SOSYAL EKONOMİK ARAŞTIRMALAR DERGİSİ
THE JOURNAL OF SOCIAL ECONOMIC RESEARCH
ISSN: 2148-3043
CİLT VOLUME 21 SAYI ISSUE 1 YIL YEAR 2021

THE EFFECTS OF PANDEMIC DISEASES ON THE WORLD ECONOMY

PANDEMİK HASTALIKLARIN DÜNYA EKONOMİSİNE ETKİLERİ

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Makale Türü
Araştırma Makalesi

Makale Geliş Tarihi
24.06.2020

Makale Kabul Tarihi
12.01.2021

ABSTRACT

Purpose –The purpose of this research is to review the recent literature of epidemics and to evaluate the potential economic effects of COVID-19 pandemic compared with SARS-COV and MERS-COV.
Methodology – Impacts of previous epidemics on income of 16 selected countries were estimated for 2000-2015 within a panel econometric framework.
Findings – SARS-COV has depreciating effects on all economies and its incidence had reduced average per capita income by almost 1.900 Dollars. Effects of MERS-COV were limited due to its contagion area. It has been understood that dispersed epidemics affect economies inversely.
Conclusions – Labour demand of services has been reduced already. However, rising online shopping tendency and potential integration of agro-food and services sectors may lead compensation for the losses. Yet, in the apparent situation it is hard to talk about a potential recovery due to continuously declining income and rising unemployment.
Keywords: COVID-19, income, agriculture, services, labour market
JEL Codes: B22, B23, E21, E24, J21

ÖZ

Amaç –Bu çalışmanın amacı epidemiler ile ilgili geçmiş yazını gözden geçirmek ve COVID-19 pandemisinin olası ekonomik etkilerini SARS-COV ve MERS-COV ile karşılaştırmalı olarak değerlendirmektir.
Yöntem – Önceki epidemilerin 16 seçilmiş ülke gelirine olan etkileri 2000-2015 yılları için panel ekonometrik yöntem çerçevesinde tahmin edilmiştir.
Bulgular – SARS-COV tüm ekonomiler üzerinde daraltıcı etkide bulunmuş ve hastalığın oluşması ortalama kişi başına milli geliri yaklaşık 1.900 dolar azaltmıştır. MERS-COV' un etkileri bulaş alanı nedeniyle sınırlıdır. Yaygın salgın hastalıklarının ekonomiyi negatif yönlü etkilediği anlaşılmıştır.
Sonuç – Hizmetler sektörü işgücü talebi hâlihazırda azalmıştır. Ancak, artan çevrimiçi alışveriş eğilimi ve tarım-gıda ile hizmetler sektörünün olası bütünleşmesi kayıpların karşılanmasını sağlayabilecektir. Buna karşın, süreğen gelir düşüşü ve artan işsizlik nedeniyle mevcut durumda potansiyel bir iyileşmeden bahsetmek zordur.
Anahtar Kelimeler: COVID-19, gelir, tarım, hizmetler, işgücü piyasası
JEL Kodları: B22, B23, E21, E24, J21

1. INTRODUCTION

The new decade of the world had started with a compelling situation. The world had to face a disaster which was forgotten a long time ago. The devastation had entered the world like a recently recognised virus called COVID-19. While history had witnessed many devastating epidemics, the recent cases experienced were limited in terms of geographical dispersion and contagious effects. COVID-19 was encountered in Wuhan district of China at the end of 2019 and it spread to the world quickly afterwards. There appeared more than 7,5 million cases and 420.000 deaths in 6 months all around the world (Worldometer, 2020).

Epidemics had been part of the history and affected livelihoods all the time. One of the well-known epidemics was the Black Death or the plague that started in the 14th century that resulted in millions of deaths. Spanish Flu or the Great Influenza took place between 1918 and 1920 in the Europe and lead to economic and socio-political changes. SARS-COV (Severe Acute Respiratory Syndrome) started in China again and affected the eastern Asia and northern America between 2002 and 2003. The contagious respiratory diseases continued with the Avian Influenza (2004-2006) and MERS-COV (2012). SARS-COV resulted in 900 deaths (Siu & Wong, 2004), Avian Influenza lead to 400 life losses (Otte, Hinrichs, Rushton, Roland-Holst, & Zilberman, 2008) and MERS-COV lead to around 550 deaths in the Middle East and South Korea. Accordingly, COVID-19 virus is significantly different with its contagion speed, fatality rate (6 %) and geographical dispersion and it was named as a pandemic by the WHO three months after it started. Although it is hard to compare, its effectiveness is much closer to the plague actually.

