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Method Article

A method to analyze the sectoral impact of Fiscal support for COVID-19 affected economies: The case of Oceania



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A B S T R A C T

In this paper, we apply the method of computable general equilibrium (CGE) modeling in economics to ascertain how fiscal support measures such as wage subsidies, small business loans, and finance guarantee schemes have impacted at an economy-wide and sectoral level for 8 COVID-19 affected economies in Oceania. We model our scenarios based on IMF World economic outlook projections, combined with the fiscal stimulus packages offered to counter this global health pandemic's recessionary effect. Our study confirms that the adverse impact of COVID-19 on output is cushioned through a large fiscal stimulus package wherever offered. This package would still be inadequate to avoid unemployment and job losses in tourism and education services in Oceania, with continued support essential for their survival in 2021.

- The approach entails steps (1) to (3), as outlined in the paper.
- Future researchers will find this method useful in evaluating the adverse impact of not only COVID-19 but any other external shocks to the economy, either directly or indirectly, that involves fiscal support mechanisms.

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A R T I C L E I N F O

Method name: Applied General Equilibrium (AGE) modelling

Keywords: Sectoral impact, COVID-19 pandemic, Fiscal stimulus, Oceania, New Zealand, Pacific Islands

Article history: Received 6 February 2021; Accepted 25 February 2021; Available online 3 March 2021

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Specifications table

Subject Area:	Economics and Finance
More specific subject area:	<i>Applied Economics, Economic Modelling</i>
Method name:	<i>Applied General Equilibrium (AGE) modelling</i>
Name and reference of original method:	<ul style="list-style-type: none"> • Corong, E. L., Hertel, T. W., McDougall, R., Tsigas, M. E., & van der Mensbrugge, D. (2017). <i>The standard GTAP model, version 7. Journal of Global Economic Analysis</i>, 2(1), 1–119. • <i>Global Trade Analysis Project (GTAP) Publications and Model versions</i>
Resource availability:	<ul style="list-style-type: none"> • <i>Global Trade Analysis Project (GTAP) Publications and Model versions</i>

Introduction

In this paper, we apply the computable general equilibrium (CGE) modeling method in economics to ascertain how fiscal support measures (such as wage subsidies, small business loads, and finance guarantee schemes) have impacted at an economy-wide and sectoral level, in countering the external shock delivered by the COVID-19 pandemic for eight affected economies in Oceania. It is well known that several governments have responded to the unprecedented economic shock from the global pandemic with a full/partial lockdown of economic activities, using fiscal stimulus packages and expansionary monetary policies to support the economy in the short-term. However, empirical evidence on whether these measures are likely to cushion the adverse impact upon the economies and the key industries affected by them has been less forthcoming.

A growing body of literature has emerged around examining the economic impact of COVID-19 pandemic on (i) financial markets and their uncertainty (See Iyke [20], Sha and Sharma [42], Mishra et al. [27], Chen et al. [4], Salisu, and Sikiru [41], Salisu and Akanni [40], Narayan, [29,30], Phan and Narayan [33], Prabheesh [35], Gil-Alana & Claudio-Quiroga, [10], Sharma, S. S. [43], Narayan, et al. [28], He et al. [14,15], Qin et al. [37] among others); (ii) energy markets and impact on oil prices (Ertuğrul, Güngör, & Soytaş, U. [8]. Fu, & Shen, [9]. Gil-Alana, & Monge [11], Liu et al. [22], Narayan [30], Qin et al. [36], Devpura & Narayan [6], Huang & Zheng [17], Iyke [21], Prabheesh et al. [34] Salisu, & Adediran [39] among others); (iii) industry impact in the Chinese context (Gu et al. [12], He et al. [14], Liu et al. [23,24], Ming et al. [26], Shen et al. [38], Wang et al. [46] and Xiong et al. [47] among others); (iv) household and labor force participation (Yue et al. [48] and Yu, et al. [49] as well as (v) trade connectivity and supply chain networks [45]. While studies such as Tisdell [44] and Debelle [7] have attempted to focus on the policy issues around expansionary fiscal/monetary policy during the pandemic in a few countries in Oceania, they have not provided any empirical evidence on the overall macroeconomic and microeconomic impact through a theoretical model. Haldar and Sethi [13], using a negative binomial regression, concludes that government policies play a crucial role in mitigating COVID-19 cases, which motivates us further to analyze the fiscal policy impact specifically.

