working paper
2016-09

Mining and petroleum development and public spending policies in Niger: A dynamic calculable general equilibrium analysis

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February 2016

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policy analysis on growth and employment

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Abstract

This study analyzes public spending options from mining and oil resources and their impact on economic variables in the Nigerien economy. The model is based on an updated Social Accounting Matrix for 2012 that takes into account the structural changes in the economy. To analyze the different policy options, we use a dynamic calculable general equilibrium model (CGE) that takes into account spillover effects of public investment. Two scenarios are analyzed: (1) public spending in road infrastructure and (2) investment in the agricultural infrastructure. Both scenarios are compared to a situation where there is no intervention and thus where revenues from mining and oil are allocated by the market.

JEL: C68, J23, O13, Q18

Keywords: Mineral and oil resources, CGE, public expenditures, infrastructure investments.

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Acknowledgements

This study benefitted from financial assistance from the Partnership for Economic Policy (PEP) (www.pep-net.org), financed by the Department for International Development (DfID) of the United Kingdom and the government of Canada through the International Development Research Centre (IDRC).

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I. Introduction

In Niger, recent new exploitation[1] of uranium and petroleum deposits is generating substantial additional revenue flows. The contribution of the mining and petroleum sector to budget receipts is estimated at 13% in 2012 and will probably be about 26% in 2016, as compared to 6% during the 1990-2005 period (Institut National de la Statistique, 2013). These extra financial resources should ease government budgetary constraints and support an increase in public investment and job creation. At present, with per capita income barely at $360 per year, Niger is an economy characterized by the predominance of an agricultural sector which relies on variable weather conditions and weak overall infrastructure.

Also, to face these challenges, Nigerien public authorities envisage using mining and petroleum wealth to finance public infrastructure, agriculture, health care and education (IMF, 2012). The country is not sheltered from the risks associated with expanding extractive resources, the most common of which are weak management capacity and absorption of revenues. These risks are linked to real exchange rate appreciation and a loss of competitiveness of tradable sectors outside of natural resources (Dutch disease).

The link between public infrastructure and economic growth are the object of an abundant literature. Some studies show the importance of the stock of public infrastructure as a necessary factor for agricultural productivity (Esfahani and Ramirez 2002). Other studies instead address the efficiency with which existing capital stocks are used by citizens (Calderón and Servén 2008). Access to and use of public infrastructure have important social effects, notably in terms of reducing poverty and rural inequality (Fan and Zhang 2008). However, the size of these welfare effects depends on the institutional setup of the country (Duflo and Pande 2007).

The present study examines the impact on the Nigerien economy (economic growth and employment) of using revenues from extraction[2] for investments in agricultural and public infrastructure. We use a recursive calculable dynamic equilibrium model with a 2012 social accounting matrix which includes uranium production, crude oil and refined oil. The

[1] Since 2007, the country has been between a new phase of intensifying mining and petroleum activity, portending good economic prospects.

[2] These revenues are comprised of royalties and taxes paid by mining and oil companies, dividends received by the State as a shareholder and taxes on profits of firms.

study highlights the future evolution of the economy when accounting for expansion of mining and petroleum extraction along with spending options which contribute to growth and productivity in economic sectors. The paper is organized as follows. Section 2 and 3 respectively describe the literature review and possible options to spend the extractive revenues in consideration of the priorities and challenges in the Nigerien context. The data used, the methodology and the structure of the national economy are presented in section 3. The results of the analysis are presented in section 5, and section 6 is devoted to policy recommendations.

II. Literature review

To analyze the effects of public spending on infrastructure on an economy, the use of dynamic calculable equilibrium models[3] is needed because the impact of infrastructure unfolds over a long period of time. However, in the economic literature, the link between extractive resources and development remains ambiguous. For many authors, this link is only positive if resources are used to improve infrastructure, human capital and good governance (Acemoglu et al. 2003) or increase productive investments (Esfahani and Ramirez, 2002; Estache et al. 2008). Conversely, poor management of extractive resources has negative effects on production growth and competitiveness of non-extractive sectors (Sachs and Warner, 1999, 2001; Gylfason, 2001). Bategeka and Matovu (2011), using a dynamic CGE on data from Uganda, find important productivity gains in the extractive sector which lead to a significant reduction in poverty in rural areas. Similar results are found by Wiebielt et al. (2011). These authors highlight, however, that economic benefits in agriculture, income disparities between rural and urban areas, and poverty reduction, are larger when extractive resources are used to increase public investments in agriculture and to overcome chronic under-investment in public goods.

[3] In the literature, this model is increasingly used in particular to address issues relating to natural resources, because it makes it possible to account for the evolution of capital (Boccanfuso et al. 2014).

In fact, two areas of study can be discerned: the effects of infrastructure on economic growth or poverty and the effects associated with the mode of financing (Dutch disease[4]) infrastructure. Thus, Levy (2006)[5] analyzes the impacts of public spending on the development of road infrastructure and irrigation in Chad, financed by resources generated from oil. The author concludes that renovating water access leaves Chad less dependent on food aid, thereby also improving the wellbeing of Chadians. Positive impacts are also found by Boccanfuso and Savard (2010), Estache, Perrault and Savard, (2012) and Adam and Bevan (2006). For Bayoudh (2012), the impact is positive regardless of which type of public infrastructure investment is financed. His analysis is based on an inter-temporal dynamic model which incorporates positive externalities into total productivity of production factors in the private sector.

In the same vein, Savard (2010) analyzes the impact of an increase in public spending on infrastructure in the Philippines. The originality of the study has to do with two assumptions where in our case we account for a nominal wage rate above that of the market where there is also excess labour supply, and also the presence of externalities. It shows that the presence of unemployment in addition to externalities can attenuate or even change the impact of Dutch disease. This is confirmed by the study of Maisonnave et al. (2013) on South Africa. The authors show that in the presence of rigidities, increasing investment expenditures via taxation has very different effects on unemployment. In the short term, only less qualified workers experience a decline in unemployment. In the long term, the investment plan is not able to generate the right kind of economic activity to reduce unemployment.

In Niger, Go et al. (2013), using a calculable general equilibrium calibrated on a 2009 social accounting matrix, examine the implications of spending options proposed in recent literature on Dutch disease. The scenarios developed involve a transfer of resources to households and an increase in public spending on education and health via improved labour productivity. They find that while exchange rate appreciation cannot be ruled out, transferring resources to households is the option with the greatest impact on poverty

[4] The issue of Dutch disease is associated with the mode of financing public expenditures undertaken, particularly if this increase in public expenditures is through foreign aid.

[5] The author is interested in the relevance of agricultural policies and investment in infrastructure likely to help avoid Dutch disease in Chad.

reduction in the short and medium term. They also find that one of the ways to speed up this poverty reduction is through development of the agricultural sector. The study uses a 2004 SAM updated to 2009 using provisional estimates of extractive income flows because the economic structure of Niger has been evolving since the mining and petroleum boom[6]. Our study, which uses a SAM updated to 2012 and accounts for the new structure of the economy, extends upon the works of Go et al. (2013).

