

How fisheries can support a small island economy in pandemic times: the Seychelles case

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Abstract – The COVID-19 pandemic has depressed the world economy to a magnitude and timeliness that could hardly be predicted by economists. Because of remoteness and a lack of resources, small island developing states (SIDS) are often considered more vulnerable than others to external shocks such as weatherization or disease. In 2020, the Republic of Seychelles has suffered a 70% collapse of foreign visitors, while tourism represents a key pillar of the economy with two thirds of its Gross Domestic Product and employment. The fishery-related industries have nonetheless resisted to this economic shock and become more prominent, with a foreign-owned tuna fleet supplying the local canning plant, main provider of private jobs and trade in the archipelago. This research attempts to forecast the economic effects of several scenarios affecting both fishing and tourism activities in a small island economy. It shows that fish-related industries can represent a resilient contributor to the domestic economy as long as natural stocks are sustainably managed.

Keywords: COVID-19 / Social Accounting Matrix / scenarios / Small Island Developing States / Seychelles

1 Introduction

The first image that comes to mind when thinking about Seychelles is naturally the Eden postcard of luxury tourism showing some of the most beautiful sandy beaches in the world, the sparkling turquoise of the Indian Ocean and the lush green mountains. On the flip side, the economy of Small Island Developing States (SIDS) remains fragile and vulnerable to external shocks, as demonstrated by the global financial crisis of 2008 and more recently by the COVID-19 pandemic in 2020. Some industries are more sensitive to external shocks than others. This is the case of tourism when dramatic events such as war conflicts or disease hamper the mobility of travellers. The foreign trade of commodities can somehow resist as long as shipping remains accessible to exportable goods and that foreign customers keep on buying them. To what extent fishery products have resisted the pandemic shock and could support a small island economy like Seychelles?

By taking into account the relevance of producing knowledge baseline to inform future management measures in the framework of early warning shock management

(Mangano *et al.*, 2022), here we developed a Social Accounting Matrix model on the basis of novel Supply and Use tables published by the Seychelles National Bureau of Statistics. Two scenarios for the post-pandemic period were simulated with the model: one with a business-as-usual fishing activity, and the other one with a 50% increase of export demand for fishery products, tourism being stuck into a half-recovery pattern after the pandemic shock in both cases. The results show a greater diversification towards a blue economy, making the country more resilient to such economic shocks in the future if tuna stocks are exploited in a sustainable way.

Here, we introduce the context of the pandemic and the economic effects projected by several domestic and international institutions. The SAM framework and multipliers of the Seychelles Blue economy are additionally reported. This second section introduces the model and includes a first assessment of the pre-pandemic respective contributions of fishery-related and tourism sectors to the domestic economy. A third section estimates the external shock of COVID-19 and extends it through two scenarios, showing the greater resilience of the fishing and fish manufacturing industries to the new context. Finally we discuss the results before a brief conclusion.

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2 Context of the pandemic crisis for a small island economy

On 11 March 2020, the World Health Organization declared COVID-19 a worldwide pandemic, resulting in major travel restrictions and a wave of lockdowns for many countries (Kim, 2020; Rassool *et al.*, 2020; IMF, 2021; AfDB, 2021a, 2021b). The pandemic combined with economic policy uncertainty quickly affected the global financial and commodity markets, with strong negative effects on economic growth predictions (Ahmed and Sarkodie, 2021). The International Monetary Fund (IMF) considered that the global economic growth would be reduced in 2020 by 3.5% in their revised estimation of January 2021, before bouncing back to a growth of 5.5% in 2021 and 4.2% in 2022 according to projections (IMF, 2021). The African Development Bank, in its outlook of March 2021, predicted the worst growth rate (−12% in 2020) of all East-African countries (AfDB, 2021a). The World Trade Organization forecast said that global trade would contract between 13 and 32% in 2020 (WTO, 2020). Based on autoregressive models and impulse response functions, the UN Department of Economic and Social Affairs reported a situation for SIDS that should be even worse than the financial crisis of 2008–2009 since the length of recovery depends on the magnitude of the initial shock: it would take about four years to return to the baseline forecast path (Kim, 2020).

The fundamental characteristics of SIDS are likely to increase the risk of macroeconomic collapse and slow recovery compared to large, developed economies, especially in the context of global warming (Guillotreau *et al.*, 2012; Kelman, 2018; Nath and Madhoo, 2021). Such economies depend to a large extent on tourism receipts, and Seychelles in particular. In comparison with six other SIDS, Seychelles showed the highest touristic output multiplier, with a value of 1.81 (Pratt, 2015). SIDS rely heavily on foreign trade and supply of commodities for the day-to-day life. In particular, the energy required by the Seychellois households and industries is fossil fuel-based, with machinery and transport equipment representing 30% of all imports (NBS, 2021). Even the fish canning plant needs raw materials like frozen tuna and metal cans which are imported from overseas. A sudden disruption of foreign trade affects dramatically the whole economy (Kontoyas and Sooprayen, 2020). In Seychelles, a comprehensive report assessing the economic consequences of COVID-19 pandemic for the country was published by the Government and the United Nations System in Seychelles under the leadership of UNDP in December 2020 (Rassool *et al.*, 2020). It showed the extent of the social and economic crisis caused by the pandemic, with a GDP contraction of 11.5% in 2020 (the IMF 2020 forecast is even higher at −13.8% for 2020). The budget balance as a share of GDP was one of the worst among SIDS at −15.5% in 2020, with a projection of −6% in 2021 (Pratt, 2015). Exports have decreased by 38.9% in 2020 (IMF, 2021).

The COVID-19 pandemic has flipped the whole economy upside down, with a 70% fall in the number of foreign visitors and a resulting 58% contraction of receipts from tourism, main pillar of the economy which would represent directly and indirectly two-thirds of the GDP (Archer and Fletcher, 1996; Valenghi, 2004; Pratt, 2015; CBS, 2021), and a new prevailing

role assigned to fisheries and the blue economy (Rassool *et al.*, 2020; AfDB, 2021b). In the recent years, Seychelles has developed an ambitious and innovating programme for the development of the Blue economy (Republic of Seychelles, 2018). The blue economy is hard to define and delineate accurately, though it follows the overarching objective of UN-SDG14 (“Conserve and sustainably use the oceans, seas and marine resources for sustainable development”). The national ocean-based framework and roadmap aim to integrate the economic development with the quality of the marine environment and social well-being. “The Blue Economy concept acknowledges small islands’ unique dependencies on oceans and their vulnerability to environmental economic risks. It proposes options for mitigating some of the inherent structural challenges of small, undiversified economies, including small populations, high dependency on imports, limited space, skills, capacity and high unit costs of providing public services” (The Republic of Seychelles, 2018). In that respect, the country pioneered the creation of “Blue Bonds” in October 2018 for an amount of USD 15 M with a maturity of ten years and interest payments (“coupons”) of 6.5% under a re-payment guarantee of the World Bank (Roth *et al.*, 2018).

