

**Mining boom and economic growth:
A case study of the Simandou project in Guinea using a new CGE model**

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Abstract

Guinea has been experiencing an economic boom driven by its mining sector since 2016. Bauxite and gold export growth have made it the fourth fastest growing economy globally over the period and the third largest mineral exporter in Africa. This growth has not translated human development at the rate that could have been expected and there is evidence it has crowded out activity in other sectors of the economy.

As the \$20 billion plus Simandou high grade iron ore megaproject comes close to commissioning, the project presents new challenges as well as opportunities to the country's economy.

This paper provides the first attempt to measure and publicly share the fiscal and economic impacts of Simandou, using the IMF's Financial Analysis of Resources Industries (FARI) model and developing a new CGE model for Guinea's economy.

The FARI model shows a direct fiscal impact of the project for Guinea of between \$0.8 billion and \$2.7 billion annually at full production before 2035. Corporate tax rates increase from 2035, resulting in higher government revenues of between \$1.9 billion and \$3.5 billion thereafter, at \$70/t and \$100/t iron ore prices.

This CGE modelling exercise finds that Simandou will have a significant impact on the size of the economy: by 2030 the economy will be between 26% (\$7.8 billion) and 42% (\$12.5 billion) larger than it would have been without the project at \$70/t and \$100/t iron ore prices respectively. The results also show a detrimental impact on other exports as the real exchange rate appreciates. Finally, they show that without structural changes, once the project has ramped up to full iron ore production of 120 million tonnes, economic growth reverts to a path lower than it would have been without Simandou.

The paper concludes by highlighting policy priorities that can help translate this growth into human development and structural transformation, and which are more broadly applicable to African countries experiencing mining booms.

1. Introduction

Guinea has been experiencing an economic boom driven by its mining sector since 2016. Bauxite and gold export growth have made it the fourth fastest growing economy globally over the period and the third largest mineral exporter in Africa behind South Africa and the DRC. This growth has not translated into as much human development as could have been expected and there is evidence it has crowded out activity in other sectors of the economy.

As investment in the \$20 billion Simandou high grade iron ore megaproject gathers pace, the project presents challenges as well as opportunities to the country's economy. Understanding its fiscal and broader economic impacts ahead of exports starting in 2026 is fundamental:

- (1) To set clear and realistic expectations in order to avoid what has been called the “resource curse”, Governments’ tendency to engage in excessive borrowing and spending ahead of the new financial flows materialising (Cust and Zeufack, 2023).
- (2) To help plan and design mitigating measures for the expected real exchange appreciation and broader negative impacts on the non-mining sectors of the economy (“Dutch disease”).

This paper provides the first attempt to measure and publicly share the fiscal and economic impacts of Simandou, using the IMF’s Financial Analysis of Resources Industries (FARI) model and developing a new Computable General Equilibrium (CGE) model for Guinea’s economy.

The analysis relies on data on the project volumes, timing, costs and fiscal regime available in the public domain. The main sources are Rio Tinto’s investor updates over the past 2 years and the last publicly available mining convention from the Winning Consortium Simandou (WCS) dating from 2020 (WCS, 2020).

While the findings have been discussed with the Government, international development organisations and the mining corporations developing the project, the analysis has been carried out by the authors independently of these stakeholders.

The paper starts by setting the context, reviewing the literature on the impact of extractive resource booms and assessing Guinea’s recent economic and mining performance in that context, before summarising the key metrics of the Simandou project. It then describes the FARI modelling exercise implantation and results, followed by the CGE modelling exercise. It concludes by discussing some of the policy options available to the Guinean authorities and how these are more widely applicable to other African countries undergoing mining booms now and in the near future.

2. Mining boom, Dutch Disease and economic growth: A review

In their recent analysis, Cust and Zeufack (2023) show how resource-rich African nations largely squandered the growth and development opportunities offered by the commodity price boom between 2004 and 2014. One of the main reasons for this is the well-known Dutch Disease.

Dutch Disease appears in an economy when there is an appreciation of the real exchange rate and a movement of productive resources from traditional tradable sectors to the booming extractive sector and non-tradable sectors. Large inflows of foreign capital into an economy increase demand for non-tradable products, thus leading to an appreciation of the real exchange rate under the income effect (Corden and Neary, 1982). Real exchange rate appreciation can be exacerbated by the mismanagement of windfall revenues from the resource boom (Edwards and Aoki, 1983).

The appreciation of the real exchange rate triggers a reallocation of factors of production from the traditional tradable sectors to the non-tradable sectors and the booming natural resources sector: this is the resource movement effect of Corden and Neary (1982). Ismail (2010) shows that the permanent oil shock led to a reduction in the manufacturing output of oil-exporting countries. Sachs and Warner (2001) argue that resource-rich countries tend to have a low contribution to manufacturing export growth. In Botswana, the discovery of vast diamond deposits from 1967 onwards contributed to the appreciation of the local currency and reduced the performance of the agricultural sector (Imi, 2006).

However, real exchange rate appreciation does not necessarily imply a reallocation of productive resources from tradable to non-tradable sectors. Spatafora and Warner (1995) and Gellb (1988) observe that the real exchange rate of oil-exporting countries tends to appreciate in response to terms-of-trade shocks, but without the emergence of Dutch Disease. Sala-i-Martin and Subramanian (2003) find no evidence of Dutch Disease in Nigeria. The IMF (2009) analyses the case of Chad, concluding that the effects of Dutch Disease are difficult to assess, not only because of a lack of information, but also because the non-oil sector is very underdeveloped. The paper concludes that there is little evidence to support the presence of Dutch Disease, with the exception of a significant increase in the wage bill, probably explained by the expansion of public spending during the oil boom (spending effect), rather than the shift of labour to oil production (resource movement effect).

Most studies of Dutch Disease have focused on the appreciation of the real exchange rate and the reallocation of productive resources between tradable and non-tradable sectors, but few have addressed the issue of economic growth. Although the causality between Dutch Disease and economic growth has been

little studied, the causality between the real exchange rate and economic growth is more exhaustive. Studies show that real exchange rate volatility hampers economic growth. The misalignment of the real exchange rate from its long-term trend also reduces the prospects for economic growth, especially in a situation of overvaluation when the evidence for undervaluation is inconclusive. As far as the level of the exchange rate is concerned, an appreciation appears to reduce growth.

For example, Prasad, Rajan and Subramanian (2007) suggest that large inflows of foreign capital can lead to an overvaluation of the real exchange rate, which is detrimental to manufacturing exports and economic growth. Ghura and Grennes (1993) find a negative relationship between GDP per capita growth and real exchange rate volatility and misalignment in sub-Saharan Africa. Similarly, Cottani et al (1990) and Dollar (1992) find a negative relationship between real exchange rate misalignments and GDP per capita in the least developed countries. Hausmann, Pritchett and Rodrik (2004) find that episodes of rapid growth tend to be associated with increases in investment and foreign trade, as well as depreciations in the real exchange rate. A negative relationship between purchasing power parity (PPP) and economic growth emerges from Ghura and Grennes (1993). However, Cottani et al (1990) find no significant relationship between the PPP exchange rate and economic growth. According to Berg and Miao (2010), deviations of the real exchange rate from its long-term trend explain long-term growth, and not the PPP used in Rodrick (2008).

Although studies suggest that exchange rate overvaluation hinders growth and undervaluation stimulates it, the evidence is still limited and inconclusive, and there is no consensus on the precise channels through which they operate. Sachs and Warner (1999) find that resource booms are sometimes accompanied by declines in GDP per capita in seven Latin American countries, but acknowledge that they cannot distinguish between the several possible channels associated with them, i.e. Dutch Disease, political instability, etc.

