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Impact of the RDIA and the building of the Blaise Diagne International Airport on tourism demand and economic growth in Senegal

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Abstract

The place of airports in the economics of development is poorly understood. So, in this research, we assess the impact of the construction of the International Blaise Diagne Airport (BDIA) and the fee for the development of airport infrastructure (RDIA) on tourism demand and economic growth in Senegal. For this purpose, we use a dynamic computable general equilibrium model (CGEM) based on the 2005 social accounting matrix. The results show that the increase in public investment in the airport construction sector associated with increases in RDIA negatively affects foreign demand for tourism services. The variation in GDP is positive but of small amplitude. Thus, a reduction in the level of taxation of the RDIA after the airport is operational would be appropriate to boost the tourism sector, related sectors and GDP.

Keywords: Excise tax; construction; tourism demand; growth; CGEM.

JEL Classification:C68, H22, H54, L83, O41

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1. Introduction

Many policymakers and scientists advocate infrastructure spending to boost economic activity. Yet, empirical evidence about this nexus can be surprisingly limited, perhaps because different infrastructural projects generate diverse outcomes. In the early 1990s, most of the literature pointed out that the low level of economic infrastructure in African countries was the reason for the high cost of production and a quasi-absence of competitiveness in these economies (Wheeler and Mody, 1992; Steel and Webster, 1992; Gyamfi, 1992). The theoretical literature on infrastructure notes its spillover effects on private investment in developing countries (Hirschman, 1958) and its ability to improve the use of other factors of production (Meade, 1952). According to their function, infrastructure can be divided into two groups (Hansen, 1965). A distinction is made between social infrastructure, which functions to maintain and develop human capital, and economic infrastructure, whose role is to facilitate the productive process. The indivisibility and/or non-rivalry characteristics of infrastructure means that their production is most often entrusted to the state.

Barro's work (1990) confirms the importance of public investment in infrastructures. Barro (1990) highlighted the central role of public infrastructures as a growth factor that generates increasing returns over the long term because of the positive externalities they generate for firms. Public capital is only a form of physical investment that results from investments made by the Government. Following Barro (1990), several extensions were developed to more deeply understand the causal effects from public spending to economic growth. For some authors, capital component of public expenditures has a positive effect on economic growth. However, if used in excess, the effect become negative (Ndiaye, 2018; Yovo, 2017; Devarajan *et al.*, 1996). Different kinds of public spending will systematically have different effects on economic growth (Karagianni and Pempetzoglou, 2019; Moller and Wacker, 2017; Carboni and Medda, 2011; Perkins *et al.*, 2005). For example, increased investments in transport infrastructure have been demonstrated to generate a positive gain effect on the structural competitiveness of the economy (Sigue and Sirpe, 2019; Bhatt and Sardoni, 2016).

It is within this context that the Senegalese government authorities decided in 2005 to build a new international airport with the aim of improving space management by decongesting Dakar and promoting the emergence of a second economic hub outside Dakar. This initiative is also designed to make Senegal a preferential hub and technical stopover in West Africa for air traffic to and from

Europe, North and South America, and to create a favourable framework for attracting foreign investment, the Senegalese government authorities decided in 2005 to build a new international airport (Republic of Senegal, 2005).

The literature emphasizes the major role of road infrastructure as an engine of urban development (Harding, 2015; Obeng-Odoom, 2015; 2016, chapter 8; Arthur, 2018). Roads contribute to the expansion of economic activity, facilitate the mobility and expand the economic choices of individuals and enterprises. Roads drive and shape trade, among others, by reducing transaction costs and facilitate the expansion of markets. Thus, they contribute to economic growth and poverty reduction. Apriori, therefore, we would expect parallels with the development of airport infrastructure as a point of attraction and development of a new city. However, the empirical literature offers mixed results. On the one hand, a study by Appold (2015) shows that the expansion of an airport city does not result directly from airport activity, but from a strong urbanisation of the existing agglomerations towards the airport zone. On the other hand, other authors indicate that an enlightened vision of airport and government authorities can lead to the building of an airport city or region, enhance tourism, promote foreign direct investment, and drive globalisation (see, for example, Otiso *et al*., 2011). In doing so, they promote the deployment of a harmonized urban city, respect for the airport security corridor, increased economic activity and job creation (Korah, 2020; Arthur, 2018; Freestone and Baker, 2011). Wang and Hong (2011) highlight the need for government and airport authorities to promote an airport city. Governments can take advantage of the growth of passenger flows to boost local economic development. The work of Kasarda (2008) shows that the turnover generated by shops in airport terminals is much higher than that of shops in shopping centers outside the airport area.

For airport and government authorities to improve their revenues outside of airport operations, Gillen (2011) identifies seven forms of governance. It is about: Government owned/operated airports; government owned, privately operated; independent not-for-profit corporations; fully private for-profit via Initial Public Offering; fully private for-profit via trade sale; partially private for-profit with government controlling interest and partially private for-profit with private controlling interest. Nevertheless, an inclusive and participatory approach of government authorities (centralised and decentralised administration), which favors a Public-Private Partnership and conditions for entrepreneurial activity, stimulates private investment, could promote sustainable urban development (Arthur, 2018; Obeng-Odoom, 2017; Fuseini and Kemp, 2016).

In order to reap the benefits from airports, the Government of Senegal has tried to build an international airport. To finance the project, it introduced in 2005[1] and then revised upward in 2008 and 2011, a fee on passengers using international airports in Senegal. This fee is called *Redevance pour le Développement des Infrastructures Aéroportuaires* (RDIA). The RDIA was intended to exclusively finance the design, construction, maintenance and development of the new international airport called Blaise Diagne International Airport (BDIA). The RDIA is due by any passenger of a public transport company, embarked from the airports of Senegal. This expression is intended to distinguish aircraft used for commercial and profit purposes from aircraft owned by individuals (private jet) and whose use is not open to the general public. For this purpose, the amount of the RDIA is included in the air ticket price of the public airline. The basis of the RDIA applicable to each passenger depends on the destination of the passenger concerned. The method of financing the airport infrastructure adopted by the decision-makers, backed by a tax fee, has an impact on the price of the air ticket. As a result, it can affect the tourism sector and, given the inter-branch relationships between the latter and the rest of the economy it can also negatively affect growth. To this end and given the low competitiveness[2] of the Senegalese tourist destination, what are the potential impacts of the successive increases in the RDIA with a view of constructing the BDIA on tourism demand and economic growth in Senegal?

