Hacettepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi
Hacettepe University Journal of Economics and Administrative Sciences

https://dergipark.org.tr/tr/pub/huniibf
ISSN:1301-8752 E-ISSN:1309-6338

Başvuru Tarihi / Submission Date: 03/04/2021
Kabul Tarihi / Acceptance Date:27/11/2021

DOI: 10.17065/huniibf.909154
2021, 39(Covid 19 Özel Sayısı), 109-122

Araştırma Makalesi / Research Article

Non-Pharmaceutical Interventions and Their Economic Effects During the Covid-19 Pandemic

Barbaros Güneri[1]

Abstract

This paper evaluates the relationship between economic activity and non-pharmaceutical interventions implemented during the COVID-19 pandemic for 29 countries for the period between March 2020 and November 2020. Using industrial production as a proxy for economic activity and employing a dynamic panel data methodology to deal with the possible endogeneity problem, the empirical results suggest that non-pharmaceutical interventions negatively affect economic activity. Furthermore, this paper also contributes to the literature by analyzing the link between economic support provided by governments and economic activity during the pandemic. The findings indicate that governments can stabilize the decline in economic activity stemmed from non-pharmaceutical interventions by increasing the amount of economic support to households.

Keywords: *Non-pharmaceutical Interventions, COVID-19, Economic Activity, industrial production, dynamic panel data.*

Covid-19 Pandemi Sürecinde Uygulanan Farmakolojik Olmayan Yöntemler ve Ekonomik Etkileri

Öz

Bu makale, Mart 2020 ve Kasım 2020 arasındaki dönem ve 29 ülke için COVİD-19 salgını sırasında uygulanan farmakolojik olmayan yöntemler ile iktisadi faaliyet arasındaki ilişkiyi incelemektedir. Endüstriyel üretimi iktisadi faaliyet için bir vekil olarak kullanarak ve olası içsellik sorunuyla başa çıkmak için dinamik panel veri metodolojisinden yararlanılarak elde edilen ampirik sonuçlar, farmakolojik olmayan yöntemlerin iktisadi faaliyeti olumsuz etkilediğini göstermektedir. Ayrıca bu makale, salgın sırasında hükümetler tarafından sağlanan ekonomik destek ile iktisadi faaliyet arasındaki bağlantıyı analiz ederek de literatüre katkıda bulunmaktadır. Bulgular, hükümetlerin farmakolojik olmayan yöntemlerden kaynaklanan iktisadi faaliyetteki düşüşü hane halklarına sağladıkları ekonomik destek miktarını artırarak dengeleyebileceklerini göstermektedir.

Anahtar Kelimeler: *Farmakolojik olmayan yöntemler, COVİD-19, iktisadi faaliyet, endüstriyel üretim, dinamik panel very****.***

[1] Arş. Gör.Dr., Çankırı Karatekin Üniversitesi İktisadi ve İdari Bilimler Fakültesi İktisat Bölümü, barbarosguneri@karatekin.edu.tr, https://orcid.org/0000-0003-1341-9380

INTRODUCTION

The world was shocked when a new highly contagious coronavirus, namely COVID-19, appeared in China in December 2019. Although China took strict precautions against the spreading of the virus, such as lockdowns, curfews, school closings, and travel restrictions, it has rapidly spread around the globe. By the end of February 2021, there were almost 115 million cases and more than 2.5 million deaths around the world. Many Eastern countries were relatively more prepared for such a pandemic since these countries have experienced similar diseases like SARS or MERS in previous years. Thus, they rapidly developed various measures such as contact tracing and substantial testing activity; on the other hand, Western Countries could not respond to the pandemic as fast and effective as Eastern countries (Demirguc-Kunt, Lokshin and Torre, 2020). Until the vaccination policy is effectively implemented, only precaution(s) against the pandemic is to restrict the activities of people.

The spread of the virus has resulted in severe precautions and restrictions around the globe. As a result, many countries have experienced sharp decreases in growth and employment rates. Financial markets faced up with great uncertainty, supply chain activities have been constrained and household consumption expenditures have decreased significantly during the pandemic. Such restrictions and precautions can be defined as Non-pharmaceutical Interventions (NPIs). According to the Centers for Disease Control and Prevention (CDC) NPIs can be defined as *"actions, apart from getting vaccinated and taking medicine, that people and communities can take to help slow the spread of illnesses like pandemic influenza (flu). NPIs are also known as community mitigation strategies. "(CDC,* 2020: Par: 1) Main purpose of these restrictions is to flatten the curve, which means limiting the daily cases so that hospitals and medical systems around the world operate properly and offer quality services to patients. The empirical evidence from China (Kraemer *et al*., 2020) and a group of countries (Deb, Furceri, Ostry, and Tawk,2020b) showed that NPIs help flatten the curve and diminish the number of infections. However, these restrictions also dampened the economic activity. Coibion, Gorodnichenko, and Weber (2020a) stated that it is not the infections, but the containment measures that cause a decrease in consumption, employment and economic activity. According to Brodeur, Gray, Islam, and Bhuiyan (2021), NPIs have crucial impacts on economic activity and these impacts depend on the strictness, duration, and compliance of these containment measures.