Sachs and Warner (2001) implicitly assume that a large tradable manufacturing sector stimulates long-term growth. Consequently, the decline in the manufacturing sector would be the cause of the slowdown in the national economy. Gylfason et al (1997) found a statistically significant inverse relationship between the size of the primary export sector and economic growth. Rodrik (2008) finds that an undervalued real exchange rate has a positive effect on growth and provides evidence that the operational channel is the size of the tradable (manufacturing) sector. Van Wijnbergen (1984) suggests that Dutch Disease reduces a country's long-run growth through learning-by-doing and productivity, mainly in tradable sectors. According to Gylfason (2001), natural resource abundance undermines economic growth by reducing public and private incentives to accumulate human capital.

Other studies suggest that the effects of a depreciated real exchange rate on economic growth do not stem from an expansion in exports, but rather from an increase in domestic savings-investment. An undervalued real exchange rate is associated with lower real wages, which leads companies to invest more and maintain higher savings rates to finance them (Levy-Yeyati and Sturzenegger, 2007). However, Montiel and Servén (2008) find a weak theoretical and empirical relationship between the real exchange rate and savings.

However, empirical evidence is mixed on the adverse effect of Dutch Disease on economic growth. Although Dutch Disease may be accompanied by a contraction in tradable sectors, this may not necessarily outweigh the beneficial effects associated with its income effect. According to Krugman (1987), for the mining shock and exchange rate appreciation to cause a decline in manufacturing output or deindustrialisation, it must last long enough or be sufficiently large. While the real exchange rate generally appreciates following a permanent mining shock, this real appreciation generally represents a new equilibrium that reflects a change in the fundamentals of the national economy.

The economic management of the natural resource boom is also an important determinant of economic performance. Sachs and Wyplosz (1984) find that the reaction of the real exchange rate to changes in public spending is ambiguous. According to these authors, the evidence is not sufficiently robust to various hypotheses concerning the degree of substitutability of assets (i.e. foreign versus domestic bonds) or the composition of public spending (i.e. tradable versus non-tradable goods).

Several studies suggest that the policy response to Dutch Disease should focus on limiting exchange rate appreciation to levels that maximise the benefits of the mining boom.

Thus, Vegh (2013) suggests that a permanent increase in public spending will lead to an appreciation of the real exchange rate if that spending is biased towards non-tradables relative to private spending. An increase in public spending on non-traded goods leads to an appreciation of the real exchange rate, while an increase in public consumption of tradable goods leads to a depreciation of the real exchange rate. According to the same author, regression methods focusing on developing countries in Asia and Latin America point to an appreciation of the real exchange rate as a result of increased public spending.

According to Treviño (2011), directing spending towards tradable goods (e.g. imported capital goods) would help to reduce the adverse effects associated with Dutch Disease. He suggests exploring the extent to which revenues from natural resources have been channelled into productive investment rather than current

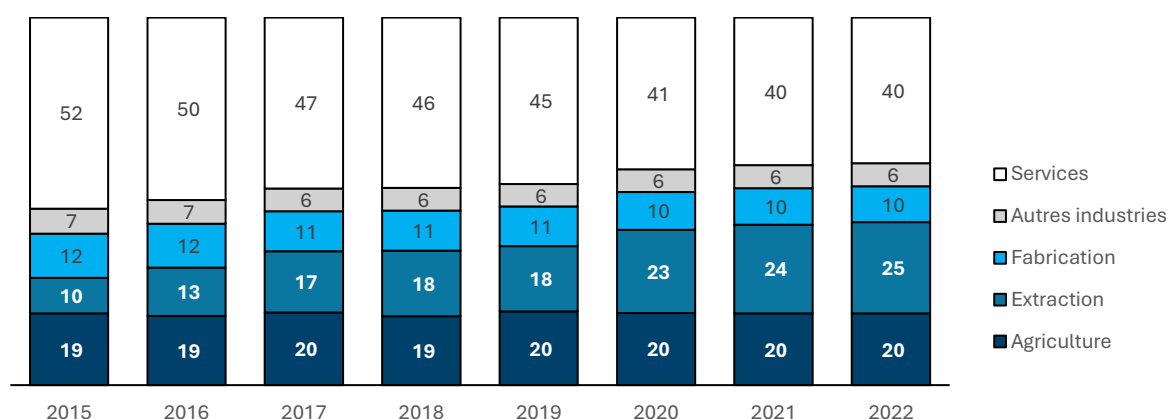
expenditure, as their appropriate use can help create the right conditions to improve competitiveness and support stronger growth.

Excessive public spending has often been identified as the main cause of the economic mismanagement associated with natural resource booms. A prudent fiscal policy would save part of the windfall revenue, which could be used either to repay foreign debt or to accumulate foreign assets, usually in a sovereign wealth fund to be invested abroad (Bruno and Sachs, 1982; Habegger, 1983; Corden, 1981). This would help to limit pressure on aggregate demand and, consequently, on the appreciation of the real exchange rate. According to Matsen and Torvik (2005), the ability to generate the optimal inter-temporal level of savings makes some resource-rich countries successful and others not.

3. Guinea's mining economy: contribution and recent developments

Guinea's gross domestic product (GDP) is estimated at around 20 billion US dollars (USD) in 2022 current values. It has more than doubled since 2015, when it was estimated at around USD 9 billion. The strong increase in GDP is mainly driven by extractive activities, mainly mining, whose share has risen considerably, from 10% in 2015 to 25% in 2022. The share of agriculture - including crops, livestock, forestry and fishing - has remained stable at around 20%. In contrast, the shares of services and manufacturing industries fell between 2015 and 2022 (Figure 1), to 40% and 10% respectively in 2022.

Figure 1: Sectoral breakdown of Guinea's gross value added over time (%)

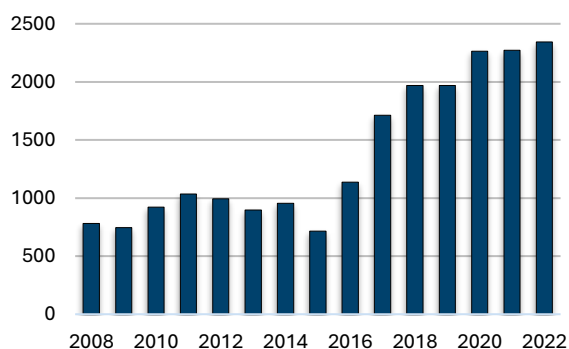


Source: Government of Guinea Macroeconomic framework (Ministère du Plan et de la Coopération Internationale, 2023)

Guinea's mining production has more than doubled over the past decade (2013-2022). At the start of the decade (2013-2016), average annual mining production was estimated at around 856 million US dollars in constant 2015 values (Figure

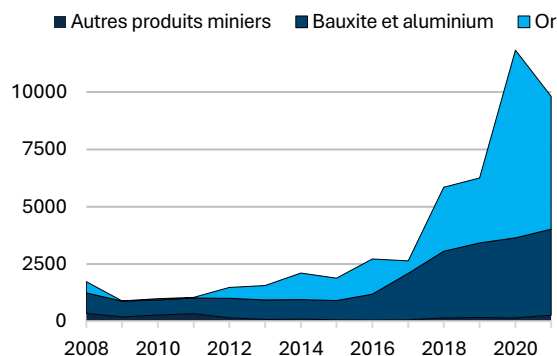
2). By the end of the decade (2020-2022), it had risen to 2,293 million US dollars, an increase of 168% between the beginning and the end of the decade. Exports of mining products increased by a factor of 5 over the same period, thanks to exports of gold and bauxite-alumina, which increased by a factor of 6 and 4 respectively (Figure 3).

