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PUBLIC INVESTMENT AND PUBLIC DEBT IN THE CONGO: AN APPLICATION OF THE KEYNESIAN REPRESENTATION OF INVESTMENT DETERMINATION

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ABSTRACT

This research aims to show how public investment has increased Congo's public debt. We proceeded to estimate the ARDL model with error correction on variables covering 24 recent years. Econometric modeling, using the Keynesian framework for determining investment, shows that a shock to own-source public investment observed in a year is only fully absorbed after one year and nine months.

Keywords: Long-Term Growth, Public Debt, Efficiency of Public Investment, Financial Risks, Cost-Benefit Method.

JEL Code: Public Economics: E62, H00, H63, O10.

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1. INTRODUCTION

In a speech delivered at the "Rencontres économiques d'Aix-en-Provence"[1] on 6 July 2014, Christine Lagarde, Managing Director of the International Monetary Fund (IMF), stressed that "an increase in public investment could raise long-term growth potential. It could also boost demand."

[1] https//www.imf.org/fr/News/Articles/2015/09/28//04/53/sp070614.

Christine Lagarde, in this speech, joins the various authors who highlight the importance of public investment in an economy and its impact on economic growth. To this end, to speak of public investment is to reflect on the productive efficiency of society as a whole, because investment is a flow that makes it possible to increase or renew a stock of capital (Bialès, 1999: 354).

As a general rule, investment, considered an essential factor in economic development (Villieu, 2000: 3), is a fundamental component of gross domestic product (GDP) that links the present and the future, but also the most volatile (Mankiw 2010: 652). It allows the implementation of more efficient production techniques, integrating technological innovations, and the rejuvenation of equipment increases the productivity of capital (Villieu, 2000: 97).

In this context, "investment has a double influence on the economy. On the one hand, through its "demand" aspect (multiplier), it determines income and aggregate demand. On the other hand, it also increases its "supply" aspect by increasing production capacity" (Muet, 1993: 14).

According to the IMF (2014: 83), "an increase in public infrastructure investment affects output in the short term, by stimulating aggregate demand through the play of fiscal multipliers and possibly mobilizing private investment, and in the long term, because the strengthening of the infrastructure stock increases the productive capacity of the economy."

Accumulation through public investment refers to the process by which the government invests in projects to stimulate economic growth and improve the well-being of the population. This accumulation is based on the investment multiplier highlighted by R. Kahn in 1931 and then introduced by J. M. Keynes (1936).[2]

Lagarde (2014)[3] questions the type of investment. What investments are we talking about? Quality investments, i.e. those that increase the productivity of the economies concerned. Higher public investment could raise long-term growth potential.

Thus, even if the possibility for developing countries to finance themselves endogenously exists, but only on one condition that the state mobilizes a *potential economic surplus* in the main production sectors by itself (Assidon, 2002: 16). To this end, the state should, inter alia, (i) invest in key infrastructure projects that boost the productivity and competitiveness of enterprises, (ii) invest in workforce training and education to improve workers' skills and productivity (human capital development), and (iii) simplify regulations and reduce administrative barriers that hinder business growth.

In January 2010, Congo benefited from debt cancellation and accumulated substantial oil surpluses[4] over the period 2010-2014 with total public revenues[5] representing 111.7% of non-oil GDP (IMF, 2014: 4).

[2] Cf. page Abraham-Frois (2005), Introduction to contemporary macro-economics, Economica, Paris page 152.
[3] Aix-en-Provence Economic Meetings, July 6, 2014 on the theme "Investing in the Future—Investing More to Promote Growth"
[4] These surpluses were, as a precautionary measure, placed in a stabilization account in China.
[5] This is significantly higher than that of most low-income oil-exporting countries, including Angola, Cameroon, Chad, Equatorial Guinea, Gabon, and Yemen. See IMF Report No. 14/273, September 2014, http://www.imf.org 2014.

Thanks to this debt cancellation and the high level of international oil prices[6] , Congo has embarked on an ambitious investment program through the National Development Program (NDP) 2012-2016 which had proposed to "diversify the economy to accelerate growth, create jobs, reduce poverty, and boost the industrialization of Congo". The level[7] of investment, expenditure increased significantly from CFAF 1,030.8 billion in 2011 to CFAF 1,477.7 billion in 2012 and reached CFAF 2,079.1 billion in 2014.

Despite the favorable oil situation, which has made it possible to mobilize significant budgetary revenues, the Congolese state has borrowed from abroad to finance public investment. It is accepted that the financing of public investments by public debt is a common practice because it allows governments to spread the costs over several years.

According to Lagarde (2014), financing investment through debt is only possible in the context of low borrowing costs and under certain conditions—sustainable debt, very low demand (large output gaps), and implementation capacities. Under other conditions, the government's financial capacity may be undermined, thus reducing the resources available to finance public investment. To this end, the accumulation process can stop before the end of the transition (Assidon, 2002: 13).

In Congo, recourse to external borrowing and the deterioration in the terms of trade due to the fall in oil prices led to an increase in the public debt ratio to 41.8% of GDP[8] in 2014, compared to 20% of GDP[9] in 2010. While investment expenditure financed by borrowing was only 31.4 billion CFA francs in 2010, it will increase considerably in 2011 to 209.5 billion CFA francs, a difference of 178.1 billion CFA francs. From the period of 2011 to 2014, this difference increased to 239.2, 491.9, and 324 billion CFA francs in 2012, 2013, and 2014 respectively.

According to the IMF (2014: 5), as a result of the 2012-2016 NDP, the ratio of government spending[10] to non-oil GDP is now one of the highest among oil exporters in Africa and the Middle East. Indeed, public sector investment spending rose from 18.8% of GDP in 2010 to 51.7% of GDP, mainly in infrastructure (but infrastructure projects that did not stimulate the productivity and competitiveness of companies) and to only 16.7% of GDP in economic development in 2014.

The interest of this paper is to try to verify the supposed link between the financing of major investment projects and the increase in debt. Also, the purpose of this study is to show whether public investment is one of the reasons for Congo's indebtedness.

Do the multiple debt crises, following the implementation of[11] ambitious development programs financed by the fallout from the oil boom and public debt, call for an explanation of Congo's indebtedness by investment spending? This is the main hypothesis defended in this paper.

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[6] The price of a barrel gradually returned to a price of around $80 in 2009-2010, then from $100 to $120 between 2011 and mid-2014 until falling to $95.07 in the second quarter before the collapse. The price of Brent reached a new peak on March 13, 2012, at $128. Then it was set at a level above $100 in 2013 (PRIXDUBARIL.com/Boursorama).

