Lucas Paradox, Institutional Quality and Corruption: Evidence from D.R. Congo

MULOWAYI, Francis K. and PINSHI, Christian P.

Ministry of Planning, University of Kinshasa

2023

Lucas Paradox, Institutional Quality and Corruption: Evidence from D.R. Congo

Francis K. Mulowayi[1] & Christian P. Pinshi[2]

Abstract

This paper aims to examine the Lucas paradox in the DRC, and more specifically to test whether institutional quality could be a key variable for the resolution of the paradox in the DRC. Using Granger's dynamic causality analysis and Toda-Yamamoto's in-depth analysis, we find that the Lucas paradox is true in the DRC, and that institutional quality, including corruption or macroeconomic management, are far from resolving this paradox in the DRC.

Keywords : Lucas Paradox, Foreign direct investment, Institutional quality, corruption
JEL Classification : C32, D73, E02, F21, F41.

[1] Ministry of Planning, kangombaf@gmail.com
[2] University of Kinshasa, christian.pinshi@unikin.ac.cd

1. Introduction

The boom in capital flows, fueled by developed countries, has grown at an incredible rate worldwide, coupled with the liberal policy practices of developing countries (DCs) in the 1980s. The main reason for the policies of developing countries, especially sub-Saharan African countries, in favor of financial liberalization is the desire to obtain the financing they need in the process of economic development. In this context, to attract more foreign capital, developing countries have significantly lifted their capital controls and implemented policies to remove social, political, and economic barriers to foreign investment. Foreign capital investment is an important factor affecting growth performance, unemployment rates and levels of prosperity. Among foreign investment, foreign direct investment (FDI) is particularly crucial. It is emphasized that FDI, which can play an important role in the process of economic growth, not only provides the necessary capital for countries, but also increases output, exports, employment, and productivity (Fontagné, 1999); Osano and Koine, 2016; Traore, 2017). In addition, FDI results in transfers of technology and management skills (Traore, 2017). Sub-Saharan African countries, most notably the Democratic Republic of Congo (DRC), in putting in place policy incentives and regulations to attract these investments to their domestic markets due to the growing importance of FDI, have not achieved the desired results due to various constraints, including corruption and institutional quality in these countries.

According to the neoclassical hypothesis, capital should flow from rich (developed) countries, which have more physical capital per worker, to poor (developing) countries, which have relatively less physical capital per worker. This assumption is because the returns to capital in rich countries are relatively low compared to poor countries. However, economist Lucas concluded in 1990 that there is no capital flow (foreign investment) in this direction at the level predicted by neoclassical theory. Lucas' discovery is called the Lucas paradox in the economic literature. According to this theory, most serious investors do not invest in developing countries, as is the case in sub-Saharan Africa. Lucas' findings have raised arguments about other determinants of FDI as well as the marginal return on capital. Considering other factors, such as lack of skilled labor, poor infrastructure, high levels of corruption, and the quality of institutions (Mengistu and Adhikary, 2011). At this point, many other factors such as market size, trade openness, exchange rate, economic stability, institutional quality, infrastructure, labor costs, tax rates, macroeconomic stability, and political stability have been generalized as determinants of FDI in the literature (Koukpo, 2005; Abdellah, Nicet-Chenaf, and Rougier, 2009; Thaalbi, 2013; Griguer and Debbarh, 2022).

More than a quarter of a century later, despite a significant number of empirical studies attempting to find a solution to Lucas' paradox, it remains relevant and, arguably, unsolved. Recent work supports and is concerned with the issue of institutional quality, which may be the dose that best explains the Lucas paradox, also inserting the level of corruption (Alfaro, Kalemli-Ozcan, and Volosovych, 2007; Azémar and Desbordes, 2013; Snyder, 2013; Akhtaruzzaman, Hajzler, and Owen, 2018). More recently, institutional quality, including the extent of government corruption and sovereign default risk, has been found to affect political risks and the cost of doing business, thereby influencing ex-ante FDI returns (Habib and Zurawicki , 2002; Bénassy-Quéré, Coupet, and Mayer, 2007; Nahia, 2008; Mtiraoui, 2020).

Thus, Alfaro, Kalemli-Ozcan and Volosovych (2007) find that institutional quality is a quantitative and statistically significant determinant of FDI. Moreover, they argue that institutional quality can fully explain the paradox, in that the positive and statistically significant relationship between a country's level of GDP per capita and FDI disappears if the country has low institutional quality. However, other researchers clearly and forcefully argue that institutional quality does not explain the Lucas paradox. As it happens, Aluko and Ibrahim (2019) conducted a cross-sectional regression analysis to empirically investigate whether institutional quality explained the Lucas paradox in Africa. Their result attested to the existence of the Lucas paradox in Africa. But they found that institutional quality did not explain the Lucas paradox. Similarly, Kim and Jun (2022), very recently surpassed this aspect, noting that institutional quality does not sufficiently and significantly explain the Lucas paradox. It is obvious that FDI is a parameter of economic growth and development. It has been of crucial importance in the DRC since the financial liberalization instilled by the arrival of Joseph Kabila in 2001 as President of the DRC. As a result, the country hopes to attract FDI as a source of long-term capital that can infuse new technologies, management knowledge and marketing capabilities into the economy. This in turn will increase the country's economic activities by creating jobs, increasing managerial skills, disseminating technology, and encouraging innovation. Regardless of the internal or external factors that determine FDI inflows, the perceived level of corruption in an economy could also be a determining factor in attracting FDI. Corrupt practices are influenced by factors such as an excessive bureaucratic system, heavy use of discretionary power in the formulation and implementation of public policies, inefficient and slow legal institutions, low civil service wages, and low levels of economic liberalization. These elements inevitably affect various aspects of the economy, including FDI inflows and economic growth in the DRC. This situation has attracted the attention of international organizations such as the World Bank, Transparency International and the International Monetary Fund (IMF). Currently, corruption appears to be the biggest problem facing the DRC's economic growth and development efforts. Corruption is present at all levels of governance and within public and private sector organizations. Examples of corrupt practices in Africa and the DRC include bribery, embezzlement, fraud, nepotism, cronyism, etc. (Kodila and Bolito, 2014; Tshikengela, 2020). Corruption is a multidimensional and persistent problem. An appropriate institutional environment can significantly reduce corruption and increase FDI in the DRC (Assembe, 2015). However, to achieve better institutional quality, appropriate reform-oriented institutions are needed to fight corruption (Ramirez, 2022).