Besides tightening health conditions and hit to the depressed health-care systems of the old continents, it is expected that the impacts of COVID-19 would be long-lasting in the world economy mostly. Departing from this point of view, it was considered essential to overview the economic impacts of previous epidemic diseases and to evaluate the potential impacts of COVID-19. In addition, it was intended to estimate per capita GDP effects of two recent epidemics, SARS-COV and MERS-COV among 16 selected countries between 2000 and 2015 to make inferences about COVID-19.

2. EFFECTS OF EPIDEMICS THROUGHOUT HISTORY

As mentioned above, diseases that affected lives and economic and political structures are on the world's agenda throughout history. It is important to overview previous studies to depict the potential effects of the COVID-19.

There had been many economic and socio-political effects of the plague. Yet, the data availability concerning this disease is limited, while it is well known that national income and welfare of both societies and countries were affected seriously. Spanish Influenza or the Great Influenza Epidemic can be noted as the first economically measurable disease. Around 40 million people died during this pandemic and it had devastating effects. It led to downsizing of the global economy with respect to revenues, expenditures, labour market that around 10 % of per capita income was lost (Barro & Ursua, 2008). A significant result of the disease was the second World unfortunately. The relationship of overall income and consumption with labour supply were estimated to differentiate effects of WWI and Spanish Flu (Barro, Ursua, & Weng, 2020).The epidemic led to 6 % income and 8 % consumption loss that signed to a devastating economic effect.

The impact Spanish Flu in Sweden for 1858 and 1930 were estimated and it was understood that the effects on poverty and investment earnings were negative (Karlsson, Nilsson, & Pichler, 2012).It was found that female labour replaced male labour during and after the Great Influenza. The economic impact of SARS-COV on Hong Kong was analysed regarding demand and supply aspects (Siu & Wong, 2004). It was understood that the negative effects of the epidemic on tourism and transportation were significant. There were also reductions in consumption and international trade. All these challenges resulted in rising unemployment. It was understood that there was a demand shock but supply in the industry remained unchanged. Accordingly, the revival did not take a long duration. The effects of quarantine implementations issued during SARS-COV were evaluated for Canada (Gupta, Moyer, & Stern, 2005). Immediate quarantine and post-syndrome health care service costs were compared, and it was found out that direct lockdown measures were more economical when compared with long-term hospitalisation. A simulation study for China and Hong Kong departing from SARS experience showed that if authorities take relevant precautions, healthcare costs might be economically manageable and vice versa (Lee & McKibbin, 2004). The costs were estimated considering the loss of labour force and foregone income. Yet, the study set forward that both consumption and overall demand for goods and services had led to declining overall supplies. All these hits resulted in the loss of services income by 15 % on average.

Besides, the impact of different diseases was compared in 2004 (Bell & Lewis, 2004). It was noted that Spanish Flu led to a declination in real per capita GDP and opened the job market to female labourers. HIV being a continuous disease mostly affected underdeveloped African countries due to labour loss and negative supply shifts. In contrast, SARS-COV had affected services negatively calling for public intervention. Declined overall income, savings and investment potential, productivity and changed labour

market composition in Europe were the results of the Great Influenza (Boucekkine, Dienne, & Azomahou, 2006). The social fear and declining social contact experienced during epidemics, as observed during SARS-COV, led to negative shift in services supplies and labour demand by 20-70 %, confirming the need to prevent and take precautions (Lionello, 2017).