This paper attempts to analyze these issues empirically and aims to contribute to the literature on the economic effects of containment measures by examining the link between NPIs and economic activity. To this end, the data for NPIs are collected from the Oxford University Government Response Tracker of the Blavatnik School of Government (BSG) to measure the strictness of NPIs in a group of countries. This database has a total of 20 indicators under 3 different sections (containment and closure policies, economic policies, and health policies) about the governments' policy responses against the pandemic. To make the data more practical, BSG also calculates 3 indices (government stringency index, containment and health index, and economic support index) using various indicators that reflect the general response of governments to the pandemic. In particular, this paper tries to estimate the relationship between these indices and economic activity.

Specifically, there are three main contributions of this paper to the literature. First of all, majority of the existing literature (Deb *et al.* 2020a; Demirgüç-Kunt et al. 2020; Kok, 2020; König and Winkler, 2020) examined the relation between NPIs and economic activity by using OLS, fixed effects or instrumental variables technique. However, this paper employs a dynamic panel data methodology to control for possible endogeneity problem and also to account for the dynamic nature of the relationship between NPIs and economic activity. Secondly, this paper proxies the economic activity by industrial production. A strand of the existing literature (Deb *et al.* 2020a; Demirgüç-Kunt *et al*. 2020) proxied the economic activity by electricity consumption, mobility trends, or nitrogen dioxide emissions. Another strand of the literature used quarterly growth rates for the first and second quarters of 2020 (König and Winkler, 2020; Kok, 2020). However, considering the fact that lockdowns mostly started around the globe in March 2020, using quarterly growth might yield biased estimates. Therefore, monthly industrial production data from the OECD is used in this paper to capture the economic activity. Last but not least, this paper contributes to the literature by evaluating the effects of economic support provided by governments during the pandemic to mitigate the unfavorable impacts of containment measures. To measure economic support, the economic support index calculated by BSG is used in this paper. This index mainly measures income support provided by governments and debt relief. The empirical results suggest that NPIs negatively affect economic activity, which is measured by industrial production. Furthermore, the results show that economic measures taken by governments help strengthen economic activity and improve industrial production.

The rest of the paper is organized as follows: The first section briefly reviews how COVID-19 pandemic could affect economic activity and discusses the related literature, section two explains the data and the methodology, section 3 presents estimation results, and finally, section four offers conclusion and policy implications.

1. COVID-19, ECONOMIC ACTIVITY AND RELATED LITERATURE

Global pandemics cause economic activities to slow down, especially in the short run. Jonas (2013) argued that countries are interconnected via travel, trade, and capital movements, thus pandemics can cause a worldwide shock by a sudden decrease in demand and supply shocks or social disturbances. Carlsson-Szlezak, Reeves, and Swartz (2020) argued that there are several mechanisms by which the COVID-19 pandemic could affect economic activity. First of all, there is an indirect impact on consumers through financial markets since household wealth and thus consumption decreases during a pandemic. Secondly, there is a direct impact, which worsens future expectations so that households avoid unessential spending and furthermore a pandemic makes consumers pessimistic about economic conditions. Finally, since the supply chain does not work properly, and demand is expected to fall, there might be decreases in industrial production as well as labor supply.

According to Gourinchas (2020), the global economy is a highly complex system and every single part of the economy, i.e., consumers, producers, banks, financial institutions, firms, etc. is connected via various channels; thus, a global shock would affect all these parts. Gourinchas (2020) also argued that there are mainly three channels how a worldwide pandemic influences economic activity. The first one is the medical channel, which suggests that sick people cannot contribute to the economy. The second one is the effects of precautions and restrictions against the pandemic, which slows down the economic and social activity. Lastly, the third one is expectations, which makes individuals more risk-averse and cuts back spending.

There have been many attempts to analyze the effects of the pandemic on economic outcomes. Several papers concentrated on the impact of the pandemic on labor markets (Adams-Prassl *et al*., 2020; Coibion *et al.,* 2020b, Dingel and Neiman, 2020, Kahn, Lange and Wiczer, 2020) and the effects of pandemic on gender and racial inequality (Fairlie, Couch, and Xu, 2020; Bartos, Bauer, Cahlikova, and Chytilová, 2020; Forsythe, 2020; Yasenov, 2020). There are also numerous studies which examined the impact on financial markets (Albulescu, 2021; Sansa, 2020; Zhang, Hu and Ji, 2020), the determinants and implications of social distancing (Maloney and Taskin, 2020; Sheridan *et al.,* 2020; Farboodi *et al*., 2021) the effectiveness of fiscal and monetary policies during the pandemic (Benmelech and Tzur-Ilan, 2020; Bhar and Malliaris, 2020; Casado *et al*., 2020).