[7] Directorate-General for the Budget, data from the macro-budgetary framework report.

[8] IMF, Regional Economic Outlook: Sub-Saharan Africa, October 2017, http://www.imf.org 2017 and IMF (April 2019).

[9] See IMF Report No. 15/263, July 2015, http://www.imf.org 2015.

[10] See IMF Report No. 14/272, July 2014, http://www.imf.org 2014.

[11] Congo is on its third national development plan. The first ambitious development programme was the 1982-1986 five-year plan.

Thus, we will proceed to the estimation of the ARDL error-corrected model (ARDLCE) based on the Keynesian representation of the determination of investment to show how long it takes to absorb a shock to investment in own resources (IORP) observed during a year is fully absorbed.

The rest of this research is structured in three parts, namely: the financing of investment by public debt (2); the efficiency of public investment and financial risks (3), and the econometric analysis of the relationship between public investment and public debt (4).

2. FINANCING PUBLIC INVESTMENT FROM PUBLIC DEBT: A REVIEW OF THE LITERATURE

2.1. Theoretical foundations of public investment

The theoretical foundations of public investment are based on economic concepts such as allocative efficiency, social welfare theory, and economic growth theory. The authors of allocative efficiency want to ensure the efficient use of the resources allocated to the production of goods and services intended to satisfy the needs of individuals. Adam Smith[12], a follower of the invisible hand, was one of the economists who developed this concept, in his famous work Investigations into the Nature and Causes of the Wealth of Nations, where he determined the means of increasing material production. On the other hand, J.-S. Mill[13] disputes the existence of the invisible hand insofar as the interest of the strongest can prevail and inequalities exist. This then requires greater intervention by the State.

Another well-known economist, who also developed this concept, is Pareto. He considered that if all the conditions for pure and perfect competition were met, the economic optimum was achieved. This is the best possible situation because at the optimum it is impossible to improve the situation of one individual without deteriorating that of another (Montoussé and Chamblay, 2009: 211). Also, an optimal situation cannot be demonstrated to be improved – or deteriorated – by any transformation (Jessua, 1991: 359)

Social welfare theory is a field of study that aims to assess and improve the collective well-being of a society. This theory focuses on how public policies and government decisions can influence the well-being of individuals and society as a whole. Many authors and researchers have developed this theory, among others, Alfred Marshall, in his work Principles of Political Economy, emphasizes the importance of resource allocation in an economy to maximize social welfare. He puts forward the concept of general equilibrium, where resources are optimally allocated to achieve a level of production and consumption that maximizes the well-being of society as a whole (Jessua, 1991: 373). The Nobel Prize winner Sen (2000: 90) made a profound contribution to this theory in his book *Rethinking* Inequality, in which he puts forward the concept of capability, i.e. the freedom to perform value functions. The concept of capabilities is used by the author to assess the well-being of individuals, emphasizing their ability to achieve their aspirations and lead a life that they have reason to value. Similarly, in another book, A New Economic Model: Development, Justice, Freedom, Sen (2003: 87 and 99) proposes solutions so that economic prosperity allows everyone to live as they wish.

In the field of economic growth theory, there is an abundant literature. Keynesian analysis, through Domar's model, states that investment causes a double effect, an income effect (increase in income due to the investment multiplier) and a capacity effect (increase in productive capacity and production) (Bialès et al. (1999: 156), Muet (1993: 12)).

[12] Montoussé (2003), page 12.
[13] Cf. Montoussé (2009), page 213.

Authors who have made a major contribution here are Romer (1986) and Lucas (1988), the former of whom has renewed the analysis of investment as a factor of growth, and for the latter, human capital generates positive externalities and it is the responsibility of the State to create institutional structures designed to encourage investment, research, education and the construction of infrastructure (Bialès et al., 1999: 159). To these two authors, we associate Barro, who built his endogenous growth around public infrastructures [(Muet, 1993: 54), (Montoussé, 1999: 79)] or public capital, which corresponds to communication and transport infrastructures (Bialès et al., 1999: 159).

However, doubts about Solow's (1957) model appeared as early as the late 1950s because the residue of this model does not only measure technical progress, but all factors other than capital and labor, and all estimation errors. However, it has shown that investment only affects the growth rate in a transitory way. In the long term, growth is determined only by two exogenous variables: the pace of technical progress and that of the working population (Villieu, 2000: 96-97).

By investing in key sectors of the economy, the government can create an environment conducive to innovation, productivity, and business competitiveness. Public investment can also help reduce inequalities, improve people's living conditions, and strengthen the resilience of the economy to external shocks.

2.2. External capital and investment financing

Assidon (2002: 11) recalls Ragnar Nurkse's formula according to which "a country is poor because it is poor". Initiating development and financing the transition is the main problem. Development then becomes a promise of funding.

Ragnar Nurkse's problem is to multiply the opportunities to attract foreign capital for a country that is poor because the "inhabitants" are not very productive. Productivity is low because there is not enough technical capital (Fauvel, 1957: 141).

There are therefore countries in need of financing and countries with financing capacity that make available the capital necessary to finance investments. This contradicts the argument that at the macroeconomic level, financing is automatic because Keynes (1936)[14] "states the principle of the multiplier according to which investment will always find savings".

According to Bialès et al., 1999: 300), international financing operations are ancient. From the middle of the nineteenth century, we can see the rise of international financial flows. Capital from developed countries (France and Great Britain) contributes to financing new countries (the United States, Paraguay, and Russia, for example).

In his illustrious book, The Stages of Economic Growth, Rostow (1960)[15] describes the take-off stage as proceeding from an increase in investment of 5 to 10% of income. It shows that an increase of US$4 billion in foreign aid would be required to induce steady growth in Asia, Africa, and Latin America (Delas, 2008: 666).

The interest in financing investment by external capital was also highlighted by the public relations policy put in place by the Marshall Plan. For Abelshauser (1993: 415), this American aid program for the reconstruction of Europe is often considered one of the greatest successes in the history of this century, because it has become synonymous with economic assistance.

However, Kuznets and Rottier (1953: 359) already pointed out that in the case of international capital movements, government borrowing depends especially on political considerations which not only have very little to do with the formation of real capital but may even, in a certain way, run against it.

[14] Quoted by Villieu (2000), p. 57.
[15] W.W. Rostow, Les étapes de la croissance économique (1960), Paris, Seuil, coll. "Points", 1970.