The DRC provides a prime example of the Lucas paradox. Not only does the country contain a disproportionate number of the world's poorest people, but the effects on marginal productivity of capital of the country's high labor-to-capital ratio should instead be magnified by its rich endowment of natural resources. In other words, relative to the world's rich countries, the DRC is both labor and resource abundant. By the conceptual measure that best fits the predictions of the neoclassical model, the country has received disproportionately low net FDI flows on average since 2005 compared to countries in other regions. Following these in-depth analyses, this work reflects on the following questions: Does the Lucas paradox hold true in the DRC? Does institutional quality explain the Lucas paradox in the DRC? Is it corruption or institutional quality that causes the Lucas paradox in DRC? That is, the low importance of FDI?

The purpose of this paper is to examine Lucas' conundrum of the lack of reliable investment in the DRC due to corruption and questionable institutional quality. Specifically, it examines a series of possible factors that discourage significant FDI inflows into the DRC. This work is a

reflection on the problem rather than an attempt to solve it, as its objective is to provide a conceptual framework for a systematic reflection on possible explanations, rather than the defense of a single explanation. The objective is to identify a set of potential obstacles that the DRC might face in attracting FDI and to assess their plausibility, rather than to provide ad hoc tests of sophisticated explanations. This study is of systemic interest to the Congolese economy to raise the country's level of attractiveness. A return to standard economic theory, which advocates that capital should flow from rich to poor countries. However, it is the opposite trend that prevails in the global economy. This is known as the Lucas paradox. Furthermore, it has been shown that, against all expectations, there is a negative correlation between FDI and growth in developing countries. This is called the allocation puzzle. The interest of this work is to highlight the issues raised in the problem to provide material for Congolese policy makers. Furthermore, considering corruption and questioning the institutional quality of the country would be a very important perspective for analyzing the Lucas paradox in the DRC, and identifying this problem that continues to intrigue policy makers. Thus, this work will be a turning point in the study of the issue. Far from altering the legitimacy of this analysis in the DRC, but upon investigation, this research proves to be pioneering in the DRC, and would serve as a future reference on the Lucas paradox combined with corruption and institutional quality in the DRC.

This paper will be structured around 4 sections, the first will describe the choice of variables, thus the data used and their sources. The second section will present the model. The third section will illustrate the results found and the last section will conclude.

2. Data

The data cover a monthly period from 2000 to 2021 for a sample of 264 observations. The data used are mainly GDP/capita, FDI, institutional quality, corruption, and macroeconomic management. Other data, such as the exchange rate, are used at the estimation level to serve as a control variable, and to indirectly identify and capture the international economy. These data, their source and coverage period are presented in Table 1.

- FDI data, expressed in U.S. dollars, are from the World Bank's World Development Indicators (WDI) database.

- GDP/capita data are from the IMF's World Economic Outlook (WEO). They are expressed in constant US dollars, base 2015.

- Institutional quality is derived from the Country Policy and Institutional Assessment (CPIA) index published by the World Bank. The CPIA consists of 16 criteria grouped into four equally weighted groups: economic management, structural policies, social inclusion and equity policies, and public sector management and institutions. For each of the 16 criteria, countries are rated on a scale of 1 (low) to 6 (high). Ratings are based on the level of performance each year assessed against the criteria, rather than on changes in performance from the previous year. Ratings are based on actual policies and

performance, rather than promises or intentions. In some cases, actions such as the passage of a specific law may represent an important action worth considering.
The public sector management and institutions cluster criterion is taken as a specific indicator of institutional quality, including in its approach property rights and rules-based governance, quality of budget management and financial performance, efficiency of revenue mobilization, quality of public administration, and transparency, accountability, and corruption in the public sector.

- Macroeconomic management, like institutional quality, is also derived from the EPIC, economic group, or macroeconomic management. This indicator inserts variables related to monetary and exchange rate policy, fiscal policy, debt management, and thus assesses the health of aggregate demand. This variable is very useful because one of the necessary conditions for attracting FDI is macroeconomic stability, and macroeconomic management as a variable covers this panoply of information on the stability of the macroeconomic framework.

- Corruption data is taken from Transparency International's Corruption Perceptions Index (CPI), which ranks 180 countries and territories around the world by their perceived level of corruption in the public sector. The results are given on a scale of 0 (very corrupt) to 100 (very clean). They measure how corrupt each country's public sector is perceived to be. These data sources are collected by various reputable institutions, including the World Bank and the World Economic Forum.
  The data sources used to compile the CPI specifically cover the following manifestations of corruption in the public sector: corruption; embezzlement of public funds; civil servants using their public office for private purposes without suffering the consequences; the ability of governments to contain corruption in the public sector; excessive bureaucracy in the public sector which can increase opportunities for corruption; nepotistic appointments in the civil service; laws ensuring that public officials must disclose their finances and potential conflicts of interest; legal protection for people who report cases of corruption; state capture by narrow vested interests and access to information about public affairs and government activities[3].

  The problem with the CPI is that it does not cover citizens' direct perceptions or experiences of corruption; tax evasion; illicit financial flows; facilitators of corruption (lawyers, accountants, financial advisers, etc.); money laundering; corruption in the private sector and informal economies and markets. However, this would not have a very significant impact on our empirical work landscape since the focus is much more on the public sector.

- As for the data on the nominal exchange rate (indicative or interbank), we have taken them from various reports of the Central Bank of Congo as well as from its bulletins and statistical digests. Nominal exchange rate (local currency units CDF to US dollar USD) refers to the exchange rate determined in the legally sanctioned foreign exchange market.

