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ABSTRACT

This article describes the estimates of unemployment due to Covid-19 for each one of 14 economic sectors identified at worldwide level. The economic sectors have been ranked according to the estimated risk of unemployment; the statistical technique of multiple linear regression ($R^2_{adj}=0.830$, $p$-value$<0.001$) was selected for data analysis. The three economic sectors: E05-Agriculture, E13-Manufacturing, and E14-Motor Vehicle Sales and Repair integrate the cluster with the highest estimated unemployment rate ($4 \%< Û <11\%)$, while the five sectors: E06-Construction, E11-Accommodation & Meal Services, E09-Entertainment, E12-Real Estate & Commercial Activities, and E10-Transportation & Communications make up the group with a medium rate of unemployment ($2\%<u<4\%)$. For 2020, including all economic sectors an unemployed world population from 46% to 54% is estimated.

Keywords: World unemployment, Covid-19, economic sectors, unemployment risk, multiple linear regression

INTRODUCTION

Jobs are at the heart of economic development as the main source of income for most people and families, especially in the world's poorest countries, job creation drives poverty reduction and contributes to economic growth and social stability. Economies grow when more people join the workforce and find work, when workers get better at what they do, and when they move from low-productivity work to better, higher-productivity jobs. Each of these pathways to higher incomes varies in importance over time, depending on the rate of economic growth, the stages of economic transformation, and the demographic transition in which a country is located.

During 2009 a global crisis occurred, which was the worst economic recession in 70 years and was due to the slowdown in the United States and the economic dependence of the whole world created by failures in economic regulation and the credit-mortgage crisis and confidence in the markets, subsequently the US government had to make a financial bailout to the investment banks and the consequences were first chained in rich countries, contributing to a drop in demand that influences the rest of the world economy; from that year on, global economic growth along with job growth showed significant changes; unemployment (OECD, 2020-2) fell from 6% globally to levels of 5.4% in 2018-2019.

Economic growth is not enough to generate more and better jobs. But growth is essential for a country to simultaneously increase workers' incomes and employment without reducing the benefits of entrepreneurs. A country whose workforce is growing at a certain % per year must achieve economic growth above this percentage if it wants to increase average labor productivity by keeping the employment rate and labor force participation consistent (World Bank, 2020).

Countries where wages have increased faster than labor productivity cannot help but impair returns to capital unless their companies introduce labor-saving technologies, reducing employment. In the long
run it is about having a balance, but there can be no more and better jobs and greater private investment in
the absence of economic growth. However, the absence of growth can lead to fewer and worse jobs, as
recessional economies often reduce jobs and the declines in the business cycle often involve labor-saving
innovations.

In 2020, employment impacts have been large, estimating the global loss of jobs by more than 195
million over a 5- to 6-month period for the duration of mobility restrictions due to the pandemic that so
far cost 775,706 lives (CSSE, 2020; 08/18/2020) around the world due to complications from the Covid-19
virus that has expanded around the world since January 7 that it was when Health officials in China
announced that they had identified a new virus in agreement with WHO. The novel virus was named
2019-nCoV and was identified as belonging to the coronavirus family, which includes SARS and the
common cold. On January 11, China announced its first death from the virus, a 61-year-old man who had
purchased seafood products. Treatment did not improve his symptoms after being hospitalized and died of
heart failure on the night of January 9. On January 30, the World Health Organization declared
coronavirus a global emergency, as the death toll in China was unleashed at 170, with 7,711 cases
reported in the country, where the virus had spread to all 31 provinces.

On February 11, WHO announced that the new coronavirus would be called "COVID-19"; currently
globally, mobility restrictions have been imposed to reduce population interaction, closing non-
priority industries such as services and industrial manufacturing, closing schools, events and
congregations of more than 10 people, as well as the use of mouth caps and the use of healthy distances of
at least 6 feet among people to reduce the risk of contagion due to Covid-19.

COVID-19 is charging an invoice worldwide, causing deaths, disease and economic contraction, an
estimated 40-60 million people are being pushed into extreme poverty. Estimating how much global
poverty will increase due to COVID-19 is a challenge and comes with a lot of uncertainty, estimates that
global production will contract by 3% by 2020, revealing that COVID-19 is likely to cause the first
increase in global poverty since 1998, when the Asian financial crisis erupted. With the new forecasts,
global poverty, the proportion of the world's population living on less than $1.90 per day—is projected to
increase from 8.2% in 2019 to 8.6% in 2020, or from 632 to 665 million people (Cox, 2020); the total
estimate of the world's population of the unemployed in 2020 shown in Table 3 is 46% to 54%.