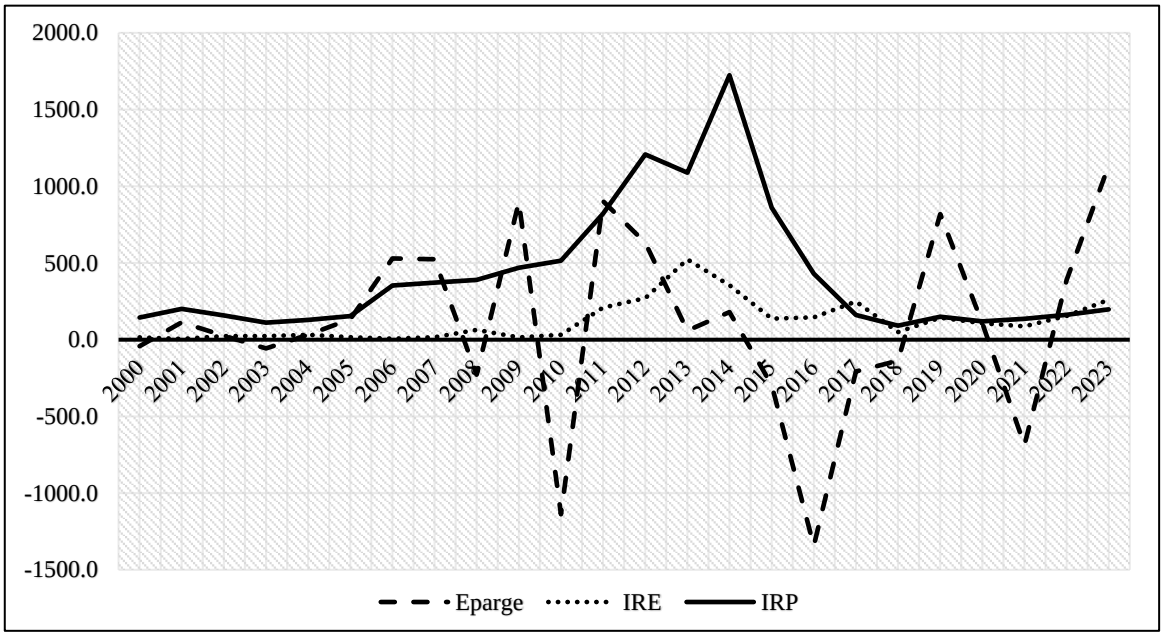
Questioning whether public investment should be financed by borrowing, and based on an endogenous growth model, Minea and Villieu (2008: 15) have shown that in the case of a permanent increase in public debt, public investment will increase only temporarily, and will decrease in the long term. This result is because the interest burden crowds out long-term public investment.

The results of Minea and Villieu (2008: 15) therefore support the statements of Demaria (1965: 426) who previously stated that it was a mistake for Anglo-Saxon research to maintain that the expansion and intensification of investments accomplished economic development.

The Congolese public sector has been and remains the main investor in infrastructure financed by the extraction of natural resources (oil). The large revenues derived from these natural resources are allocated to public investment which, according to Keynesian theory, was intended to promote the process of accumulation.

With the rise in oil prices, there has been a "loss of competitiveness of the Congolese economy" called *Dutch disease*. The resulting accumulation of oil revenues has led to a short-term appreciation in overall expenditure, as Novak (1998) has pointed out[16]. The financing of public investment expenditures by oil revenues has been a factor in both budgetary and financial overheating, with negative implications for the management of public procurement.

Graphic 1: Evolution of investments from resources (own and external) and savings



Source: Authors' calculations based on TOFE data from the Directorate-General for Budget (DGB)

Notes: IORP = investments from own resources; IRE = investment from external resources.

The analysis of Figure 1 shows that investments from own resources increased significantly from 2005 to 2014, with a peak in 2014. These investments will fall significantly over the period 2015-2018 and will increase from 2019 onwards. Despite the significant resources, there has been an upward trend in investment from external resources over the period 2000-2023. The savings curve (the difference between the receipts of year n and that of year n-1) has followed an erratic trajectory.

[16] Cf. Assidon (2002), page 13.

We note that despite the realization of significant savings between 2011 and 2014 (1772.6 billion FCA), investments from external resources also increased (1358.8 billion FCFA). These savings for the period 2011-2014 are far higher than those for the rest of the period (-220.9 billion CFA francs).

Despite an increase in total government revenues, which amounted to 111.7% of non-oil GDP, the Congolese government continued to borrow from abroad. The fiscal anchor adopted by the government in 2013, which should protect public spending from oil price volatility, could not be observed. In 2014, the overall budget deficit[17] was 8.5% of GDP, almost double what it was in 2013.

This indebtedness can be explained by the fact that the increase in foreign exchange earnings from exports has led to an increase in overall expenditure[18]. This overall expenditure has led to an increase in demand which has been met by an increase in imports, because the major infrastructures, which have mobilized significant financing, and carried out, for the most part, by Chinese companies, have required the purchase of public works equipment abroad, for example. To this end, the value of the multiplier is reduced (Le Garrec and Touzé, 2021: 9) because the interest charge and the outflow of foreign currency intended to pay for equipment crowd out long-term public investment.

The new budget provisions[19], which affected about 60 percent of production until 2017, were intended to encourage new investment and encourage higher costs for maturing deepwater oil companies. In 2017, debt reached a record level of 117% of GDP and is expected to rise to 107% of GDP[20] in 2021. All this shows that the 2014 budget deficit has made a dent in the future, and is financed by new debts that Congo is repaying at a higher price.

3. EFFECTIVENESS OF PUBLIC INVESTMENT AND FINANCIAL RISKS

3.1. Investment efficiency problem

In addition to the interest burden that crowds out long-term public investment, there is also the problem of the efficiency of investment. Since central government investment is positively correlated with both growth and private investment (Easterly and Rebelo, 1993), [21]the problem of investment efficiency[22] arises, since the limits of absorption may appear due to the social imbalances generated by government behavior.

Le Garrec and Touzé (2021: 9) point out that when looking at the efficiency of public spending, the degree of consensus on the value of the multiplier is low, even if it is positive on average.

The IMF (2014: 89), in an analysis of public investment expenditure, embarked on an empirical exercise that led to the results that public investment affects output. In countries where public investment is highly efficient, a shock to public investment expenditure increases output by about 0.8% in the same year, and by 2.6% four years after the shock[23].