As early as in 2014, the Seychelles also initiated a Marine Spatial Plan (MSP) with the assistance of an environmental NGO, The Nature Conservancy, to ensure that representative species and habitats have long-term protection, to improve resilience of coastal ecosystems with a changing climate, and to ensure economic opportunities for fisheries, tourism and other uses (Chassot *et al.*, 2018). By doing so, it was a way to re-gain control over the Exclusive Economic Zone (EEZ) by reducing the spatial occupation of the distant water fishing nations (DWFN) in the territorial waters, hence potentially changing the amount of fishing right fees paid by the foreign fleets to the government which was estimated at USD12 M in 2017 (Chassot *et al.*, 2018). There is growing concerns in the country about the small proportion of tuna value transhipped at Port-Victoria benefitting to the domestic economy which is estimated to be less than 15%, even after including the indirect effects on the local industries (Rassool *et al.*, 2020).

From any crisis emerge new opportunities for the sustainable development of SIDS, and some important questions arise about the post-COVID situation in the Seychelles: “*What has been the actual loss caused by the pandemic on the domestic blue economy and its various components? Does the new context weaken or strengthen the strategic blue economy roadmap and re-align sectoral priorities? What are the lessons drawn to increase the national resilience and face similar shocks in the future?*”

These questions need the development of assessment and planning tools which are still in progress in the country, despite the high standards of macroeconomic data collection schemes and reports by the National Bureau of Statistics, the Ministry of Finance, the Central Bank of Seychelles and other parastatal institutions. A few analyses have been undertaken in the past to develop satellite national account (SNA), input-output (IO) analysis or even Computable General Equilibrium models in Seychelles, particularly regarding tourism or fisheries (Archer and Fletcher, 1996; Valenghi, 2004; Robinson *et al.*, 2010; Pratt, 2015; Chassot *et al.*, 2018; Bistoquet *et al.*, 2018). However, none could rely so far on a robust Supply-Use table (SUT), using instead close SIDS economies such as Hawaii or

Aruba as proxies of the IO table structure (Valenghi, 2004; Pratt, 2015). Therefore a first important step is to build a country-tailored IO table and Social Accounting Matrix (SAM) based on the major local industries (Pyatt and Round, 1985; Miller and Blair, 2009; Breisinger et al., 2009). Since our own study, another very recent piece of research has used the domestic SUT and is certainly the most advanced effort to develop a dynamic CGEM in Seychelles attempting to assess the economic impacts of the COVID-19 pandemic and its possible futures (AfDB, 2021b). Interestingly, our results converge to a large extent with the scenarios and outcomes of this comprehensive study.

3 The SAM input-output framework¹

3.1 Converting the supply-use table into a Social Accounting Matrix

A SAM provides a standardized framework organizing aggregate national statistics of an economy, including transactions and transfers between macroeconomic agents (Pyatt and Round, 1985; Miller and Blair, 2009). It represents a cornerstone to develop a computable general equilibrium model (Pratt, 2015; AfDB, 2021b). Because of the high reliance of SIDS' economies on exports of specific goods or services², we focused the analysis on the spillover effects of decreasing exports caused by the pandemic on the domestic economy. The pandemic first hit the foreign demand for tourism (transportation, accommodation, and restaurants), prior to trickle down to other industries (craftwork, agriculture, fisheries, beverage, recreational services, construction, etc.).

Finally, a selection of industries must be made with regard to the most representative activities in the country. We used the Seychelles Industrial Classification (SIC) designed on purpose by the NBS for the country on the basis of the International Standard Industrial Classification (ISIC Rev4). The fish canning plant (Indian Ocean Tuna canning plant, whose 60% of shares belong to a foreign investor, Thai Union, since 2010) is the main job provider of the Archipelago, employing more than 2000 workers, representing 8% of private jobs, of which 68% are foreigners (NBS, 2021). Therefore the 'Manufacture of fishery products' industry was distinguished from the 'Manufacture of beverage and tobacco' and the 'Manufacture of other food products'. Tourism is mainly represented by two industry categories: 'Transportation and storage' (e.g., Air Seychelles) and 'Accommodation and food service activities' (e.g., restaurants and resort hotels), but non-resident tourists also consume many other public and private services (retail shops, arts and entertainment activities, tour operators, etc.).

¹ The SAM model is a standard matrix adapted to the Seychelles case based on the industrial classification of the country. The full matrix and the models used in this section are available as [supplementary materials](#) to avoid a tedious presentation in this article.

² The tourism activities represent directly 24% and indirectly two thirds of the GDP in Seychelles. They also account for 40% of total export revenue. Canned tuna represented 85% of exported commodities in value in 2019 and 2020; Pratt, 2015; Rassool et al., 2020; AfDB, 2021b).

To develop the SAM for the Seychelles, we followed the stepwise procedure suggested by Miller and Blair (2009) and Breisinger et al. (2009). First, we built a simplified circular flow table of the Seychelles economy (Fig. 1). We started with the system of national accounts to check the basic macroeconomic equilibria and used several data sources:

- The SUT and GDP tables published by NBS;
- The Government Finance and Balance of Payments (BoP) published by the Central Bank of Seychelles (CBS);
- The tax and revenue details published by the Ministry of Finance through the Seychelles Revenue Commission (SRC);
- The Seychelles Investment Board (SIB) for the annual investment by industry.

Year 2014 was taken as period of reference because it was the only one for which a SUT with 23 industries and 35 product categories were published by NBS. An update for 2019 was also achieved with respect to the macroeconomic equilibria but without the SUT details concerning intermediate consumption by industry. It showed the steady state structure of the economy in the pre-COVID period, indicating that the current SAM structure is stable enough and can be used for short-term estimations and projections.