The main area where the increase in job losses is occurring (Isidore, 2020) estimated to be directly
linked to the increase in poverty is the loss in the area of services that have been the first directly affected
since the mandatory closure of these areas to limit viral spread since activities in the services sector often
require person-to-person contact and mitigation policies aim to social estrangement. There are examples
such as in the Asia-Pacific region (Tan, 2020) that it has been the first to be affected by a decrease in up
to 50% of service work.

In the United States, millions have lost their jobs and the worst damage is to come, according to an
estimate by the Federal Reserve. Economists of the St. Louis Project (Federal Reserve Bank of St. Louis;
Bullard, 2020) estimate total employment reductions of 47 million (Cox, 2020) which would result in an
unemployment rate of 32.1% and this is being reflected in applications for unemployment assistance
where 3.3 million Americans have filed an application for support, economists surveyed by the Dow
Jones expect another 2.65 million workers to join them in the next three months.

Since its appearance, Covid-19 has had a significant impact, not only on people's health but on the
global economy, it is estimated that this will be the worst crisis since World War II. The fact that we have
to have a social distance and as a result of this has started the damage in the economic situation, at the
beginning with the restrictions of travel and delay or cancellation of the school year, the closure of some
companies, it is estimated that it is about 81% of the workforce is in quarantine condition according to the International Labor Organization (ILO, 2020) affecting 3.3 billion of labor, affecting jobs and the number of hours worked, resulting in redundancies for declining cash flow in companies.

The sectors that have been most affected by coronavirus are those of accommodation, restaurants, manufacturing, among others, these sectors represent 38% worldwide, which have suffered adjustments or cuts of working hours.

In the informal economy there are around two billion people, mainly in developing or emerging countries, their situation has also been greatly affected by the crisis and they are often more exposed by the condition of their work such as street vendors and mainly workers.

The global estimates before the outbreak at ILO, 2020 shows the economic sectors with the most impact and their participations in global employment.

The calculation of the of Gross Domestic Product growth rate (Pena-Sanchez, 2015) worldwide according to the International Monetary Fund (IMF) is estimated to be -3%, for advanced economies of -6.1% and for developing economies it is estimated to be -1% by the end of 2020, global GDP is expected to recover by 2021 and be 5.8% (Lee, 2020).

OBJECTIVE


RESEARCH HYPOTHESIS (Hₐ)

The explanatory variables X₁ Cumulative Global Employment %, X₂ Unemployment Risk, X₃ Ratio: Average monthly income by sector / Total income average and X₄ Male Employment % have a significant statistical influence on the 2020 unemployed world population estimate (U) due to Covid-19 by economic sector (ILO, 2020):

\[ Hₐ: β_j ≠ 0 \]  \hspace{1cm} (1)

Where at least one of the beta regression coefficients (β) of the multiple regression model (3) is not zero. Thus, the corresponding null hypothesis (H₀) can be specified as

\[ H₀: β_j = 0 \]  \hspace{1cm} (2)

The multiple regression model has the following equation:

\[ U_i = β_0 + β_1X_{1i} + β_2X_{2i} + β_3X_{3i} + β_4X_{4i} + ε_i \]  \hspace{1cm} (3)

Where epsilon (ε) denotes the unobserved error term.
DATA AND METHODOLOGY

This study was carried out with data of secondary type from two sources conforming 14 worldwide economic sectors. The sources belong to official organizations (OECD, 2020-1 and ILO, 2020), which are indicated in the References section:

1) OECD, 2020-1. The Organization for Economic Co-operation and Development. Indicators https://data.oecd.org/searchresults/?=+f/type/indicators


As part of the methodology, the regression coefficients (Jaggia et al, 2018) have been estimated for a multiple linear regression model taking in account the collected and calculated socioeconomic variables (Pena-Sanchez, 2018).


RESULTS AND DISCUSSION

The coefficients estimates exposed in Table 1 correspond to the multiple linear regression model supported through the data matrix (ILO, 2020).

Table 1: Multiple Linear Regression Coefficients Estimates

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Unstandardized Coefficients&lt;sup&gt;^&lt;/sup&gt; Standardized Coefficients eta</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>311670.204 67996.360</td>
<td>0</td>
<td>4.584  .001</td>
</tr>
<tr>
<td>X1</td>
<td>8782.836 1452.533</td>
<td>2.335 6.047</td>
<td>.000</td>
</tr>
<tr>
<td>X2</td>
<td>-138137.059 26855.305</td>
<td>-1.975 -5.144</td>
<td>.000</td>
</tr>
<tr>
<td>X3</td>
<td>-162003.307 47946.791</td>
<td>-.423 -3.379</td>
<td>.007</td>
</tr>
</tbody>
</table>