III. Characteristics of the Nigerien economy

3.1. State of public infrastructure in Niger

In Niger, public infrastructure has a low contribution to economic growth. The contribution of road, electricity and telecommunications infrastructure to per capita growth were among the lowest in West Africa (0.3 percentage points annually over 2000-2005). Survey data from firms indicate that infrastructure constraints are responsible for about 35% of the productivity gaps of Nigerien firms, the remainder being due to poor governance, bureaucracy and financing difficulties. Transportation infrastructure includes a road network of 16 945 km, of which 80% are "classed"[7]. The network of classed roads is comprised of about 6 055 km of primary roads (interstate and national roads) and 7 500 km of rural roads. Given that the country is landlocked, transportation infrastructure is essential for cross-border trade. Four main corridors are used to reach ports, including the Cotonou-Niamey route which enables the import of oil and most goods. Fundamentally, public infrastructure (roads, electricity, telecommunications, bridges, sanitation and water treatment) are an essential input for production. They make it possible to concentrate economic resources on a specific productive activity at hand, to create markets, and to improve factor productivity.

The dearth of infrastructure in developing countries contributes hugely to low factor productivity: repeated electricity outages, problems with the communications system, insufficient quantity and quality of roads, for example, are impediments to investment,

[6] This boom began in 2007 with uranium and 2011 for petroleum.
[7] This attribute is given to the road network via a regulatory provision which determines the status of a road.

growth and poverty reduction in these countries (World Bank, 2002). In the agricultural sector, needs for agricultural infrastructure involve rural roads and irrigation systems. For a country, the effects of infrastructure on growth via total factor productivity depend not only on the type of infrastructure but also the initial endowment in terms of infrastructure. A study by Yeaple and Golub (2007) estimated the effects of three types of infrastructure (roads, telecommunications and electricity), and in that situation found that roads came in first place.[8]

3.2. Size of mining and petroleum sector in Niger

In Niger, exploitation of uranium is done by two subsidiaries[9] of the French nuclear group AREVA and the Société des Mines d'Azelik (SOMINA)[10]. In 2009, AREVA obtained rights to exploit the Imouraren deposit[11] which has estimated reserves of 200 000 tonnes, for estimated annual production of between 5000 and 6000 tonnes. Exploitation of this deposit (the largest in Africa) will make Niger the second largest producer of uranium in the world.

Production of oil started in November of 2011. Operations are governed by a production sharing agreement between the State of Niger (40%) and a Chinese company, the China National Petroleum Company (60%). The operating contract enabled development of the Agadem oil field and building of the Zinder refinery (SORAZ)[12] linked to the oilfields by a pipeline. At present, domestic demand is about 7000 barrels per day, so the remainder of production (13,000 barrels/day) is for export. By 2017 total oil production will reach 80,000 barrels/day, 60,000 of which will be exported through a pipeline via Chad. The oil reserves, initially estimated at about 300 million barrels, may be 900 million barrels according to more recent national estimates.

[8] The study deals with 12 developing countries and productivity was evaluated in 10 industrial sectors between 1979 and 1997. The final sector is 9/10 for roads as compared to 2/10 for telecommunications networks.
[9] COMINAK (Communauté Minière d'Akouta) and SOMAIR (Société des Mines de l'Air).
[10] A subsidiary of the China National Nuclear Corporation (CNNC)
[11] The timeline to start extraction at the Imouraren mine has been delayed to 2017.
[12] This refinery has a capacity of 20,000 barrels per day, and produces gasoline, diesel and liquefied gas.

Receipts from the oil sector include receipts from crude oil by the CNPC, receipts generated by the Société de Raffinage de Zinder (SORAZ) and receipts from the distributor (SONIDEP) on domestic and international markets. For uranium, revenues generated are from taxes (royalties and dividends) and exports.

Between 2006 and 2012, the value of uranium exports increased fourfold (from 80 to 338 billion FCFA) and the volume of production increased by 35% (3434 tonnes to 4623 tonnes). Public receipts generated are six times greater than in 2006 (70.4 billion as opposed to 12.1 billion FCFA). Extractive revenues accounted for 10.8% of public receipts in 2012 and 6% in 2013 (Table 1). They are estimated to rise to 258 billion FCFA by 2016, 175 of which from uranium and 82.5 billion of which from oil (IMF, 2013). Compared to the level reached in 2012, this would represent an overall increase of 232%[13], of which 148.6% from uranium and 39.8% of which from oil, while the share of mining and petroleum revenue flows to the budget of the State reaches 26.8%. The start of operations at the Imouraren deposit will increase uranium production to 10,000 tonnes per year by 2020.

Table 1: Contribution of extractive sector to receipts of State

	Resource	2007	2008	2009	2010	2011	2012	2013
Exports in billions FCFA	Uranium	136.6	198.2	195.1	228	317.4	338.3	302.8
	Petroleum					0.026	109	180.3
Contribution (%) of budget receipts excluding aid	Uranium	28.6*	10.0	13.3	14.2	10.4	12.9	9.5
	Petroleum						10.8	25.6
Weight in total exports	Uranium	63.8	62.6	64.0	61.0	74.8	59.6	49.2
	Petroleum						20.1	29.3
Contribution (%) to GDP	Total	4.4	6.0	6.4	7.2	7.5	10.8	6.1

Source: IMF, 2011, Nigerien authorities, and authors' calculations
* Budget receipts plus revenues from sale of mining assets (46 763 797 690 FCFA) both occurred in this year.

3.3. Extractive revenues: which options for spending?

In Niger, the boom in the extractive sector has permitted growth in public spending which has reached 26% of GDP (World Bank, 2013). But considering the weak initial stock of physical infrastructure, an investment plan is needed to accelerate productivity growth in

[13] Government revenues from mining and petroleum resources rose to 129.4 billion in 2012, 70.4 billion of which from uranium and 59 billion from petroleum.

tradable and non-tradable sectors. The most important levers of growth defined in the Social and Economic Development Plan (PDES) are investment in agriculture and sectors connected to agroindustry and trade in agro-sylvo-pastoral products[14] as well as investments in roads favourable to the industrial sector. Investment in agricultural infrastructure is a determinant of changes in poverty reduction (Diao, Hazell and Thurlow, 2010; Valdés and Foster, 2010), especially in countries like Niger where agriculture accounts for more than 40% of GDP and occupies more than 80% of the active population. As for tradable goods sectors, they are a small share of the Nigerien economy and productivity could be improved through appropriate investments in road and energy infrastructure. Basically, due to being landlocked, weak transportation infrastructure is very relevant for the functioning of markets and household welfare.[15]

Extractive revenues can be a source of financing for infrastructure. They are associate with some management risks, however (Collier et al. 2010; Arezki et al. 2012) and risks of Dutch disease[16] (Levy 2006). In Niger, the main challenges relate to volatility of prices, and thus revenues (which makes any long-term planning difficult) and also the institutional capacities to manage the investment budget to avoid slippage of expenditures or otherwise fiscal indiscipline. Another important point relates to the weak absorption capacity of the economy which makes infrastructure investment inefficient while leading to illusory short-term growth. But in the long run the investments did not result in higher production capacity or higher productivity (Wiebelt et al. 2011). So, despite development challenges, taking a prudent approach to public spending remains desirable. Among others, one of the recommendations of the IMF and World Bank is to make a fund for future generations and plan spending more carefully.