The GDP of Seychelles at purchasers' prices in 2014 was SCR 17 688 M, the exchange rate being SCR 12.75 per USD in 2014 (i.e., GDP USD 1.4 B, and GDP per capita USD 14 700). When excluding indirect taxes less subsidies on products, the GDP at basic prices amounted to SCR 14 670 M (factor earnings in Fig. 1), and the net indirect taxes on products to SCR 3018 M. Most of the monetary amounts are released by the System of National Accounts. The private savings, fiscal surplus, and foreign capital inflows were adjusted to balance out the savings/investment account with others. The rest of the world purchases and sells goods and services (Seychelles' exports and imports, respectively), with a negative current account balance for Seychelles. Foreign workers send more remittances abroad than the opposite, hence a financing capacity from the rest of the world towards the domestic economy (spent in direct and portfolio investment, aids, grants, loans, etc.).

The last and final figures to be included concerned the breakdown of intermediate consumption (IC) and total output (sales) revenue by industry. We relied on the Use table produced by NBS to collect output value for the 23 industries, along with value-added at basic prices and ICs at purchasers' prices. All flows of income and expenditure were then balanced within the SAM, including the relationship with the rest of the world. A few adjustments were made. Firstly, the final demand of the non-profit institutions and services to households (NPISH) was aggregated to the households' consumption. Secondly, the SUT did not include the shares of capital and labour income. However, from the 'Earnings and employment' NBS bulletin, we could estimate the labour income by industry (annual earnings x employment) and calculate the shares of capital and labour by industry. Thirdly, because the domestic standard product classification of imports (SPC_35 product codes) did not match perfectly the SIC_23 nomenclature, we aggregated some product catego-

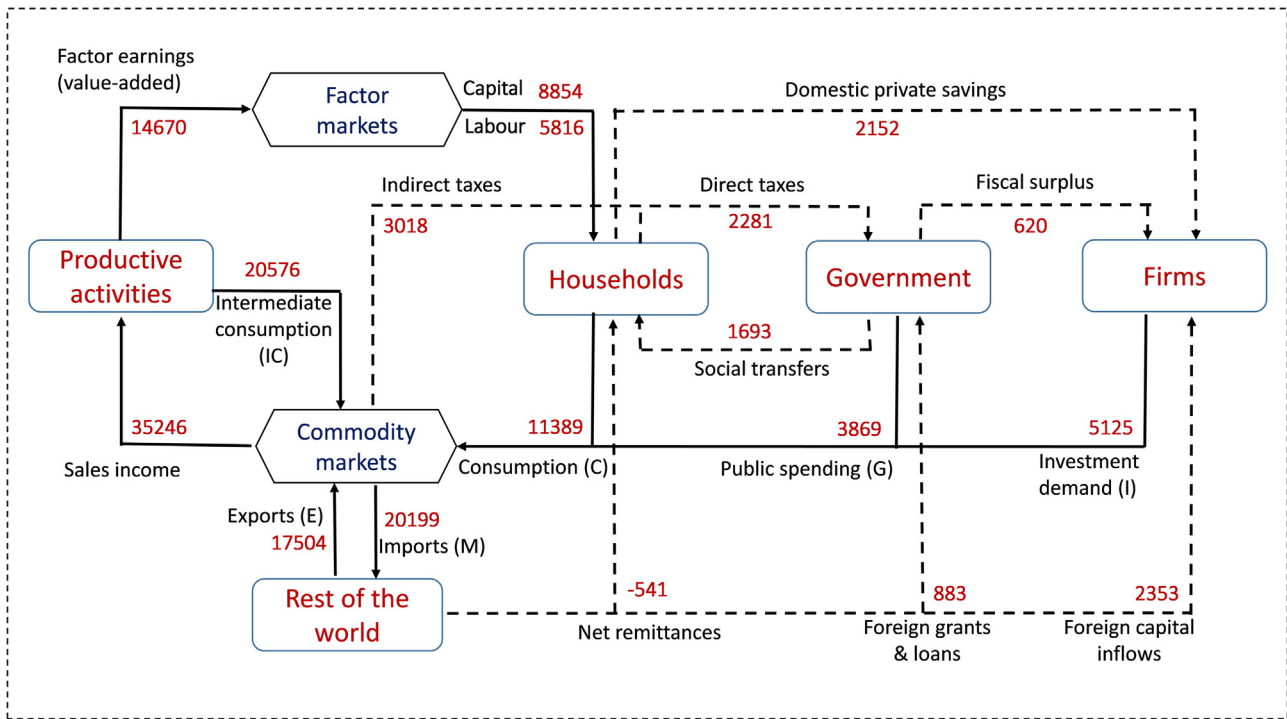


Fig. 1. A simplified circular flow of the SAM in 2014 (in MSCR). Dashed-line arrows represent transfers (taxes, savings, remittances, grants, and loans) between institutions (adapted from Breisinger et al., 2009)

Table 1. Pre-pandemic economic effects expressed in contribution (%) resulting from a stimulation of the domestic economy by the final demand for fishery products (fishing + processing) and by the demand for tourism (transportation + accommodation and food services) with the SAM model.

Contribution (%)	Fish industry	Tourism industry
GDP at basic prices	8%	25%
Tax receipts	6%	28%
Investment	7%	22%
Imports	15%	19%

ries. Fourthly, we allocated the ‘Travel debits and credits’ value among those industries actually exporting goods and services, mainly transportation, wholesale and accommodation and food services. At equilibrium, the sum in columns corresponds to the sum in rows for each account. The full SUT and SAM matrix are available from the corresponding author upon simple request.

3.2 A first pre-pandemic assessment of the fish industry contribution

The stimulation of the economy was first performed by the mere final use vector of fishery products (demand for products from fishing and fish processing, null values everywhere else). In a second step, we performed the same estimates for the two activities associated with tourism. The effects are estimated through the contribution of each industry to the GDP, the public budget, investment and imports. Results are summarized in Table 1 at the general economic level.