[3] https://www.transparency.org/en/cpi/2021/index/can

Table 1. Table of variables

Variable	*Sources*	*Period (Monthly)*
FDI	World Bank, World Development Indicators, 2022	2000 - 2021
GDP/capita	IMF, World Economic Outlook, April 2022	2000 - 2021
Institutional Quality	World Bank, World Development Indicators, 2022	2000 - 2021
Corruption	Transparency International	2000 - 2021
Macroeconomic management	World Bank, World Development Indicators, 2022	2000 - 2021
Exchange rate	World Bank, World Development Indicators, 2022	2000 - 2021

3. Model

In the following is displayed our macroeconometric framework, deemed relevant to assess the causal relationships between the variables to test our hypotheses on the Lucas Paradox on the one hand, and the questioning of institutional quality on the other. We set up a multivariate framework integrating GDP/capita (Y), foreign direct investments (FDI) and institutional quality (IQ), corruption (CPI), macroeconomic management (MM) and the exchange rate (E), which leads us to define our approach as follows:

$$Y = F(FDI_t, IQ_t, CPI_t, MM_t, E_t) \qquad (1)$$

Where Y corresponds to the quality of economic growth, measured by GDP/capita. FDI refers to FDI flows; the IQ designates the institutional quality, which is one of the key variables of the country's credibility and good governance; The CPI refers to corruption, which is a disturbing variable of a good viable economic system; MM refers to the macroeconomic management of the country, which is a pull factor for attracting FDI and a necessary condition for emergence. E corresponds to the nominal exchange rate, taken arbitrarily as a control variable, but also sensor and identifier of the open economy. Finally, t indicates the time. With these series covering the period 2000-2021, we also specify the determinant of FDI in our function as follows:

$$IDE = F(IQ_t, CPI_t, MM_t, E_t) \qquad (2)$$

The first function examines the existence of the Lucas paradox in the DRC, while the second, conditioned by the first, tries to explain this paradox in the DRC, from the questioning of institutional quality in the DRC. Thus, with time series spanning our period, the linear specification is identified as:

$$\ln(Y)_t = \alpha_1 + \alpha_2 \ln(FDI)_t + \alpha_3 \ln(IQ)_t + \alpha_4 \ln(CPI)_t + \alpha_5 \ln(MM)_t + \alpha_6 \ln(E)_t + \mu_t \qquad (3)$$

When the elasticity of FDI, institutional quality, corruption, macroeconomic management and exchange rate are indicated by $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5 \; et \; \alpha_6$ respectively. When implementing such an analysis, key steps should be followed to effectively test causality. First, it is necessary to test the stationary properties of the series. It has been shown that using nonstationary data in causality can produce spurious and misleading causality results because the test will have a nonstandard distribution (Toda and Phillips, 1993). Our stationary test procedure includes the Augmented Dickey-Fuller (ADF) test, Dickey and Fuller (1979; 1981).

We can say, intuitively, that a series is stationary if, after having undergone the effect of a shock, it tends to return to its average value over a long period (Fuster *et al.*,2010). More generally, the series does not include any factors changing over time. To check the stationarity of the series, in addition to the correlogram observation, it is necessary to perform stationarity tests or unit root tests (Ammi, 2016). These tests make it possible to identify the presence of unit root in a time series and to check whether it is stationary. More exactly, we will seek to verify the null hypothesis of existence of unit root and that the autoregressive process is non-stationary. If the unit root confirms non-stationarity, the differences should be taken until the series is stationary at the same level. If a non-stationary series, Y_t must be differentiated once before becoming stationary, then it is said to be integrated of order 1. This would be written as $Y_t \sim I(1)$. Thus, if $Y_t \sim I(1)$, then $dY_t \sim I(1)$i implying that the application of the difference operator $d \; in \; continuous \; time \; or \; \triangle \; in \; discrete \; time$, leads to the process $I(0)$, a rootless process unitary. A stationary series has constant average, constant variance, and constant auto-covariance for each given lag. In this work, the augmented Dickey-Fuller unit root test is adopted to infer the number of unit roots or non-stationarity of the variables contained in the series. This test involves the estimation of the three equations, in our calculation we estimate a single equation:

$$\Delta y_t = \alpha + \beta t + \vartheta y_{t-1} + \sum_{j=1}^{p-1} \phi_j \, \Delta y_{t-j} + \nu_t \qquad (4)$$

Where ν_t is the residual, p is the lag length chosen according to the Schwarz information criterion (SC) (Schwarz, 1978). The null hypothesis is that $y_t = y_{t-1} + \nu_t$ where $\nu_t \approx NID(0, \sigma^2)$. According to the null hypothesis, ϑ will be negatively biased in a limited sample, so only one test is needed to determine $H_0: \vartheta = 0[y_t \approx I(1)]$ against $H_1: \vartheta < 0[y_t \approx I(0)]$. This model is less restricted, as it considers a deterministic trend (Pinshi, 2020; Athanasios and Antonios, 2010). Once the series fulfills the required stationarity, i.e., the series $I(1)$, the cointegrating properties can be examined, this will depend on your analysis. In our case, we go directly to the analysis of causality. This is the most important step of the present approach since the causal relationship can nevertheless inform us about the anteriority of the events between our variables.

The classic test, for this purpose, is that of Granger (1969), it is a common but very robust approach to detect the existence and direction of causalities between two pairs of variables (Simionescu *et al.*, 2022). It consists of detecting the strengths of correlation between the current value of one variable and the past values of another. It is therefore widely used in the

literature and suitably adapted to evaluations of country policies (Guilkey and Salemi, 1982). Consider a standard bivariate VAR (Vector Auto-Regressive) framework and two time series Y_t $(GDP/capita)$ and $X_t(FDI, IQ, CPI, MM, E)$, the theoretical model of the Granger causality test is the following:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \, \Delta Y_{t-i} + \sum_{i=1}^{p} \beta_i \, \Delta X_{t-i} + \mu_{1t} \qquad t = 1, \ldots, T \qquad (5)$$

$$\Delta X_t = \phi_0 + \sum_{i=1}^{p} \phi_i \, \Delta X_{t-i} + \sum_{i=1}^{p} \lambda_i \, \Delta Y_{t-i} + \mu_{2t} \qquad (6)$$

Where Δ represents the first difference operator, p is the lag length, $\alpha, \phi, \beta \; and \; \lambda$ are the parameters to be estimated, and μ is a white noise error process. To determine the existence and direction of the causalities, the Granger causality test is applied to the group of β_i coefficients in equation (5), with $i = 1,2, \ldots p$. It checks whether they are jointly significant or not, which is equivalent to examining if $\beta_1 = \cdots = \beta_p = 0$, then *X* does not Granger cause *Y*. Whereas, if the opposite is true and at least one of β_i coefficients is not equal to 0, then the past value of *X* has a significant predictive ability about the current value of *Y*. In this case, *X* can be said to Granger cause *Y*. This reasoning is then repeated in the equation (6) to test feedback causality between variables. For each test, note that the selection of the lag-order is chosen based on information provided by the final prediction error, the Schwarz Information Criterion (SC).