Effects of Avian Influenza –H5N1 in poultry production and consumption and different trade policies on poultry were analysed for Philippines (Rodriguez, Garcia, Garcia, & Tan, 2007). The authors indicated that timely investment on personal and social hygiene and disease prevention may reduce the economic impact of a forthcoming disease. The authors sorted out costs due to different forms of the disease for the Taiwanese economy. They concluded that if influenza can be controlled and does not spread from birds to human, the reduction in income would be 0,4 % at most. On the contrary, the estimated loss in real GDP would be between 4,2 and 5,9 %, attached to a 4,9 to 6,4 % declination in labour supply (Chang, Lee, Lin, & Hsu, 2007). As H5N1 mostly affected the poultry industry, many studies indicated a reduction in poultry farm income and consumer loss in the USA (Lasley, 1987) (Paarlberg, 2007).

Checking out these previous studies, it was decided to analyse economic impacts of the recent epidemics and make inferences on potential effects of COVID-19. Accordingly, impacts of measurable SARS-COV and MERS-COV, on economies of 16 countries were analysed for 2000 and 2015.

3. MATERIAL AND METHODOLOGY

Due to the research objective, the per capita GDP of 16 countries were estimated against some selected indicators mainly related with labour market composition within a panel framework for 16 years between 2000 and 2015 with the data withdrawn from the World Bank considering data availability for all relevant countries. Most of the included countries were those that suffered from SARS-COV and/or MERS-COV and under the impact area of COVID-19. The countries in the sample are as follows.

Canada	China	France	Germany
Greece	Italy	S. Korea	Mexico
The Netherlands	Portugal	Poland	Russia
Spain	Turkey	the UK	the USA

Depending on the research objective, a growth model was estimated with reference to neo-classical Solow modelling approach (Solow, 1957). Capital and labour were considered as internal explanatories of GDP growth. For international comparison objectives, net Foreign Direct Investment was taken as the capital account of the GDP composition. For labour dimension, the impacts on and of human resources were considered as critical. The existing literature refers to employment downsizing in agriculture and specifically services sectors (Lemieux, Milligan, Schirle, & Skuteru, 2020) (Nicola, ve diğerleri, 2020). Departing from the previous epidemics that were considered within this study, the labour market effects were visible as well (Siu & Wong, 2004)

Yet, in order to differentiate effects of health-related occasions on country dynamics, the recent global pandemics of SARS and MERS were measured through incorporation of quantified data. GDP per capita was estimated using E-views statistical package within a panel framework to measure effects on different cross-sections for a given time dimension (Balgati, 2005) (Gujarati, 2003) (Arellano, 2003).The methodology is mostly preferred for comparative research when the time length is limited (Ceylan & Özkan, 2013) (Olofin, Kouassi, & Salisu, 2009) (Lloyd, Morrisey, & Osei, 2001).Therefore, the proposed equation and relevant variables are as following:

$$GDP_{it} = \beta_0 + \beta_1 FDI_{it} + \beta_2 AL_{it} + \beta_3 SL_{it} + \beta_4 SARS_{it} + \beta_5 MERS_{it} + e_{it}$$

GDP_{it}	per capita GDP ($)	$SARS_{it}$	Dummy for SARS-COV (1:2003-05; 0)
FDI_{it}	per capita Foreign Direct Investment ($)	$MERS_{it}$	Dummy for MERS-COV (1:2012-15; 0)
AL_{it}	Agricultural labour (.000)	i	Country i (16 countries)
SL_{it}	Services sector labour (.000)	t	Year (2000-2015)
e_{it}	Error term		

4. FINDINGS

This paper aimed to examine the macroeconomic effects of two epidemics. For this purpose, per capita GDP and some other selected indicators were used in the analyses based on cross-sections and time frame (Gujarati, 2003)Firstly, the relationships between the variables used in the model were checked. The correlations between per capita GDP and independent variables were given in Table 1.