Prior to the pandemic, the tourism activity would contribute three times more (25% against 8%) to the GDP at basic prices than the fishing and fish processing industry (Tab. 1). This is perfectly in line with the African Development Bank study published in 2021, the most advanced research in modelling the Seychelles economy, which found a pre-pandemic contribution of tourism representing 24% of the 2019 GDP (AfDB, 2021b). The fish industry is more difficult to isolate because the fishing industry is separated from the fish processing activity which is merged under other manufacturing activities. In our estimation, the tax receipts from tourism fetch a higher value (28%) because of important taxes on products like excise duties. The contribution of tourism to investment in new buildings is also much higher (22% of the national gross capital formation). However, the fish-related industries contribute significantly to foreign trade (Tab. 1). The fishing industry is probably under-estimated because the artisanal and semi-industrial sectors are included but not the industrial one. The reconstructed Seychelles catch by the 460 small-scale vessels was approximately 5000 to 10 000 t in the late 2010s

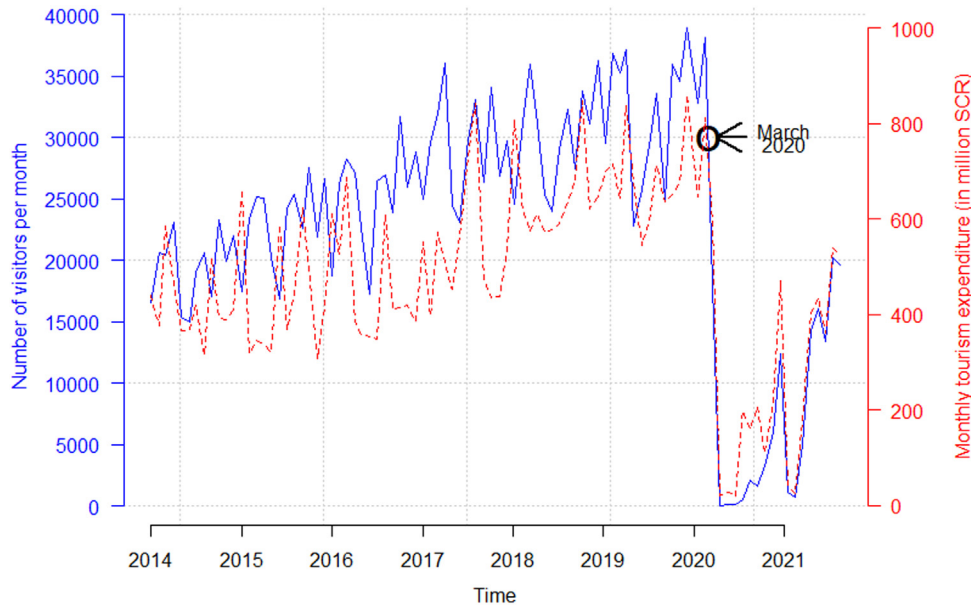


Fig. 2. Number of visitors (solid blue and left axis) and estimated tourism expenditure (MSCR – dashed red and right axis) per month in Seychelles between January 2014 and August 2021. Source: NBS and CBS.

(Christ *et al.*, 2020), to which could be added 112 000 t by industrial Seychelles-flagged purse seiners, 23 000 t by industrial Seychelles-flagged longliners, and 2000 t by coastal longliners, i.e., nearly 150 000 t of fish landings in overall (SFA 2021). FAO reports 157 000 t of exports valuing USD 420 million in 2019. The reality is however different because most industrial and semi-industrial vessels belong to foreign-owned companies (i.e., EU, Taiwan, Sri-Lanka). This is why NBS only reports in 2020 some 64 000 t of fish exports valuing USD 282 million, of which 88% is made of canned tuna.

4 Simulation of the COVID-19 shock on the domestic economy

4.1 The decreasing demand for tourism services

The external shock of the pandemic on the Seychelles economy since March 2020 was caused by the contraction of major exported services and commodities, but mostly by the dramatic reduction in the number of foreign visitors. A ban on international travel was implemented with effect from 23 March 2020 until 30 July 2021. Cruise ship visits were also suspended indefinitely from February 2020 and extended until November 2021 (Rassool *et al.*, 2020). The second semester of 2020 was not better than the first one because most foreign countries where tourists originate from had implemented a lockdown and restricted travels abroad.

The UNDP report estimated the impact through the decreasing earnings from tourism before and after the pandemic, taking year 2019 as the reference (Rassool *et al.*, 2020). The number of visitors sharply fell in 2020 (114 858) compared to 2019 (384 204), resulting in a 70% reduction, while expenses collapsed by 58% (Fig. 2).

A first shock was introduced in the SAM model, applying the contraction of exports (−38.9% between 2019 and 2020,

according to IMF, 2020) proportionately to the SUT structure of exports (Tab. 2).

According to our model, the effect of the COVID-19 pandemic on the domestic GDP would represent a 13.2% decrease in 2020, a 10.5% reduction of the public budget, a 6.1% reduction for investment and a 15.3% decrease of imports compared to 2019 (Tab. 2). It is to note that such effects are projected other things being equal, i.e., they do not account for the growth of other industries, price effects, and the mitigation measures quickly adopted by the government from March 2020 with the support of IMF, the African Development Bank, and the World Bank.

This first simulation reveals the shock of the pandemic and proves to be fairly well in line with other institutional projections, such as forecast by UNDP (−11.5%), the IMF (−13.8%), the World Bank (−10.5%), and the African Development Bank worst case (−11.6%) (IMF, 2020; Rassool *et al.*, 2020; AfDB, 2021a). The actual figure released by NBS in March 2021 reported a 10.7% decrease of GDP in 2020 compared to 2019, but with a second quarter particularly impacted (−20.5% relatively to 2019–Q2) by the pandemic crisis (NBS, 2021). On that basis, we were quite confident in using this SAM model to test for further scenarios for 2021–2022.

4.2 The new prevailing role of fishery-related activities after the pandemic shock

The COVID-19 pandemic did not affect fish trade in the Seychelles. International trade data available from NBS indicate that the exports of seafood have steadily increased between 2015 and 2020, showing no significant change in composition or decrease in 2020 compared to previous years (Fig. 3). Exports of canned tuna products, making the bulk of Seychelles fish exports, have even increased by 20% in tonnage and 41% in value between 2019 and 2020 (Fig. 3).

Table 2. Estimated effects (MSCR) of the COVID-19 pandemic on the Seychelles domestic economy.