Nevertheless, an important criticism of the Granger causality test is that the estimates tend to be very sensitive to the lag length chosen. To fill this gap, Toda, and Yamamoto (1995) devised a framework for this inference. Unlike Granger's method, Toda Yamamoto's causality test can be performed on all series, regardless of their stationary properties $[I(0) \; ou \; I(1)]$. Similarly, the cointegrating properties of the series do not need to be pre-tested, which reduces the well-known risks associated with the order identification stage (Zachariadis, 2007; Rahman *et al.*, 2017). In doing so, it gives robust results regardless of the integration and cointegration properties of the variables (Zapata and Rambaldi, 1997). In practice, the Toda Yamamoto technique artificially increases the selected lag length (p) (obtained from standard lag selection procedures) y the maximum order of integration (d_{max}). Consequently, the initial $VAR(p)$ is thus increased with the maximum order of integration of the variables, which leads to a $VAR(p + d_{max})$. Then, the causal directions are inspected using a modified Wald test (MWALD) on the augmented VAR specification. This has the advantage of removing constraints on the parameters of the VAR model without hampering its asymptotic chi-squared distribution (Savalei and Kolenikov, 2008). Toda Yamamoto's standard specification is as follows:

$$Y_t = \delta_0 + \sum_{i=1}^{p} \theta_i \, Y_{t-i} + \sum_{i=p+1}^{d_{max}} \theta_i \, Y_{t-i} + \sum_{i=1}^{p} \gamma_i \, X_{t-i} + \sum_{i=p+1}^{d_{max}} \gamma_i \, X_{t-i} + \mu_t \qquad (7)$$

Where Y_t indicates the response to Granger causality of *X* if $\gamma_i \neq 0$. In fact, this is equivalent to testing non-causality among series (Toda, 1995). This study also assesses the long-term causalities operating among the variables by defining the specific Toda-Yamamoto causality framework in the following equation (8):

$$Y_t = \delta_0 + \sum_{i=1}^{p} \rho_1 Y_{t-1} + \sum_{i=p+1}^{d_{max}} \rho_2 Y_{t-i} + \sum_{i=1}^{p} \varpi_1 FDI_{t-1} + \sum_{i=p+1}^{d_{max}} \varpi_2 FDI_{t-i} + \sum_{i=1}^{p} \tau_1 IQ_{t-1} + \sum_{i=p+1}^{d_{max}} \tau_2 IQ_{t-i} + \sum_{i=1}^{p} \kappa_1 CPI_{t-1} + \sum_{i=p+1}^{d_{max}} \kappa_2 CPI_{t-i} + \sum_{i=1}^{p} \zeta_1 MM_{t-1} + \sum_{i=p+1}^{pd_{max}} \zeta_2 MM_{t-i} + \sum_{i=1}^{p} \eta_1 E_{t-1} + \sum_{i=p+1}^{d_{max}} \eta_2 E_{t-i} + \mu_t$$

Where $\rho, \varpi, \tau, \kappa, \zeta \; and \; \eta$ denote the parameters of lagged GDP/capita, FDI, institutional quality, corruption, macroeconomic management, and exchange rate, respectively. Overall, our empirical methodology may raise criticism because it disaggregates certain data, such as GDP/capita, using the quadratic decomposition method. We assure that was done carefully (with a slight margin of error) and that the gaps between the annual and monthly series, after being plotted cyclically, moved very closely in the same direction. With a mathematical expectation and a variance evolving stably over time, we can, with very high observation frequencies, test our study with this efficient methodology.

4. Results

This section aims to report the empirical results of the tests explained in the previous section as well as their interpretations. The presentation of the tests necessary for our work was supported by the methodology adapted from Simionescu *et al.* (2022). To test the stationary properties of the data, we perform the Augmented Dickey-Fuller test (ADF, Dickey and Fuller, 1979), it should be noted, once again, that the power of the test is relatively high, in particular because of the large number observations, the risk of having poor stationarity results is very low. The stationarity results are shown in Table 2. Note that the optimal lag length was selected based on information provided by the Bayesian information criterion Schwarz (SC) with a maximum allowed of 8 lags (Table 3).

Table 2. Augmented Dickey-Fuller (ADF) Results

Intercept and trend		
Variable	T-stistic ADF (I)	Critical Values (1%, 5%, 10%)
GDP/capita	-14,091*** (2)	-4,00
FDI	-5,028** (1)	-3,43
Institutional quality (IQ)	-3,285* (1)	-3,14
Corruption (CPI)	-3,222* (1)	-3,14
Macroeconomic management (MM)	-4,378*** (1)	-4,00
Exchange rate (E)	-4.945*** (1)	-4,00

Notes: In this model, (I) denotes the order of integration. $^{***}\, p < 0{,}01$, $.^{**}\, p < 0{,}05$, $.^{*}\, p < 0{,}10$.

Source: Our elaborations

Table 3. Optimal lag order(p) and maximum (d_{max})

Lag (p)	*Lag ($p+d_{max}$)*	*Schwarz information criterion (SC)*
0	*0+1*	-37.40177
1	***1+1***	**-39.50420***
2	*2+1*	-39.31575
3	*3+1*	-38.69356
4	*4+1*	-37.91142
5	*5+1*	-37.06844
6	*6+1*	-36.20645
7	*7+1*	-35.34125
8	*8+1*	-34.47925

Source : Our elaborations

For all variables, the results did not reject the null hypothesis of non-stationarity for log-scale series. All the variables are differentiated after their non-stationarity in level. This refines the causality results to draw good conclusions from our assumptions. It appears for this purpose that the Bayesian information criterion of Schwarz is minimized either for an optimal delay of one month and a maximum of two months. It is therefore necessary to rely on a framework integrating a stability of the increased VAR in the estimation (figure 1), implementing the reliability of our parameters and the results of causality.

