AN ECONOMIC AND PUBLIC HEALTH PREPARDNESS ANALYSIS ON PERSONAL PROTECTIVE EQUIPMENT TARIFFS IN THE COVID-19 ERA

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Abstract

Existing research on the rise of trade protectionism during the Trump administration to recover the trade deficit and improve the unemployment rate suggests that high tariffs have protected countries' national economies. However, during the COVID-19 pandemic, many countries have posed restrictions, especially on personal protective equipment (PPE) to secure their domestic needs. This paper uses a multiple linear regression model to analyze whether there is a significant relationship between high PPE tariffs and a country's economic and public health index profile. Results show that countries with large populations tend to impose higher tariffs on PPE than their average annual tariffs rate. It was also found that trade indices were more important indicators of PPE tariffs rate than public health preparedness indices. However, the evidence reveals that countries that scored highly on public health preparedness indices were still likely to impose tariffs restrictions on PPE products to protect their domestic supplies.

Keywords

Trade Protectionism, Public Health Preparedness index, PPE tariffs

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1. Introduction

Nowadays, global trade has reached unprecedented level as a proportion of total world production,[1] and in some countries, international trade brings mutual benefits like increasing the variety of goods and competition in the domestic market for consumers. However, in the current administration, President Trump argued that the U.S. trade deficit was caused by emerging Asian economies and need to eliminate these unfavorable trade agreements with renegotiations and tariffs.[2] During the COVID-19 pandemic crisis, this trade protectionism practice has been enforced as most of countries pose higher tariffs on PPE (Personal protective equipment) to secure their domestic use.

Tariff is one of common predictors to estimate the trade protectionism in existing socio-economic studies. Some academic researchers suggest the positive relationships between the size of government and trade openness in the majority of countries.[3] Non-tariffs restrictions, like government regulations that limit the right to exchange, gain credit, labor standards or business operation intervention, can be an alternative of tariffs. At the same time, some countries pose a variety of measures to protect their local businesses and manufacturers.[4] Most often, the tariff rate is common index or predictor that has been defined or studied to measure economy's trade protectionism or their liberalization stance, but few studies have looked at it individually.

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[1] Martín Lizaso, Laura. "International Trade in Medical Products: An analysis of Spanish Imports of Pharmaceutical products and personal protective equipment", (Facultad de Ciencias Económicas y Empresariales, 2020), 1.

[2] Lin, Justin Yifu, and Xin Wang. "Trump Economics and China–US Trade Imbalances." *Journal of Policy Modeling*, 40, no. 3, (2018), 579–600

[3] Epifani, Paolo, and Gino Gancia. "Openness, Government Size and the Terms of Trade." *Review of Economic Studies*, 76, no. 2, (2009), 629–668

[4] Cheong et al. "The Trade Effects of Tariffs and Non-Tariffs Changes of Preferential Trade Agreements." *Economic Modelling*, 70, no. F15, (2018), 370–382

However, in a current COVID-19 situation, most countries pose under name of health privacy or medical protectionism to secure their personal protective equipment (PPE) supplies. World imports of PPE in 2019 was $131.47 billion, whereas exports added up to $139.42 billion.[5] Top PPE product exporters like the U.S., China, Vietnam and Germany still face a shortage of PPE due to the fact that the containment measures prevent factories from producing. For example, Germany imposed export licensing requirements on certain PPE products due to anticipated shortage in the country on March of 2020.[6]

This paper seeks to understand what the main predictors for countries' PPE tariff rates in the very unprecedented pandemic situation are, using the countries' economic index and public health index profile. In order to test these relationships, the empirical strategy adopts in this paper using multi linear regression model analysis to investigate the relationship among these variables. Using 2019 Economic Freedom of the World Index from Frasier institute and 2019 Global Health Security Index from165 countries, this research finds that trade indices were more important indicators of PPE tariffs rates than public health preparedness indices.

