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COVID-19 and employment in Mexico: Initial impact and short-term forecast

COVID-19 y el empleo en México: impacto inicial y pronósticos de corto plazo

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Abstract

This paper describes the economic effects of the Covid-19 pandemic in Mexico and its initial repercussions in the Mexican labor market. The steep drop in the employment of the economically active population and the reduction of formal employment since April 2020 stand out. Two univariate times series models and a vector autoregressive model were estimated to forecast the short-term employment trend. The results indicated that after the initial shock, in the shortterm, the Mexican economy will experience a period of stagnation in the levels of employment of the economically active population, with a possible recovery beginning with the first quarter of 2021.

JEL Code: J01, J23, C22, C32
Keywords: COVID-19 pandemic; economic recession; economically active population; unemployment; time series forecast

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Resumen

El trabajo busca estimar los efectos económicos de la pandemia del Covid-19 en México y las repercusiones iniciales en el mercado laboral en México. Se destaca el desplome de la población económicamente activa ocupada a partir del mes de abril, así como de la ocupación de trabajadores formales. Se establecieron dos modelos de series de tiempo univariadas y un modelo de vectores autoregresivos para pronosticar las tendencias de la ocupación en el corto plazo. Los resultados indican que, con base en el choque económico inicial, en el corto plazo, la economía mexicana experimentará un periodo de estancamiento en los niveles de ocupación de la población económicamente activa, con la posibilidad de recuperación de la tendencia hacia el primer trimestre de 2021.

Código JEL: J01, J23, C22, C32
Palabras clave: pandemia del COVID-19; recesión económica; población económicamente activa; desocupación; pronósticos de series de tiempo

Introduction

The Mexican economy is facing an economic crisis caused by Covid-19. As a result, the labor market has had a severe impact, reflected on the employment levels of the economically active population (EAP). In particular, employment has plummeted since April 2020. The duration and depth of the economic recession will depend on the lockdown measures and their effect on supply and on the loss of dynamism of external and internal demand. The economic outlook will have a severe impact on employment in the country.

From this perspective, it is of utmost importance to know the short-term employment recovery expectations for the Mexican economy in the economic conditions prevailing as of April 2020. In the literature on the relationship between the economy and employment, several empirical studies indicate that the recovery of employment may lag several periods behind the dynamics of economic activity (Seyfried, 2011). In this regard, Okun's law (1962), considered a stylized fact of macroeconomic analysis, has been used to estimate the relationship between the unemployment rate and output level. However, there is great variability in the correlation of these two variables across countries, as it is affected by the period of the studies or by supply and demand shocks in the different economies (Blanchard & Quah, 1989).

The heterogeneity results of the link between employment and GDP among different countries have provided evidence of changes in Okun's relationship, indicating that more and more economies demonstrate that the loss of employment is related to a smaller fall in output (Lee, 2000). It can be concluded that the relationship between the cyclical components of employment and output is not stable and depends on several factors related to demand, such as technical progress and productivity, and on labor supply, such as demographic issues and labor market institutions (Islas & Cortez, 2013).

In Mexico, the sharp decline in economic activity has negatively affected employment. The most important impact recorded until May 2020 was the pronounced increase in the unemployed Economically Active Population (EAP). The impact of the supply shock derived from the health crisis has not led to a significant increase in the unemployment rate. However, it is reflected in the impossibility of obtaining work and, therefore, desisting from continuing to look for work. Thus, the unemployed EAP reflects the impact of the economic recession more clearly.

This paper focuses on analyzing the labor market situation in the Covid-19 pandemic and on short-term employment forecasts. For this purpose, it uses the employed EAP as a study variable and the Global Index of Economic Activity (IGAE, Spanish: Índice Global de Actividad Económica) as an explanatory variable to replace GDP since the estimation of the latter indicator is not available. This index is considered to capture movements at the level of economic activity and may be the most appropriate tool available.

This paper examines the effect of the fall in economic activity on EAP employment at the national level in Mexico. It makes a short-term forecast of employment using univariate time series models and a VAR model. It is based on the hypothesis that the Mexican economy is highly dependent on the contraction of external demand for goods produced in Mexico and on the fall in demand for the labor factor resulting from the lockdown measures, which has led to an employment crisis in the sector. This paper has the following structure: The first subsection briefly describes the characteristics of the economic recession generated by the Covid-19 pandemic in Mexico. The second subsection analyzes the characteristics of the labor market and the impact of the economic recession on EAP employment and other labor indicators in Mexico. The methodology used in the time series models is explained in the third subsection. The fourth subsection presents and analyzes the results of the estimations and short-term forecasts, and finally, the fifth subsection presents the conclusions and final reflections of the paper.