Existing research does not address this question. The theoretical framework for analyzing the effects of tourism on the economy was developed by Copeland (1991). He defined international tourism as a basket of particular goods and/or services where the consumer moves across borders to obtain a utility, unlike other categories of goods accessed through exporters.

The work of Gooroochurn *et al.* (2005) on Mauritius was one of the first to analyze the impact of taxation policies on tourism. These authors showed that tourism taxes affect household welfare less if the tax was on tourist services than if it directly burden the tourist. Ponjan *et al*. (2016) conducted a similar study for the Thai economy. They examined how the reduction of tourism taxes could help mitigate the negative effects of the floods that occurred in

[1] By decree n°: 2005-138 of February 28th, 2005 and n°: 2011-1113 of August 5th, 2011.

[2] Various studies have shown that the high cost of the Senegalese destination is an obstacle to its development (Lettre de Politique sectorielle de développement du tourisme, 2005; Stratégie de croissance accélérée, 2007).

Thailand in 2011. They found that lowering the level of taxation would benefit the tourism sector but does not significantly increase the Gross Domestic Product (GDP). In contrast, Forsyth *et al*. (2014) showed that the Passenger movement charge negatively affected the tourism sector but benefited the Australian GDP.

Moreover, Balassa (1978), Inchausti-Sintes (2015) and others have shown that the success of Asian countries in recent years was due to the export of industrial products and the growth of tourism. Many studies have focused on the causal link that may exist between tourism development and economic growth. For some authors, tourism development drains growth. Kibara *et al*. (2012), in the case of Kenya, Ertugrul *et al*. (2015), in the case of Turkey, Tang *et al*. (2015), in the case of Lebanon, Sri Lanka, Antigua and Barbuda and Malaysia, showed that tourism stimulates growth. For other authors, it is growth that promotes tourism development. According to Oh (2005), growth favored the development of tourism activity in South Korea. For another group of authors, the link between tourism growth and growth is bi-directional. For example, the work of Samimi *et al*. (2011), covering 20 developing countries and of Cárdenas-García *et al*. (2015), covering a sample of 144 countries, highlighted these dual causalities. Moreover, some authors highlighted the fact that the causal link is observable only in homogeneous groups (De Vita *et al*., 2016; Cárdenas-García *et al*., 2015).

While these studies are important, they do not address the question we ask. A critical question, not only for Senegal, but also for the wider literature on the infrastructure-economic development nexus, particularly now when airports around the world are slowly beginning to re-open, this research seeks to close this gap. The objective is to quantify the impact of the increase of RDIA devoted to the construction of the BDIA on tourism demand and economic growth in Senegal. Using the computable general equilibrium model and real data representing the structure of the Senegalese economy, we consider that the increase in taxation runs counter to the conclusions of previous studies which state that the high cost of the Senegalese destination is an obstacle to the development of the tourism sector. Also, we choose tourism to analyze the repercussions of these policies because according to the literature, there are links between air transport and tourism (Forsyth *et al*., 2014, Ihalanayake *et al*., 2008). The advantage of this type of model is its capacity to represent in a coherent way the sectoral and institutional interaction of the countries with the rest of the world.

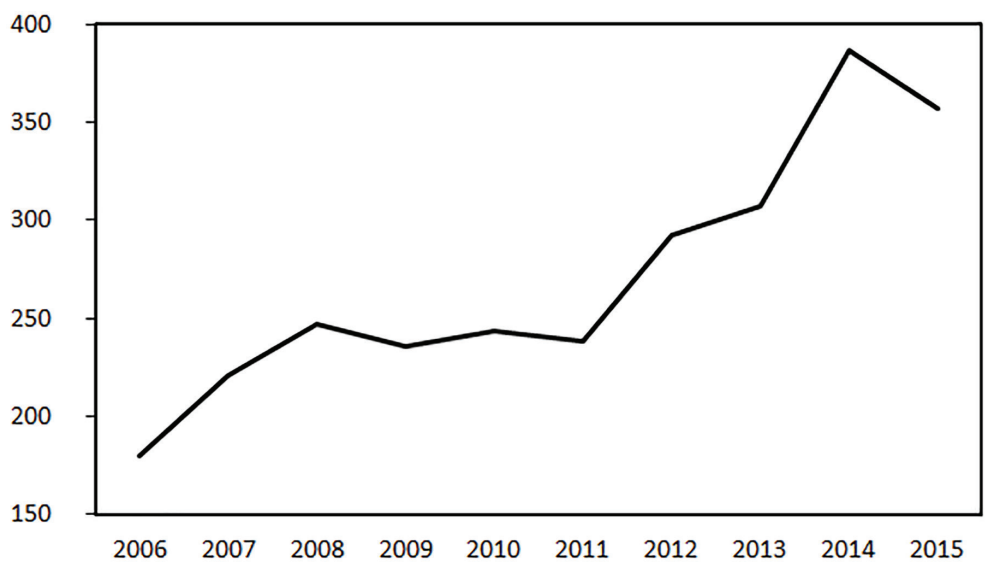
In the following developments, we present the evolution of public investment and tourism demand in Senegal (section 2). We present our methodology (section 3) and finally the results in section 4.

2. Public investment and tourism demand in Senegal

2.1. Evolution of public investment

Senegal has made an enormous budgetary effort in terms of investment, for the construction and rehabilitation of infrastructures. In one-decade, public investment in infrastructure has practically doubled. From about 180 billion in 2006, investments increased at an annual rate of 8% to reach 357 billion in 2015 (Figure 1). The inflexion observed in 2011 results from the resumption of construction works of the new international airport, which began in 2007. In addition, these efforts have made it possible to increase the road network by about 2415 km between 2006 and 2015, including the Dakar-Diamniadio motorway which links Dakar and the new airport, and to renovate the Cap-Skiring[3] airport in order to strengthen the attractiveness of the Senegalese touristic destination.