[17] IMF Report No. 15/263, July 2015, p. 5.
[18] This expenditure increased steadily between 2011 and 2014 by 45.3%, 2.2% and 24.6% respectively (TOFE_DGB)
[19] IMF Report No. 19/244, October 2019, Box 1, page 9.
[20] IMF Report No. 22/226, August 2022, p. 16.
[21] Cf. Hervé Diata (2003), op. cit. City.
[22] On this question, we recommend the work of Hervé Diata (2003), op. cited.
[23] For the IMF, the macroeconomic effects of public investment shocks differ considerably across economic regimes (periods of very weak (recessions) and very strong (large expansions))

On the other hand, in countries where public investment is inefficient, the effect on output is about 0.2% in the same year, and 0.7% in the medium term.

In the case of rentier economies, it has become apparent that when it comes to public investment projects, public contracts are only awarded to economic agents of the same political persuasion (or family). In Congo, most of the major infrastructure projects are awarded to Chinese companies based on the strategic partnership agreement[24]. To this end, we find here, as Lafay (1993: 109) emphasizes, a domination of "political rationality" over "economic rationality". The result is a political-economic cycle, as established by Nordhaus[25], a cycle linked to the political market, and not to the natural game of business, and in which certain economic agents and heads of certain ministerial departments or institutions become politically powerful.

In analyzing public investment from budgetary funds, Lambert (1959: 302) already admitted that these investments facilitated the development of resources often neglected by private capital, and pointed out that the underdeveloped economy, of the South American type, has structural characteristics that aggravate the normal financial risks of investment.

Although massive investments continue to be made in Congo, infrastructure bottlenecks prevent the attraction of new activities and foreign direct investment (FDI) in sectors other than natural resources, including agriculture. The problems posed by these bottlenecks, including load shedding and electricity shortages as well as the deterioration of roads, have a negative impact on the productive sector. To this end, public investment is negatively correlated with both growth and private investment.

3.2. Public investment and financial risks

In terms of investment, the cost-benefit method is the one that makes it possible to minimize the financial risks of public investment. Indeed, the concerns of coherence and optimization are at the basis of this method (Roberts, 1975: 822). Thus, according to the IMF (2022),[26] in Congo "improving the quality of public investment management requires cost-benefit analysis. As infrastructure needs are particularly high, measures will be taken to improve the efficiency of implementation."

It therefore appears that in Congo, public investment in infrastructure has so far been carried out without any cost-benefit analysis. The consequence is that roads are in poor condition and businesses face power cuts at least once every two weeks. Indeed, the survey[27] carried out on companies shows that they give a score of five or six to the quality of the roads, on a scale of one (very good) to six (very bad).

The evaluation of the last two plans, contained in the 2022-2026 NDP document, calls for better targeting of investments, which, coupled with a substantial improvement in the quality of the services offered, make it possible to increase the economic and social profitability of roads. Regarding energy, this assessment noted that the rate of technical loss in Congo is the highest in the world.

The United Nations system in the Republic of Congo, in its December 2021 results report, specifies that only 38% of households use electricity and 45% of the population has access to electricity with only 20% to basic access to sanitation. However, the state is only enriched by the work and productive efficiency of society as a whole (Daniel, 2022: 3).

[24] The 2006 Strategic Partnership Agreement provides $1.6 billion in loans for major infrastructure projects. Another $1 billion agreement was reached to support infrastructure investment over the period 2013-2016 (see IMF Report, July 2014).
[25] Nordhaus W.D. (1975), "The Political Business Cycle," Review of Economic Studies, vol. 42, April, 169-190.
[26] IMF Report No. 22/49, May 2022, http://www.imf.org 2022.
[27] Cf. Easterly (2006), p. 285, op. cit.

With the rise in the price of a barrel of oil, Congo has gone into debt and used these resources as collateral. Although a fiscal rule[28] was adopted to ensure long-term fiscal sustainability, it was not observed in its first year of implementation. Of the 2295 billion FCA in oil revenues in 2013, only 795 billion should have been saved at the Bank of Central African States (BEAC).[29] Congo's public debt, which was 34.1% of GDP in 2012, rose to 38.2% of GDP in 2013 and reached 41.8% of GDP in 2014. This recourse to external financing has increased the level of public debt[30] to 96.3% of GDP in 2015 and reached 127.8% of GDP in 2016.

In November 2018, discussions on a possible financial arrangement supported by the Extended Credit Facility (ECF) were initiated to help Congo restore public debt sustainability. To this end, it is difficult to go far in financing public investment in full austerity when the economy is weak because the adjustment is prolonged. Under these conditions, if the country has not succeeded in its economic diversification, it is likely that it will get bogged down in the debt crisis or that this crisis will become an eternal renewal.

Thus, there is a great contrast between the abundant oil surpluses earned by Congo and the fragility of its fiscal governance, which has been revealed on several occasions in the past and recently: debt crises from 1986 to January 2010 with successive waves[31] and from 2015 to today marked the termination of the program concluded in July 2019 and the conclusion of another program under the Extended Credit Facility completed in November 2021.

4. ECONOMETRIC ANALYSIS OF THE RELATIONSHIP BETWEEN PUBLIC INVESTMENT AND PUBLIC DEBT

4.1. Keynesian Determination of Investment

According to Keynesian analysis, public investment can be represented, according to the mathematical form, by the following equation:

Ie = f(G, T), with Ie public investment; G is government expenditure and T is tax revenue.

The function f(G, T) shows how public investment varies with government spending and tax revenues. An increase in government spending or a decrease in tax revenues could lead to an increase in public investment, which could boost aggregate demand and promote economic growth.

This relationship, which captures the essence of the relationship between public investment, public spending, and tax revenues, finds another mathematical formulation (Daniel (2022, pp. 82-83).

This relationship is represented by: $I(t) = a[R(t-1) - R(t-2)]$ (1), i.e. investment depends on saving, which is only the difference between the incomes of the two previous periods and *t* the reference period. They start from Say's law, that supply creates its own demand: $Y(t) = R(t)$ (2).

At equilibrium, supply is equal to demand: $Y(t) = C(t) + I(t)$. Since consumption is a function of income o a: $C(t) = cR(t-1)$.

[28] This envisaged that 1500 billion CFA francs of oil revenues would be allocated each year to current expenditure (500 billion CFA francs) and investment (1000 billion CFA francs). The rest would be saved in state deposits.

[29] See IMF Report No. 14/272 of July 2014, http://www.imf.org 2024.

[30] IMF, Regional Economic Outlook: Sub-Saharan Africa, October 2017, http://www.imf.org 2017 and IMF (April 2019).