The paper starts with reviewing of past literature about what predictors have been studied to have an impact on tariff rates. Then, this paper provides information on the main characteristics of the dependent and independent variables. In Section 3, it will describe how health preparedness levels are different from countries' income size

[5] As defined by World Trade Organization (2020)

[6] Sithanonxay, Suvannaphakdy. "Tackling COVID-19 in ASEAN: Sustain an Open Trade Policy on Personal Protective Equipment." *RESEARCHERS AT ISEAS – YUSOF ISHAK INSTITUTE*, 49, (2020), 1–10.

comparable to the overall tariffs' percentage. Then investigate the difference between PPE and general tariff rates by each of the countries' population size in section 4. Finally, this paper overview which variable—economic or health preparedness level— have a greater impact on PPE tariffs. The article concludes by discussing the direction of future research on PPE related tariffs and non-tariffs measurements.

2. Literature Review

A robust research literature exists regarding how economic features have an impact on tariff rates. For example, Kim suggests in his paper "Economic growth and tariff levels in the United States: A Granger causality analysis" that domestic business growth has unidirectional impacts on tariffs in the short term.[7] Using Granger causality, the paper concludes that the U.S. trade policies have been influenced by the U.S.' economic performance. Kim refers to a study by McKeown which demonstrates that economic growth influenced the level of trade protection in the U.S. between 1854 and 1914.[8] Also, Kim's research provides empirical evidence that the previous level(s) of tariffs protection affect the current levels of tariffs protection and economic growth in the U.S. This provides some theoretical hypothesis that previous tariff rates and non-tariffs measurements may affect the current level of tariffs, which will be analyzed with trade freedom level and previous year's import and export size.

[7] Kim, Hyung Min. "Economic Growth and Tariffs Levels in the United States: A Granger Causality Analysis.", *Journal of International Studies*, 11, no. 4, (2018), 79–92.

[8] McKeown, Timothy J. "Firms and Tariffs Regime Change: Explaining the Demand for Protection.", *World Politics*, 36, no. 2, (1984), 215–233.

Some influential research has suggested there is a negative relationship between country size and trade openness and country size and government size, and these may account for the positive association between trade openness and government size. Ram analyzed[9] these relationships using OLS estimates with 41-year panel data for over 150 countries. Adopting previous work from Rodrick,[10] country size was proxied by population; and ratio of trade (imports + exports) to GDP was the measure of openness in his research. He also found that in a fixed-effect format, does not support the negative relationship between country size and both government size and openness but rather found the positive relationship among them. Similarly, further research from Epifani and Gancia suggest that there is a positive relationship between the size of government and trade openness in most countries.[11] This pattern was found by Cameron in 18 OECD countries and extended this research to broader country data samples.

Ray, who first to analyze systemically the cross-national structure of tariffs, calculated the average tariffs for 225 U.S.' commodity classification across 7 countries (Canada, U.K., Germany, Belgium, Italy, France and Japan) and found out that foreign tariffs were negatively related to labor and skill intensity of production. In general, the U.S. tariffs provide more restrictive protection to those industries if the U.S. companies are not leading the industry due to lack of low level of skill intensity.[12] Inspired by Ray's study, Conybeare suggests different predictors of tariff levels, both in the developed and

[9] Ram, Rati. "Openness, Country Size, and Government Size: Additional Evidence from a Large Cross-Country Panel.", *Journal of Public Economics*, 93, no. 1–2, (2009), 213–218.

[10] Rodrik, D. "Why do more open economies have bigger governments?", *Journal of Political Economy*, 106, (1998), 997–1032.

[11] Epifani and Gancia. "Openness, Government Size and the Terms of Trade."

[12] Ray, Edward John. "The optimum commodity tariffs and tariffs rates in developed and less developed countries.", *The Review of Economics and Statistics*, 56, No. 3, (1974), 369-377.

developing countries: the nature of the international system, intergovernmental power and influence of non-profit or interest groups.[13]

Not only tariffs, but non-tariffs measures, such as a government regulation that limits the right to exchange, gain credit, labor standards or business operation intervention, can be alternative of tariff.[14] Trade openness indices evaluate not only current and past tariff rates but also non-tariffs measures by posing import and export processing fees and government export control regulations.

