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Impact of the Global COVID-19 Pandemic on FDI: Evidence from a Small Open Economy

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Abstract

This study sets out to empirically examine the effect of the outbreak of the global COVID-19 pandemic on the foreign direct investment flows of a small open economy, Mauritius. A preliminary analysis of the monthly gross direct investment flows data clearly shows that in general, the series departed from their original trends after the outbreak of the pandemic. As such, we employ the newly developed Bayesian structural time series (BSTS) framework for causal analysis to determine the initial impact of the pandemic on the gross direct investment flows of the country. The results indicate that the outbreak of the pandemic negatively affected investments coming from South Africa, Switzerland, Belgium, China and Reunion and those in the "Real Estate Activities" sector. Surprisingly, a considerable increase was observed for the "Manufacturing" sector. Our findings also reveal that in the long run, gross direct investment flows from some countries and in some sectors will surely be influenced by the pandemic although this was not obvious at the time of the investigation. However, this will be highly dependent upon the measures taken by the country and worldwide to contain the spread of the pandemic.

Keywords: Impact; COVID-19 pandemic; FDI; Bayesian Structural Time Series; Mauritius

1. Introduction

Foreign direct investment worldwide has been severely hit by the COVID-19 pandemic and fell by 35 per cent to reach $1 trillion at the end of 2020 (from $1.5 trillion in 2019), worse than the effect of the global financial crisis a decade ago (UNCTAD, 2021b). Developed economies suffered the most where FDI plummeted by 58 per cent, in part due to oscillations caused by corporate transactions and intra-firm financial flows. Europe registered a fall of 80 per cent, magnified by large swings in conduit flows while flows to North America fell by 42 per cent (mostly caused by a fall in reinvested earnings) and those to other developed economies by about 20 per cent on average. While FDI in developing economies decreased by a more moderate 8 per cent, mainly because of resilient flows in Asia (China and India even registered increases in FDI but South Asia suffered a decline of 25%), Latin America and the Caribbean were severely hit with a 45 per cent drop in their FDI level, with those economies dependent on investment in natural resources and tourism more heavily affected. FDI flows to Africa fell by 16 per cent to $40 billion, its lowest level since 2005.

Although the impact of the pandemic on global FDI was concentrated in the first half of 2020 and largely recovered in the second half, greenfield investment, crucial for developing countries continued its negative trend throughout 2020 and into the first quarter of 2021. According to the UNCTAD (2021b), global FDI flows are expected to improve in 2021 with a projected increase of about 10 to 15 per cent, still leaving FDI some 25 per cent below the 2019 level. Best scenarios forecasts reveal that FDI may be back to its pre-pandemic level in 2022, but such prospects are dependent on the pace of economic recovery and the possibility of pandemic relapses, the potential impact on FDI of recovery spending packages, and policy pressures among others.

Mauritius, one of the continent's best performers, has not been spared by COVID-19 and this pandemic has been the greatest test that the island has ever encountered both as a sanitary and an economic crisis. Although the country dealt with the sanitary crisis relatively well as compared to most countries worldwide[1], however, the drastic sanitary measures that probably allowed the country to avoid the worst of the pandemic brought severe disruptions, entailed a very high cost for the economy. The GDP plummeted by an estimated 15.8% in 2020, marking the country's worst contraction since 1980, mostly due to restrictions on international travel which engendered a collapse in tourist arrivals. This sector, which represents one-fifth of the island's GDP and over 20% of employment, resulted in significant spillover effects on the whole economy. The impact of

[1]It should be highlighted that Mauritius successfully responded to the global COVID-19 pandemic through a drastic, fast and hard lockdown and quarantine measures, and has effectively contained the disease, being 'COVID-free' from August 2020 to March 2021, when a second outbreak occurred. With a total of around 1,800 cases as at end of June 2021, 18 deaths and over 1,500 recovered (315 cases and 10 deaths for the period Jan to Dec 2020).

the pandemic on FDI inflows to the country, an input that has been critical for economic progress given the island's limited resources, has also been consequential, with a 48% decline in FDI inflows in 2020 (from 471 in 2019 to 256 million USD in 2020) (UNCTAD, 2021b; BoM, 2021). Gross direct investment flows received from the main countries of investment of the country for instance declined in the range of 37.1% (for France) to 99.1% (for China) during the period January to June 2020. In terms of sectors, the construction sector was heavily hit, registering a 100% decrease in direct investment flows, followed by the real estate activities (58%) and information and communication sectors (52%).

Against this backdrop, this study sets out to empirically investigate the impact of the outbreak of the COVID-19 pandemic on the foreign direct investment (FDI) flows in Mauritius. In particular, it conducts an in-depth analysis of its effect in terms of the main geographical origins of the investments (10 countries) and main sectors of investments (6 sectors). In this context, the recently developed methodology of the Bayesian structural time-series (BSTS) framework for causal analysis is employed. This was first proposed by Brodersen et al. (2015) and relies on the implementation of the CausalImpact package in R. As Perles-Ribes et al. (2019) posited, the BSTS model is used mostly for the analysis of structural time series and it is now widely used in the fields of philosophy, statistics, engineering as well as econometrics. Consistent with the aim of this study, this technique is mainly used for short-term/long-term predictions of time series and inferring causal impact. Monthly gross direct investment flows data spanning from January 2014 to June 2020, amounting to a total of 78 observations is used and the set of countries and sectors in our sample were selected based on maximum investments registered. Data were extracted from the Bank of Mauritius (Bank of Mauritius, 2020).