Figure 1: Evolution of Public Investments, 2006 -2015

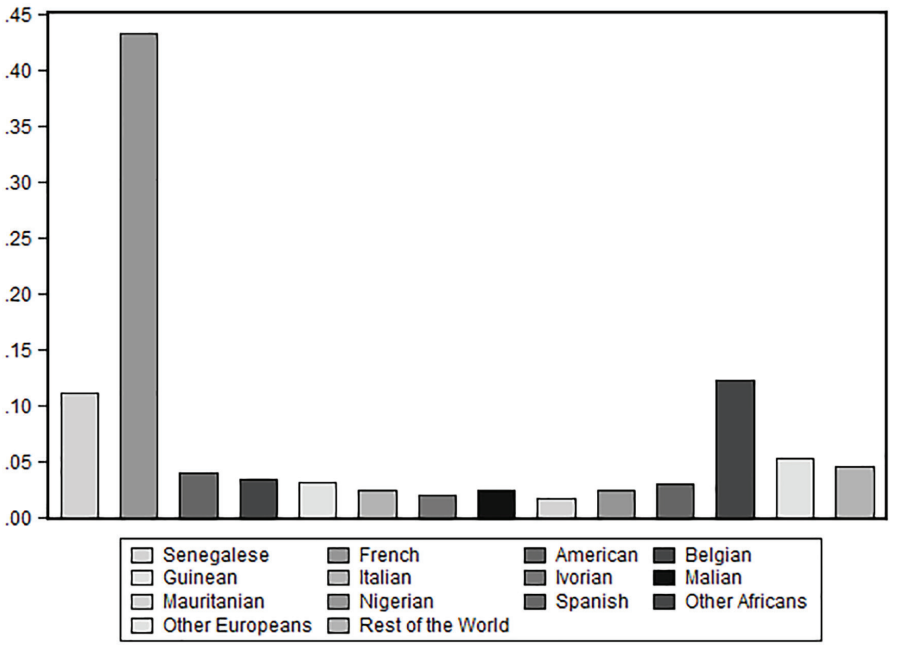


Source: Authors from National Agency for Statistics and Demography 2016 data.

[3] Cap Skiring is located 70 kilometres west-southwest of Ziguinchor, on the border with Guinea-Bissau and 575 km from Dakar (capital of Senegal).

Figure 2 shows that the bulk of tourists in Senegal are French nationals (43%). Nearly 23.5% of international tourist arrivals in Senegal come from Africa, the majority of whom are Guinean, Nigerian, Malian, Ivorian and Mauritanian nationals. About 11% of international tourists are the Senegalese diaspora, followed by the US (4%), Belgian (3%) and Italy nationals (2.3%).

Figure 2: Distribution of International Tourists by Nationality

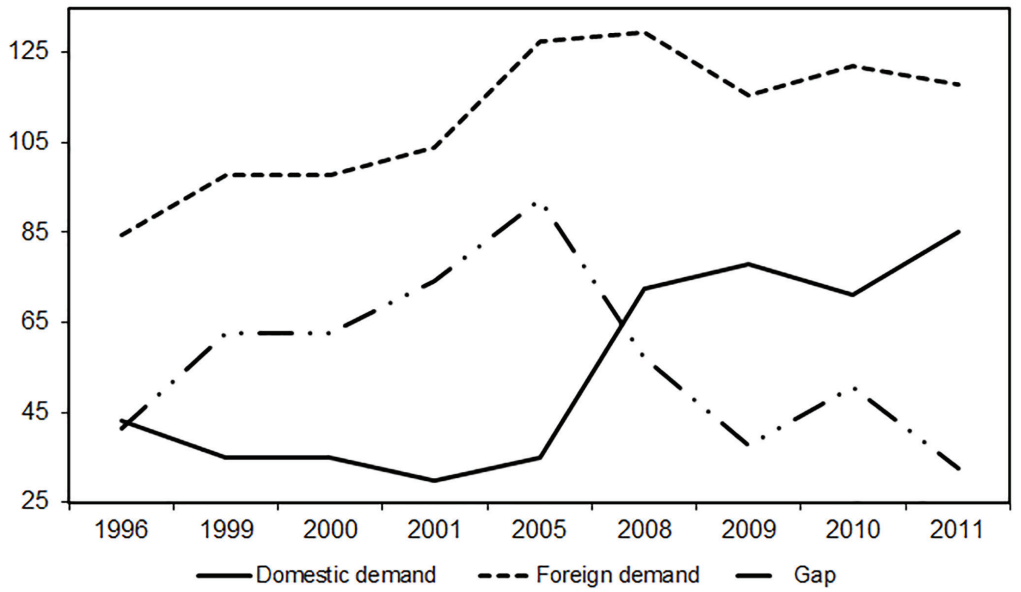


Source: Authors from Ministry of Tourism and Air Transport 2016 data.

Statistical analysis from a series of Input-Output Tables (IOT) and presented in Figure 3 shows over the period 1996 to 2011 that 68% of the final demand for tourism goods and services is the fruit of demand resulting from the rest of the world.

In 2005, foreign demand for tourism goods and services accounted for almost 78% of the market share. In 2011, six years after the implementation of the RDIA, it represented only 58%, a decrease of 20 percentage points. Moreover, the gap between the demand of residents (domestic demand) and that of non-residents has narrowed since 2005. This decrease in the gap may be due to the conjunction of two phenomena: the fall in prices by tour operators to make the tourist product accessible and a substitution effect related to the increase in residents' demand. Moreover, Forsyth (2014) highlighted these phenomena in the case of Australia.

Figure 3: Evolution of Tourist Demand in Senegal, 1996 to 2011 (in billions XOF)



Source: Authors based on data from [IOT, (1996-2011)].

These analyses show that the demand for tourist services is constantly increasing. And the government is making significant investments to provide the country with adequate infrastructure such as the airport in order to maintain Senegal's international competitiveness. However, wouldn't the financing mechanism of the new airport through the RDIA constitute a brake on the expansion of the tourist demand? Indeed, the tourist service is drained by external demand, and moreover by nationals of other nationalities than the Senegalese diaspora.

3. Methodology

To quantify the impact of the increase of RDIA devoted to the construction of the BDIA on tourism demand and economic growth in Senegal, we extend the dynamic computable general equilibrium model developed by Decaluwe, Lemelin, and Robichaud (2013). However, we are inspired by Forsyth *et al.* (2014) for the modeling of the RDIA and Cabral (2015) for the specificity of the Senegalese economy.