Before the COVID-19 crisis, many WTO countries had been charged high tariffs on imported PPE products such as medical devices, medicines, disinfectants, and soap.[15] Because big exporters of world (U.S., China, Japan, Germany, Britain, France and Italy) have been hit hard by the virus in the first quarter of 2020, trade restrictive policies are now mostly anti-export, which affects 65% of world manufacturing.[16] In addition to import barriers, many countries' lawmakers introduced export barriers on PPE and food exports during the COVID-19 pandemic crisis.

Although existing literature have examined some economic indexes attribute the rate of tariffs in general, no research has investigated in this special circumstance under the COVID-19 pandemic. Most countries put out the reason of high PPE tariffs and non-tariffs measures to secure their domestic needs, however, this current study aims to investigate whether high PPE tariffs are caused according to countries' domestic needs by

[13] Conybeare, John A.C. "Tariffs protection in developed and developing countries: a cross-sectional and longitudinal analysis", *International Organization,* 37, no. 3, (1983), 441-463.

[14] Cheong et al. "The Trade Effects of Tariffs and Non-Tariffs Changes of Preferential Trade Agreements."

[15] Stellinger et al. "How Trade Can Fight the Pandemic and Contribute to Global Health.", *CEPR Press*, 1, no. 2, (2020), 21–30.

[16] Baldwin, Richard, and Simon J. Evenett. "Covid-19 and Trade Policy: Why turning inward won't work.", *CEPR Press*, (2020), 2-14.

comparing the impact of economic independent variable and countries' health properness level.

3. Data and Methods

3.1 Independent Variable

In recent social science and economic studies about economic freedom, researchers use two most prominent indicators developed by the Fraser Institute and the Heritage Foundation. Both measurements use government size, tax rates, and business freedom as subgroups to analyze the holistic economic freedom index. Hartmann and Uhlenbruck[17] states in their research that the Economic World Freedom Index (EWFI) from Fraser Institute is more precise and transparent information than the Heritage Index. For this study, EWFI is chosen since it is from a non-partisan institute whereas the Heritage Foundation is a renowned conservative think tank. Also, both indexes are highly correlated.[18] In EWFI's 2019 world report, it ranked 162 countries based on five areas— size of government, legal structure and property rights, access to sound money, freedom of trade internationally (in this paper, it will be referred as "Trade Freedom") and regulation of credit and labor in business (referred as "Domestic Business regulation"). Size of government, trade freedom, and domestic business regulation are selected as independent variables to measure overall economic freedom. All indexes range is between 0 to 10 with higher values indicating more freedom. Lastly, Caudill and Zanella

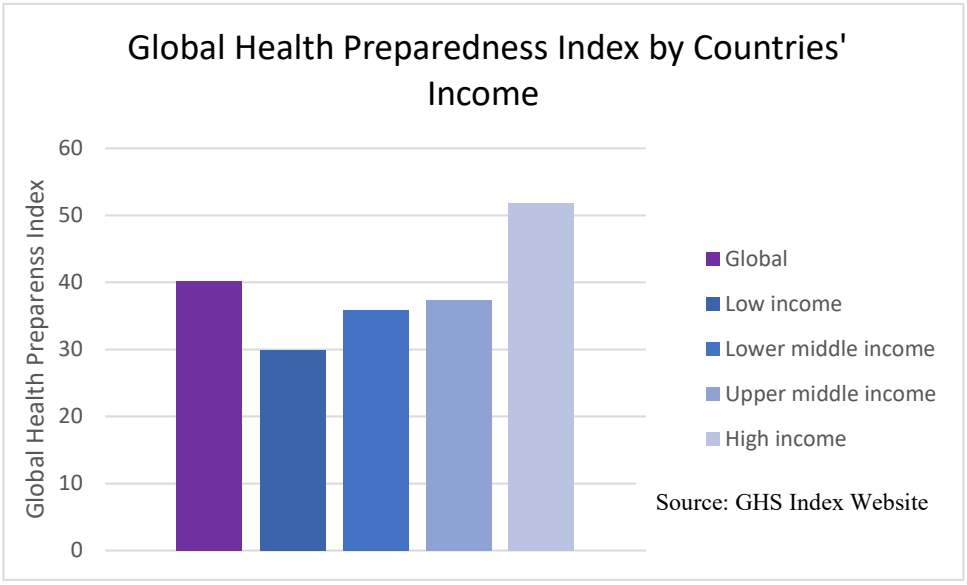
[17] Hartmann, Julia, and Klaus Uhlenbruck. "National Institutional Antecedents to Corporate Environmental Performance", *Journal of World Business*, 50, no. 4, (2015), 729–741.