Our study contributes to the literature by applying CGE methods to understand the economic impact of a fiscal stimulus shock. Since the global pandemic is still evolving and new evidence about the virus's resurgence and re-infections keep emerging daily, analyzing the economic impact of such a large-scale disruptive event on an economy is challenging. Economists have primarily relied on the use of global computable general equilibrium analysis in assessing the policy impact of this pandemic (see Park et al. [32] and McKibbin [25]. CGE methods utilize real-world economic data to analyze the impact of a range of policy shocks both at a macroeconomic as well as at a microeconomic level. We model our scenarios based on IMF World economic outlook projections [18], combined with the fiscal stimulus packages offered to counter this global health pandemic's recessionary effect. Our study confirms that COVID-19 on output's adverse impact is cushioned through a large fiscal stimulus package wherever offered. This package would still be inadequate to avoid unemployment and job losses in tourism and education services in Oceania, continued support essential for their survival in 2021. We organize the rest of the paper as follows. Section 2 presents our modeling framework and the methodology, explaining the policy scenarios. It then discusses the results of our simulation exercises at both the economy and sector level. Section 3 concludes by offering some policy implications.

Method details

Step-by-step method/approach

We utilize the Global Trade Analysis Project (GTAP) database version 10a [1] and the standard GTAP model [5] applied to the COVID-19 affected economies. GTAP Model is a global multi-region, multisector, CGE model. In the GTAP model, each country/region is represented by a regional household, which has a Cobb-Douglas utility function that distributes aggregate demand into three different categories in every regional household: savings, private households, and government. The model links various types of prices in the model through tax/subsidy wedges, which exist across the user types, output, and source of use and production. Armington assumption helps differentiate domestic commodities from imports and imports from one source with those from another [2,3,5]. GTAP model determines all prices and quantities, keeping technological changes and taxes exogenous and unchanged unless they are shocked. The employment of skilled labor is assumed to be exogenous. In contrast, we assume unskilled labor to be endogenous, giving room for an increase in unemployment if triggered, reflected in our model closure.

Step 1: We aggregate the database to 40 countries from 141 and 48 sectors from 65 for our policy simulations and update the dataset to 2019, from the World Bank. We assume the baseline GDP growth for 2020 to be the same as that for 2019 and compare it against the post-COVID projections from IMF [18], which has data for all countries covered.

Step 2: We utilize the *splitreg* algorithm [16] to create a regional database for individual Pacific island economies as most of them were not disaggregated by default in the GTAP database. The algorithm uses the shares of GDP and its components of the countries in the region, derived from the World Bank dataset. We derive input-output shares from those in the aggregated region, and the whole new dataset is balanced using matrix rebalancing and adjustment programs.

Step 3: We create policy scenarios and run the simulations:

Policy scenarios

The first scenario involves a medium-term containment scenario of the pandemic without any fiscal response. For this shock, we endogenize the TFP variable in GTAP, $afereg(r)$, to target the impact of COVID, estimated by IMF [18]. The details of our policy scenarios are as follows:

- (i) Medium-term containment: We assume that the pandemic is contained, and normal economic activities resumed by early 2021 with the outcome of several vaccine trials going on around the world realized successfully in the next 6 to 8 months. In this scenario, we base the GDP decline shocks on IMF's World Economic Outlook Database updated up to July 24, 2020.
- (ii) Fiscal stimulus: We focus on discretionary actions and measures taken by the government of the affected countries in response to COVID-19 in this scenario [31]. The fiscal stimulus packages consist of expenditure and revenue measures through subsidies and cash flow schemes to affected businesses. We compile this information from the IMF [19], which tracks COVID-19 policy responses by country. We process the measures to calculate effective consumption subsidies and the production subsidies given to the businessmen and consumers, collecting fiscal measures from several sources, including UNESCAP and government department websites for countries not covered in IMF [19]. The simulations present the results of the fiscal stimulus-response both at an economy-wide and at a sectoral level.