In many countries, computable general equilibrium models are widely used to analyze the impact of economic policies and external shocks. They make it possible to take into account the important effects of interactions that they

induce within the economy (Cabral, 2015; Dwyer, 2015; Song *et al.*, 2012; Suwa, 1991). Dwyer (2015) reports on the themes relating to tourism which can be dealt with using this model. The table he describes corroborates that of Song *et al.* (2012). The authors argue that there are several techniques for policy analysis, however, computable general equilibrium models provide a much more comprehensive and rigorous framework. For Senegal, several studies, including those by Cabral (2015) Boccanfuso and Savard (2010), have already been conducted using this methodological approach. In addition, the computable general equilibrium models mainly compensate for the lack of continuous data availability for certain problems for which econometric models could have been used (Suwa, 1991).

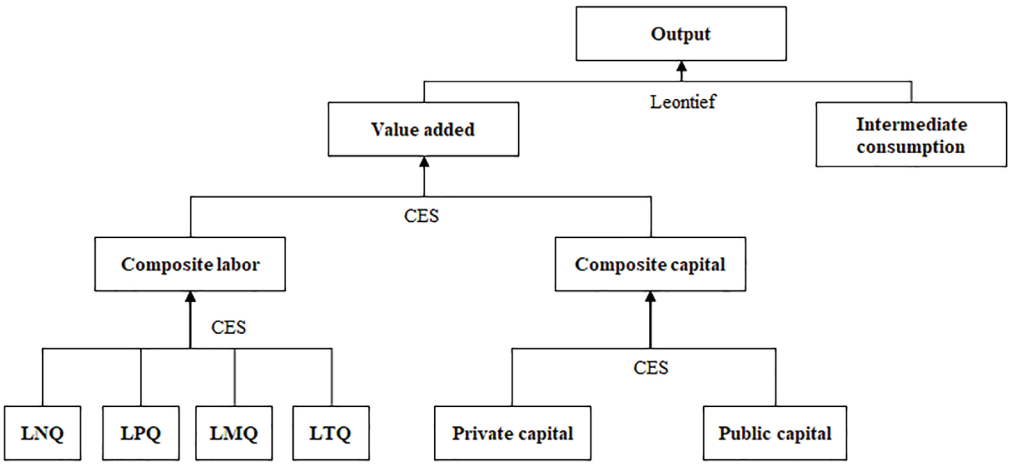
The model is recursively dynamic, which means that it is solved as a sequence of static equilibria linked in time, through the accumulation of capital and the growth of labor, and the equations of behavior for endogenous variables. One of the advantages of a dynamic model specification is the possibility of generating a medium- and long-term path. In addition, structural changes can be analyzed over time. The model applies to a small economy for which world prices are given. In the following discussion, we focus on the specifics of the model.

3.1. Model specification

We distinguish two factors of production which are composite labor and composite capital. The composite labor factor is disaggregated into unskilled labor, low-skilled labor, medium-skilled labor and highly skilled labor. The composite capital factor is, in turn, disaggregated into private capital and public capital.

The output of a sector is expressed as a Leontief type function combining fixed shares of value added and intermediate consumption. In addition, value added is a constant elasticity of substitution (CES) function that combines composite labor and composite capital. Except for the non-market sector where the capital consists only of public capital, the composite capital is specified using a CES function that combines private and public capital. The composite labor is represented by a CES function combining the four labor categories. Except for the non-profit sector where capital is only composed of public capital, the composite capital is specified using a CES function that combines private capital and public capital. Composite labor is represented by a CES function that combines the four work categories (Figure 4).

FIGURE 4: STRUCTURE OF PRODUCTION



Source: Authors from Lemelin *et al.* (2013).

The initial factor endowments of households play an important role in the transmission of the shock effects to households. Each household receives, in fact, a share of the incomes of the factors of unskilled labor, low-skilled labor, moderate labor, highly skilled labor and private capital. A fixed proportion of transfers paid by the State, the rest of the world and other households as well as dividends paid by firms also go to households. The consumption structure that is affected by price changes is also critical in the transmission of the shock effects to households. The consumption of each product is valued at the price of the composite good. It is an LES-type function known as the Stone Geary linear expense system. It distinguishes the incompressible consumption from the discretionary one. The specificity of this demand function is that it includes a minimum basket of consumption. It is the volume of the product that the consumer must have if he wants to maintain a minimum living standard. This volume is fixed in the short term but changes according to the rate of increase in the population. Discretionary consumption is, on the other hand, endogenously determined by changes in consumer prices and consumer disposable income (Decaluwé, Martens and Savard, 2001).

The model applies to a small open economy. World prices of imports and exports are given. In addition, a finite elastic export demand function is introduced to take into account the constraints faced by Senegalese producers in the global market.

Modeling the RDIA

The RDIA on imported products (*TRDIAM*) is a function of the RDIA rate at import (*ttrdiam*), the world price of the good (*PWM*), the exchange rate (*e*) and the quantity of the imported good (*IM*).

$$TRDIAM_{transp,t} = ttrdiam_{transp,t} \times PWM_{transp,t} \times e_t \times IM_{transp,t} \quad (1)$$

The RDIA on exported products (*TRDIAX*) is a function of the rate of RDIA at export (*ttrdiax*), the world price (*PE*), the purchase price of the composite product (*PC*) and the quantities exported (*EXD*).

$$TRDIAX_{transpx,t} = ttrdiax_{transpx,t}\left(PE + \sum_{transpxj} PC_{transpxj,t} \times tmrg_{transpxj,t}\right) \times EXD_{transpx,t} \quad (2)$$

Thereby, the indirect tax collected on domestic sales of transport services, net of operating subsidies (TIC_{transp}), is a product of the tax rate on sales and the supply of composite good (sales of local and imported product). The import of transport services takes the surtax into account (RDIA).

$$TIC_{transp,t} = ttic_{transp,t}\left[\begin{array}{l}\left(PL_{transp,t} + \sum_{transp,t} PC_{transp,t} tmrg_{transpj,i}\right) DD_{transp,t} \\ + \left(\begin{array}{l}\left(1 + ttim_{transp,t} + ttrdiam_{transp,t}\right) PWM_{transp,t} e_t \\ + \sum_{transp,t} PC_{transp,t} tmrg_{transpj,i}\end{array}\right) IM_{transp,t}\end{array}\right] \quad (3)$$

The price paid for the imported product is the world price (PWM_{transp}), converted into local currency (e_t), plus taxes and duties on imports ($ttim_{transp,t}$), the surtax ($ttrdiam_{transp,t}$), margins and domestic indirect taxes ($ttic_{transp,t}$).