[18] Hanke, S. H., & Walters, S.J.K. "Economic freedom, prosperity, and equality: A survey", *CATO Journal*, (1997), 17-117

stated in their research that the components of the indices are orthogonal, this could be done without multicollinearity problems in regression models.[19]

For the public health preparedness measurement, the Global Health Security (GHS) Index, developed by the Nuclear Threat Initiative (NTI) and the Johns Hopkins Center for Health Security is used in this paper. This index is developed by combining six different categories: prevention, Detection and Reporting, Rapid Response, Health System, Compliance with International Norms, and Risk Environment.[20] This index is 0- 100 scale analyzing 195 countries worldwide. Before analyzing a multiple linear regression model, this study reviews how the global health security level differs according to a country's income. As shown in figure 1, the countries with high incomes tend to score higher global health preparedness compared to those with low incomes.

Figure 1



[19] Caudill et al. "Is economic freedom one dimensional? A factor analysis of some common measures of economic freedom.", *Journal of economic development*, 25, no. 1, (2000), 17-40.

[20] Global Health Security Index. (n.d.). *GHS INDEX 2019*. https://www.ghsindex.org/about/ (accessed November 11, 2020)

According to figure 1, an average overall GHS index score is 40.2, while 60 high-income countries scored 51.9.[21] However, 116 high- and middle-income countries do not score above 50. According to the 2019 GHS report, "GHS Index Global Health Security Index", fewer than 7% of countries which scored in the highest tier can prevent the emergence of the global pandemic.

Table 1 Summary Statistics of Independent Variables

Independent Variables	Mean	Stand Deviation	Minimum	Maximum
Trade Freedom	7.391	1.086	3.393	9.491
Domestic Business regulation	7.01	1.797	0.194	9.469
Government Size	6.637	1.099	3.333	9.505
Population (Million)	52.26	178.316	0.10	1395.40
Global Health Security Index	72.81	27.64	2.80	99.90
Import ($)	7.898e+09	20,365,338,401	3.000e+06	1.800e+11
Export ($)	8.094e+09	21,367,917,882	5.480e+02	1.380e+11

Lastly, the 2019 world export and import data from UN Comtrade Database center is used to study the relationship between countries' trade size and PPE tariff rates. Using HS 2017 code, all 2019 PPE related export and import trade values will be

[21] Cameron et al. "GHS Index Global Health Security Index", *NTI & Johns Hopkins Bloomberg school of public health*, https://www.ghsindex.org/wp-content/uploads/2020/04/2019-Global-Health-Security-Index.pdf, (accessed October 20, 2020)

extracted. This list includes medicine, medical supplies, medical equipment, and personal protective products (See appendix B). The underlying hypothesis states that if countries are extensive exporters, they already have strong supply chains to produce their own goods. At the same time, import data will be used to see if countries rely on most of their PPE products from global import, and how this impacts the tariff rates.

Table 1 shows the mean, standard deviation, and minimum and maximum value of independent variables. After examining table 1, 2019 PPE export and import values are too large scale compared to other independent variables. To balance out the range of trade values, this study adapts log transformation in export and import variables. Most of the time, log transformation is often used in economic analysis to stabilize the variance of a series (LÜTKEPOHL et al., 2009).