[14] In 2011 Niger launched an initiative called Nigeriens Feeding Nigeriens (*Nigériens Nourrissent les Nigériens*) aiming to promote food security and sustainable agricultural development, which also comprised one of five main strategic axes of the economic and social development plan of Niger, developed by the government for the 2012-2015 period. Other strategic axes relate to: i) consolidation of the credibility and efficacy of public institutions; ii) the creation of sustained conditions for equitable and inclusive development; iii) promotion of a competitive and diversified economy for accelerated and inclusive growth and iv) promotion of social development.

[15] On the one hand high transportation costs are not good for interconnectedness and trading facilities between regions; on the other hand household wellbeing is affected through reduced access to commodities and social services.

[16] Generally, the fear linked to Dutch disease relates to sudden and massive increases in State revenues following mining and petroleum expansion.

IV. Model used

To study the effect of an increase in public spending in infrastructure on employment and economic growth, we use the PEP 1-t recursive dynamic general equilibrium model of Decaluwé et al. (2013) with some additional specifications suitable to the Nigerien economy.

The model is constructed using a 2012 social accounting matrix with 10 sectors (4 of which extractive), 4 production factors and 11 agents including 3 types of firms (cf. annex 1). It is typical of a small multi-sectoral economy, which does not influence world prices. It considers the labour market as segmented by qualification level and a specification of extractive firms. Equilibrium on each market is reached through changes in relative prices. The nominal exchange rate, the numeraire in the model, is fixed. Also, production and processing/transformation decisions are determined using a profit maximization process. Producers have a choice between selling their goods on the domestic market or to export their production, and are influenced by relative prices on markets and the elasticity of transformation of different goods.

On the demand side, the final consumption of households is represented by an LES-type demand function derived from a utility maximization process under a household budget constraint. Public spending of the State is exogenous and corresponds to total production in the non-market sector. Consumption may substitute between domestic and imported goods according to a substitution elasticity specific to each product (Armington assumption). Finally, investment demand for different products is distributed between public investment and private[17] under the assumption of a unitary substitution elasticity between the different products. Public investment is a determinant of growth in total productivity of factors.

The sources of income for private agents are basically from remuneration to production factors and different transfers. Savings is defined as a fixed share of disposable household income. In terms of firms, it is calculated as a residual, after deducting dividends and taxes from total income. The State gets revenues from total tax receipts (direct taxes, indirect

[17] Private investment is the sum of savings of households, firms and the rest of the world (incoming investment) while public investment is exogenous and is done through public savings.

taxes, customs tariffs and export taxes), in addition to transfers from the rest of the world and a share of capital income. The government allocates its revenues between transfers to firms, to households and public spending.

In order to account for the specificities of Niger, we have changed some assumption of the base model. One change is to account for the situation on the labour market in Niger: we assume that there is unemployment on each market (qualified labour and unqualified labour), following the approach of Blanchflower and Oswald (1995)[18] according to which we consider that there is a negative slope between unemployment and wage rates on labour markets.

Also, to capture the increase in maintenance costs which may result from growth in public investment (ITP), the model includes a cost factor ω in specifying public spending (G):

$$G = G_0 + \quad (ITp \quad ITpo)$$

where ITp represents public investment, ITpo public investment in the reference year and G_0 the level of public spending at the reference date. The values attributed to ω are specific to each subsector and are taken from Fay and Yepes (2003)[19]. Finally, our model accounts for effects of positive externalities of infrastructure investments on other sectors of economic activity.

Increased public spending is not necessarily directly linked to productivity in the private sector. It increases purchases of public goods and services and promotes employment in the public sector. To establish a link between growth in public capital and productivity of the labour force and capital, a multiplier Ψj is introduced into the value added equation (Maisonnave et al. 2013; Adam and Bevan, 2006).

As done by Eustache et al. (2007), the productivity multiplier Ψj is specified as a linear function of the ratio between public investment at time t (ITp) and at the reference date (ITpo). Public investment makes it possible to build new infrastructure which leads to an

[18] According to Blanchflower and Oswald (1995) and Card (1995), studies from many countries show that the wage-unemployment curve is "virtually identical from one country to another and stable over time" with an elasticity of generally about -0.1.

[19] In an analysis of Sub-Saharan African countries over 205 to 2010, these authors find values of ω de 0.84 for investments in road infrastructures, 0.9 for electricity and 0.74 for telecommunications.

increase in the stock of capital compared to the previous period, producing a positive externality

$$_j = \left(ITp/ITpo\right)^{j}$$

where ε_j is the elasticity of investment specific to the sector which makes it possible to account for the different impacts of investment in each sector. The values of the elasticities are taken from Vanduzai et al. (2012).

V. Results

5.1. Simulations

Three types of scenarios are presented, the first of which is the reference situation and accounts for continued growth in mining and petroleum production in the absence of any specific policy to use resources from mining and petroleum. In this scenario, there is no State intervention in terms of economic policy.

Two other simulations are the options of policy choices for use of extractive resources which can be summarized as follows:

Simulation 1: Attributing resources generated to a 25% increase in road infrastructure.
Simulation 2: Attributing resources generated to a 25% increase in agricultural infrastructure.

These two scenarios are consistent with the priority axes presented in the PDES, in particular strengthening industry and developing the agricultural sector as engines of the Nigerien economy[20]. The chosen rate of increase is estimated using the share of road investments in the total investment budget. It is assumed that public investments will facilitate access to equipment and inputs (fertilizers and phytosanitary products, among others) in the agricultural sector and promote diversification of export industries. Also, public investments in road infrastructure (construction and upkeep) can increase total productivity of factors in industry (Dumont and Mesple-Somps, 2008 ; Bayoudh 2012).

[20] This sector employs more than 80% of the population and accounts for more than 80% of economic growth.

Generally speaking, investments in public infrastructure affect the economy in two ways. On the demand side, they increase public spending (investments and maintenance costs), which leads to an increase in aggregate demand which drives income. On the supply side, they reduce production costs, facilitate integration of production areas and market into the broader economy and increase efficiency and productivity.

In the reference scenario, the shocks represented include growth in uranium and oil export revenues as per the forecasts provided by the Ministry in charge of mines and petroleum (cf. annex 4). It is assumed that the export of crude oil (60,000 barrels/day) will begin in 2017 and the substantial increase in uranium production via the Imouraren mine will come in 2019. The base scenario uses economic growth forecasts from the IMF.

