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Chinese Investment, Technology Spillovers, and Economic Growth in the Democratic Republic of Congo

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Abstract

This study investigates the nature and effect of technological spillovers from Chinese overseas investments towards the economic development of the Democratic Republic of Congo (DRC). We focus on technology transfer and analyze it along short-term technological diffusion and long-term technological growth. We aim to identify and analyze potential challenges and risks of technology spillovers associated with economic dependence, environmental social impact, and governance issues, as well as demonstrate the quantitative impact of the investment rate policy of Chinese investments on economic growth and technology spillovers. To model the short-term technological diffusion, we examine the insurance policy in productivity, job creation and improved living standards in DRC from 2005 to 2023. To model the long-term technological growth, we identify high and low potential sectors of investment and formulate optimal investment strategies. The insights of this study lead to a new institutional economic policy that boosts the economic growth of DRC and capitalizes on China's foreign direct investments.

Keywords: Technology Spillovers, Economic Growth, Chinese FDI, Policies, Democratic Republic of Congo

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1. Introduction

The Democratic Republic of Congo (DRC) is the third largest African country by both size and population. It is especially rich in natural resources, hydropower and land, hosting up to an estimated 24 trillion U.S. dollars' worth of untapped mineral resources (Stimpson 2020). A key concern is that DRC lacks the financial capabilities to support its economy, making it a candidate for alternative financing options (Kupa 2023) . Some studies suggest that foreign direct investment (FDI) can boost economic development in host countries, making FDI relevant for DRC. The relationship between DRC and China dates back to 1967, a period of global influence by the West and the Soviet Union (Shinn 2009; Liu 2010). Different from the West-DRC relation, China advocates a win-win economic approach and states its non-involvement in internal affairs of the DRC. China views DRC as a strategic source of mineral resources, while DRC views China as a potential source of investment, practical knowledge and manufactured goods (Putzel et al. 2011). Between 2005 and 2023, DRC has received from China a total of FDI outflows of 5,554.1 million USD and a total of Outward FDI Stock of 42,941.5 million USD (Ministry of Commerce of China 2014, 2016, 2024).

According to some studies, FDI is positively associated to Economic growth (Herzer 2010). Conforming to (Mohanty and Sethi 2019) FDI has a positive impact on economic growth, by significantly increasing short- and long-term economic growth as well as short-term human capital. The study of (Razzaq et al. 2021) reveal a positive direct impact with a nonlinear effect observing for both FDI and technology spillovers. Research of (Morita and Nguyen 2021) show that, when policies boost absorptive capacity of local skills, linkages and competition effects improves the effectiveness of FDI and Technology spillovers. Thus, Economic growth and Technology spillover demonstrate positive substantial to trade in the way of diffusion depending on the value of exports and imports over total GDP, human capital, and institutions (Seck 2012) . Trade openness as a technology transfer component demonstrated during the study panel, data from five Asian countries, from 1972 to 2018 indicate by (Haq et al. 2022) that the combination of absorptive capacity and associated indicators revealed the result that technological spillovers have a positive effect on Economic growth.

Other study argues that FDI and Economic growth have no existing direct positive advantage (Azman-Saini et al. 2010) and need significant level of financial intermediation, besides, the size of financial markets in overall local economy and Education as auxiliary link as show (Agustín Bénétrix et al. 2023) . In accordance with (Liu 2008) FDI and Technology spillovers have a negative level impact, especially in a low-level country where FDI isn't captivate through Technology spillovers explain (Yan and Li 2023) . The econometric study of China's economic growth in province data from 1996 to 2002 illustrate by (LAI et al. 2006) concludes that, there is evidence that the relationship between Econometric growth and Technology spillovers is uncertain, and suggest that FDI serving as a more substantial canal compared to imports.

While there are a few papers found on Microeconomic studies that claim that, FDI does not stimulate growth and fails to produce positive spillover impact from overseas companies to local (Görg and Greenaway 2004). Some report deducted by (Iamsiraroj and Ulubaşoğlu 2015) found that, the empirical evidence relationship of FDI and Economic Growth, on 108 empirical studies of 880 regression demonstrate, 43% with a positive and significant impact, 26% are positive and insignificant impact, 17% a negative and significant impact, 14% are negative and insignificant impact and only 40% of statistically insignificant impact.

This paper studies the impact of Chinese Investment on the Economic Growth of DRC, and investigates the nature and the effect arising of Technology Spillovers. Per focusing on

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technology transfer in line with studies by (Voytovych et al. 2018) , we come out with two categories, the short-term Technological Diffusion approach rooted in insurance policy tools (Neale et al. 2024) and the long-term Technological Growth approach rooted in investment rate policies (Borrás et al. 2024) . In the short-term approach, we use empirical data of 0 observations and 0 Variables to model technological diffusion.

Leontief's input-output model quantifies how these sectors' outputs become inputs for others, highlighting the broader economic impact perception of (Haimes and Jiang 2001) several questions appear: DRC implement effective insurance policy and investment rate policies? How technological spillovers of Chinese investment foster the economy's growth DRC? How DRC can create new jobs in the Research and Development (R&D) production and service? In order to maintain the continuity of DRC's economic growth and to identify institutional factors that hinder and promote technology spillovers according to studies (Barbarino and Bura 2024), we examine the impact of technology transfer on economic growth perspective of (Balasubramanyam et al. 1996) and quantify Rate of return receive on technology spillover includes technology diffusion with the study of (Woo 2009) . We implement and studies the effects of Chinese investment on economic growth, insurance policy tools, and investment rate policies of DRC. By providing the possibility of collaboration between the two existing DRC entities in terms of insurance in DRC, we redefine the role of the Insurance Regulatory and Control Authority (ARCA) and the General Directorate of Customs and Excise (DGDA).

The main objective of this paper is to implement the New Institutional Economic Policies and to assess the effectiveness of insurance policies and the investment rates policies resulting from the technological spillovers of Chinese investments on economic growth in the DRC. We empirically examine the technological diffusion and technological growth policy tools evidence on Chinese FDI spillovers and technology transfer (Blalock Garrick and Gertler Paul J. 2008). We analyze the heterogeneity of the relationship between the two policy tools, to identify moderator variable and factors that influence high and low potential sectors. We adopt the percentage of GDP invested by Chinese investment for the Investment rate policy, and the amount of insurance coverage of Chinese investment for Insurance policy, then run time series data analysis Ordinary Least Squares (OLS) regression, to mitigate endogeneity and provide reliable empirical evidence.

The remainder of this paper is organized as follows. Literature is review in next section. In section 3, we present the model, the subsection 3.1, presents all variables in our study. In subsection 3.2, we introduce the basic model settings. In subsection 3.3, the insurance policy is analyzed. Then, in subsection 3.4 we implement the organization of investment rate policy. We developed in subsection 3.5 the relationship between the two institutional economic policies tools. In section 4, we have our conclusion with the recommendations, and the reference in the last section.

2. Literature Review

In this section, we review three kinds of literature. First, we examine the relationship between Chinese investment and economic growth. Second, we review the literature concerning technology spillovers from Chinese investment. Third, we demonstrate how insurance policies and investment rates interact with technology transfer and spillovers.

Whilst some studies indicate a positive correlation, especially when it comes to capital accumulation and infrastructure development, others emphasize how complex and frequently conditional this Chinese investment and economic growth relationship is, impacted by

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variables like sector-specific dynamics, governance, institutional quality, and possible negative consequences.

Early studies conducted in the early 2000s found that Chinese investment in developing nations had increased as a result of China's "Going Out" strategy (Peterson 2008) . This strategy aims to promote job creation, to inject capital towards the low economies of developing countries and to enable quality infrastructure distributions of economic activity (Bluhm et al. 2025).

Recent research has established a positive correlation between Chinese investment and economic growth, particularly in contexts where research on infrastructure development an essential aspect of Chinese investment indicates that enhancements in infrastructure can reduce transaction costs, improve connectivity, and subsequently stimulate overall economic activity (Foster and Briceño-Garmendia 2010) . Also, the investment and development of transportation and energy infrastructure including roads, railways, ports, and energy facilities by Chinese entities have been recognized for their role in enhancing trade, drawing in additional investment, and fostering GDP growth in various host nations (Kolstad and Wiig 2011) . It is essential to underscore the critical importance of institutional quality influencing relationship of Chinese investment and economic growth, as strong governance is known to attract productive capital, a point highlighted by (Acemoglu et al. 2019) . As well, going from research work revisiting institutional theory, we emphasize the significance of both evolving informal and formal rules (Casson et al. 2010) in fostering an environment that is conducive to innovation and increased competitiveness (Buitrago R. and Barbosa Camargo 2021) . Thus, establishing an education fund utilizing profits derived from Chinese investment associate with economic growth, elucidates that a country's education level of a nation can be important enough to spell the difference between convergence in growth rate and divergence as presented by the theoretical model of (Aghion et al. 2005).

Other studies argue that, the extensive financing offered by Chinese development banks for infrastructure initiatives has, in certain instances, raised alarm over increasing debt levels and the potential for debt distress in developing nations, particularly those that are already facing vulnerabilities (Brautigam 2020) Consequently, the terms and conditions associated with these loans, as well as the transparency surrounding lending practices, have become focal points of rigorous examination. Therefore, while some studies provide evidence of job creation associated with projects funded by Chinese investments, other microeconomic analyses raise concerns regarding labor practices and the quality of employment opportunities (Burchell et al. 2014) . Additionally, environmental issues, including pollution and resource depletion linked to certain initiatives financed by China, have been identified as potential negative externalities that could jeopardize long-term sustainable growth (Liu and Raven 2010). Then, Chinese investment in the institutional environment to economic growth has no significant effect from the political, economic, and financial aspects (Han et al. 2022).