Before elaborating causality, it is important to understand the main characteristics of the variables. For this purpose, it is very useful to inspect the nature of the data series of linear relations, to compose a representation of it and to obtain statistics, in this case the coefficient of the correlation. This test, although less robust, allows an exploratory view of an approximation of the relationship. This analysis shows the direction and degree of the relationship between our variables. The values of the matrix (Table 4) are called "correlation coefficient". This coefficient is always between -1 and 1. A value equal to 1 indicates that the two variables are perfectly linked in a positive way. A value of -1 indicates that the two variables are perfectly negatively related. Values close to zero indicate that the two variables are not linearly related (Anderson *et al.*, 2015).

The statistical inspection of the correlation gives us fruitful results on theoretical proofs. All variables are in logarithm (*L*), the correlation analysis gives us a significant linear link between economic growth and FDI in the DRC, with a coefficient amounting to 0.66, which implies that the more FDI accumulate in the DRC, the higher the quality of economic growth would be. This is consistent with traditional neoclassical theory on the accumulation of international capital to developing countries. This information would seem to deny the existence of the Paradox in the DRC. Similarly, institutional quality has a robust relationship (0.66) with FDI in the DRC, which would be in the eyes of our various authors quoted in the literature review, on the role that the development of institutions would play as a potential factor and intermediary between FDI and economic growth in a country (Kose *et al.*, 2007; Ngouhouo, 2008; Jude and Levieuge, 2017; Hayat, 2019). The logic would continue with macroeconomic management, which also involves macroeconomic discipline, one of the potential factors for softening the

relationship between FDI inflows and economic growth (Kose *et al.*, 2007). The correlation coefficient is 0.67.

Tableau 4. Descriptive analysis of the correlation

	LFDI	*LGDP/capita*	*LIQ*	*LPCI*	*LMM*
LFDI	1.000000				
LGDP/capita	0.667541	1.000000			
	(0.0000)				
LIQ	0.668073	0.733084	1.000000		
	(0.0000)	(0.0000)			
LPCI	0.438432	0.405261	0.720462	1.000000	
	(0.0000)	(0.0000)	(0.0000)		
LMM	0.697430	0.450416	0.745865	0.648449	1.000000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	

Note: $(\ldots)p$

Source: Our elaborations

On the other hand, corruption seems profoundly very disruptive and calls into question all the assumptions advocated above. Corruption would have a very strong and robust relationship between institutional quality (0.72) and a strong and robust relationship with macroeconomic management (0.64). This would constitute a major brake on the economic development of the country, and would intuitively explain the Lucas paradox, by reducing the incentives to invest, thus considerably retarding economic growth. As a result, talents will be misallocated, financial incentives may induce the most talented and educated people to engage in rent-seeking rather than productive work, with negative consequences for the country's growth rate (Mauro and Driscoll, 1997). Awarding public contracts through a corrupt system can lead to a decline in the quality of infrastructure and public services, and therefore in the institutional quality of the country (Efobi, 2015; Ojeka *et al.*, 2019).

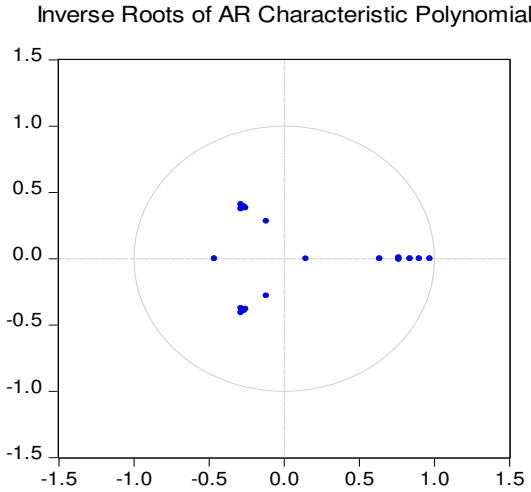
These results reveal many theoretical asymptotes and could constitute good arguments to reflect on the improvement of our economic landscape. However, as we have said, the analysis of the correlation, certainly robust but less in relation to causality, the correlation only gives us a presumptuous image of the thing. To draw good reliable and more robust conclusions, we go through Granger causality and more in depth with the analysis of Toda Yamamoto

The stability of the model is very important for the reliability of the results found, in this context, Figure 1 plots the stability test, the results show that there is a dynamic stability of the augmented VAR model, because all the roots have a modulus less than one and lie inside the unit circle. It should also be noted that the model does not include any serial correlation of the residuals (Table 7 in the appendix), which in view of the results shows that the model is well

specified, and its estimate is very solid, hence the calculated standard errors, and therefore p values are not misleading.

All its properties and results presented above, put us at ease to analyze Grange causality, which is a common but robust approach to detect the existence and direction of causalities between our variables of interest. The results derived from the causality analysis are shown in Figure 2 and Table 6 in the appendix. Note that the lag-order selection is chosen based on information provided by the final prediction error, the Bayesian Schwarz information criterion. The associated results show no evidence of causal links between multiple variables. However, there is unidirectional causality from corruption to economic growth, and the latter, in turn, causes institutional quality.