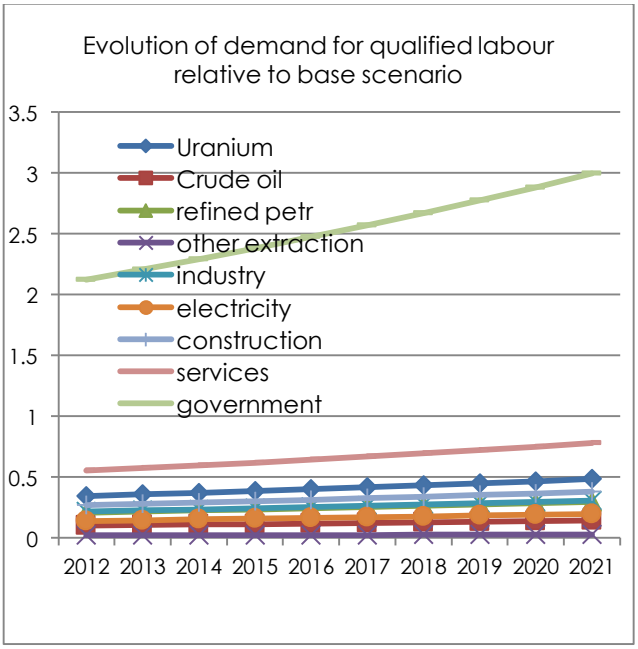
5.2. Analysis of simulation results

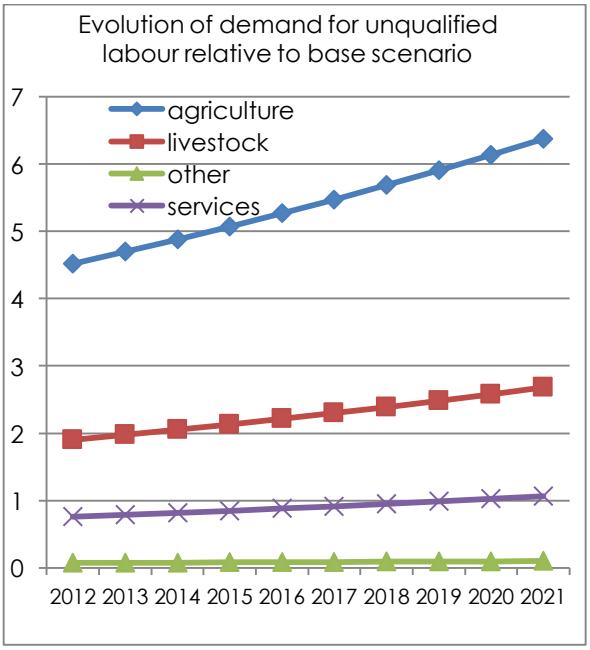
The simulation results are presented with an emphasis on the effects on employment, household income and economic growth. Each sub-section first presents the results of the reference situation which are then compared with those from the simulations.

5.2.1. Effects on employment

The increase in annual public investment has a positive impact on employment in all sectors. More specifically, qualified employment grows most in the public administration and services sectors and unqualified employment grows most in agriculture and livestock.

Figure 1: Evolution of demand for labour by type in the base scenario



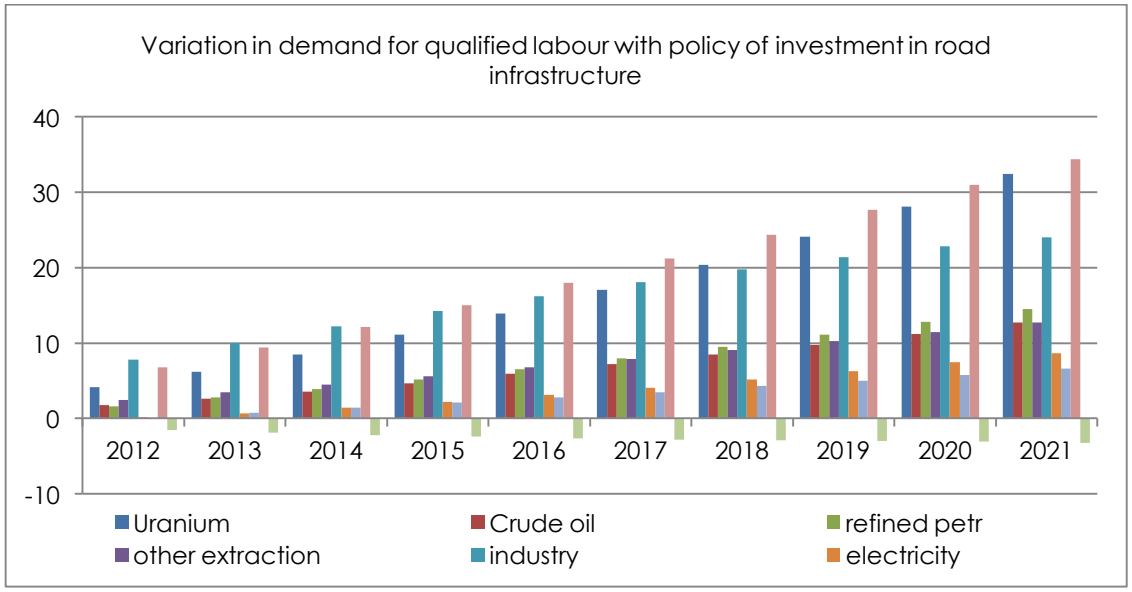


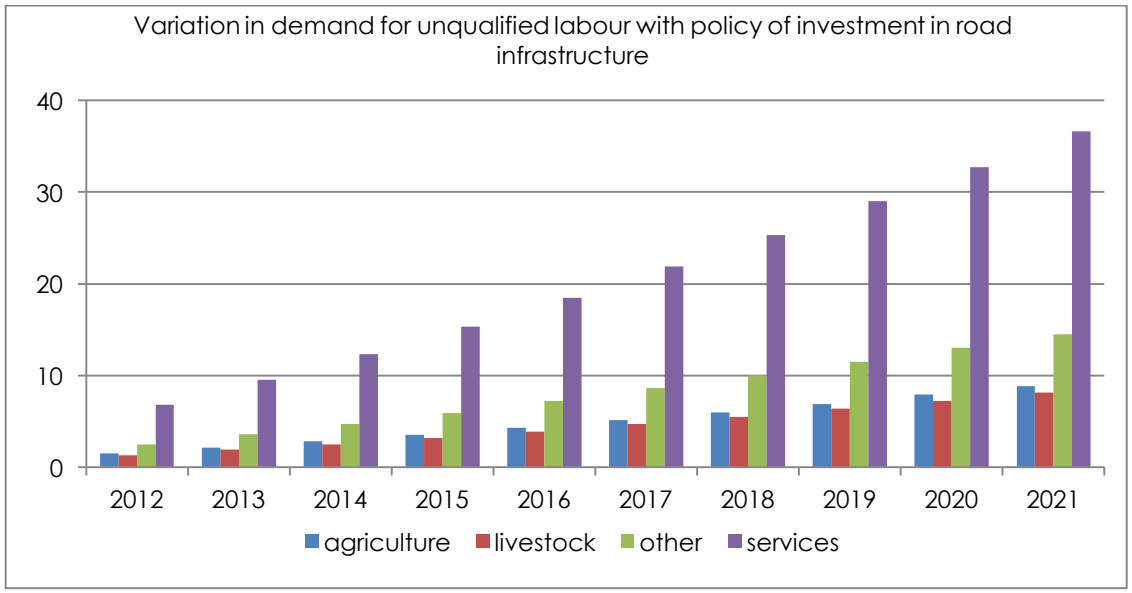
Source: authors, simulation results

In setting a policy in favour of road infrastructure, the rate of growth of demand for qualified labour compared to the reference scenario is stronger in the extractive sectors, in industry and in services, while it declines in the public administration sector. It happens as though there is a reallocation of workers. This is all the more relevant because improving factor productivity and reducing transportation costs through infrastructure makes it possible to increase demand for labour in sectors which use these services most intensively.