	Shock	Effect	% change 2020/19
Activities	Δ Demand	Δ Output	
Agriculture	−10	−114	
Fishing	0	−62	
Manufacture of fishery products	−777	−1180	
Manufacture of other food	−40	−301	
Manuf. of beverage & tobacco	−52	−259	
Manufacturing, other	−390	−2024	
Electricity, gas, steam	0	−219	
Water supply; sewerage, waste	0	−47	
Construction	−9	−325	
Wholesale and retail trade; repair	−208	−427	
Transportation and storage	−498	−985	
Accommodation and food service	−869	−1023	
Information and communication	−114	−342	
Financial and insurance activities	−90	−262	
Real estate activities	−31	−217	
Owner occupied dwellings	0	−263	
Professional, scientific and technical	−154	−440	
Administrative and support service	0	−331	
Public administration and defence	0	−430	
Education	0	−112	
Human health and social work	0	−110	
Arts, entertainment and recreation	0	−89	
Other service activities	0	−46	
Macroeconomic variables		Δ result	
GDP	0	−2420	−13.2
Households' income	0	−2662	−13.8
Tax receipts	0	−884	−10.5
Investment	0	−451	−6.1
Imports	0	−3244	−15.3

Catches from the local small-scale fisheries that are usually sold to local restaurants and fish shops suffered more from the collapse of tourism, as other primary sectors, but their contribution to the economy remains small compared to that of the industrial fleet and the fish processing industry. To highlight the new winners and losers since the pandemic crisis, Figure 4 summarizes the percent change of their contribution to GDP between quarters Q2 and Q4 of 2020, relatively to the same average contribution (Q2–Q4) of years 2017–2019 (actual figures from NBS, 2021).

The industrial classification is slightly different from the previous one used in the SAM³, but there is no ambiguity about the new status of the fish processing industry since the pandemic crisis. This industry saw its direct contribution to GDP jumping by more than 80% since March 2020, from 3% to 5.4%, while the accommodation and food services plummeted by nearly the same proportion from 15% to less than 4%. Among the primary sectors, agriculture (+18%) has not experienced the same damage as the domestic longline and

coastal fisheries (−52%) which proved to be more dependent on foreign tourism and exports because of freight restrictions for the latter. Administrative and support services' contribution to GDP has also decreased significantly (−58%), falling from 3.5% on average prior to the COVID-19 pandemic to 1.5% only. Transportation followed the same declining trend (−14%) but represents a more severe impact because of its usually substantial contribution to GDP, around 12% on average over the past four years.

Some new investment projects in fishing and fish processing have been decided after an agreement between private investors and the government and will emerge in the coming years. The “Turn quay” (120 m long quay with 9.5 meters draft) to service the industrial fleet has been recently built for a cost of SCR 50M, financed by the EU sectorial programmes included in the EU-Seychelles fishing agreement. At Providence zone 6, the quay facilities measuring 100 m long can yet service some 50 fishing vessels per week for loading ice, unloading catch and boat moorings. Zones 6 and 14 of Ile du Port are planned to host several processing and storage facilities for high-quality fish caught by the industrial purse-seiners, industrial and semi-industrial longliners. The Central Common Cold Store (CCCS) started its operations in early

³ ‘Manufacture of fishery products’ and ‘Manufacture of other food’ are merged, and a new category ‘Manufacture of concrete, rock products, glass’ is introduced in this classification.

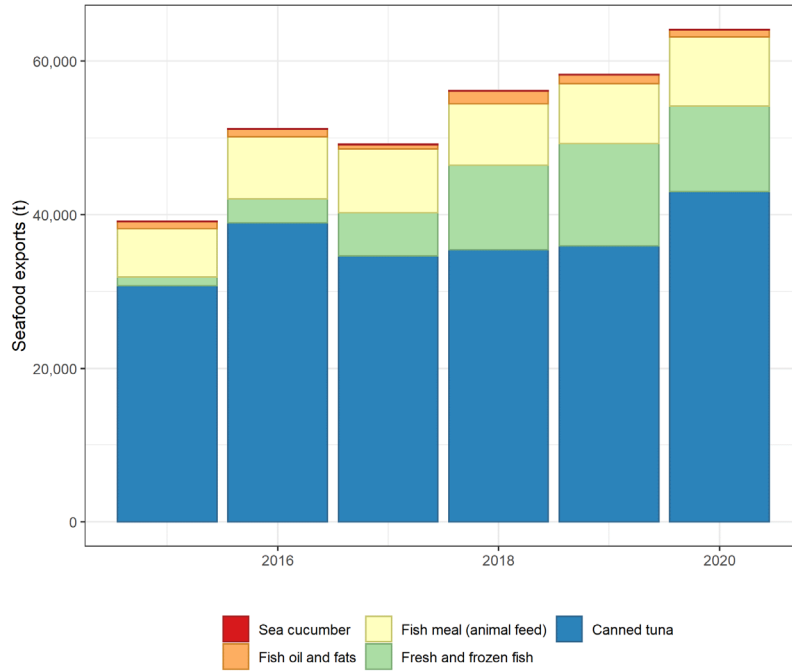


Fig. 3. Seychelles exports of seafood products (metric tons). The data do not include tuna caught with purse seine. Source: NBS (2021).