Figure 2: Added value of the mining sector in Guinea, constant 2015 US\$ million



Source: World Development Indicators (World Bank, 2023), African Statistical Yearbook (AfDB, AUC and UNECA, 2023).

Figure 3: Guinea mining exports, current US\$ million

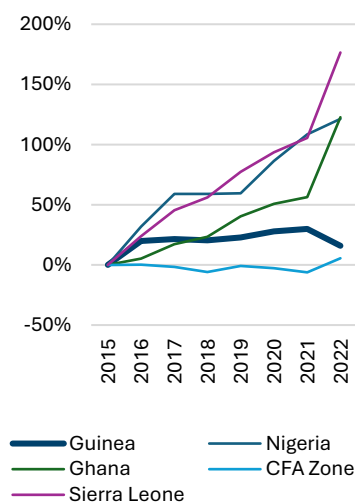


Source: Comtrade (United Nations, 2023)

Figures 5 and 6 compare Guinea's purchasing power parity (PPP) with those of a group of countries in the CFA zone of West Africa (Benin, Cote d'Ivoire, Senegal and Togo). Guinea and these countries show relative stability in the evolution of the official exchange rate of their currencies against the US dollar over the period 2016-2022 compared to other countries in the region (Figure 4). Between 2017 and 2022, Guinea's PPP exchange rate increased substantially, while those of the CFA zone countries considered fell. This situation reveals an appreciation of the real exchange rate coinciding with the period of the mining boom in Guinea. It confirms that resource-intensive economies tend to have higher price levels, i.e. higher prices of non-tradables assuming broadly similar prices of tradables across countries (Sachs and Warner, 2001).

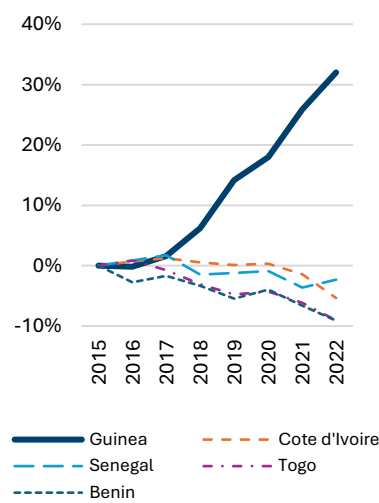
In addition to the appreciation of the real exchange rate induced by the income effect, Dutch Disease manifests itself in the reallocation of productive resources from tradable sectors to the booming mining sector and non-tradable sectors (Corden and Neary, 1982). This is true when the factors of production are fully employed in the economy, without the contribution of external resources. In a situation of labour force underemployment and foreign capital inflows, Dutch Disease could also manifest itself in a weaker allocation of additional resources to the traditional tradable sectors, thus reducing their weight in the national economy.

Figure 4: Changes in nominal exchange rate, 2015-22 indexed to 2015



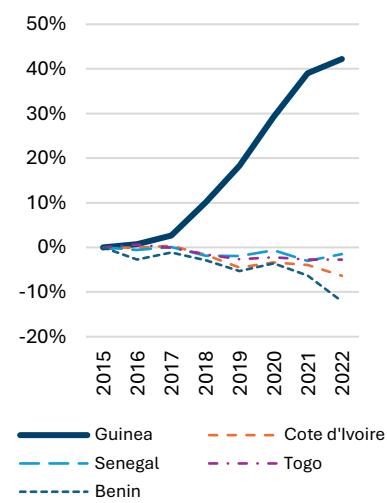
Source: World Development Indicators (World Bank, 2023)

Figure 5: Changes in PPP GDP conversion factor, indexed to 2015



Source: World Development Indicators (World Bank, 2023)

Figure 6: Changes in PPP private consumption conversion factor, indexed to 2015



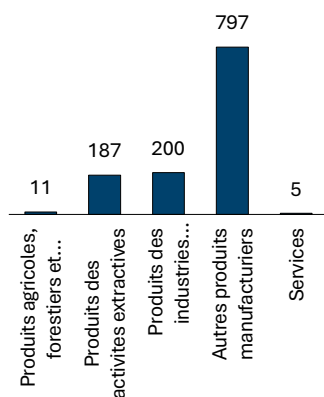
Source: World Development Indicators (World Bank, 2023)

With a relatively low rate of openness to foreign trade (Figure 7), agricultural products and services have traditionally been little traded by Guinea. On the other hand, manufacturing and extractive products are traded relatively more with the outside world. A comparison of recent real value added (average from 2020 to 2022) with that prior to the mining boom (average from 2013 to 2015) shows rapid growth in all sectors (Figure 8). The increase is most pronounced for industry, driven by mining (87%) and agriculture (78%). Manufacturing and services grow more slowly and as a result lose weight in relative terms, as a percentage of GDP (Figure 9).

Guinea's economic growth accelerated during the mining boom period (2016-2022) compared to the pre-boom period (2008-2015) (Figures 10 and 11). Between 2008 and 2015, Guinea was one of the countries with low economic growth. In fact, Guinea's GDP grew cumulatively by almost 30% over this period, i.e. an average annual increase of 3.8%. Between 2015 and 2022, wealth creation accelerated, placing Guinea at the top of the group of five countries. Cumulative GDP growth of nearly 60% over this period was almost double that of the previous period.

Despite the appreciation of the real exchange rate and a (tradable) manufacturing sector that is underperforming compared to other economic sectors - possible signs of Dutch Disease - Guinea has recorded a good economic performance over the 2015-2022 period, driven by the income effect associated with the mining boom.

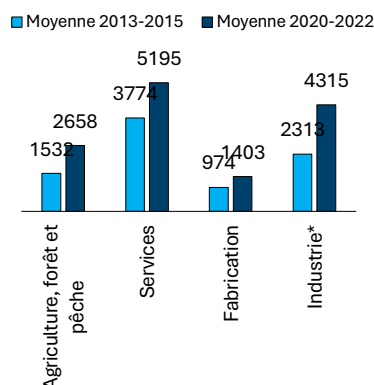
Figure 7: Trade openness rate (%)



Source: Tableaux des ressources et emplois 2006-2017 (Ministère du plan et de la coopération internationale, 2020).

Note : The trade openness rate is the ratio of the sum of exports and imports, and total value added

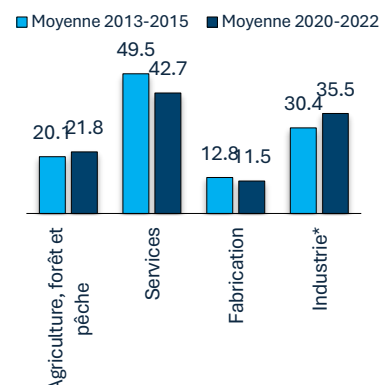
Figure 8: Annual value added, 2015 constant US\$ million



Source: World Development Indicators (World Bank, 2023)

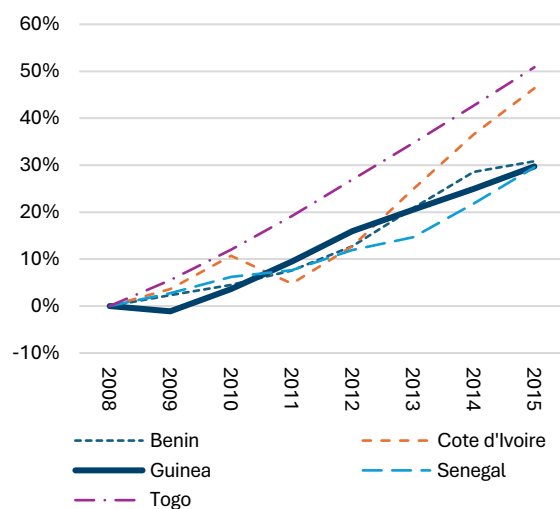
Note : Industry includes mining and quarrying