In terms of unqualified labour, the policy measure has the effect of increasing labour demand by more than the reference scenario, especially in the services and other production sectors. Expansion in the primary sector is comparatively smaller.

Figure 2: Impact of investments in road infrastructure on demand for labour by type (% with respect to reference scenario)





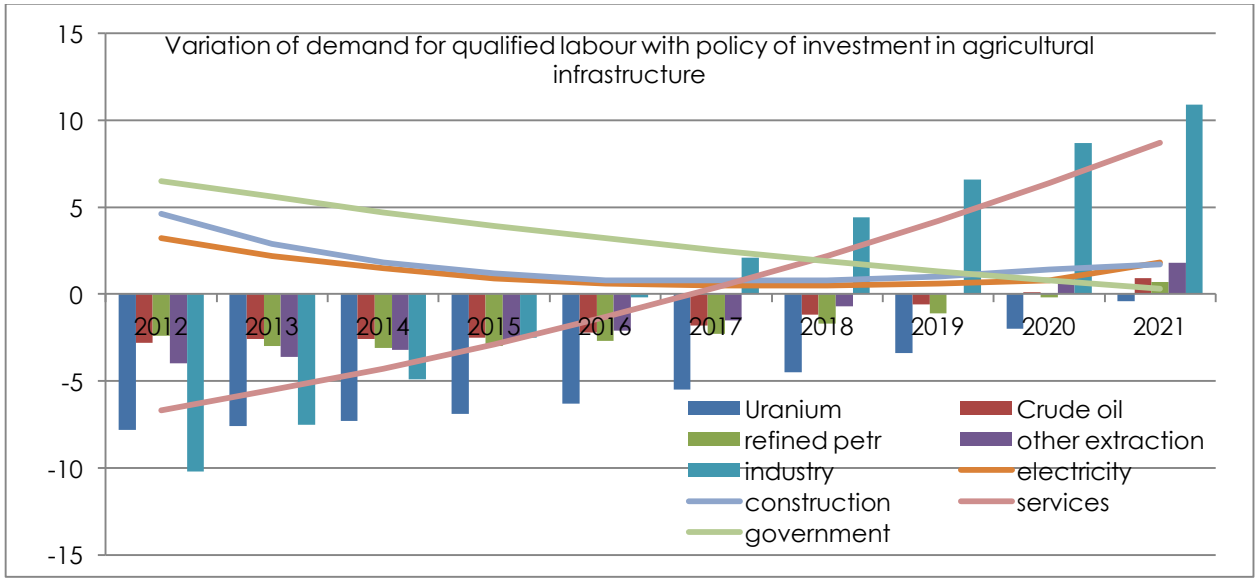
Source: authors, simulations results

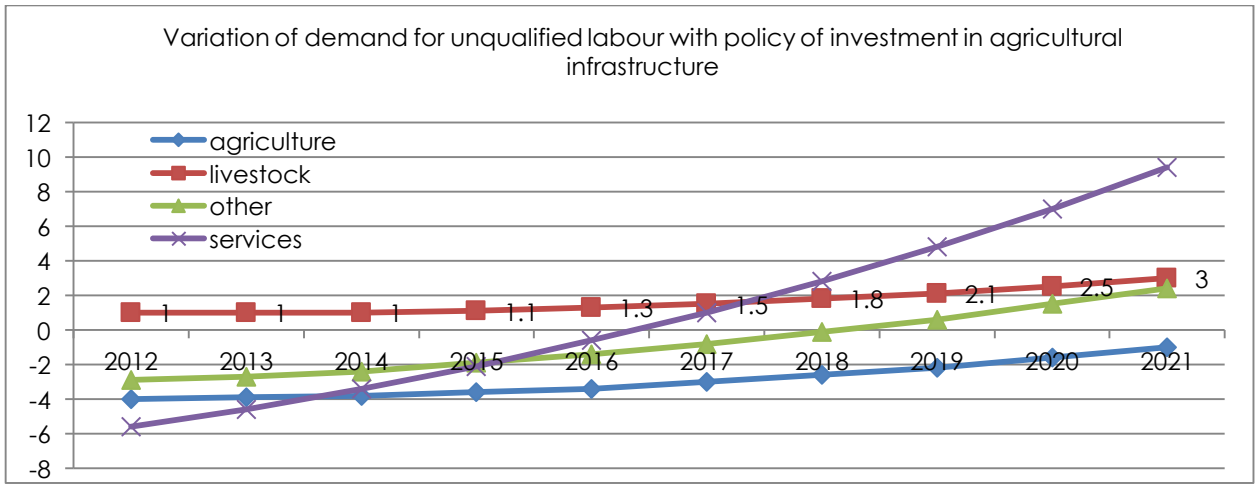
As opposed to the preceding scenario, the policy measure of increasing investments in agricultural infrastructure has mixed effects on employment (Figure 3). Short-term demand

for qualified employment rises in three sectors (public administration, construction and electricity) but then declines over time. The situation is different in other sectors where the quantity of labour employed declines. The largest observed variations are in the services sector (8.7% larger by 2021) and industry (11% higher by 2011). Employment of unqualified workers does not increase as quickly in services sectors.

The increase in agricultural infrastructure has initially negative effects on demand for qualified labour while demand for unqualified labour rises rapidly in the services sector (from -5% in 2012 to 10% larger by 2021). This results from a notable decline in agricultural prices as well as improved returns to capital which make it more attractive to invest in productive capital.