3.2 Dependent Variables

Average applied Most-favored-nation (MFN) tariff rates on PPE from the World Trade Organization database is used as a dependent variable in this study. MFN tariff is the one that WTO member countries, promise to impose all trading partners unless the country is part of a preferential trade agreement, which means it is the highest and most restrictive tariff that WTO members can charge one another.[22] Since World Trade Organization (WTO) only provides its members notified data from 122 countries, there is a data limitation problem in PPE MFN tariff rates. To build more accurate model analysis, 40 missing values are recoded with a mean value in this study. Same as 2019

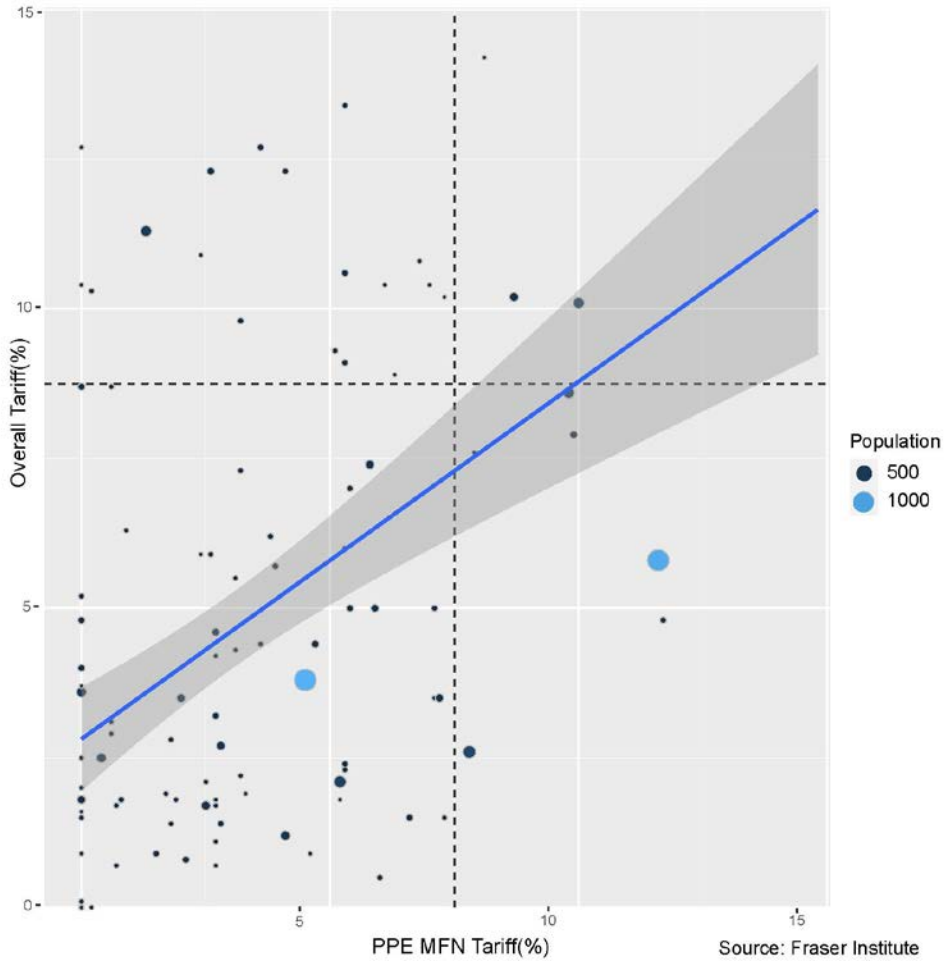
[22] World Trade Organization. Blog, *WTO*, 2020, https://blogs.worldbank.org/trade/picture-trade-types-tariffs-explained, (Accessed 11.25.2020)

PPE export and import trade values, PPE MFN tariff values are exported based on the Harmonized System (HS) Classification.[23]

4. Results

4.1 PPE vs Overall Tariffs comparison by countries' population size

Figure 2: PPE vs Overall Tariff comparison by population size in 2020



In figure 2, most of the countries' PPE tariffs fall between 0-5 %. Generally, in Figure 2, more countries pose higher PPE tariff rates than their general tariff rates during the

[23] World Trade Organization, "How WTO Members have used trade measures to expedite access to COVID-19 critical medical goods and services", *WTO*, 2020, https://www.wto.org/english/tratop_e/covid19_e/services_report_16092020_e.pdf (accessed 10.20.2020).