[31] As long as Congo receives adjustment loans, the government appears to be making adjustments over and over again, before always returning to its starting point. As Easterly (2006) pointed out with reference to Max Escher's lithograph *Rise and Fall* on page 141.

The combination of the four equations gives the evolution of production as a function of time:

$Y(t) – (c + a)\ Y(t-1) + aY(t-2) = 0$ (3)

$I(t) = a[R(t-1) - R(t-2)]$ (4) or It = a(Rt-1-Rt-2)

Investments are made up of investments from own resources and investments from external resources, so we have It = Itrp + Itre

ITRP = Investment from own resources at time t

Itre = Investment in external resources at time t

Itrp+ Itre = a(Rt-1-Rt-2) (5)

Itrp = a(Rt-1-Rt-2) -Itre (6) budgetary saving can be represented by $En = R_{t-1-Rt-2}$

We therefore have the following relationship:

$Itrp = aEn – I_{to\ be}$ with $n \in [1 ; [24]$

Generally speaking, we want to check whether *En* and *Itre* can explain *Itrp*. However, since the data used is temporal, it is important to check the order of integration of each variable to determine the type of model.

The establishment of a mathematical relationship between public investment and public debt is based on the stats of the macro-budgetary framework of the Directorate-General for the Budget and the Table of State Financial Operations (TOFE).

4.2. Theoretical determination of the model

To determine the model, it is necessary to do the stationarity test (unit root test). Indeed, this test makes it possible to check whether the series is stationary or not. There are several tests of stationarity, namely: the Augmented Dickey-Fuller Test (DFA), the Phillip-Perron Test (PP), and the KPSS Test.

We will use the Dickey-Fuller Augmented test (appendix, figure A1) because it allows us not only to verify the stationarity of the series but also to determine the order of integration of the variable. For this purpose, when a series is stationary, it means that it is integrated of order 0. An integrated series of order 1 requires that it be differentiated only once to make it stationary.

4.3. Test on the stationarity of the series

We will check whether investment from own resources (IORP), investment from external resources (IRE), and savings are included in the same order. To do this, we will apply the Augmented Dickey-Fuller (DFA) test for each variable.

By testing the unit root of the investment from own resources (IORP), we find that the P-value of the test of the presence or absence of the unit root is greater than 5% (Table 1). This is equivalent to saying that we will proceed to the nullity test of the deterministic tendency by a Fisher test.

Table 1: Test of Dickey-Fuller Augmented on the variables of the model

Variables	MODEL 3				MODEL 2				MODEL 1	
	Root Testing	Conclusion	Test	Conclusion	Root Testing	Conclusion	Test	Conclusion	Root Testing	Conclusion
IRP	0.7958	Fisher's test	0.2750	Skip to Template 2	0.4615	Fisher's test	0.2943	Skip to Template 1	0.2438	I(1)
WRATH	0.4195	Fisher's test	0.0959	Skip to Template 2	0.2917	Fisher's test	0.1482	Skip to Template 1	0.2434	I(1)
SAVINGS	0.0064	Fisher's test	0.9822	Skip to Template 2	0.0010	Student's Test	0.4117	Skip to Template 1	0.0000	I(0)

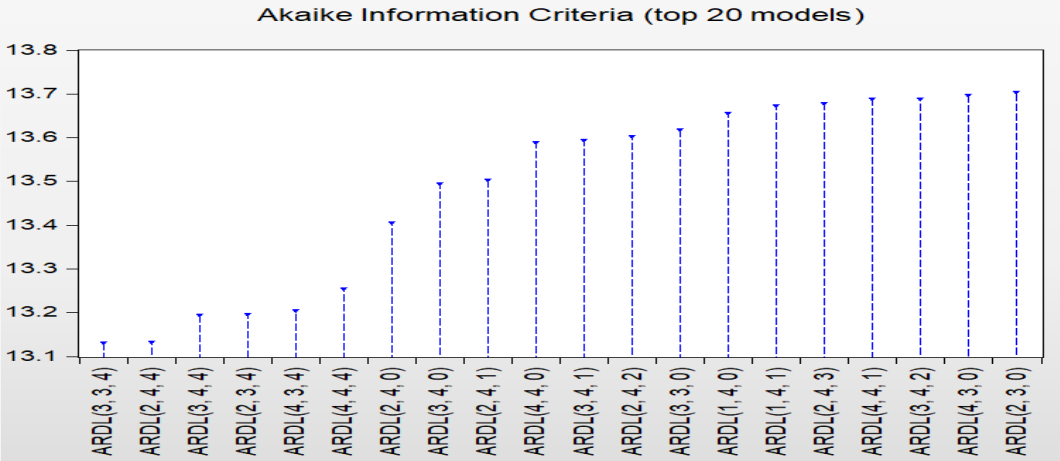
Source: Authors

According to the results in Table 1, it appears that investment from own resources (IORP) and investment from external resources (IRE) between 2000 and 2023 are integrated series of order 1 [I (1)], i.e. non-stationary. However, savings are stagnant. For this purpose, we will estimate the ARDL model.

4.4. Model estimation

Using the Akaïké information criterion with a maximum lag of 4, we obtain the following results.

Graphic 2: Selection of the optimal model by the Akaïké criterion



Using a maximum of 4 lags, an optimal ARDL model is obtained out of the 100 estimated models (3,3,4). This model means that we have three offsets on the IRP and the IRE; and four shifts in savings.

Table 2: Results of the estimate

Dependent Variable: IRP
Method: ARDL
Date: 03/13/24 Time: 20:10
Sample (adjusted): 2004 2023
Included observations: 20 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): IRE EPARGE
Fixed regressors: C
Number of models evalulated: 100
Selected Model: ARDL(3, 3, 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
IRP(-1)	0.574255	0.309824	1.853490	0.1062
IRP(-2)	0.842467	0.242785	3.470011	0.0104
IRP(-3)	-0.285300	0.254065	-1.122943	0.2985
IRE	-0.822061	0.478228	-1.718972	0.1293
IRE(-1)	0.181811	0.698673	0.260223	0.8022
IRE(-2)	0.023674	0.732031	0.032340	0.9751
IRE(-3)	2.053597	0.648465	3.166860	0.0158
EPARGE	0.087840	0.094223	0.932259	0.3822
EPARGE(-1)	-0.092596	0.143323	-0.646064	0.5388
EPARGE(-2)	-0.102366	0.116061	-0.882009	0.4070
EPARGE(-3)	0.058801	0.094373	0.623072	0.5530
EPARGE(-4)	-0.300942	0.100799	-2.985563	0.0204
C	116.4679	76.69666	1.518553	0.1727

R-squared	0.957302	Mean dependent var	476.4812
Adjusted R-squared	0.884104	S.D. dependent var	445.2842
S.E. of regression	151.5902	Akaike info criterion	13.13042
Sum squared resid	160857.2	Schwarz criterion	13.77764
Log likelihood	-118.3042	Hannan-Quinn criter.	13.25676
F-statistic	13.07836	Durbin-Watson stat	1.751008
Prob(F-statistic)	0.001162		

Source: Authors

After estimating the model, we need to check if there is a long-term dynamic relationship. To this end, we will do the Pesaran test to verify this relationship.

