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Dynamics of Malaysia's Bilateral Export Post Covid-19: A Gravity Model Analysis

(*Dinamik Eksport Bilateral Malaysia Pasca Covid-19: Analisis Model Graviti*)

Muhamad Rias K V Zainuddin
Universiti Malaysia Terengganu

Md Shafiin Shukor
Universiti Kebangsaan Malaysia

Muhamad Solehuddin Zulkifli
Universiti Teknologi Mara

Amirul Hamza Abdullah
Institut Masa Depan Malaysia

ABSTRACT

The recent pandemic outbreak has distorted international trade flows as the global economic activity reaches a near-standstill due to stricter movement control imposed by most countries worldwide. Despite gaining the researcher's attention, the impact of Covid-19 on trade performances are still relatively understudied. Hence, this study aims to analyse the impact of the Covid-19 pandemic outbreak on the bilateral sectoral export for Malaysia. This study employs Poisson Pseudo Maximum Likelihood (PPML) regressions to analyse the sectoral impact in gravity models. The findings provide new perspectives on the varying impacts of the current pandemic outbreak on sectoral trade performances. The dummy variables that represent the existence of Covid-19 have significantly reduced bilateral exports for 11 sectors while increased the exports for seven sectors. Meanwhile, the severity of the Covid-19 outbreak (measured by the number of new cases and death cases) in Malaysia has negative impacts on 14 sectors. The reason for this is that when the current pandemic outbreak in Malaysia is more severe, the government has to enforce stricter movement controls that affect productions and reduce exports. On the other hand, the severity of the Covid-19 outbreak in trading partners has positive impacts on the export for 13 sectors in Malaysia. This is because the more severe pandemic outbreak in trading nations causes lower production capacities and thus higher dependence on imported goods. Differences between the impact of Covid-19 existence and severity by sectors should serve as a red flag for Malaysia's policymakers to take immediate actions to minimise the impact of the ongoing pandemic outbreak and maximise gains from sectors that have higher demand post Covid-19. The net negative impact on the export performance further reiterates the need for government intervention policies to ensure domestic firms can withstand the current tide, which then minimises the social and economic impacts and helps the economy to recover.

Keywords: Covid-19; exports; sectoral; gravity model; Malaysia.
JEL Codes : F10; F14

ABSTRAK

Pencetusan pandemik baru-baru ini telah mengganggu aliran perdagangan antarabangsa kerana aktiviti ekonomi global hampir terhenti di sebabkan oleh kawalan pergerakan yang lebih ketat yang dikenakan oleh kebanyakan negara di seluruh dunia. Walaupun mendapat perhatian penyelidik, kesan Covid-19 terhadap prestasi perdagangan secara relatifnya masih kurang dikaji. Oleh itu, kajian ini bertujuan untuk menganalisis implikasi wabak pandemik Covid-19 terhadap eksport sektoral dua hala bagi Malaysia. Kajian ini menggunakan regresi Kebarangkalian Maksimum Poisson Pseudo (PPML) untuk menganalisis impak sektoral dalam model graviti. Hasil kajian memberikan perspektif baru mengenai kepelbagaian kesan wabak pandemik semasa terhadap prestasi perdagangan sektoral. Pembolehubah dami yang mewakili kewujudan Covid-19 didapati telah mengurangkan eksport dua hala untuk 11 sektor, dan meningkatkan eksport untuk tujuh sektor. Sementara itu, keparahan wabak Covid-19 (diukur dengan jumlah kes baru dan kes kematian) di Malaysia mempunyai kesan negatif bagi 14 sektor. Hal ini kerana, ketika wabak di Malaysia semakin parah, kerajaan harus mengenakan kawalan pergerakan yang lebih ketat yang menjejaskan pengeluaran dan mengurangkan eksport. Sebaliknya, keparahan wabak Covid-19 dalam rakan dagang memberikan kesan positif kepada export bagi 13 sektor di Malaysia. Hal ini kerana semakin parah wabak pandemik di negara rakan dagangan menyebabkan keupayaan pengeluaran yang lebih rendah dan dengan itu semakin bergantung pada barangan import. Perbezaan antara kesan kewujudan Covid-19 dan keparahan pandemik mengikut sektor harus memberikan amaran kepada pembuat dasar di Malaysia supaya mengambil tindakan segera untuk meminimumkan kesan wabak pandemik yang sedang berlaku dan

memaksimumkan keuntungan dari sektor yang mempunyai permintaan yang lebih tinggi setelah Covid-19. Kesan bersih yang negatif terhadap prestasi eksport menekankan lagi keperluan campur tangan kerajaan untuk memastikan syarikat domestik dapat mengharungai cabaran semasa yang kemudiannya membantu mengurangkan kesan sosial dan ekonomi dan membantu ekonomi untuk pulih.

Kata kunci: Covid-19; eksport; sektoral; model graviti; Malaysia.

Kod JEL: F10, F14.

INTRODUCTION

International trade plays a vital role in raising living standards, creating jobs, boosting the domestic economy, and enabling consumers to benefit significantly from a greater variety of goods. Trading between countries also led to higher efficient use of resources as countries specialised in sectoral production with relatively larger comparative advantage. This helps to increase the overall welfare in the economy. International trade, however, subject to market demands and supply factors such as income (Morland et al. 2020; Zainuddin & Zaidi 2020), prices (Tee et al. 2018; Sugiharti et al. 2020), exchange rate (Ghani & Sofyan 2014; Baek & Choi 2020), and trade policies (Boysen-Urban et al. 2019; Zainuddin et al. 2019). In addition, international trade also affected by several external factors such as natural disasters (Nguyen & Pham 2020; Chang & Zhang 2020), economic and financial crisis (Pattnaik et al. 2020; Nasrullah et al. 2020), and also health crisis such as the severe acute respiratory syndrome (SARS) outbreak in 2003 (Lee & McKibbin 2004; Fernandes & Tang 2020).

Recently, international trade faces an unprecedented crisis which is the Covid-19 pandemic outbreak. Similar to SARS, Covid-19 is also a coronavirus that causes a health crisis. However, unlike SARS that only had 774 known fatalities, Covid-19 is an ongoing pandemic that has spread globally and has claimed more than two million souls within one year (World Health Organization 2020). In addition, Covid-19 has more adverse implications on social and economic development, and it is expected to cause the largest global recession since the Great Depression in the 1930s (Ehnts & Paetz 2021; International Monetary Fund 2020). Thus, most governments worldwide have taken drastic measures to curb the pandemic outbreaks by enforcing lockdown and restricting movement in several countries, and also enforcing social distancing to break the chain of Covid-19 infections (Tang 2020).

These measures, however, have repercussions as global demand had plummeted drastically together with international supply chain disruptions (Ataguba 2020). The huge reduction in demand causes firms unable to sustain their production, and several even had to close their business. The ripple effect even extended to rising unemployment in the economy as more workers are being laid off (Fairlie et al. 2020; Larue 2020). In addition, the international transportation systems are also heavily affected by the pandemic outbreak as countries opted to close their borders to curb incoming clusters. According to the United Nations Conference on Trade and Development (UNCTAD, 2020), global merchandise trade fell 5 per cent in the first quarter and continues to suffer a fall of 27 per cent in the second quarter. This further intensifies the magnitude of impacts on international trade flow from the recent pandemic outbreak.

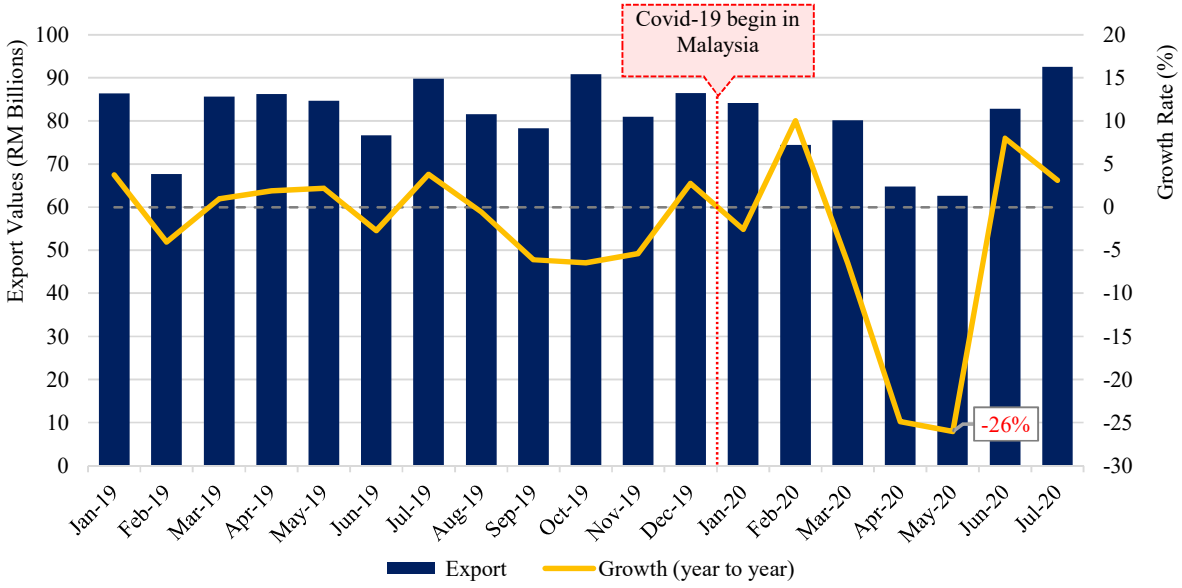

FIGURE 1: Malaysia Export Values and Export Growth Rate from January 2019 till July 2020.
**Source*: Department of Statistics Malaysia (2020).