COVID-19 pandemic. Countries with a larger population tend to impose a higher tariff rates in PPE than general tariffs in 2020. It can be interpreted that countries with a large population would like to secure domestic use of PPE by imposing higher tariffs than average. However, except very populated countries such as those who have more than a billion population, the linear regression graph does not show a significant relationship between PPE tariff rates and population variable.

4.2 Multiple linear Regression

Multi linear regression analysis is used to set up a useful relationship between a dependent variable *y* and diverse predictors.[24] To compare all independent variables suggested above, it is easier to use a multiple regression approach to see how each predictor's covariates and adjusted R^2 value have been changed. The hypothesis can be expressed in the following regression model for the relationship between dependent variable *Y* and independent variables *A, B* and *C,* etc.

$$Y = \beta_0 + \beta_1 A + \beta_2 B + \beta_3 C + \cdots + \varepsilon$$

The aim of this paper's analysis is to see if countries' economic and health preparedness indices have an impact on the level of PPE tariff rates and, if so, then to identify the impact of the interaction. As stated in the literature review, this study will compare gradually how economic indices like trade openness, government size and non-tariff measure have an impact on the PPE tariff rates in the first model. In the Model 2, the health security level index was added to investigate the relationship with the PPE tariff rates. The third model will solely investigate how countries import and export size

[24] Gan, Sarimah Omar, and Sabri Ahmad. "Multiple Linear Regression to Forecast Balance of Trade.", *Journal of Fundamental Sciences*, 7, (2011), 150-155

affect the PPE tariff rates. Unlike other independent variables, there is no relevant academic research about how export and import size of countries impact tariff rates in general. By analyzing this model, it will give some sense of empirical analysis and how these two factors attribute to PPE tariff rates. Lastly, all independent variables are used in Model 4. Ultimately, a total of four multi-linear regression models were estimated to explore the impact of independent variables by comparing how their covariates and adjusted squared R values different with others.

In the first model, EWFI's economic freedom variables are used as quantitative factors to analyze the relationship between the MFN tariffs and countries' economic statuses. The second model, the global health security index has been added as a public health preparedness measure. The third model analyzes 2019 export and import value on PPE products, adopting log transformation to balance out the range of values. In model 1 and 2, trade freedom has significant negative impact on the PPE MFN tariff rates ($p < 0.001$). In the Model 1, a one unit increase in country's trade freedom index decreases probability of PPE tariff rates by 1.494 %, holding country's government size, population, domestic business regulation, health preparedness level, and import and export size constant. Whereas in Model 2, the probability of PPE tariff is decreased by 0.082. The reported impacts are both statistically significant at a 5% significance level. A one-point increase in government size index will increase PPE MFN tariff rates by 0.375 % (Model 1) and 0.401 % (Model 2) accordingly. Comparatively, the global health security index is not shown as significant predictor of PPE tariff rates compare to economic indices. One point increase of the global health security index is associated with increases of PPE tariff rates by 0.0129 % in the Model 2 which is lower than all

three economic indexes (Trade freedom, domestic business regulation and government size). Compared to EWFI economic indices, trade size does not have a significant impact on PPE tariffs in Model 3. As 1% of import size increase is associated with 0.1186 decreases in PPE tariff rates whereas 1% of the increase in export size increases the PPE tariff rates by 0.0986.