Figure 1. Model dynamic stability

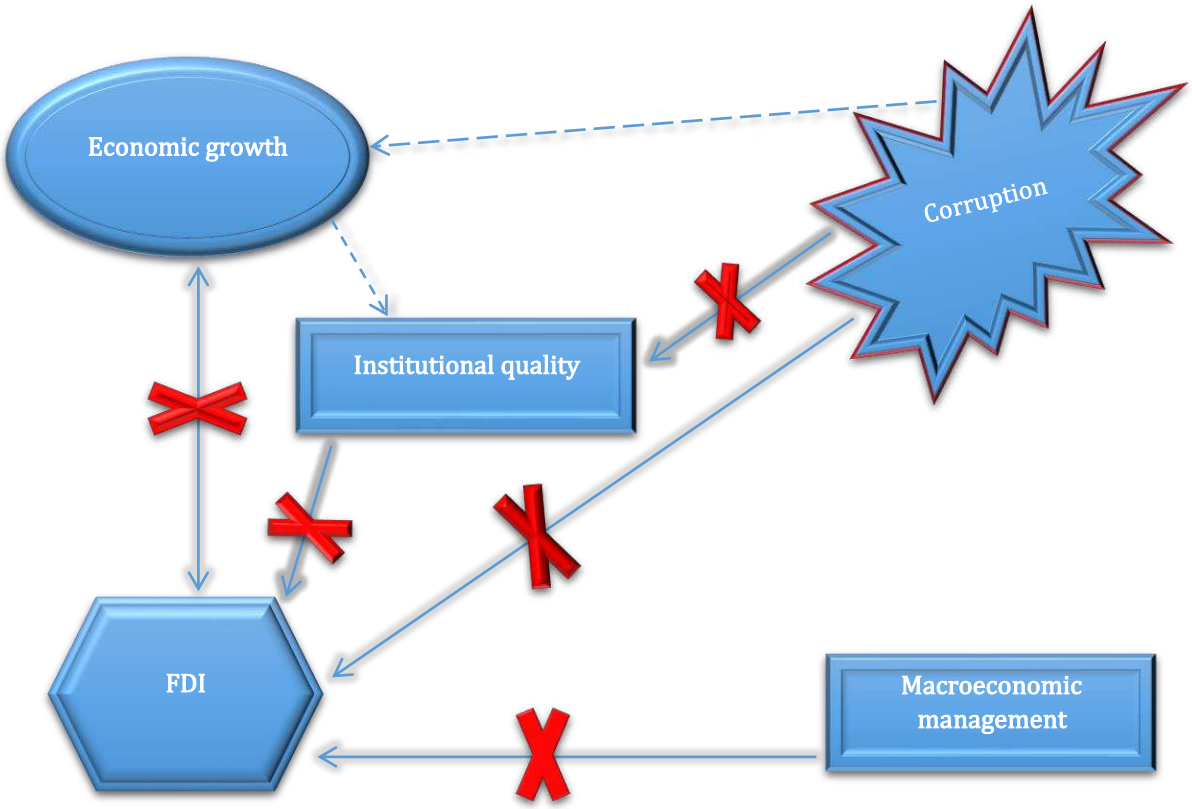


Source: Our elaborations

The robustness of these results gives us fruitful information for the framework of our study. The non-causality between FDI and economic growth stipulates that the Lucas paradox is verifiable in the DRC, that FDI does not contribute significantly to the quality of Congolese economic growth. This confirms the Lucas riddle and challenges the neoclassical theory of capital flows in the DRC. For many authors institutional quality would be the key to resolving this paradox, unfortunately in the DRC our results suggest that institutional quality is far from being the key variable to explain this phenomenon in the DRC. Even macroeconomic management, which is one of the factors conditioning the effective contribution of FDI to economic growth, does not seem to fulfill this role in the DRC, in the light of our results.

However, corruption has a predictive effect on economic growth and as growth considering the Granger causality test influences institutional quality, we say that corruption indirectly causes institutional quality in the DRC.

Figure 2. Granger causality test



Source: Our elaborations

Toda Yamamoto's methodology is more solid and robust than that applied by Granger. Toda Yamamoto's results produce strong estimates regardless of several pre-estimate properties. Also, unlike Granger causality which has a short-term dimension, Toda Yamamoto causality gives an understanding of long-term outcomes. Considering our results (Table 5), not all variables (apart from the link of corruption to economic growth) are robustly related. These results confirm the Lucas Paradox in the DRC, demonstrate as Aluko and Ibrahim (2019) and Kim and Jun (2022), that the institutional quality does not explain this paradox in the DRC, nor the corruption which would be according to our evidence at the base the non-significance of the role that institutional quality could play in resolving the Lucas paradox in the DRC.

These two methodologies would have given similar results, stipulating that the Lucas paradox is verified in the DRC, through the non-causality between FDI and economic growth, whether in the short run or in the long run. The literature emphasizing the institutional quality for the resolution of this problem would not be solid for the case of the DRC, which leaves us to reflect further and to take seriously the direction that should be taken to make efficient FDI inflows. Corruption, on the other hand, seems to have a strong impact on the quality of economic growth, an element that reinforces the government's challenges in the face of corruption in the DRC, in view of sustained and sustainable economic growth. Macroeconomic policies appear to be highly ineffective in attracting FDI and promoting growth, which considering our results exposes the unresolved problem of sustainable macroeconomic stability in the DRC.

Tableau 5. Toda-Yamamoto causality (1995) test.

Null Hypothesis	Chi square	Prob.	Direction of causality
GDP/capita does not cause FDI	0.184540	0.9800	No causality
IQ does not cause FDI	1.963517	0.5800	No causality
CPI does not cause FDI	2.458862	0.4828	No causality
MM does not cause FDI	0.292081	0.9615	No causality
E does not cause FDI	0.374571	0.9454	No causality
FDI does not cause GDP/capita	0.988247	0.8041	No causality
IQ does not cause GDP/capita	1.347565	0.7179	No causality
CPI does not cause GDP/capita	10.11562	0.0176	$CPI \rightarrow GDP/capita$
MM does not cause GDP/capita	0.540467	0.9099	No causality
E does not cause GDP/capita	2.263210	0.5196	No causality

Source : Our elaborations

The results have enlightened us with fruitful answers on the question of the Lucas paradox in the DRC and the questioning of institutional quality in the DRC. Our results validated the hypothesis that the Lucas paradox was confirmed in the DRC. However, considering the results, the lack of institutional quality is not at the root of the Lucas paradox in the DRC. From where it would be necessary to push reflections linking the geopolitical and strategic aspect to explain this paradox of capital flows in the DRC.

5. Conclusion

This study aimed to examine the puzzle launched by Lucas on his paradox linked to the lack of reliable investment in the DRC, through corruption and the questioning of institutional quality. Based on the causality tests of Granger and Toda Yamamoto, we deepened our investigation. The results showed that the Lucas paradox is indeed verified in the DRC, and the institutional quality would be far from being the key variable to solve this problem. Even macroeconomic management and corruption are also far from trying to solve this problem. The analysis requires a deepening, with questions related to geopolitical choices, war, lobbying, etc.