Figure 3: Impact of investments in agricultural infrastructure on demand for labour by type (% relative to reference situation)



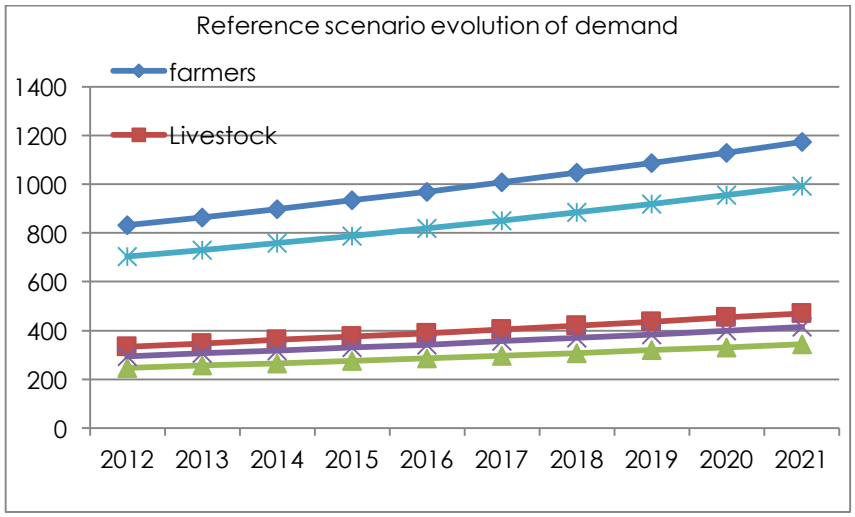


Among qualified workers, unemployment disappears in 2019. The decline in demand for labour observed in the simulation can be explained by the decline in investment available for other sectors outside of agriculture, which increases prices. The phenomenon is attenuated by the positive impact of agricultural investment on their production through lower marginal costs. Finally, qualified employment is not higher in the industry and services sectors until 2018. These two sectors are linked to the agricultural sector through internal demand.

5.2.2. Effects on income of households

With the decline in unemployment, workers will see their wages rise. The increase in public activities causes an overall increase in demand for labour.

Figure 4: Impact on household income (base scenario)



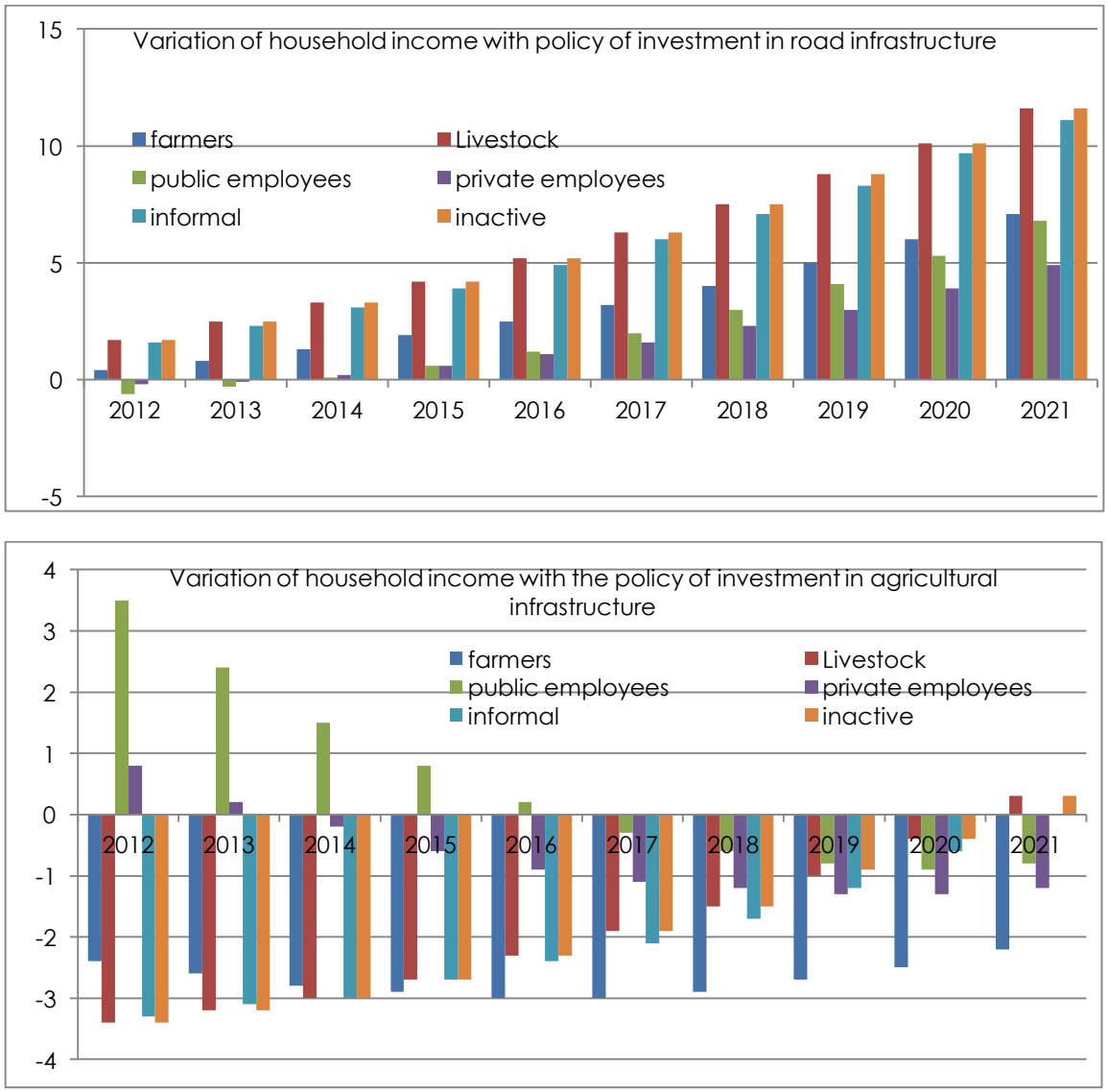
Source: authors' simulation results

Also, to keep their workers and avoid losing them to the public sector, in other sectors there will be higher wage constraints. The increase in wages leads to higher household income, in particular among agricultural and informal households.

In the two implemented simulations, it seems that the road infrastructure investment policy is better. For example, over the time horizon, farmers, informal workers and the inactive will see their income rise by more than 10%, which is consistent with the increase in labour demand. Among other things, this type of infrastructure facilitates transportation of goods and enables better availability of energy, parts and various other inputs needed for

production, and distribution of goods and services. Household savings and consumption also rise.