From the standpoint of technology spillovers from Chinese investment, several research resulting from Chinese's investment activities both inward and outward (Dept 2024) Technology spillovers, characterized by the transfer of knowledge and skills between foreign entities and domestic firms, play a vital role in international investment. For example, the changing landscape of the developing country influence to economy productivity (Ulferts et al. 2021) , and the transformation include clean energy access to renewable energy such as solar, wind, geothermal, hydropower, and bioenergy reveal positive FDI industry technology spillover (Liu et al. 2016) . These spillovers can profoundly influence technological advancement and productivity in both host and home countries (Newman et al. 2015a) . A

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substantial amount of scholarly research has examined the technology spillovers resulting from inward foreign direct investment (FDI) in China, acknowledging its contribution to the country's accelerated economic and technological advancement (Zhang and Song 2001; Tseng et al. 2002; Davies 2012).

Technology spillovers mechanisms of Chinese investment inward occur through different pathway. First, per Imitation, the process causes domestic firms to observe and imitate the technologies and management practices of Chinese invested enterprises (FIEs) (Liu and Zheng 2013; Slivko and Theilen 2014) . Second, Labor Mobility, we see employees trained in FIEs may move to domestic firms, bringing valuable skills and knowledge (Foster and Pöschl 2009; Castillo et al. 2016). Third, by backward and forward linkages, the domestic suppliers and customers of FIEs can benefit from technology transfer through the supply chain (Baldwin and Venables 2015) . Four, with the competition effects, the presence of technologically advanced foreign firms intensify competition, pushing domestic firms to innovate and adopt new technologies to remain competitive (Aghion et al. 2001; Braguinsky et al. 2007).

The magnitude of technology spillovers of Chinese inward is also influenced by a variety of factors. First, per Absorptive Capacity, which is describes by aptitude of host firms to identify, assimilate, and utilize new information playing a pivotal role in their ability to leverage technology spillovers benefits (Duan et al. 2021). Moreover, firms that exhibit elevated levels of absorptive capacity and which are typically marked by substantial investments in research and development (Coe and Helpman 1995; Audretsch and Belitski 2020) as well as a proficient workforce, are more inclined to derive positive outcomes from such spillovers (Ross and Fleming 2022) . Second, the technology gap, refers to the disparity in technological capabilities between foreign and domestic firms, which significantly affects the potential for knowledge spillovers (Ferreira et al. 2024) So, a moderate technology gap is typically conducive to more efficient knowledge transfer (Glass and Saggi 1998) . Third, Foreign Investor Characteristics, including the industry in which they operate, the level of technological intensity they bring, and their geographic origin, can significantly influence both the nature and extent of spillover effects in the host economy(Aghion et al. 2001; Braguinsky et al. 2007). Four, Host Country Characteristics, factors such as the level of economic development, institutional quality, and intellectual property rights protection in the host country play a significant role (Segerstrom 1991; Helpman 1993; Boldrin and Levine 2009).

The Outward Chinese Investment and the reverse Technology Spillovers have been the subject of various studies in recent years (Li et al. 2016) . Thus, this fields of inquiry have examined reverse technology spillovers, wherein the home country, specifically China, derives technological advantages from its foreign investments. Technology spillovers mechanisms reverse of Chinese investment outward is subdivided into three categories. First, Knowledge repatriation (Lazarova and Tarique 2005; Rui and Yip 2008), this process involves recognizing Chinese companies that have invested abroad, especially in high-tech countries, and then acquiring this new knowledge and technology that will ultimately be transferred to China. Second, the concept is to actively participating in international markets and competing with foreign companies to boost the technological capabilities and innovation processes of Chinese firms (Argote and Ingram 2000) . Third, exploring strategic assets, the process involves the systematic organization within China of technological advancements that are advantageous (Liang et al. 2022) . This initiative enables Chinese entities, motivated by aspirations to gain access to specific technologies, as well as research and development competencies, to engage

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effectively with a skilled workforce. Consequently, this fosters direct partnerships with host countries (Jiang et al. 2024).

Despite the potential benefits, technology spillovers from Chinese investment are not always straightforward and can be associated with challenges. The forced technology transfer, for example, concerns have been raised by the United States and other countries regarding alleged practices of forced technology transfer by China in exchange for market access(Hossain et al.; Prud'homme et al. 2018). While competition can spur innovation, it can also lead to the displacement of less competitive domestic firms, particularly those with low absorptive capacity that ultimately results in a negative expected return with labor shock (Knesl 2023). Therefore, the long-term effectiveness and sustainability of knowledge transfer through training and linkages in host countries, particularly in Africa, can vary from sector to sector and discourage technological advancement (Herzer 2008; Corsi et al. 2020).

The literature on technology spillovers from Chinese investment highlights the complex and multifaceted nature. Empirical studies using firm-level data in China have generally found positive and significant technology spillovers from FDI to domestic firms, leading to increased labor productivity and technological innovation (Newman et al. 2015b). However, the impact can vary across regions and industries (Cheung and Lin 2004). For instance, FDI in China's eastern region has shown a positive spillover effect on both output and technological innovation in the high-tech industry, while the effects in the central and western regions present a more nuanced picture (Zhang 2017). As a result, studies suggest that investments in R&D-intensive countries and regions, which lead to significant technological spillovers, should be at the top of the list of contributions to China's technological progress and spillover effects, so that ODI sustaining policies reinforce these spillover effects (Huang and Wang 2013).

The interplay between insurance policies, investment rates, technology transfer and technology spillovers are an emerging but potentially impactful area of research. This literature review aims to integrate the disjointed comprehension of these interconnected elements, by elucidating possible direct and indirect mechanisms at play, since the existing literature primarily deals with each dyad separately, with limited explicit consideration of their synergistic effects. The influence of insurance policies on investment rates is a well-documented phenomenon. By alleviating a range of risks, including operational, financial, and political uncertainties, insurance effectively reduces the perceived cost of capital (Wieczorek-Kosmala 2012). This, in turn, fosters increased investment, particularly in projects characterized by high innovation demands and long-term horizons (Kamarlaila 2024). Specific forms of insurance, including political risk insurance and trade credit insurance, play a significant role in facilitating cross-border investments, which serve as a vital mechanism for the transfer of technology (Dickinson 1998). Thus, in his examination of wealth inequality, (Piketty 2020) posits that investment returns may intensify disparities, thereby underscoring the need for a progressive taxation system. From a Keynesian perception, insurance assumes an indirect yet crucial function in fostering economic activity through the mitigation of uncertainty (ARROW 1978). By safeguarding both businesses and households against unexpected financial setbacks, insurance fosters an environment conducive to risk-taking and investment (Mossin 1968). The reduction in risk aversion created by insurance can invigorate Keynesian "animal spirits," resulting in more adventurous investment choices (Akerlof and Shiller 2009). Moreover, the insurance sector, as a prominent institutional investor, facilitates considerable capital flows into financial markets, which may help sustain lower interest rates (Keynes 1937). Additionally, unemployment insurance, serving primarily as a social safety net,

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functions as an automatic stabilizer by bolstering aggregate demand during periods of recession (Meltzer 1976) . On the other hand, Keynesian theory describes the interest rate serves as a fundamental determinant of private investment (Keynes 1937) . This is how a low interest rate decreases the cost of capital, enhancing the profitability of investment projects consequently leads to an increase in business investment expenditure. This uptick in investment generates a multiplier effect within the economy, leading to heightened income and employment levels (Kahn 1931) . However, Keynes also underscored the possibility of a liquidity trap, where very low interest rates may fail to stimulate investment if economic expectations are pessimistic. In short, the Keynesian perception highlights the significance of insurance in mitigating uncertainty and promoting financial stability, which are factors that indirectly facilitate investment. Central to this discourse is the interest rate, which serves as a pivotal mechanism for directly impacting private investment and, by extension, the overall dynamics of economic activity. Although insurance does not function as a direct tool of countercyclical policy in the same manner as interest rates or government expenditure, its influence on risk perception and financial stability renders it a crucial component within the macroeconomic landscape where Keynesian policies operate.

The extensive research has been conducted on Investment rates playing a crucial role in facilitating technology transfer and spillovers, creating a significant channel for the diffusion of advanced technologies, management practices, and knowledge across national borders (Caves and Greene 1996) . Increased domestic investment in R&D significantly enhances technological progress and has the potential to create positive spillover effects across various firms and sectors (Griliches 1992). Thus, study conducted on digital investments, highlighting the critical role of data governance and competition policies in enhancing innovation spillovers. (Furman and Seamans 2019) Ensured that investments contribute to long-term technological development. The absorptive capacity of the host economy plays a critical role in influencing the magnitude of these spillover (Cohen and Levinthal 1990) and technology transfer is significantly influenced by the absorptive capacity of the recipient, as highlighted by (Keller 2002) . This aspect is vital in fostering local competencies throughout the international technology transfer process, enabling recipients to effectively leverage the acquired knowledge, skills, and technologies.

The existing literature exploring the direct relationship between insurance and technology transfer, as well as spillover effects, is notably limited. Nevertheless, one can deduce potential indirect connections (Yang and Maskus 2009) . Specifically, Intellectual Property (Furukawa 2010) insurance may motivate firms to pursue increased technology licensing and collaborative R&D endeavors by mitigating infringement risks, although empirical evidence supporting this notion remains scarce (Ding and Xue 2023) . The endogenous growth theory underscores the significance of investment policies that promote knowledge accumulation (Romer 1986) . Such policies have the potential to generate technology spillovers, which can fundamentally alter the economic landscape by enhancing productivity, fostering job creation, and driving innovation (Tambe and Hitt 2014) . Additionally, insurance instruments that bolster supply chain resilience and diminish the associated risks of adopting new technologies could indirectly promote their wider dissemination within the market (Liu et al. 2023; Yang et al. 2025).

To conclude, in DRC, where the imperative of investment is critical for the adoption of technology, the existing theoretical frameworks indicate that the implementation of sound insurance and investment rate policies, in conjunction with initiatives aimed at enhancing local absorptive capacities, as well as tax incentives and favorable interest rates, can

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substantially optimize the benefits derived from technology spillovers associated with Chinese investments.