Figure 9: Sectoral contribution to GDP (%)



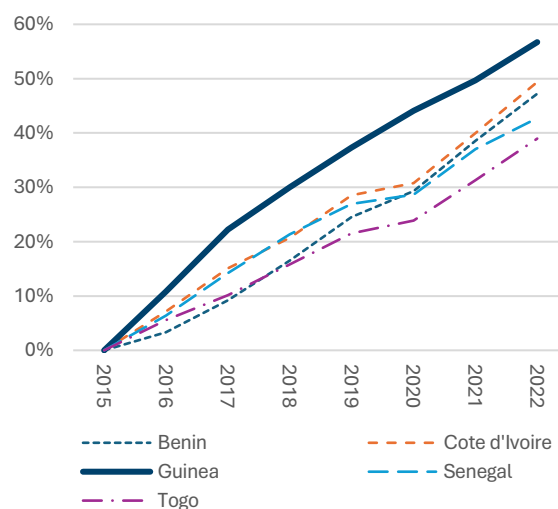
Source: World Development Indicators (World Bank, 2023)

Figure 10: Cumulative real GDP, 2008-2015, indexed to 2008



Source: World Development Indicators (World Bank, 2023)

Figure 11: Cumulative real GDP, 2015-2022, indexed to 2015

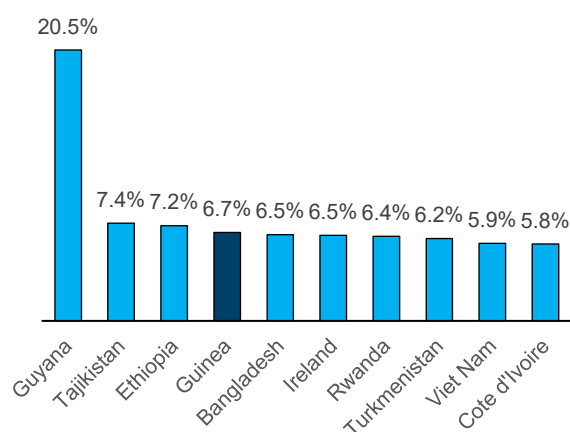


Source: World Development Indicators (World Bank, 2023)

Indeed, Guinea has been the fourth fastest growing economy in the world since 2016 (Figure 12), with average growth of 6.7%, despite the shocks of COVID, the war in Ukraine and the reduction in aid levels following the military coup in September 2021.

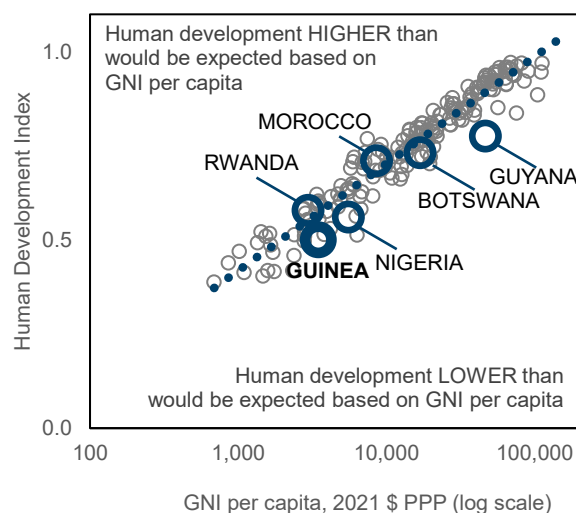
However, this economic growth has not translated into as much human development as might have been expected. The failure to translate GDP growth into human development is a common result in resource-rich countries, the most obvious example being Nigeria, but it also affects, to some extent, good performers such as Botswana (Figure 13).

Figure 12: Average real GDP growth, 2016-23



Source: World Development Indicators (World Bank, 2023)

Figure 13: GNI per capita vs human development



Source UNDP's Human Development Index 2023

4. Description and key assumptions about the Simandou project

The Simandou project is designed to bring to market the high-grade iron ore from the largest known still unexploited resource in the world (Rio Tinto, 2023). It is an integrated project comprising two separate 60 million tonne per annum mines, and a shared railway over more than 600km and port facilities. The corridor crosses the entire length of the country and, as such, has the potential to transform the nation (Figure 14).

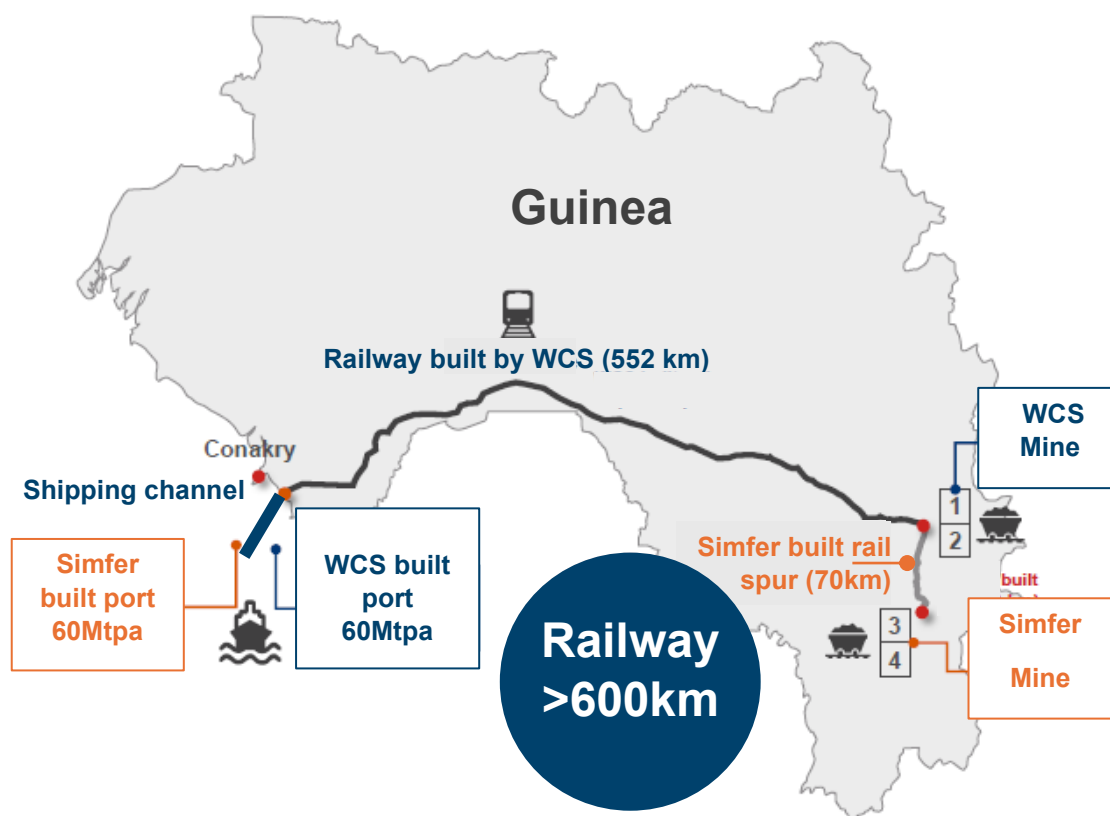
At over \$20 billion, the scale of the Simandou project is equal to the size of all other mining and energy investments in Guinea over the previous decade. The project is in an advanced state of construction and remains on target to start exports in 2026 with full ramp up over 30 months to reach 120 million tonnes by 2029 (Rio Tinto, 2025).