References

Anderson, D. R., Sweeney, D. J., Camm, J. D., Williams, T. A., & Cochran, J. J. (2015). *Statistiques pour l'économie et la gestion*. De Boeck Supérieur.

Abdellah, K., Nicet-Chenaf, D., & Rougier, E. (2009). Entre instabilité externe et instabilité interne : Les déterminants des IDE dans les MENA. In *The international conference" Dimensions socio-politiques et économiques de la crise dans les pays émergents*.

Alfaro, L., Kalemli-Ozcan, S., & Volosovych, V. (2007). Capital flows in a globalized world: The role of policies and institutions. In *Capital controls and capital flows in emerging economies: Policies, practices, and consequences* (pp. 19-72). University of Chicago Press.

Aluko, O., & Ibrahim, M. (2019). Does institutional quality explain the Lucas Paradox? Evidence from Africa.

Akhtaruzzaman, M., Hajzler, C., & Owen, P. D. (2018). Does institutional quality resolve the Lucas Paradox? *Applied Economics*, *50*(5), 455-474.

Ammi, M. (2016). Tests des liens de causalité épargne-croissance économique.

Assembe-Mvondo, S. (2015). Les risques et stratégies de réduction de la corruption dans la mise en œuvre de REDD+ en République Démocratique du Congo : Un aperçu de la situation actuelle. *U4 Issue*.

Athanasios, V., & Antonios, A. (2010). Financial development and economic growth: An empirical analysis for France. *International Review of Applied Economic Research*, *5*.

Azémar, C., & Desbordes, R. (2013). Has the Lucas Paradox been fully explained? *Economics Letters*, *121*(2), 183-187.

Bal, H., Akça, E. E., Tekin, İ., & Laleh, M. M. (2019). Reexamination of lucas paradox: Gravity model approach for brics countries. *Celal Bayar University Journal of Social Sciences/Celal Bayar Üniversitesi Sosyal Bilimler Dergisi*, *17*(2).

Bénassy-Quéré, A., Coupet, M., & Mayer, T. (2007). Institutional determinants of foreign direct investment. *World economy*, *30*(5), 764-782.

Cohen, D., Jacquet, P., & Reisen, H. (2006). Au-delà de la controverse prêts ou dons: comment utiliser la dette pour le développement?. *Revue d'économie du développement*, *14*(2), 131-158.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American statistical association*, *74*(366a), 427-431.

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica: journal of the Econometric Society*, 1057-1072.

Efobi, U. (2015). Politicians' attributes and institutional quality in Africa: A focus on corruption. *Journal of Economic Issues*, *49*(3), 787-813.

Fontagné, L. (1999). *L'investissement étranger direct et le commerce international*. OECD Publishing.

Fuster, A., Laibson, D., & Mendel, B. (2010). Natural expectations and macroeconomic fluctuations. *Journal of Economic Perspectives*, *24*(4), 67-84.

Granger, C. W. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica: journal of the Econometric Society*, 424-438.

Griguer, S., & Debbarh, M. A. A. (2022). La Taille de Marché et l'Ouverture Economique : Des facteurs en faveur des IDE automobiles à Tanger ? *Revue Française d'Economie et de Gestion*, *3*(1).

Guilkey, D. K., & Salemi, M. K. (1982). Small sample properties of three tests for Granger-causal ordering in a bivariate stochastic system. *The Review of Economics and Statistics*, 668-680.

Habib, M., & Zurawicki, L. (2002). Corruption and foreign direct investment. *Journal of international business studies*, *33*(2), 291-307.

Hayat, A. (2019). Foreign direct investments, institutional quality, and economic growth. *The Journal of International Trade & Economic Development*, *28*(5), 561-579.

Jude, C., & Levieuge, G. (2017). Growth effect of foreign direct investment in developing economies: The role of institutional quality. *The World Economy*, *40*(4), 715-742.

Kim, H., & Jun, H. (2022). Can Blended Finance Be a Game Changer in Sustainable Development? An Empirical Investigation of the "Lucas Paradox". *Sustainability*, *14*(4), 2186.

Kodila-Tedika, O., & Bolito-Losembe, R. (2014). Corruption et Etats fragiles africains. *African Development Review*, *26*(1), 50-58.

Kose, A., Prasad, E., Rogoff, K., & Wei, S. J. (2007). Mondialisation financière: au-delà de la polémique. *Finances et développement, FMI, Washington, DC*.

Koukpo, M. T. (2005). Déterminants des investissements directs étrangers dans les pays de l'UEMOA. *African Institute for Economic Development and Planning (IDEP), Dakar*.

Kratou, H. (2015). *Essais des effets économiques et distributifs des afflux de financements extérieurs* (Doctoral dissertation, Université d'Auvergne-Clermont-Ferrand I).

Lucas, R. E. (1990). Why doesn't capital flow from rich to poor countries? *The American economic review*, *80*(2), 92-96.

Mengistu, A. A., & Adhikary, B. K. (2011). Does good governance matter for FDI inflows? Evidence from Asian economies. *Asia Pacific business review*, *17*(3), 281-299.

Mauro, P., & Driscoll, D. D. (1997). *Why worry about corruption?* (Vol. 6, pp. 1-19). Washington, DC: International Monetary Fund.

Mtiraoui, A. (2020). La corruption entre l'aspect institutionnel économique et l'aspect social à travers la gouvernance.

Nahia, B. B. (2008). L'impact de la corruption sur L'IDE : Application Sur Quelques Pays MENA.

Ngouhouo, I. (2008). *Les investissements directs étrangers en Afrique centrale: attractivité et effets économiques* (Doctoral dissertation, Université du Sud Toulon Var).

Ojeka, S., Adegboye, A., Adegboye, K., Umukoro, O., Dahunsi, O., & Ozordi, E. (2019). Corruption perception, institutional quality and performance of listed companies in Nigeria. *Heliyon*, *5*(10), e02569.

Osano, H. M., & Koine, P. W. (2016). Role of foreign direct investment on technology transfer and economic growth in Kenya: a case of the energy sector. *Journal of Innovation and Entrepreneurship*, *5*(1), 1-25.