This paper, on the other hand, concentrates on another strand of the literature and examines the relationship between policy responses of governments against the pandemic and economic activity and follows upon the works of Demirgüç-Kunt *et al.* (2020), Deb *et al*. (2020a), Kok (2020) and König and Winkler (2020). Demirgüç-Kunt *et al.* (2020) analyzed the economic impacts of NPIs on economic activity by using high-frequency proxies such as electricity consumption and nitrogen dioxide emission using fixed effects and instrumental variables (IV) methodology and found that NPIs cause a decrease in economic activity about 10 percent. Similarly, Deb *et al.* (2020a) proxied the economic activity by various indicators such as Nitrogen Dioxide (NO2) emissions, energy consumption, or mobility indices and showed that NPIs negatively affect economic activity. Moreover, they also found that effective implementation of monetary and fiscal policy instruments helps to reduce the economic costs of NPIs. König and Winkler (2020) examined the impact of social distancing on economic performance for a sample of 46 countries using OLS, IV, and fixed effects for the first and second quarters of 2020 and argued that voluntary and mandatory distancing leads to a decrease in economic growth. Kok (2020) also found that NPIs lower the economic activity by using quarterly growth rates for 106 countries for the first two quarters of 2020; however, the negative effect of NPIs differs between Advanced and Developing Economies.

2. DATA AND METHODOLOGY

2.1. Data

To capture the economic performance and activities of countries, the industrial production index (IPI) is used as the dependent variable. While economic growth might be a better index to capture the economic activity, it is unfortunately not available on a monthly basis. The data for IPI comes from the OECD database (Organization for Economic Development and Cooperation (OECD), 2020) and it captures the total output in mining, manufacturing, electricity, gas, and steam. In addition, this paper also includes the change in industrial production relative to the previous year as a second measurement. Although Stanger (2020) argued that industrial production has its weaknesses in measuring the economic activity since it does not take into account the service activities, the era of COVID-19 has resulted in a sharp decline in services globally. As it is stated by the United Nations Conference on Trade and Development (UNCTAD) (2020), services trade is expected to fall by 15.4% in 2020 compared to 2019, which is the highest decline in history. Moreover, industrial production not only has shown a strong co-movement with growth (Fulop and Gyomai, 2012) and has also been used as an indicator for economic activity and growth (see Bernanke, Gertler, Watson, Sims, Friedman, 1997; Grilli and Roubini, 1996; Hatmanu, Căutişanu and Ifrim, 2020). Therefore, industrial production is proven to be a robust index in measuring economic activity, especially throughout the COVID-19 pandemic.

In terms of the NPIs, Oxford BSG data has three main groups which indicate a different measure on lockdowns. The first one is containment and closure policies, the second one is the economic policies, and the third one is the health policies. All these policies have several sub-sections, which take various values depending on restrictions. Oxford BSG data brings together these values to generate different indexes as an indicator of how strict lockdown/restriction policies are. This paper uses three different indexes from these measures to capture the strictness of governments' responses throughout the pandemic. The first one is the government stringency index, the second one is the containment and health index, and the third one is the economic support index.

Government Stringency Index is calculated by taking into account nine policy measures, and they are: Closing of schools-universities, closing of workplaces, closing of public transportation, restrictions on domestic movements, restrictions on international travel, stay at home requirements, limits on social gatherings, cancellation of public events and public information campaigns. Containment and Health Index mainly builds on Stringency Index, but also includes additional measures such as testing policy, contact tracing, facial coverings, vaccination policy and protection of elder people. Oxford BSG database calculates each of these policy measures ordinally and then combines them into stringency and containment and health index. The values of these indices vary between 0 and 100, where 100 means the strictest policy. Economic support index is calculated by taking into account two metrics: Income support for households and debt or contract relief. These indexes are measured on a daily basis; thus, monthly averages are calculated to employ them in the regression analysis.

For macroeconomic control variables, two different monthly indicators such as long-run interest rates and nominal exchange rates are used. An increase in interest rates, in general, is expected to lower the output or GDP growth. For example, both neo-Keynesian models (Wickens, 2012) and the neoclassical theory (Haavelmo, 1960) argued that higher interest rates cause higher cost of capital and thus dampens economic activity. In addition, real business cycle theory (Kydland and Prescott, 1982) also suggests that a rise in interest rates could yield to a decrease in labor supply and thus reduces output growth. Hansen and Seshadri (2013) found that interest rates have a negative effect on productivity growth, and Hatmanu *et al*., (2020) noted that there is a negative relationship between interest rates and industrial production.

Nominal exchange rate is also included in the model. Exchange rate alters production through international trade and might affect industrial production depending on firms' production structure. Dhasmana (2013) argued that appreciation in exchange rate may benefit firms if they have a high dependence on imports by decreasing variable costs and vice versa. Rodrik (2007) stated that exchange rate appreciation could lead to a scarcity of foreign currency, large trade deficits, corruption, and balance of payment crises. Thus, undervaluation of currency is expected to boost growth; however, Rodrik (2007) also found that undervaluation increases economic growth only in developing countries, but not in rich/developed ones. Considering the fact that the country sample in this paper is mostly limited to OECD Countries and most of them are relatively richer, the effects of exchange rate on industrial production seems ambiguous. The variables, their brief definitions, and sources can be found in Table A1 in the Appendix.