Table 1 provides a summary of operating and capital costs, and royalty, tax and state equity rates for the project.

The assumptions regarding the tax regime applicable to the Rio Tinto operated mine and the infrastructure are given in Rio Tinto (2023). WCS have not provided

an update of their latest fiscal settings, so these are assumed to remain unchanged from their 2020 exploitation convention (WCS, 2020).

Figure 14: Simandou high grade iron ore project scope



Source: Rio Tinto (2023)

Table 1: Simandou cost and tax assumption summary by company

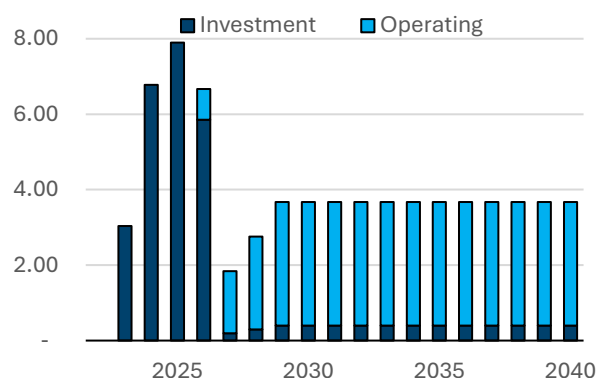
	Compagnie du Transguinéen infrastructure	Simfer Rio Tinto mine	Winning Consortium Simandou mine
Royalties (rate over total revenues)	\$0.50/t	3.5%	5%
Local development fund (rate over total revenues)	N/A	0.25%	0.5%
Corporate income tax	15% years 1-17 25% years 18+	15% years 1-8 30% years 9+	0% years 1-10 30% years 11+
Guinea Government equity	15%	15%	15%
Capex	\$13 billion	\$5.1 billion	?
Opex and sustaining capex	\$17/wmt	\$11/wmt	?

Source: Rio Tinto Investor Seminar December 2023, Convention de Base de WCS Juin 2020

In the absence of published data from WCS, the assumption is that the capital and operating costs for both mines are the same and are therefore based on Rio Tinto (2023). Beyond the estimated capital cost for mines and infrastructure of over \$20 billion, the ongoing operating and sustaining capital costs are expected to be around \$30 per tonne, totalling \$3.6 billion annually (Figure 15).

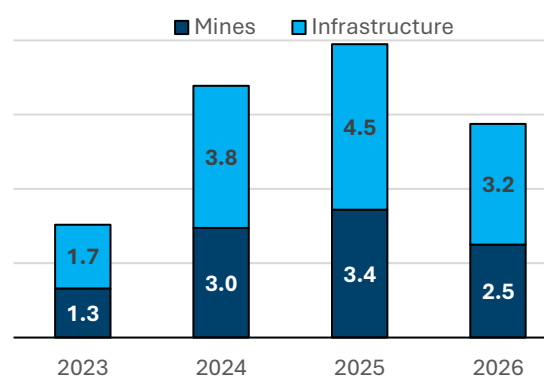
The profile of capital expenditure over time also assumes that WCS expenditure matches the costs incurred by Rio Tinto as reported in their latest full year financial results (Rio Tinto, 2025). The modelling also assumes that peak construction was achieved in the second half of 2024 and that expenditure is maintained at that level throughout 2025, with the remainder of the investment taking place in 2026 (Figure 16).

Figure 15: Simandou investment and operational expenditure, 2023 US\$ billion



Source: Authors' estimates, based on Rio Tinto (2023)

Figure 16: Simandou investment timing and breakdown, 2023-2026, 2023 US\$ billion



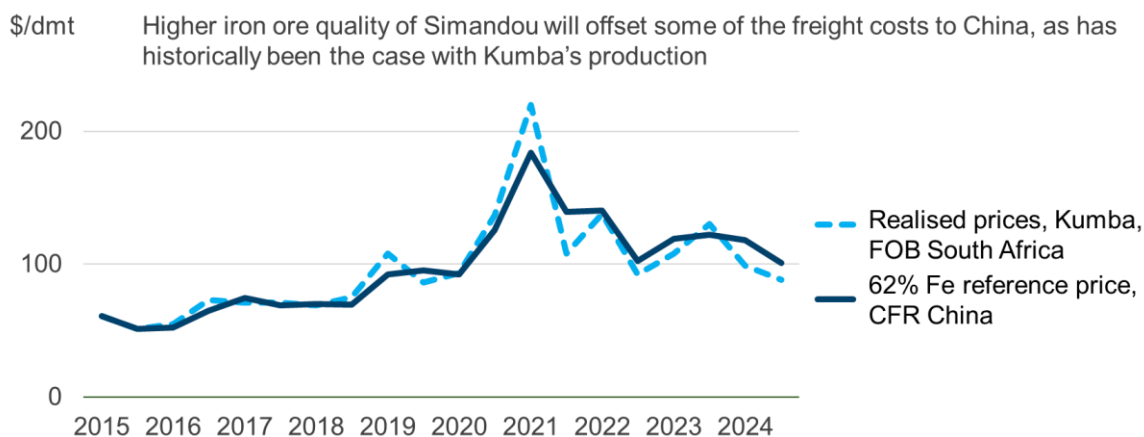
Source: Authors' estimates, based on Rio Tinto (2023)

The price of iron ore will be a key determinant of the ultimate impact and success of Simandou. Global reference prices are readily available from the futures market in traded in the Singapore Stock Exchange, and summarised on a monthly basis by the World Bank in its “Pink Sheet”. However, they do not a priori provide a suitable benchmark for the project’s ore as they are quoted delivered to China and for an inferior quality: 62% iron content compared to Simandou’s 65% Fe.

Figure 17 compares the reference price with prices achieved by the other significant high grade iron ore mine in Africa, Anglo-American’s Kumba in South Africa. The data show that higher iron content broadly offsets the cost of shipping the ore to China.

The analysis that follows assumes an iron ore price of \$100 per tonne, in line with average prices over the past decade for both the reference product and Kumba’s ore. The results will be tested for the potential downside case of prices averaging the estimated breakeven price for the project, which is determined in the FARI model in the following section.

Figure 17: Iron ore prices over the past decade

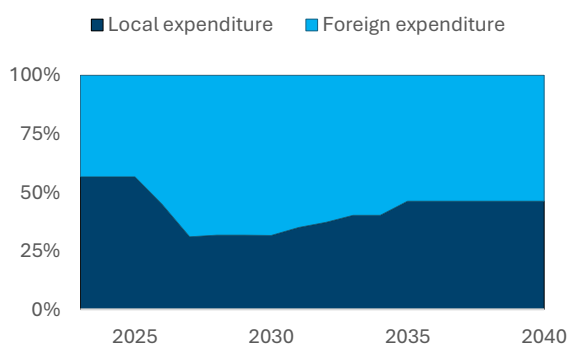


Source: World Bank “Pink Sheet”, Kumba Iron Ore Financial Results

The economic benefits of a mining operation are closely linked to its degree of integration into the local socio-economic environment, i.e. its local content. Local content refers to the business and revenue opportunities created by a mining project for local stakeholders in terms of the purchase of local goods and services, employment of local workers, mandatory (taxes, dividends, etc.) and non-mandatory contributions, and capacity building of local stakeholders to achieve socio-economic development objectives.