As an active trading nation among the top 30 exporting countries, Malaysia also faces the impact of the recent pandemic outbreak. This can be seen from Figure 1, where Malaysia's export has decreased drastically after the Covid-19 outbreak in Malaysia. Malaysia's total exports drop 26 per cent in May 2020 and reach the lowest growth in 11 years, which further reiterates the severe impact of the COVID-19 pandemic on export performances. Despite the huge reduction, Malaysia's exports have shown signs of recovery since June 2020. This can be attributed to the lower number of cases and the easing of movement restriction policies that allowed most economic sectors to resume operation, contributing to higher production and export capacity in the economy (Bank Negara Malaysia 2020). This is because a lower number of cases led the government to allow more economic sectors to operate with less stringency. Similarly, a higher number of cases can cause the government to impose stricter standard operating procedures to curb the outbreak. However, the positive impacts on export are not mutual for all sectors as some sectors have a decreasing trend. For certain sectors, the stringency of movement restrictions has disrupted the supply-side (production distortion) and demand-side (lower global demand). Aside from the vital sectors during the current pandemic, such as food sectors and rubber gloves products, the implications of higher outbreak severity on most sectors are still not clear (Hayakawa & Mukunoki 2020).

The severity impact of Covid-19 has attracted the attention of policymakers and researchers to understand how it affects economic performances (Demir et al. 2020; Funke & Tsang 2020; Kerr 2020). However, most literature focussed more on the financial impact (see Vidya & Prabheesh 2020). Several researchers had investigated the trade impact, but their analysis is either at the country level, aggregated sectors or focussed on specific sectors (Cao et al. 2020; McEwan et al. 2020; Vidya & Prabheesh 2020). Thus, their studies may subject to aggregation bias and unable to explain the varying sectoral impact. In addition, lack of empirical studies used current data, as most used simulation analysis (Walmsley et al. 2020; Zeshan 2020) based on the past base year and subject to simulation scenario and numerous assumptions (Dixon & Jorgenson 2013; Kehoe et al. 2017). The utilisation of real trade data able to represent the actual impact of the current pandemic outbreak. Hence, this study intends to fill the gap in the literature by answering the main research questions: what is the impact of Covid-19 on Malaysia's sectoral export?

The objective of this study is to analyse the impact of the Covid-19 pandemic outbreak on the sectoral bilateral export for Malaysia. This study uses the dummy variables that represent the existence of Covid-19 cases in Malaysia, together with the number of new cases and death cases in Malaysia and trading partners as indicators of the severity of Covid-19. The impact of these variables is estimated in gravity models using the Poisson Pseudo Maximum Likelihood (PPML) regression. This study contributes to the existing literature in three aspects: First, this study analyses the impact of the recent pandemic outbreak by using several indicators. This can help policymakers identify whether the existence of Covid-19 or the severity of the current pandemic outbreak causes export distortions. Sufficient knowledge of the post-Covid trade flows can help policymakers build a more resilient economic structure (Zeshan 2020). Second, this study overcomes the issue of aggregation bias by estimating the impacts of Covid-19 on a detailed sectoral level (SITC 3-digit). Third, this study employs ex-post analysis based on real trade data and thus able to provide reliable information on the impact of the current pandemic. As trade is one of the cornerstones for Malaysia's economic development, it is interesting to understand the implications of the Covid-19 outbreak on the dynamic of sectoral bilateral export.

The outline of this study is as follows. The first section of this paper explains the Covid-19 issues on trade performances and the importance of the current study. Section 2 describes past studies that investigate the implications of Covid-19; and gaps that are to be filled by this paper. Section 3 presents the methodology and data used in the study. Section 4 explains the current study outcome and interpretation. Section 5 discusses the conclusion and policy implications.

LITERATURE REVIEW

The ongoing pandemic outbreak that spreads with alarming speed has urged researchers and policymakers to empirically investigate its consequences on economic performances and propose suitable policy measures (Baldwin & Mauro 2020; He et al. 2020; Funke & Tsang 2020; Kerr 2020). Baldwin and Freedman (2020) state that the current pandemic distorts the international trade and supply chain as demand worldwide had reduced drastically. Lockdown and movement restrictions included various measures that limit production and consumption activities. This resulted in demand and supply shocks that emanated not only from significantly weak external demand conditions but also from production constraints in many economic sectors in internal. However, lack of attention has been given on trade impact as most studies usually address the financial impact (Ashraf 2020; Apergis & Apergis 2020; Fu & Shen 2020; Gil-Alana & Monge 2020; Hassan et al. 2020; Hassan et al. 2021a; Kinateder et al. 2021; Liu et al. 2020; Narayan 2020; Phan & Narayan 2020; Qin et al. 2020).

Krugman (1997) has provided the theoretical framework on how random shocks affect the production network and might lead to changes in the fundamentals. Vidya and Prabheesh (2020) used this framework to analyse the impact of the Covid-19 pandemic on the world trade network and found a significant reduction in trade for most countries until

December 2020. A similar conclusion was reached by Gruszczynski (2020) and Zeshan (2020). For the top two largest economies and trading nations in the world, the United States and China lost export value in the first quarter by 38 billion USD and 64 billion USD, respectively (Hayakawa & Mukunoki 2020). Meanwhile, for Canada, Barichello (2020) expected a drop in the range of 12%–20% in the real trade value. The magnitude of the impact is clearly higher for Pakistan, where Shafi et al. (2020) analysis shows that Pakistan's exports dropped by 50%. However, not all sectors were expected to have negatives impacts of the recent crisis.

Export for certain products such as face masks and hand sanitisers are expected to increase due to increased demand for the products that defend against COVID-19 infection (Gereffi 2020; Goodell & Huynh 2020, Hayakawa & Mukunoki 2020). The same is expected for the export of food sectors in Kenya, such as tea and fruit (Mold & Mveyange 2020). However, not all food sectors are expected to benefit, as McEwan et al. (2020) study show that the Canadian pork export face challenges from trade ability. The same is expected for the agricultural exports for China in the long-term due decline in demand for agricultural imports (Zhang et al., 2020; Barichello, 2020). A similar finding is obtained by Cao et al. (2020), where the agricultural exports for China have been negatively impacted in the short-term due to the disruption of the supply chain. Furthermore, some studies expect that the high probability of the pandemic would lead to increasing non-tariff measures, posing limits to agricultural exports (Barichello, 2020; Cao et al. 2020). Besides focusing on trade volume, Qin et al. (2020) and Akter (2020) analyse the impact of Covid-19 on the volatility of commodity prices and food prices, respectively, and find that the current pandemic is expected to increase prices. However, not for the crude oil price, as shrinking global demands have caused the price to drop (Hassan et al. 2021b).

Aside from the agricultural sector, Zeshan (2020) studies show that light manufacturing and heavy manufacturing export industries are the most affected globally. In addition, Barichello (2020) expects the trade for sectors with complex supply chains such as electronics and automotive products are expected to be most affected. Besides, the Covid-19 outbreak is expected to burden the neighbouring countries as international trade and foreign direct investment play a larger role in transmitting shocks to domestic production in other countries (Boehm et al. 2019). On a global scale, several studies find that the impact varies by region, where Zeshan (2020) study found that the worst-hit regions are the MENA region, followed by EU 28. However, in terms of export, the World Trade Organization (2020) results indicate that exports from North America and Asia will hit the hardest. The varying impact has motivated several studies to analyse country-specific impacts, such as for Canada (McEwan et al. 2020; Barichello 2020), United States (Walmsley et al. 2020), China (Cao et al. 2020), and Africa (Ataguba 2020).