Pinshi, C. P. (2020). Rethinking error correction model in macroeconometric analysis: A relevant review. *Journal of Applied Economic Sciences (JAES)*, *15*(68), 267-274.

Rahman, M. S., Noman, A. H. M., & Shahari, F. (2017). Does economic growth in Malaysia depend on disaggregate energy?. *Renewable and Sustainable energy reviews*, *78*, 640-647.

Ramirez, R. S. E. (2022). Foreign direct investment, corruption, and institutional reforms. *Panoeconomicus*, *69*(1), 17-34.

Savalei, V., & Kolenikov, S. (2008). Constrained versus unconstrained estimation in structural equation modeling. *Psychological methods*, *13*(2), 150.

Schwarz, G. (1978). Estimating the dimension of a model. *The annals of statistics*, 461-464.

Simionescu, M., Schneider, N., & Gavurova, B. (2022). Decarbonized energies and the wealth of three European nations: A comparative nexus study using Granger and Toda-Yamamoto approaches. *Frontiers in Environmental Science*, 693.

Snyder, T. J. (2013). Increasing returns, institutions, and capital flows. *Eastern Economic Journal*, *39*(3), 285-308.

Thaalbi, I. (2013). *Déterminants et impacts des IDE sur la croissance économique en Tunisie* (Doctoral dissertation, Strasbourg).

Toda, H. Y. (1995). Finite Sample Performance of Likelihood Ratio Tests for Cointegrating Ranks in Vector Autoregressions. *Econom. Theor.* 11 (5), 1015–1032.

Toda, H. Y., & Phillips, P. C. (1993). The spurious effect of unit roots on vector autoregressions: an analytical study. *Journal of Econometrics*, *59*(3), 229-255.

Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of econometrics*, *66*(1-2), 225-250.

Traore, I. (2017). Productivité globale des facteurs et transformation structurelle dans l'espace CEDEAO : une analyse du rôle des externalités technologiques.

Tshikengela, B. K. L. (2020). *Systèmes traditionnels de gestion des ressources naturelles et persistance des conflits autour des aires protégées de la RD Congo : Cas du Parc national de la Salonga en territoire de Monkoto*. Presses universitaires de Louvain.

Zachariadis, T. (2007). Exploring the relationship between energy use and economic growth with bivariate models: New evidence from G-7 countries. *Energy economics*, *29*(6), 1233-1253.

Zapata, H. O., & Rambaldi, A. N. (1997). Monte Carlo evidence on cointegration and causation. *Oxford Bulletin of Economics and statistics*, *59*(2), 285-298.

Appendices

Tableau 6. Granger causality test

Pairwise Granger Causality Tests
Sample: 2000M01 2021M12
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
GDP/capita does not Granger Cause FDI	246	1.04309	0.3081
FDI does not Granger Cause GDP/capita		0.01700	0.8964
IQ does not Granger Cause FDI	246	0.52299	0.4703
FDI does not Granger Cause IQ		0.37686	0.5399
CPI does not Granger Cause FDI	246	0.43084	0.5122
FDI does not Granger Cause CPI		0.55732	0.4561
MM does not Granger Cause FDI	246	0.02405	0.8769
FDI does not Granger Cause MM		0.00815	0.9281
E does not Granger Cause FDI	241	0.00571	0.9398
FDI does not Granger Cause E		0.00389	0.9503
IQ does not Granger Cause GDP/capita	262	1.35621	0.2453
GDP/capita does not Granger Cause IQ		4.26321	0.0399
CPI does not Granger Cause GDP/capita	262	5.09784	0.0248
GDP/capita does not Granger Cause CPI		0.40850	0.5233
MM does not Granger Cause GDP/capita	262	0.03123	0.8599
GDP/capita does not Granger Cause MM		0.31125	0.5774
E does not Granger Cause GDP/capita	257	3.25245	0.0725
GDP/capita does not Granger Cause E		4.23632	0.0406
CPI does not Granger Cause IQ	262	0.28934	0.5911
IQ does not Granger Cause CPI		1.06168	0.3038
MM does not Granger Cause IQ	262	0.19928	0.6557
IQ does not Granger Cause MM		1.97780	0.1608
DLTCH does not Granger Cause IQ	257	2.91397	0.0890
IQ does not Granger Cause DLTCH		1.13827	0.2870
MM does not Granger Cause CPI	262	0.01434	0.9048
CPI does not Granger Cause MM		0.05046	0.8224
E does not Granger Cause DLIPC	257	1.89315	0.1701
DLIPC does not Granger Cause E		4.59426	0.0330
E does not Granger Cause MM	257	0.46761	0.4947
MM does not Granger Cause E		0.17003	0.6804

Source : Our elaborations

Tableau 7. Serial correlation test

VAR Residual Serial Correlation LM Tests
Sample: 2000M01 2021M12
Included observations: 235

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	46.78514	36	0.1076	1.308564	(36, 903.0)	0.1077
2	36.99963	36	0.4226	1.029336	(36, 903.0)	0.4228
3	30.18860	36	0.7408	0.836730	(36, 903.0)	0.7410
4	5.173645	36	1.0000	0.141454	(36, 903.0)	1.0000
5	3.936291	36	1.0000	0.107551	(36, 903.0)	1.0000
6	3.077685	36	1.0000	0.084052	(36, 903.0)	1.0000
7	2.262492	36	1.0000	0.061762	(36, 903.0)	1.0000
8	1.950634	36	1.0000	0.053239	(36, 903.0)	1.0000

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	46.78514	36	0.1076	1.308564	(36, 903.0)	0.1077
2	57.77798	72	0.8882	0.797811	(72, 1088.5)	0.8885
3	62.31498	108	0.9999	0.565749	(108, 1113.3)	0.9999
4	67.97940	144	1.0000	0.456591	(144, 1100.8)	1.0000
5	72.42722	180	1.0000	0.383430	(180, 1076.0)	1.0000
6	75.94103	216	1.0000	0.329695	(216, 1046.2)	1.0000
7	81.99024	252	1.0000	0.300331	(252, 1014.0)	1.0000
8	84.83767	288	1.0000	0.267035	(288, 980.4)	1.0000

*Edgeworth expansion corrected likelihood ratio statistic.

Source : Our elaborations