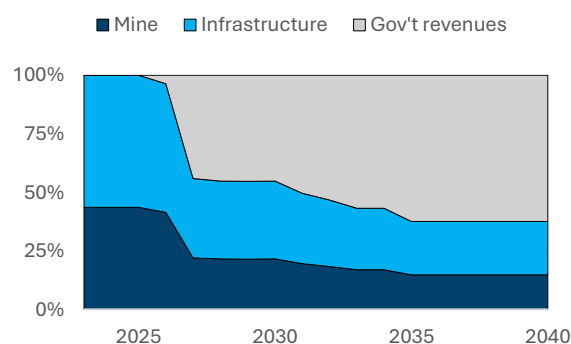
Based on data from 2024, local content at the Simandou project is expected to average 54% during the investment phase (2023-2026), then fall to just one third during the ramp up period (2027-2030) as foreign investors recover their capital investment, and only then do Government revenues start increasing in earnest so the local contribution settles at almost 50% of the total revenue flows by 2035 (Figure 18).

Figure 18: Simandou local and foreign expenditure breakdown



Source: Authors' estimates, based on Rio Tinto (2023)

Figure 19: Simandou breakdown of local expenditures



Source: Authors' estimates, based on Rio Tinto (2023)

Local expenditure on the Simandou project mainly relates to the purchase of goods and the provision of services to local businesses, salaries and capacity-building for local workers, the payment of taxes and dividends to the government, and social and community contributions (Figure 19).

During the investment phase, the majority of local expenditure (92% on average) is devoted to the purchase of goods and services. During the operating phase, operating expenses represent 46%, compared with 54% for taxes and dividends paid to the Government.

The Simandou project is not expected to be very employment-intensive, with an average of 3% and 9% of local expenditure devoted to salaries and capacity-building for local employees during the investment and operating phases respectively.

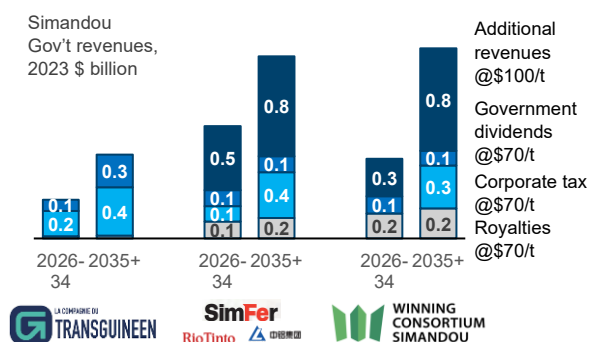
5. The FARI model and Simandou's fiscal impact

The next step is to use the publicly available Simandou data inputs to create a simplified financial model for the project. The IMF's simple, Excel-based FARI model (Luca and Puyo, 2016) provides the framework for estimating tax and other government revenues.

Based on the assumptions discussed above and at a 10% discount rate, the FARI model provides an estimate of a breakeven price for the project of around \$70 per tonne. Using this price assumption each mining company and the infrastructure company would provide similar revenues to the state.

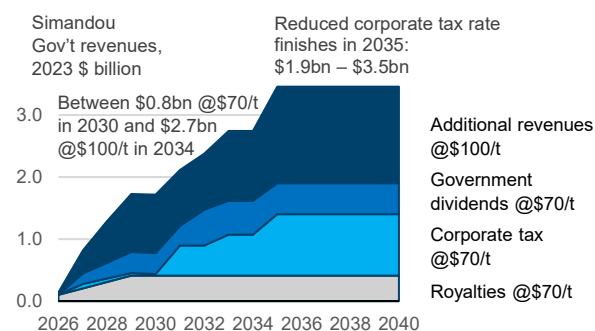
However, at the more optimistic price assumption of \$100 per tonne there is significant upside for each mine's contribution to the state. That is not the case for the infrastructure company, which is treated as a regulated utility (Figure 20).

Figure 20: Simandou fiscal contribution by infrastructure and mining company



Source: Authors' estimates, based on IMF's FARI model

Figure 21: Simandou total fiscal contribution over time



Source: Authors' estimates, based on IMF's FARI model

Under these price assumptions, the direct fiscal impact of the project for Guinea is estimated at between \$0.8 billion and \$2.7 billion annually at full production before 2035. Corporate tax rates increase in 2035, resulting in higher government revenues of between \$1.9 billion and \$3.5 billion thereafter (Figure 21).

6. The CGE model and Simandou's broader economic impacts

Sectoral interrelationships are ideally captured by a CGE model. The model is based on the neoclassical theory of general equilibrium, i.e. profit-maximising producers and utility-maximising consumers react to relative prices that simultaneously balance the quantities offered demanded on all markets.

In its standard structure, the model developed for Guinea is close to the methodological framework proposed by Decaluwé et al (2012). It is a model of a small open economy in which economic agents are takers of international prices for both exports and imports.

The model is dynamic, i.e. it reproduces the equilibrium state of the economic system on an annual basis. The dynamics are recursive or sequential, meaning that economic decisions are taken for one period at a time; there is no anticipation of the future on the part of the economic players. The dynamic component of the model involves the updating of factor endowments (labour and capital) and changes in total factor productivity.

The rate of increase in the labour force is used to update the exogenous labour supply for the period, while the demand for labour from the various economic activities is endogenous. The labour market is in imperfect competition with the appearance of excess labour supply (a mixture of unemployment and underemployment). The wage rate is maintained endogenous through the introduction of the wage-unemployment curve (Blanchflower and Oswald, 1994).

The vintage model, as proposed by van der Mensbrugghe (2021), specifies the availability of a rigid old capital per economic activity and a new capital that is mobile between the various economic activities. The old capital is periodically updated by the accumulation phenomenon; i.e. for each economic activity, the old capital for period T is the sum of the depreciated old capital of period $T-1$ and the new capital of period $T-1$. The new capital of period T is equal to the aggregate investment of period $T-1$. Aggregate investment is determined by aggregate savings - savings-led model.

The total factor productivity of an economic branch is related to its proportion of new capital to old capital by an elasticity parameter.

The current account balance of foreign trade or foreign savings of period T is indexed to the economic performance of period $T-1$. The government's budget balance balances its endogenous income and exogenous expenditure. Consequently, the government's fiscal policy directly affects the level of savings available for private investment (crowding out or leverage effect).

The model is calibrated to the Social Accounting Matrix (SAM) for the year 2021. The latter is a double-entry table describing transactions (creation, distribution and use of wealth) for the economy over that year.

Simandou's capital and operating expenditure is integrated into the Guinean economy through four channels. Firstly, local purchases of goods and services help to increase domestic demand (demand shock for local goods and services).

Secondly, the jobs created provide income opportunities that help to amplify the demand shock for goods and services. On the other hand, the shock to the labour market should be limited, at least for low-skilled jobs, with the economy's surplus labour supply.

The additional revenues from the project contribute to a substantial improvement in the State budget (budget shock). These revenues are assumed to be invested abroad, providing an annual income flow to the State over the entire period.

Finally, the foreign trade current account would be seriously impacted (foreign account shock). Not only will the project's direct imports and exports be significant, but so will movements in income from productive factors and indirect effects from other economic sectors.

The new CGE model is run in GAMS to project the Guinean economy over the period 2022-2040 according to three scenarios: without Simandou, and with Simandou at \$70/t and \$100/t iron ore prices.

The scenario without Simandou, or Reference, replicates the GDP growth rates from 2022 to 2026 derived from the latest macro-budget framework without Simandou. Growth rates for the remainder of the period (2027-2040) are then projected, maintaining the assumptions of the 2024-2026 period.