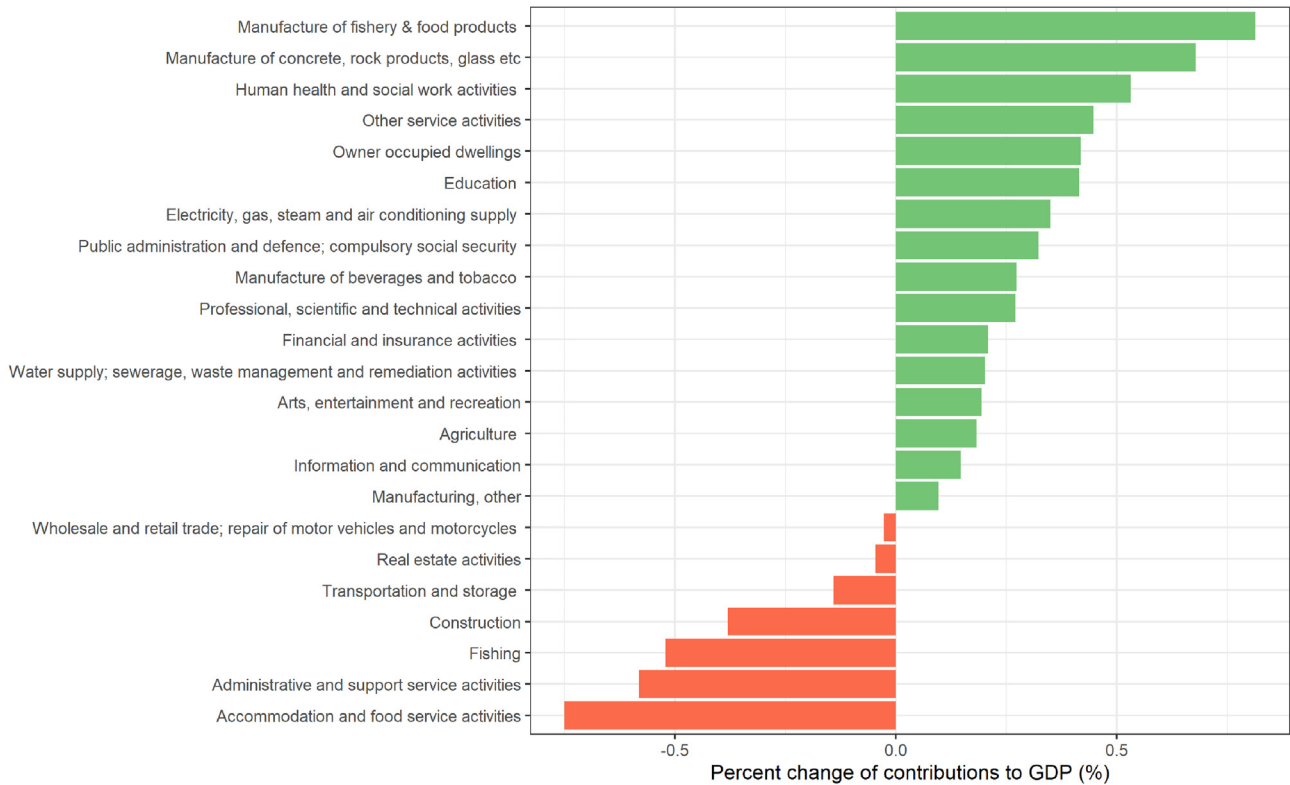


Fig. 4. Percent change of contributions to GDP by industry (Q2:Q4_2020/Q2:Q4_2017–2019). Source: own elaboration from data collected by NBS (2021).

Table 3. Two scenarios (see text for details) for fish-related and tourism industries.

	Contribution of the fish industry (%)		Contribution of tourism (%)
	Scenario 1. BAU for fish demand	Scenario 2. +50% demand for fish	Scenario 1 & 2. half demand for tourism
GDP at basic prices	11%	14%	15%
Tax receipts	6%	7%	22%
Investment	7%	7%	22%
Imports	18%	22%	11%

December 2021, providing 12 600 t of cold rental storage at -20 and -40°C . The principal objective is to increase the local landings and processing to add value to fishery products. If it remains difficult to estimate the consequences of such investment plans, the ambition is clearly to increase the quantity and the unit value of exports, in addition to the sales of canned tuna products. A huge development plan concerns in particular the semi-industrial longliners and some local fishers heard of 72 additional licences (Fishing Boat Owner Association, pers. com.) which would be granted by the government to supply the current traders and the new processors (note that the current number of active licences is 33). The total catch of the coastal long-liners was only 2000 t in 2019, which is marginal when compared to the total catch of purse-seiners (more than 400 000 t, of which 21% in the Seychelles EEZ). However, Yellowfin tuna was deemed overfished by IOTC which has implemented a total allowable catch limit since 2017. The national quota will have to be shared between the various segments of the domestic fleet and may represent a boundary to the expansion of future domestic catches.

The new economic hierarchy resulting from the pandemic and the numerous investment plans in fishing and fish processing were used to create two novel scenarios for 2021 and possibly for 2022 if tourism does not fully recover. The first one would assume a Business-As-Usual (BAU) trend for the fishery product demand and a slight recovery of tourism, but still representing half of its pre-pandemic magnitude. This assumption looks realistic from the most recent CBS data on the number of visitors (up to August 2021). The Main Scenario designed by the African Development Bank study for the period 2021–2025 is quite similar, with a gradual recovery of tourism revenue, a slight decline of government spending and an increasing trend of fish exports (AfDB, 2021b). Two other AfDB scenarios, called pessimistic and optimistic scenarios, foresee a faster or slower recovery of exports for three main sectors: petroleum products, tourism and other services. In our own second scenario, we would assume the same slight recovery of tourism at half of its current demand, but with a 50% increase in the demand for fishery products. These two additional scenarios were performed with the SAM model.

Even under the optimistic second scenario, the GDP will still be 7% lower than the pre-pandemic level, but trade would have fully recovered then (Tab. 3). Comparing now the respective economic effects of fisheries and tourism reported in Table 3 to the pre-pandemic outcomes of Table 1 shows the new prevailing role of fish-related activities: under the first (BAU) scenario, the latter would increase their contribution to

the domestic wealth from 8% to 11%, whereas tourism would see its own share falling from 25% to 15% (Tab. 3). Once again, this scenario fits with the recent study of reference published by the African Bank of Development, predicting with its Main Scenario built on IMF projections, a reduction of the tourism contribution from 23.8% to 8.9%, which is even more pessimistic than our prediction (AfDB, 2021b). If the contribution of the fish industry to the public budget or to investment would not be improved after the pandemic crisis, the role of fisheries in trade would slightly increase (from 15% to 18%) while imports for the sake of tourism activities would still be significantly reduced. The second scenario would support a contribution of fisheries to the domestic wealth (in terms of GDP) quasi-equivalent to the one of tourism (14 vs 15%), but twice more important regarding trade. Nevertheless, it would not change the participation of the fish industry to the tax receipts of the government (nor to the investment level), which remain three times lower than the contribution of tourism because of higher VAT rates or excise duties in particular. The new situation depicts a more balanced effort of the two main economic pillars to the country's income, which become less dependent on one single activity.

5 Discussion of the results

SIDS are particularly vulnerable to external shocks and the COVID-19 pandemic can certainly be considered as a major shock for the world economy, with potential amplifying effects for small island countries (Kim, 2020; Rassool *et al.*, 2020). Because of the health safety measures and travel bans since March 2020, Seychelles lost 11% of its GDP in 2020, and the year that followed has not seen any particular sign of full recovery (cruise ferries were stopped until November 2021 for instance, and the airline traffic was restricted for the first semester of 2021).

Several challenges are inherent to islandness: low returns to scale because of limited space and population, weak degree of diversification, remoteness from main trade routes and markets, trade specialization based on natural resources, dependence on imports for equipment and manufactured goods, etc. (Kim, 2020; The Republic of Seychelles, 2018; Kontovas and Sooprayen, 2020). However, islandness can also represent a strength when it comes to recovery after a crisis, whether caused by climate extreme events (e.g., cyclones, rainfalls, flooding) or by other factors like the pandemic which has affected the world economy since March 2020 (Guillotreau *et al.*, 2012; Kelman, 2018, Nath and Madhoo, 2021). The

community spirit and resilience can do a lot to bounce back when facing such external shocks.