3. Model

This section presents the building blocks of our new institutional economic policy (NIEP), the variables used and the model. We use Ordinary Least Squares (OLS) to evaluate the effectiveness of insurance policies and investment rates in order to address the questions of implementation of the NIEP. We statistically use SPSS 19 to determine the high and low sector that influence economy growth in DRC. And identify institutional factors that hinder and promote technology spillovers in DRC. We therefore assess the impact policies and institutions on economic growth and technology spillovers in the 26 province's panel data. First, we analyzed the insurance policy behaviors. Second, we implement the organization of investment rate policy. Third, we explain the relationship between the two institutional economic policies developed, and obtain the NIEP implemented to maintain the continuity of economic growth.

3.1 Variables

3.1.1. Dependent Variable

In our study, Economic growth is positioned as the dependent variable, as it remains a critical factor for assessing a nation's economic strength in relation to its permanent population.

3.1.2. Independent Variable

The formulation of innovative institutional economic policies is an unavoidable prerequisite for enhancing both economic and social development within the DRC. In examining the 26 provinces, we identify technology spillovers and the ratio of the annual flow of Chinese investment relative to DRC consumption as the primary independent variables. This selection aims to evaluate the developmental impact on economic growth.

3.1.3. Control Variables

Moreover, to dependent and independent variables, the economic growth in DRC is also affected by a plentiful natural resource, hosting investment rate, increases in capital goods, labor force, population growth, and human capital. Thus, Investment Rate, Employment, Human Capital, Insurance Policy, Institutional Quality, Regulatory Quality, Governance, and Corruption Control are selects as control variables.

3.1.4. Data Sources

The datasets consist for 26 provinces covering the period 2005–2023 with a sample of 789 observations and 49 variables. The original data of Insurance, Investment Rate, Institutions, Governance, Corruption Control, Education, Employment, GDP Constant, Gross Capital formation, Gross fixed capital formation (including Acquisitions less disposals of valuables), Household consumption expenditure (including Non-profit institutions serving households), Imports of goods and services, Exports of goods and services, Final consumption expenditure, General government final consumption expenditure, Population, Laboure Force, Mobile-cellular telephone subscriptions per 100 inhabitants, Percentage of individuals using the internet, CO_2 per capita constant, Final consumption of oil products, Transport energy consumption, Clean energy access, Industry (Mining, Manufacturing, Construction, electricity, water, gas), Renewable energy consumption (solar, wind, geothermal, hydropower, and bioenergy), Agricultural land use, Trade, Urban population, Output per worker (include GDP constant) were collected from the World Bank national accounts data, (World Development Indicators 2025) , International Laboure Organization, International Monetary Fund (lMF), World Intellectual Property Organization (via World Bank 2025), United Nations (2022),

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(Worldwide Governance Indicators 2025) , State Market Insurance DRC 2022 Report State Market Insurance (ARCA 2022), (Index Mundi 2019), (Human Capital Index 2020).

3.2 Basic model

We create two equations with economic growth and technology spillovers in order to address the questions of implementation of the new institutional economic policy. By following OLS model equation:

$$Y = \beta_0 + \beta_1 r + \beta_2 I + \beta_3 (r \times I) + \varepsilon$$

Where Y is the Economic growth measured by the GDP growth rate. r is the Investment rate represents the level of investments, influenced by interest rate policies. I is the Institutional quality encompasses factors such as political stability, regulatory quality, and anti-corruption measure. r×I is the interaction variable between investment rate and institutional quality, this variable allows us to measure the joint effect of these two variables. β_0, β_1, β_2, β_3 are the parameters to be estimated, and ε is the Error term.

Equation 1: Impact of Insurance and Investment Rates on Economic Growth

$$Growth = \beta_0 + (\beta_1 \times Insurance) + (\beta_2 \times Investment\ Rate) + (\beta_3 \times Institutions) + \varepsilon_1$$

Where, Growth is Annual GDP growth rate of all productivity growth. Insurance is the measure of insurance policy effectiveness in insurance penetration rate. Investment Rate is Gross fixed capital formation as a percentage of GDP. Institutions is a composite index of government effectiveness. β_0, β_1, β_2, β_3 are the parameters to be estimated. And ε_1 is the Error term.

So, we have:

β_0 represent the parameter estimate in the market evolutions of premiums issued.

$$\text{Variations: } (-24\%) + 4\% + 11\% + 86\% + 19\% + 47\% + 32\% = 175\%$$

β_1 represent the parameter estimate in the evolution of insurance density.

$$Density\ per\ living: 0{,}74 + 0{,}79 + 1{,}43 + 1{,}65 + 2{,}36 + 3{,}02 = 9.99\$$$

$$\Longrightarrow (0{,}74\$ \div 9.99\ \$) \times 100 = 7.40\%$$
$$\Longrightarrow (0{,}79\$ \div 9.99\$) \times 100 = 7.90\%$$
$$\Longrightarrow (1{,}43\$ \div 9.99\$) \times 100 = 14.31\%$$
$$\Longrightarrow (1{,}65\$ \div 9.99\$) \times 100 = 16.51\%$$
$$\Longrightarrow (2{,}36\$ \div 9.99\$) \times 100 = 23.62\%$$
$$\Longrightarrow (3{,}02\$ \div 9.99\$) \times 100 = 30.23\%$$
$$\Longrightarrow 7.40 + 7.90 + 14.31 + 16.51 + 23.62 + 30.23 = 99.97\%$$

β_2 represent the parameter estimate in Percentage of individuals using the internet.

$$\text{Pii: } 0.23\% + 0.29\% + 0.37\% + 0.44\% + 0.56\% + 0.72\% + 1.2\% + 1.67\% + 2.2\% + 3\% + 3.8\% + 10.1\% + 8.61\% + 11.7\% + 16.48\% + 19.83\% + 26.17\% + 27.24\% = 134.65\%$$

β_3 represent the parameter estimate in Rule of law.

$$\text{RL: } 0.30 + 0.30 + 0.30 + 0.30 + 0.30 + 0.30 + 0.30 + 0.28 + 0.40 + 0.40 + 0.40 + 0.38 + 0.38 + 0.38 + 0.38 + 0.40 + 0.40 + 0.40 + 0.40 = 6.7USD$$

$$\Longrightarrow (0.30\$ \div 6.7\$) \times 100 = 4.47 \times 7 = 31.29\% \quad \Longrightarrow (0.28\$ \div 6.7\$) \times 100 = 4.17\%$$
$$\Longrightarrow (0.40\$ \div 6.7\$) \times 100 = 5.97 \times 7 = 41.79\%$$
$$\Longrightarrow (0.38\$ \div 6.7\$) \times 100 = 5.67 \times 4 = 22.68\%$$
$$\Longrightarrow 31.29 + 4.17 + 41.79 + 22.68 = 99.93\%$$

$$\text{Insurance: } 0.16\% + 0.14\% + 0.24\% + 0.30\% + 0.39\% + 0.44\% = 1.67\%$$

$$\text{Investment Rate: } 11.68\% + 14.58\% + 13.61\% + 10.75\% + 14.49\% + 28.72\% + 24.82\% + 14.25\% + 21.74\% + 23.11\% + 21.59\% + 19.93\% + 24.77\% + 20.58\% + 24.28\% = 309.79\ \%$$

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Institutions: 0.37% + 0.30% + 0.33% + 0.33% + 0.33% + 0.33% + 0.33% + 0.38% + 0.44% + 0.44% + 0.43% + 0.42% + 0.42% + 0.39% + 0.39% + 0.35% + 0.38% + 0.38% + 0.40% = 7.14%

$\mathcal{E}_1 = 0$

$$Growth = 175 + (99.97 \times 1.67) + (134.65 \times 309.79) + (99.93 \times 7.14) + 0$$
$$= 175 + 166.9499 + 41713.2235 + 713.5002$$
$$= 42768.6736\%$$

Equation 2: Impact of Institutional Factors on Technology Spillovers

$$Spillovers = \alpha_0 + (\alpha_1 \times Go) + (\alpha_2 \times CC) + (\alpha_3 \times RQ) + (\alpha_4 \times Education) + \varepsilon_2$$

Where, Spillovers is a proxy for technology spillovers include patent applications, technology adoption rate, productivity growth. Governance (Go) is the Political stability and absence of violence and terrorism index. Corruption Control (CC) is all control of corruption index. Regulatory Quality (RQ) is the regulatory quality index. Education is a human capital average years of schooling index. α_1, α_2, α_3, α_4 are the parameters to be estimated. And ε2 is the Error term.