Both scenarios with Simandou simulate project capital and operating expenditure over the period 2022-2040. This assessment assumes that the government's windfall revenues from the project are invested productively in the local economy and not consumed. The impact of the project on the Guinean economy is assessed by comparing the results of the Simandou and Reference scenarios.

- Effects on the real exchange rate

The Simandou project's expenditure shock contributes to a strong appreciation of the real exchange rate compared with the benchmark during the investment phase (Figure 22). During the peak construction years of 2024 and 2025 the real exchange rate is on average over 5% higher than in the Reference case.

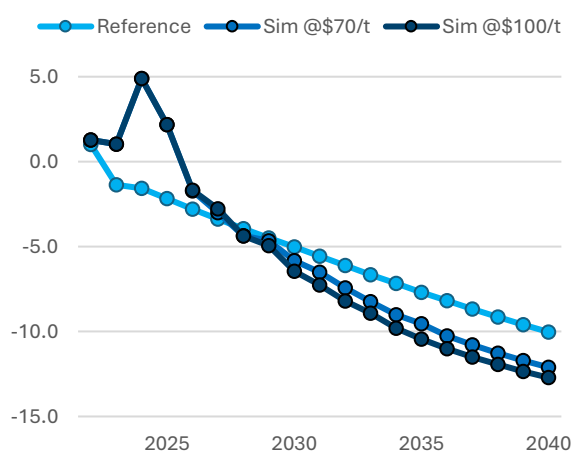
However, this is only a short-term because spending on the Simandou project helps to stimulate domestic supply through private savings-investment and thus reduces the inflationary pressure created by the increase in demand.

Moreover, assuming that all additional government cashflows are invested productively in the domestic economy, allows Guinea to reverse the short-term real exchange rate appreciation and settle at a lower real exchange rate in the longer term.

The real exchange rate appreciation created by the Simandou project expenditure would contribute to a significant performance gap between the tradable and non-tradable sectors. Value added in the non-tradable sectors of services and other industries (including construction services and electricity, gas and water) is increasing rapidly compared with more tradable sectors (Figure 23).

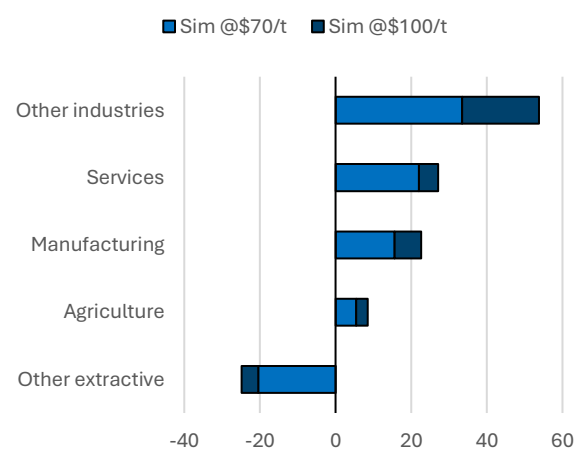
Other extractives, in particular, shrink by over 20% in the period to 2030 relative to the Reference case. This is the result of the sector being almost entirely export focused, and therefore the most exposed to the reduced international competitiveness implied by the short-term real exchange rate appreciation.

Figure 22: Modelled real exchange rate changes over time (%)



Source : Simulation results

Figure 23: Modelled changes in 2030 value add in the Simandou scenario vs Reference case (%)



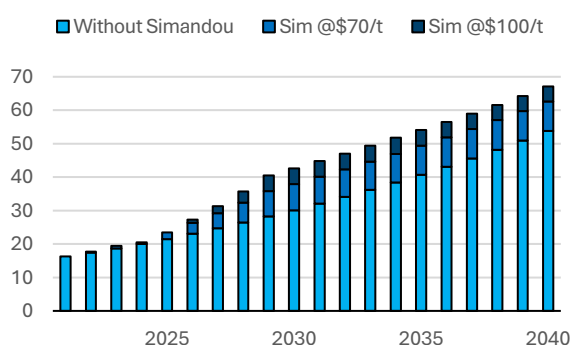
Source : Simulation results

- Effects on gross domestic product

The simulations show that Simandou should have a significant positive impact on the Guinean economy. It will contribute to an increase in GDP over the entire 2022-2040 period, with the incremental impacts slowing after 2029, the year iron ore production is expected to reach nameplate capacity (Figure 24).

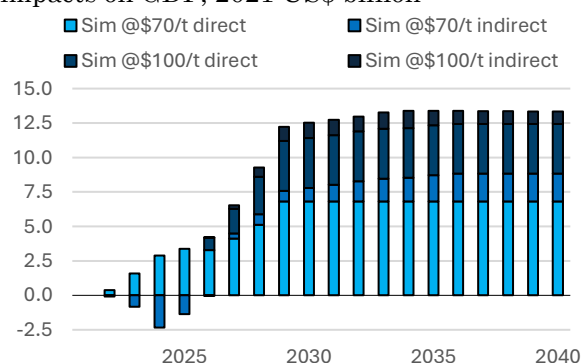
The incremental GDP ranges from \$7.8 billion in 2030 at a \$70/t iron ore price to \$13.4 billion in 2035 at a \$100/t iron ore price. By 2040, GDP is expected to rise to between \$62.6 billion at \$70/t prices to \$67.2 billion at \$100/t, compared to GDP of \$53.8 billion in 2021 US\$ in the Reference scenario.

Figure 24: Real GDP over time with and without Simandou, 2021 US\$ billion



Source: Simulation results

Figure 25: Direct and indirect Simandou impacts on GDP, 2021 US\$ billion



Source: Simulation results

The increase in GDP results mainly from the Simandou project's direct impact. However, the project should also contribute to the expansion of other economic activities (indirect effects). These indirect effects range from \$0.9 billion per annum at \$70/t to \$1.6 billion per annum over the period 2022-2040, i.e. about 15% of the total effects (Figure 25).

These positive indirect impacts are only observed from 2027 onwards. They grow gradually to reach \$2.0 billion per annum at \$70/t and \$3.0 billion at \$100/t by 2040. During the investment phase (2023-2026) these indirect impacts are negative, because of the sharp real exchange rate appreciation. This adverse effect is more marked in 2024 and 2025, the peak investment years.

In 2025, the Simandou project is expected to require investment of around \$6 billion in 2021 US\$, of which 43% will be in the form of direct imports (Table 2). The other 57% would be used almost entirely to purchase goods and services for local businesses. Local spending would represent 16% of projected GDP in the Reference. As a result, the economy would face a major product demand shock.

As the scale of the shock exceeds the economy's capacity to absorb it, a rise in the general price level and, consequently, an appreciation in the real exchange rate would be expected. The direct consequence is a fall in exports (\$2.1 billion) and a rise in imports (\$1.4 billion). Other things being equal, a sharp depreciation in the trade balance is expected in 2025 due to direct imports from Simandou and these indirect impacts on other imports and exports.

On the other hand, the additional revenues generated directly or indirectly by the project (positive effect) should be greater than the rise in prices (negative effect), helping to increase final consumption (\$0.9 billion) and investment (\$1.2 billion). The net negative indirect effects of \$1.4 billion are offset by the net positive direct effects of \$3.4 billion. The overall effect is a \$2 billion increase in GDP relative to the baseline in 2025.