Table 2 Multivariable Models Results

	Model 1	Model 2	Model 3	Model 4
Intercept	12.1978	12.2021	7.3084	17.3733
Trade Freedom	-1.4944*** (0.227)	-1.5767*** (0.265)		-1.6695*** (0.273)
Domestic Business regulation	-0.1160*** (0.135)	-0.1394 (0.141)		-0.0935 (0.152)
Government Size	0.3755 (0.212)	0.4012 (0.217)		0.3959* (0.216)
Population	0.0031* (0.001)	0.003* (0.001)		0.0033* (0.001)
Global Health Security Index		0.0129 (0.021)		0.0328 (0.027)
Log(Import)			-0.1186 (0.1512)	-0.388 (0.2383)
Log(Export)			-0.0986 (0.2817)	0.1266 (0.134)
Adj. R^2	0.33	0.33	0.03	0.34
N	162	162	162	162

***p < 0.001 ** p <0.05 * p < 0.01

Source: Fraser Institute, UN Comrade Database, WTO Database, GHS Index Website

Model 4 has quite interesting result as trade freedom, global health preparedness level, import and export variables show higher covariates values in aggregated model when compared to Model 1 and Model 3. Assessing adjusted R squared value, which gives good indication how much variation is explained by model, Model 4 is slightly better option to explain with 34% of variability of the response data around its mean than other models. Using the data in Table 2, the following multiple regression estimate is obtained:

$$\widehat{Y} = 17.373 - \underset{(0.273)}{1.669} \times \textit{Trade Freedom} - \underset{(0.152)}{0.093} \times \textit{Domestic Biz Regulation} +$$

$$\underset{(0.216)}{0.395} \times\times \textit{Government Size} + \underset{(0.001)}{0.003} \times \textit{Population} + \underset{(0.027)}{0.032} \times \textit{Health Preparedness}$$

$$- \underset{(0.238)}{0.388} \times \textit{Log(Import)} + \underset{(0.134)}{0.126} \times \textit{Log(Export)}$$

Trade freedom variable inevitably influenced both import and export values since it is broader trade-policy measure based on data collected from the International Monetary Fund and World Trade Organization.[25] However, the resulting index captures the general tariff rates and regulatory trade barriers of 2019 and each country's trade and capital policy stance,[26] whereas 2019 PPE export and import value only describes the import and manufacturing size of PPE products. As shown in Annex A, even import and export variables scored relatively high on the VIF test on a Model 3 (Export: 5.1864, Import: 5.1864) and Model 4 (Export: 5.9924 Import: 6.0549) compare to other independent

[25] Gwartney, et al. "Economic Freedom of the World 2019 Annual Report.", *Fraser Institute*, 10, (2019)

[26] Wagner, Patrick and Plouffe, Michael. "Electoral systems and trade-policy outcomes: the effects of personal-vote incentives on barriers to international trade", *Public Choice*, 180, (2018), 333–352.

variables. However, all independent variables scored less than 10 in VIF test, so there are no multicollinearity problems in all models.

Overall, the model analysis shows that if countries have more conservative stance in terms of trade or moreover, they are not the main PPE product importer, they are less likely to impose higher PPE tariffs than others. The global health security index also suggests that there is a positive correlation between PPE MFN tariffs and GHS index.

5 Conclusion

This study aimed to research economic and public health indicators affecting the PPE tariff rate of countries by measuring trade freedom, government size, domestic business regulation, population, global health preparedness level and the export and import size of PPE products. The results of this analysis show that the trade openness is predictive of the PPE tariff rate ($p < 0.001$). Specifically, an increase of one point of countries' trade openness index is associated with a decrease of 1.669 PPE tariff rate (%). This result indicates that countries general tariffs, non-tariff measures, compliance costs for trade, black-market exchange rates, financial openness and, foreign labor immigration policies have largely affected PPE tariff rates in 2020. One point of domestic business regulations is associated with a decrease of 0.093 % of the PPE tariff rate. However, a one-point increase in government size index is associated with a 0.395% increase in tariffs rate ($p<0.01$). This is an interesting result that government size, which includes government consumption, transfers investment, and top marginal tax rate is the second highest indicator in the final model. This result can be interpreted by the fact that countries with a

