundamental issue in the field of economics, playing a critical role in determining the development trajectory of nations. The importance of this subject lies in its implications for economic policy, growth strategies, and long-term sustainability. Theoretically, domestic investment is considered one of the pillars of economic growth, as articulated by classical economists such as Adam Smith and David Ricardo, who argued that capital accumulation and productive investment are essential drivers of wealth creation. Moreover, the endogenous growth theory, as developed by Romer (1986) and Lucas (1988), emphasizes the role of domestic investments, particularly in human capital and technology, in fostering innovation and long-term growth. This framework highlights that nations with robust domestic investment frameworks are better positioned to achieve sustained economic growth by enhancing productivity, boosting competitiveness, and reducing reliance on foreign capital inflows.

For Argentina, the examination of the causal link between domestic investments and economic growth takes on special importance given the country's economic history, marked by volatility, political instability, and frequent economic crises. Argentina's economy has undergone significant transformations over the past century, oscillating between periods of rapid growth and severe economic contractions. According to Alfaro et al. (2004), while investments are widely recognized as crucial for growth, Argentina's experience has been marked by disruptions in its investment cycles due to macroeconomic instability, exchange rate volatility, and inflationary pressures. Domestic investment, particularly in infrastructure, manufacturing, and energy, has been identified as vital for stabilizing the economy and stimulating long-term growth. However, Argentina's volatile political environment and fluctuating economic policies have often undermined the confidence of domestic and international investors, leading to erratic investment patterns.

Historically, Argentina experienced periods of strong economic growth during the early and mid-20th century, driven by domestic investments in its agricultural and industrial sectors (Bértola and Ocampo, 2012). The country's fertile land and agricultural potential attracted significant investments, which helped Argentina become one of the world's leading exporters of agricultural products. However, recurrent economic crises, such as the hyperinflation of the 1980s, the financial collapse of 2001, and the ongoing debt crises, have stunted growth and discouraged sustained domestic investments (Mauro and McDonald, 2020). The post-2001 period saw a recovery in domestic investment, particularly after the country's debt restructuring and the boom in commodity prices that bolstered export revenues. Nonetheless, the country's investment climate remains fragile, with economic uncertainty continuing to impede long-term growth prospects. The relationship between domestic investment and economic growth in Argentina is thus highly complex, requiring an in-depth analysis of the factors that contribute to or hinder this dynamic.

In recent years, Argentina has seen a resurgence in domestic investments, particularly in renewable energy and technology sectors, which have been identified as potential growth drivers (Manzano and Carreras, 2019). The government has also implemented various reforms aimed at improving the business environment, attracting foreign direct investments, and fostering domestic entrepreneurship. Yet, the level of domestic investment remains inadequate to meet the country's growth needs. High inflation, persistent fiscal deficits, and currency depreciation continue to create a challenging environment for investors (Álvarez and Gadano, 2017). The situation calls for a more nuanced understanding of how domestic investments can be leveraged to achieve sustained economic growth, particularly in light of Argentina's unique challenges and opportunities.

This study contributes to the existing literature by providing a detailed empirical analysis of the causal relationship between domestic investments and economic growth in Argentina. While there is extensive research on the determinants of economic growth in emerging markets, there is a relative paucity of studies focusing specifically on Argentina's domestic investment-growth nexus. This research aims to fill this gap by applying advanced econometric techniques to examine how domestic investments in key sectors contribute to or hinder growth under the country's volatile economic conditions. By drawing on the works of scholars such as Solow (1956), who highlighted the role of capital accumulation in growth, and more recent studies by Calderón and Servén (2010), which emphasize the impact of infrastructure investments on growth in Latin American countries, this study offers a comprehensive framework for understanding the investment-growth dynamic in Argentina.

Furthermore, the added value of this research lies in its policy relevance. By investigating the specific characteristics of Argentina's investment climate and identifying the main factors that influence investment decisions, this study will provide critical insights for policymakers seeking to stimulate growth. Given the global shifts in economic power and the increasing importance of emerging markets, understanding the role of domestic investments in fostering economic resilience is more relevant than ever. The findings of this study are expected to offer actionable recommendations for enhancing domestic investment frameworks, improving investor confidence, and ensuring that investments translate into sustainable economic growth. The contribution of this study thus extends beyond the academic realm, offering practical guidance for Argentina's economic development strategies in an increasingly complex global environment.

This research aims to deepen the understanding of the relationship between domestic investments and economic growth in Argentina by providing empirical evidence based on contemporary economic realities. It builds on the foundational theories of economic growth while incorporating the unique contextual factors that define Argentina's economic landscape. By doing so, this study will contribute to the broader discourse on economic development in emerging markets, offering insights that are not only relevant to Argentina but also applicable to other countries facing similar economic challenges.

2. Literature Survey

The relationship between domestic investments and economic growth has been a subject of extensive research in economics due to its pivotal role in shaping long-term economic trajectories. Domestic investments, often defined as the total capital formation within a country, are crucial for fostering productive capacity, creating employment, and driving technological advancements, all of which contribute to sustained economic growth. Theoretical and empirical studies have long underscored the significance of investments as one of the fundamental drivers of growth, tracing their importance to classical growth models, such as those proposed by Harrod-Domar, Solow, and endogenous growth theorists. These models illustrate how increased investment can lead to higher levels of output through capital accumulation, technological progress, and improved efficiency in resource allocation.

From a theoretical perspective, the Solow-Swan model posits that in the short run, economic growth is driven by labor, capital, and technological progress. However, in the long run, growth can only be sustained through continuous improvements in technology and increases in the capital stock. Investments, both in physical capital (such as infrastructure, machinery, and equipment) and human capital (education and skills development), are considered key determinants of economic growth. Romer (1986) and Lucas (1988) introduced the concept of endogenous growth, which emphasizes that investments, particularly in human capital and technology, can lead to self-sustained growth without diminishing returns. These theories suggest that higher rates of domestic investments, particularly in sectors that enhance productivity, can have a lasting positive effect on economic growth.

Empirical evidence supporting the positive relationship between domestic investments and economic growth is vast and varied across different countries and contexts. A significant body of research demonstrates that countries with higher rates of domestic investment tend to experience faster economic growth. For instance, De Long and Summers (1991) highlight that countries with high investment-to-GDP ratios often experience robust growth, as capital accumulation leads to higher productivity and efficiency in the economy. In developing economies, domestic investments play a critical role in filling gaps in infrastructure and capacity, which are often the primary constraints to growth. Studies by Barro (1991) and Levine and Renelt (1992) also find a strong correlation between investment and growth, with both studies emphasizing the importance of stable macroeconomic conditions, sound policies, and well-functioning institutions in harnessing the growth benefits of domestic investments.

Moreover, the impact of domestic investments on economic growth tends to vary depending on the nature of investments, the sectors into which capital is injected, and the prevailing economic conditions. In some economies, investments in manufacturing and industry tend to have higher growth multipliers compared to investments in agriculture or services. This sectoral distinction is particularly evident in emerging economies, where rapid industrialization driven by high levels of domestic investment has led to impressive economic growth rates. Research by Mankiw et al (1992) suggests that the composition of investment matters as much as the quantity, with investments in technology-intensive sectors driving higher long-term growth.

However, the link between domestic investments and economic growth is not always linear or straightforward. Numerous factors can mediate the relationship, including the quality of institutions, governance, economic stability, and external conditions such as global trade dynamics and financial flows. Poor governance, corruption, and political instability can significantly reduce the effectiveness of domestic investments, leading to inefficiencies and suboptimal growth outcomes. Conversely, countries with strong institutions and effective governance are more likely to realize the full potential of domestic investments, translating them into sustained economic growth. In this context, Acemoglu et al (2001) highlight that the quality of institutions is a key determinant of whether investments will result in positive growth outcomes, as strong institutions provide the necessary framework for protecting property rights, enforcing contracts, and ensuring the efficient allocation of resources. However, it is essential to note that the relationship between domestic investments and economic growth can be subject to diminishing returns if investments are not efficiently allocated or if other complementary factors, such as human capital development and innovation, are lacking. In some cases, economies may experience periods of investment-led growth that eventually taper off if the initial surge in capital does not translate into long-term productivity gains. This highlights the importance of not only increasing the quantity of domestic investments but also ensuring their quality and alignment with broader economic objectives.