Table 2: Simandou GDP impact breakdown, 2021 US\$ billion

	At \$70/t iron ore price			At \$100/t iron ore price	
	2025	2030	2040	2030	2040
Investment project (Direct)	5.9	0.0	0.0	0.0	0.0
Exports project (Direct)	0.0	8.4	8.4	12.0	12.0
Imports project (Direct)	-2.6	-1.6	-1.6	-1.6	-1.6
Total Effect (Direct)	3.4	6.8	6.8	10.4	10.4
Final consumption (Indirect)	0.9	1.5	1.8	2.0	2.3
<i>Reference</i>	17.8	24.0	40.1	24.0	40.1
<i>Simulation</i>	18.7	25.5	41.9	26.0	42.4
Investment (Indirect)	1.2	2.6	4.5	4.1	5.8
<i>Reference</i>	4.0	6.2	13.3	6.2	13.3
<i>Simulation</i>	5.1	8.8	17.8	10.3	19.1
Exports (Indirect)	-2.1	-1.1	-1.5	-1.1	-1.6
<i>Reference</i>	8.3	11.9	21.7	11.9	21.7
<i>Simulation</i>	6.2	10.8	20.3	10.8	20.2
Imports (Indirect)	-1.4	-2.0	-2.9	-3.0	-3.6
<i>Reference</i>	-8.5	-12.0	-21.4	-12.0	-21.4
<i>Simulation</i>	-9.9	-14.0	-24.3	-15.0	-25.1
Total Effect (Indirect)	-1.4	1.0	2.0	2.1	2.9
Total Effect (Direct and Indirect)	2.0	7.8	8.8	12.5	13.3
Total Reference	21	30	54	30	54
Total Simulation	23	38	62	43	67

Source: Simulation results

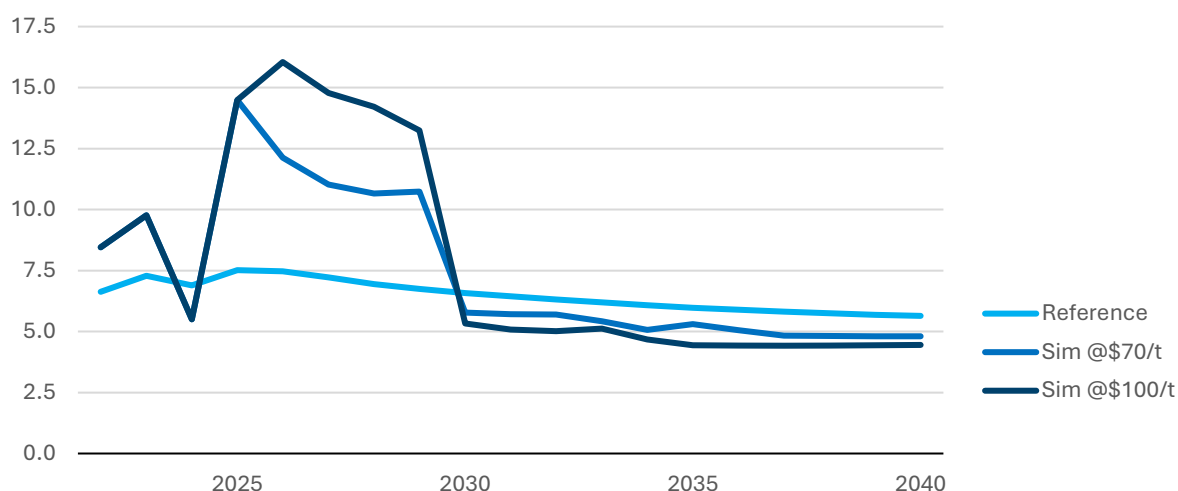
By 2030, the project would generate additional exports of between \$8.4 billion at \$70/t and \$12 billion at \$100/t. The associated rise in income drives an increase in investment (\$2.6 billion to \$4.1 billion) and final consumption (\$1.5 billion to \$2 billion). Operating the project requires ongoing additional imports of \$1.6 billion. The lagged impact of the initial real exchange rate shock combined with the investment boom results in continued higher imports and lower exports from the rest of the economy. The net positive indirect effects would amount to between \$1 billion and \$2.1 billion in 2030. The overall contribution of the project is a significant increase in GDP relative to the baseline of between \$7.8 billion at \$70/t iron ore prices and \$12.5 billion at \$100/t by 2030. There are additional modest increases in indirect effects to 2040.

The main impact of Simandou on growth starts to be felt in 2025 and 2026, when growth is projected to average about 14% per annum (compared with an average 7.5% in the Reference case. Growth is expected to continue to be above 10% until 2029, when the project is assumed to achieve full production capacity.

Although the latest IMF (2025) World Economic Outlook forecasts Guinea's growth will average 10.5% in the next four years, the estimates presented here suggest substantially higher growth of between 11.8% and 14.6% to 2029. Not only that, but this modelling suggests 2025 growth might be end up being double the IMF estimate of just 7.1%.

One final, important observation about these results is that without structural change growth rates return to a lower path than in the Reference case once Simandou production is fully ramped up. The reason for this is that in the Simandou simulations iron ore exports represent between 22% and 28% of GDP by 2030 and they stop growing.

Figure 28: GDP Annual Growth rate (%), 2022-2040



Source: Simulation results

7. Conclusion

Guinea and its partners have embarked on the \$20 billion Simandou project to exploit the world's largest untapped reserve of high-grade iron ore. This paper has deployed the IMF's FARI model to provide an ex-ante assessment of the fiscal impact of the project, and a GAMS-based CGE model to provide estimates of its wider economic impact.

The first finding from this modelling exercise is that the Simandou project should have a significant impact on Government revenues and on the size of the economy. Government revenues of between \$1.9 billion and \$3.5 billion by 2035, at \$70/t and \$100/t iron ore prices. By 2030 the economy will be between 26% (\$7.8 billion) and 42% (\$12.5 billion) larger than it would have been without the project, again estimated at \$70/t and \$100/t iron ore prices respectively.

Other things being equal, the results also show a detrimental impact on non-Simandou exports as the real exchange rate appreciates. However, at between \$1.1 billion and \$2.1 billion these are small enough that the positive impact of the additional iron ore revenues far outweighs them.

The third key finding is that without structural changes, once the project has ramped up to full iron ore production of 120 million tonnes by 2030, the country will revert to an economic growth path even lower than that of the Reference case. This result challenges the conclusion from other recent analysis which shows higher economic growth rates being sustained because of the Simandou project beyond the date of it achieving full ramp up (IMF, 2024).

Further analysis is needed to estimate the impact of policies that could lead to additional and sustained growth over time. In particular, the literature identifies three policy areas that could drive the structural economic transformation required to ensure Simandou does not turn into a missed opportunity.

First, the IFC (2020) recommends a local content policy and investment in sectors with strong synergies with mining, including housing, transport, energy and agribusiness. Second, the example of Brazil's largest iron ore corridor shows that shared-use infrastructure (which Simandou will provide) can have an impact on the productivity agricultural sector, with the corridor carrying 9 million tonnes of agricultural exports as well as nearly 2 million tonnes of fuel and fertiliser imports (Brauch et al., 2020). Finally, IMF modelling has shown that additional investment in education could lead to a sustainable increase in economic growth in Guinea (Badel and Lyngass, 2023 and IMF, 2024).

There is also a need to analyse the impact of Simandou investment on poverty and gender inequality. This is beyond the scope of this paper, but there is considerable experience in applying such approaches to estimate these effects, for example in

work on taxation (Fofana et al., 2016), trade liberalisation (Fofana et al., 2019), social subsidy programmes (Fofana et al., 2024) and climate change (Sawadogo et al., 2023).

Over the next few years, Guinea and the Simandou project should provide a rich source of research and policy evidence for how to translate mining-driven economic growth into sustained and broader-based human development.

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