α_0 represent the parameter estimate in Bound rate, simple mean, all products

α_0 : 96.26% + 96.26% + 96.26 % + 96.26 % + 96.07% + 96.10% + 96.10% + 96.10% = 769.41%

α_1 represent the parameter estimate in Voice and Accountability

α_1: 0.13% + 0.28% + 0.28% + 0.23% + 0.18% + 0.17% + 0.17% + 0.16% + 0.15% + 0.15% + 0.17% + 0.16% + 0.11% + 0.11% + 0.9% + 09% + 0.10% + 0.11% + 0.12% = 4.58%

α_2 represent the parameter estimate in Control of Corruption Standard Error

α_2: 0.18% + 0.20% + 0.21% + 0.21% + 0.17% + 0.16% + 0.16% + 0.16% + 0.16% + 0.16% + 0.15% + 0.15% + 0.14% + 0.14% + 0.15% + 0.15% + 0.15% + 0.15% + 0.15% = 3.1%

α_3 represent the parameter estimate in Regulatory Quality Standard Error

α_3: 0.15% + 0.18% + 0.18% + 0.17% + 0.16% + 0.15% + 0.16% + 0.18% + 0.18% + 0.18% + 0.17% + 0.17% + 0.17% + 0.17% + 0.17% + 0.18% + 0.16% + 0.17% + 0.17% = 3.22%

α_4 represent the parameter estimate in Learning-adjusted Years of School: 4.5%

Go: 0.44% + 0.43% + 0.47% + 0.50% + 0.52% + 0.47% + 0.46% + 0.47% + 0.45% + 0.42% + 0.44% + 0.43% + 0.43% + 0.46% + 0.50% + 0.45% + 0.44% + 0.46% + 0.43% = 8.67%

RQ: 0.40% + 0.40% + 0.35% + 0.35% + 0.35% + 0.35% + 0.35% + 0.38% + 0.44% + 0.39% + 0.41% + 0.41% + 0.41% + 0.41% + 0.41% + 0.40% + 0.40% + 0.40% + 0.42% = 7.43%

CC: 0.40% + 0.30% + 0.40% + 0.40% + 0.40% + 0.40% + 0.40% + 0.47% + 0.47% + 0.47% + 0.47% + 0.47% + 0.47% + 0.37% + 0.37% + 0.40% + 0.40% + 0.40% + 0.43% = 7.89%

Edu: 9.1%

$$Spillovers = 769.41 + (4.58 \times 8.67) + (3.1 \times 7.89) + (3.22 \times 7.43) + (4.5 \times 9.1) + 0$$
$$= 769.41 + 39.7086 + 23.9246 + 40.95$$
$$= 873.9932\%$$

3.3 Insurance policy analysis behavior

Behavioral economics has shed light on how cognitive biases impact insurance decisions. (Kahneman 2011) book, Thinking, Fast and Slow provides a foundational understanding of cognitive biases that influence decision-making, including those related to risk and insurance.

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These biases are highly relevant to how people perceive and purchase insurance. The (Kunreuther et al. 2001) work extensive research on how people react to low-probability, high-consequence events, which is very relevant to insurance. With social and psychological factors (McDonald and Crandall 2015), research on how social networks and cultural norms influence insurance adoption (Cai 2012), particularly in developing countries consists of examining the role of trust, social norms and the dissemination of information through social networks in order to adopt the confidence of sociologists and economists. Thereby, in some communities, informal risk-sharing mechanisms may substitute for formal insurance policies.

Technology is also transforming insurance behavior (Shahana Beegam S 2024) . The emergence of telematics and data analytics has enabled insurance providers to tailor policies to individual needs and encourage safer driving behaviors. This technological advancement has facilitated the development of usage-based insurance, where in premiums are directly correlated to the policyholder's actual driving practices (Amelia Matthewson 2024). Thereby, it is essential to comprehend the reasons that lead individuals to either under-insure or over-insure, as this inquiry further examines how departures from rational choice affect economic behavior, as illustrated by (Thaler 2015).

In its early stages, the insurance sector in the DRC was characterized by a strong dependence on foreign insurance companies. Premiums collected locally were largely transferred abroad, which significantly limited the sector's contribution to national economic and social development. In response to this situation, the government established SONAS in November 1966 as a state-owned monopoly with exclusive authority to underwrite insurance risks across the country. The primary objective of this initiative was to retain financial resources within the national economy and strengthen the role of the insurance sector in economic development.

A major turning point occurred with the adoption of Law No. 15/005 of March 17, 2015, which introduced the Insurance Code and marked the liberalization of the sector. This reform aimed to foster competition, improve transparency, and enhance the overall performance of the insurance industry. In line with this transformation, the government established ARCA in January 2016 as the regulatory and supervisory authority of the sector. Although placed under the supervision of the Ministry of Finance, this institution operates with administrative independence in carrying out its regulatory and oversight functions. The mandate of ARCA includes protecting policyholders and beneficiaries, ensuring the financial stability of insurance and reinsurance companies, and verifying their ability to meet contractual obligations. Through these responsibilities, the authority contributes to strengthening confidence, discipline, and sustainability within the insurance market.

Within this reformed institutional framework, the Congolese insurance sector has experienced notable growth in recent years. In 2022, the market comprised ten operational insurance companies, including seven operating in the non-life segment and three in the life segment, reflecting the predominance of non-life activities. During the same year, total gross written premiums reached USD 287.07 million, compared to USD 217.37 million in 2021 and USD 148.03 million in 2020. Although the sector maintained a strong growth dynamic, with an increase of 32% in 2022, this rate was lower than the 47% recorded in 2021, suggesting a gradual moderation following a period of rapid expansion. From a broader perspective, the evolution of the insurance market over time highlights its significant development. Between 2015 and 2022, total premium production increased from USD 82.72 million to USD 287.07 million, representing a cumulative growth of approximately 247.8%. This sustained expansion

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reflects the positive impact of regulatory reforms, market liberalization, and improved sector governance.

Overall, these developments illustrate the progressive transformation of the insurance sector in the DRC. The reforms undertaken have not only modernized the institutional and regulatory framework but have also contributed to improving the business climate and enhancing the country's attractiveness to investors. Ultimately, the continued growth of the insurance industry is expected to play a crucial role in supporting economic development and improving social welfare.

Table 1. Market evolutions of premiums issued

The insurance sector in the DRC has gradually grown thanks to reforms and the opening of the market to competition. Over time, premiums collected have risen sharply, from USD 82.72 million in 2015 to USD 287.07 million in 2022.This long-term increase shows that the industry has been consistently expanding, even if yearly growth has not been uniform.

Year	Amount (USD)	Variations
2015	82 718 517	-
2016	62 895 104	-24%
2017	60 069 795	4%
2018	66 748 339	11%
2019	124 268 049	86%
2020	148 034 604	19%
2021	217 374 301	47%
2022	287 066 854	32%

Source: ARCA annual report 2022

3.3.1 Density and Penetration Rate

In 2022, the level of insurance spending per person in the Congolese market reached 3.02 US dollars, compared to 2.36 US dollars in 2021. This represents a noticeable increase of about 28.2% in one year.

Looking at the longer term, the situation has improved significantly since the market was opened to more insurance companies in 2019. At that time, the amount spent per person was still below 1 US dollar, but by 2022 it had risen to more than 3 US dollars, showing clear growth in insurance use among the population.

Table 2. Evolutions of Insurance Density

Insurance density in the DRC has increased steadily, rising from less than USD 1 before 2019 to over USD 3 in 2022. This growth reflects a gradual improvement in insurance use and greater market penetration among the population.

Year	Populations (In thousands living)	Premiums Issued (In thousands USD)	Density (In USD/Living)
2017	81 399	60 070	0,74
2018	84 068	66 748	0,79
2019	86 791	124 268	1,43
2020	89 561	148 035	1,65
2021	92 248	217 374	2,36
2022	95 016	287 067	3,02

Source: ARCA annual report 2022

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In 2022, the insurance penetration rate in the DRC reached 0.44%, slightly higher than the 0.39% recorded in 2021. This represents an annual increase of about 11.2%.

Since the introduction of competition in the insurance market, this indicator has improved considerably, rising by more than 200%, which shows a gradual but continuous expansion of insurance activity within the economy.

Table 3. Evolutions of Insurance Penetration Rate

The insurance penetration rate in the DRC has increased gradually, reaching 0.44% in 2022 compared to 0.39% in 2021. This long-term rise shows a steady but still limited integration of insurance services into the national economy.

Year	GDP (In billions USD)	Premiums issued (In USD)	Penetration Rate
2017	38,00	60 069 795	0,16%
2018	47,60	66 748 339	0,14%
2019	51,80	124 268 049	0,24%
2020	48,70	148 034 604	0,30%
2021	55,40	217 374 301	0,39%
2022	65,80	287 066 854	0,44%

Sources: ARCA annual report 2022

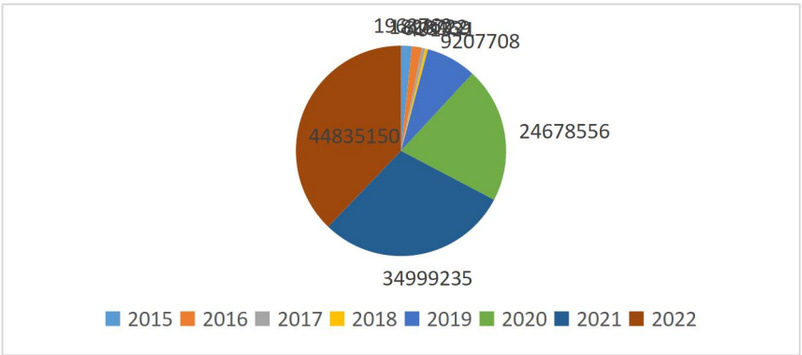
3.3.2 Tax Contribution

In 2022, insurance companies in the DRC paid 44.8 million US dollars in taxes, compared to 35.0 million US dollars in 2021. This shows a clear rise of about 28.1% in one year.

Since the insurance market was opened to competition, the tax contribution of the sector has increased dramatically, moving from very low levels to a much higher amount today, reflecting the strong expansion of the industry.

Figure 1. Evolution of Tax Contribution

Explain the trend between insurance companies increased overs years with opening competition



Sources: ARCA annual report 2022

In 2022, insurance intermediaries in the DRC contributed 0.95 million US dollars in taxes, compared to 0.87 million US dollars in 2021. This represents a small but steady increase of about 9.2% over one year.

Since the market was opened to competition, their tax payments have risen significantly, showing a strong long-term improvement in their economic activity and role within the insurance sector.

Figure 2. Evolutions of Intermediaries Insurance

Insurance intermediaries in the DRC have seen a steady increase in their activity and tax contribution, rising from USD 0.87 million in 2021 to USD 0.95 million in 2022.