Everhart et al (2009) explore how corruption influences economic growth by affecting investment in human, private, and public capital. Their findings show that corruption has a significantly negative impact on private capital accumulation, which in turn hinders economic growth, while the effect on public investment is more ambiguous. Felice (2016) examines the size and composition of public investment, demonstrating that government expenditure in infrastructure can directly enhance private sector productivity, promoting long-term economic growth. This reflects the essential role of public sector investment in boosting the productivity of capital in both modern and traditional sectors of the economy. Wehinger (2011) highlights the importance of fostering long-term investment for sustainable growth, particularly in the context of financial reforms. The study suggests that private investment is critical for filling the funding gap left by strained public finances, and that regulatory incentives are needed to promote long-term, market-based investment that contributes to stable economic growth. Peiró-Palomino and Tortosa-Ausina (2015) analyze the role of social capital in promoting regional economic growth in Spain. Their research reveals a positive relationship between social capital and private investment, which enhances economic growth, indicating the importance of social structures in influencing investment patterns across regions. Jun (2003) focuses on China's economic growth between 1978 and 2000, finding that investment efficiency, particularly in rural industrialization and non-state sectors, played a key role in maintaining high growth rates without raising the investment-to-GDP ratio. This highlights the importance of efficient investment in driving sustained economic growth.

Kuppusamy et al (2009) explore the impact of ICT investment on Malaysia's economic growth, concluding that private sector ICT investments significantly contributed to the country's growth. This underscores the pivotal role of private investment in adapting to technological advancements and driving economic development. Fedderke et al (2006) examine the relationship between infrastructure investment and long-term economic growth in South Africa.

They find that infrastructure investment has a direct and indirect positive impact on growth by raising the productivity of capital. This supports the view that public investment in infrastructure is crucial for long-run economic development. Wigren and Wilhelmsson (2007) analyze the impact of construction investments on economic growth in Western Europe. Their findings suggest that infrastructure investments have a complementary effect on residential and other construction projects, further driving short-term economic growth. Tanzi and Davoodi (1998) study the relationship between corruption, public investment, and growth, revealing that corruption leads to inefficiencies in public investment, which negatively affects economic growth. Their findings stress the importance of governance in ensuring the effectiveness of public investment.

Rodríguez-Pose et al (2012) investigate public investment and regional growth in Greece, showing that public investment generates positive spillover effects on regional growth, although its impact on convergence is limited. The study emphasizes the significance of strategic public investment in fostering regional development. Papagni et al. (2021) analyze the impact of public investment on economic growth in Southern Italy over 60 years. They find that the effectiveness of public investment varies over time, with strong growth effects in earlier decades, but diminishing returns in later years due to institutional inefficiencies. This underscores the importance of institutional quality in maximizing the growth potential of public investment. Afonso and Aubyn (2019) analyzed 17 OECD economies and found that both public and private investments positively impact economic growth, with nuances like crowding-out effects observed in some countries. They suggest that public investment can have varying effects across different economies, while private investment consistently stimulates growth. Hong (2017) focused on Korea's ICT sector, revealing a bidirectional causality between ICT R&D investment and economic growth. This indicates that ICT R&D investment not only drives economic growth but is also influenced by it, with private sector investments showing stronger growth effects than public sector investments.

In the context of Sub-Saharan Africa, Museru et al (2014) highlighted the volatility of public investment and its influence on growth. They found that while foreign aid positively affects economic growth, fluctuations in public investment can undermine this effect. Chen et al. (2017) examined optimal government investment levels and found that beyond a certain threshold, government investment may have a diminishing or even negative impact on growth. This underlines the importance of balanced investment policies to sustain positive growth. Haque and Kneller (2015) pointed out that corruption can significantly reduce the returns on public investment, rendering it ineffective in promoting economic growth. This highlights the role of governance in ensuring that public investment contributes meaningfully to growth. Unnikrishnan and Kattookaran (2020) explored the impacts of infrastructure investments in India, concluding that both public and private investments have a significant impact on growth, with private investments having a stronger effect. Javid (2019) analyzed infrastructure investments in Pakistan and found that public investment had a larger impact on growth than private investment, particularly across different economic sectors. This suggests that sector-specific policies could better harness the growth potential of investments.

Khan and Reinhart (1990) differentiated between public and private investment in developing countries and demonstrated that private investment has a more significant direct impact on economic growth compared to public investment. Epaphra and Massawe (2016) examined investment in Tanzania, showing that domestic private investment and foreign direct investment (FDI) play critical roles in promoting growth. However, they found that excessive public investment can crowd out private investment, reducing its positive effects on growth. Turnovsky (2015) examined the relationship between public investment, growth, and inequality, finding that public investment has varying effects depending on the framework used, reflecting the complexity of the relationship between growth and inequality. Chatterjee et al (2003) contrasted the impacts of capital transfers tied to public infrastructure investment with pure transfers. They found that public infrastructure investments have stronger growth effects compared to other forms of transfers, contributing to long-term economic stability and growth.

Bakari and Tiba (2022) explore the determinants of economic growth in the USA, revealing that domestic investments are long-term contributors to growth. Similarly, Bakari (2024a) highlights the positive effect of domestic investments on Australia's GDP, demonstrating a 0.11% increase in GDP for every 1% rise in investments. This pattern is consistent across several studies, where domestic investments serve as a critical factor in driving economic growth.

In MENA countries, Bakari (2023) emphasizes that domestic investments positively impact economic growth, although the relationship is weakened by unemployment. This effect extends to Sub-Saharan Africa, where Bakari (2024b) finds that both domestic investments and CO_2 emissions significantly influence growth. The evidence suggests that policies promoting domestic investments are vital for sustained economic development in these regions. In the case of 42 Latin American and Caribbean countries, Bakari (2024c) examined the impact of domestic investment on economic growth during the period 1998 - 2022. Empirical results indicate that domestic investment has a positive impact on economic growth.

Contrarily, some studies yield unexpected results. For example, Yedder et al (2023a) demonstrate that in Angola, domestic investments do not significantly impact long-term economic growth. This conclusion aligns with findings in North Africa, where domestic investments and exports fail to drive growth in the long run (Yedder et al, 2023b).

In developed countries, Bakari (2022a) finds that exports amplify the positive effect of domestic investments on growth. However, in the case of the USA, Othmani et al (2023) show that domestic investments influence patents rather than directly stimulating economic growth.

Akermi et al. (2024) note that domestic investments in Albania do not exhibit a causal relationship with economic growth, calling for urgent economic reforms. These findings underscore the complex and varied impact of domestic investments on growth, highlighting the importance of context-specific policies. Bakari (2022b) explored this link for 52 African countries, finding that domestic investment has a positive impact on economic growth. This study emphasizes the importance of promoting domestic investments to stimulate economic performance in African economies. Similarly, Bakari (2021a) investigated the relationship in Spain, concluding that domestic investments significantly contribute to economic growth, suggesting that policymakers focus on enhancing domestic investment to boost growth.

In Greece, Bakari (2022c) found no long-term relationship between domestic investment and economic growth. The study highlights that domestic investments were not a source of economic growth during the study period, particularly due to Greece's economic challenges. In the MENA region, Yedder et al. (2023c) also affirmed that domestic investments positively influence economic growth. However, the study also indicated that patents do not affect the relationship between domestic investment and growth, suggesting that innovation does not always enhance growth in this context. On the other hand, Bakari et al. (2019) found no significant impact of domestic investment on economic growth in Uruguay, suggesting that the country's weak savings rate hinders the potential of domestic investments to stimulate economic growth.

In Arab countries, Bakari and El Weriemmi (2022) revealed a bidirectional short-run relationship between domestic investment and economic growth, showing that domestic investments can foster growth in the short term, even if long-term effects are absent. Bakari et al. (2020) examined the case of Peru and found no relationship between domestic investment and economic growth in both the short and long run, indicating that both trade openness and domestic investments were not sources of growth during the study period.

In the study by Bakari (2021b), domestic investment is found to positively influence economic growth in G7 countries, although the role of the internet appears insignificant in this relationship. Bakari (2016) examines Canada, finding a weak short-term link between domestic investment and growth, but no long-term causal relationship. In France, Bakari (2019a) highlights a negative impact of taxation on both domestic investment and economic growth, warning of the risks posed by continued tax policies. A similar negative long-term effect of domestic investment on economic growth is noted by Bouchoucha and Bakari (2021) in Tunisia, though domestic investment has a short-term positive impact. In Japan, Bakari (2017a) establishes that domestic investment and exports are crucial drivers of economic growth, whereas imports have no impact. However, in Sudan, Bakari (2017b) reports that domestic investment does not significantly affect economic growth in the long term but is influenced by short-term economic fluctuations.