The summary statistics of the data can be found below in Table 1. The statistics show that the volume of the industrial production decreased compared to the previous year as expected. The minimum and maximum values of stringency and containment and health indexes fluctuate significantly, which indicates that some countries took almost all the possible precautions, whereas some of them took very little action(s) during the period between March 2020 and November 2020.

Table 1: Summary Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Total Ind. Prod.	260	100.1049	12.4935	59.59503	135.4113
Change in Ind. Prod.	261	6.82468	10.46973	-43.346	41.68399
Government Stringency	261	58.5033	15.20676	24.909	92.59433
Economic Support	261	67.2182	24.45246	0	100
Exchange Rate	261	85.86146	259.9113	0.757051	1229.057
Interest Rate	261	0.905912	2.206329	-0.61524	16.272
Containment and Health	261	55.02137	11.76925	22.82033	82.977

Table A2 in the appendix shows the ranking of countries in terms of the stringency index. Recall that one of the most affected countries from COVID-19 is Italy, especially when the virus was spreading rapidly among Europe in March and April 2020. Accordingly, the maximum value of stringency index belongs to Italy in April 2020, and the minimum value belongs to Luxembourg in July 2020. Taking the averages of the indexes between the period March 2020 and November 2020 shows that Chile is ranked number 1 in both stringency index and containment and health index. On the other hand, United Kingdom ranked number 1 on economic support index.

Table 2 below shows the correlation between variables. Since the correlation is high between stringency and containment and health index as expected, the effects of these indices on industrial production are evaluated on different models.

Table 2: Correlation Table

	Total Ind. Prod.	Change in Ind. Prod.	String ency	Economic Support	Exchange Rate	Interest Rate	Containment and Health
Total Ind. Prod.	1						
Change in Ind. Prod.	0.8236	1					
Government Stringency	-0.3560	-0.3154	1				
Economic Support	-0.0733	-0.0657	0.2220	1			
Exchange Rate	0.0616	0.1264	0.0194	-0.1618	1		
Interest Rate	0.2038	0.142	0.1341	-0.0705	0.1476	1	
Containment and Health	-0.2585	-0.1988	0.9107	0.3404	0.0687	0.1652	1

2.2. Methodology

The empirical analysis is based on a panel of 29 countries for the period between March 2020 and November 2020. The empirical model can be written as follows:

$$INDPRO_{i,t}=\beta_0 + \beta_1 INDPRO_{i,t} +\beta_2 NPI_{i,t} + \beta_3 ECO_{i,t} + \beta_4 X_{i,t} + \mu_i + \varepsilon_{i,t} \quad (1)$$

where INDPRO represents industrial production, NPI is the Nonpharmaceutical Interventions such as stringency index or containment and health index, ECO represents economic support index, X is a vector of macroeconomic control variables such as exchange rates or interest rates, μ is the individual fixed effects and ε is the error term. Although the easiest way to estimate the above equation is the Ordinary Least Squares (OLS), it might cause several problems such as autocorrelation, endogeneity of explained variables and omitted variable bias because of the unobservable country specific effects (Voitchovsky, 2005). To overcome these issues, the preferred estimation technique is the dynamic panel data methodology proposed by Arellano and Bover (1995) and Blundell and Bond (1998). Dynamic panel data consists of two methods: difference and system GMM. Between these methods, system GMM is superior to difference GMM, since it generates a decline in finite sample bias and also allows precision gains because of the extra moment conditions (Bond *et al.,* 2001). Thus, system GMM estimation may be considered as an expansion of difference GMM, since it extracts more information (Voitchovsky, 2005). Therefore, the above equation is estimated by system GMM methodology. Taking the first differences of the above equation to remove the fixed effects yields the equation below:

$$\Delta INDPRO_{i,t} = \beta_0 + \beta_1 \Delta INDPRO_{i,t-1} + \beta_2 \Delta NPI_{i,t} + \beta_3 \Delta ECO_{i,t} +\beta_3 \Delta X_{i,t} + \mu_i + \Delta\ \varepsilon_{i,t} \quad (2)$$

System GMM estimation uses two types of instruments, GMM-style, or IV-style. GMM style instruments are constructed in Arellano-Bond sense and use lagged values of the variables in levels, whereas IV-type instruments use variables themselves as instruments (Mileva, 2007). To obtain consistent and unbiased estimates of the above equation, two post estimation tests suggested by Arellano and Bond

(1991), Arellano and Bover (1995) and Blundell and Bond (1998) should also be examined. The first one is AR (2) test, and the null hypothesis is that there is no serial correlation. The second one is the Hansen test, which is an over identification test for instruments and the null hypothesis of the Hansen test is that the group of instruments are exogenous (Mileva, 2007). Furthermore, as Roodman (2009) argues, to avoid biased estimates and a weak Hansen test, the numbers of instruments are also controlled during estimations.