In analysing the trade implications, several methods have been utilised, and these methods can be categorised into the ex-ante and ex-post analysis. The ex-ante analysis is simulation-based studies such as the computable general equilibrium (Walmsley et al. 2020; Zeshan 2020), system dynamic (Wang et al. 2020), and network analysis (Vidya & Prabheesh 2020). Although few methods in the ex-ante analysis are among the most preferred in trade analysis, these methods subject to few drawbacks such as usage of outdated data, ad-hoc simulation scenario, and numerous assumptions (Dixon & Jorgenson 2013; Raza et al. 2014; Kehoe et al. 2017). In addition, unlike the previous economic crisis that mostly distorts financial sectors only, the current pandemic outbreak affects the health, financial, economics, and social aspects on a totally different level (International Monetary Fund 2020). Thus, the utilisation of simulation analysis based on past experience might not be able to capture the actual scenario.

Dissimilar to ex-ante analysis, ex-post analysis, such as the gravity model of trade, utilises real trade data, which helps in investigating the actual impact of any event on the trade flows (Grumiller 2014). Thus, by using the gravity model, without any need for simulation, researchers can understand whether the Covid-19 existence or its severity that really distort bilateral trade flow. Besides, Irwan et al. (2013), Tham et al. (2017) and Yang and Chew (2020) are among studies that have proven the ability of the gravity model in explaining Malaysia's bilateral trade flow. However, empirical studies on the impact of Covid-19 that gravity models are still limited. In addition, past empirical studies either analyse the trade impact at the country level (Vidya & Prabheesh 2020) or specific aggregated sectors (Barichello 2020; McEwan et al. 2020; Wang et al. 2020), and this might lead to aggregation bias. There is still a lack of comprehensive study that covers all sectors. Hence, this study intends to fill the gap in the literature by estimating the impact of the current pandemic outbreak using the gravity model on detailed sectoral export for Malaysia.

METHODOLOGY

This study utilised multi-dimensional panel data, consisting of 5 Malaysia export destination countries throughout January 2019 – July 2020 (19 months) at the sectoral level (SITC 3-digit). The selected countries chosen for the study include Singapore, Japan, South Korea, India, and the United States of America. The selection of these countries was based on their importance as Malaysia's top trading partner, representing around 40% of Malaysia's export. In addition, several other major trading partners such as China, Hong Kong, Thailand, Taiwan, and Vietnam were excluded due to data unavailability. The period selected is based on the existence of Covid-19 in Malaysia, which started in January 2020.

The estimations methodologies applied in this study are based on a well-grounded theory which is the gravity model of trade. The gravity model is considered as one of the economists' most reliable empirical relationships (McCallum

1995; Feenstra et al. 2001; Anderson 2011; Lundmark 2018). Thus, it has been widely used in international trade studies. The basic gravity model is in a cross-sectional dimension can be written as follow:

$$X_{ij} = \frac{Y_i Y_j}{t_{ij}} \quad (1)$$

where X_{ij} denotes the export (or trade) values from country *i* to country *j*; Y_i and Y_j denotes the income for country *i* and country *j,* respectively; t_{ij} denotes the trade cost between two countries, such as the distance, adjacency, and policy factors.

The basic model implies that the bilateral export (or trade) from country *i* to country *j* is proportional to their respective income and inverse to trade cost. The solve the issues of heterogeneity among countries, more empirical studies have been utilising panel data. Moreover, past studies have proven that the exchange rate is one of the important control variables in trade analysis (Ozcan 2017; Tham et al. 2018)[1]. Thus, this study added exchange rate into the standard gravity model and transformed it into a panel dimension in a logarithmic form as follows:

$$\ln Export_{ijt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln Dist_{ij} + \beta_4 \ln EXR_{jt} + \varepsilon_{ijt} \quad (2)$$

where ln denotes variables in the natural logs form, $Export_{ijt}$ is the bilateral export from country *i* to country *j* at time *t*; GDP_{it} and GDP_{jt} are the incomes for country *i* and country *j* at time *t*, respectively; $Dist_{ij}$ is the distance from country *i* to country *j*; EXR_{jt} is the exchange rate for country j at time *t*; and ε_{ijt} is the error term.

This research further expands the model to include sectoral dimension in order to avoid aggregation bias. Furthermore, to capture the impact of Covid-19 on Malaysia's bilateral export, several additional variables are included, which is the dummy for the pandemic outbreak (equation 3), the number of new positive cases (equation 4), and the number of deaths cases (equation 5). These variables are included separately to avoid the issues of multicollinearity. Thus equation (3), (4), and (5) are derived as follows:

$$\ln Export_{ijnt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln Dist_{ij} + \beta_4 \ln EXR_{jt} + \beta_5 Dummy_t + \varepsilon_{ijnt} \quad (3)$$

$$\ln Export_{ijnt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln Dist_{ij} + \beta_4 \ln EXR_{jt} + \beta_5 Cases_{it} + \beta_6 Cases_{jt} + \varepsilon_{ijnt} \quad (4)$$

$$\ln Export_{ijnt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln Dist_{ij} + \beta_4 \ln EXR_{jt} + \beta_5 Death_{it} + \beta_6 Death_{jt} + \varepsilon_{ijnt} \quad (5)$$

where $Export_{ijnt}$ denotes bilateral export values from country *i* to country *j* for sector *n* in time *t*; $Dummy_t$ denotes dummy variables that equal to 1 if the time is during the pandemic outbreak, and zero otherwise; $Cases_{it}$ and $Cases_{jt}$ denotes the number of monthly new cases in country *i* and country *j*, respectively; and $Death_{it}$ and $Death_{jt}$ denotes the number of monthly death cases in country *i* and country *j*, respectively. Dummy variables able to prove whether the Covid outbreak distorts the bilateral export for Malaysia. On the other hand, the number of new cases able to determine whether the severity of Covid-19 in importing and exporting countries affects Malaysia's bilateral exports. The same goes for the number of death cases which is to show whether to determine whether the severity of Covid-19 based on the death toll from the current pandemic outbreak in either country affects Malaysia's bilateral exports.

The log-log regression model is only valid if the export values are positive. Hence the observation with zero export values will be drop out during estimation and this can lead to bias in results (Burger et al. 2009). The existence of a large number of zeros export values in Malaysia's bilateral export at the SITC 3-digit level further strengthens the need to solve zero trade issues. In addition, the above gravity model includes distance, which is a time-invariant variable. This can cause the estimation results to suffer heteroscedasticity problems. Thus, this study employed the Poisson Pseudo-Maximum Likelihood (PPML) regression to solve the zero trade and heteroscedasticity issues. PPML has been widely used to estimate the gravity model. Following Sun and Reed (2010) and Santos and Tenreyro (2006, 2009), to estimate using PPML regression, equation (3), (4), and (5) are transformed to exponent form as follows:

$$Export_{ijnt} = e^{(\beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln Dist_{ij} + \beta_4 \ln EXR_{jt} + \beta_5 Dummy\_Covid_t)} + \varepsilon_{ijnt} \quad (6)$$

$$Export_{ijnt} = e^{(\beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln Dist_{ij} + \beta_4 \ln EXR_{jt} + \beta_5 Cases_{it} + \beta_6 Cases_{jt})} + \varepsilon_{ijnt} \quad (7)$$

$$Export_{ijnt} = e^{(\beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln Dist_{ij} + \beta_4 \ln EXR_{jt} + \beta_5 Death_{it} + \beta_6 Death_{jt})} + \varepsilon_{ijnt} \quad (8)$$

where equation (6), (7), and (8) known onwards as model (1), (2), and (3), respectively.

All three models are estimated using PPML regression. Due to the high number of sectoral level (SITC 3-digit) data, regression is conducted by group at sub-group level (SITC 2-digit). Detailed sub-group code and description are reported in Appendix A, where there are 66 sectors at SITC 2-digit. Hence, there are 198 separate regressions (3 model x 66 sectors). The regressions results are able to answer the current study objective, which is the impact of the current pandemic outbreak on Malaysia's bilateral export. From the estimated regression, this study expects to find a positive relationship between bilateral export and income. This is because the increment in importer's income will lead to higher demand for imported products. The same is true for exporter's income, where increasing income led to higher export capability. Distance, on the other hand, is expected to be negatively related to export. This is due to transportation costs and all plausible trade costs. The exchange rate is expected to have a positive relationship as the exchange rate of country *j* is per US dollar. An increase in the country *j* exchange rate means depreciation of country *j* exchange rate, and this causes higher prices of import which will eventually lead to a reduction in import for country *j* (export for country *i*).

In addition, for the dummy of Covid-19, the current study expects to obtain either a positive or negative relationship. This is because, although certain sectoral exports are disrupted during the current pandemic outbreak, there are few sectors that have higher demand due to inoperability in the trading partner. Furthermore, for the number of positive

and death cases in Malaysia, the current study expects to find negative impacts on export. The direct explanation for this impact is that the higher severity of the Covid-19 outbreak in Malaysia causes stricter intervention measures by Malaysia's policymakers (such as the movement control), and this will disrupt production and export along the supply chain. Oppositely, the number of positive and death cases in a trading partner is expected to have a positive relationship with Malaysia's bilateral export. A higher number of cases in importing nations will disrupt their domestic production and might lead to higher dependence on imports.