Characteristics of the economic crisis caused by Covid-19

The world's international economic activities have been affected by the health crisis caused by the COVID-19 pandemic. The depth of the crisis is due to various factors, such as the effectiveness of recession containment policies, the extent of the dismantling of supply chains, changes in spending patterns, and measures to contain the spread of the disease.

There is great uncertainty about the behavior of the world economy in both the short and the long term. According to the International Monetary Fund (IMF), the contraction of the world economy would be around -4.9% in 2020 and -8.0% for advanced economies. The forecast for Latin America would be a drop of -9.4% and -10.5% for the Mexican economy (IMF, 2020). The Bank of Mexico predicted that the drop in Mexico's gross domestic product (GDP) for 2020 would be around 6.6%. In the case of Mexico, the institution indicated that, in addition to the supply shock, the fall in external financing due to the uncertainty of international investors and the reduction of raw material prices would be an additional negative factor (Banco de México, 2020).

External shock and its impact on the mexican economy

World trade-related activities have experienced a severe slump. The World Trade Organization (WTO) forecasts a drop of between 13.0% and 32.0% in merchandise trade in 2020, depending on recovery scenarios in the third quarter of the said year (2020). In particular, exports from North America and Asia will see more drastic declines. By April 2020, freight trade had fallen 30.0% from the same month in 2019 (OECD, 2020). Prospects for trade recovery are determined by the behavior of commodity prices and the recovery of global supply chains.

In the case of Mexico, which has close economic ties with the United States, the reduction in demand for exports of goods and manufacturing inputs, and the collapse of commodity prices, particularly oil, have led to a drastic reduction in trade between Mexico and the U.S. Therefore, during the first four months of 2020, Mexico's trade with the U.S. decreased dramatically.

Exports to and imports from the U.S. declined 47.8% and 43.8% between April 2019 and April 2020, respectively. In particular, April 2020 saw a plunge in Mexico's total exports. Drastic reductions in the trade of oil and its derivatives can be appreciated when analyzing the main exporting sectors. Thus, Mexico's oil exports decreased by 76.0% due to lower demand and the drop in crude oil prices. Additionally, automobile exports decreased 78.0% during the same period.[1]

The drastic drop in international trade between Mexico and the U.S. impacts the supply chain developed in the North American region. In a context of uncertainty for investment, it helps to assume that the recovery of trade between both countries will be difficult to achieve in the short term. The reactivation of trade will depend on the ability of the three-member countries of the treaty to adapt to the new provisions of the United States, Mexico, and Canada Agreement (USMCA) to revive investment in these countries and thus enable the reestablishment of supply chains.

[1] https://usatrade.census.gov/index.php?do=login

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Containment measures and the collapse in economic activity

The Mexican economy was in a slowdown phase during 2019. GDP growth was -1.1, -0.4%, and -0.7 in the last three quarters of 2019.[2] Furthermore, the spread of COVID-19 has required containment measures to avoid further contagion. Therefore, the Mexican government decreed a period of social isolation that further deepened the country's economic recession. Thus, the impact of the containment was added to the recessionary trends of the world economy and the Mexican economy, which were severely impacted by the pandemic, generating a severe contraction of economic activity and trade, particularly as of the second quarter of 2020.

The lockdown resulted in the closure of construction, services, and manufacturing companies within the Mexican economy, which generated a supply shock that led to a sharp drop in economic activity. As a result, in the first quarter of 2020, GDP fell 1.4%, adding to the declines experienced in the third and fourth quarters of 2019. However, several economic subsectors presented considerable declines. This is the case for the manufacture of engines, turbines, and transmissions (-16.5%), computer equipment, electronic components, audio, and video (-16.4%), construction (-8.25), lodgings and food preparation (-7.9%).[3]

A direct implication of the economic recession generated by COVID-19 is the unemployment rate, which has increased significantly. This situation affects both formal and informal markets. The increasing levels of unemployment measured by different indicators suggest that rising levels of unemployment will increase poverty in the country.

Impact of COVID-19 on employment

A distinguishing characteristic of the Mexican economy is a labor market that cannot absorb the growth of the economically active population (EAP). Therefore, although the open unemployment rate in Mexico is low, another distinguishing characteristic of the country is the high participation of the labor force employed in the informal sector.