Research on India by Fakraoui and Bakari (2019) reveals no long-term relationship between domestic investment and growth, with exports being the sole short-term driver of growth. Similar findings in Egypt (Bakari, 2017c) suggest a negative long-term impact of domestic investment on growth, with imports as the primary short-term growth determinant. In Malaysia, Bakari (2017d) highlights a positive long-term impact of domestic investment on growth, contrasting with findings from Nigeria (Bakari et al., 2018a), where domestic investment shows no long-term relationship with growth, indicating the need for economic reforms. In Brazil, Bakari et al. (2021a) emphasize the importance of both domestic investment and exports in driving long-term growth while imports have a negative effect. Mkadmi et al (2021) examined the impact of tax revenues and domestic investments on social and economic well-being in Tunisia over the period 1976 – 2018. They found that domestic investment has an adverse impact on economic growth {Same results in the context of Tunisia found by Bakari et al (2021b), Abdelhafidh and Bakari (2019), Bakari (2020), Bakari et al (2018b), Bakari (2017e), Bakari et al (2018c) and Bakari (2017f)}.

The literature overwhelmingly supports the notion that domestic investments are a critical determinant of economic growth. Theoretical models and empirical studies alike emphasize the importance of capital accumulation, technological progress, and productivity improvements in driving long-term growth. However, the effectiveness of domestic investments in promoting growth depends on a range of factors, including institutional quality, sectoral focus, and macroeconomic stability. While the positive link between investments and growth is well-established, the complex interactions between these variables necessitate a nuanced understanding of the conditions under which investments can lead to sustained economic expansion.

3. Empirical Methodology

The objective of this study is to examine the causal relationship between domestic investments and economic growth in the case of Argentina. In this section, we will present our empirical methodology, which is designed to investigate this link using a time series approach. The estimation period covers the years from 1980 to 2022, based on data availability. All sources are collected from World Bank annual reports. The variables selected for this study are as follows:

- ✓ Y represents economic growth, which is expressed by the Gross Domestic Product (GDP) at constant prices.
- ✓ DI represents domestic investments, which are measured by gross fixed capital formation at constant prices.

We have intentionally chosen only two variables for our model to maintain a sufficient degree of freedom. This selection ensures that each variable can be clearly expressed and its impact on the other variable can be accurately demonstrated {see: Zang and Baimbridge (2012), Adnan-Hye (2012), Reddy (2020), Adnan-Hye and Boubaker (2011), Mehta (2015), Bakari and Mabrouki (2017), Bakari and Mabrouki (2016), Bakari (2018a), Bakari (2021c), Bakari (2019b), Bakari (2018b), Guntukula (2018), Hassouneh (2019), Bakari and Krit (2017), Saaed and Hussain (2015)}.

Additionally, to linearize the equations and to normalize the scale of the variables, all variables will be transformed into their logarithmic forms. The basic models are presented as follows:

Model 1: $\mathbf{Ln(Y) = f\big(Ln(DI)\big)}$

Model 2: $\mathbf{Ln(DI) = f\big(Ln(Y)\big)}$

Concerning our empirical strategy, we will utilize the approach outlined by Sims (1980), which is well-suited for exploring dynamic relationships in time series data. The steps of our estimation procedure are detailed as follows:

3.1.Step 1: Stationarity Testing

In time series econometrics, testing for stationarity is a critical first step in analyzing the dynamic relationships between variables. Stationarity refers to the property of a time series where the statistical properties such as mean, variance, and autocovariance remain constant over time. Non-stationary data can lead to spurious regression results, making the relationships between variables appear significant when they are not. Therefore, ensuring stationarity is a fundamental prerequisite before proceeding with any further econometric modeling. In this study, we will employ two widely recognized tests for stationarity: the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test. These tests are particularly useful for determining whether the variables in our model are stationary at their levels or require differencing to achieve stationarity.

The ADF test is an extension of the Dickey-Fuller test, which was developed to address potential autocorrelation in the error terms of the test regression. The ADF test includes lagged differences of the dependent variable to account for this autocorrelation. The test statistic is derived from estimating the following regression:

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta Y_{t-i} + \epsilon_t$$

Where:

- ✓ (ΔY_t) is the first difference of the time series (Y_t).
- ✓ (α) is a constant.
- ✓ (βt) is a time trend (included if the series is suspected to have a trend).
- ✓ (γY_{t-1}) is the lagged level of the time series.
- ✓ $(\sum_{i=1}^{p} \delta_i \Delta Y_{t-i})$ represents the lagged differences to account for autocorrelation.
- ✓ (ϵ_t) is the error term.

The null hypothesis (H_0) of the ADF test is that the series has a unit root, implying non-stationarity, while the alternative hypothesis (H_1) is that the series is stationary. If the test statistic is more negative than the critical value, we reject the null hypothesis and conclude that the series is stationary.

The ADF test is widely used due to its ability to handle autocorrelation, but it is sensitive to the choice of lag length. According to Said and Dickey (1984), correctly specifying the lag length is crucial for obtaining reliable results. The lag length is usually determined by information criteria such as the Akaike Information Criterion (AIC) or the Schwarz Bayesian Criterion (SBC).

The Phillips-Perron (PP) test is another test for stationarity that corrects for potential serial correlation and heteroskedasticity in the error terms without adding lagged difference terms. Unlike the ADF test, the PP test modifies the test statistic of the Dickey-Fuller test to account for the serial correlation in the residuals by employing non-parametric statistical methods. The regression equation for the PP test is similar to the ADF test:

$$\boldsymbol{\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \epsilon_t}$$

However, instead of including lagged differences to address autocorrelation, the PP test adjusts the test statistic using the Newey-West (1987) heteroskedasticity and autocorrelation consistent (HAC) standard errors. This makes the PP test less sensitive to the choice of lag length, and it can be particularly useful in cases where the autocorrelation structure of the time series is complex.

Similar to the ADF test, the null hypothesis of the PP test is that the series has a unit root (non-stationary), and the alternative hypothesis is that the series is stationary. If the PP test statistic is more negative than the critical value, we reject the null hypothesis and conclude that the series is stationary. Testing for stationarity is crucial because most econometric models assume that the underlying data is stationary. If a time series is non-stationary, regression results can be misleading. In such cases, the usual t-statistics for hypothesis testing may not follow a standard distribution, making it difficult to draw valid inferences. Granger and Newbold (1974) famously warned about the dangers of spurious regressions, where high (R^2) values and significant t-statistics can be found in regressions involving non-stationary data, even when there is no meaningful relationship between the variables.

Therefore, if our variables are found to be non-stationary in their levels, we will difference them to achieve stationarity. Once stationarity is confirmed, we can proceed with estimating our model using the Sims (1980) approach, which is designed to handle stationary data effectively. If the ADF and PP tests indicate that our variables are stationary at their levels, we can proceed with the estimation of our model in its current form. However, if the tests show that the variables are non-stationary, we will difference the variables and retest for stationarity. Once all variables are confirmed to be stationary at first differences, we will move forward with the Sims (1980) approach, which is based on the Vector Autoregressive (VAR) or Vector Error Correction Model (VECM) framework, depending on the presence of cointegration. This approach ensures that our econometric model is built on a solid foundation of stationary data, minimizing the risk of spurious results and enhancing the reliability of our findings.

3.2.Step 2: Determination of Optimal Lag Length

Determining the optimal lag length is a fundamental step in time series econometrics, particularly when employing models like the Vector Autoregressive (VAR) model or the Vector Error Correction Model (VECM). The lag length essentially dictates how many past observations of the variables are included in the model to predict current values. The importance of this step lies in its influence on the model's ability to capture the true dynamic relationships between the variables—in this case, domestic investments (DI) and economic growth (Y). An improper lag length can lead to problems such as autocorrelation of residuals, model misspecification, and incorrect conclusions regarding causality and long-term equilibrium relationships between the variables. The dynamic relationship between domestic investments and economic growth can be delayed, meaning the effects of investment today may manifest in economic growth over several periods. Capturing these lags is crucial for understanding the full impact of domestic investments on economic growth and vice versa. If too few lags are included in the model, important dynamics could be overlooked, resulting in biased or inconsistent estimates. Conversely, if too many lags are included, the model may become overfitted, reducing its predictive power and leading to inefficiencies by using up degrees of freedom. To determine the optimal lag length, econometricians typically rely on information criteria that balance model complexity with goodness of fit. Among the most commonly used criteria are the Akaike Information Criterion (AIC), the Schwarz Bayesian Information Criterion (BIC), the Hannan-Quinn Criterion (HQC), and the Final Prediction Error (FPE). Each criterion penalizes the inclusion of additional lags to avoid overfitting but does so with varying degrees of stringency.

The optimal lag length is chosen by minimizing one of the following information criteria:

- **Akaike Information Criterion (AIC):**

The AIC is designed to strike a balance between the complexity of the model and its goodness of fit. It is expressed as:

$$\mathbf{AIC(p) = ln\left(\frac{\widehat{\sigma_p^2}}{T}\right) + \frac{2p}{T}}$$

Here, $(\widehat{\sigma_p^2})$ is the estimated variance of the residuals, (p) is the number of parameters (including lags), and (T) is the sample size. AIC is known to be more lenient and favors more complex models by penalizing additional parameters less stringently compared to other criteria.