Table 1. The Correlations Between GDP Per Capita and Independent Variables

Correlations	GDPpc[1] & FDIpc	GDPpc & SL	GDPpc & AL
Cross sections	0,26	-0,22	-0,41
Time	0,27	-0,24	-0,39

All partial correlations were significant at 1 %, indicating the linear relationship with the dependent variable. While per capita incoming investment had a positive correlation with GDP per capita, the labour market indicators were negatively correlated. Keeping the inference to the analysis phase, the linear relationships between independent variables were checked. As expected, labour market shares of services and agriculture markets seemed to be highly correlated by 87 % and services labour (SL) that had lower correlation with income was removed from the analysis. Following, time dependency was tested for quantitative variables with LLC unit root test for continuous variables and discrete variables were reduced from the test (Levin & Lin, Unit Root Test in Panel Data: New Results, 1993) (Levin, Lin, & Chu, 2002).

Table 2. Common Unit Root Existence – Level

GDPpc	FDIpc	AL
3,41***	-0,1,57*	1,87**

*: 10 % significance, **: 5 %, *** :1 % significance

The test statistics provided time-invariant data for unique variables. However, this is not completely valid for panel data. Accordingly, Pedroni Panel Cointegration test was used to verify unit root tests. Yet, the existence of a co-integrating relationship was refused respecting 2,01 Panel ADF statistic with 90 % probability value (Pedroni, 1999).

The selection of variables was based on the correlation analysis and economic interpretability. Besides, the dummy variable referring to the 2008-2009 global economic crisis was also removed as it was correlated with epidemic indicators and as the main focus is to measure the impact of these diseases. The results for panel estimation were shown in Table 3.

Table 3. Panel estimation results for per capita GDP (16 countries*16 years)

Variable	Estimate	Significance – t(p)	Test	Score
FDIpc	3,29	4,43 (0,00)	R2	0,23
AL	-0,075	-6,50 (0,00)	MDV	25.280,16
SARS	-2.384,98	-1,06 (0,29)	F-statistic (p)	18,69 (0,00)
MERS	5.697,07	2,53 (0,01)	DW	0,22
Constant	25.611,78	22,81 (0,00)		

Even though the economic indicators had interpretable effects on the income level and they are significant jointly concerning F-statistic, the time dependency was regenerated as seen with the DW statistic. Besides, the constant is both higher than the MDV and has a so close value. Accordingly, the methodological selection needs to be tested. Cross-sectional dependency was tested with Hausman statistic to decide between the panel and random-effects methods and Likelihood ratio test was used to decide between panel and fixed effects methods (Balgati, 2005). The tests results were demonstrated in Table 4.

[1] *pc: abbreviation for 'per capita'*

Table 4. Hausman Cross-Sectional Dependency Test and Likelihood Ratio Test

Ho: Per capita income should be estimated due to random effects – Hausman	
Independent Variables	FDIpc, AL
Cross-Sectional – X2	6,28 (0,04)
Ho: Per capita income should be estimated in a panel framework – Likelihood Ratio	
Cross-section F statistic	63,66 (0,00)
Cross section X^2 statistic	413,64 (0,00)

Hausman test results provided inference on whether the model can be estimated with REM. Cross-sectional X^2 results led us to reject the hypothesis and it was concluded that REM was not suitable for the dataset. In deciding between the panel and fixed effects, Likelihood Ratio test proposed for E-views by Baltagi (2005) was used in exchange of Lagrange multiplier test (Breusch & Pagan, 1979) (Godfrey, 1978). Due to the values of F and X^2 statistics, estimation within a panel structure was rejected as well. Therefore, the proposed methodology had appeared as FEM for the given dataset. The estimation findings were indicated in Table 5.

Table 5. FEM Results for GDP Per Capita (16 Countries*16 Years)

Variable	Estimate	Significance – t(p)	Test	Score
FDIpc	0,62	1,75 (0,08)	R2	0,87
AL	-0,02	-0,63 (0,53)	MDV	25.280,16
SARS	-2,639,51	-2,73 (0,01)	F-statistic (p)	80,93 (0,00)
MERS	5,380,85	5,52 (0,00)	DW	0,37
Constant	25.046,58	31,57 (0,00)		

The findings indicated that 86 % of the variation in per capita income could be explained with per capita net FDI, agricultural labour incorporated and incidence of two epidemics. Considering the differences between individual and joint significances of parameter estimates there appeared a suspicion of overestimation. This is due to the insignificance of quantitative indicators. Besides, much of the average per capita income (97 %) was explained by the constant estimate of 24.600,12. Remembering the unit root test results for FDI per capita it was decided to proceed in difference estimation disregarding the cointegration test results. The panel findings were indicated below.