An analysis of the employment structure in Mexico indicates that, by the last quarter of 2019, the population totaled 126.4 million people, of whom 95.9 million were at least 15 years of age. Of this last category, the EAP, which is the population seeking employment, was 57.6 million, and the employed EAP totaled 55.7 million people. The open unemployment rate hardly captures the unemployment

[2] National Accounts, Economic Information Bank, INEGI
[3] National Accounts, Economic Information Bank, INEGI

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situation, as it does not record the loss of employment due to the fall in the EAP. In the third quarter of 2019, it reached 2.9%.[4] The distribution of the employed population by economic sector in the last quarter of 2019 indicates that the tertiary sector accounted for most of the employment with 62.3% of total employment, with the commerce subsector being the most important with 19.6%. For its part, the secondary sector accounted for 24.8% and manufacturing for 16.5%.

Regarding employment in the informal sector, in the first quarter of 2020, the employment rate of the informal sector, which includes non-agricultural establishments that work with household resources and are not incorporated companies (TOSI1), totaled 27.7% of the employed population. This represented a total of 15.6 million people. Moreover, considering the labor informality rate calculated by the National Institute of Statistics and Geography (INEGI) (TIL1), which includes workers who are vulnerable due to the informal nature of the activity and who are not recognized in their source of work, such as those who work in subsistence agriculture or have no social protection, the level of informality is high in Mexico. As of the first quarter of 2020, this informality rate included 56.6% of the employed population, representing 31.5 million workers.[5]

Characteristics of the drop in employment at the national level

The drop in employment in Mexico became more severe as of April 2020. There were noticeable changes in Mexico's employment composition between the first quarter of 2020 and April of this year. On the one hand, in April 2020, the EAP decreased by 11.9 million workers available for work but who desisted from seeking employment due to the lockdown measures established in the period (Figure A1). On the other hand, between March and April, the non-economically active population (NEAP) increased by 13.3 million people who, according to the ETOE, desisted from looking for work due to the lockdown.[6] The result is an unemployment rate in April that is not comparable to the international level for April 2020.[7]

As a result of the drop in the EAP, employment in the EAP fell by 12.1 million people, generating the largest increase in worker unemployment in Mexico's recent history. According to statistics from the Telephone Occupation and Employment Survey (ETOE, Spanish: Encuesta Telefónica de Ocupación y Empleo), the loss of employment was not reflected in the unemployment rate, which increased from 3.8% to 4.7%, but in the drop in EAP employment and informal employment, which fell

[4]Source: National Occupation and Employment Survey and Economic Information Bank, INEGI
[5]Calculations by the author with data from the National Occupation and Employment Survey and Economic Information Bank, INEGI
[6]Calculations by the author based on the results of the Telephone Occupation and Employment Survey (ETOE), Latest Figures of April 2020. https://www.inegi.org.mx/app/saladeprensa/noticia.html?id=5769
[7]While in Mexico the unemployment rate in April 2020 was 4.7%, according to the ETOE, in the U.S. it was 14.7%, according to the Current Population Survey and the Bureau of Labor Statistics https://www.bls.gov/cps/.

from 57.7% to 47.7% of the total employed population. In May, there was a slight recovery in employment and the EAP, but it is far from being significant enough to determine a turning point in the fall of employment.[8]

Regarding the impact of unemployment by type of economic activity, between March and May 2020 there were significant job losses in the services sector with a decrease of 7.0 million jobs, particularly in the commerce sector, which presented a drop of 3.2 million jobs. Meanwhile, 3.6 million workers lost their jobs in the secondary sector and 1.4 million in the construction industry. The decline in employment in the economic sector reflects the composition of Mexico's economic activities, concentrating on the services and manufacturing sectors.[9]

An important aspect to consider is that the size both of the underemployed population and of the population employed in the informal sector are closely related to the trends in in-work poverty. For the first quarter of 2020, there are increases in all three items mentioned (Figure A2). Therefore, it is likely that the deterioration of employment in Mexico will increase in-work poverty in Mexico.

Unemployment of insured workers at the national level

It is convenient to use employment statistics for those insured by the Mexican Social Security Institute (IMSS) to analyze the structure and trends of formal employment in Mexico. This type of worker receives the best benefits and social security (Botello, 2011). The share of this formal and insured employment in the total employed EAP in Mexico in March 2020 was 37.0%, which indicates the importance of analyzing this segment of workers in the Mexican economy. It should be noted that this type of employment has had significant growth in the last 15 years (Nápoles & Ordaz, 2011). Between January 2010 and December 2019, IMSS insured employment went from 14.7 million workers to 20.4 million, increasing 36.5%.[10]

The economic crisis caused by COVID-19 has negatively impacted the formal employment of insured workers since March 2020. In March, April, and May, formal employment decreased by 130,593, 555,247, and 344,526 jobs, respectively. As a result, the cumulative reduction in formal employment as of May was 907,207 jobs (Figure A3).