$$PM_{transp,t} = \left(1 + ttic_{transp,t}\right)\left(\begin{array}{l}\left(1 + ttim_{transp,t} + ttrdiam_{transp,t}\right) PWM_{transp,t} e_t \\ + \sum_{transp,t} PC_{transp,t} tmrg_{transpj,i}\end{array}\right) \quad (4)$$

The FOB price ($PE^{FOB}_{transpx}$) paid by consumers on the export market is different from that received by the producer, because it adds export taxes ($ttix_{transpx,t}$), the surtax ($ttrdiax_{transpx,t}$), and margins.

$$PE^{FOB}_{transpx,t} = \left(1 + ttix_{transpx,t} + ttrdiax_{transpx,t}\right)\left(PE_{transpx,t} + \sum_{transpxj} PC_{transpxj,t} tmrg^{x}_{transpxj,t}\right) \quad (5)$$

Model dynamics

The stock of private capital of market sectors (*tr*) at the end-of-period (KD^{t+1}_{tr}) is equal to the beginning-of-period stock (KD^{t}_{tr}), net of the fixed capital consumption (or depreciation) of the period at a rate (*dep*) to which adds an investment flow (IND^{t}_{tr}):

$$KD_{tr}^{t+1} = KD_{tr}^{t}(1 - dep) + IND_{tr}^{t} \quad (6)$$

The rule of private capital accumulation is determined as follows: the sectoral accumulation rate of private capital (i.e., the ratio of the investment flows IND to the capital stock KD) is assumed to be an increasing function of the earnings-to-earnings ratio. Cost of capital, the latter evolving at a decreasing rate:

$$\frac{IND_{tr}^{\ t}}{KD_{tr}^{\ t}} = f\left[\frac{r_{tr}^{\ t}}{c_{tr}^{\ t}}\right] \quad (7)$$

This equation determines the manner in which new investments are spread among different sectors of destination. This function of investment by destination is inspired by the functional forms proposed by Bourguignon, Branson and de Melo (1989) and Jung and Thorbecke (2003). As for the public capital stock of each sector at the end of the period ($KDpub_j^{t+1}$), it is equal to the beginning of the period stock ($KDpub_j^t$), net of the fixed capital consumption (or depreciation) of the period at a rate to which is added the flow of public investments allocated to the sector during the period ($ING_{tr}^{\ t}$) :

$$KDpub_j^{t+1} = KDpub_j^t(1 - dep) + ING_j^t \quad (8)$$

In market sectors, destination public investment flows (ING_{tr}^t) ING are a fixed part (b) of destination private investment flows (IND_{tr}^t). This specification reflects the complementarity between these two types of investments in the market sectors. Consequently, the relationship between public capital and private capital in the market sector is defined by the following equation:

$$ING_{tr}^t = b * IND_{tr}^t \quad (9)$$

In the non-market sector, we assume that public investment flows depend on the disposable income of the State (YD_{GOV}^t) and therefore constitute a fixed part (μ_{ntr}) of the latter:

$$ING_{ntr}^t = \mu_{ntr} * YD_{GOV}^t \quad (10)$$

The total value of destination investments is the overall investment, and therefore the total value of investments by origin (IT_t):

$$IT_t = pk_t\left(\sum_j IND_j^t + \sum_j ING_j^t\right) \quad (11)$$

The average price of capital is a weighted sum of consumer prices, the weighting coefficient being the relative share of demand for good or service i in aggregate investment demand (by origin):

$$pk_t = \sum_i pc_i^t * v_i \quad (12)$$

The user cost of capital in the market sector is the average price of capital pk multiplied by the sum of the interest rate (*ir*), the depreciation rate (*dep*) and capital adjustment costs (αc):

$$uc_t = pk_t * (ir + dep + \alpha c) \quad (13)$$

Labor market modeling

The labor market is segmented into four categories, namely unskilled labor, low-skilled labor, medium-skilled labor and highly skilled labor. However, we have taken into account, in modeling, the rigid nature of the segment of the skilled labor market, by introducing unemployment endogenously according to the wage curve approach, developed by Blanchflower and Oswald (1994). In the unskilled labor market segment, workers generally move in the informal sector. The wage rate is determined by the confrontation of supply and demand for labor. Thus, in this market, the equilibrium resulting from the equality between the sum of supply and the demand for unskilled labor makes it possible to determine the wage rate at equilibrium.

Calibration, closure and robustness tests

The specification of production, household consumption, import and export functions require parameters including: the income elasticity of demand for products, the Frisch parameter, the elasticity of substitution between capital and labor, the elasticity of substitution between imported and local products, the elasticity of transformation between external sales and local sales, and the elasticity of external demand. In the absence of long series, these parameters were not estimated on data from Senegal. They were borrowed from the CGEMs literature, and from empirical studies conducted in other developing economies[4]. All other parameters of the model were calculated from the Social Accounting Matrix (SAM) data to ensure the consistency of the baseline year data.

The ratio between current account and GDP is assumed to be fixed[5]. The exchange rate, the change in inventories and the savings rate of institutions are also fixed[6]. Public expenditures are assumed to be fixed, in real terms, in the first

[4] Details of the parameters in the CGEMs are provided by Annabi *et al* (2002).

[5] This closure is in line with Senegal's commitments under the West African Economic and Monetary Union (WAEMU), which require it not to deviate from certain convergence criteria, including the ratio between the external balance and GDP. This procedure also restricts the situation where too much capital inflow could finance domestic policies. In sum, this condition forces the model to seek additional resources only from within the economy.

[6] We had to fix the exchange rate. Indeed, it represents the price of the foreign currency expressed in local currency. In addition, the national currency is in fixed parity.

period[7]. They then increase at the same rate as the population. The same is true for public savings, transfers and labor supply, which are growing at the same rate as the population. The reconciliation of savings and investment is ensured through the adjustment of public savings that allows the establishment of the RDIA[8].

We have executed robustness tests on the borrowed parameters. These tests consist in first decreasing by 10% and 20% the value of the borrowed parameters and then increasing by 10% and 20% these same parameters. The results are compared to those obtained in the reference scenario (business as usual, BAU). The results obtained indicate that the variation of the parameters does not lead to a modification of the trajectories. Consequently, the results are identical whatever the value of the parameters. We can thus conclude that the model is stable. It can therefore be used to quantify the impact of policies or exogenous shocks on the Senegalese economy.