3. ESTIMATION RESULTS

Table 3 below shows the estimation results of the above empirical model. In the first and third columns, the dependent variable is the total industrial production, whereas in the second and fourth columns, the dependent variable is the change in industrial production relative to the previous year. The third and fourth columns also include containment and health index instead of the stringency index as a robustness check.

Lagged dependent variables (lagged total industrial production and change in industrial production) have a positive and significant effect on industrial production as expected. Among our main variables of interest, stringency and containment and health indexes are found to have a negative impact on industrial production, in line with the findings of Demirgüç-Kunt *et al*. (2020), Deb et al. (2020a), and König and Winkler, (2020). Similar to our results, Demirgüç-Kunt *et al*. (2020) found that NPI's lower the economic activity measured by electricity use or emissions. Furthermore, Deb et al. (2020a) also showed that containment measures cause a decrease in economic activity as well as industrial production. Moreover, König and Winkler (2020) argued that stringency index decreases growth rates. These findings suggest that when restrictions get stricter, industrial production and thus economic activity declines. Recall that stringency index includes precautions such as workplace closings, travel restrictions, school closings and cancelling major events, and thus it mainly is a social distancing measurement. Hence, an increase in this index means a decline in consumption, and of course in aggregate demand. In turn, producers anticipate the decrease in demand, which motivates them to decrease production and thus economic activity slows down. Containment and health index is also very similar to stringency index, but in addition to restrictions and closings, it includes other measures such as testing policy and contract tracing. Similar to stringency index, an increase in containment and health index also yields a decrease in industrial production.

Table 3: Estimation Results

VARIABLES	(1) Total Ind. Prod.	(2) Change in Ind. Prod.	(3) Total Ind. Prod.	(4) Change in Ind. Prod.
L.Total Ind. Prod.	0.972***		0.968***	
	(0.050)		(0.051)	
Government Stringency	-0.245***	-0.278***		
	(0.039)	(0.041)		
Economic Support	0.247***	0.194***	0.192***	0.151***
	(0.063)	(0.036)	(0.058)	(0.042)
Exchange Rate	0.005*	0.005*	0.004**	0.005***
	(0.003)	(0.003)	(0.002)	(0.002)
Interest Rate	-0.408	-0.110	-0.300	-0.086
	(0.477)	(0.593)	(0.515)	(0.646)
L.Change in Ind. Prod.		0.620***		0.670***
		(0.044)		(0.043)
Containment and Health			-0.180***	-0.230***
			(0.048)	(0.053)
AR(2) z value	-1.66	-0.40	-1.74	-0.53
AR(2) p value	0.096	0.693	0.081	0.593
Hansen test statistic	24.07	25.84	23.47	24.11
Hansen test p value	0.088	0.056	0.102	0.087
Observations	231	232	231	232
Number of Inst.	21	21	21	21
Number of country	29	29	29	29

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: The estimations are done in STATA, using the syntax xtabond2 by Roodman (2009). Instrument matrix is collapsed and GMM type instruments are used for all variables.

In terms of economic support, the empirical results suggest that economic support index has a positive and significant impact on industrial production. Because this index includes various incentives for consumers such as income support or debt relief, which aims to stimulate spending, the policies that support households economically help mitigate the economic impacts of the pandemic. Similar to this paper but using a different economic indicator, namely fiscal stimulus data from the IMF policy tracker, Deb *et al*. (2020a) also argued that fiscal stimulus, measured as a percentage of GDP, could reduce the negative impacts of NPIs.

In terms of macro-economic control variables, it is found that nominal exchange rates have a positive impact on industrial production. The literature has somewhat ambiguous results on the relationship between these two variables. For example, Akinlo and Lawal (2015) argued that depreciation in exchange rate has no short-run effects on production but has a positive impact on the long run. Habibi (2019) showed that exchange rate appreciation increases the production of the sectors in which firms use a high ratio of imported goods for their exports, but depreciation in the exchange rate positively affects the production of consumer goods if firms do not use any imported goods for export. Therefore, it can be concluded that the majority of the firms in the selected country sample mostly use imported goods for exports. In terms of the relationship between interest rates and industrial production, although the effect is negative, it is found to be insignificant.

4. CONCLUSION

The COVID-19 outbreak in 2020 has resulted in severe health conditions as well as economic and social costs. Without an effective vaccination policy, NPIs seem to be the only precaution against the pandemic. This paper evaluates whether and how NPIs -restrictions implemented to slow down the spread of COVID-19 pandemic- affected economic activity on a selected group of countries. For this purpose, government policy responses data about the social distancing and economic and health policies are obtained from the Oxford COVID-19 Government Response Tracker, which illustrates how strict measures governments have taken. This database uses several indicators to calculate the strictness of measures and creates two indexes, namely government stringency index and containment and health index. Moreover, an economic support index that measures income support and debt/contract relief is also included into the model to control for the economic support provided by governments during the pandemic. In addition to these indexes, this paper proxies the economic activity by industrial production and includes nominal exchange rate and monthly interest rates data from the OECD database to account for macroeconomic trends. The results suggest that both stringency index and containment and health index decrease industrial production, thus it can be concluded that containment measures cause a decline in economic activity. On the other hand, the results reveal that economic support index contributes significantly in terms of declining the economic impact of the pandemic.