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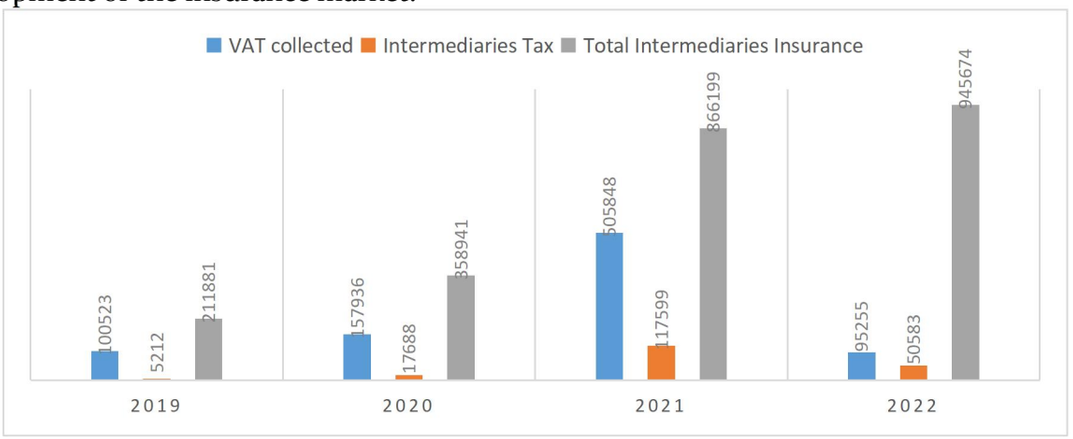
This long-term growth shows their expanding role and stronger participation in the development of the insurance market.



Source: ARCA annual report 2022

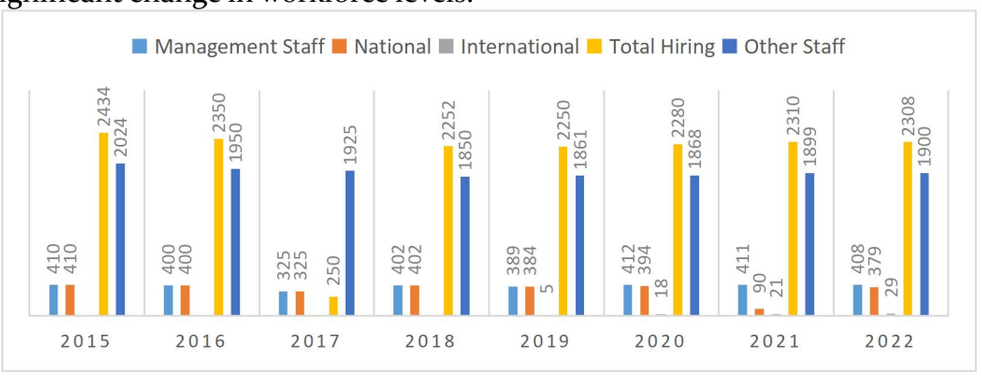
3.3.3 Jobs

In 2022, insurance companies in the DRC employed a total of 2,308 staff members, a figure that is almost unchanged compared to 2,310 employees recorded in 2021.

This slight variation indicates that employment in the sector remained broadly stable over the period, with no significant expansion or reduction in the workforce Overall, employment in the insurance sector in the DRC remained stable between 2021 and 2022, with only a minimal decrease from 2,310 to 2,308 employees.

Figure 3. Evolutions of Direct Jobs

Direct employment in the insurance sector in the DRC remained stable, with 2,308 employees in 2022 compared to 2,310 in 2021. This shows that job creation in the sector has stagnated, with no significant change in workforce levels.



Source: ARCA annual report 2022

In 2022, insurance intermediaries in the DRC employed 121 people directly, compared to 84 employees recorded in 2021. This indicates a clear increase in staffing levels over the one-year period. The rise suggests that intermediary activities expanded and required more human resources to support their operations.

Figure 4. Direct Employment by Intermediaries

Direct employment in insurance intermediaries in the DRC increased significantly, rising from 84 employees in 2021 to 121 in 2022. This growth reflects an expansion of intermediary activities within the insurance market. It also shows a greater need for staff to support the development and functioning of these services.

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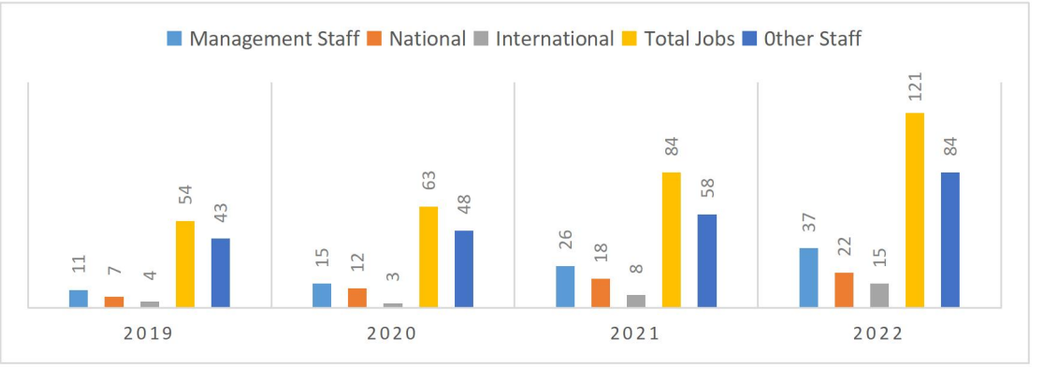
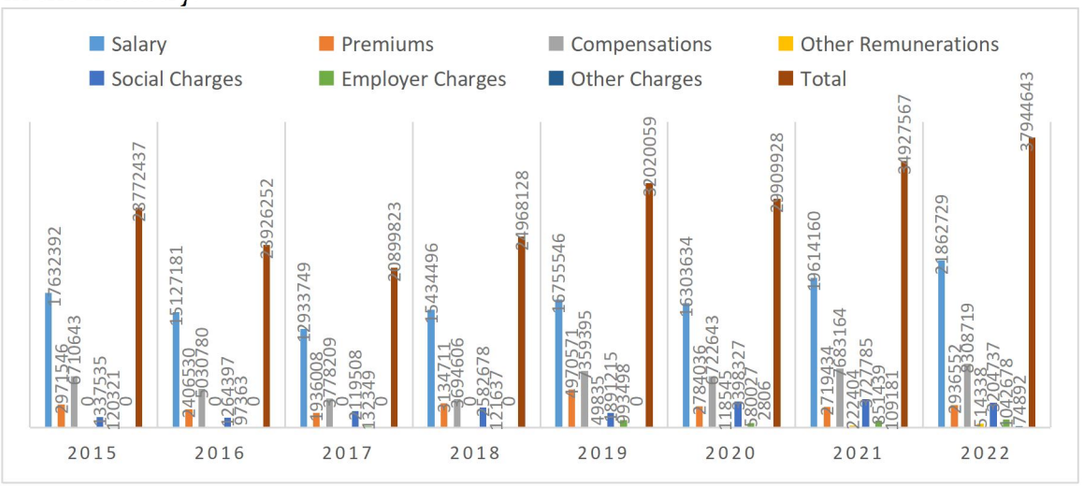


Source: ARCA annual report 2022

In 2022, insurance companies in the DRC paid a total payroll of 37.94 million US dollars, compared with 34.93 million in 2021 and 29.91 million in 2020. This shows a continuous rise in staff remuneration over the three-year period. The steady increase reflects both sector growth and improved financial capacity within the industry.

Figure 5. Evolutions of Distribution Payroll

Payroll distribution in the insurance sector of the DRC has shown a steady upward trend over time. This consistent rise reflects improved financial performance and growing employment costs in the industry.



Source: ARCA annual report 2022

In 2022, insurance intermediaries in the DRC distributed a total payroll of 0.97 million US dollars. This represents a notable increase compared to 0.61 million US dollars in 2020. The growth over this period indicates an expansion of intermediary activities and a higher level of compensation paid to employees.

<u>Figure 6. Payroll Distribution by Intermediaries</u>

Payroll distribution for insurance intermediaries in the DRC has increased over time and shows improved financial capacity within the intermediary sector of the insurance market.

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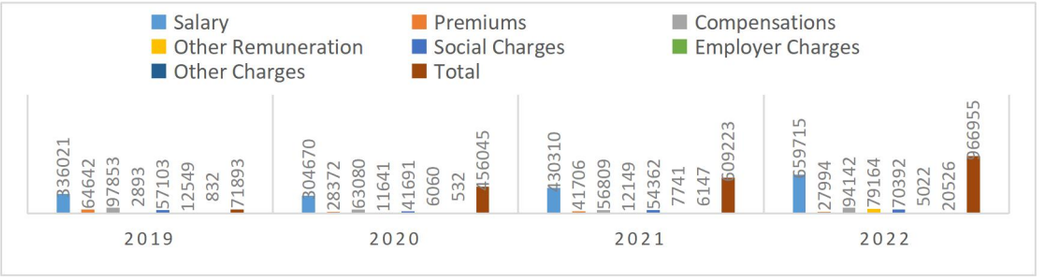


Sources: ARCA annual report 2022

3.4 Investment Rate Policy

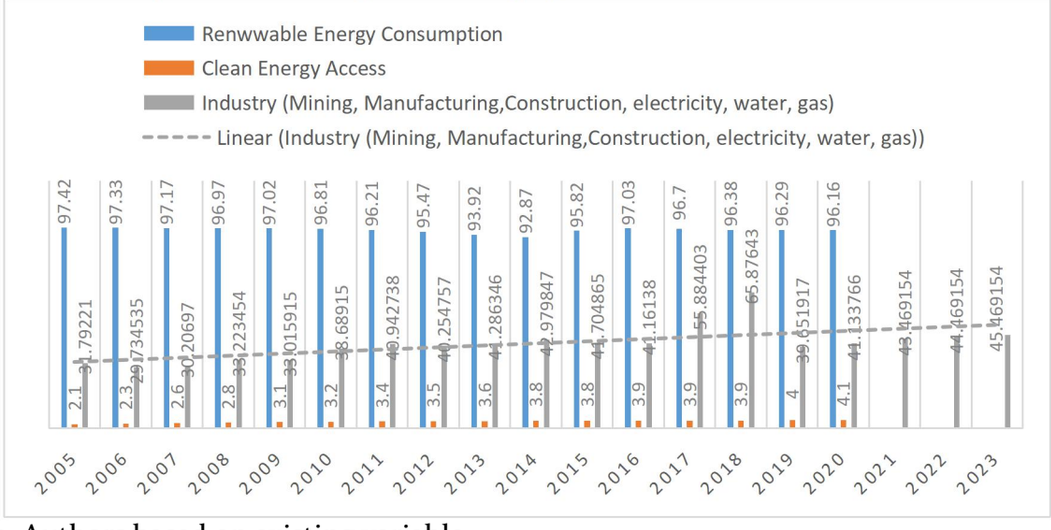
The precise objectives of the investment rate policy in this study, aiming to stimulate economic growth, attract Chinese investment, promote infrastructure development as roads, energy, water, agriculture, technology, health and Education sectors. In the target of GDP growth rate in Industry investment level sector. The policy scope types of investments included Chinese Direct Investment. The geographical coverage policy will extend over all areas with focus on essential infrastructure. The implementation of investment rate policy organization will be as follow:

3.4.1 Identifying High and Low Potential Sectors

The process consists of three steps. Analyze technological trends of emerging technologies in the renewable energy and clean energy sectors, to assess the potential of existing technologies and create new markets. Estimate with OLS by linear regression, the identification of institutional factors that hinder and promote technological spillovers in DRC. Statistically use SPSS 19 to determine the high and low sector that influence the growth potential in the DRC economy from Chinese investment. We use the common approach of imputation and replaced the missing value with the Series Mean.