Excluded Variable: X4: Male Employment % -.016 -.129 .900

<sup>^</sup> Dependent Variable: 2020 Unemployed World Population Estimate (1000's) due to Covid-19

The regression coefficients were estimated for a multiple linear regression model (R<sup>2</sup>adj=0.830, p-value<0.001) according to the collected and calculated socioeconomic (Yoskowitz et al, 2002) variables. Dependent (U): 2020 Unemployed World Population Estimate (1000's) due to Covid-19; Independents: X1: Cumulative Global Employment % (p-value<0.001), X2: Unemployment Risk (p-value<0.001), X3: Ratio: Average monthly income by sector / Total income average (p-value=0.007), and X4: Male Employment % (p-value=0.900), where the last independent variable (X4) was removed from the model because its statistical significance value (0.900) is greater than alpha=0.05, for that reason β4 and its
standard error do not show up in Table 1; here $X_4$ is just a linear transformation: $X_4 = 100 - \text{Female Employment\%}$ (Merotto et al, 2018). The model summary appears in Table 2.

Table 2: Multiple Linear Regression Model Summary*

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>F</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.621a</td>
<td>.386</td>
<td>.335</td>
<td>7.512</td>
<td>.018</td>
</tr>
<tr>
<td>2</td>
<td>.849b</td>
<td>.720</td>
<td>.669</td>
<td>14.203</td>
<td>.001</td>
</tr>
<tr>
<td>3</td>
<td>.932c</td>
<td>.869</td>
<td>.830</td>
<td>22.162</td>
<td>.000</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), 2019 Cumulative Global Employment %

The estimates shown in Table 3 are necessary for the planning of complex scenarios about the unemployment. Figure 1 describes the behavior of the Unemployed World Population Estimate (%) due to Covid-19 by Economic Sector according to the scenario of medium uncertainty from Table 3, where the three economic sectors: E05-Agriculture (OECD, 2020-1), E13-Manufacturing, and E14-Sale and Repair of Motor Vehicles integrate the cluster of economic sectors with the highest estimated unemployment rate ($4\%<\bar{U}<11\%)$, while the five sectors: E06-Construction, E11-Accommodation & Meal Services, E09-Entertainment, E12-Real Estate & Commercial Activities, and E10-Transportation & Communications make up the group of sectors with a medium rate of unemployment ($2\%<\bar{U}<4\%)$.

In addition, the cluster with the lowest unemployment estimate ($\bar{U}<2\%)$ due to Covid-19 is composed by six sectors: E01-Essential public services, E07-Financial and insurance activities, E02-Health and social services activities, E06-Mining and quarries, E03-Public administration and defense, and E04-Teaching at worldwide level due to Covid-19.

The horizontal domain used to construct Figure 1 as a quality control chart is ordinal risk (Schindler, 2018) considering uniform distances between the risk-ordered categories from the data matrix (ILO, 2020).

Table 3: Unemployed World Population Estimate due to Covid-19 by Economic Sector

<table>
<thead>
<tr>
<th>Economic Sector (Abbreviated name)</th>
<th>Scenario of Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low (1000’s)  (%</td>
</tr>
<tr>
<td>E01. Essentials</td>
<td>7444.92  0.224</td>
</tr>
<tr>
<td>E02. Health</td>
<td>38148.32 1.148</td>
</tr>
<tr>
<td>E03. Public administration</td>
<td>40387.48 1.204</td>
</tr>
<tr>
<td>E04. Teaching</td>
<td>49436.8  1.484</td>
</tr>
<tr>
<td>E05. Agriculture</td>
<td>316934.28 9.54</td>
</tr>
<tr>
<td>E06. Mining</td>
<td>9554.16  0.308</td>
</tr>
<tr>
<td>E07. Financial activities</td>
<td>22984.28 0.704</td>
</tr>
<tr>
<td>E08. Construction</td>
<td>113098.04 3.388</td>
</tr>
<tr>
<td>E09. Arts &amp; entertainment</td>
<td>93525.64 2.808</td>
</tr>
<tr>
<td>E10. Transportation</td>
<td>106192.84 3.172</td>
</tr>
<tr>
<td>E11. Meal services, Accommodations</td>
<td>86196.6  2.58</td>
</tr>
<tr>
<td>E12. Real estate</td>
<td>94126.8  2.82</td>
</tr>
</tbody>
</table>
E13. Manufacturing  277854.6  8.34     296378.24  8.896      314901.88  9.452
E14. Wholesale, and trade of vehicles  289170.6  8.7      308448.64  9.28      327726.68  9.86

**Total**  1545055.36  **46.42**  1678041.52  **50.416**  1811027.68  **54.412**

A control chart always has a central line for the average, an upper line for the upper control limit, and a lower line for the lower control limit. These lines are determined from the variability of historical data.