In terms of data sources, several international databases have been utilised to gather all the necessary data. Bilateral export values data were obtained from the Malaysia External Trade Statistics database developed by the Department of Statistics Malaysia (DOSM, 2020). To capture the impacts of the current pandemic, model (1) used a dummy variable, where the value 1 represents the existence of Covid-19 cases in selected countries (January 2020 – July 2020) and zero otherwise. Model (2) and (3) use the daily number of new cases and death cases, respectively, which then aggregated to monthly. Data for the daily number of new positive cases and death cases were obtained from Our World in Data (Roser et al. 2020). Since the monthly GDP data are not available for most country, this study uses the Index of Industrial Production (IPI) as a proxy for GDP. IPI data were obtained from the Organisation for Economic Co-operation and Development (OECD 2020) and the International Monetary Fund (IMF 2020) database with the base year 2015. Meanwhile, data for bilateral distances were obtained from the CEPII database (Mayer & Zignago 2011). Exchange rate data is obtained from the International Monetary Fund (IMF 2020) database. In brief, the description for each variable included in the current study, data sources, and expected signs are provided in Table 1.

Table 1: Variables Descriptions, Sources and Expected Sign.

Variable	Descriptions	Sources	Expected Sign
$Export_{ijnt}$	Bilateral export values at SITC 2-digit level, in RM.	Department of Statistics Malaysia (DOSM)	
$\ln GDP_{it}$	Log of income for exporter *i* at time *t* (proxied by industrial production index, base year 2015).	International Monetary Fund (IMF)	+
$\ln GDP_{jt}$	Log of income for importer *j* at time *t* (proxied by industrial production index, base year 2015).	Organisation for Economic Co-operation and Development (OECD) & International Monetary Fund (IMF)	+
$\ln \mathrm{Dist}_{ij}$	Log of bilateral distance between capital in country *i* and country *j* (kilometres).	Centre d'Etudes Prospectives et d'Inform'tions Internationales (CEPII)	-
$\ln \mathrm{EXR}_{jt}$	Log of nominal exchange rate for country *j* per US dollar at time *t*.	International Monetary Fund (IMF)	-
$Dummy_t$	Dummy variable, where 1 indicates the existence of Covid-19 cases in focus country (since January 2020), 0 otherwise.	Our World in Data	+/-
$\ln Case_{it}$	Log for the number of new Covid-19 cases in country *i* at time *t*.	Our World in Data	-
$\ln Case_{jt}$	Log for the number of new Covid-19 cases in country *j* at time *t*.	Our World in Data	+
$\ln Death_{it}$	Log for the number of new death cases due to Covid-19 in country *i* at time *t*.	Our World in Data	-
$\ln Death_{jt}$	Log for the number of new death cases due to Covid-19 in country *j* at time *t*.	Our World in Data	+

RESULTS

The descriptive results for each variable used in the current study are reported in Table 2. Overall, there is 24,510 number of observations for each variable which comprise of multiple export destinations and sectors. Furthermore, the mean values for $\ln Case_i$ and $\ln Death_i$ are lower than $\ln Case_j$ and $\ln Death_j$, respectively. This shows that in the current sample, Malaysia overall had a lower number of new cases and death cases compared to trading partners. Besides, the low standard deviation values for all variables except export shows that data included in the model have low dispersion and normally distributed. For the export variables, the nature of the data at the level contributes to the high standard deviation (Zainuddin et al. 2020). This can also be seen from the wide range of export data from the minimum value of zero to a maximum of RM4.87 billion. The high dispersions of export value further strengthen the need to utilise the PPML regression.

Table 2: Descriptive Statistics.

Variable	Mean	Std. Dev.	Min	Max
$Export_{ijnt}$	23,600,000	142,000,000	0.000	4,870,000,000
$\ln GDP_{it}$	4.703	0.108	4.331	4.771
$\ln GDP_{jt}$	4.664	0.138	3.850	4.956

$\ln\text{Dist}_{ij}$	8.130	1.280	5.754	9.624
$\ln\text{EXR}_{jt}$	3.715	2.215	1.097	7.113
$Dummy_t$	0.368	0.482	0.000	1.000
$\ln Case_{it}$	2.165	3.142	0.000	8.108
$\ln Case_{jt}$	2.941	4.501	0.000	14.460
$\ln Death_{it}$	0.732	1.333	0.000	4.159
$\ln Death_{jt}$	1.500	2.938	0.000	10.965

Note: Total number of observations is 24,510.

Next, this study reports the correlation between the selected variables in Table 3. It can be seen that the importer's and exporter's GDP have a positive correlation with bilateral export. This is according to gravity model theory. Meanwhile, distance negatively correlates with bilateral export, which is also in line with the theory. The correlation between export and the dummy for the existence of Covid-19 is negative and are expected. This is due to distortion in production activity and reduction in global trade. The same goes for the other Covid-19 related variables. These variables also have negative relationships towards countries income as expected. Overall, all the variables (except between Covid-19 variables) have low correlations, and this shows that there are no collinearity issues. The high correlation between Covid-19 variables supports the justification to separate these variables into different models. Next, this study proceeds with PPML estimation results as can be seen in Table 4.

Table 3: Correlation Matrix.

Variables	$Export_{ijnt}$	$\ln GDP_{it}$	$\ln GDP_{jt}$	$\ln\text{Dist}_{ij}$	$\ln\text{EXR}_{jt}$	$Dummy_t$	$\ln Case_{it}$	$\ln Case_{jt}$	$\ln Death_{it}$	$\ln Death_{jt}$
$Export_{ijnt}$	1.000									
$\ln GDP_{it}$	0.016	1.000								
$\ln GDP_{jt}$	0.039	0.450	1.000							
$\ln\text{Dist}_{ij}$	-0.048	0.000	-0.477	1.000						
$\ln\text{EXR}_{jt}$	-0.077	-0.004	-0.245	0.304	1.000					
$Dummy_t$	-0.007	-0.498	-0.299	0.000	0.005	1.000				
$\ln Case_{it}$	-0.011	-0.667	-0.392	0.000	0.006	0.894	1.000			
$\ln Case_{jt}$	-0.008	-0.628	-0.443	0.049	-0.052	0.851	0.944	1.000		
$\ln Death_{it}$	-0.012	-0.755	-0.392	0.000	0.005	0.723	0.944	0.865	1.000	
$\ln Death_{jt}$	-0.016	-0.611	-0.558	0.193	-0.018	0.667	0.824	0.920	0.801	1.000

Overall, this study can conclude that the regression models fit the observed data from the high value of R^2 in almost all regression. In addition, the estimation results obtained are according to the gravity model theory. This is because most of the coefficients correspond to the expected signs. For example, the importer and exporter's incomes have positives and significant relationships towards bilateral export for most sectors. This supports the hypothesis that the higher country's income leads to higher import (for importing countries) and higher export capacity (for exporting countries). In contrast, distance has a negative relationship with bilateral export. This shows that a higher distance between two countries increases transportation cost and thus leads to lower bilateral trade. The exchange rate has negative and significant signs for 21 sectors. This is in line with theory as increasing exchange rate (depreciation) causes higher import prices, thus lower import for importers (export for exporters).

However, there are a few sectors that have contradicting signs. For example, the dairy products and eggs (2) sector have a negative sign for the exporter's incomes. This can be explained by higher domestic demand that can also affect export negatively. This study also finds that the bilateral distance has a positive relationship with the bilateral export for ten sectors such as crude rubber (23), fixed vegetable oils and fats (42) and fertilisers (56) sector. This relationship can be justified from varying countries production structure, and these relationships often occur in the disaggregated analysis (Linders 2005; Jordaan 2015; Lugovskyy & Skiba 2016). Moreover, Dreyer (2014) explained that differences in growing conditions between nations contribute to the positive relationship between distances and bilateral trade for certain agricultural sectors. This study also found that the exchange rate has a positive relationship for six sectors. This can be justified due to the purchasing contract between nations and also low price elasticities that causes import quantity not affected by increasing exchange rate, thus led to higher import values (Davies & Green 2010; Begović & Kreso 2017).