The rest of the chapter is organised as follows, section 2 details the methodology and data used while section 3 dwells on the analysis and discusses the results and section 4 concludes.

2. Data and Methodology

In this study, we employ monthly gross direct investment flows data spanning from January 2014 to June 2020 (78 observations) to empirically assess the impact of the outbreak of the COVID-19 pandemic on the Mauritian foreign direct investment (FDI) flows[2]. In particular, we conduct an in-depth analysis of its effect in terms of the main geographical origins of the investments (10

[2]Despite that our sample size is relatively small, it is adapted to the recommendations of Brodersen (2016) on the application of Bayesian structural time-series (BSTS) models for causal analysis, which stipulates that the length of the pre-intervention period should be approximately two or three times that of the post-intervention period whenever the impact of an intervention variable is examined on another variable.

countries) and main sectors of investments (6 sectors)[3]. Data were extracted from the Bank of Mauritius (Bank of Mauritius, 2020). As compared to the same period the previous year, a sharp decline can be observed in the gross direct investment flows received from the main countries of investment in the country (see Table 1). This decline ranges from 37.1% (for France) to 99.1% (for China). Similarly, it can be seen that the construction sector suffered the most with a 100% decrease in direct investment flows, followed by the real estate activities and information and communication sectors, with a respective decrease of 57.9% and 51.7% (see Table 1). Nevertheless, a radical increase can be found in gross direct investment flows emanating from the United States of America: an increase of 1309.2% can be noted. Our analysis also shows that gross direct investment flows increased considerably in two of the main sectors: manufacturing (1550%) and accommodation and food service activities (440%).

Table 1. Gross Direct Investment Flows (Rs million) for the period January-June 2019/20

	January		**March**		**June**		**January-June**		**% Decrease**
Country/Year	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**	**2019-2020**
France	321.53	305.83	421.94	532.16	386.97	387.58	3395.91	2129.06	**37.3**
South Africa	293.31	295.67	554.10	163.61	336.52	84.61	2498.97	696.66	72.1
Switzerland	16.48	15.72	45.44	116.17	5.16	76.39	801.19	239.81	70.1
United Kingdom	21.32	10.41	49.52	26.72	13.30	105.22	444.70	170.72	61.6
United Arab Emirates	20.79	44.30	70.76	7.43	41.82	48.66	291.32	172.83	40.7
Belgium	25.11	4.83	13.24	13.17	25.90	8.05	223.88	32.05	85.7
China	23.23	3.54	162.64	0	52.17	0	617.22	5.69	**99.1**
United States of America	0	63.99	12.14	0.29	1.63	2.52	25.21	355.25	+1309.2
Reunion	0	0	7.84	0	0	0.58	20.25	0.58	97.1
Germany	0	0.80	87.84	50.74	6.29	0	317.97	55.45	82.6
India	21.59	76.06	356.90	35.97	119	14.50	501.34	132.99	73.5
Sector/Year	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**	**2019-2020**
Manufacturing	0	47	37	12	8	185	98	1,617	+1550
Construction	0	0	2	0	0	0	2	0	**100**
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	0	15	12	0	26	20	52	64	+23.1
Accommodation and Food Service Activities	0	0	3	0	0	11	5	27	+440
Information and Communication	15	23	9	0	32	8	74	36	**51.7**
Financial and Insurance Activities	0	0	0	24	177	169	189	197	+4.4
Real Estate Activities	930	789	1,443	931	1,188	879	9,563	4,030	57.9

Source: Authors' elaboration based on Bank of Mauritius (2020).

[3]The set of countries and sectors in our sample were selected based on the maximum investments registered as at July 2020. For the specific case of empirical analysis, 11 main geographical origins and 7 sectors are first considered. This was then reduced whereby one of them has been used as a synthetic control.

In the same spirit as previous empirical studies investigating the causal impact of an intervention variable[4] (see, for instance, Perles-Ribes et al. 2018; 2019a; 2019b), we follow a two-step procedure to apply the Bayesian Structural Time Series (BSTS) framework for causal analysis.

First, we employ autoregressive integrated moving average (ARIMA) models to have a visual inspection of the impact of the outbreak of the pandemic on the gross direct investment flows of the country and to identify an appropriate synthetic control for causal analysis. This not only helps us to check whether the pandemic affected the series but also whether the latter was influenced by any structural changes. Consequently, each series is divided into two, whereby the first 72 observations in the pre-intervention period are used for the estimation of an optimal model based on the ARIMA framework, and the remaining to generate forecasts for the post-intervention period, assuming that the pandemic never struck[5]. We, thus, choose the series whose real values and predicted ones match closely as a suitable synthetic control. In other words, the series, which is not/less affected by the occurrence of the pandemic, is considered the most appropriate control.