3.2. Data

The SAM used is that of 2005[9] built by National Agency for Statistics and Demography (NASD). We modified it by disaggregating the "Construction" sector into "BTP airport" and "other construction", and the "transport" sector into "air transport" and "other transport". We highlighted the amount collected from the RDIA. Institutional units are: households, firms, government and the rest of the world. The sub-unit of households includes three categories of entity: Dakar, other urban centers and rural areas. We obtain, after aggregation of activity sectors belonging to the same sector (agricultural, industrial or service), thirteen (13) sectors and products. Table 1 below shows the result of the aggregation.

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[7] It seemed appropriate to us, as a principle of sovereignty, to make public expenditures exogenous. Thus, they are not defined by the model.

[8] We set the savings rates of institutions because they are parameters. These savings rates represent the average propensity to save of the various institutions. Apart from the price variables, the exogenous variables are assumed to grow with population growth in order to take account of the evolution of the population.

[9] In order to be able to simulate the totality of the investments made in the airport construction sector, we need an accounting framework that does not take into consideration the amounts allocated for this purpose. As construction work started in 2007, we chose an accounting matrix prior to this year, namely the 2005 matrix built by NASD.

Table 1: Sectors and Products in the SAM

Sectors Label	Products Label
Food agriculture	Food agriculture
Crop farming	Crop farming
Fishery	Fishery
Food industry	Food industry
Other industries	Other industries
Other construction	Other construction
Airport construction	Airport construction
Other market services	Other market services
Repair Services	Repair Services
Tourism	Tourism services
Air Transport	Air Transport
Other transports	Other transports
Non-market services	Non-market services

Source: Authors from SAM (2005).

RDIA

Data[10] made available from the Ministry of the Economy, Finance and Planning covers only the period from July 2007 to July 2017. To this end, we had to estimate the amount collected from the RDIA for the year 2005, from departures noted. In 2005, 716841 departures were recorded at the Léopold Sédar Senghor airport in Senegal (ADS[11], 2017). The RDIA is both an export tax and an import tax insofar as it strikes the ticket of non-residents arriving in Senegal and residents leaving for the rest of the world. The weight of non-residents[12] equals 54%. The RDIA collected in 2005 is thus estimated at nearly 21.506 million euros. Nearly 11.597 million euros are considered as export tax revenues collected on air transport and 9.909 million euros as revenue from import taxes collected on air transport.

Over the period from July 2007 to July 2017, about 3.033 million euros in average were donated monthly in the escrow account under the collected RDIA.

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[10] Data concerning the amount collected from the RDIA can be downloaded via the link below (http://www.finances.gouv.sn/images/yootheme/demo/RDIA_Juillet2017.pdf).

[11] ADS: Agence des aéroports du Sénégal.

[12] According to the Senegalese Ministry of the Craft Trade and Tourism data (2007), the recorded departure of non-residents at the airports of Senegal equals 386565, 54% of the total.

The amount donated in total in the escrow account over this period would be 400.39 million euros (Ministry of the Economy, Finance and Planning, 2017).

4. Simulation and results

4.1. Justification of the simulation

In order to finance the construction of the new international airport Blaise Diagne, the Government of Senegal has introduced in 2005 a fee on passengers called: the RDIA, worth 30 euros. This fee was increased to 45 euros per passenger in 2008 and to 54 euros in 2011. Two simulation series were carried out covering a period of twenty years from 2005 to 2025. In the first simulation (Sim1), we simulate the increases in RDIA and the increase in public investment in the airport construction industry. The shock on the RDIA consists of a relative increase of 50% and 20% compared to the previous level of taxation which corresponds to the respective variations noted between the periods 2005 and 2008, then between 2008 and 2011. We simulate an average annual investment of 76.911 million euros (Niang and Gueye, 2017); an average increase of 43.8% of the investment in the airport BTP sector from 2007 to 2017. Beyond 2017, we simulate an average increase of 3.3%[13]. The second series (Sim2) consists of simulating an increase in investments without the introduction of the RDIA. We chose to extend the horizon to 2025 to analyze different trajectories after the completion of the airport construction[14]. The results are compared to the baseline situation (BAU).

4.2. Results

Analysing the shocks' transmission requires a good understanding of the Senegalese economy. The analysis of the sectoral components of GDP highlights the predominance of the tradable services sector in the Senegalese economy. Its contribution to GDP formation is 35.78%. The industry contributes 19.39%, agriculture in the broad sense 14.06% and non-market services 14.74%. The airport BTP, tourism and transport sectors contribute 1.11%, 0.77% and 3.79%, respectively, to GDP formation. However, the tourism sector[15] employs nearly 75,000 people (ENES, 2015), (Table 2).

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[13] Level of public investment in the airport construction sector (BCI 2004, 2005, 2006).

[14] The BDIA was operational on December 7, 2017.

[15] As Senegal does not currently have a satellite account for tourism, we considered the activity branch of "accommodation and restaurant services" as a tourism sector.

TABLE 2: SECTOR CONTRIBUTION TO VALUE ADDED (IN %), 2005

	Factor-intensity (Capital/Labor)	Value added share in sectoral production	Sectoral value-added share in total value added
Food agriculture	0.59	86.8	5.88
Crop farming	0.96	82.71	8.76
Fishery	14.55	47.83	2.13
Food industry	0.84	16.77	4.81
Other construction	1.51	32.27	2.63
Airport construction	1.51	32.27	1.32
Other industries	0.83	22.79	14.33
Other market services	2.55	62.09	35.95
Repair Services	0.28	31.67	1.23
Tourism	0.4	23.95	0.91
Air Transport	0.91	54.01	1.41
Other transports	0.91	54.69	3.10
Non-market services	0.47	77.42	17.56
Global	1.16	45.02	100

Source: Authors from SAM (2005).

Two transmission channels can be explored to understand the impact of the RDIA on the tourism demand and growth in Senegal: public finance channel where the RDIA comes to increase government income and savings and the channel of tourism demand.