The most interesting variables in this study are those related to the Covid-19 outbreak. This research has included several variables that are related to the recent pandemic, which is the Covid-19 existence (model 1), the number of new cases in exporting and importing countries (model 2), and also the number of death cases in exporting and importing countries (model 3). Overall, the impacts of Covid-19 variables on the sectoral export performances vary significantly in sign and magnitude. In model 1, dummy variables are used to represent Covid-19 existence since January 2020, and estimation results show that 7 out of 65 sectors have positive impacts on export performances. This means that seven sectors have higher export during the Covid-19 pandemic. Among these sectors are the gas, natural and manufactured (34), sanitary, machinery specialised for particular industries (72), plumbing, heating and lighting (81), and furniture (82) sectors are the top positive sectors. On the other hand, 11 sectors have a negative and significant impact on export performances and among these sectors are the tobacco and tobacco manufacture (12), hides, skins and furskins (21) and the leather and leather manufactures (61) sectors have the highest negative impacts.

Table 4: PPML Estimation Results.

Sub Sector	Model	$\ln GDP_{it}$	$\ln GDP_{jt}$	$\ln Dist_{ij}$	$\ln EXR_{jt}$	$Dummy_t$	$\ln Case_{it}$	$\ln Case_{jt}$	$\ln Death_{it}$	$\ln Death_{jt}$	Constant	R^2
0	1	0.415[a]	0.257[b]	-2.131[a]	4.805[b]	0.079[a]					21.742[a]	0.994
0	2	0.496[a]	0.456[a]	-1.946[a]	2.556		-0.029[b]	0.035[a]			21.840[a]	0.994
0	3	0.453[b]	0.274	-2.000[a]	3.024				0.005	0.030	22.709[a]	0.993
1	1	-0.388	0.680	-2.312[a]	-3.723	0.046					32.149[a]	0.949
1	2	-0.077	1.087	-2.072[a]	-6.654		-0.082	0.086[c]			30.588[a]	0.948
1	3	-0.112	0.653	-2.173[a]	-5.658				0.014	0.042	32.325[a]	0.949
2	1	-0.636[a]	0.367[c]	-1.109[a]	-0.863	-0.140[a]					26.158[a]	0.985
2	2	-0.694[a]	0.238	-1.315[a]	1.638		0.010	-0.025			25.453[a]	0.983
2	3	-0.584[a]	0.388	-1.257[a]	0.976				-0.025	-0.006	24.593[a]	0.980
3	1	0.646	0.470	-0.227	-1.365	-0.093					13.847[a]	0.745
3	2	0.584	0.416	-0.254	-1.037		0.000	-0.012			14.192[a]	0.745
3	3	0.649	0.303	-0.269	-0.825				0.005	-0.027	14.254[a]	0.744
4	1	0.236	0.687[b]	-0.323[c]	-1.146	-0.015					16.419[a]	0.955
4	2	0.277	1.244[a]	-0.157	-3.194[c]		-0.131[a]	0.114[a]			14.854[a]	0.961
4	3	0.186	1.230[a]	-0.188	-2.858				-0.071	0.068[c]	15.184[a]	0.953
5	1	0.187	0.339	-1.196[a]	3.610	0.036					15.221[a]	0.979
5	2	0.278	0.432	-1.101[a]	2.441		-0.015	0.020			15.088[a]	0.979
5	3	0.155	0.048	-1.388[a]	6.202[c]				0.063[c]	-0.083	14.990[a]	0.978
6	1	0.677	0.627	-0.533[a]	-1.266	-0.036					13.603[a]	0.885
6	2	0.715	0.732	-0.512[a]	-1.532		-0.029	0.024			13.080[a]	0.886
6	3	0.740	0.690	-0.490[a]	-1.831				-0.013	0.016	13.373[a]	0.885
7	1	0.057	0.082	-0.281	1.909	0.021					14.306[a]	0.928
7	2	0.028	0.174	-0.225	1.218		-0.021	0.018			14.444[a]	0.927
7	3	-0.040	0.515	-0.125	0.018				-0.048	0.040	13.907[a]	0.930
8	1	0.160	0.224	-0.021	0.415	0.139[c]					14.429[a]	0.736
8	2	0.460	0.223	0.053	-0.470		0.041	-0.005			13.551[a]	0.746
8	3	0.533	0.157	0.036	-0.336				0.069	0.004	13.497[a]	0.739
9	1	0.333	0.336	-0.632[a]	1.514	0.022					16.611[a]	0.967
9	2	0.349	0.517[b]	-0.577[a]	0.841		-0.040	0.037			16.100[a]	0.967
9	3	0.317	0.506[c]	-0.571[a]	0.722				-0.020	0.027	16.415[a]	0.966
11	1	0.787[c]	-0.162	-1.128[a]	0.330	-0.057					21.005[a]	0.919
11	2	0.682	0.215	-1.117[b]	0.215		-0.093	0.066			19.756[a]	0.920
11	3	0.325	-0.199	-1.555[a]	5.915				-0.001	-0.099	19.628[a]	0.922
12	1	0.081	0.781	0.308	-24.939[a]	-0.565[b]					38.135[a]	0.748
12	2	-1.088	2.332[b]	0.064	-21.485[a]		-0.507[a]	0.309[a]			33.801[a]	0.772
12	3	-2.517	2.198[c]	-0.437	-15.308[c]				-0.505[b]	0.122	37.219[a]	0.757
21	1	5.102[b]	0.369	-14.611	11.243	-0.653[c]					58.927	0.627
21	2	6.099[c]	-2.316	-25.455	19.652		0.605[a]	-0.609[a]			120.111	0.675
21	3	7.460[b]	-0.842	-16.863	12.971				0.170	-0.164	64.445	0.574
22	1	21.330[b]	-5.259	-65.834[b]	51.976[b]	0.354					258.090[c]	0.920

Sub Sector	Model	$\ln GDP_{it}$	$\ln GDP_{jt}$	$\ln Dist_{ij}$	$\ln EXR_{jt}$	$Dummy_t$	$\ln Case_{it}$	$\ln Case_{jt}$	$\ln Death_{it}$	$\ln Death_{jt}$	Constant	R^2
22	2	7.236	3.746	-35.553	28.216		-0.681[b]	0.621[a]			133.881	0.929
22	3	10.454[c]	1.348	10.175	-8.265				-0.144	0.639[a]	-92.370	0.930
23	1	-0.480	0.988[c]	0.721[a]	-3.266	-0.149					10.530[a]	0.721
23	2	-0.522	0.854	0.691[a]	-2.918		0.006	-0.023			11.149[a]	0.718
23	3	-0.202	0.928	0.832[a]	-4.583[c]				0.027	-0.010	10.266[b]	0.719
24	1	1.677[b]	0.900	0.524[b]	-5.013	-0.093					5.848	0.468
24	2	1.738[b]	0.883	0.546[b]	-5.276		0.001	-0.007			5.789	0.466
24	3	2.015[b]	0.833	0.572[b]	-5.524[c]				0.054	-0.025	4.814	0.466
25	1	-1.133	4.275[b]	-1.230	2.334	-0.070					1.471	0.450
25	2	1.309	5.362[a]	0.165	-14.779		-0.150	0.272[a]			-4.734	0.575
25	3	1.904	4.485[b]	0.899	-25.575[b]				0.222[c]	0.293[a]	4.493	0.613
26	1	2.115[b]	1.593	0.653[c]	-6.788	-0.087					-2.192	0.791
26	2	2.016[c]	1.410	0.632	-6.608		0.003	-0.019			-0.917	0.792
26	3	1.915	1.320	0.646	-6.787				-0.018	-0.024	0.093	0.792
27	1	3.636[a]	0.403	-0.819[b]	-2.634	-0.109					4.311	0.873
27	2	2.801[b]	0.123	-1.098[a]	0.774		0.053	-0.098			7.481	0.888
27	3	2.231	0.867	-1.022[a]	0.032				-0.186	0.018	6.971	0.886
28	1	1.991	-0.102	-0.190	-1.497	0.216					8.665	0.368
28	2	2.693[c]	-0.194	-0.266	-0.340		0.186	-0.114			4.914	0.375
28	3	3.166[c]	-0.128	-0.165	-1.533				0.251	-0.051	3.065	0.370
29	1	1.393[a]	0.655	-0.143	-5.891[b]	-0.071					13.980[a]	0.954
29	2	1.150[b]	0.351	-0.265	-4.419[c]		0.083	-0.093[c]			15.670[a]	0.957
29	3	1.472[b]	1.019	-0.108	-6.224[b]				-0.031	0.024	12.008[a]	0.953
32	1	13.673	-2.235	-22.723	17.475	-0.743					66.758	0.052
32	2	16.938[c]	-5.734	-37.788	29.175		0.408	-0.507[c]			141.723	0.061
32	3	16.823	-6.271	-51.771	40.211				0.295	-0.677[b]	212.924	0.059
33	1	0.519	1.305	-1.014[b]	-3.423	0.134					18.190[b]	0.743
33	2	0.360	0.981	-1.091[b]	-2.503		0.100	-0.080			19.948[a]	0.747
33	3	0.675	1.021	-1.107[b]	-2.251				0.080	-0.048	18.058[b]	0.743
34	1	0.337	2.880[a]	-1.381[a]	-2.684	0.237[c]					11.377[b]	0.906
34	2	0.312	2.738[b]	-1.429[a]	-2.320		-0.030	0.049			12.083[b]	0.898
34	3	0.180	3.244[b]	-1.445[a]	-2.215				-0.081	0.094	10.327	0.893
41	1	3.087	8.258	3.853	-75.087	-1.598					22.800	0.301
41	2	3.208	4.780	1.648	-48.959		0.246	-0.375			22.538	0.250
41	3	7.004	3.861	1.526	-47.697				-0.045	0.141	8.105	0.206
42	1	-1.089	1.302[c]	0.653	-6.911	-0.433					17.524[b]	0.786
42	2	-1.261	2.131[a]	1.097[a]	-12.485[a]		-0.346[a]	0.254[a]			21.620[a]	0.816
42	3	-0.997	1.946[b]	1.209[a]	-14.043[a]				-0.233[c]	0.147[a]	18.690[a]	0.756
43	1	0.375	2.318[a]	-0.047	0.903	0.012					4.034	0.383
43	2	0.458	2.751[a]	0.102	-0.830		-0.069	0.065			2.619	0.385
43	3	0.398	2.610[c]	0.036	-0.077				-0.023	0.028	3.141	0.386