Figure 5: Impact on household income (% with respect to base scenario)



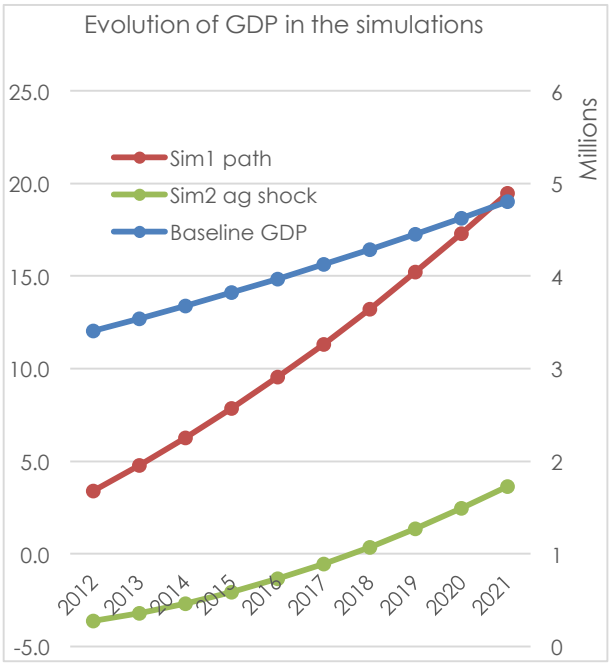
Source: authors, simulation results

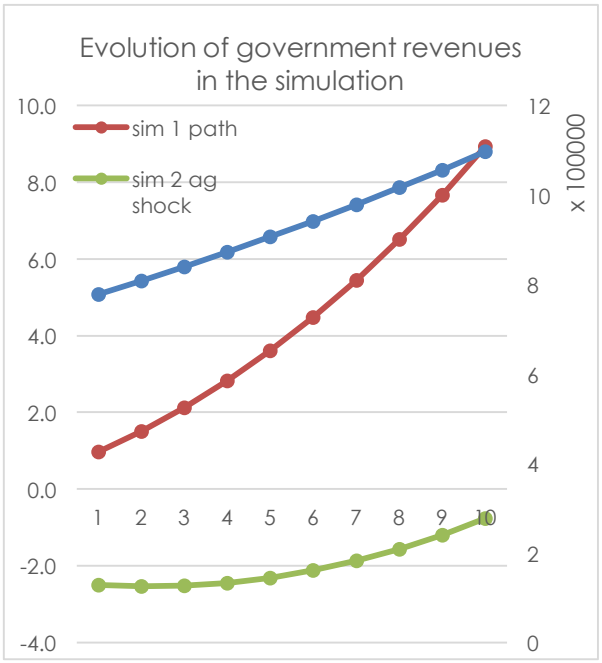
In terms of the policy of investment in agricultural infrastructure, in the short term it leads to a decline in total income of all household groups except for private and public employees compared to the base scenario. The beneficial effects of the policy measure appear progressively over the long term for households involved in farming, informal activities or with inactive members. Paradoxically, we observe that agricultural households ultimately do not benefit much from the measure because their total income remains nearly stable in the long run. This situation is due to higher prices in markets outside of agriculture.

5.2.3. Effects on economic growth and government revenues

The reference scenario in a context of a mining and oil boom shows a good growth trend. GDP grows regularly. In opting for a policy targeting infrastructure in roads or agriculture and assuming a 5% increase in annual growth in capital, the State can optimize the beneficial impacts on the economy.

Figure 6: Impact on GDP and governments revenues (reference scenario)





Source: authors, simulation results.

Compared to the reference scenario, GDP increases by more and the government deficit is smaller. Over the period, the best returns are from the road investment policy. This can be explained through productivity gains induced in the industrial sector which have larger spillover effects. The figure above shows that the larger effects on government revenues are in the long term.

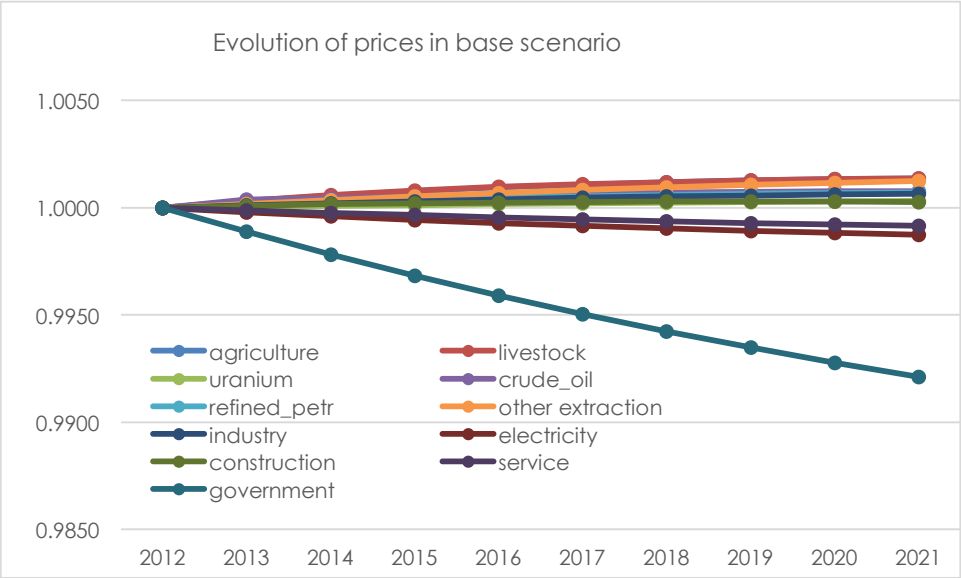
5.2.4. Effects on prices

In the reference scenario, expansion of the extractive sector does not cause much price variation in the long run outside of oil products.

The multiplier effects induced by the presence of road infrastructure lead to a general decline in prices which grows over time in all sectors. However, in the case of a policy in

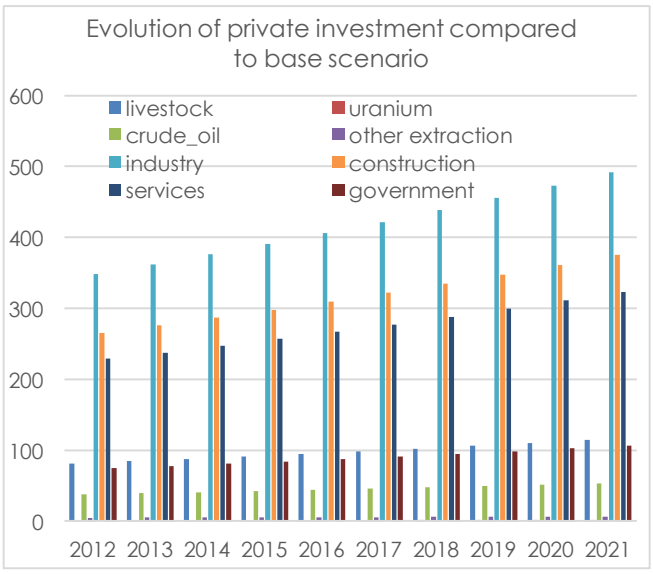
favour of agriculture, the decline in prices is limited to the agriculture sector in the short term. It appears later in other sectors, mostly after 2018.