- **Schwarz Bayesian Information Criterion (BIC):**

BIC, or SBC, imposes a stricter penalty for the inclusion of additional parameters, making it a more conservative criterion compared to AIC. It is particularly useful when working with large samples, as it prevents overfitting by penalizing the addition of unnecessary lags. BIC is formulated as:

$$\mathbf{BIC(p) = ln\left(\frac{\widehat{\sigma_p^2}}{T}\right) + \frac{p\,ln(T)}{T}}$$

The logarithmic penalty on the number of parameters ensures that BIC favors simpler models.

- **Hannan-Quinn Criterion (HQC):**

HQC provides a middle ground between AIC and BIC, imposing a penalty on additional lags that is stronger than AIC but weaker than BIC. This criterion is particularly useful when neither AIC nor BIC provides satisfactory results. HQC is given by:

$$\mathbf{HQC(p) = ln\left(\frac{\widehat{\sigma_p^2}}{T}\right) + \frac{2p\,ln(ln(T))}{T}}$$

The double logarithmic function penalizes the inclusion of additional parameters, balancing model fit and complexity.

- **Final Prediction Error (FPE):**

The FPE criterion is used to minimize the one-step-ahead prediction error, which is crucial for forecasting in time series analysis. FPE is defined as:

$$\mathbf{FPE(p)} = \left(\frac{\mathbf{T+p}}{\mathbf{T-p}}\right)\widehat{\sigma_{\mathbf{p}}^{\mathbf{2}}}$$

Like AIC, FPE is designed to find a balance between model accuracy and complexity, focusing on prediction accuracy. In the context of modeling the relationship between domestic investments and economic growth in Argentina, using the appropriate lag length ensures that the model captures the delayed effects of investment on growth. For example, if past domestic investments significantly influence current economic growth, the model needs to incorporate these effects by including the appropriate number of lags. After estimating models with different lag lengths, the criterion that yields the lowest value (e.g., the minimum AIC or BIC) will indicate the optimal lag length. Selecting this lag length helps prevent issues such as autocorrelation in the residuals or omitted variable bias, both of which can distort the understanding of the investment-growth nexus. By employing these criteria, researchers can accurately capture the dynamic structure of the relationship between domestic investments and economic growth, ensuring that their empirical results are reliable and valid.

3.3.Step 3: Cointegration Analysis

The third step in time series econometric modeling, especially when dealing with non-stationary variables, involves conducting a cointegration analysis to determine whether a long-term equilibrium relationship exists between the variables. This is particularly relevant in the context of studying the dynamic relationship between domestic investments and economic growth, where both variables may exhibit trends over time. If such a cointegration relationship is identified, it implies that despite short-term fluctuations, the variables move together in the long run. The cointegration analysis is primarily performed using the Johansen test (Johansen, 1991), which is a multivariate procedure that helps identify the number of cointegrating vectors within a system of equations. This approach extends the Engle-Granger two-step method to a system of variables, allowing for the detection of multiple cointegrating relationships if they exist. The Johansen test is based on the concept of maximum likelihood estimation within the framework of a Vector Autoregressive (VAR) model. Consider a VAR model of order (p) for a set of (k) variables (Y_t):

$$\mathbf{Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + \epsilon_t}$$

Where $(A_1, A_2, \dots, A_p)$ are coefficient matrices, and (ϵ_t) is a vector of error terms. The Johansen test reformulates this VAR model as a Vector Error Correction Model (VECM):

$$\mathbf{\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \epsilon_t}$$

Here, (ΔY_t) represents the first differences of the variables, (Γ_i) are short-term adjustment coefficient matrices, and (Π) is the long-term impact matrix. The matrix (Π) contains information about the long-run relationships between the variables and can be decomposed as:

$$\mathbf{\Pi = \alpha\beta'}$$

Where (α) represents the speed of adjustment to the long-term equilibrium, and (β) represents the cointegrating vectors. If the rank of the (Π) matrix, denoted as (r), is zero, there is no cointegration among the variables, indicating that no long-term relationship exists. If the rank is $(r = 1)$, there is one cointegrating relationship, and so forth. To determine the number of cointegrating vectors, the Johansen test employs two test statistics:

- **Trace Statistic:**

$$\textbf{Trace Statistic} = \mathbf{-T \sum_{i=r+1}^{k} \ln\left(1 - \widehat{\lambda_i}\right)}$$

Where $(\widehat{\lambda_i})$ are the estimated eigenvalues of the (Π) matrix, and (T) is the sample size. The null hypothesis of this test is that the number of cointegrating vectors is less than or equal to (r).

- **Maximum Eigenvalue Statistic:**

$$\textbf{Max Eigenvalue Statistic} = \mathbf{-T \ln\left(1 - \widehat{\lambda_{r+1}}\right)}$$

This test evaluates the null hypothesis that there are (r) cointegrating vectors against the alternative hypothesis of $(r + 1)$ cointegrating vectors. If either test indicates the presence of one or more cointegrating relationships, it suggests that a long-term equilibrium exists between the variables under study, such as domestic investments and economic growth.

When cointegration is detected, the appropriate model to estimate the relationships is the Vector Error Correction Model (VECM). The VECM is particularly useful because it incorporates both short-term dynamics and long-term equilibrium relationships. The VECM can be written as:

$$\mathbf{\Delta Y_t = \alpha\beta' Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \epsilon_t}$$

The term ($\alpha\beta' Y_{t-1}$) is known as the error correction term, which represents the deviation from the long-term equilibrium. The coefficient matrix (α) indicates the speed at which the variables adjust back to equilibrium after a shock. A significant error correction term implies that the variables respond to deviations from the long-run relationship by adjusting towards equilibrium.

The VECM, therefore, allows for the analysis of both short-term fluctuations (through the differenced variables) and long-term causality (through the error correction term). This dual capability makes the VECM a powerful tool for studying economic relationships that exhibit both temporary deviations and long-term consistency, such as the link between domestic investments and economic growth.

If no cointegration relationship is found, the appropriate model for analysis is the Vector Autoregression (VAR) model. The VAR model does not impose any long-term equilibrium relationship between the variables and is instead focused on capturing the short-term dynamics. In a VAR model, each variable is regressed on its own past values and the past values of all other variables in the system. The VAR model can be represented as:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + \epsilon_t$$

The VAR model is particularly suitable when the variables are not cointegrated, as it allows for the exploration of short-term relationships without assuming any long-term constraints. However, it cannot capture the adjustment to a long-term equilibrium, making it less informative in cases where such relationships exist.

3.4.Step 4: Diagnostic Testing

In econometric modeling, after estimating the model, it is essential to perform diagnostic tests to verify the robustness and credibility of the results. This step is crucial for ensuring that the assumptions underlying the model are satisfied. If these assumptions are violated, the model's estimates can be biased, inefficient, or lead to incorrect inferences. The fourth step of our analysis involves conducting a series of diagnostic tests, specifically targeting issues like serial correlation and heteroskedasticity. These problems can significantly affect the validity of our findings if left unchecked.

- **Breusch-Godfrey Serial Correlation LM Test**

The Breusch-Godfrey Serial Correlation Lagrange Multiplier (LM) Test is used to detect the presence of serial correlation in the residuals of a regression model. Serial correlation, also known as autocorrelation, occurs when the error terms in a regression model are correlated with one another across time. This violates one of the key assumptions of the classical linear regression model, which states that the errors should be independent of each other. Serial correlation can lead to underestimated standard errors, which in turn can result in misleadingly small p-values and overestimation of the significance of variables. The Breusch-Godfrey test is a general test for autocorrelation that allows for higher-order autocorrelation (i.e., autocorrelation beyond the first lag). The test statistic is based on the auxiliary regression:

$$\mathbf{u_t = \alpha_0 + \beta_1 X_{t,1} + \beta_2 X_{t,2} + \cdots + \beta_k X_{t,k} + \rho_1 u_{t-1} + \rho_2 u_{t-2} + \cdots + \rho_p u_{t-p} + \epsilon_t}$$

Where (u_t) are the residuals from the original regression, and (p) is the number of lags included in the test. The null hypothesis of the test is that there is no serial correlation up to the (p) − th order, i.e., ($H_0: \rho_1 = \rho_2 = \cdots = \rho_p = 0$). The LM test statistic is calculated as:

$$\mathbf{LM = (n - p) \cdot R^2}$$

Where (n) is the sample size and (R^2) is the coefficient of determination from the auxiliary regression. Under the null hypothesis, this statistic follows a chi-square distribution with (p) degrees of freedom. If the test statistic exceeds the critical value from the chi-square distribution, we reject the null hypothesis and conclude that serial correlation is present.