Sub Sector	Model	$\ln GDP_{it}$	$\ln GDP_{jt}$	$\ln Dist_{ij}$	$\ln EXR_{jt}$	$Dummy_t$	$\ln Case_{it}$	$\ln Case_{jt}$	$\ln Death_{it}$	$\ln Death_{jt}$	Constant	R^2
51	1	0.132	0.736[b]	0.130	-1.679	-0.020					11.807[a]	0.767
51	2	-0.070	0.805[a]	0.102	-1.350		-0.036	0.019			12.247[a]	0.769
51	3	-0.296	0.985[a]	0.136	-1.802				-0.092[c]	0.035	12.770[a]	0.771
52	1	1.419[c]	0.780	-0.245	-0.529	0.008					7.397	0.295
52	2	1.328[c]	1.006	-0.148	-1.756		-0.075	0.064			7.540	0.295
52	3	1.252	0.747	-0.271	-0.229				-0.014	-0.003	8.166	0.295
53	1	1.581[a]	0.284	-0.174	-4.237[c]	-0.067					14.656[a]	0.971
53	2	1.207[a]	0.028	-0.347[c]	-2.106		0.064[c]	-0.081[b]			16.309[a]	0.975
53	3	1.044[b]	0.108	-0.484[a]	-0.292				-0.017	-0.075[b]	15.451[a]	0.976
54	1	-0.112	0.098	-0.168	0.305	-0.055					17.127[a]	0.372
54	2	-0.131	0.198	-0.130	-0.164		-0.032	0.021			17.031[b]	0.372
54	3	-0.296	0.314	-0.113	-0.377				-0.056	0.024	17.406[a]	0.372
55	1	0.353	0.354	-0.227	-2.754	0.107					16.171[a]	0.829
55	2	0.688[b]	0.351	-0.140	-3.829[c]		0.023	0.007			17.374[a]	0.837
55	3	0.868[a]	-0.002	-0.220	-2.844				0.111[a]	-0.037	17.589[a]	0.836
56	1	-1.308	3.822[b]	2.138[a]	-21.705[b]	0.163					14.207	0.161
56	2	-0.714	4.614[b]	2.350[a]	-23.840[a]		-0.036	0.085			8.652	0.160
56	3	-0.910	2.020	1.921[a]	-19.411[b]				0.269[c]	-0.174	19.628	0.161
57	1	0.762[c]	0.413	-0.421[b]	0.456	0.000					8.958[a]	0.630
57	2	0.697	0.217	-0.501[a]	1.446		0.048	-0.051			9.587[a]	0.633
57	3	0.607	0.312	-0.460[a]	0.939				-0.006	-0.014	9.865[a]	0.630
58	1	0.785[a]	0.192	-0.175	-1.259	-0.030					13.228[a]	0.924
58	2	0.781[b]	0.111	-0.205[c]	-0.875		0.023	-0.025			13.387[a]	0.923
58	3	0.761[c]	0.236	-0.167	-1.338				-0.011	0.002	13.173[a]	0.923
59	1	0.375	0.799[a]	0.021	-0.447	0.040					2.107	0.899
59	2	0.402	0.846[a]	0.041	-0.688		-0.004	0.010			1.907	0.899
59	3	0.334	0.948[a]	0.052	-0.855				-0.018	0.021	1.871	0.899
61	1	4.823[a]	0.207	-0.911	0.867	-0.696[a]					-9.980	0.760
61	2	4.059[c]	-1.195	-1.429	6.794		0.321	-0.407[b]			-3.229	0.754
61	3	3.982	-0.116	-1.738	11.243				-0.080	-0.274[c]	-11.282	0.713
62	1	1.852[a]	0.222	0.243	0.262	0.088					4.273	0.573
62	2	1.918[a]	0.416	0.367	-1.230		-0.019	0.030			3.966	0.577
62	3	1.811[a]	0.572	0.378	-1.385				-0.035	0.040	3.870	0.576
63	1	0.341	1.130	0.117	0.114	-0.037					9.380[c]	0.810
63	2	0.227	1.132	0.159	-0.464		-0.040	0.025			10.311[c]	0.811
63	3	0.128	1.415	0.175	-0.589				-0.066	0.029	1.673	0.791
64	1	0.305	0.654[c]	-0.135	-1.694	-0.048					16.113[a]	0.933
64	2	0.302	0.835[b]	-0.065	-2.536		-0.046	0.034			15.788[a]	0.932
64	3	0.301	0.858[b]	-0.032	-2.968				-0.035	0.026	15.973[a]	0.932
65	1	0.745	0.322	0.349[c]	-2.569	-0.073					8.501[b]	0.703
65	2	0.558	0.166	0.288	-1.872		-0.003	-0.017			9.725[a]	0.704

Sub Sector	Model	$\ln GDP_{it}$	$\ln GDP_{jt}$	$\ln Dist_{ij}$	$\ln EXR_{jt}$	$Dummy_t$	$\ln Case_{it}$	$\ln Case_{jt}$	$\ln Death_{it}$	$\ln Death_{jt}$	Constant	R^2
65	3	0.538	0.198	0.312	-2.123				-0.024	-0.014	9.782[a]	0.703
66	1	2.185[a]	-0.021	-0.402	1.365	0.021					5.421	0.563
66	2	1.868[b]	-0.077	-0.510	2.684		0.002	-0.016			6.370	0.567
66	3	1.474	0.616	-0.329	0.470				-0.140	0.071	6.345	0.572
67	1	0.130	1.368[c]	0.334	-4.231	-0.146					12.266[b]	0.352
67	2	-0.359	1.059	0.174	-2.368		0.012	-0.054			14.953[a]	0.354
67	3	-0.538	1.341[c]	0.243	-3.111				-0.100	-0.010	14.844[a]	0.352
68	1	1.193[b]	1.629[a]	0.081	-1.510	-0.267[b]					-0.203	0.676
68	2	1.085[c]	1.351[a]	0.051	-1.239		-0.007	-0.032			1.508	0.672
68	3	1.162[c]	1.227[b]	0.079	-1.527				-0.014	-0.051	1.854	0.672
69	1	1.998[a]	-0.129	-0.195	0.484	0.075					10.204[a]	0.859
69	2	1.937[a]	0.003	-0.123	-0.394		-0.025	0.025			10.430[a]	0.859
69	3	1.759[a]	0.369	0.027	-2.233				-0.065	0.057[b]	10.723[a]	0.863
71	1	1.091[b]	0.458	0.319	-5.102	-0.169[c]					11.811[c]	0.801
71	2	0.883[c]	0.488	0.224	-3.921		-0.029	-0.002			11.883[b]	0.801
71	3	0.902	-0.025	-0.099	0.036				0.009	-0.072	11.689[b]	0.810
72	1	1.550[a]	0.196	-0.817[a]	7.323[a]	0.280[a]					7.599[b]	0.948
72	2	1.844[a]	0.241	-0.558[b]	4.117		0.019	0.028			8.066[b]	0.949
72	3	1.861[a]	-0.007	-0.663[b]	5.298				0.093[c]	0.007	8.504[b]	0.940
73	1	1.493[b]	0.162	0.108	-3.195	-0.069					10.163[b]	0.650
73	2	1.804[b]	0.135	0.188	-4.169		0.012	-0.002			9.411[c]	0.653
73	3	2.040[b]	0.062	0.248	-4.959				0.045	0.001	9.168[c]	0.652
74	1	1.767[a]	0.040	-0.008	-2.049	0.017					10.707[a]	0.773
74	2	1.627[a]	0.389	0.127	-3.667[c]		-0.083[b]	0.065[b]			10.726[a]	0.776
74	3	1.261[a]	0.569	0.095	-3.277				-0.106[a]	0.055[a]	11.367[a]	0.776
75	1	0.819	-0.218	0.053	-0.141	0.072					15.756[a]	0.576
75	2	0.825	-0.122	0.145	-1.275		-0.021	0.025			16.008[a]	0.577
75	3	0.667	-0.052	0.121	-1.006				-0.030	0.024	16.279[a]	0.578
76	1	1.541[b]	-0.011	0.297	0.153	0.040					9.821[b]	0.851
76	2	1.638[b]	0.185	0.419[c]	-1.285		-0.011	0.021			9.309[b]	0.851
76	3	1.624[c]	-0.022	0.315	-0.070				0.019	0.000	9.633[b]	0.851
77	1	0.737[b]	0.877[b]	-0.243[b]	1.945	0.017					8.865[a]	0.952
77	2	0.742[c]	0.939[b]	-0.216[c]	1.630		-0.008	0.009			8.741[a]	0.953
77	3	0.684[c]	0.858[c]	-0.265[b]	2.212				0.000	-0.002	9.044[a]	0.952
78	1	1.052[b]	0.385	-0.145	-0.590	-0.125[c]					8.688[b]	0.910
78	2	0.892[c]	0.392	-0.165	-0.344		-0.027	0.003			9.256[b]	0.910
78	3	0.794	0.454	-0.178	-0.142				-0.053	-0.003	9.258[b]	0.910
79	1	1.314[a]	1.493[a]	0.228	-1.178	-0.213[c]					2.517	0.904
79	2	0.632[c]	0.962[b]	-0.164	3.480		0.031	-0.081			5.411[c]	0.913
79	3	0.144	1.508[a]	-0.111	3.035				-0.168[a]	-0.020	5.275[c]	0.910