The second step involves estimating the impact of the pandemic on the gross direct investment flows together by controlling for the series identified in the initial step using the methodology proposed by Brodersen et al. (2015) (i.e. the BSTS framework for causal analysis). In this study, the intervention variable refers to the outbreak of the COVID-19 pandemic which was first identified in December 2019. We, thus, use data up until December 2019 to create the counterfactual scenarios for each series, and data between January 2020 and June 2020 are employed to estimate the impact. In line with previous studies applying the BSTS framework for causal analysis (see, for instance, Perles-Ribes et al. 2018, 2019a, 2019b; Soto-Valero and Pic, 2019), the static regression technique is favoured to avoid any overfitting problems.

3. Results

In this section, we present the results obtained from the ARIMA and BSTS frameworks. Figure 1 illustrates the findings based on the optimal ARIMA models for each country of origin and sector considered. It can be observed from the figure that the gross direct investment flows series began to move off their actual trends in February 2020 (i.e. nearly two months following the declaration of the outbreak of the pandemic). Surprisingly, it can be seen that at some point, gross direct investment flows coming from countries such as Germany, France, United Arab Emirates, Unites States of America and Switzerland experienced an increase in contrast to what was predicted by the models. Similar results were found for the "Manufacturing", "Wholesale and Retail Trade; Repair

[4]In our case, the intervention variable refers to the outbreak of the COVID-19 pandemic, first identified in December 2019 in Wuhan, China.

[5]The pre-intervention period is the period from the first data point to the one just before the outbreak of the pandemic was first declared (i.e. up until December 2019); The post-intervention period considers data from January 2020 to June 2020.

of Motor Vehicles and Motorcycles" and "Financial and Insurance Activities" sectors. However, gross direct investment flows from China and South Africa and in sectors such as "Construction", "Information and Communication", "Accommodation and Food Service Activities" and "Real Estate Activities" were well below those predicted.

On the other hand, Table 2 summarises the trends in gross direct investment flows based on the monthly forecasts and the original values of each series for the period January 2020-June 2020. The results indicate that overall, gross direct investment flows from the main countries of investments and main sectors were affected. In terms of geographical origins, Germany was the least affected with merely a 2% decrease while investments from Reunion encountered a dip of 97%. Moreover, it can be seen that the "Construction" sector was the most affected with a 100% decrease in its gross direct investment flows whereas the "Accommodation and Food Service Activities" was the least affected (-30%). It is worth pointing out that there was a considerable increase in gross direct investment flows in some countries (Switzerland, United Arab Emirates, United States of America, India) and sectors (Manufacturing, Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles, Financial and Insurance Activities). This brings about the question of whether these shifts were due to the outbreak of the COVID-19 pandemic or due to some other structural changes. In this study, we consider "India" and the "Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles" sector as potential controls since they seemed to be less affected; instead, an increase can be noted for the period of investigation (see Table 2).

After an analysis of the time series using ARIMA models, we interpret the results of the estimations of the impact of the outbreak of the COVID-19 pandemic on the gross direct investment flows starting from January 2020 for each main country of origin and sector using the methodology proposed by Brodersen et al. (2015). For each country and sector, the same analytical structure is provided: the results are reported for the whole post-COVID-19 period (January 2020-June 2020) when the selected synthetic controls mentioned above are employed. Table 3 and Table 4 display a breakdown of the results obtained according to the country and sector investigated.