The 2008 financial crisis proved the resilience of the Seychelles economy to external shocks (Kim, 2020). Strong and structural decisions have been taken thereafter: i.e., floating exchange rate scheme in 2008 and monetary policy rate introduced in January 2019. It is well known that countries having adopted a flexible exchange rate regime, like the Seychelles, should be more resilient than those with a fixed rate regime as demonstrated after the financial crisis⁴ and after the pandemic shock (IMF, 2021). In a first phase after the shock, the current trade balance is affected by more expensive imports and the domestic currency is depreciated, but the competitiveness is improved and the balance of payment positively re-adjusted by increasing exports in a second period, as long as the Marshall-Lerner condition on trade elasticities holds (AFD, 2021; AfDB, 2021b). This flexible rate regime leaves more autonomy to the Central Bank to change the policy rate, as seen with a 75% reduction between March and July 2020. However, the price to pay is a greater variability of exchange rates, especially for small countries depending on others' decisions. The risk of inflation is therefore greater, hence the foreign exchange interventions of the CBS to cushion the exchange rate depreciation. Despite the efforts, the Seychelles rupee lost 50% to 60% of its value against the major currencies (USD, EUR, GBP) between March and December 2020 (CBS average exchange rates in SCR per currency) and the exports of tourism services did not adjust instantaneously in numbers in 2021 because of travel restrictions, whatever the gain of competitiveness.

A strong and timely response was also proposed by the government and the CBS after the pandemic in March-May 2020. Actually, several relief programmes were created or activated by the Seychelles government and the Central Bank of Seychelles to alleviate the socioeconomic consequences of the fallout: salary bailout, unemployment relief scheme, postponed taxes and temporary relief for private companies, reduction of loan repayments for households, new budget allocation for social protection to ensure assistance to children at home, etc. (Rassool et al., 2020; IMF, 2021). The Central Bank of Seychelles cut the monetary policy rate⁵ by 100 basis points from 5% to 4% on 23 March 2020, and by 100 more basis points down to 3% on 22 June 2020. The lower deposit and lending rates along with growing prices contributed to reduce the real interest rate and to depreciate the rupee by more than 50% between March and December 2020, although the CBS sold USD 10 M of foreign exchange to support the national currency. The IMF also granted an emergency

financial assistance loan of USD 31.2 million after a government request to the Rapid Financial Instrument in May 2020, complemented by an external support from the World Bank (USD 46 M), the African Development Bank (USD 10 M) and an unidentified budget support (USD 40 M), thus inflating the gross international reserves (GIR) of the Central Bank to cover the huge balance of payment deficit (IMF, 2021).

Altogether, these measures have mitigated the consequences of the pandemic shock in the short run, but what about the long-run effects? A decade ago, the Republic of Seychelles has made the choice of investing in the blue economy, creating a Ministry of the Blue economy and fisheries, a blue Bond scheme to raise funds for long-term investments in sustainable marine activities, wrote a roadmap and an ocean-based framework, implemented a marine spatial plan, etc. (The Republic of Seychelles, 2018; Roth et al., 2018). This is not the only SIDS to adopt such a pathway, as proved by the efforts also made by Mauritius (Cervigni and Scandizzo, 2017), but the Seychelles concentrate most of their resources and strategy into this blue economy domain. This is perhaps a key factor of success for their economic future, as shown by the present study on the basis of a SAM Model (Pyatt and Round, 1985; Breisinger et al., 2009; AfDB, 2021b).

After the pandemic, the new structure of the national economy showed a fish-related industry nearly unharmed compared to the tourism-related industries, the administrative and support services, or the other manufacturing sectors. Because of the global lockdown, the international demand for canned tuna and related industrial fishing activities have particularly well resisted to the pandemic and even increased, canned food being considered as a safe commodity in periods of crisis. Despite the quarantine of some infected crew and the immobilization of purse seine vessels sometimes for a few weeks, the foreign purse seine fleet operated quasi-normally, benefitting to other industries through the backward linkages of bunkering operations, stevedoring, shipping, and other domestic value-added activities, not even mentioning the fishing right fees paid to the government (Chassot et al., 2018; Rassool et al., 2020). This reminds us the importance of the Seychelles EEZ tuna fisheries and connected activities for the domestic economy. The catch of purse seiners varies between 300 000 and 400 000 t per year, one third of it being sold and processed at Port-Victoria (*Ibid.*, p. 20). It has been shown that a strong El Niño Southern Oscillation episode, by displacing the tuna stocks and the industrial fishing fleet to the Eastern side of the Indian Ocean, would cause a one-third reduction of port service activities, resulting in a five-point decrease of GDP other things being equal (Robinson et al., 2010). The resistance of purse seine fisheries to the pandemic was made possible because frozen or canned tuna products are shipped by reefers and containerships, not by air freight. The canned fish exports to the GDP even grew up by 41% in value between 2019 and 2020, thanks to firm prices and higher volumes (NBS, 2021). As an illustration, canned tuna production increased in quantity by 16% between Q2 2019 and Q2 2020, while all other food produces registered decreased in levels over the same period because of declining tourism (Rassool et al., 2020; AfDB, 2021b).

Some authors have estimated the economic contribution of fisheries and fishery-related activities in 2014 to be SCR 4923

⁴ In 2008, the trade deficit was so important and the debt amounted to 150% of the GDP when the establishment of a flexible exchange rate regime after the financial crisis depreciated the Seychelles Rupee by 60%, thus correcting the macroeconomic imbalance and re-boosting rapidly the economy with steady growth rates over 10% in the early 2010s (AFD, 2021, p. 69).