Although governments impose restrictions to ease down the medical effects of the pandemic and flatten the curve, these restrictions might result in severe economic costs. Accordingly, the results of the empirical model suggest that as governments take more precautions and increase the restrictions on social activity and distance, economic activity, i.e., industrial production in countries slows down. However, at the same time, governments are aware of the economic costs of the pandemic and to diminish its economic impact, they also took economic precautions such as income support or debt relief. These precautions are measured mainly by economic support index in this paper, and the results show that this index has a positive impact on economic activity. Thus, governments could mitigate these negative effects by increasing the amount of economic support to their citizens. Moreover, the results also indicate that nominal exchange rate has a positive impact on industrial production, whereas interest rates have no significant effects. It can be concluded from these results that if governments can effectively canalize economic support to their citizens, slowdown in economic activity caused by NPIs can be reduced and countries could overcome the economic burden of COVID-19 in moderation.

AUTHOR STATEMENT

Research and Publication Ethics Statement

This study has been prepared in accordance with the ethical principles of scientific research and publication.

Author Contribution

The author performed the whole study alone.

Conflict of Interest

There is no conflict of interest arising from the study for the authors or third parties.

REFERENCES

Adams-Prassl, A. T. Boneva, M. Golin, C. Rauh (2020), “Inequality in the Impact of the Coronavirus Shock: Evidence from Real Time Surveys”, Journal of Public Economics, 189, 104245.

Akinlo, O. O., Q. A. Lawal (2015), “Impact of Exchange Rate on Industrial Production in Nigeria 1986-2010”, International Business and Management, 10(1), 104-110.

Albulescu, C. T. (2021), “COVID-19 and the United States Financial Markets’ Volatility”, Finance Research Letters, 38, 101699.

Arellano, M., S. Bond (1991), “Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations”, The Review of Rconomic Studies, 58(2), 277-297.

Arellano, M., O. Bover (1995), "Another Look at the Instrumental Variable Estimation of Error-Components Models", Journal of Econometrics, 68(1), 29-51.

Bartos, V., M. Bauer, J. Cahlikova, J. Chytilová (2020), "COVID-19 Crisis Fuels Hostility against Foreigners", IZA Discussion Paper No. 13250, Institute of Labor Economics, Bonn, Germany.

Benmelech, E., N.Tzur-Ilan (2020), "The Determinants of Fiscal and Monetary Policies During the COVID-19 Crisis", NBER Working Paper No. 27461. National Bureau of Economic Research, Cambridge, MA.

Bernanke, B. S., M. Gertler, M. Watson, C. A. Sims, B. M. Friedman (1997), "Systematic Monetary Policy and the Effects of oil Price Shocks", Brookings Papers on Economic Activity, 1997(1), 91-157.

Bhar, R., A. G. Malliaris (2020), "Modeling US monetary Policy During the Global Financial Crisis and Lessons for Covid-19", Journal of Policy Modeling, 43(1), 15-33.

Blundell, R., S. Bond (1998), "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models", Journal of econometrics, 87(1), 115-143.

Bond, S., A. Hoeffler, J. Temple (2001), "GMM Estimation of Empirical Growth Models", Discussion Paper No. 2048, Centre for Economic Policy Research.

Brodeur, A., D. Gray, A. Islam, S. Bhuiyan (2021), "A literature Review of the Economics of COVID-19". Journal of Economic Surveys, 35(4), 1007-1044.

Carlsson-Szlezak, Phillip, M Reeves, P. Swartz (2020), "What Coronavirus Could Mean for the Global Economy", Harvard Business Review, https://hbr.org/2020/03/what-coronavirus-could-mean-for-the-global-economy

Casado, M. G., B. Glennon, J. LaneMcQuown, D. Rich, B. A. Weinberg, (2020), "The Effect of Fiscal Stimulus: Evidence from COVID-19", NBER Working Paper No. w27576, National Bureau of Economic Research, Cambridge, MA.

Centers for Disease Control and Prevention (2020), Nonpharmaceutical interventions (npis). Centers for Disease Control and Prevention, https://www.cdc.gov/nonpharmaceutical-interventions/index.html, (Accessed on 15 March 2021).

Coibion, O., Y. Gorodnichenko, M. Weber (2020a), "The Cost of the Covid-19 Crisis: Lockdowns, Macroeconomic Expectations, and Consumer Spending", NBER Working Paper No. w27141. National Bureau of Economic Research, Cambridge, MA.