To implement the fiscal stimulus shock, we take the total stimulus from IMF [18] and apportion it into two equal parts: one for consumption ($SC(r)$) and the other for production ($SP(r)$) in region r . Then, we compute the tax shocks by dividing them by the appropriate base (C and P , respectively, for consumption and production). For simplicity, we denote the percent change in power of taxes by T followed by the respective base below:

$$TC(r) = -SC(r) * 100/C(r) \quad (1)$$

$$TP(i, j, r) = -SP(r) * 100/P(r) \quad (2)$$

Where i stands for factors and intermediate inputs (domestic and imported, separately), and j stands for the industries (set named IND). We use the negative sign to capture subsidies (or negative taxes).

In the GTAP model, tax shocks affect prices and corresponding demand through elasticities. For consumer prices, a simplified representation of this pass-through (the prefix p stands for percent change) is as follows:

$$pC(j, r) = \text{IncomeElasticity}(j, r) * pY(r) - \text{sum}\{j, \text{IND}, \text{PriceElasticity}(i, j, r) * (pPM(j, r) + TC(r))\} \quad (3)$$

Similarly, the following is a simplified representation of what happens to producer prices.

$$pDemand(i, j, r) = pPr od(j, r) - \text{ProductionElasticity}(i, j, r) * (pPM(i, r) + TP(I, j, r)) \quad (4)$$

Changes in total output affect sector demand for primary factor composite good j used in an industry i in region r through the following equation in the model

$$qva(j, r) = -ava(j, r) + qo(j, r) - ao(j, r) - \text{ESUBT}(j) * [pva(j, r) - ava(j, r) - ps(j, r) - ao(j, r)] \quad (5)$$

These changes in value added (qva) in use of factor j in region r affects demands for endowment commodities (qfe) i for use in industry j in region r and hence employment of factors of production in this model, through the following equation:

$$qfe(i, j, r) = -afe(i, j, r) + qva(j, r) - \text{ESUBVA}(j) * [pfe(i, j, r) - afe(i, j, r) - pva(j, r)] \quad (6)$$

Results

All countries in Oceania experience a decline in their output, exports, and investment without fiscal stimulus support (Table 1). New Zealand (NZL)'s real GDP declined by -13.6%, the highest in the region, while that for the Pacific-island economies drops to -8%, based on IMF [18] estimates we imposed on the model. NZL was under the most stringent lockdown than all other Covid-19 affected economies in Oceania during the second quarter of 2020. While saving lives and reducing exponential growth of the number of infections, this stringent lockdown delivered a greater demand, supply, and productivity shock to its economy. Therefore, it is no surprise that it has aggressively resorted to expansionary fiscal and monetary policies to counteract this unexpected adverse external shock, as observed in studies such as Lyke Lyke [31].

Fig. 1 summarizes the economic impact of fiscal stimulus on our chosen economies across four panels. NZL (21%), Guam (17%), and Australia (14%) provide the most prominent fiscal stimulus packages as a proportion of GDP, respectively, among the countries studied (Panel A). As a result, welfare and real GDP losses are mainly cushioned in NZL (with a real GDP decline of 5.2%¹) and Guam (-3.1%). A smaller fiscal stimulus to GDP for Australia cushions an otherwise adverse output decline of -8.3 to -6.2% in the medium-containment scenario. Contrastingly, the absence of a fiscal stimulus in French Polynesia and New Caledonia leads to a sharp decline in their real output to about 8% in a medium-term scenario (Panel B).

We present the sectoral impact results in terms of changes in output from the baseline for the medium-containment scenario² (in the presence of fiscal stimulus) for seven key industries, namely, Dairy, Fishing, Meat, Forestry, Education, Recreational and Accommodation, food and retail services, that are of importance to countries in Oceania in Panel C. Education services, as well as Tourism (including recreational as well as accommodation and food retail services), seem to be the worst impacted industries across Oceania, experiencing a short-term output decline of -25% in education services and -s14% in tourism-related recreational services for NZL, the sharpest among the countries

¹ Note these will be conservative estimates, as they do not consider the resurgence of the pandemic in NZL during August-September 2020, and again in February 2021.