Table 6. PLS Results for GDP Per Capita in Difference Form (16 Countries*16 Years)

Variable	Estimate	Significance – t(p)	Test	Score
DFDIpc	0,021	0,22 (0,82)	R^2	0,10
AL	-0,001	-0,72 (0,48)	MDV	788,89
SARS	-1.868,73	-4,53 (0,00)	F-statistic (p)	6,35 (0,00)
MERS	381,93	0,92 (0,36)	DW	1,68
Constant	523,49	2,47 (0,02)		

Due to the findings, time variance was purified. However, despite the high joint significance, most of the individual parameter estimates were insignificant and the overestimation problem remained. Just checking the estimates an inter-period rise in incoming foreign investment has a 2 % effect on the level of income. Rising agricultural labour stocks seemed to reduce per capita income. The main motivation of the analysis was to measure the effects of epidemic incidences on the level of income. The indicators showed that during SARS-COV and its effective period, the average income of the sample had reduced by almost 1.900 Dollars, while MERS incidence resulted in 382 Dollars rise in the average. This is mainly related to the geographical limits of MERS-COV in contrast to dispersion of SARS-COV.

In all cases, the number of people employed in agriculture in the previous year had a negligible effect on the per capita income change. Even though it was not indicated hereby, when agricultural labour supply is changed with services sector labour, a reduced contribution level was recognised. This is related to declination in demands for services, leisure, tourism and transportation. As demand for services declined, the demand of the sector for employees declined and it was followed by a declination in income.

Before conclusion, it is important to note that the time dependency remained after the estimation. The low Durbin-Watson statistic (0,34) indicated the existence of positive autocorrelation between variables. However, difference estimation was rejected as well with Pedroni test result indicated earlier. Therefore, it was decided to make a complementary assessment.

5. RESULTS

The paper focused on determining the impacts of two past epidemics experienced at the beginning of the 20th century to predict inferences for the apparent situation on COVID-19. Accordingly, the effects of recent epidemics on the income level were analysed for 16 selected countries. The main objective is to determine reducing or inducing effects of SARS-COV and/or MERS-COV. Depending on the dataset, the statistical findings were not fulfilling. Yet, a direct relationship between the disease incidences and per capita income level could be interpreted depending on the estimation.

There recognised a negative relationship between SARS-COV and per capita income in 16 countries. In the meantime, all countries seemed to have accelerated income growth. Therefore, SARS-COV, with its dispersion and mortality rate, reversed the rising income levels. Accordingly, it could be pointed out that if SARS-COV did not appear, per capita income was expected to rise more significantly. On the other hand, the effect of MERS-COV on the income level was reverse. With its narrower geographic dispersion in the Middle East and Arabic countries, the disease did not affect overall income desperately everywhere. The income loss was observed mainly in OPEC countries that also experienced MERS attack. Accordingly, the majority of the examined countries, which were not affected by MERS mostly, had benefited from reducing oil prices from 2010 to 2015 (Berikan & Hüseyinli, 2017) (Baffes, Kose, Ohnsorge, & Stocker, 2015). Accordingly, it is not correct to conclude with the existence of a so-called positive impact of the disease on income levels for the concerned countries.

6. DISCUSSIONS AND CONCLUSIONS

The diseases affect economy and socio-politics of countries due to their fatality and contagious characteristics. Past epidemics seemed to have various impacts. Specifically, the furthest one, plague and the Great Influenza or Spanish Flu changed the world seriously in time. Yet, even though the recent epidemics have lower mortality and contagious effects, they maintain to affect countries in many aspects. Recent research emphasized that precautions are economically cheaper than healing expenses for spreading diseases. Besides, two weeks of quarantine seemed to be less costly than a long health care provision due to recent experiences on COVID-19 (Alvarez, Argente, & Lippi, 2020).The persisting pandemic seems to affect global economy negatively for a long period of time. Most of these effects have become visible in the third and fourth quarters of 2020.