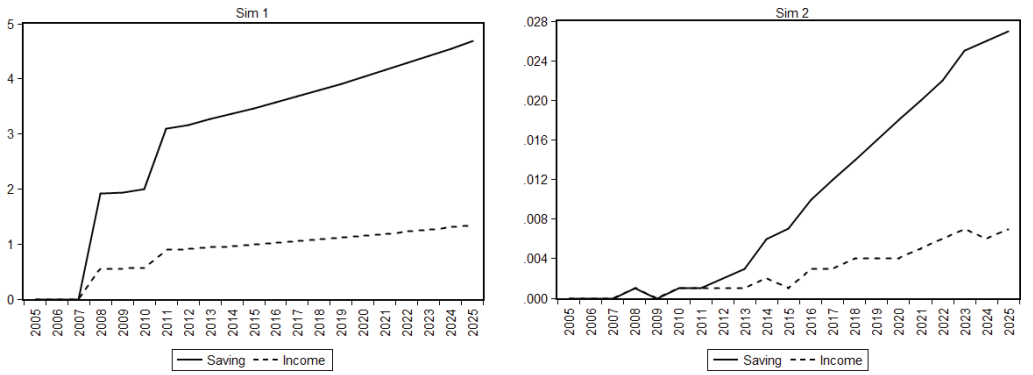
Through the public finance channel, the introduction or increase of the RDIA would result in the increase of government revenue as well as its level of savings. An increase in savings would induce the one of the total investments. The other channel of transmission of the effect of the RDIA passes through the reaction of tourism demand. The RDIA increases the cost of the tourist service basket and thus would be decrease the entry of international tourists. This would reduce the activity of the sector and should have an impact on the demand for factors and returns to factors.

Given the link that the tourism sector has with the rest of the economy through the input-output matrix, a decline in the consumption of tourism goods and services would also affect other sectors according to the intensity of inter-branch links. The distribution of factor incomes in the rest of the economy can therefore be modified. The effect on households will be different depending on the factor endowments and the structure of the consumer baskets.

Effect on public finance

Public finances (income and savings) are positively impacted by public investment in the airport construction sector. However, the impact is greater when the investment is associated with increases in RDIA (Figure 5).

Figure 5: Change in Government Income and Savings (% compared to BAU scenario)



Source: Authors from simulation results.

Tourist demand

The analysis of the SAM reveals that the tourism sector exports nearly 52% of its production, fishing 48.7% and air transport 23% (Table 3).

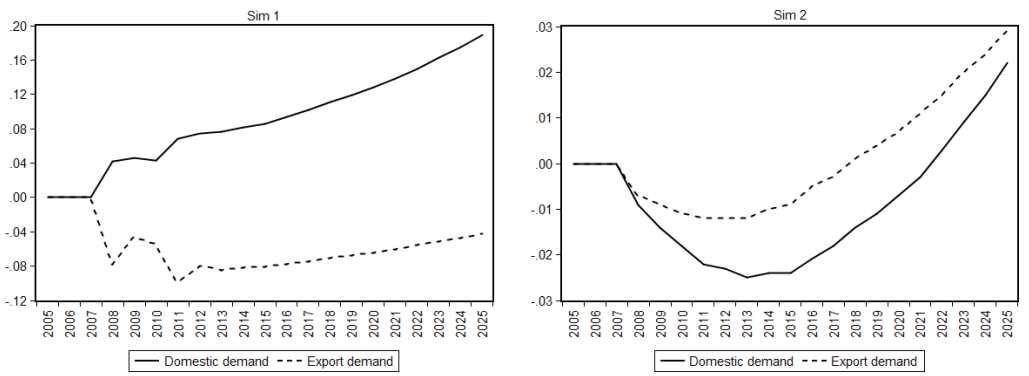
Table 3: Share of Exports in the Production, 2005

	Sectoral export share in total export	Value added share in sectoral production
Food agriculture	1.61	7.3
Crop farming	2.86	8.27
Fishery	7.06	48.74
Food industry	12.96	13.85
Other construction	0	0
Airport construction	0	0
Other industries	44.66	21.78
Other market services	21.8	11.54
Repair Services	0	0
Tourism	6.47	52.1
Air Transport	1.99	23.4
Other transports	0.59	3.21
Non-market services	0	0
Global	100	13.8

Source: Authors from SAM (2005).

Public investment in the airport construction sector combined with the successive increases in RDIA (sim 1) induces a fall in external tourist demand which is replaced by an increase in domestic tourist demand. Indeed, the RDIA acts as a surcharge on exports and imports and its increases raise the cost of transport. As a result, non-residents would prefer other tourist destinations while residents, given the surcharge, would shift their demand to a domestic preference. In the context of public investment in the airport construction sector without an increase in the RDIA (sim 2), the change in tourism demand would be negative only at the beginning of the period, during the construction phase of the new airport, but with the commissioning of this infrastructure, it would be positive (Figure 6).

Figure 6: Variation of Tourism Demand (% compared to BAU scenario)



Source: Authors from simulation results.

Value added

The increase in public investment should encourage an increase in value added in the relatively more capital-intensive sectors. Consequently, the increase in public investment in the construction sector is reflected in the increase in value added in that sector. Successive increases in RDIA would have a negative impact on the demand for certain goods and services. As a result, the output of these branches would fall.

When public investment in the airport construction sector is combined with successive increases of RDIA (sim 1), the air transport sector, which is relatively more open to the outside world, is directly affected by the surcharge, becomes less competitive and consequently loses market share. This translates into a decrease in its value added. The tourism sector, like most branches of the economy, uses

air transport services in their production process. There is therefore a decline in the value added of the tourism sector between 2005 and 2015. From 2016 to 2025, the change in value added would become positive, which could be explained by the increase in domestic demand for tourism services.

Like air transport service, other goods and services are involved in the production of tourism service through the input-output matrix. Thus, the pattern of change in the value added of the agri-food, food agriculture, fishing and other industries is almost similar to that of tourism.

Relatively more capital-intensive, the airport construction sector, due to public investment, is recording an increase in the value added of the airport construction sector. There is also an increase in the value added of the other construction, repair and non-market services sectors.

Public investment in the airport construction sector without the successive increases in RDIA (sim 2) results in an increase in the value added of the airport construction sector, other industries, repair and non-market services. The change in the value added of the tourism sector is negative between 2008 and 2019 during the airport construction phase and is positive for all sectors after the airport construction phase.

Successive increases in RDIA have a more negative impact on the air transport, agri-food, fishing, food agriculture and other industries (Table 4).