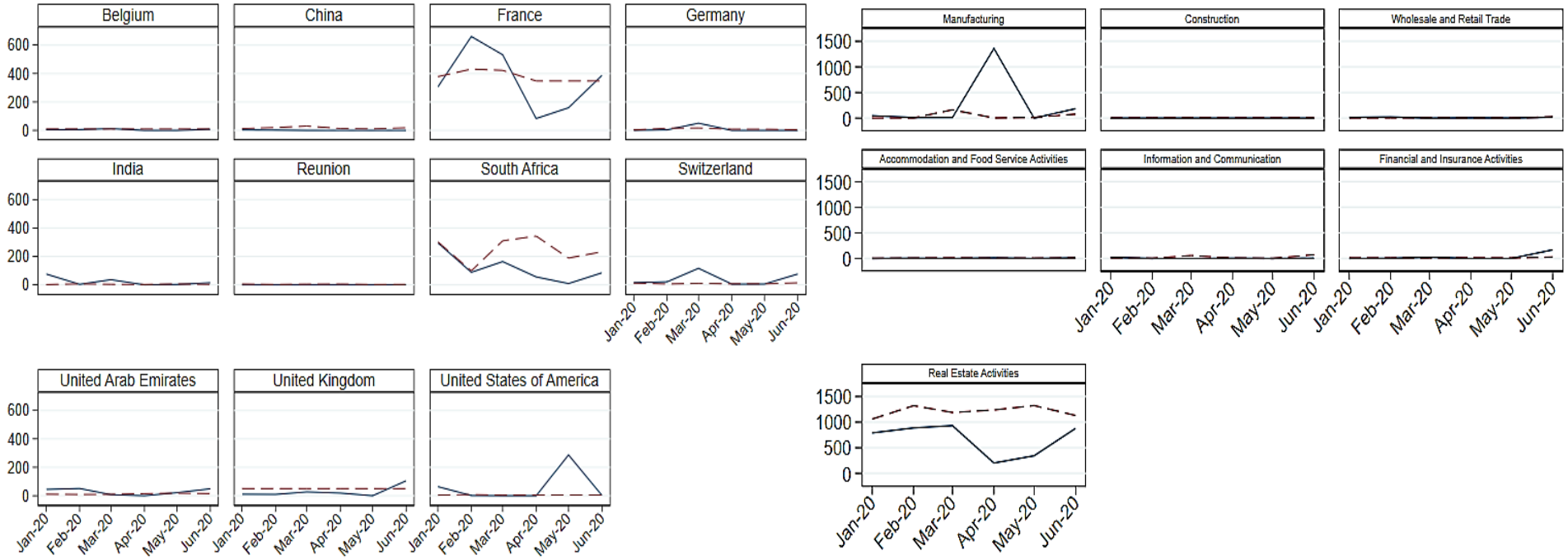

Figure 1. Predicted and real Gross Direct Investment Flows (Rs Million) January 2020-June 2020.

Notes: ARIMA models; solid lines represent original values and dotted lines predicted ones; Gross Direct Investment Flows (Rs Million) on the y-axis and date on the x-axis.
Source: Authors' elaboration.

Table 2. Predicted and real Gross Direct Investment Flows (Rs Million): January 2020-June 2020. ARIMA models.

	Predicted Gross Direct Investment Flows (Rs Million) (Jan 2020 - Jun 2020)	**Original Gross Direct Investment Flows (Rs Million) (Jan 2020 – Jun 2020)**	**Absolute effect**	**Relative effect**
Country				
France	379.38	354.84	-25	-6
South Africa	245.75	116.11	-130	-53
Switzerland	9.45	39.97	31	+323
United Kingdom	50.07	28.42	-22	-43
United Arab Emirates	12.77	28.81	16	+125
Belgium	10.36	5.34	-5	-48
China	17.61	0.95	-17	-95
United States of America	5.24	59.21	54	+1029
Reunion	**3.69**	**0.10**	**-4**	**-97**
Germany	**9.42**	**9.54**	**0**	**-2**
India	3.91	22.16	18	+467
Sector				
Manufacturing	44.0	269.47	225	+512
Construction	**2.1**	**0**	**-2**	**-100**
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	7.2	10.67	4	+49
Accommodation and Food Service Activities	**6.4**	**4.5**	**-2**	**-30**
Information and Communication	24.1	5.93	-18	-75
Financial and Insurance Activities	13.0	32.85	20	+153
Real Estate Activities	1210.0	671.7	-538	-44

Note: Average Gross Direct Investment Flows (Rs Million) for the period January 2020-June 2020.
Source: Authors' elaboration.

Although this effect is only significant for five of the countries investigated (South Africa, Switzerland, Belgium, China and Reunion) and one sector "Real Estate Activities", the posterior probability of a causal effect is above 50% for all models (see Table 3 and Table 4). This means that despite that the impact of the pandemic was not apparent during the first six months after the outbreak of the pandemic (January 2020-June 2020), the latter will eventually have a greater influence on the foreign direct investments of Mauritius. Nevertheless, the size of the impact will subsequently depend on the measures taken by the government and worldwide to mitigate the spread of the virus in the coming months. A detailed explanation of the impact of the outbreak in each country and sector investigated is given in the paragraphs that follow[6].

During the whole post-intervention period (January 2020-June 2020), it can be observed that on average, gross direct investment flows from South Africa amounted to about Rs 116 million.

[6]For the sake of brevity, we only discuss the significant average impacts of the outbreak of the pandemic on the gross direct investment flows according to each country and sector investigated.

This would have been much higher (approximately Rs 210 million) in the absence of the outbreak of the pandemic. As such, this represents an absolute decrease of Rs 94 million in gross direct investment flows coming from South Africa and a relative decrease of 45% with a 95% confidence interval of [-85%, -4.7%]. As illustrated by the posterior tail-area probability (0.0150), this negative effect is statistically significant.

Moreover, during the post-COVID-19 period, gross direct investment flows emanating from Switzerland also encountered a reduction. On average, the gross direct investment flows from this country were approximately Rs 40 million compared to Rs 74 million if the pandemic did not occur. In relative terms, this denotes a reduction of 46% with a 95% confidence interval of [-100%, 10%], indicating that the outbreak of the pandemic had a significant and negative impact on gross direct investments from Switzerland.

Table 3. Estimated impact of the COVID-19 pandemic on Gross Direct Investment Flows (Rs Million) by geographical origin: January 2020-June 2020.