Table 3: Test result Pesaran

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n=1000		
F-statistic	10.93447	10%	2.63	3.35
k	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5
Actual Sample Size	20	Finite Sample: n=30		
		10%	2.915	3.695
		5%	3.538	4.428
		1%	5.155	6.265

Source: **Authors**

Since the value or value of 10.93447 is much higher than the values at the bounds, we can conclude that there is a long-term relationship between the ERI and the two exogenous variables of the model. Therefore, we will estimate the ARDL error-corrected model (ARDLCE) where we have both the short-term and long-term relationship.

Table 4: Result of the ARDL model estimation

ARDL Error Correction Regression
Dependent Variable: D(IRP)
Selected Model: ARDL(3, 3, 4)
Case 2: Restricted Constant and No Trend
Date: 03/13/24 Time: 20:14
Sample: 2000 2023
Included observations: 20

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IRP(-1))	0.131421	0.037307	3.522733	0.0097
D(IRP(-2))	0.285300	0.127650	2.235019	0.0605
D(IRE)	-0.822061	0.381862	-2.152771	0.0683
D(IRE(-1))	-2.077271	0.426715	-4.868048	0.0018
D(IRE(-2))	-2.053597	0.515993	-3.979892	0.0053
D(EPARGE)	0.087840	0.049215	1.784816	0.1175
D(EPARGE(-1))	0.344507	0.076085	4.527930	0.0027
D(EPARGE(-2))	0.242141	0.064280	3.766986	0.0070
D(EPARGE(-3))	0.300942	0.062142	4.842799	0.0019
CointEq(-1)*	-0.557167	0.163194	-3.414145	0.0112

R-squared	0.906686	Mean dependent var	4.350000
Adjusted R-squared	0.822703	S.D. dependent var	301.2102
S.E. of regression	126.8295	Akaike info criterion	12.83042
Sum squared resid	160857.2	Schwarz criterion	13.32828
Log likelihood	-118.3042	Hannan-Quinn criter.	12.92761
Durbin-Watson stat	1.751008		

Source: Authors

The term error-correction being significant, the model seems to be acceptable. To confirm this, we will first check whether the assumptions made on the model are validated. These include, among others, stochastic tests (stationarity, non-autocorrelation, homoscedasticity, and normality of residues), parameter stability tests (simple CUSUM and CUSUM squared), and the Ramsey test.

4.4.1. Stochastic Testing

The results in Figure A2, in the appendices, show that the P-value (0.61382) is well above 5%. This means that the residues follow the normal distribution[32].

One of the most widely used tests for the homoscedasticity of residues is the "Breusch-Pagan-Godfrey" test. Thus, the observations made in Table A1, in the appendices, prove that the residuals of the model are homoscedastic, because all the P-values are greater than 5% and that no explanatory variable of the model is related to the square of the residuals.

To test the non-autocorrelation of the residues, the best-used test is the Breusch-Godfrey test. The latter is based on the Fisher test of the nullity of the coefficients (F-statistic) or the Lagrange Multiplier (LM-Test) whose test statistic is nR2. The general idea of the test lies in the search for a significant relationship between the residue and this same offset residue. Thus, Table A2, in the appendices, gives the results of the Breusch-Godfrey test for p=1. Reading this figure, we see that no delay is significant (all the P-values of RESID (-1) and RESID (-2) are greater than 5%). Therefore, we conclude that errors are not autocorrelated.

4.4.2. Coefficient stability tests

To ensure the overall stability of the model parameters, CUSUM and CUSUM squared tests are often used. These make it possible to detect structural and cyclical instabilities. Regarding the graphs shown in Figure A2 in the appendices, it can be concluded that the model parameters are structurally stable (from the result of the graph on the left) and punctually stable (based on the result of the graph on the right). It is clear from this figure that the two curves are entirely contained in the air formed by the lines represented by the confidence threshold. This means that the parameters of the model are stable in the long term and the short term.

4.4.3. Tests de Ramsey

This test allows you to know if the model is correctly specified. In other words, it allows us to check if we have not forgotten to insert a very important variable in the model. To this end, the results in Table A3 in the appendices reveal that there is not an important variable missed in the model. Indeed, the P-value of the variable "FITTED^2" being far from significant (P-value = 0.0854>0.05), allows us to conclude that the model is well specified.

4.4.4. Interpretation of ARDLCE coefficients

Insofar as all the assumptions of the model are validated, it is therefore up to interpret the coefficients of the said model, in particular the value of the error correction coefficient. The negative value of the restoring force (-0.557167) means that in the face of a shock, the adjustment towards equilibrium takes place at a speed of about 56% by the feedback effect. In other words, a shock to investment from own resources (IORP) observed in a year is fully absorbed after one year and nine months[33].

[32] We used the Jarque and Bera test.

[33] $\frac{1}{0{,}557167} = 1{,}79479\ années\ \approx 1\ an\ et\ 9\ mois.$

Public investment expenditure is allocated for one year of implementation. To this end, if it takes one year and nine months to adjust towards equilibrium in the face of a shock over a year, it can be pointed out that the value of the multiplier is reduced (Le Garrec and Touzé, 2021: 9). With a permanent increase in public debt, public investment will be reduced in the long term. This result is the fact that the interest burden crowds out long-term public investment (Minea and Villieu, 2008: 15).

Congo has invested little or no in production capacity and continues to rely more heavily on the export of raw materials, mainly oil. As a result, Congo has not experienced a diversification of its economy, which testifies to the absence of a growth dynamic. Thus, the Congolese economy has structural characteristics, which aggravate the normal financial risks of public investment, as Lambert (1959: 302) has pointed out.

In this context, "the commonly accepted idea that investment in infrastructure and machinery is the key to long-term growth is another panacea that has not lived up to the expectations that were placed on it" (Easterly, 2006: 66). The cause can be found in the words of Lagarde (2014) who insists on quality investments, i.e. those that increase the productivity of the economies concerned and raise the long-term growth potential. In addition, the absence of a cost-benefit analysis in the management of public investment may also be an explanatory factor (IMF, 2022). Thus, "the Congolese economy is therefore likely to accumulate its structural imbalances (Badouin, 1967: 222).