Figure 7. Technological Trends

Technological trends in the renewable and clean energy sectors focus on the development of more efficient and sustainable energy solutions, such as solar, wind, and low-carbon technologies. This figure shows these innovations aim to improve energy access while reducing environmental impact and creating new emerging markets.



Source: Authors based on existing variable

OLS by linear regression: institutional factors that hinder and promote technology spillovers in DRC

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Table 4. Model Summary

The model summary indicates a moderately strong relationship between the independent variables and the dependent variable, as shown by an R value of 0.778. The R Square value of 0.606 suggests that approximately 60.6% of the variation in the dependent variable is explained by the model, while the remaining 39.4% is attributable to factors not included in the analysis. However, the Adjusted R Square of 0.319 provides a more conservative estimate, indicating that only 31.9% of the variation is explained after adjusting for the number of predictors, which suggests limited explanatory power when model complexity is considered. The standard error of the estimate (161.31) reflects the average deviation of observed values from the regression line, indicating a relatively moderate level of prediction error. Overall, while the model demonstrates a meaningful relationship between variables, its explanatory strength appears limited after adjustment, suggesting that additional relevant variables may be required to improve model performance.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.778[a]	.606	.319	161.31349

Source: Author calculation based on SPSS 19

a. Predictors: (Constant), Go, LAYs, VAc, Gfcfp GDP, RQ, RQSE, CC, CCSE

The R Square value of 0.606 indicates that approximately 60.6% of the variation in technology spillovers is explained by the model, suggesting a moderate to strong model fit. The Adjusted R Square of 0.319 provides a more conservative estimate after accounting for the number of predictors included in the regression.

Table 5. Coefficients[a]

This table shows how each independent variable affects **technology spillovers**, indicating whether the relationship is positive or negative, significant or not, and whether there are multicollinearity issues.

The results of the regression analysis indicate that CCSE, RQSE, and RQ are statistically significant determinants of technology spillovers in the model. While CCSE and RQ positively influence technology spillovers, RQSE exhibits a significant negative effect. In contrast, the remaining variables are not statistically significant, suggesting limited explanatory power. However, the presence of high multicollinearity in several variables, particularly RQSE, RQ, and Go, as indicated by elevated VIF values, suggests potential instability in the regression estimates. This may affect the robustness and reliability of the model results.

	Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Collinearity Statistics	
Model	B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1(Constant)	9.780	160.623		.061	.953	-343.748	363.308		
CCSE	6655.010	2180.292	1.434	3.052	.011	1856.219	11453.801	.162	6.156
RQSE	-16736.034	4528.761	-3.345	-3.695	.004	-26703.770	-6768.298	.044	22.841
VAc	83.968	175.259	.102	.479	.641	-301.775	469.710	.789	1.267
Gfcfp GDP	-.071	5.132	-.003	-.014	.989	-11.366	11.224	.603	1.658
RQ	5227.939	1492.596	2.449	3.503	.005	1942.756	8513.121	.073	13.634

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CC	441.103	426.301	.302	1.035	.323	-497.179	1379.384	.421	2.377
LAYS	-21.761	38.702	-.112	-.562	.585	-106.944	63.422	.903	1.107
Go	-973.867	1125.412	-.525	-.865	.405	-3450.882	1503.148	.097	10.282

Source: Author calculation based on SPSS 19

a. Dependent Variable: Technology spillovers

The only positive and statistically significant determinant of technology spillovers in the model is CCSE, with a coefficient of B = 6655.010 and a significance level of 0.011. This implies that, holding all other variables constant, a one-unit increase in CCSE is associated with an increase of 6655.010 units in technology spillovers. Conversely, RQSE has a significant negative effect on technology spillovers, with B = -16736.034 and a p-value of 0.004, indicating that higher levels of RQSE reduce technology spillovers. The remaining variables are statistically insignificant, suggesting that they do not have a reliable measurable association with technology spillovers in the model.

Overall, the model shows moderate explanatory power, but only a limited number of variables significantly influence technology spillovers. While CCSE and RQ contribute positively, RQSE reduces spillovers.

The presence of insignificant variables and strong multicollinearity suggests that the model may need to be improved by removing or adjusting correlated variables. This explains why the adjusted R^2 is much lower than the R^2 value, indicating weaker robustness when controlling for model complexity.

Table 6. Collinearity Diagnostics[a]

The collinearity diagnostics reveal the presence of severe multicollinearity in the model. This is evidenced by high condition index values, particularly 42.296 and 69.196, which exceed the critical threshold of 30. Additionally, the presence of eigenvalues closes to zero indicates that certain dimensions explain minimal variance, suggesting linear dependence among explanatory variables. The concentration of high variance proportions within these dimensions further confirms that several independent variables are highly correlated, thereby compromising the stability and reliability of the regression estimates.

				Variance Proportions								
Model	Dimension	Eigenvalue	Condition Index	(Constant)	CCSE	RQSE	VAc	Gfcfp GDP	RQC	CLAYS		Go
1	1	7.339	1.000	.00	.00	.00	.00	.00	.00	.00	.00	.00
	2	.951	2.778	.00	.00	.00	.01	.00	.00	.00	.87	.00
	3	.430	4.131	.00	.00	.00	.78	.01	.00	.00	.02	.00
	4	.175	6.473	.01	.00	.00	.11	.70	.00	.01	.04	.00
	5	.048	12.303	.51	.00	.00	.01	.14	.00	.43	.00	.00
	6	.035	14.454	.45	.03	.00	.02	.12	.01	.50	.01	.01
	7	.015	21.963	.02	.39	.01	.00	.02	.10	.00	.03	.00
	8	.004	42.296	.01	.21	.05	.02	.00	.05	.05	.01	.99

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9	.002	69.196	.00	.36	.94	.04	.02	.85	.02	.01	.01

Source: Author calculation based on SPSS 19

a. Dependent Variable: Technology spillovers

The collinearity diagnostics indicate the presence of multicollinearity among the explanatory variables. Several eigenvalues close to zero suggest that some dimensions explain very little variance, indicating potential linear dependence among predictors. In addition, high condition index values (21.963, 42.296, and 69.196) confirm a strong degree of multicollinearity, particularly for dimensions with condition indices above 30. The distribution of variance proportions across these dimensions further suggests that multiple variables load heavily on the same components, reinforcing the presence of intercorrelation among independent variables in the model.

Table 7. ANOVA[b]

The ANOVA results assess the overall significance of the regression model by examining whether the independent variables collectively explain variations in technology spillovers. The model includes Go, LAYs, VAc, Gfcfp GDP, CC, CCSE, RQ, and RQSE as predictors. The findings suggest that the model is statistically significant, indicating that the explanatory variables, when considered together, contribute to explaining changes in technology spillovers. However, despite this overall significance, the presence of multicollinearity and several insignificant coefficients may limit the reliability of individual parameter estimates.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	439428.432	8	54928.554	2.111	.125[a]
	Residual	286242.476	11	26022.043		
	Total	725670.908	19			

Source: Author calculation based on SPSS 19

a. Predictors: (Constant), Go, LAYs, VAc, Gfcfp GDP, CC, CCSE, RQ, RQSE

b. Dependent Variable: Technology spillovers

Statistically determine the high and low sector that influence growth potential in the DRC

Table 8. Residuals Statistics[a]

The residual statistics indicate that the model's predictions are reasonably well distributed, with predicted values covering a broad range. The residuals have a mean close to zero, suggesting the absence of systematic bias in the model's estimates. Furthermore, the standardized residuals fall within the acceptable range of -3 to +3, indicating that there are no significant outliers affecting the regression results. Overall, these findings suggest that the model provides a reasonably good fit, although some prediction errors remain.

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.98541639680000E10	5.68459100160000E10	3.52307618842110E10	1.11421670283809E10	19
Residual	-2.27753088000000E8	1.93950512000000E8	-.00001313341291	1.00332554100111E8	19
Std. Predicted Value	-1.380	1.940	.000	1.000	19
Std. Residual	-.927	.789	.000	.408	19

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	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.98541639680000E10	5.68459100160000E10	3.52307618842110E10	1.14216702838090E10	19
Residual	-2.27753088000000E8	1.93950512000000E8	-.00001313412910	1.00332554100111E8	19
Std. Predicted Value	-1.380	1.940	.000	1.000	19
Std. Residual	-.927	.789	.000	.408	19

Source: Author calculation based on SPSS 19

a. Dependent Variable: GDP (constant)

Table 9. Coefficients[a]

The regression results indicate that several variables related to Chinese investment have positive coefficients, suggesting that increases in these factors are associated with higher economic growth in the DRC. However, these results reflect statistical relationships rather than definitive causal effects.