² The detailed sectoral results are available from the authors upon request.

Table 1

Changes in Key Macroeconomic variables in the model (% change from baseline).

This Table shows how key macroeconomic variables, such as overall welfare and changes in output, imports, exports, and investment change compared to the baseline from a scenario of no fiscal support to one where such support is provided COVID-19 affected economies in Oceania. Medium-term containment refers to an output shock scenario based on the IMF [18], which we impose on our model. Fiscal stimulus refers to the shock only based on the author's estimates from IMF [18], which we simulate in our model. A negative sign suggests an adverse impact from the shock on the model. It shows that New Zealand, Australia, and Guam gain the most in real GDP gain due to fiscal stimulus cushioning the external shock from the COVID-19 pandemic.

Country	Welfare change (in US \$ billion)	Real GDP (% change)	Import (% change)	Exports (% change)	Investment (% change)
Scenario 1: Medium Containment					
Australia	-185.8	-12.6	-14.3	-4.4	-13.7
New Zealand	-26.6	-13.6	-10.3	-13	-6.2
Papua New Guinea	-2.2	-8.8	-6.6	-6.8	-0.9
Guam	-0.5	-8.0	-5.3	-7	0.6
Fiji	-0.5	-9.4	-7.3	-6.7	-2.1
French Polynesia	-0.5	-8.0	-5.4	-6.6	0.2
New Caledonia	-0.2	-8.0	-5.3	-7.3	0.8
Northern Mariana	-0.1	-8.0	-5.3	-7	0.7
Scenario 2: Fiscal stimulus					
Australia	95.1	6.4	7.1	6.6	35.8
New Zealand	15	8.4	13.3	15.4	49.4
Papua New Guinea	0.1	2.4	3.7	15.3	14.6
Guam	0.02	4.9	6.5	31.9	27.7
Fiji	0.01	3.0	4.3	21.6	18.4
French Polynesia	0.02	0.2	1	0.3	1.3
New Caledonia	0.01	2.9	4.4	17.3	17.4
Northern Mariana	0.006	0.3	1	0.7	1.7

Source: Author's calculations based on IMF [18] and GTAP database.

studied.³ Fishing, meat, and meat products are also affected adversely across all countries to a comparatively lesser extent (the Northern Mariana Islands and French Polynesia being an exception). The dairy sector gets a significant boost in output due to fiscal stimulus in NZL but declines elsewhere (Panel C).

How is the demand for skilled labor affected (*qfe* variable in the GTAP model, see Eq. (6)) in the key sectors whose output suffers, even with a fiscal support package? Panel D presents the results for the medium-term containment scenario. Education services and Tourism industries suffer large declines in output due to the pandemic's adverse effects from the maximum decrease in demand for skilled labor, worsening all COVID affected economies in Oceania. This decline is the sharpest for NZL among the countries studied, ranging around -19% for education services,⁴ -11% for accommodation and food retail services, and -7% for recreational and cultural services related to tourism (Panel D). Australia, Guam, and Fiji witness a smaller but sharp decline in demand for skilled labor in these industries, most of whom are likely to be impacted the most by prolonged international border restrictions. We do not report unskilled labor results, which are primarily not adverse due to the fiscal stimulus package's wage subsidies in these countries. Adverse effects for the demand for unskilled labor are observed for fishing, dairy, and meat in French Polynesia, wherein fiscal support was absent. In Oceania, services sectors suffer in terms of both output and employment. Tourism constitutes a significant contributor to GDP in most economies in Oceania, and both Australia and NZL are virtual tourism gateways to the Pacific island economies. Economic recovery and reduced restrictions on

³ Note that this is could be a conservative estimate as it does not consider the impact of domestic tourism being affected due to the ongoing restrictions to and from the Auckland region.