Country		**Average**		**Cumulative**
France	Actual	354.84		2129.06
	Prediction (S.D.)	349.25 (69.29)		2095.52 (415.74)
	95% confidence interval	[219.68, 486.73]		[1318.06, 2920.36]
	Absolute effect (S.D.)	5.59 (69.29)		33.54 (415.74)
	95% confidence interval	[-131.88, 135.17]		[-791.29, 811.01]
	Relative effect (S.D.)	1.6% (20%)		1.6% (20%)
	95% confidence interval	[-38%, 39%]		[-38%, 39%]
	Posterior tail-area probability		0.4699	
	Posterior probability of a causal effect		53%	
South Africa	Actual	116.11		696.66
	Prediction (S.D.)	210.06 (43.57)		1260.37 (261.41)
	95% confidence interval	[125.95, 295.08]		[755.72, 1770.46]
	Absolute effect (S.D.)	-93.95 (43.57)		-563.71 (261.41)
	95% confidence interval	[-178.97, -9.84]		[-1073.79, -59.05]
	Relative effect (S.D.)	-45% (21%)		-45% (21%)
	95% confidence interval	[-85%, -4.7%]		[-85%, -4.7%]
	Posterior tail-area probability		**0.0150****	
	Posterior probability of a causal effect		98.50%	
Switzerland	Actual	39.97		239.81
	Prediction (S.D.)	73.67 (20.88)		442.03 (125.30)
	95% confidence interval	[32.64, 113.93]		[195.83, 683.55]
	Absolute effect (S.D.)	-33.70 (20.88)		-202.22 (125.30)
	95% confidence interval	[-73.96, 7.33]		[-443.74, 43.99]
	Relative effect (S.D.)	-46% (28%)		-46% (28%)
	95% confidence interval	[-100%, 10%]		[-100%, 10%]
	Posterior tail-area probability		**0.0548***	
	Posterior probability of a causal effect		95%	
United Kingdom	Actual	28.45		170.72
	Prediction (S.D.)	179.21 (147.60)		1075.25 (885.61)
	95% confidence interval	[-105.46, 467.75]		[-632.77, 2806.49]
	Absolute effect (S.D.)	-150.75 (147.60)		-904.52 (885.61)
	95% confidence interval	[-439.30, 133.92]		[-2635.77, 803.49]
	Relative effect (S.D.)	-84% (82%)		-84% (82%)
	95% confidence interval	[-245%, 75%]		[-245%, 75%]
	Posterior tail-area probability		0.1519	
	Posterior probability of a causal		85%	

	effect			
United Arab Emirates	Actual	28.81		172.83
	Prediction (S.D.)	52.01 (21.96)		312.06 (131.76)
	95% confidence interval	[7.71, 95.08]		[46.25, 570.50]
	Absolute effect (S.D.)	-23.21 (21.96)		-139.23 (131.76)
	95% confidence interval	[-66.28, 21.10]		[-397.67, 126.58]
	Relative effect (S.D.)	-45% (42%)		-45% (42%)
	95% confidence interval	[-127%, 41%]		[-127%, 41%]
	Posterior tail-area probability		0.1400	
	Posterior probability of a causal effect		86%	
Belgium	Actual	5.34		32.05
	Prediction (S.D.)	23.82 (8.07)		142.94 (48.40)
	95% confidence interval	[7.58, 39.53]		[45.51, 237.19]
	Absolute effect (S.D.)	-18.48 (8.07)		-110.89 (48.40)
	95% confidence interval	[-34.19, -2.24]		[-205.13, -13.45]
	Relative effect (S.D.)	-78% (34%)		-78% (34%)
	95% confidence interval	[-144%, -9.4%]		[-144%, -9.4%]
	Posterior tail-area probability		**0.0108****	
	Posterior probability of a causal effect		98.92%	
China	Actual	0.95		5.69
	Prediction (S.D.)	144.31 (86.32)		865.87 (517.89)
	95% confidence interval	[-26.51, 313.08]		[-159.05, 1878.47]
	Absolute effect (S.D.)	-143.36 (86.32)		-860.17 (517.89)
	95% confidence interval	[-312.13, 27.46]		[-1872.78, 164.74]
	Relative effect (S.D.)	-99% (60%)		-99% (60%)
	95% confidence interval	[-216%, 19%]		[-216%, 19%]
	Posterior tail-area probability		**0.0466****	
	Posterior probability of a causal effect		95.34%	
United States of America	Actual	59.21		355.25
	Prediction (S.D.)	22.68 (61.62)		136.09 (369.73)
	95% confidence interval	[-100.31, 140.88]		[-601.87, 845.28]
	Absolute effect (S.D.)	36.53 (61.62)		219.16 (369.73)
	95% confidence interval	[-81.67, 159.52]		[-490.03, 957.12]
	Relative effect (S.D.)	161% (272%)		161% (72%)
	95% confidence interval	[-360%, 703%]		[-360%, 703%]
	Posterior tail-area probability		0.2764	
	Posterior probability of a causal effect		72%	
Reunion	Actual	0.08		0.58
	Prediction (S.D.)	6.91 (4.02)		41.47 (24.15)
	95% confidence interval	[-0.89, 14.98]		[-5.36, 89.87]
	Absolute effect (S.D.)	-6.81 (4.02)		-40.89 (24.15)
	95% confidence interval	[-14.88, 0.99]		[-89.29, 5.94]
	Relative effect (S.D.)	-99% (58%)		-99% (58%)
	95% confidence interval	[-215%, 14%]		[-215%, 14%]
	Posterior tail-area probability		**0.0473****	
	Posterior probability of a causal effect		95.27%	
Germany	Actual	9.24		55.45
	Prediction (S.D.)	20.89 (27.03)		125.33 (162.19)
	95% confidence interval	[-31.47, 75.37]		[-188.82, 452.19]
	Absolute effect (S.D.)	-11.65 (27.03)		-69.88 (162.19)
	95% confidence interval	[-66.12, 40.72]		[-396.74, 244.27]
	Relative effect (S.D.)	-56% (129%)		-56% (129%)
	95% confidence interval	[-317%, 195%]		[-317%, 195%]
	Posterior tail-area probability		0.3324	
	Posterior probability of a causal effect		67%	