Sub Sector	Model	$\ln GDP_{it}$	$\ln GDP_{jt}$	$\ln Dist_{ij}$	$\ln EXR_{jt}$	$Dummy_t$	$\ln Case_{it}$	$\ln Case_{jt}$	$\ln Death_{it}$	$\ln Death_{jt}$	Constant	R^2
81	1	3.355[a]	0.246	-0.438	5.961	0.370[b]					-5.263	0.635
81	2	3.318[a]	0.195	-0.349	4.840		0.034	0.006			-4.053	0.626
81	3	2.874[a]	0.704	-0.280	4.063				-0.025	0.048	-3.867	0.626
82	1	3.163[a]	-0.153	0.103	5.089[c]	0.194[b]					-2.577	0.927
82	2	2.843[a]	0.265	0.327	2.378		-0.105[c]	0.084[a]			-1.282	0.920
82	3	2.228[a]	0.721	0.164	4.444				-0.238[a]	0.091[a]	-1.857	0.932
83	1	2.205[a]	0.445	-0.439	1.153	0.049					4.163	0.900
83	2	2.388[a]	0.206	-0.463	1.401		0.054	-0.033			4.303	0.903
83	3	2.548[a]	0.447	-0.243	-1.350				0.029	0.023	4.174	0.902
84	1	0.630	-0.559	0.418[a]	1.828	0.099[b]					13.061[a]	0.982
84	2	0.716[c]	-0.466	0.480[a]	1.130		0.021	0.000			12.625[a]	0.982
84	3	0.742[c]	-0.490	0.501[a]	0.802				0.022	0.011	12.881[a]	0.982
85	1	3.289[a]	-0.206	-0.446	-4.763	-0.160[c]					10.154[a]	0.965
85	2	2.689[a]	0.038	-0.656[b]	-2.070		-0.056	0.007			10.056[a]	0.971
85	3	2.034[a]	0.267	-0.979[a]	2.153				-0.134[a]	-0.048	9.225[a]	0.974
87	1	1.559[a]	0.053	0.067	1.153	0.036					9.976[a]	0.888
87	2	1.586[a]	0.172	0.129	0.425		-0.010	0.014			9.728[a]	0.889
87	3	1.609[a]	-0.067	0.045	1.398				0.021	-0.007	10.175[a]	0.888
88	1	2.414[a]	-0.276	-0.448	0.157	-0.158[c]					9.745[b]	0.869
88	2	2.123[a]	-0.647	-0.670[c]	2.835		0.055	-0.077			11.215[a]	0.871
88	3	1.999[a]	-0.320	-0.619[c]	2.363				-0.050	-0.035	10.438[b]	0.869
89	1	1.473[a]	-0.150	-0.411[c]	4.154	0.072					9.535[a]	0.767
89	2	1.360[a]	0.425	-0.062	-0.059		-0.111[b]	0.096[b]			9.989[a]	0.778
89	3	1.124[b]	0.685	-0.037	-0.395				-0.108[b]	0.083[b]	10.123[a]	0.776
93	1	0.502	-0.367	0.259	-3.756	-0.244[c]					18.810[a]	0.501
93	2	0.405	-0.086	0.366	-5.040[c]		-0.094[c]	0.055			18.706[a]	0.487
93	3	0.515	0.797	0.496[c]	-6.408[b]				-0.132	0.079	14.721[b]	0.491
96	1	15.362[c]	-16.293	-4.765[b]	50.654[b]	1.575					-16.160	0.920
96	2	-11.678	14.594[a]	7.630	-108.298		-4.782[a]	3.576[a]			69.415	0.989
96	3	0.415	7.908[c]	15.207[b]	-269.789[a]				-1.845[b]	4.471[a]	179.162[b]	0.991
97	1	3.659[a]	-0.202	-0.324	-0.627	0.072					3.036	0.813
97	2	3.092[a]	-0.631	-0.317	-0.937		-0.037	0.009			8.140	0.814
97	3	2.167[b]	0.744	0.028	-5.065				-0.349[a]	0.158[c]	8.567	0.840

Notes: Superscript a, b and c denotes significant level at 1%, 5%, and 10%, respectively.

Model 2 includes the number of monthly new cases in exporting and importing countries. From the number of new cases in Malaysia (exporting countries), two sectors have positive impacts, and ten sectors have negative impacts. Meanwhile, from the number of new cases in the trading partners (importing countries), 11 sectors have positive impacts, and five sectors have negative impacts. Interestingly, the highest affected sectors in both variables are almost the same. For example, the number of new cases in Malaysia has the highest negative impacts on the export for sectors coin (96), oil seeds and oleaginous fruit (22), tobacco and tobacco manufacture (12) and fixed vegetable oils and fats (42). The same sectors have the highest positive impacts on the number of new cases in importing countries. Meanwhile, sectors that have positive impacts from the number of new cases in Malaysia are the hides, skins and furskins (21) and the dyeing, tanning and colouring materials (53) sectors. These sectors, together with the coal, coke and briquettes (32) and the leather and leather manufacture (61) sector, have the highest negative impact from the number of new cases in trading partners.

Model 3 substitutes the number of new cases in Model 2 with the number of death cases for both Malaysia and trading partners. Estimation results show that number of death cases in Malaysia has negative impacts on the exports of 10 sectors with the most affected are the coin (96), tobacco and tobacco manufactures (12), gold (97) and furniture (82) sector. Meanwhile, five sectors have a positive impact on the number of death cases in Malaysia, such as the manufactured fertilisers (56), pulp and wastepaper (25) and also oils and perfume materials (55) sector. For the number of death cases in trading partners, ten sectors have positive impacts on Malaysia's bilateral export, and the highest positive impacts are the coin (96), oil seeds and oleaginous fruit (22) and pulp and wastepaper (25) sector. On the other hand, three sectors show a negative impact, and the most negatively affected sectors are the coal, coke and briquettes (32) sector.

Table 5: Outcome Summary.

Code	Description	Dummy	$\ln Case_i$	$\ln Case_j$	$\ln Death_i$	$\ln Death_j$
0	Live animals	+	-	+		
1	Meat and preparations			+		
2	Dairy products and eggs	-				
4	Cereals and cereal preparations		-	+		+
5	Vegetables and fruit				+	
8	Feeding stuff for animals	+				
12	Tobacco and tobacco manufacture	-	-	+	-	
21	Hides, skins and furskins	-	+	-		
22	Oil seeds and oleaginous fruit		-	+		+
25	Pulp and wastepaper			+	+	+
29	Crude animal and vegetable materials			-		
32	Coal, coke and briquettes			-		-
34	Gas, natural and manufactured	+				
42	Fixed vegetable oils and fats		-	+	-	+
51	Organic chemicals				-	
53	Dyeing, tanning and colouring materials		+	-		-
55	Oils and perfume materials				+	
56	Fertilisers, manufactured				+	
61	Leather, leather manufactures	-		-		-
68	Non-ferrous metals	-				
69	Manufactures of metals					+
71	Power generating machinery and equipment	-				
72	Machinery specialised for particular industries	+			+	
74	General industrial machinery and equipment		-	+	-	+
78	Road vehicles	-				
79	Other transport equipment	-			-	
81	Sanitary, plumbing, heating, lighting	+				
82	Furniture	+	-	+	-	+
84	Articles of apparel and clothing accessories	+				
85	Footwear	-			-	
88	Photographic equipment and supplies, optical goods	-				
89	Miscellaneous manufactured articles		-	+	-	+
93	Special transactions	-	-			
96	Coin		-	+	-	+
97	Gold				-	+
	Net	-	-	+	-	+

Notes: + denotes positive and significant relationship, while – denotes negative and significant relationship.