The sharp drop in formal employment in 2020 is larger than that experienced in 2008-2009. Figure A4 indicates that the cyclical component of the formal employment series in Mexico during the

[8]Source: National Occupation and Employment Survey and the Telephone Occupation and Employment Survey, INEGI
[9]Source: National Occupation and Employment Survey and the Telephone Occupation and Employment Survey, INEGI
[10]IMSS Dynamic Information Query, http://www.imss.gob.mx/conoce-al-imss/cubos

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COVID-19 crisis is significantly more pronounced than that of the 2008-2009 crisis. This reflects the severity of the employment crisis experienced in 2020 and the difficulty of recovering the jobs lost in the short term.

Short-term employment outlook and forecasts in mexico

Mexico's unemployment rate is an imprecise measure of the number of employed workers in Mexico. It is the ratio of the unemployed EAP to the EAP. Accordingly, if the EAP decreases because unemployed workers are not looking for work, this accounting may result in a lower unemployment rate that is not comparable to the international level.

The severity of the economic crisis caused by the Covid-19 pandemic and the uncertainty regarding the reactivation of the Mexican economy complicate the analysis of the prospects for the recovery of employment. Since there are many scenarios for the Mexican economy to return to growth and for employment to recover, one methodology for analyzing trends in employment behavior in Mexico is using time series forecasting models. This study estimates the autoregressive moving average model (ARMA) and an integrated autoregressive moving average model (ARIMA) for the employed EAP. Subsequently, it will use a vector autoregressive model (VAR) to relate the employed EAP to the IGAE. Based on these models, the study will make forecasts of short-term employment trends.

Methodology for occupancy level forecasting

A first approach to determine employment trends in the recessionary environment caused by the pandemic is to use univariate time series models. This type of analysis requires stochastic processes, which implies that the present value of the process is a combination of past values of the process.

Likewise, the time series must be stationary, i.e., the probability distribution of any subset of the series must be the same as the probability distribution at all times of the sample. Therefore, the series must be stationary, i.e., the mean, variance, and covariance must be constant over time.

The most commonly used models for forecasting univariate series are the moving average (MA), autoregressive variables (AR), and autoregressive models with integrated moving average (ARIMA), each of which has different ways of capturing autoregressive behavior (Mills, 2001). To analyze trends and forecast the employment level of the EAP in Mexico from a univariate perspective, the first approach is based on an autoregressive ARMA model comprised of an equation different from a stochastic series that linearly relates the present value of the series with its past values and a stochastic shock (Diebold, 2004).

The equation representing this process has no independent variables and only includes an autoregressive process:

$$E_t = \beta_0 + \theta_1 E_{t-1} + \theta_2 E_{t-2} + \ldots \theta_\rho E_{t-\rho} + \varepsilon_t + \phi_1 \varepsilon_{t-1} + \phi_2 \varepsilon_{t-2} + \ldots + \phi_q \varepsilon_{t-q}$$

(1)

Where E is the economically employed population, θ y ϕ are the coefficients of the autoregressive process, p and q are the past values of E, and ε is the error term.

A second methodology to generate the forecast is the ARIMA model developed by Box and Jenkins (1976), which helps to understand the implications and properties of economic models fitted to time series analysis (Mills, 2001). This model explains any moment of the series based on its past values, that is, on its lags and lagged forecast errors. This model has three terms: p is the order of the autoregressive error, q is the order of the moving average of the error, and d represents the differencing of the series to make it stationary. Therefore, the model can be taken as an ARMA model after transforming the series to make it stationary. The variable to be forecast depends on the lags of that variable (AR) and the lagged forecast errors. This method for forecasting univariate variables has a high probability of generating accurate forecasts in the short term and can explain the residuals.

The third forecasting methodology used is the vector autoregressive model (VAR). This model presents a multivariate autoregressive model that helps to include additional variables for forecasting. Thus, N-equations can be estimated for an autoregressive vector of order p and with N-variables. The regression of the variable to be forecast is estimated with respect to the lags p of the same and the lags P of the other variable. Therefore, there is a cross-dynamic between the variables of the model.