Notes: Analysis using the CausalImpact (Brodersen et al., 2015) with "India" as synthetic control; Standard deviations in parentheses; 95% confidence intervals in square brackets; ***, **, * represent significance at the 1%, 5% and 10% respectively.
Source: Authors' elaboration.

Additionally, gross direct investment flows from Belgium were on average Rs 5.34 million during the whole post-COVID-19 period (January 2020-June 2020). The latter would have been expected to be Rs 24 million if the pandemic did not take place. Thus, in absolute terms, gross direct investment flows from Belgium were reduced by Rs 19 million. Relatively, this accounts for a fall of 78% in gross direct investment flows. The posterior tail-area probability (0.0108) once again proves that there is no chance that the outbreak of the pandemic would have led to an increase in gross direct investment flows from Belgium.

Likewise, for China, we find that during the whole post-COVID-19 period, gross direct investment flows from the latter were approximately Rs 1 million compared to Rs 144 million if the pandemic did not crop up. This indicates a decrease of Rs 144 million in absolute terms. Relatively, this depicts a reduction of 99% with a confidence interval of [-216%, 19%]. Thus, suggesting that indeed the outbreak of the COVID-19 pandemic had largely affected direct investment flows coming from China.

Furthermore, gross direct investment flows from Reunion were not spared; the latter averaged Rs 80 thousand. If the pandemic did not occur, we would have expected this figure to be on average Rs 6.91 million. Thus, in absolute terms, the outbreak of the pandemic had reduced gross direct investment flows originating from Reunion by Rs 6.81 million. Relatively speaking, this represents a decrease of 99% with a 95% confidence interval of [-215%, 14%]. The posterior tail-area probability value of 0.0466 also shows that there is a very low chance that the pandemic positively influenced the gross direct investment flows from the latter.

Concerning the main sectors of investigation, it can be seen that only the "Real Estate Activities" sector was negatively affected by the pandemic during the first six months preceding its outbreak. In particular, gross direct investment flows in the latter experienced a relative drop of 31%. On average, during the post-COVID-19 period, gross direct investment flows in the real estate activities sector accounted for approximately Rs 672 million. This figure would have been Rs970 million in the absence of the outbreak of the pandemic. In other words, this represents an absolute decrease of Rs 298 million in the gross direct investment flows. Again here, the posterior tail-area probability (0.0094) indicates that the outbreak of the pandemic had a significant and negative impact on the gross direct investment flows in this particular sector.

On the other hand, it can be found that surprisingly, the "Manufacturing" sector benefited the most from the pandemic, with a mind-blowing relative effect of 410%. Indeed, in an attempt to

mitigate the effect of contagion among locals, the use of face masks and hand sanitisers became compulsory in public places. Moreover, front-liners were also condemned to wear special work overalls. Ventilators were also needed for the treatment of infected people. Local manufacturing companies, thus, enlisted themselves to help in the manufacturing of these special types of equipment, which are also considered part of the "Manufacturing" sector. In this context, Mauritius also received donations from India, Japan and United States to help to fight the pandemic. A glance at the results for this specific sector in Table 4 reveals that during the whole post-intervention period (January 2020-June 2020), gross direct investment flows in this sector had an approximate value of Rs 269 million compared to Rs 53 million in the absence of the COVID-19's outbreak. In other words, this represents an absolute increase of Rs 216 million in the gross direct investment flows. This positive effect is highly significant (p-value < 0.005) and is unlikely to be due to random fluctuations.

Table 4. Estimated impact of the COVID-19 pandemic on Gross Direct Investment Flows (Rs Million) by sector: January 2020-June 2020.