⁴ International education services constitute the fourth largest contributor to the New Zealand economy, estimated to be about 1.5% of its GDP (See https://www.universitiesnz.ac.nz/sites/default/files/uni-nz/documents/UNZ_NZL%27_s_Universities_Key_Facts%26_Stats_Nov_2018_2.pdf)

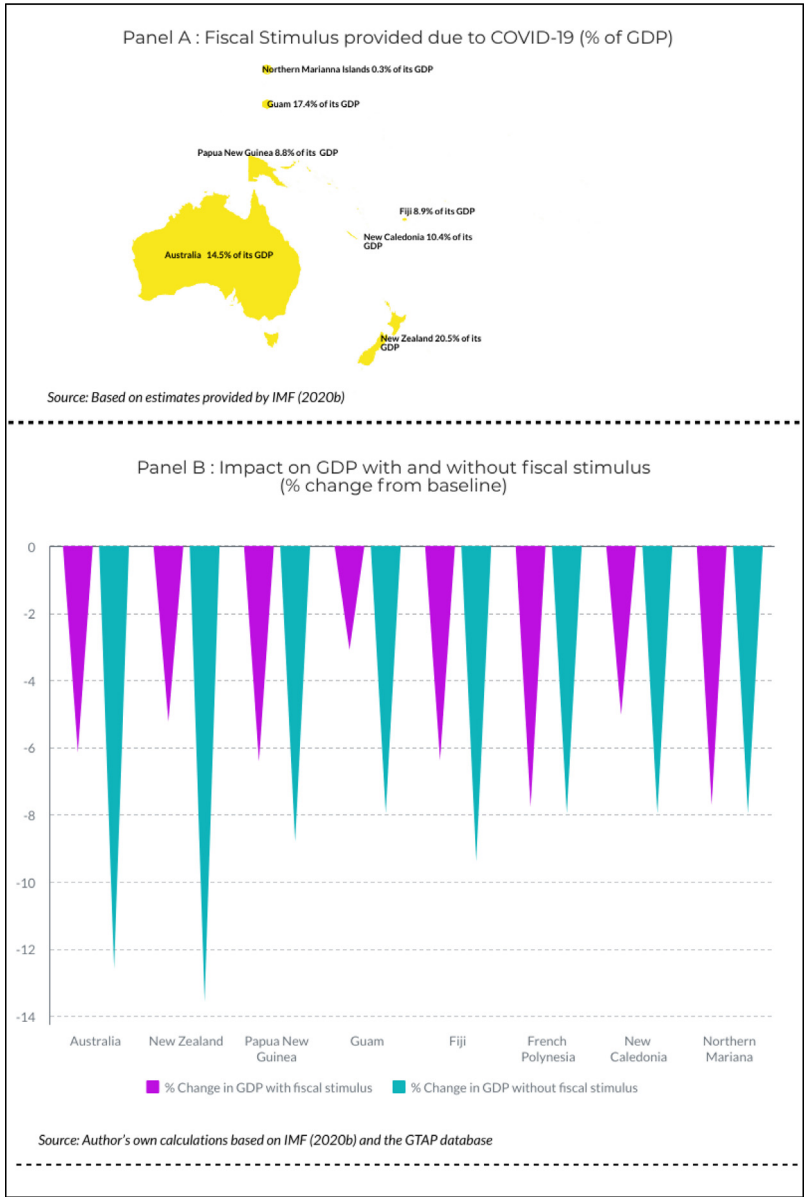


Fig. 1. Economic Impact of Fiscal stimulus on output and employment in COVID-19 affected economies in Oceania. This Figure summarizes the economic impact of COVID-19 on output and employment on the COVID-19 affected economies in Oceania across four panels. Panels A and B present macroeconomic results, while the sectoral (microeconomic) results on output and employment are shown in Panels C and D, respectively. Panel A depicts fiscal stimulus in terms of wage subsidies and business loans etc., provided as a percentage of the country's GDP shown in a graphical map of Oceania. The highest fiscal stimulus is given in New Zealand, followed by Guam and Australia. Panel B reflects the changes in GDP compared to the baseline scenario of the pre-COVID-19 19 period, with and without stimulus, which shows New Zealand mitigating the impact to the most considerable extent due to its sizeable fiscal support provided as shown in Panel A. Panel C shows how fiscal stimulus has impacted the five most affected sectors in Oceania, education, and tourism being the most severely affected ones. Panel D depicts the changes in employment of skilled workers due to fiscal stimulus response in the five key sectors in some of the COVID-19 19 affected countries of Oceania, confirming job losses in education and tourism-related sectors even in the presence of a generous fiscal stimulus.