⁵ In January 2019, the CBS changed its policy by introducing a Monetary Policy Rate (MPR). The monetary policy therefore transitioned from reserve money targeting (i.e. indirect control of the money supply growth) to a monetary policy rate framework (i.e. direct guiding of short term interest rates).

million, accounting 27% of the national Gross Value Added (GVA) (Bistoquet *et al.*, 2018). However, this estimate is derived from a Satellite National Account approach and includes both the activity of industrial fleets (of foreign-owned companies) and the shares of GVA from non-fishery activities that could be attributable to the presence of the fish-related activities. The SAM-based approach used in the present research gives a more macroeconomic picture through the standard IO model applied to the 23 industries of the Seychelles classification, including the Keynesian multiplier effect of factors' incomes but subtracting all leakages flowing out of the domestic economy (taxes, savings, imported inputs and final goods, net remittances...). It shows the respective contributions of both fish and tourism sectors as if the entire economy was solely stimulated by their final demand. In a pre-pandemic year, the weights of fish and tourism in the GDP at basic prices would be 8% and 25%, respectively. On the basis of observed data for 2020 and the first semester of 2021 regarding these two sectors, we constructed two scenarios: a first one with a Business-as-usual trend for fisheries ('Fishing' + 'Manufacture of fishery products') but a half-level of demand for tourism (here restricted to 'Transportation' and 'Accommodation & food services'), and a second one with the same slow recovery pace of tourism but a growing demand (+50%) for fish products fostered by the boom of planned investments in new vessels (mostly longliners) and in new fish processing and storage facilities at Ile-du-Port, a new land zone created recently. With the first scenario, the blue economy stands still behind the recovering tourism activity, but in the second one, the two domains of activity contribute equally to the wealth of the country, if not in terms of tax receipts (because of different VAT rates) or investment. We can therefore conclude that "the development of the fishing sector was a salvation for the economy (and that) the government should accompany the process and consider taking microeconomic measures to foster productivity in this sector" (AfDB, 2021b).

Some limits can be put forward concerning the ambitious plan of investment designed by the government concerning the blue economy: how will the natural resources respond to the steady growth of the fleet, knowing that the Indian Ocean Tuna Commission has already reported some concerns about the abundance and effort levels for some species like yellowfin and bigeye tunas, which are also targeted by longliners (IOTC 2020)? A quota limit has been set by IOTC for Yellowfin in 2017, and this will probably be the case too for Bigeye. New IOTC resolutions have been adopted in February 2023 to create a temporary suspension of drifting fish aggregating devices used by purse-seiners for 72 days in 2024 (IOTC resolution 23-02). These conservation measures will therefore set new limits for the development of the fishing industry in the years to come. Will the semi-industrial longline fleet still be profitable after the significant increase of granted licenses (yet the economic model of this fleet is not viable)? Will the global market absorb the supplement of high-value products exported by the local processors, overcoming the extra-cost of expensive air freight rates for the remote consumers?

On a more methodological ground, progress still has to be done to improve the macroeconomic planning models that have been used in this research. Firstly, the SUT used for the SAM does not distinguish between imports for intermediate and final uses. Some adjustments have also to be made regarding the mere exports from the re-exports of products that are produced by

foreign companies and transit to the territory without any added value (oil products, frozen tuna, etc.). This step is also required to compute a symmetric product-by-product or industry-by-industry Input-Output Table to be inserted into the SAM. There are also avenues of future research in turning the SAM into a more flexible Computable General Equilibrium (CGE) model. Such CGE models consider price effects in addition to quantity changes, and more complex behavioural patterns of production and consumption, hence being more realistic and flexible to test for policy changes. It has been done for Mauritius regarding the Ocean economy and to other SIDS economies for tourism (Pratt, 2015; Cervigni and Scandizzo, 2017) and it could also be useful for the Republic of Seychelles to forecast the economic consequences of an external shock or a development plan. A first attempt was proposed by Pratt (2015), comparing several SIDS with a very simple and short model. A second one was released more recently by the African Development Bank in 2021, and represents certainly the most comprehensive effort ever made for Seychelles with a dynamic CGEM simulating three post-pandemic scenarios and two policy options (AfDB, 2021b). However, both studies do not rely on country-specific estimations of elasticity parameters in their behavioural equations, but use instead parameters found for equivalent SIDS in the literature. These modelling efforts should be further extended to provide the Seychelles with a tailored-made forecasting tool.

6 Conclusion

In this article, we have analysed the economic consequences of the COVID-19 pandemic for the Seychelles economy through a SAM approach. Such a macroeconomic planning tool including 23 distinct industries had not been developed in the past (prior to the parallel study of the African Development Bank) and may serve to other assessments of policy changes or economic impacts. Open economies like SIDS are more deeply affected by a trade shutdown like the one following the WHO declaration of the pandemic in March 2020. It may create a very tough situation for domestic households whose consumption relies heavily on imported goods, but also for the foreign exchange income inflowing from exporting industries.

The number of foreign visitors coming for tourism has fallen by 70% in 2020, and their economic expenses decreased by 58% according to the CBS. The depressing effect for the GDP was estimated to be -13.2% in our model, other things being equal, i. e., not too far from the -10.7% actually observed by the NBS and not including all efforts made by the government to mitigate the detrimental effects of the crisis. The long-term investment of the country in the Blue economy (creation of blue bonds, marine spatial plan, strategic framework and roadmap for the Blue economy, etc.) has partially offset the loss of tourism services. In particular, the fish processing industry has shown a strong resistance to the pandemic by increasing its own exports by more than 20% in tonnage and 40% in value in 2020.

The development plan of new semi-industrial vessel licenses, storage facilities and processing units should strengthen the role of fishery-related activities in the years to come. Two scenarios were built with a half-recovering tourism sector relatively to the pre-pandemic period: a Business-as-Usual scenario for fishery-related activities

maintaining the same level of development before and after the COVID-19 crisis, and a growth scenario where the demand for high-valued fish would increase by 50%. With the second scenario, the contribution of fisheries to the national wealth would be equivalent or so to the weight of tourism, around 15% each. This statement would only hold if the natural stocks and international markets could absorb this growing amount of supply, and not considering a potential full recovery of the tourism sector. Current concerns in IOTC about the degraded status of biomass levels for both yellowfin and bigeye tunas highlight the limits to blue growth for the Seychelles economy. It will be interesting in the future to see whether other sectors of the blue economy may represent viable substitutes to tourism in SIDS.

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Supplementary Material

The Supplementary Material is available at <https://www.alr-journal.org/10.1051/alr/2023020/olm>.

Table 1. Social Accounting Matrix in monetary flows.

Table 2. Social Accounting Matrix in ratios.

Table 3. SAM with the RoW as sole external sector.

Table 4. The Seychelles Industry Classification in 23 industries.

Table 5. Simplified SAM of the Seychelles economy in 2014 (million SCR)

Table 6. The 23-industry Seychelles SAM in 2014.

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