Sector		**Average**	**Cumulative**
Manufacturing	Actual	269.47	1616.80
	Prediction (S.D.)	52.86 (26.36)	317.16 (158.18)
	95% confidence interval	[1.28, 104.92]	[7.67, 629.52]
	Absolute effect (S.D.)	216.61 (26.36)	1299.64 (158.18)
	95% confidence interval	[164.55, 268.19]	[987.28, 1609.13]
	Relative effect (S.D.)	410% (50%)	410% (50%)
	95% confidence interval	[311%, 507%]	[311%, 507%]
	Posterior tail-area probability	**0.0002*** **	
	Posterior probability of a causal effect	99.98%	
Construction	Actual	0	0
	Prediction (S.D.)	46.99 (40.07)	281.92 (240.41)
	95% confidence interval	[-31.14, 127.03]	[-186.82, 762.17]
	Absolute effect (S.D.)	-46.99 (40.07)	-281.92 (240.41)
	95% confidence interval	[-127.03, 31.14]	[-762.17, 186.82]
	Relative effect (S.D.)	-100% (45%)	-100% (85%)
	95% confidence interval	[-270%, 66%]	[-270%, 66%]
	Posterior tail-area probability	0.1202	
	Posterior probability of a causal effect	88%	
Accommodation and Food Service Activities	Actual	4.5	27.0
	Prediction (S.D.)	29.17 (110.17)	175.01 (661.04)
	95% confidence interval	[-186.10, 250.59]	[-1116.62, 1503.51]
	Absolute effect (S.D.)	-24.67 (110.17)	-148.01 (661.04)
	95% confidence interval	[-246.09, 190.60]	[-1476.51, 1143.62]
	Relative effect (S.D.)	-85% (378%)	-85% (378%)
	95% confidence interval	[-844%, 653%]	[-844%, 653%]
	Posterior tail-area probability	0.4060	
	Posterior probability of a causal effect	59%	
Information and Communication	Actual	5.93	35.60
	Prediction (S.D.)	12.06 (12.49)	72.38 (74.92)
	95% confidence interval	[-12.07, 37.73]	[-72.40, 226.37]
	Absolute effect (S.D.)	-6.13 (12.49)	-36.78 (74.92)
	95% confidence interval	[-31.80, 18.00]	[-190.77, 108.00]
	Relative effect (S.D.)	-51% (104%)	-51% (104%)

	95% confidence interval	[-264%, 149%]		[-264%, 149%]
	Posterior tail-area probability		0.3100	
	Posterior probability of a causal effect		69%	
Financial and Insurance Activities	Actual	32.85		197.10
	Prediction (S.D.)	162.66 (226.80)		975.98 (1360.80)
	95% confidence interval	[-278.68, 602.00]		[-1672.07, 3611.98]
	Absolute effect (S.D.)	-129.81 (226.80)		-778.88 (1360.80)
	95% confidence interval	[-569.15, 311.53]		[-3414.88, 1869.17]
	Relative effect (S.D.)	-80% (139%)		-80% (139%)
	95% confidence interval	[-350%, 192%]		[-350%, 192%]
	Posterior tail-area probability		0.2792	
	Posterior probability of a causal effect		72%	
Real Estate Activities	Actual	671.70		4030.20
	Prediction (S.D.)	969.55 (128.21)		5817.33 (769.29)
	95% confidence interval	[720.70, 1228.33]		[4324.21, 7369.98]
	Absolute effect (S.D.)	-297.85 (128.21)		-1787.13 (769.29)
	95% confidence interval	[-556.63, -49.00]		[-3339.78, -294.014]
	Relative effect (S.D.)	-31% (13%)		-31% (13%)
	95% confidence interval	[-57%, -5.1%]		[-57%, -5.1%]
	Posterior tail-area probability		**0.0094*** **	
	Posterior probability of a causal effect		99.06%	

Notes: Analysis using the CausalImpact (Brodersen et al., 2015) with the sector "Wholesale and Retail Trade: Repair of Motor Vehicles and Motorcycles" as synthetic control; Standard deviations in parentheses; 95% confidence intervals in square brackets; ***, **, * represent significance at the 1%, 5% and 10% respectively.
Source: Authors' elaboration.

4. Conclusions

In this chapter, we have empirically examined the impact of the outbreak of the COVID-19 pandemic on the gross direct investment flows in Mauritius in terms of main geographical origins and sectors. Relying upon the availability of data and maximum investments, we considered 10 geographical origins and 6 sectors. For our empirical investigations, 11 countries and 7 sectors for the period spanning January 2014-June 2020 (78 observations) were first studied.

The results from an initial examination of the series of gross direct investment flows showed that as compared to the same period the previous year (January 2019-June 2019), there was a change in the figures of the gross direct investment flows. Despite that a decline was observed overall, there was an increase in investments coming from the United States of America and in sectors such as "Manufacturing", "Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles", "Accommodation and Food Service Activities" and "Financial and Insurance Activities". Further analysis of the series through the ARIMA framework revealed that the gross direct investment flows series indeed departed from its actual trends two months after the outbreak of the pandemic was first declared; figures were below/above those predicted by the optimal ARIMA models. This gave rise to the question of whether this was due to the outbreak of the pandemic or the results of other structural changes.