It uses two variables in the forecast, the employed EAP and the global index of economic activity. Their specification would be as follows:

$$E_{1,t} = \beta_{1,0} + \theta_{11} E_{1,t-1} + \theta_{12} E_{2,t-2} + \ldots + \varepsilon_{t-1}$$

(2)

$$I_{2.t} = \beta_{1,0} + \theta_{2,1} I_{1,t-1} + \theta_{2.2} I_{2.t-2} + \varepsilon_{2,t}$$

(3)

Where I is the overall index of economic activity. In the VAR model, each variable depends on the lags of the other variable, which can be useful in forecasting; particularly because these two variables contain causality information useful for forecasting. The information was obtained from the Economic

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Information Bank, from which the IGAE and the employed EAP calculated from the National Occupation and Employment Survey (ENOE) were obtained.

Results of the estimations of the employed EAP forecasts

The ultimate impact of the lockdown and the pandemic on economic growth and employment is still uncertain. However, it is possible to make estimates with different econometric time series methods to evaluate the prospects for employment in Mexico. This helps visualize, in the short term, the prospects for recovery from the perspective of the time series analysis of the employed EAP.

As mentioned above, the unemployment rate calculated in Mexico is an indicator that does not accurately reflect the employment situation due to the abrupt movements of the EAP in the context of the economic crisis. Therefore, this study uses the employed EAP in the country as a forecasting variable. This variable is considered a more accurate reflection of the fluctuations in employment levels in Mexico.

An analysis of the time series of the employed EAP for the period from the first quarter of 2005 to the second quarter of 2020-2 shows that there is an increasing trend with an abrupt drop in employment in the second quarter of 2020[11] (Figure A5). An ARMA forecast is initially applied to model the behavior of employment. The model does not require testing whether the variables are stationary and assumes that this does not affect the estimation and forecasting of the series. The forecast is modeled due to its past values, and the series is assumed to be stationary.

The results of the ARMA model yield significant coefficients for the autoregressive component and the moving average component (Table A1). Using the model, it is possible to forecast the next four quarters of the employed EAP variable, from the third quarter of 2020 to the second quarter of 2021. The statistical evidence from the forecasts suggests that Mexico's EAP employment will continue to present a negative trend until the third quarter of 2020. In the absence of any other disturbance, it would start its upward trend from the fourth quarter of 2020 (Figure A1). According to Table A2, the delayed impact of the employment slump would continue in the third and fourth quarters of 2020. The employment recovery would be gradual and indicated in the first quarter of 2021 with slow growth.

Since most time series are stationary, it is necessary to solve the problem of stationary variables. Box and Jenkins (1976) proposed the differencing of time series. Accordingly, the ARIMA model includes a differencing term in addition to the autoregressive order and the moving average. The model must fit the forecasts to the historical data; thus, it is necessary to check that the residuals are different from zero and the partial autocorrelation.

[11]The second quarter is approximate and consists of statistics provided by the ETOE for the months of April and May.

The employed EAP series had to be differenced to make it non-stationary. The EAP variable in first difference rejects the null hypothesis of the existence of a unit root in the series (non-stationary). Additionally, the KPPS test evaluates the null hypothesis that the series is non-stationary; the result fails to reject the hypothesis, corroborating that the series is stationary (Table A2). Consequently, the estimation of the ARIMA model helps generate forecasts of the employed EAP variable. The coefficients of AR and MA were statistically positive and with adequate goodness of fit, so the analysis of the forecasts was made based on this model (Table A3). The forecasts of the employed EAP indicate the last thirty observations of the sample and make a forecast for the third and fourth quarters of 2020 and the first and second quarters of 2021. The results obtained in this estimation indicate that the forecast observations are in line with the historical data of the sample.

The forecasts adjust appropriately, and the lags only capture the unexpected drop in the second quarter until the third quarter, where the trend adjusts again. The forecast estimates for these four quarters indicate a drop in the third quarter of 2020 (Figure A2). However, the fourth quarter of 2002 and the first two quarters of 2021 present stagnation with moderate employment growth, implying that the EAP unemployment level will remain high in the first half of 2021. Although a slight recovery is estimated in the fourth half of 2020 to 42.53 million EAP employed, this level remains stagnant in the two subsequent quarters (Table A2).

Finally, the VAR short-term forecasting model requires testing that the series is stationary. However, it is flexible, and it only needs to be verified that there is no serial correlation of the residuals in the individual equations of the model and that they comply with having a normal distribution. Additional tests require cointegration of the residuals and the direction of causality.

With the model variables being the employed EAP and the IGAE, the study analyzed the number of lags by autocorrelation. [12]Subsequently, it examined the unit roots of the series using the Augmented Dickey-Fuller test and the KPPS test. The results of the tests indicate that in first differences, the autoregressive series do not present unit roots and are stationary (Table A3).