5. CONCLUSION

From the analysis of public investment, three major facts emerge. First, the implementation of ambitious development programs has fallen short of expectations, as these programs have resulted in one of the highest ratios of government spending to non-oil GDP among oil exporters in Africa and the Middle East (IMF, 2014).

Second, despite the high total government revenue (111.7% of non-oil GDP), the government continued to borrow from abroad. This recourse to external financing increased the level of public debt to 127.8% of GDP in 2016. This level is expected to remain at a record level of 117% of GDP in 2017 and is expected to rise to 107% of GDP in 2021.

Third, to adjust to equilibrium in the event of a shock in a year, it takes one year and nine months. This clearly shows that the value of the multiplier is reduced (Le Garrec and Touzé, 2021: 9). With a permanent increase in public debt, public investment will be reduced in the long term. This result stems from the fact that the interest burden crowds out long-term public investment (Minea and Villieu, 2008: 15).

To overcome this situation, which aggravates the normal financial risks of public investment, it is important to focus on the investment psychology of a handful of public actors, particularly those in charge of public investments. This investment psychology is perhaps a source of investment inefficiency since the limits of absorption appear because of the social imbalances it generates.

The aim is to understand how psychological factors such as cognitive biases, individual preferences, political pressures, and public perceptions can influence the choices and management of public investment. Examining these psychological aspects could provide a better understanding of why certain projects are chosen over others, how decisions are made and what are the consequences of these choices and types of management on society as a whole. The psychology of public investment would certainly shed additional light on the issue of public investment financed by debt by taking into account the behavioral and psychological aspects that underlie the investment decisions of public actors.

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Annexes

Figure A1: Procedure for the stationarity root test (Dickey-Fuller test)

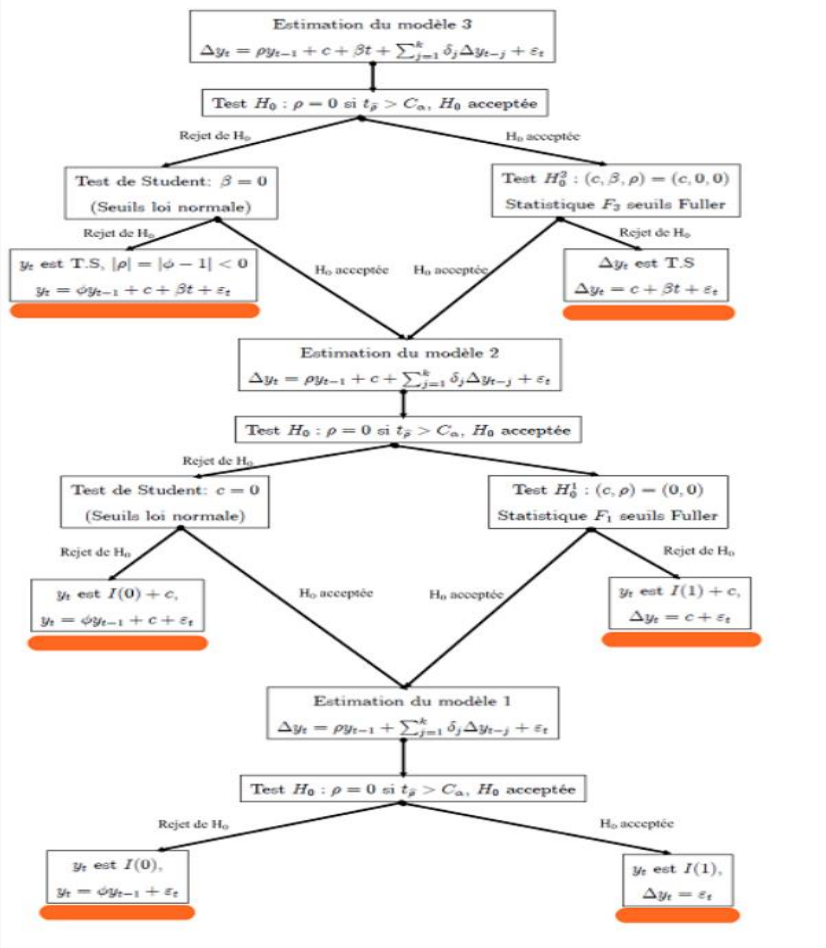
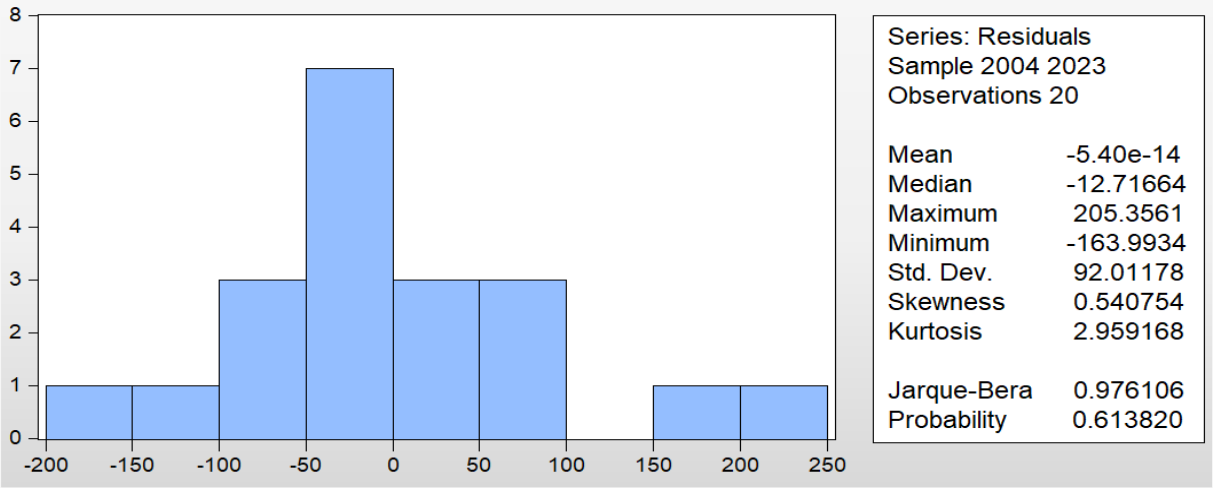