COVID-19 has been affecting supply and demand aspects of the economy. With regards, consumption and market preferences have changed. With quarantine applications and lockdowns, people tend to shift to web-based from store-based shopping. Some recent research signed the forthcoming change. Offline consumption signed to a declination of 32 % in 214 cities of China within three months specifically in retailing and services sectors. Accordingly, economic downsizing projected for China due to 2019 GDP level was 1,2 % (Chen, Qian, & Wen, 2020). In a pre-assessment research for the USA, the bank transaction data was used to portray spending and saving attitudes of Americans. It was put forward that consumption spending referring to necessities rose at first by around 56 % from February 26 to March 11 due to stockpiling efforts. Yet, most of this spending shifted to online shopping and records indicated a strict reduction in leisure spending (Baker, Farrokhnia, Meyer, & Pagel, 2020).

In addition, services demand had shrunk almost in everywhere. Transportation, tourism, catering and face to face retailing services have been downsizing, which also means rising unemployment. Rising unemployment would lead to reducing income and further declining demand. Even though agricultural labour was used hereby to undermine the effects of labour market changes, considering its high correlation with labour in services sector, a minimised reflection of past series to contemporary situation in employment in services market can recognised.

The expected foregone tourism revenue has been critical for China due to the cancellation of flights and the shut-down of the tourism industry. The contribution of the sector was $ 127, 3 billion in 2019.

Managers of Hilton hotels declared that they expect a loss between $ 25 and $ 50 million in 2020 (Hoque, Shikha, Hasanat, Arif, & Abdul Hamit, 2020). An evaluation for India estimated that labour loss in retail and services sectors, including aviation, hotels and restaurants, will be 20 % and lockdown in restaurants will lead to 50 % loss in gross revenue if the process continues for three months (Kasare, 2020). Apparently, the process continues even if quarantine implementations had become more flexible. This is due to changing attitudes. Downsizing in tourism, transportation and leisure sectors will affect related sectors as food and agriculture. Even if food and agriculture supplies are maintained at the same level, excess supplies would lead to declining prices.

Reducing demand and supply surplus in most economic fields will reduce the prices. The declining prices and reducing productive capacities are expected to lead stagnation and economic downsizing. Most of the manufacturing industries that purchase intermediaries are in loss as well (Di Mauro, 2020). In accordance, declining prices will not mean more industrial gains. Even if the prices decline, the initial excess demand due to stockpiling had stopped. Expenditures in grocery stores and supermarkets in the USA had risen by 39 % between 16th and 22nd of March 2020 compared with 2019 due to expected and announced lock-downs (Lusk, 2020). However, unemployment was induced unfortunately in most of the sectors and all trade opportunities seemed to shrink (Baldwin & Mauro, 2020) (Mallory, 2020).

The pandemic seemed to have a downsizing effect in all economies and most sectors, which will be more measurable in the future. On the other hand, it is hard to estimate the potential effects on agriculture, as agriculture does not respond to the changes at the time. But the sector is and will be affected by the process as it is both attached to direct consumption and demand of the services sector. A downsizing in services, hotels and/or restaurants may reduce the agro-food demand. However, it may be possible in the close future to arrange courier delivery systems and to relate agriculture and food production with services again depending on the challenges in consumption attitudes. Yet, labour market contraction is critically visible, which seems to contribute declining income levels and downsizing economies. Therefore, declining labour demand of sectors seems to accelerate adverse effects of COVID-19 on income and economic and social sustainability in a cyclical manner. Agricultural production and food industries are downsizing as well to control contagion. Accordingly, it is accurate to note that detailed analysis on a micro level will be needed to understand the effects of COVID-19. However, supporting mechanisms need to be developed and issued not only for the contemporary process but for future as well.

Ethics Statement: *This study does not need any permission from the Ethics Committee. In case of detection of a contrary situation, the Journal of Social Economic Research has no responsibility and all responsibility belongs to the authors of the study.*

Author Contributions Statement*: 1st author's contribution rate is 40%, 2nd author's contribution rate is 30% and 3rd author's contribution rate is 30%*

Conflict of Interest: *The authors declare that there is no conflict of interest.*

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