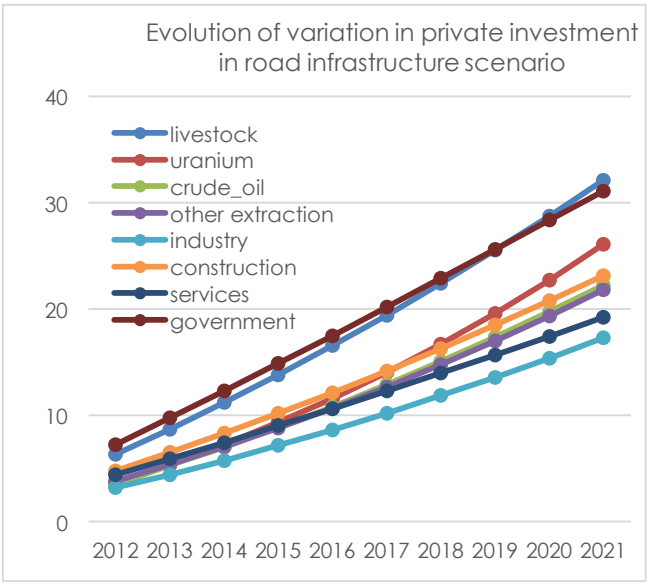
Figure 7: Impact on prices (base scenario)

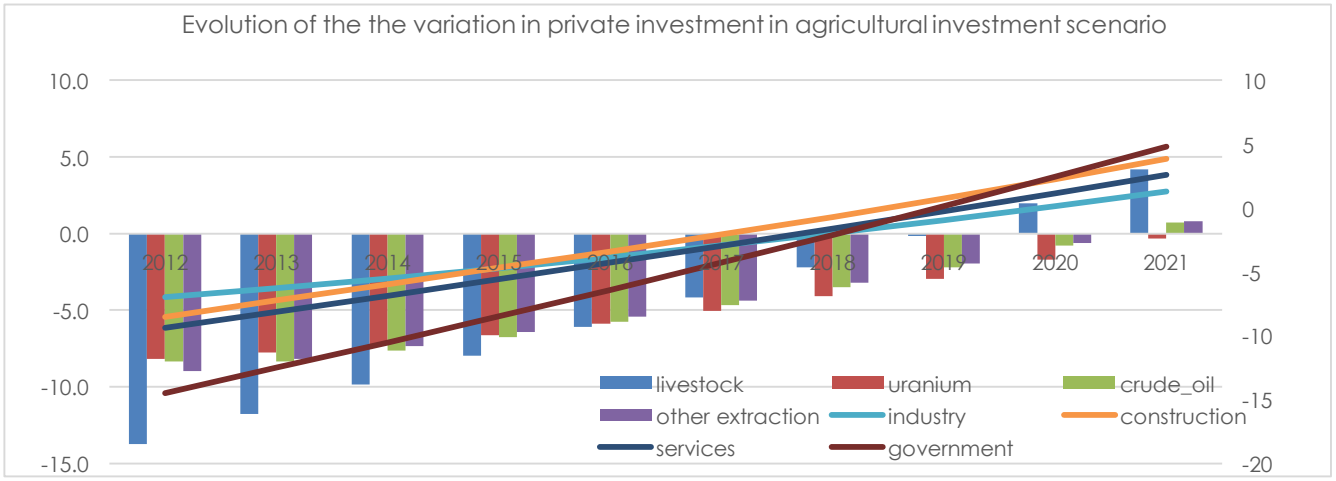


In all simulations, growth in private investment is observed. The improved infrastructure promotes private firms to invest. In the case of road infrastructure, investment rises as of the first years, especially in livestock and extractive sectors. In reality, the increase in public investment should lead to a decline in private investment which is rapidly countered because some of the government investment is productive. The situation is different in the case of measures in favour of agriculture where the benefits are delayed (and hence the short-term decline in investment). Compared to the reference scenarios, the sectors which benefit most from the measures are livestock and public administration in both scenarios.

Figure 8: Impact on private investment by each simulation







Source: authors, simulation results

VI. Conclusions and policy implications

The overall objective of this work was to evaluate the macroeconomic impact of public infrastructure spending options on employment and economic growth. The reference scenario has a very decent economic growth trend, especially due to developments in mining and petroleum. The two scenarios of allocating resources generated from this were developed and compared to the reference scenario. The first considers public spending on

road infrastructure and the second considers an investment policy in agricultural infrastructure.

The simulation results showed that implementing an investment policy targeted to infrastructure will positively impact the Nigerien economy compared to no policy. In both cases we observed higher growth, more private investment, and higher household and firm income. The policy in favour of road infrastructure brings better results for economic growth with beneficial effects appearing from the first years, while improvements in agricultural infrastructure have delayed effects which do not appear until after 2018.

It is thus essential for the State to play a leading role in public spending to drive the economy. The spillover effects are larger in the case of a policy in favour of road infrastructure.

The results obtained only enable us to see the effects of investment policies at an aggregate level. It would be useful, following this work, to perform a micro-simulation in order to evaluate effects on wellbeing and poverty of individuals.

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Annexes

Annex I Uranium production and export, Niger (2000-2013)

Year	Production	Exports	Exports		
	Tonnes		billions FCFA	% of export receipts	% of budget receipts	% of GDP at current prices
2000	2898	2950	64.0	45.9	58.1	5.4
2005	3093	3400	78.5	47.7	41.5	4.5
2006	3434	3160	79.6	55.3	32.2	4.2
2007	3153	3415	136.6	63.8	44.2	6.6
2008	3072	3181	201.0	63.5	45.5	8.4
2009	3245	3200	195.1	63.6	53.6	7.8
2010	3939	3939	227.9	61.0	59.1	9.0
2011	4264	4499	317.5	74.8	61.7	10.5
2012	4623	4623	338.3	62.5	62.2	9.8
2013	4277	4912	306.7	60.4		

Source: Statistical yearbook (*Annuaire statistique*) (INS, 2010) and 2013 national accounts

Annex II Contribution of mining and petroleum sector to forecast receipts of State (billions FCFA)

	2012	2013	2014	2015	2016
Natural resources receipts	129.4	162.6	188.4	237.3	257.7
Uranium	70.4				
Petroleum	59.0	71.5	72.5	73.6	82.5
Total receipts	654.1	693.0	771.0	870.0	963.2
% of State budget	19.8	23,4	24,4	27,2	26,8

Source: IMF 2012 and Nigerien authorities.

Annex III Forecast of extractive production and government revenues, 2013-2020

	2013	2014	2015	2016	2017	2018	2019	2020	2021-2026	2026-2030
Uranium										
Value (billions FCFA)	290	292	290	290	306	314	441	604	787	941
Volume (tonnes)	4790	5050	5050	5050	5374	5551	7733	10417	11106	11298
Average price USD/kg	130	123	121	120	119	118	119	121	148	174
Average price FCFA/kg	60746	57982	57490	57456	56977	56498	56977	57935	70862	83311
Government revenues (billions FCFA)	73	73	73	73	76	78	110	151	197	235
Petroleum										
Value (billions FCFA)	298	379	333	336	1363	1390	1418	1446	1535	1694
Volume (barrels/days)	16000	20000	20000	20000	80000	80000	80000	80000	80000	80000
Price (USD/barrel)	109	110	96	96	98	99	101	103	110	121
Price (FCFA/barrel)	50934	51854	45612	45965	46922	47401	48359	49316	52668	57935
Government revenues (billions FCFA)	55	79	73	74	474	634	648	705	771	863

Source: authors, calculations of World Bank team and IMF revision