Model		Unstandardized Coefficients	
		B	Std. Error
1	(Constant)	-9.013E10	3.038E10
	Gfcf	.107	.084
	Hce	.335	.141
	Egs	.213	.281
	Ind	47008905.699	23294757.841
	Opw	32050650.476	18998036.521
	SN Mob	-19575466.481	60199730.947
	SN CO2	5.552E11	2.628E11
	SN Pii	1.106E8	28721639.420
	SN fcop	-484560.817	248711.710
	SN tec	-51907.879	65145.639
	SN cea	8.499E8	1.819E9
	SN alu	-58008039.806	3.488E8
	SN T	-44581329.921	18068493.686
	SN Upop	1.186E9	5.992E8
	SN rec	1.855E8	4.126E8

Source: Author calculation based on SPSS 19

The regression results indicate that several variables associated with Chinese investment exhibit positive coefficients, suggesting a positive relationship with economic growth in DRC.

Specifically, variables such as GFCF, HCE, EGS, IND, OPW, and other socio-economic indicators show a positive association with growth when other factors are held constant.

This implies that increases in these variables are linked to improvements in economic performance over the period 2005–2023. However, these results should be interpreted as statistical associations rather than definitive causal relationships.

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Table 10. Coefficients[a]

Standardized coefficients (Beta) are used to compare the relative importance of variables in explaining economic growth, as they are expressed on a common scale with a mean of zero and a standard deviation of one.

The results show that OPW (β = 0.614), SN(CO_2) (β = 0.418), SN(Upop) (β = 0.252), HCE (β = 0.178), and GFCF (β = 0.131) are among the most influential variables, indicating stronger effects on economic growth. In terms of statistical significance, variables such as SN(Pii) and OPW show significant effects based on their p-values, meaning their impacts are unlikely to be due to random variation. Overall, OPW appears to be the most influential positive determinant of economic growth, while SN(alu) (β = -0.007) shows a negligible and statistically insignificant effect, suggesting no meaningful impact on the dependent variable.

Model		Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Partial
1	(Constant)		-2.967	.059		
	Gfcf	.131	1.275	.292	.786	.593
	Hce	.178	2.372	.098	.981	.808
	Egs	.093	.757	.504	.987	.400
	Ind	.036	2.018	.137	.623	.759
	Opw	.614	1.687	.190	.975	.698
	SN Mob	-.027	-.325	.766	.812	-.185
	SN CO_2	.418	2.113	.125	-.165	.773
	SN Pii	.089	3.850	.031	.801	.912
	SN fcop	-.463	-1.948	.147	.319	-.747
	SN tec	-.045	-.797	.484	.674	-.418
	SN cea	.044	.467	.672	.668	.260
	SN alu	-.007	-.166	.878	.693	-.096
	SN T	-.048	-2.467	.090	-.130	-.818
	SN Upop	.252	1.980	.142	.714	.753
	SN rec	.019	.449	.684	-.236	.251

Source: Author calculation based on SPSS 19

The Opw with 0.614, SN (CO_2) with 0.418, SN (Upop) with 0.252, Hce with 0.178, Gfcf with 0.131 are the higher absolute values of Beta indicating a stronger influence. By indicating the statistical significance of coefficient, SN (Pii) is less than Opw and has a statistically significant influence on DRC Economic Growth.

Table 11. Coefficients[a]

The diagnostic results indicate the presence of multicollinearity in the model, as several variables exhibit Variance Inflation Factor (VIF) values greater than 10 and tolerance values below 0.1. This suggests a high degree of interdependence among explanatory variables, which complicates the interpretation of their individual effects on the dependent variable.

Model		Correlations Part	Collinearity Statistics Tolerance	VIF
1	(Constant)			
	Gfcf	.007	.003	389.349
	Hce	.012	.005	209.258
	Egs	.004	.002	559.572

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	Ind	.010	.083	12.065
	Opw	.009	.000	4904.408
	SN Mob	-.002	.004	255.714
	SN CO_2	.011	.001	1449.945
	SN Pii	.020	.051	19.556
	SN fcop	-.010	.000	2093.216
	SN tec	-.004	.009	115.626
	SN cea	.002	.003	328.223
	SN alu	-.001	.016	64.105
	SN T	-.013	.071	14.020
	SN Upop	.010	.002	599.246
	SN rec	.002	.015	65.633

Source: Author calculation based on SPSS 19

In particular, SN(Pii) shows strong multicollinearity, with a tolerance value of 0.051, a VIF of 19.556, and a very low correlation measure, indicating redundancy with other variables. As a result, the model may require adjustment through the removal or transformation of highly correlated variables to improve its reliability and interpretability.

Table 12. Model Summary[b]

The Model Summary indicates an R Square value of 1.000, suggesting that the independent variables collectively explain 100% of the variation in GDP at constant prices. While this indicates a perfect fit of the model, such a result is uncommon in empirical economic analysis and may reflect potential issues such as overfitting or strong multicollinearity among explanatory variables. The ANOVA results confirm that the model is statistically significant, implying that the explanatory variables jointly contribute to variations in GDP.

Model	R	R Square	Adjusted RSquare	Std. Error of the Estimate	Durbin-Watson
1	1.000[a]	1.000	1.000	2.457635621356 44E8	3.003

Source: Author calculation based on SPSS19

a. Predictors: (Constant), SN (rec), SN (T), Gfcf, Ind, SN (cea), SN (tec), SN (Mob), SN (CO_2), Hce, SN (alu), SN (Upop), Egs, SN (fcop), Opw

b. Dependent Variable: GDP constant

Table 13. ANOVA[b]

The ANOVA results indicate that the regression model is statistically significant, as shown by an F-statistic of 2466.525 with a p-value of 0.000. This implies that the explanatory variables jointly have a significant effect on GDP at constant prices. The regression sum of squares is significantly larger than the residual sum of squares, suggesting that the model explains most of the variation in GDP. However, the very low residual degrees of freedom indicate a potential risk of overfitting due to the large number of predictors relative to the sample size.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.235E21	15	1.490E20	2466.525	.000[a]
	Residual	1.812E17	3	6.040E16		
	Total	2.235E21	18			

Source: Author calculation based on SPSS 19

a. Predictors: (Constant), SN (rec), SN (T), Gfcf, Ind, SN (cea), SN (tec), SN (Mob), SN (CO_2), Hce, SN (alu), SN (Upop), Egs, SN (Fce), Opw

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b. Dependent Variable: GDP constant

Table 14. Excluded Variables[b]

The excluded variables table indicates that several predictors, including GCF, IGS, and Population, were not retained in the final regression model. Although IGS shows statistical significance at the 5% level, its exclusion may be due to multicollinearity issues and lack of improvement in overall model performance. All excluded variables present extremely high Variance Inflation Factor (VIF) values, suggesting severe multicollinearity and strong interdependence among explanatory variables. This makes it difficult to isolate their individual effects on GDP, leading to their exclusion from the final model.

					Collinearity Statistics		
Model	Beta In	t	Sig.	Partial Correlation	Tolerance	VIF	Minimum Tolerance
1 Gcf	-1.680[a]	-2.443	.135	-.865	2.150E-5	46504.361	1.896E-5
Igs	-1.020[a]	-4.719	.042	-.958	7.151E-5	13984.951	7.151E-5
Population	-.220[a]	-.181	.873	-.127	2.711E-5	36883.015	2.711E-5

Source: Author calculation based on SPSS19

a. Predictors in the Model: (Constant), SN (rec), SN (Pii), SN (T), Gfcf, Ind, SN (cea), SN (tec), SN (Mob), SN (CO_2), Hce, SN (alu), SN (Upop), Egs, SN (Fce), Opw

b. Dependent Variable: GDP (constant)

3.4.2 Formulating Optimal Investment Strategies:

Diversification Optimal Investment Strategies

We spread Chinese investments across several sectors to mitigate risk while helping to balance investments in high-growth and stable sectors, with a long-term perspective, focusing on growth potential rather than short-term gains, so that we invest in Chinese companies with solid fundamentals and innovative technologies that will develop the DRC.

Diligence Optimal Investment Strategies

Through a due diligence approach, we will conduct in-depth research on potential Chinese investments already in the DRC, and evaluate the financial performance, management team and competitive position of these companies in order to implement the concept of technology transfer in future local companies that will be created for better development, obviously identifying and evaluating the potential risks associated with each Chinese investment, so that experienced risk assessment will develop strategies to mitigate these risks.

Partnerships Optimal Investment Strategies

By closely following emerging technologies and industry trends in day-to-day economic operations, the DRC government will itself adjust Chinese investment strategies and adapt to changing market conditions, thus imposing quality investment rates for guaranteed national development who will continue to encourage strategic partnerships between Chinese and DRC companies, to allow for technology transfers, and shared risk by granting reasonable subsidies and benefits on all construction machinery and renewable energy products.

3.5 Relationship between institutional economic policies tools

The institutional economic policies create the environment in which insurance and investment rate policies operate. Therefore, they provide the necessary stability, predictability, and security for these policies to achieve their intended goals. The two institutional economic policies tools in our study are insurance policy through insurance compagnie that fix taxes and investment rate policy. The two tools are complementary, investment rate policy directly

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influences the financial health of insurance companies, which, in turn, can affect their ability to provide insurance coverage and fulfill their obligations to policyholders.

Insurance policies contribute to economic stability, which, in turn, creates a more favorable environment for investment. Institutional frameworks shape the design and implementation of both insurance and investment rate policies, ensuring their coherence and effectiveness. Insurance companies engage in sophisticated risk management to mitigate the effects of interest rate fluctuations. They employ strategies such as asset-liability matching, which involves aligning the duration of their assets with the duration of their liabilities, to minimize interest rate risk.