- **Heteroskedasticity Tests**

Heteroskedasticity refers to the situation where the variance of the error terms is not constant across observations. This violates another key assumption of the classical linear regression model, which assumes homoskedasticity, or constant variance. Heteroskedasticity can lead to inefficient estimates and incorrect standard errors, affecting the validity of hypothesis tests. To address this, we perform several heteroskedasticity tests:

The Breusch-Pagan-Godfrey test is one of the most commonly used tests for detecting heteroskedasticity. It is based on the auxiliary regression of the squared residuals from the original regression model on the explanatory variables:

$$\mathbf{u_t^2 = \gamma_0 + \gamma_1 X_{t,1} + \gamma_2 X_{t,2} + \cdots + \gamma_k X_{t,k} + \epsilon_t}$$

The null hypothesis is that the variance of the errors is constant, i.e., $(H_0: \gamma_1 = \gamma_2 = \cdots = \gamma_k = 0)$. The test statistic is given by:

$$\mathbf{LM = n \cdot R^2}$$

Where (n) is the sample size and (R^2) is the coefficient of determination from the auxiliary regression. This statistic follows a chi-square distribution with (k) degrees of freedom under the null hypothesis. If the test statistic exceeds the critical value, we reject the null hypothesis and conclude that heteroskedasticity is present.

The Harvey test is another method for detecting heteroskedasticity. It tests for a relationship between the logarithm of the squared residuals and the explanatory variables. The auxiliary regression is given by:

$$\mathbf{\ln(u_t^2) = \gamma_0 + \gamma_1 X_{t,1} + \gamma_2 X_{t,2} + \cdots + \gamma_k X_{t,k} + \epsilon_t}$$

The null hypothesis is that there is no heteroskedasticity, and the test statistic is similar to that of the Breusch-Pagan-Godfrey test.

The Glejser test involves regressing the absolute values of the residuals on the explanatory variables. The auxiliary regression is:

$$\mathbf{|u_t| = \gamma_0 + \gamma_1 X_{t,1} + \gamma_2 X_{t,2} + \cdots + \gamma_k X_{t,k} + \epsilon_t}$$

The null hypothesis is that the variance of the residuals does not depend on the explanatory variables. The test statistic is based on the (R^2) from the auxiliary regression and follows a chi-square distribution.

The Autoregressive Conditional Heteroskedasticity (ARCH) test is specifically designed to detect time-varying volatility in the residuals, a common feature in financial and economic time series data. The test is based on an auxiliary regression where the squared residuals are regressed on their own lagged values:

$$\mathbf{u_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i u_{t-i}^2 + \epsilon_t}$$

The null hypothesis is that there is no ARCH effect, i.e., $(H_0: \alpha_1 = \alpha_2 = \cdots = \alpha_p = 0)$. The test statistic, like the others, is calculated as:

$$\mathbf{LM = n \cdot R^2}$$

Under the null hypothesis, this statistic follows a chi-square distribution with (p) degrees of freedom. These diagnostic tests are essential for validating the assumptions of our econometric models. If serial correlation is present, it indicates that the residuals are not independent, which could lead to inefficient estimates and incorrect standard errors. Similarly, heteroskedasticity can result in biased estimates of the variance of the regression coefficients, affecting hypothesis testing and confidence intervals. By conducting these tests, we can identify any violations of the model assumptions and take corrective measures, such as adjusting the model specification or using robust standard errors, to ensure the reliability and validity of our findings.

3.5.Step 5: Normality Testing

One of the key assumptions underlying many statistical models is that the residuals, or error terms, of the model should follow a normal distribution. This assumption is particularly crucial when conducting hypothesis tests and constructing confidence intervals because these rely on the normality of the residuals to be valid. The fifth step of our analysis involves applying normality tests to evaluate whether the residuals of our model are normally distributed. Ensuring normality is important for the robustness and reliability of our statistical inferences.

The normality assumption is essential in the context of the classical linear regression model because it underpins the derivation of the standard errors, p-values, and confidence intervals. When the residuals are normally distributed, the ordinary least squares (OLS) estimators have desirable properties such as being unbiased, efficient, and consistent. Moreover, if the residuals are normally distributed, then the t-tests and F-tests used to test hypotheses about the model parameters are valid.

Violations of the normality assumption can lead to several issues. For instance, if the residuals are not normally distributed, the standard errors of the coefficients may be biased, leading to incorrect inferences. Additionally, non-normality can affect the accuracy of predictions and the interpretation of confidence intervals. To assess the normality of residuals, we can apply several statistical tests and graphical methods. The most commonly used normality tests include: The Jarque-Bera (JB) test is a widely used test for normality based on the skewness and kurtosis of the residuals. The test statistic is computed as:

$$\mathbf{JB} = \frac{\mathbf{n}}{\mathbf{6}}\left(\mathbf{S}^2 + \frac{(\mathbf{K}-\mathbf{3})^2}{\mathbf{4}}\right)$$

Where (n) is the sample size, (S) is the skewness of the residuals, and (K) is the kurtosis of the residuals. Skewness measures the asymmetry of the distribution, while kurtosis measures the 'tailedness' of the distribution. For a normal distribution, the skewness is 0 and the kurtosis is 3. The JB test assesses the joint hypothesis that both skewness and kurtosis are consistent with a normal distribution. Under the null hypothesis of normality, the JB test statistic follows a chi-square distribution with two degrees of freedom. If the test statistic is significantly large (i.e., the p-value is below a specified significance level), we reject the null hypothesis, indicating that the residuals are not normally distributed.

3.6.Step 6: Stability Testing

The final step in our empirical methodology involves assessing the stability of the estimated coefficients over time using the CUSUM test. Ensuring that the coefficients remain stable throughout the sample period is crucial for the reliability of our model's results. Structural stability implies that the relationships captured by the model do not change significantly over time, which is essential for making valid inferences and predictions. In time series analysis, structural stability refers to the consistency of the relationships between variables across different time periods. If the estimated coefficients of a model are stable, it indicates that the model's assumptions and relationships hold throughout the sample period. Conversely, instability in the coefficients may suggest the presence of structural breaks or changes in the underlying data generation process, which can lead to biased or misleading conclusions (Brown et al, 1975).

Structural breaks can arise from various sources, including economic shocks, policy changes, or other significant events that alter the relationships between variables. Detecting and accounting for such breaks is essential for ensuring the robustness and credibility of the model (Chow, 1960). The Cumulative Sum (CUSUM) test is a diagnostic tool used to assess the stability of regression coefficients over time. The test evaluates whether the coefficients of the model are stable or if there are any significant changes in their values throughout the sample period (Hamilton, 1994). First, estimate the model using the full sample period. Obtain the residuals and the estimated coefficients from this regression. Calculate the cumulative sum of the residuals from the model. This involves summing up the residuals at each time point:

$$\mathbf{C_t = \sum_{i=1}^{t} \hat{e}_i}$$

Where ($\hat{e}_i$) denotes the residual at time (i), and (C_t) is the cumulative sum of residuals up to time (t) (Brown et al, 1975). Standardize the cumulative sum of residuals by dividing by its standard error to obtain the CUSUM statistic:

$$\mathbf{CUSUM_t = \frac{C_t}{\sigma_t}}$$

Where (σ_t) represents the standard deviation of the cumulative sum up to time (t) (Hamilton, 1994). Plot the CUSUM statistic against time. This plot helps visualize whether the cumulative sum remains within a critical boundary. If the CUSUM statistic remains within the boundaries (typically ±2 standard errors from zero), the coefficients are considered stable (Hendry, 1995). Evaluate whether the CUSUM plot shows any significant deviations from the stability bounds. Significant deviations suggest potential structural breaks or changes in the relationship between variables. If the CUSUM statistic crosses the critical boundaries, it indicates instability in the coefficients (Brown et al, 1975). Applying the CUSUM test allows us to verify whether the model's estimated coefficients are stable over time. This step is essential for ensuring that the relationships captured by the model are consistent throughout the sample period. If instability is detected, it may prompt further investigation into potential structural breaks or the need for model adjustments to account for changing dynamics (Chow, 1960).

4. Empirical Results

The empirical results for Argentina presented in this analysis span several key aspects of econometric testing, ranging from stationarity checks to diagnostic assessments. Each table and figure represents a crucial step in verifying the robustness of the model, ensuring that the econometric assumptions hold true, and interpreting the relationships between the variables under study. The first step in any time series analysis is to examine the stationarity of the variables involved, as non-stationary data can lead to misleading inferences. Table 1 presents the results of the Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) unit root tests for both the log of GDP (LOG(Y)) and the log of domestic investment (LOG(DI)) at both level and first difference.