big government system tend to pose high tariffs to secure their domestic needs during the pandemic. Another thing to note in the model's results is that countries are unlikely to pose a high tariff if they are large importers where they rely on other trading countries' manufacturing system. In Model 4, 1% increase of export size is associated with a 0.1266 % increase of the PPE tariff rates whereas 1% increase of import size is associated with 0.388 decrease of PPE tariffs. Which means, countries are likely to pose higher tariffs if they are a large exporter of PPE products. Furthermore, health preparedness levels have a relatively minimal positive impact as a one point of the health security level increase is associated with a 0.032% increase of the PPE tariff rate, compared to other economic predictors. This new development contradicts previous supposition since the general assumption is that countries with high health preparedness levels are less likely to build trade boundaries to protect their domestic medical supplies needs during the COVID-19 pandemic. Even countries with high health preparedness levels still need to secure their domestic needs due to lack of supplies in this unprecedented pandemic crisis. The population variable, in general, does not have a significant impact on the PPE tariff rates unless countries have above one billion citizens in total population.

A limitation this study faces is that even though this research investigates current issues, it is too premature to generalize that economic indices impact more than health preparedness to determine the PPE tariff rates. As stated in the beginning of this research, the COVID-19 crisis is a very unprecedented incident that impacts on both the global economy and the public health policy unlike previous major pandemics. This study only investigated the relationship between 2019 trade openness and economic policy data with 2020 tariff rate. There might be staggered impact from the previous economic situation

before the COVID-19 pandemic. It is challenging to conclude whether the public health policy of various countries will be a major predictor of PPE tariff rates in the long term.

Many trade and policy researchers point out that the trade will serve as a powerful tool, suggesting that lawmakers in countries should develop the policies that aim to stimulate domestic production and also facilitate international trade of PPE. They suggest that trade barriers in place limit access to PPE products and make them unnecessarily costly. Future studies should focus on whether these PPE tariffs and non-tariff measures[27] are effective in terms of securing domestic needs and preventing the global pandemic. This study can help to understand what predictor impacted the PPE tariff rate as an initial response of the COVID-19 crisis.

[27] Sithanonxay, "Tackling COVID-19 in ASEAN: Sustain an Open Trade Policy on Personal Protective Equipment."

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7 Appendices

Appendix A

Table 1-VIF Test

	Model 1	Model 2	Model 3	Model 4
Trade Freedom	1.1236	1.5156		1.6188
Domestic Business regulation	1.0949	1.1810		1.3814
Government Size	1.0017	1.0407		1.0412
Population	1.0305	1.0531		1.1695
Global Health Security Index		1.6161		2.8069
Log(Import)			5.1864	6.0549
Log(Export)			5.1864	5.9924

Notes: As a general rule, a vif>10 indicates a multi-collinearity problem[28].

Appendix B

Table 2-List of PPE Product's' HS code

PPE Sub-category	HS 2017 Code
Pharmaceuticals	300213, 300214, 300215, 300219, 300220, 300310, 300320, 300331, 300339, 300341, 300342, 300343, 300349, 300360, 300390, 300410, 300420, 300431, 300432, 300439, 300441, 300442, 300443, 300449, 300450, 300460, 300490
Medical Supplies	220710, 284700, 300120, 300190, 300212, 300290, 300510, 300590, 300610, 300620, 300630, 300650, 300670, 340212, 340213, 350400, 350790, 370110, 370210, 380894, 382100, 382200, 392620, 401490,

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	401511, 301519, 701710, 701720, 701790, 901831, 901832, 901839
Medical Equipment	841920, 901050, 901110, 901180, 901811, 901812, 901813, 901814, 901819, 901820, 901890, 901920, 902150, 902212, 902214, 902219, 902221, 902229, 902230

Source: World Trade Organization

8. Curriculum Vitae

Minsun Song is a candidate for a Master of Science degree in Data Analytics and Policy with a concentration in statistical analysis in Johns Hopkins University. She holds a Bachelor of Arts degrees in Communication and English literature major from Yonsei University in South Korea, where she focused her study on journalism and government PR. She is currently working for Samsung Electronics America's Public Affairs team based in Washington, D.C. With an interest in the future technology and international relations, she hopes to develop a new set of data analytic skills to benefit her career in government, non-profit and multinational organization.