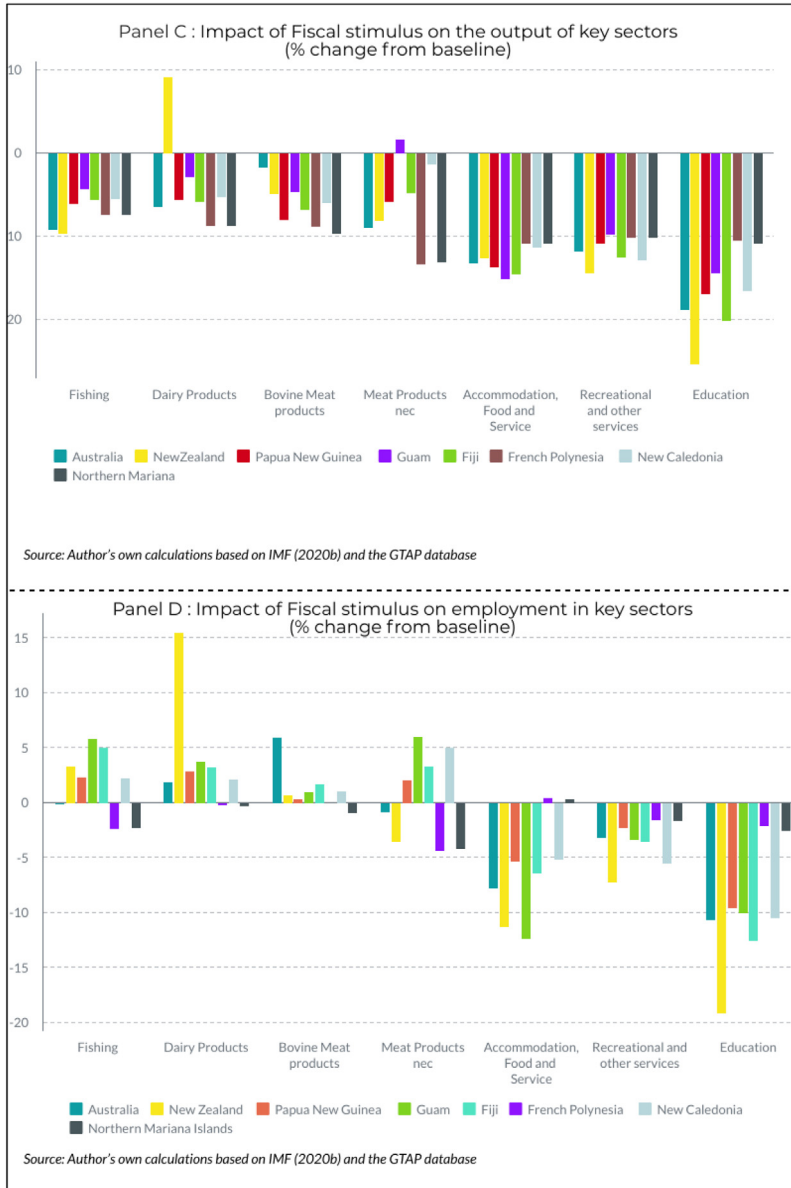


Fig. 1. Continued

international travel and border controls in these two countries would, therefore, be imperative for international tourism to recover to pre-COVID levels in the region.

Conclusion

Utilizing a global economic model that analyzes the pandemic's economic impact, our study informs policymakers that fiscal stimulus levels may be insufficient to avoid job-losses in tourism

and education services, and continued support is essential for their survival, looking forward to mid-2021. Further uncertainties to the recovery process remain in this region, so the extent to which fiscal stimulus would be effective in containing the welfare and output losses from the pandemic over the medium to longer-term can only be best estimated at this stage through these methods.

Declaration of Competing Interest

The authors declare no competing interests.

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