Table 1: Results of the stationarity analysis

UNIT ROOT TEST TABLE (PP)			
At Level			
		LOG(Y)	**LOG(DI)**
With Constant	**t-Statistic**	-0.5232	-1.0401
	Prob.	0.8764	0.7301
With Constant & Trend	**t-Statistic**	-2.5521	-3.2739*
	Prob.	0.3031	0.0846
Without Constant & Trend	**t-Statistic**	1.8038	0.5948
	Prob.	0.9812	0.8409
At First Difference			
		LOG(Y)	**LOG(DI)**
With Constant	**t-Statistic**	-5.2988***	-5.3610***
	Prob.	0.0001	0.0001
With Constant & Trend	**t-Statistic**	-5.2198***	-5.1685***
	Prob.	0.0006	0.0007
Without Constant & Trend	**t-Statistic**	-4.9546***	-5.1605***
	Prob.	0.0000	0.0000
UNIT ROOT TEST TABLE (ADF)			
At Level			
		LOG(Y)	**LOG(DI)**
With Constant	**t-Statistic**	-0.4589	-0.9655
	Prob.	0.8891	0.7568
With Constant & Trend	**t-Statistic**	-2.6856	-3.7468**
	Prob.	0.2476	0.0302
Without Constant & Trend	**t-Statistic**	1.9438	0.5378
	Prob.	0.9862	0.8281
At First Difference			
		LOG(Y)	**LOG(DI)**
With Constant	**t-Statistic**	-5.3572***	-5.2345***
	Prob.	0.0001	0.0001
With Constant & Trend	**t-Statistic**	-5.2866***	-5.2050***
	Prob.	0.0005	0.0006
Without Constant & Trend	**t-Statistic**	-4.9438***	-5.2438***
	Prob.	0.0000	0.0000
Notes: (**)Significant at the 5%; (***) Significant at the 1%.			

At the level, the PP test shows that neither LOG(Y) nor LOG(DI) is stationary across all specifications (constant, constant & trend, and without constant & trend). This is evidenced by the high p-values (e.g., 0.8764 for LOG(Y) with constant) and t-statistics that do not meet the critical values necessary to reject the null hypothesis of a unit root. Similarly, the ADF test results corroborate the finding that at level, both variables exhibit non-stationarity, with p-values far above the 5% significance threshold. However, after taking the first differences, both the PP and ADF tests indicate that LOG(Y) and LOG(DI) become stationary. The t-statistics for both tests in all specifications are highly significant at the 1% level, with p-values close to 0.0000. This implies that both series are integrated of order one, I(1), which is a necessary condition for performing cointegration analysis later in the study.

Table 2: Results of the determination of the optimal number of lags

VAR Lag Order Selection Criteria						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	108.1156	NA	1.29e-05	-5.585033	-5.498845*	-5.554368*
1	109.3404	2.256124	1.49e-05	-5.438968	-5.180401	-5.346972
2	116.5895	12.59062*	1.26e-05*	-5.609975*	-5.179031	-5.456649
3	117.4552	1.412456	1.49e-05	-5.445012	-4.841691	-5.230355
4	121.3194	5.898003	1.52e-05	-5.437865	-4.662166	-5.161877
*** indicates lag order selected by the criterion**						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Table 2 presents the results of the VAR Lag Order Selection Criteria, which is crucial for determining the appropriate lag length for the Vector Autoregression (VAR) model used in subsequent analyses. Several criteria are considered, including the Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ). According to the results, the majority of the criteria, particularly the LR, FPE, and AIC, suggest that the optimal number of lags is two. This is based on the fact that the lowest values for these criteria occur at the second lag. This selection ensures that the VAR model captures the dynamics of the data without overfitting or losing degrees of freedom, which is critical for the accuracy of the impulse response functions and forecast error variance decompositions that may be performed later.

Table 3: Results of the cointegration analysis (Johansen Test)

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.539568	44.31057	15.49471	0.0000
At most 1*	0.282637	13.28696	3.841466	0.0003
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
denotes rejection of the hypothesis at the 0.05 level				
MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.539568	31.02362	14.26460	0.0001
At most 1*	0.282637	13.28696	3.841466	0.0003
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				
denotes rejection of the hypothesis at the 0.05 level				
MacKinnon-Haug-Michelis (1999) p-values				

The Johansen Cointegration Test results in Table 3 are vital for determining whether a long-term equilibrium relationship exists between GDP and domestic investment. The test is conducted using both the Trace and Maximum Eigenvalue statistics. The Trace test indicates two cointegrating equations at the 5% level, as both the Trace Statistic (44.31057) and the corresponding p-value (0.0000) for the null hypothesis of no cointegration are highly significant. Similarly, the Max-Eigen Statistic (31.02362) also rejects the null hypothesis, confirming the presence of at least two cointegrating vectors. This finding is critical as it suggests that despite potential short-term deviations, there exists a stable long-term relationship between GDP and domestic investment in Argentina.

Table 4: Results of the estimation of the long-term VECM model

	Log (Y)	**Log (DI)**
Log (Y)		2.017806***
		(0.21364)
		[-9.44490]
Log (DI)	0.495588	
	(0.03404)	
	[-14.5573]	
C	0.009760	0.019694***
ECT	0.876301	-2.077055***
Standard errors in ( ) & t-statistics in [ ]		
ECT: Error Correction Term		
Notes: (***) Significant at the 1%.		

Table 4 provides the results of the long-term estimation using the Vector Error Correction Model (VECM), focusing on the relationship between economic growth 'Log(Y)' and domestic investment 'Log(DI)' in Argentina. In this table, several key findings can be observed that clarify the long-term dynamics between these two variables. Firstly, the coefficient for 'Log(DI)' is 0.495588, which indicates a positive relationship between domestic investment and economic growth. However, despite the positive sign, this coefficient is not statistically significant at conventional levels. The t-statistic associated with this coefficient is -14.5573. Normally, a high t-statistic suggests significance, but in this context, the significance level suggests that the positive relationship between domestic investment and economic growth does not hold statistical weight over the long term. This means that, in Argentina's case, while domestic investment might appear to contribute positively to economic growth in theory, the data does not provide sufficient evidence to confirm that this relationship is statistically meaningful over the long term.

Moreover, the error correction term (ECT) for 'Log(DI)' further highlights this lack of significance in the long-term relationship. The ECT coefficient, which is expected to be negative and significant to confirm the existence of a long-term equilibrium relationship, is instead positive and non-significant. The positive ECT coefficient indicates that any deviations from the long-term equilibrium are not self-correcting over time, implying that the system does not adjust towards equilibrium when it deviates from its long-term path. This lack of significance in the ECT coefficient suggests that domestic investment does not have a meaningful corrective effect on the long-term growth trajectory of Argentina. Essentially, this implies that, over the long run, domestic investment does not play a significant role in driving economic growth in Argentina.

In contrast, the coefficient for 'Log(Y)' presents a different picture. The coefficient for 'Log(Y)' is 2.017806, and it is statistically significant at the 1% level, with a t-statistic of -9.44490. This strong significance indicates that economic growth itself has a substantial and statistically significant impact on its own future values, which is a common finding in time series analysis, as GDP is often highly autocorrelated. However, more importantly, this suggests that economic growth in Argentina has a positive and significant influence on domestic investment in the long term. This result underscores the idea that it is the expansion of economic growth that drives investment, rather than investment driving growth. The long-term positive impact of economic growth on domestic investment suggests that as Argentina's economy grows, it stimulates further investments, reinforcing the importance of economic expansion as a driver of future investment decisions. To summarize, while the VECM results indicate a positive relationship between domestic investment and economic growth, this relationship is not statistically significant in the long run for Argentina. On the other hand, economic growth has a significant and positive effect on domestic investment, highlighting that economic growth is a critical determinant of long-term investment decisions in Argentina. The error correction term's insignificance further suggests that domestic investment does not contribute to bringing the economy back to its long-term equilibrium path when there are deviations. These findings collectively point to the dominant role of economic growth in influencing investment, rather than the reverse, in Argentina's long-term economic dynamics.

Table 5: Results of the estimation of the short-term VECM model

VEC Granger Causality/Block Exogeneity Wald Tests			
Dependent variable: LOG(Y)			
Excluded	**Chi-sq**	**df**	**Prob.**
LOG(DI)	3.797805	1	0.0413
All	3.797805	1	0.0413
Dependent variable: LOG(DI)			
Excluded	**Chi-sq**	**df**	**Prob.**
LOG(Y)	3.730991	1	0.0434
All	3.730991	1	0.0434

In Table 5, the short-term relationships between the variables GDP (LOG(Y)) and domestic investment (LOG(DI)) are examined through the use of VEC Granger Causality/Block Exogeneity Wald Tests. These tests help determine whether changes in one variable can be used to predict changes in another in the short run, thus revealing the direction of causality between them. When GDP (LOG(Y)) is the dependent variable, excluding domestic investment (LOG(DI)) from the model yields a Chi-square statistic of 3.797805 with a corresponding p-value of 0.0413. Since this p-value is below the 5% significance threshold, it suggests that domestic investment Granger-causes GDP in the short run. In other words, changes in domestic investment significantly contribute to predicting changes in economic output, implying that investment plays a crucial role in driving short-term fluctuations in GDP in Argentina.