Likewise, the Johansen cointegration test was performed for the two series considered. The p-value results indicate at least one cointegration equation. Finally, it was necessary to obtain the impulse response functions of the model to verify the direction of causality of the variables of the model. In this way, the behavior of the contemporaneous endogenous variables, derived from an external shock of another variable, responds to innovations in subsequent periods (Figure A8). Graphically, it can be seen that a shock of the IGAE in the employed EAP generates positive innovations, which suggests that the results of the VAR model are consistent with the causal relationship of the variables (Figure A7).

[12]The null hypothesis of no autocorrelation was not rejected and the hypothesis of homoscedasticity was not rejected.

Based on the estimation of the VAR model, the study proceeded to perform the forecast analysis of the series, particularly the employed EAP series. The third-quarter forecast indicates a drop in the second quarter of 2020 using the two autoregressive series, which indicates a moderate recovery (Figure A7). However, there is a slight drop in the first quarter of 2021, and, in the forecast period, there is a stagnation of employment growth until the second quarter of 2021 (Table A2).

Together with the autoregressive series of EAP employment in Mexico, these short-term forecasts suggest that, in the absence of new and deeper shocks derived from the lockdown measures, employment performance will stagnate until the second half of 2021. This outlook is not promising in terms of the ability of the Mexican economy to recover employment shortly under the current economic conditions.

Conclusions

Mexico's economy is going through an economic crisis and great uncertainty with sharp declines in GDP. Exports have declined in traditionally dynamic sectors, such as the automotive and electronics industries. Furthermore, the lockdown measures have impacted the country's economic activity, particularly with the temporary closure of the construction, services, and manufacturing industries.

The Covid-19 crisis has severely affected the labor market, which is expected to generate higher levels of working poverty in the country. One of the main characteristics of the Mexican labor market is its incapacity to absorb the growth of the EAP, which, in turn, leads to a high proportion of the EAP employed in the informal sector. This sector accounts for more than 50% of the employed EAP and, together with the underemployed population, explains the precariousness of the Mexican labor market.

Another characteristic of the Mexican labor market is how the unemployment rate in Mexico, which has remained low compared to other countries, is estimated. This is because, in Mexico, workers who have not found work during the crisis have been considered part of the unemployed or inactive EAP, which has increased significantly. Therefore, instead of being added to the numerator of the unemployment rate calculation, only an increase in the unemployed EAP is considered. This means that the unemployment rate does not reflect the magnitude of labor unemployment in Mexico. Thus, it is considered that the unemployed EAP is the best indicator in Mexico to estimate unemployment scenarios in the face of the economic recession.

It is worth noting the drop in unemployment in the EAP, which has been high both at the national level and by sector. Likewise, the formal sector, which represents less than half of the country's employment, has also suffered significantly from the economic recession. The employment situation in Mexico presents an unprecedented loss of employment with uncertain prospects for recovery.

The univariate backward vector techniques and the VAR model for forecasting the behavior of the employed EAP yielded consistent results, i.e., in the short term, the impact of the abrupt drop in employment is reflected in a lag in the models. Likewise, all of them indicate the impossibility of recovering the employment level in four quarters. This indicates that the recovery of employment will be a prolonged process.

Regarding the trends in the forecasting behavior of the different models, the results present some differences. The ARMA model and the ARIMA model indicate the impossibility of employment recovery in the short term. However, in the case of the ARMA model, after a fall in employment, it generates a positive trend in employment growth. Meanwhile, the trend in the ARIMA model presents a stagnation of employment, suggesting that unemployment levels will remain high in the short term. Finally, the VAR model corroborates the impossibility of a short-term recovery with stagnant employment in the quarters considered.

By containing the negative impacts of the pandemic, the employment potential will depend on generating the conditions that will permit a more consistent and widespread reactivation of economic activities. However, in the short term, the recovery of employment is expected to be slow because it will take time to restore the growth of productive and commercial activity to the levels that existed before the appearance of Covid-19.