Coibion, O., Y. Gorodnichenko, M. Weber (2020b), "Labor Markets During the COVID-19 Crisis: A Preliminary view", NBER Working Paper No. w27017, National Bureau of Economic Research, Cambridge, MA.

Deb, P., D. Furceri, J. D. Ostry, N. Tawk (2020a), "The Economic Effects of Covid-19 Containment Measures", CEPR Discussion Paper No. DP15087, Available at SSRN: https://ssrn.com/abstract=3661431

Deb, P., D. Furceri, J. D. Ostry, N. Tawk (2020b), "The Effect of Containment Measures on the COVID-19 Pandemic", CEPR Discussion Paper No. DP15086, Available at SSRN: https://ssrn.com/abstract=3661430

Demirguc-Kunt, A. M. Lokshin, I. Torre (2020), "The Sooner, the Better: The Early Economic Impact of Non-Pharmaceutical Interventions During the COVID-19 Pandemic", World Bank Policy Research Working Paper, (9257).

Dhasmana, A. (2013), "Real Effective Exchange Rate and Manufacturing Sector Performance: Evidence from Indian Firms", IIM Bangalore Research Paper, (412).

Dingel, J. I., B. Neiman (2020), "How Many Jobs Can Be Done at Home?", Journal of Public Economics, 189, 104235.

Fairlie, R. W., K. Couch, H. Xu (2020), "The Impacts of COVID-19 on Minority Unemployment: First Evidence from April 2020 CPS microdata", NBER Working Paper No. w27246, National Bureau of Economic Research, Cambridge, MA.

Farboodi, M., G. Jarosch, R. Shimer (2021), "Internal and External Effects of Social Distancing in a Pandemic", Journal of Economic Theory, 196, 105293.

Forsythe, E. (2020), "Labor Market flows and the Covid-19 Economy", Available at SSRN: https://ssrn.com/abstract=3586074, Accessed on March, 2021.

Fulop, G., G. Gyomai (2012), "Transition of the OECD CLI system to a GDP-based business cycle target", OECD background note, Available at: http://www.oecd.org/std/leading-indicators/49985449.pdf, Accessed on January, 2021.

Gourinchas, P. O. (2020), "Flattening the Pandemic and Recession Curves", Mitigating the COVID Economic Crisis: Act Fast and Do Whatever, 31, 57-62.

Grilli, V., N. Roubini (1996), "Liquidity Models in Open Economies: Theory and Empirical Evidence", European Economic Review, 40(3-5), 847-859.

Haavelmo, T. (1960), A Study in the Theory of Investment, Chicago, Univ. Chicago Press

Habibi, A. (2019), "Non-Linear Impact of Exchange Rate Changes on US industrial Production", Journal of Economic Structures, 8(1), 1-17.

Hale, T., N., Angrist, R. Goldszmidt, B. Kira, A. Petherick, T. Phillips, H. Tatlow (2021), "A Global Panel Database of Pandemic Policies (Oxford COVID-19 Government Response Tracker)", Nature Human Behaviour, 5(4), 529-538.

Hansen, B., A. Seshadri (2013), "Uncovering the Relationship Between Real Interest Rates and Economic Growth", Michigan Retirement Research Center Research Paper, (2013-303).

Hatmanu, M., C. Căutişanu, M. Ifrim (2020), "The Impact of Interest Rate, Exchange Rate and European Business Climate on Economic Growth in Romania: An ARDL Approach with Structural Breaks", Sustainability, 12(7), 2798.

Jonas, O. (2013), "Pandemic Risk", World Development Report Background Papers, World Bank, Washington, DC, https://openknowledge.worldbank.org/handle/10986/16343, Accessed on January, 2021.

Kahn, L., F. Lange, D. Wiczer (2020), "Labor Demand in the Time of COVID-19: Evidence from Vacancy Postings and UI Claims", NBER working paper, No. w27061, National Bureau of Economic Research, Cambridge, MA.

Kok, J. (2020), "Short-Term Trade-off Between Stringency and Economic Growth", COVID Economics, 60, 172-189.

König, M., A. Winkler (2020), "Monitoring in Real Time: Cross-Country Evidence on the COVID-19 Impact on GDP Growth in the First half of 2020", COVID Economics, 57, 132-153.

Kraemer, M. U., C. H. Yang, B. Gutierrez, C. H. Wu, B. Klein, D. M. Pigott, S. V. Scarpino (2020), "The Effect of Human Mobility and Control Measures on the COVID-19 Epidemic in China", Science, 368(6490), 493-497.

Kydland, F. E., E. C. Prescott (1982), "Time to Build and Aggregate Fluctuations", Econometrica: Journal of the Econometric Society, 1345-1370.

Maloney, W. F., T. Taskin (2020), "Determinants of Social Distancing and Economic Activity During COVID-19: A Global View", World Bank Policy Research Working Paper, (9242).

Mileva, E. (2007), "Using Arellano-Bond Dynamic Panel GMM Estimators in Stata", Economics Department, Fordham University, 64, 1-10.