Next, to have an overview of the estimation outcome, this study reports the overall summary sign for the focus variables in Table 5. The net effect has been calculated based on the product of the reported sign and export share for each Covid-19 variable. In brief, the coefficient for the pandemic variables, which varies in sign by sectors, shows that there is a heterogeneous impact of the current pandemic on export performances. For the dummy variables, the negative net effect can be interpreted as the overall impact of the Covid-19 outbreak deteriorating Malaysia export performances. The number

of new cases and death cases also reported a negative net impact, and this means that the higher severity of the pandemic outbreak in Malaysia distorts the production process and eventually reduce exports. Similarly, the net positive impact from the number of new cases and death cases in trading partners shows disruption in their domestic production and thus higher dependence on exported goods, and this led to higher export in certain sectors for Malaysia.

CONCLUSION

The Covid-19 outbreak has distorted the international trade flow as most countries impose various countermeasures to flatten the curve. This study aims to determine the dynamic impact of the Covid-19 pandemic outbreak on sectoral bilateral export for Malaysia. In order to achieve this purpose, monthly data from Jan 2019 till Jul 2020 have been utilised. In this study, few variables have been included to measures the impact of the Covid-19 outbreak, which are the dummy variables that represent the outbreak period, the number of new cases, and the number of death cases in Malaysia and trading partners. Together with several other standard gravity model variables, the impact of these variables is estimated using PPML regression at SITC 2-digit level to understand their respective roles. Overall, the outcome obtained in this study is according to the standard gravity model theory based on the coefficient for GDP and distances.

The most interesting finding to emerge from this study is that there are mixed impacts of the Covid-19 outbreak on Malaysia's export performance. The existence of Covid-19 in Malaysia (dummy variable) shows that the pandemic caused lower export values for 11 sectors and higher export values for seven sectors. Findings show that the export for the tobacco and tobacco manufacture (12), hides, skins, and furskins (21) and the leather and leather manufactures (61) are the most badly affected due to the existence of Covid-19 in Malaysia. In addition, it should be noted that these three sectors are not among the necessary good (basic needs) during the current pandemic outbreak. This can be supported by past studies that proved the demand for food, agricultural sectors, and medical supplies are higher during the Covid-19 outbreak (Gereffi 2020; Mold & Mveyange 2020). Thus, reductions in demands for these goods are justified.

Meanwhile, the severity of the current pandemic outbreak (number of new cases and death) in Malaysia has a net negative impact on Malaysia export. One way to explain this is that the higher severity of the current pandemic outbreak in Malaysia will cause the government to enact stricter movement control. This will then disrupt the domestic supply chain, which extended to exports as more inputs are immobile. Meanwhile, for certain sectors that are crucial in protecting against current pandemic outbreak such as the articles of apparel and clothing accessories (84) sectors that include the rubber gloves, estimation results from the dummy variables that have positive sign are totally in line with the data as Malaysia exports more of this product post-pandemic outbreak. The same impacts are found by several past studies (Gereffi 2020; Goodell & Huynh 2020). On the other hand, the severity of the current pandemic outbreak (number of new cases and death cases) in trading partners has net positive impacts on Malaysia's bilateral sectoral exports. This means that when the Covid-19 pandemic outbreak is more severe in the trading partner, their domestic production capacities are distorted, and this leads to higher dependence on imported goods. This outcome can be supported by Hayakawa and Mukunoki (2020) study that shows that the import for China and the United States (top severely affected countries) have increased post Covid-19 outbreak.

The empirical findings in this study provide a new understanding of the impacts of Covid-19 on bilateral export as it varies by sector. The findings of this study have a number of policy implications. First, the positive impacts on certain sectors can serve as positive indicators for policymakers that these sectors gained higher export demand and competitiveness in the international market, and thus policymakers should use this opportunity to lift the sector to the next level, such as from upstream product to a downstream with a high-quality standard. On the other hand, the negative impacts on certain sectors from the current pandemic outbreak give the opposite indicators. The export progress might be affected due to a lack of bilateral trade with another country that may need the product or, in other words, a mismatched trade partner. Without intervention policies, certain firms might not be able to sustain, and this will have spillover impacts on the labour market and other industries that have high backward and forward linkages. Thus, policymakers can either improve the existing trade agreement or propose new trade agreements with other countries. This is important to ensure that the domestic firms are able to sustain themselves during the pandemic outbreak and back to business as usual once the outbreak has subsided. It is important to note that the policy implication derive should be taken with caution as the impact of covid on trade obtained in this study are subject to the model used and the sample period involved. The impact might also change due to further adjustments with the standard operating procedures and movement restrictions throughout time.

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NOTES

1. This study has considered to include common barrier and common language as additional control variable. However, from the selected sample countries, only Singapore shares common language and common barrier with Malaysia, and this causes the model to omit these variables.

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Muhamad Rias K V Zainuddin*
Fakulti Perniagaan Ekonomi dan Pembangunan Sosial
Universiti Malaysia Terengganu
21030 Kuala Nerus, Terengganu
MALAYSIA
Email: rias@umt.edu.my

Md Shafiin Shukor
Fakulti Ekonomi dan Pengurusan
Universiti Kebangsaan Malaysia

43600 Bangi, Selangor
MALAYSIA
Email: p80550@siswa.ukm.edu.my

Muhamad Solehuddin Zulkifli
Fakulti Pengurusan dan Perniagaan,
Universiti Teknologi Mara Cawangan Terengganu,
23000 Dungun, Terengganu
MALAYSIA
Email: solehuddin@uitm.edu.my

Amirul Hamza Abdullah*
Institut Masa Depan Malaysia
192, Jalan Ara, Bukit Bandaraya
59100 Kuala Lumpur
MALAYSIA
Email: hamza.abdullah@institutmasa.com

*Corresponding author

Appendix A

Sectoral Code and Description.

SITC 2-digit	Description
0	Live animals
1	Meat and preparations
2	Dairy products and eggs
3	Fish, crustacean and molluscs
4	Cereals and cereal preparations
5	Vegetables and fruit
6	Sugar, sugar preparations and honey
7	Coffee, tea, cocoa, spices
8	Feeding stuff for animals
9	Miscellaneous edible products
11	Beverages
12	Tobacco and tobacco manufacture
21	Hides, skins and furskins
22	Oil seeds and oleaginous fruit
23	Crude rubber
24	Cork and wood
25	Pulp and wastepaper
26	Textile fibres
27	Crude fertiliser and crude minerals
28	Metalliferous ores and metal scrap
29	Crude animal and vegetable materials
32	Coal, coke and briquettes
33	Petroleum, petroleum products
34	Gas, natural and manufactured
35	Electric current
41	Animal oils and fats
42	Fixed vegetable oils and fats
43	Animal and vegetable oils and fats
51	Organic chemicals
52	Inorganic chemicals
53	Dyeing, tanning and colouring materials
54	Medicinal and pharmaceutical products
55	Oils and perfume materials
56	Fertilisers, manufactured
57	Explosives and pyrotechnic products
58	Artificial resins and plastic materials
59	Chemical materials and products
61	Leather, leather manufactures
62	Rubber manufactures
63	Cork and wood, cork manufactures
64	Paper, paperboard, and articles of pulp
65	Textile yarn, fabrics, made-up articles
66	Non-metallic mineral manufactures
67	Iron and steel
68	Non-ferrous metals
69	Manufactures of metals
71	Power generating machinery and equipment
72	Machinery specialised for particular industries
73	Metalworking machinery
74	General industrial machinery and equipment
75	Office machines and data processing equipment
76	Telecommunications equipment
77	Electric machinery, apparatus and appliances
78	Road vehicles
79	Other transport equipment
81	Sanitary, plumbing, heating, lighting
82	Furniture
83	Travel goods, handbags and similar containers
84	Articles of apparel and clothing accessories
85	Footwear
87	Professional, scientific, controlling instruments
88	Photographic equipment and supplies, optical goods
89	Miscellaneous manufactured articles
93	Special transactions
96	Coin
97	Gold, non-monetary