As such, we employed the BSTS for causal analysis to estimate the impact of the COVID-19 pandemic on the gross direct investment flows during the first six months following the outbreak (January 2020-June 2020). Our findings indicated that the outbreak of the pandemic had a negative and significant effect on investments emanating from five countries (South Africa, Switzerland, Belgium, China and Reunion) and on investments in the "Real Estate Activities" sector. Surprisingly, the latter had a positive and significant influence on the "Manufacturing" sector; a considerable increase was observed. Nevertheless, a closer look at the reported results of the posterior probability of a causal effect, showed that in the long run, there is more than a 50% chance that the outbreak may affect the gross direct investment flows from these countries. But, this will depend on the measures taken to mitigate the spread of the virus in the coming months.

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Appendix

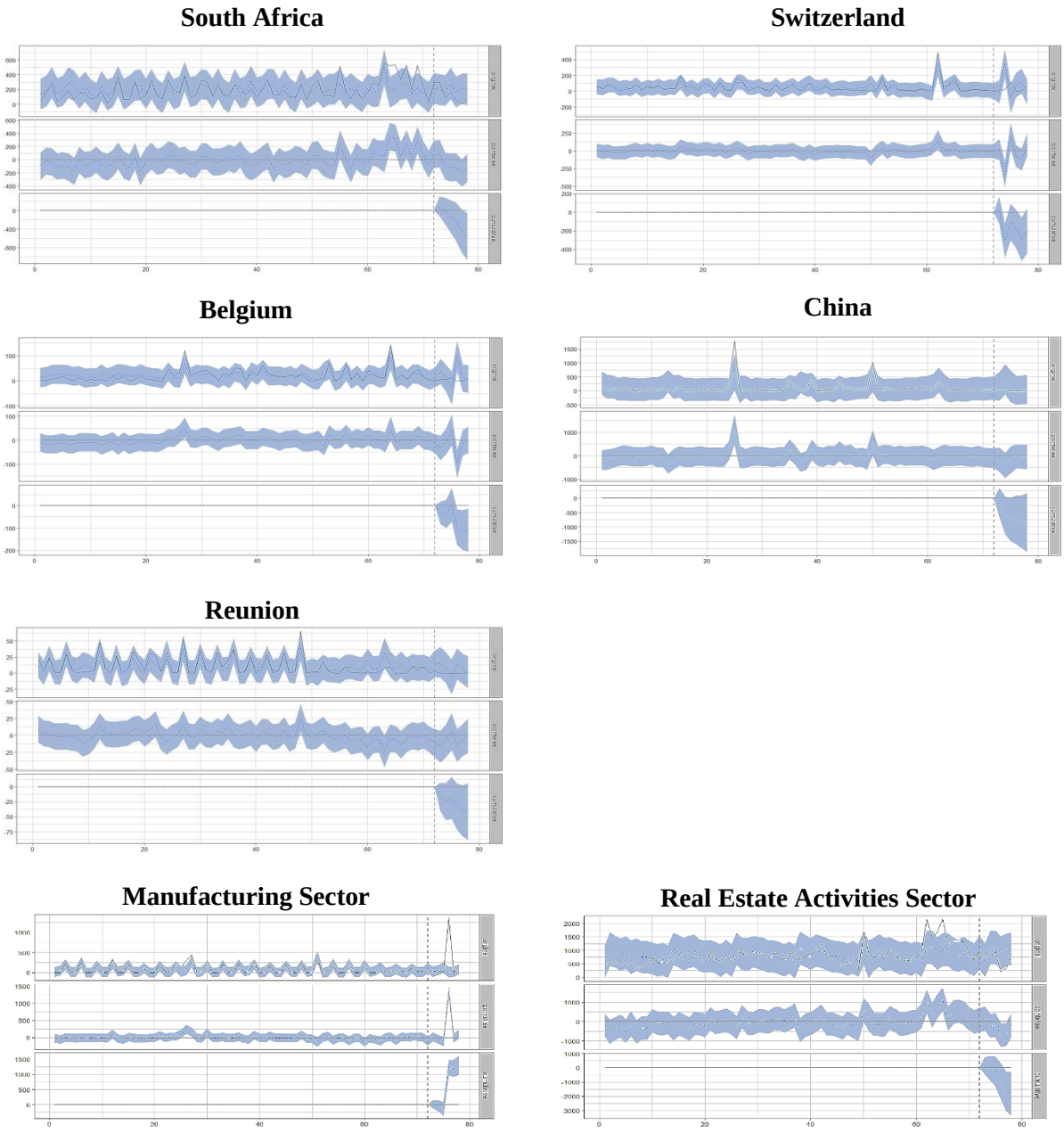

Figure A1. Bayesian posterior distribution graphs for the impact of the COVID-19 pandemic on gross direct investment flows

Notes: Gross Direct Investment Flows (Rs Million); Dotted vertical line representing the month in which the COVID-19 outbreak was first identified in Wuhan, China (December 2019 - Observation 72 on the x-axis); Top plot showing the observed series (black) and its predicted values (dotted blue); Middle plot showing the difference between the prediction and the observed values; Bottom plot showing the total effect of these differences within the post-intervention period.

Source: CausalImpact R-package output.