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Annex

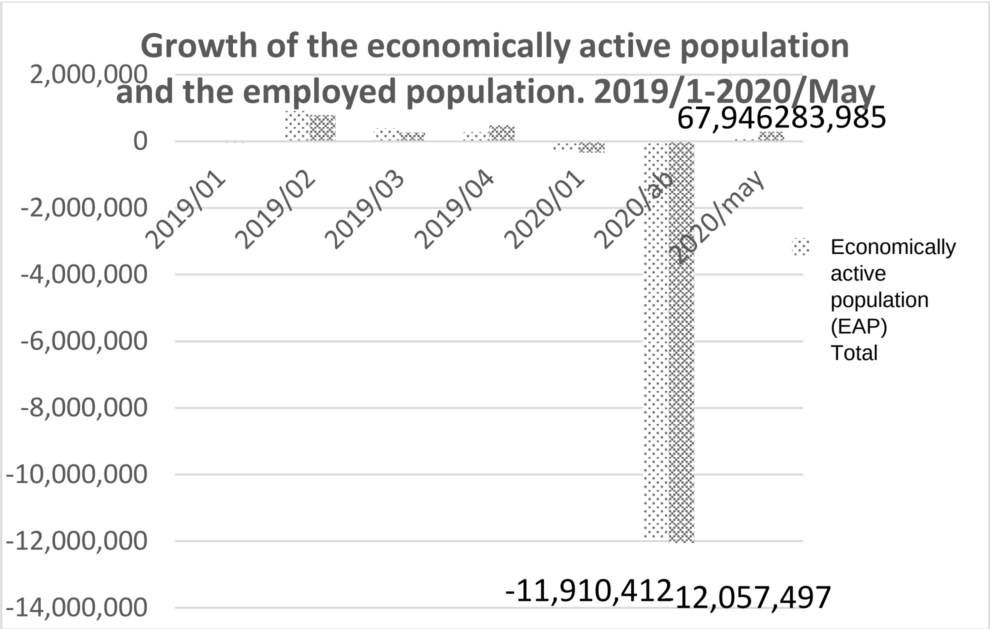

Figure A1
Source: created by the author with data from the National Occupation and Employment Survey (ENOE) and the Telephone Occupation and Employment Survey (ETOE), INEGI.

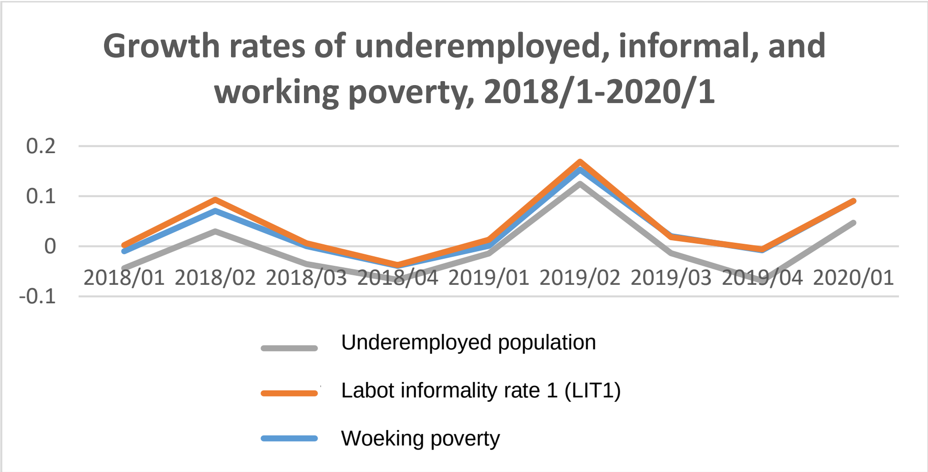

Figure A2
Source: created by the author with estimations of CONEVAL and ENOE, 2005-2020