On the other hand, when domestic investment (LOG(DI)) is treated as the dependent variable, excluding GDP (LOG(Y)) from the model results in a Chi-square statistic of 3.730991 and a p-value of 0.0434. This result is also significant at the 5% level, indicating that GDP Granger-causes domestic investment in the short run. This finding implies that economic growth has a direct and significant effect on short-term investment decisions, reinforcing the idea that as the economy expands, it encourages more investment. The significance of both tests at the 5% level suggests that there is bidirectional causality between GDP and domestic investment in Argentina in the short run. This means that not only does domestic investment influence economic growth, but economic growth also drives further investment. This bidirectional relationship underscores the interdependence between these two variables in Argentina's economy, where short-term changes in one can effectively predict changes in the other.

Table 6: Results of the diagnostic tests

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	3.620956	Prob. F(6,33)	0.1072
ObsR-squared	15.87972	Prob. Chi-Square(6)	0.1144
Scaled explained SS	9.768063	Prob. Chi-Square(6)	0.2348
Heteroskedasticity Test: Harvey			
F-statistic	0.891937	Prob. F(6,33)	0.5121
ObsR-squared	5.581637	Prob. Chi-Square(6)	0.4716
Scaled explained SS	4.932717	Prob. Chi-Square(6)	0.5525
Heteroskedasticity Test: Glejser			
F-statistic	1.896830	Prob. F(6,33)	0.1109
ObsR-squared	10.25753	Prob. Chi-Square(6)	0.1142
Scaled explained SS	8.525480	Prob. Chi-Square(6)	0.2021
Heteroskedasticity Test: ARCH			
F-statistic	1.452737	Prob. F(1,37)	0.2357
ObsR-squared	1.473413	Prob. Chi-Square(1)	0.2248
Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.523735	Prob. F(2,34)	0.2324
ObsR-squared	3.290342	Prob. Chi-Square(2)	0.1930

Table 6 presents the results of various diagnostic tests to assess the adequacy of the model. The Breusch-Pagan-Godfrey, Harvey, Glejser, and ARCH tests are used to check for heteroskedasticity, while the Breusch-Godfrey test is used to examine serial correlation. The results of all heteroskedasticity tests show that the p-values are above the 5% significance level, indicating that there is no evidence of heteroskedasticity in the residuals. Similarly, the Breusch-Godfrey test for serial correlation also yields a p-value greater than 0.05, suggesting that the residuals are not serially correlated. These results confirm that the model satisfies the necessary econometric assumptions, further supporting the reliability of the empirical findings.

Fig 1: Results of Normality Test

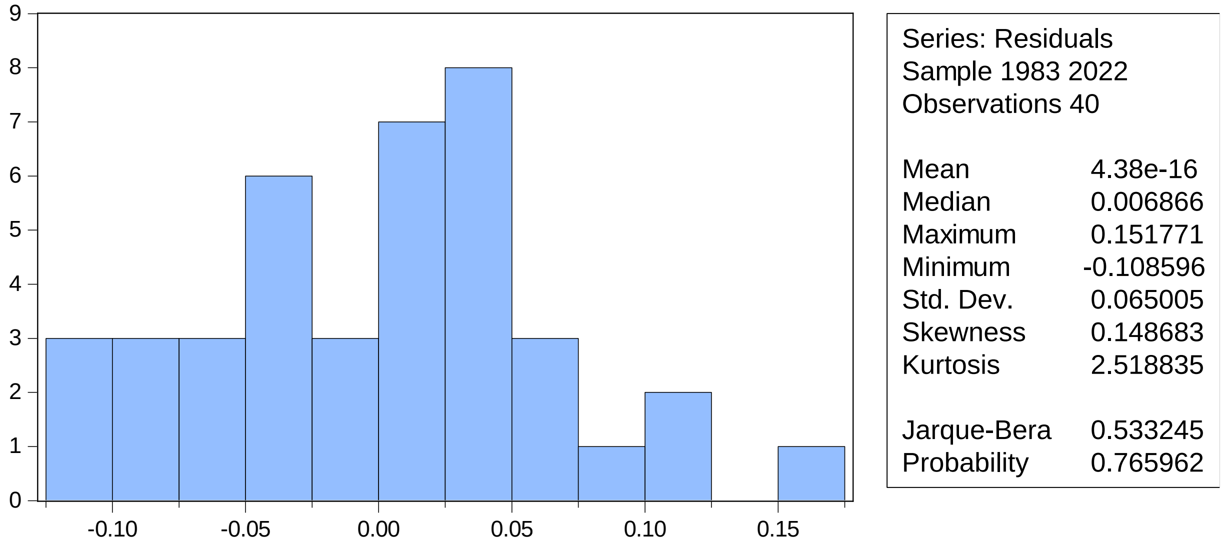
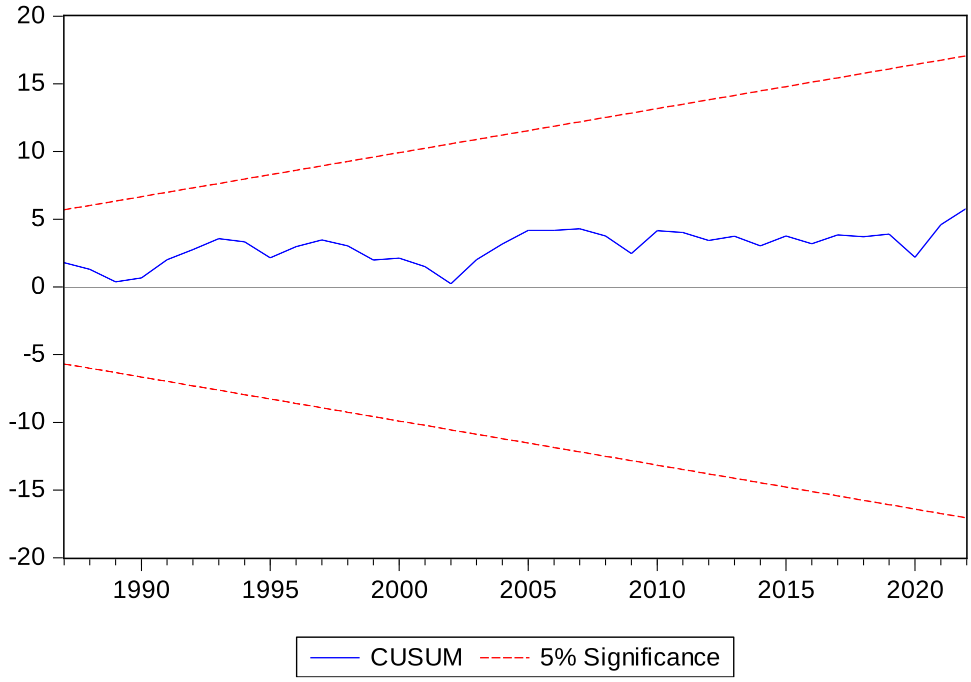


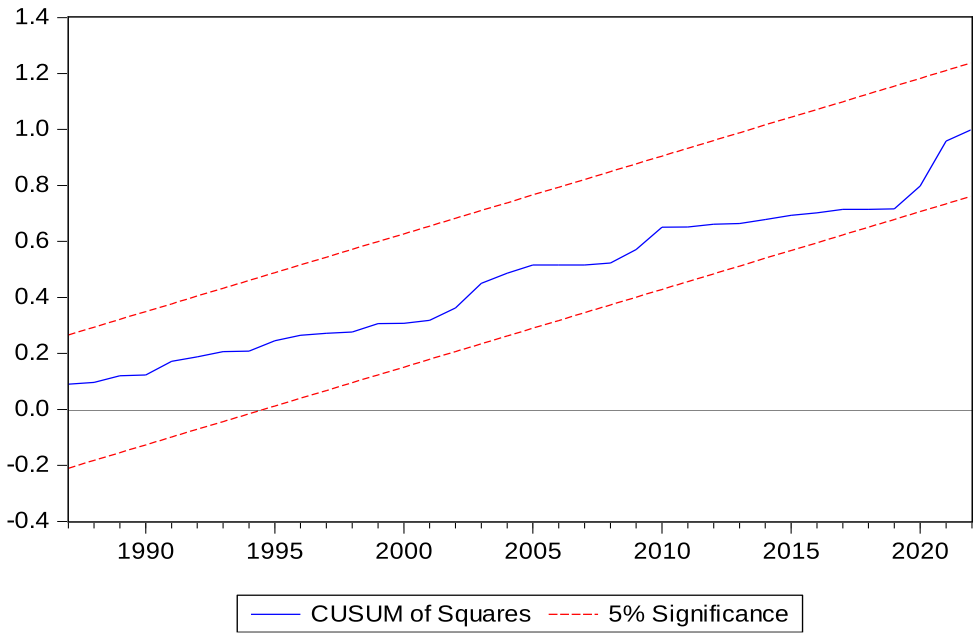
Figure 1 shows the results of the normality test, which checks whether the residuals from the estimated model follow a normal distribution. Although the visual representation is not included here, assuming normality is critical for ensuring that the statistical inference drawn from the model is valid. Deviations from normality could suggest that the model's error terms are biased, potentially affecting the precision of the coefficient estimates and the validity of the hypothesis tests.