Impact on GDP

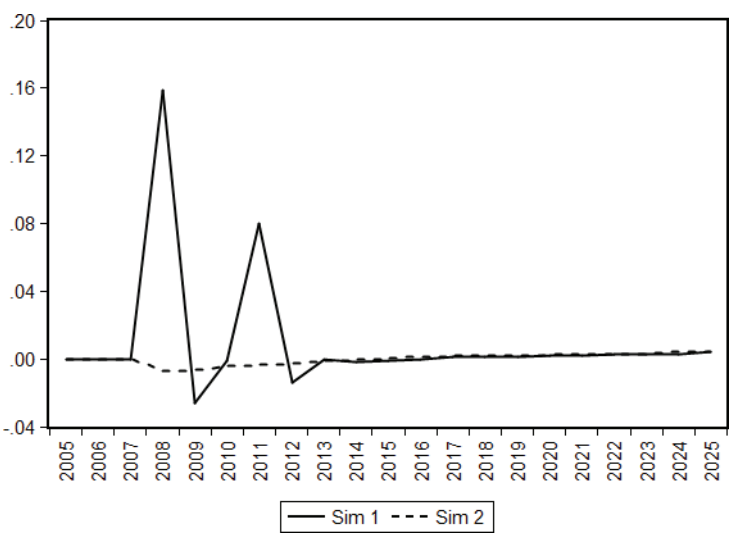
The simulations directly focused on sectors that contribute very little to value added (airport construction 1.32 and air transport 1.41). This reflects the low impact of public investment in the airport construction sector. Between 2007 and 2013, the variation in GDP is erratic with peaks in the years when increases in the RDIA are observed. Beyond that, the variation in GDP is certainly positive but of small amplitude (Sim 1). Public investment in the airport construction sector without the successive increases of RDIA (Sim 2) would lead to a decrease in GDP between 2007 and 2015 during the infrastructure construction phase. It would become positive from 2016 onwards. Indeed, the value added of several branches becomes positive from 2016, one year before the new airport is commissioned (Figure 7).

TABLE 4: CHANGE IN VALUE ADDED (% COMPARED TO BAU SCENARIO)

Period	Food agriculture	Crop agriculture	Fishery	Food industry	Airport construction	Other construction	Other industries	Repair services	Tourism	Air transport	Other transport	Other services	Non-market services
SIM 1													
2008	-0.030	-0.004	-0.026	-0.056	0.630	0.185	-0.045	0.038	-0.021	-1.184	0.004	0.005	0.027
2011	-0.072	0.010	-0.085	-0.093	1.740	0.327	-0.031	0.081	-0.019	-1.889	0.020	0.020	0.107
2017	-0.068	0.104	-0.092	-0.078	2.400	0.465	0.024	0.134	0.010	-2.464	0.063	0.080	0.216
2025	0.024	0.272	0.035	-0.004	1.054	0.698	0.072	0.223	0.069	-3.291	0.151	0.217	0.337
SIM 2													
2008	-0.018	-0.019	-0.025	-0.014	0.441	-0.008	0.001	-0.004	-0.008	-0.005	-0.007	-0.013	-0.001
2011	-0.046	-0.047	-0.066	-0.037	1.413	-0.021	0.016	-0.004	-0.017	-0.008	-0.014	-0.032	0.007
2017	-0.034	-0.028	-0.049	-0.033	1.984	-0.021	0.044	0.009	-0.010	0	-0.003	-0.022	0.012
2025	0.045	0.060	0.065	0.031	0.505	0.020	0.062	0.038	0.025	0.032	0.038	0.044	0.008

Source: Authors from simulation results.

FIGURE 7: CHANGE IN GDP (% COMPARED TO BAU SCENARIO)

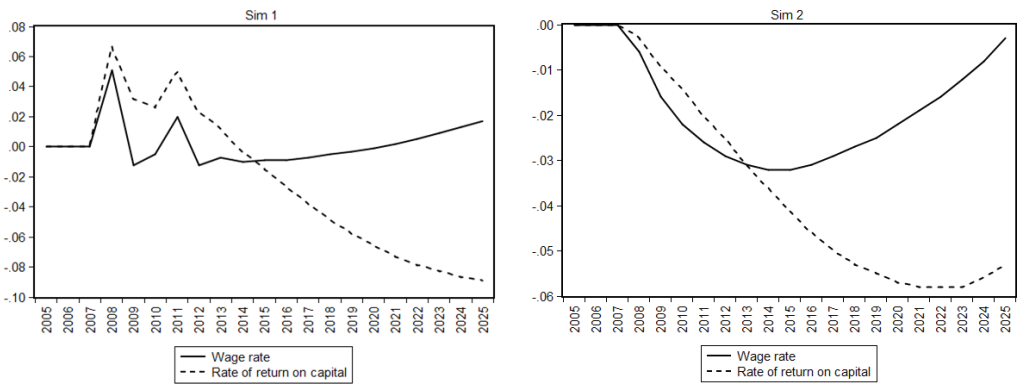


Source: Authors from simulation results.

Factor income

Due to the increased demand for capital in the airport construction sector, which is almost complementary to private capital, this factor is becoming relatively cheap. As a result, the average rate of return on capital declines, while the wage rate increases by 2023 (sim 1 and sim 2) (Figure 8).

Figure 8: Change in Average Wage Rates and Return Rates on Capital (% compared to BAU scenario).



Source: Authors from simulation results.

5. Conclusion

The research of Hirschman (1958, 1984) on the spillover effect of infrastructure investments on economic activity contributed to the renewed interest of politicians in the construction of roads, buildings or airports. Introduced in 2005 by the State of Senegal (decree n°: 2005-138 of 28 February 2005) then modified in 2008 and 2011 (decree n°: 2011-1113 of 5 August 2011), the fee for the development of airport infrastructure is intended to finance the design, construction, maintenance and development of the new Blaise Diagne international airport in Diass. As part of this research, we tried to quantify the impact of the RDIA and the construction of the BDIA on tourism demand and economic growth in Senegal. To do this, we first made changes to the 2005 social accounting matrix by disaggregating the 'construction' sector into 'airport construction' and 'other construction' and the 'transport' sector into "air transport" and "other transport". We have highlighted the amount collected from the RDIA. We then built a dynamic computable general equilibrium model by integrating the RDIA model. Our simulations covered the period from 2007 to 2025.

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Conflicts of interest

The authors declare no conflict of interest. The authors take full responsibility for any opinions and suggestions in this study.

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