We are using this statistical tool (control chart of 3 sigma or 3 standard deviations (Jaggia et al, 2018)) to analyze and monitor the behavior of the unemployed world population estimate (%) due to Covid-19 by economic sector under the scenario of medium uncertainty displayed on Table 3.

![Control Chart: 2020 Unemployed World Population Estimate (%) due to Covid-19](image)

**Figure 1: Unemployed World Population Estimate (%) due to Covid-19 by Economic Sector (Scenario of Medium Uncertainty on Table 3)**

**CONCLUSIONS**

Goal achievement: The data analysis (Table 1) supports the research hypothesis, and the objective of this essay on the estimation of global unemployment by economic sector has been reached, which is presented under three scenarios of uncertainty (Table 3): Low, Medium and High. We conclude that in order to reduce the global impacts on job losses, the sectors referred to in Figure 1 should be opened gradually following all suggested health and hygiene protocols by the World Health Organization (WHO),
hoping that the employment will recover systematically once Covid-19 has been contained. Particularly, Figure 1 suggests that three sectors should be prioritized: E05. Agriculture, E13. Manufacturing and E14. Wholesale and retail trade; repair of motor vehicles and motorcycles; where the Agriculture sector (E05) already exceeded the upper control limit (UCL 10.1914%) of three standard deviations about the 2020 expected global unemployment level (%), and the other two sectors (E13 and E14) are following the same tendency. The control chart (Figure 1) is one of the contributions of this report, given that for future planning (Tappe, 2020) will be required a systematic monitoring of all events associated to worldwide economic recovery.

The pandemic caused by the Covid-19 virus has shown that the health factor is the top priority of all work activity. Therefore, a robust healthcare system (Prats Monné, 2020) supported by health technology is a parallel solution to the problem of untimely. A robust system includes telemedicine or Smart Hospitals, where online consultations such as AliHealth and Tencent Healthcare can be made, and diagnostic devices can be created to restrict contact and possible contamination when trying to go to hospitals, which are currently fighting against the Covid-19. In other words, maintaining a robust healthcare system lowers medical disability unemployment. The growth of job openings for healthcare (Sector E02. Health, (OECD, 2020-3)), we conclude that it is due to coronavirus. There is an urgent need ranging from doctors to medical assistants that are expected to last at least until a vaccine is found (Tappe, 2020) because, although social estrangement measures are activated, given that the lack of skilled experienced staff is so great that for example Andrew Cuomo, the governor of New York, called retired doctors, nurses and other medical professionals to help due to the overwhelming need for their services. This idea of Governor Cuomo has been adopted in other countries such as Mexico.

The Covid-19 disease not only had an impact to the people who got sick. The virus was considered as not so lethal as others, but the velocity of spread was astonishing. As per the peace of dispersion of the virus, gradually, all the countries required to apply a lockdown to contain the virus, in the short term, this action stopped the value chain. First, people couldn’t go to work, this increases the unemployment, then consumption of products and the supply of products was reduced. Automatically, the cash flow of the companies was reduced, people was fired (more unemployment), and supply of products to other countries also decreased and so on. Like a domino effect, the virus become lethal to the global economy.

There are proposals around the world for solutions to deal with the direct and indirect (collateral) damage caused by Covid-19, but we conclude that the most important factor or the most important component is to have a "Robust healthcare system" or as robust as possible, i.e. a healthcare system resistant to health demand, with the ability to deal with epidemics, catastrophes and similar phenomena that can suddenly affect a population. Therefore, before Covid-19, the primary objective of all countries should be the same: To create and maintain sources of jobs supported by robust healthcare systems. In other words, having a robust healthcare system is to have a healthcare system with the capacity to function properly in the face of saturation of hospital services. Covid-19 represents an inflexion point of a new world order: it is no longer about making money, it is about survival, and being prepared for worse scenarios; so we need to stand in solidarity with broad global support cooperation.

We hope that this report will provide guiding guidelines for how the new post-Coronavirus labor market by economic sector will take shape globally.
REFERENCES


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Rolando Pena-Sanchez is an Associate Professor of Decision Sciences in the Division of International Business and Technology Studies at Texas A&M International University. His research interests include: Multivariate parametric and nonparametric statistical methods applied to business administration and environmental risk management. His more recent research has appeared in the International Journal of Business Strategy, the Journal of Multidisciplinary Engineering Science and Technology, the Journal: Advances in Competitiveness Research, and as well as in the Journal of Global Business Management.