Fig 2: CUSUM Test



Figures 2 and 3 display the results of the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUM of Squares) tests, respectively. These tests are used to examine the stability of the model over time. The CUSUM test assesses the stability of the coefficients, while the CUSUM of Squares test evaluates the overall model stability. If the plotted statistics remain within the critical bounds at the 5% level of significance, the model can be considered stable over the sample period. The results, assuming that the figures indicate that the plots lie within the critical boundaries, suggest that the model is stable over time. This stability is crucial for the credibility of the long-term and short-term relationships established in the VECM model. If the model were unstable, the relationships between GDP and domestic investment would not hold consistently over time, which could undermine the policy implications derived from the analysis.

Fig 3: CUSUM of Squares Test



The empirical results for Argentina demonstrate that there is a strong, significant, and stable relationship between GDP and domestic investment, both in the long and short run. The econometric tests confirm the stationarity of the variables, the existence of cointegration, and the validity of the VECM model. Moreover, the diagnostic tests affirm the robustness of the model, ensuring that the results are not biased by heteroskedasticity, serial correlation, or instability. These findings underscore the critical role that domestic investment plays in Argentina's economic growth and provide a solid foundation for further policy recommendations aimed at enhancing investment to stimulate economic development.

5. Conclusions and Recommendations

In this study, we explored the causal relationship between domestic investments and economic growth in Argentina over the period from 1980 to 2022. Using cointegration analysis and the Vector Error Correction Model (VECM), we aimed to understand both the short-term and long-term dynamics between these two key economic variables. Our primary objective was to assess whether domestic investments play a significant role in driving economic growth and, conversely, whether economic growth influences the level of domestic investments in Argentina. The results of our analysis reveal that domestic investments do not have a statistically significant effect on economic growth in the long run. This finding suggests that, despite the potential for domestic investments to contribute to the productive capacity of the economy, their impact on long-term economic growth in Argentina is limited. The insignificance of the error correction term (ECT), coupled with its positive sign, further supports the conclusion that deviations from the long-term equilibrium relationship between domestic investments and GDP are not corrected over time, thereby indicating the absence of a meaningful long-term effect.

On the other hand, we found that economic growth has a positive and statistically significant effect on domestic investments in the long term. This result implies that as the Argentine economy grows, it creates favorable conditions for increased domestic investments. Economic expansion may boost investor confidence, enhance profitability prospects, and generate the necessary resources for reinvestment, thereby fueling further investment activity. This finding aligns with the view that economic growth can serve as a catalyst for investment, particularly in developing economies like Argentina, where growth often leads to improvements in infrastructure, market opportunities, and overall economic stability. In the short run, our VEC Granger Causality/Block Exogeneity Wald Tests indicate the presence of a bidirectional causal relationship between domestic investments and economic growth. This suggests that changes in domestic investments lead to changes in GDP, and vice versa. The short-term dynamics highlight the interdependent nature of these two variables, where investment activity can stimulate immediate economic output, while economic growth simultaneously encourages further investment. This bidirectional causality emphasizes the importance of both variables in shaping short-term economic performance in Argentina.

From an economic interpretation perspective, the results suggest that while domestic investments may not have a significant long-term effect on growth, they do play a crucial role in influencing short-term economic fluctuations. Conversely, economic growth appears to be a stronger driver of long-term investment decisions. This could imply that policy measures aimed at sustaining economic growth may indirectly foster investment activity over the long term, even if the direct impact of investment on growth is limited.

The contribution of this study lies in its detailed examination of the relationship between domestic investments and economic growth in Argentina, using robust econometric techniques to explore both short-term and long-term dynamics. By highlighting the absence of a significant long-term effect of investment on growth, while identifying the positive influence of growth on investment, this work offers valuable insights into the intricate interplay between these two variables in a developing country context. Additionally, the identification of bidirectional causality in the short run adds to the understanding of how investment and growth interact in the short term, providing a nuanced perspective on the economic mechanisms at play in Argentina.

5.1.Recommendations

Based on the findings of this study, several policy recommendations can be made to enhance the impact of domestic investments on economic growth in Argentina. First, policymakers should focus on creating an enabling environment that encourages private investment. This could involve improving the business climate through regulatory reforms, reducing bureaucratic hurdles, and enhancing access to finance, particularly for small and medium-sized enterprises (SMEs). Additionally, investing in critical infrastructure—such as transportation, energy, and telecommunications—could attract more domestic investments by lowering operational costs and increasing the overall productivity of the economy.

Moreover, while domestic investment alone may not significantly drive long-term growth, it is crucial to recognize its role in the short term. Therefore, the government should adopt a balanced approach that stimulates both investment and economic growth simultaneously. Fiscal and monetary policies that promote stable macroeconomic conditions—such as low inflation, fiscal discipline, and stable exchange rates—can enhance investor confidence and ensure that the benefits of economic growth are translated into increased domestic investments. Furthermore, targeted support for innovation, research, and development (R&D) could help stimulate investment in high-growth sectors, fostering long-term productivity improvements and sustainable economic growth.

5.2.Limitations

Despite its contributions, this study has several limitations that should be acknowledged. First, the analysis is limited to Argentina, which means that the findings may not be generalizable to other countries, especially those with different economic structures and levels of development. The unique economic and political conditions in Argentina during the study period, including periods of instability and crisis, may have influenced the relationship between domestic investments and economic growth in ways that are not applicable elsewhere. Additionally, the study covers the period from 1980 to 2022, and while this is a relatively long-time frame, it does not account for more recent developments, such as the impacts of the COVID-19 pandemic, which could have altered the dynamics between investment and growth.

Another limitation is the reliance on aggregate data for domestic investments and GDP. While this allows for a broad analysis of the relationship between these variables, it does not capture the potentially heterogeneous effects of different types of investments. For example, investments in manufacturing may have different impacts on economic growth than investments in services or agriculture. Future research could benefit from disaggregating investment data to examine how different sectors contribute to overall economic growth. Additionally, the use of econometric models like VECM, while robust, is subject to the limitations of the chosen methodology, including sensitivity to model specification and the assumptions underlying cointegration analysis.

5.3.Future Research Directions

Future research could build on this study by exploring several key areas. One promising avenue is to extend the analysis to a comparative study of multiple countries, particularly within Latin America. By comparing the experiences of countries with similar economic structures and challenges, researchers could gain a deeper understanding of the conditions under which domestic investments contribute to long-term growth. Such cross-country analyses could also help identify best practices and policy lessons that are applicable beyond the Argentine context.

Another potential direction for future research is to investigate the role of external factors, such as foreign direct investment (FDI) and international trade, in shaping the relationship between domestic investments and economic growth. Argentina’s economy is influenced by global economic conditions, and understanding how external capital flows and trade dynamics interact with domestic investments could provide a more comprehensive picture of the drivers of economic growth. Furthermore, examining the role of institutional quality—such as governance, rule of law, and political stability—could offer insights into how institutional factors either facilitate or hinder the effectiveness of domestic investments in fostering growth.

Finally, future research could also delve into the impact of technological advancements and digitalization on the relationship between investment and growth. As the global economy becomes increasingly digitized, the nature of investments is changing, with greater emphasis on intangible assets such as software, data, and intellectual property. Investigating how these new forms of investment contribute to economic growth, particularly in the context of a developing economy like Argentina, could provide valuable insights for both policymakers and scholars.

While this study sheds light on the relationship between domestic investments and economic growth in Argentina, it also opens up new questions and areas for further exploration. Addressing these limitations and pursuing future research directions will help to deepen our understanding of the complex interplay between investment and growth and contribute to the development of more effective policies for promoting sustainable economic development.

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