Insurance companies, particularly life insurers, are major institutional investors. They collect premiums and invest those funds to meet future obligations to policyholders. A significant portion of their investments is often in fixed-income securities like bonds, which are highly sensitive to interest rate changes. When interest rates rise, the value of existing bonds held by insurance companies tends to fall. Conversely, when interest rates fall, bond values tend to rise. This inverse relationship directly affects the asset side of insurance company balance sheets. Interest rates also influence the present value of insurance companies' future liabilities. These changes in policyholder behavior, can change the length of time that the insurance company is liable for those policies.

In view of all these analyses and observations mentioned during our study, since the DRC does not have a body for setting investment rates, our study finds it wise to introduce the creation of a central body namely Directorate General of Investment Rates (DGIR) who is our "New Institutional Economic Policies" responsible for overseeing the implementation of the investment rate policy, both national and foreign in Democratic Republic of Congo. This body have the authority to coordinate activities across existent different government agencies and stakeholders. Placed under the supervision of the Ministry of Economy and enjoys independence in the performance of its missions of Implement, Collect and Redistribute Investment Rates received for the purpose of national economic development.

The newly-created management team in addition to the Executive Committee, the Board of Directors and the Technical Department, will be divided into hub and divisions. Several mechanisms for information, sharing and joint decision-making will be created. Communication between relevant government agencies, Ministries of Economy, Finance, Foreign Trade, Infrastructure, Education and relevant regulatory bodies will be clearly coordinate with transparency, trust, honesty and deep commitment. In order to maximize dialogues and maintain regular growth consultation, platforms Involve key stakeholders, including private sector investors, financial institutions, and civil society organizations, in the policy implementation process will be build. To Inform strategically investors and the public about the investment rate policy through a comprehensive communication, the websites, publications, and public events will be used as a communication channels. And the Directorate will provide training on investment promotion, regulatory reform, and financial management to have a strong knowledge capacity.

Then, Government Investment and Policy can play a vital role through this new direction by investing in R&D, providing incentives for private sector investment, creating a favorable regulatory environment, investing in education to create a work force that can utilize new technologies.

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4. Conclusion

In this paper, we explore the impact of Chinese Investment on Economic Growth of DRC, and investigates the nature and the effect arising of Technology Spillovers. The finding reveals that, the diffusion of new Chinese technologies on the DRC's economic market fosters productivity, job creation and improvement of living standards. Marketing of new products and services through insurance policy entities improve the efficiency, productivity and profitability of economic growth locale.

In the long-term approach, through innovation, the creation of new markets, new products and new services, will identify high and low Potential sectors and formulating optimal investment strategies to improve the business climate, public investment, financial inclusion to attracting Chinese investment by price stability, inflation control, sound public finance management, security, anti-corruption measures, transparency, the rule of law and the adequate infrastructure such as roads, electricity and telecommunications in DRC. With investment rate policy tools, employing the input-output analysis framework developed by Leontief, as revised by (Polenske 1995), the policy governing investment rates is construed as a national financial inclusion strategy that influences the investment rate in economic diversification. This strategic approach aims to mitigate the pronounced reliance on the mining sector by fostering investment in sectors such as agriculture, industry, and services.

We implement the possibility of collaboration between the two existing entities in terms of insurance in DRC, the Insurance Regulatory and Control Authority (ARCA) is focus on collecting the insurance data to all Chinese investment sector. And the General Directorate of Customs and Excise (DGDA) have collected all Chinese investment in imports and exports sector. Then, the insurance policy and the investment rate policy foster financial support include technological diffusion and knowledge in diversify sector.

We identify, the high influence sector with strong impact on DRC Economic Growth is Opw with 0.614 due to random chance. And the low influence sector is SN (alu) with a negative number -0.007 and the observed influence is not statistically different from zero.

Our study recommendations for the new institutional economic policies are summarize in seven steps Need:

- To develop a comprehensive insurance regulatory framework that promotes transparency, accountability, and market efficiency.
- To encourage the development of innovative insurance products that address the specific needs of Chinese investors and DRC stakeholders.
- To promote public-private partnerships to enhance insurance access and affordability.
- To strengthen DRC local capacity in the insurance sector through training and education programs.
- To establish mechanisms for monitoring and evaluating the impact of insurance policies on technology spillovers and economic growth.
- To incorporate environmental and social governance into insurance policy.
- And to create policies that encourage the insurance of DRC local small and medium sized businesses.

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5. References Appendix

Table of Abbreviations and definition of all variables

Variable	Designation	Unit of measure
GDPc	GDP Constant	U.S. dollars
Gcf	Gross Capital formation	U.S. dollars
Gfcf	Gross fixed capital formation (including Acquisitions less disposals of valuables)	U.S. dollars
Hce	Household consumption expenditure (including Non-profit institutions serving households)	U.S. dollars
Igs	Imports of goods and services	U.S. dollars
Egs	Exports of goods and services	U.S. dollars
Fce	Final consumption expenditure	U.S. dollars
Ggfce	General government final consumption expenditure	U.S. dollars
Pop	Population	-
Lf	Laboure Force	U.S. dollars
Mob	Mobile-cellular telephone subscriptions per 100 inhabitants	U.S. dollars
Pii	Percentage of individuals using the internet	%
CO_2	CO_2 per capita constant	U.S. dollars
fcop	Final consumption of oil products	U.S. dollars
tec	Transport energy consumption	U.S. dollars
cea	Clean energy access	U.S. dollars
rec	Renewable energy consumption	U.S. dollars
Ind	Industry (Mining, Manufacturing, Construction, electricity, water, gas)	U.S. dollars
Opw	Output per worker (GDP constant)	U.S. dollars
alu	Agricultural land use	U.S. dollars
T	Trade	U.S. dollars
Upop	Urban population	-
SN (Mob)	SMEAN (Mobile cellular telephone subscriptions per 100 inhabitants)	U.S. dollars
SN (CO_2)	SMEAN (CO_2 per capita constant)	U.S. dollars
SN (Pii)	SMEAN (Percentage of individuals using the internet)	%
SN (fcop)	SMEAN (Final consumption of oil products)	U.S. dollars
SN (tec)	SMEAN (Transport energy consumption)	U.S. dollars
SN (cea)	SMEAN (Clean energy access)	U.S. dollars
SN (alu)	SMEAN (Agricultural land use)	U.S. dollars
SN (T)	SMEAN (Trade)	U.S. dollars

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SN (Upop)	SMEAN (Urban population)	-
SN (rec)	SMEAN (Renewable energy consumption)	U.S. dollars
Go	Governance	%
CC	Corruption Control	%
RQ	Regulatory Quality	%
Edu	Education	U.S. dollars
RL	Rule of law	U.S. dollars
BRSMP	Bound rate, simple mean, all products	%
CCSE	Control of Corruption Standard Error	%
RQSE	Regulatory Quality Standard Error	%
VAc	Voice and Accountability	%
LAYS	Learning-adjusted Years of School	%
IDy	Insurance density	%
IPr	Insurance penetration rate	%
MPI	Market evolutions of premiums issued	%
Ge	Government effectiveness	%
PSAVT	Political stability and absence of violence and terrorism	%
HCI	Human Capital Index	%
Gfcfp GDP	Gross fixed capital formation as a percentage of GDP	%

Source: Author conception

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6. Appendix

Table of Abbreviations and definition of all variables

Variable	Designation	Unit of measure
GDPc	GDP Constant	U.S. dollars
Gcf	Gross Capital formation	U.S. dollars
Gfcf	Gross fixed capital formation (including Acquisitions less disposals of valuables)	U.S. dollars
Hce	Household consumption expenditure (including Non-profit institutions serving households)	U.S. dollars
Igs	Imports of goods and services	U.S. dollars
Egs	Exports of goods and services	U.S. dollars
Fce	Final consumption expenditure	U.S. dollars
Ggfce	General government final consumption expenditure	U.S. dollars
Pop	Population	-
Lf	Laboure Force	U.S. dollars
Mob	Mobile-cellular telephone subscriptions per 100 inhabitants	U.S. dollars
Pii	Percentage of individuals using the internet	%
CO_2	CO_2 per capita constant	U.S. dollars
fcop	Final consumption of oil products	U.S. dollars
tec	Transport energy consumption	U.S. dollars
cea	Clean energy access	U.S. dollars
rec	Renewable energy consumption	U.S. dollars
Ind	Industry (Mining, Manufacturing, Construction, electricity, water, gas)	U.S. dollars
Opw	Output per worker (GDP constant)	U.S. dollars
alu	Agricultural land use	U.S. dollars
T	Trade	U.S. dollars
Upop	Urban population	-
SN (Mob)	SMEAN (Mobile cellular telephone subscriptions per 100 inhabitants)	U.S. dollars
SN (CO_2)	SMEAN (CO_2 per capita constant)	U.S. dollars
SN (Pii)	SMEAN (Percentage of individuals using the internet)	%
SN (fcop)	SMEAN (Final consumption of oil products)	U.S. dollars
SN (tec)	SMEAN (Transport energy consumption)	U.S. dollars
SN (cea)	SMEAN (Clean energy access)	U.S. dollars

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SN (alu)	SMEAN (Agricultural land use)	U.S. dollars
SN (T)	SMEAN (Trade)	U.S. dollars
SN (Upop)	SMEAN (Urban population)	-
SN (rec)	SMEAN (Renewable energy consumption)	U.S. dollars
Go	Governance	%
CC	Corruption Control	%
RQ	Regulatory Quality	%
Edu	Education	U.S. dollars
RL	Rule of law	U.S. dollars
BRSMP	Bound rate, simple mean, all products	%
CCSE	Control of Corruption Standard Error	%
RQSE	Regulatory Quality Standard Error	%
VAc	Voice and Accountability	%
LAYS	Learning-adjusted Years of School	%
IDy	Insurance density	%
IPr	Insurance penetration rate	%
MPI	Market evolutions of premiums issued	%
Ge	Government effectiveness	%
PSAVT	Political stability and absence of violence and terrorism	%
HCI	Human Capital Index	%
Gfcfp GDP	Gross fixed capital formation as a percentage of GDP	%

Source: Author conception