Figure A2: ARDLCE Residue Normality Test



Source: Authors

Table A1: ARDLCE Residue Heteroscedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.419469	Prob. F(12,7)	0.9109
Obs*R-squared	8.365940	Prob. Chi-Square(12)	0.7559
Scaled explained SS	1.003905	Prob. Chi-Square(12)	1.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 03/15/24 Time: 16:55
Sample: 2004 2023
Included observations: 20

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14987.86	7342.911	2.041134	0.0806
IRP(-1)	7.140056	29.66239	0.240711	0.8167
IRP(-2)	9.213090	23.24415	0.396362	0.7036
IRP(-3)	-6.485235	24.32407	-0.266618	0.7974
IRE	-15.38442	45.78536	-0.336012	0.7467
IRE(-1)	35.39701	66.89073	0.529177	0.6130
IRE(-2)	7.448394	70.08441	0.106277	0.9183
IRE(-3)	57.53050	62.08377	0.926659	0.3849
EPARGE	-7.098355	9.020843	-0.786884	0.4572
EPARGE(-1)	-7.101189	13.72166	-0.517517	0.6207
EPARGE(-2)	-2.059956	11.11160	-0.185388	0.8582
EPARGE(-3)	2.292880	9.035284	0.253770	0.8070
EPARGE(-4)	-1.516687	9.650475	-0.157162	0.8796

Source: Authors

Table A2: ARDLCE Residue Non-Autocorrelation Test

Breusch-Godfrey Serial Correlation LM Test:

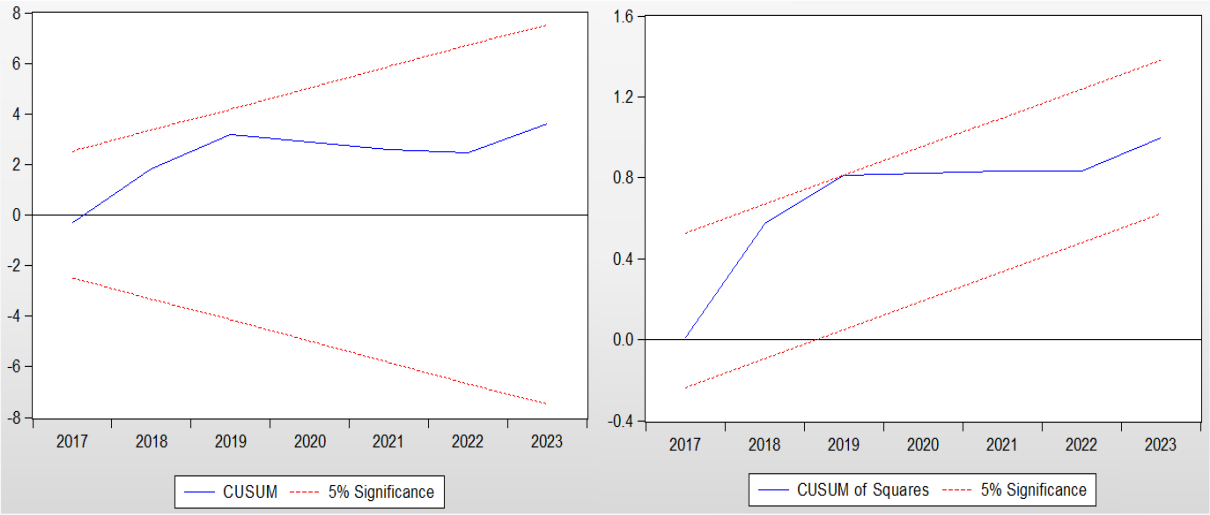
F-statistic	0.015756	Prob. F(1,6)	0.9042
Obs*R-squared	0.052382	Prob. Chi-Square(1)	0.8190

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 03/15/24 Time: 16:54
Sample: 2004 2023
Included observations: 20
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IRP(-1)	-0.043564	0.481819	-0.090416	0.9309
IRP(-2)	0.010166	0.274131	0.037085	0.9716
IRP(-3)	0.020623	0.319537	0.064540	0.9506
IRE	-0.003927	0.516816	-0.007599	0.9942
IRE(-1)	-0.027147	0.784082	-0.034623	0.9735
IRE(-2)	-0.036740	0.842149	-0.043626	0.9666
IRE(-3)	0.028145	0.734562	0.038315	0.9707
EPARGE	0.003329	0.105042	0.031691	0.9757
EPARGE(-1)	0.013858	0.189975	0.072945	0.9442
EPARGE(-2)	0.010870	0.152228	0.071407	0.9454
EPARGE(-3)	0.005809	0.111825	0.051943	0.9603
EPARGE(-4)	0.006948	0.122012	0.056947	0.9564
C	-1.663907	83.78854	-0.019858	0.9848
RESID(-1)	0.079336	0.632052	0.125522	0.9042

Source: Authors

Figure A3: ARDLCE Stability Test



Source: Authors

Table A3: ARDLCE Specification Test

Unrestricted Test Equation:
Dependent Variable: IRP
Method: ARDL
Date: 03/15/24 Time: 16:56
Sample: 2004 2023
Included observations: 20
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic):
Fixed regressors: C

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
IRP(-1)	0.291851	0.290746	1.003802	0.3542
IRP(-2)	-0.549018	0.705715	-0.777960	0.4662
IRP(-3)	0.001786	0.252289	0.007079	0.9946
IRE	0.945462	0.946042	0.999387	0.3562
IRE(-1)	0.722040	0.634820	1.137392	0.2987
IRE(-2)	0.753407	0.701814	1.073514	0.3243
IRE(-3)	-1.680748	1.893208	-0.887778	0.4088
EPARGE	-0.048255	0.102240	-0.471979	0.6536
EPARGE(-1)	-0.036794	0.121620	-0.302530	0.7725
EPARGE(-2)	0.032673	0.116307	0.280917	0.7882
EPARGE(-3)	-0.071974	0.100682	-0.714862	0.5015
EPARGE(-4)	0.273246	0.291355	0.937848	0.3845
C	298.5985	108.9326	2.741131	0.0337
FITTED^2	0.001014	0.000493	2.056778	0.0854

R-squared	0.974958	Mean dependent var	476.4812
Adjusted R-squared	0.920700	S.D. dependent var	445.2842
S.E. of regression	125.3936	Akaike info criterion	12.69682
Sum squared resid	94341.29	Schwarz criterion	13.39383
Log likelihood	-112.9682	Hannan-Quinn criter.	12.83288
F-statistic	17.96884	Durbin-Watson stat	1.140595
Prob(F-statistic)	0.000977		

Source: Authors

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