Organization for Economic Development and Cooperation (2021a), Industrial Production (indicator), doi: 10.1787/39121c55-en, Accessed on 1 March 2021.

Organization for Economic Development and Cooperation (2021b), Exchange Rates (indicator), doi: 10.1787/037ed317-en (Accessed on 1 March 2021).

Organization for Economic Development and Cooperation (2021c), Long-Term Interest Rates (indicator), doi: 10.1787/662d712c-en, Accessed on 1 March 2021.

Rodrik, D. (2007), "The Real Exchange Rate and Economic Growth: Theory and Evidence", John F. Kennedy School of Government, Harvard University.

Roodman, D. (2009), "How to do xtabond2: An Introduction to Difference and System GMM in Stata", The Stata Journal, 9(1), 86-136.

Sansa, N. A. (2020), "The Impact of the COVID-19 on the Financial Markets: Evidence from China and USA", Electronic Research Journal of Social Sciences and Humanities, 2, 29-39.

Sheridan, A., A. L. Andersen, E. T. Hansen, N. Johannesen (2020), "Social Distancing Laws Cause Only Small Losses of Economic Activity During the COVID-19 Pandemic in Scandinavia", Proceedings of the National Academy of Sciences, 117(34), 20468-20473.

Stanger, M. (2020), "A Monthly Indicator of Economic Growth for Low Income Countries", International Monetary Fund Working Papers, 2020(013).

United Nations Conference on Trade and Development (2020, December 9), Covid-19 Drives Large International Trade Declines in 2020, https://unctad.org/news/covid-19-drives-large-international-trade-declines-2020#:~:text=The%20predicted%20decline%20in%20services,services%20trade%20fell%20by%209.5%25, Accessed on March 3, 2021.

Voitchovsky, S. (2005), "Does the Profile of Income Inequality Matter for Economic Growth?", Journal of Economic Growth, 10(3), 273-296.

Wickens, M. (2012), Macroeconomic Theory: A Dynamic General Equilibrium Approach, Princeton University Press.

Yasenov, V. I. (2020), "Who Can Work from Home?", IZA Discussion Paper No. 13197, Available at SSRN: https://ssrn.com/abstract=3590895

Zhang, D., M. Hu, Q. Ji (2020), "Financial markets under the global pandemic of COVID-19", Finance Research Letters, 36, 101528.

APPENDIX

Table A1: Variables, Definitions and Sources

Variable	Definition	Source
Total Industrial Production	"Measures the output of industrial establishments. Includes sectors such as mining, manufacturing, electricity, gas and steam and air-conditioning. 2015 is considered as the base year, where this ratio is equal to 100 in 2015."	OECD
Industrial Production	"Refers to the change in industrial production compared to the same month in the previous year. "	OECD
Stringency Index	"Measures the response of governments in terms of lockdown restrictions and closures through the pandemic."	Hale *et al*., 2021
Containment and Health Index	"Combines lockdown restrictions and closures with measures such as testing policy and contact tracing, short term investment in healthcare, as well investments in vaccine."	Hale *et al*., 2021
Economic Support Index	"Records measures such as income support and debt relief."	Hale *et al*., 2021
Exchange Rate	"Currency exchange rates based on US Dollar monthly average."	OECD
Interest Rate	"Long term interest rates"	OECD

Table A2: Rankings of the Countries in terms of Stringency Index

Rank	Countries	Stringency	Containment and Health	Economic Support
1	Chile	74.7413	66.71682	67.03704
2	Portugal	69.52508	63.59159	59.16667
3	Brazil	68.46615	64.93848	45.64815
4	Israel	67.53107	62.22015	87.70754
5	United Kingdom	66.339	56.69144	93.05556
6	United States	66.03667	62.46344	56.48148
7	Ireland	65.70696	58.18348	91.66667
8	Spain	65.31115	58.206	80.55556
9	Italy	65.157	63.67856	63.14815
10	Canada	64.42189	57.28237	70.83333
11	France	63.42696	60.91985	72.59259
12	Turkey	62.37252	59.94856	70.37037
13	Greece	61.23978	57.21685	65.0463
14	Belgium	60.03033	56.68718	75.41667
15	Germany	59.35293	57.06326	43.7963
16	Netherlands	57.31481	52.99244	77.59259
17	Hungary	56.31626	52.16756	57.77778
18	Sweden	56.07011	47.22355	50
19	Slovenia	55.26611	54.30181	62.31481
20	Denmark	54.38756	49.672	77.36111
21	Poland	53.91022	48.91256	44.62963
22	Austria	53.18315	54.67656	83.7963
23	Slovak Republic	52.76559	53.84119	80.46296
24	South Korea	52.17752	54.9517	45.83333
25	Czech Republic	50.59204	52.05915	67.22222
26	Luxembourg	48.87496	52.09833	92.77778
27	Norway	47.89074	44.24796	36.75926
28	Finland	42.62752	38.03819	63.51852
29	Japan	35.5603	34.62863	66.75926