http://dx.doi.org/10.22201/fca.24488410e.2020.3028

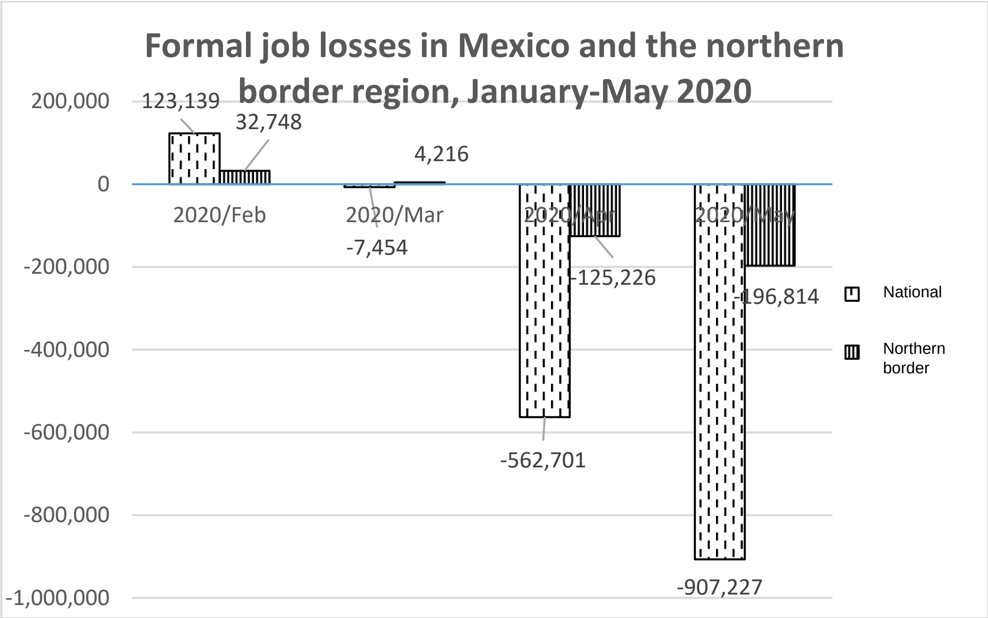

Figure A3
Source: calculations by the author with open data of insured persons, IMSS

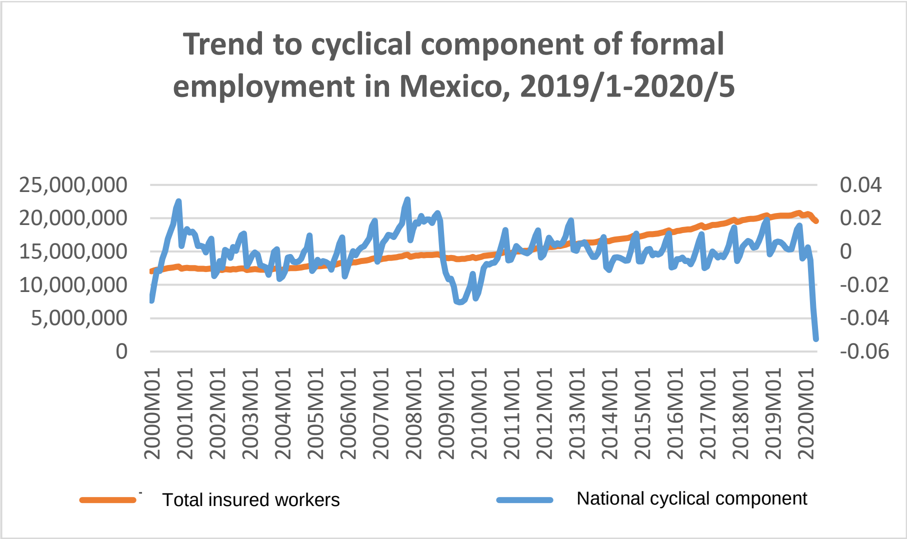

Figure A4
Source: created by the author with open data from IMSS on monthly information on the number of insured. http://datos.imss.gob.mx/dataset/asg-2020

http://dx.doi.org/10.22201/fca.24488410e.2020.3028

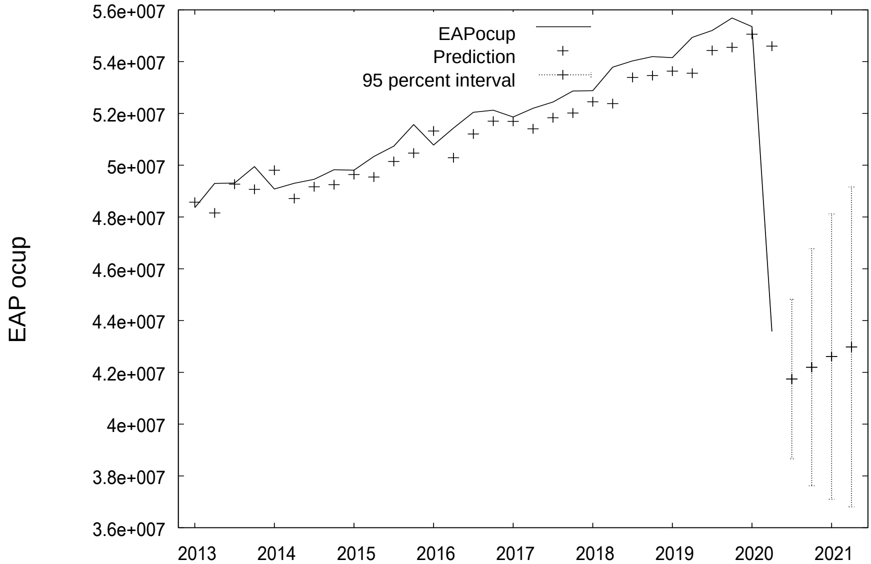

Figure A5. ARMA forecasts of employed EAP, 2005/01-2021/02
Source: created by the author with ENOE data

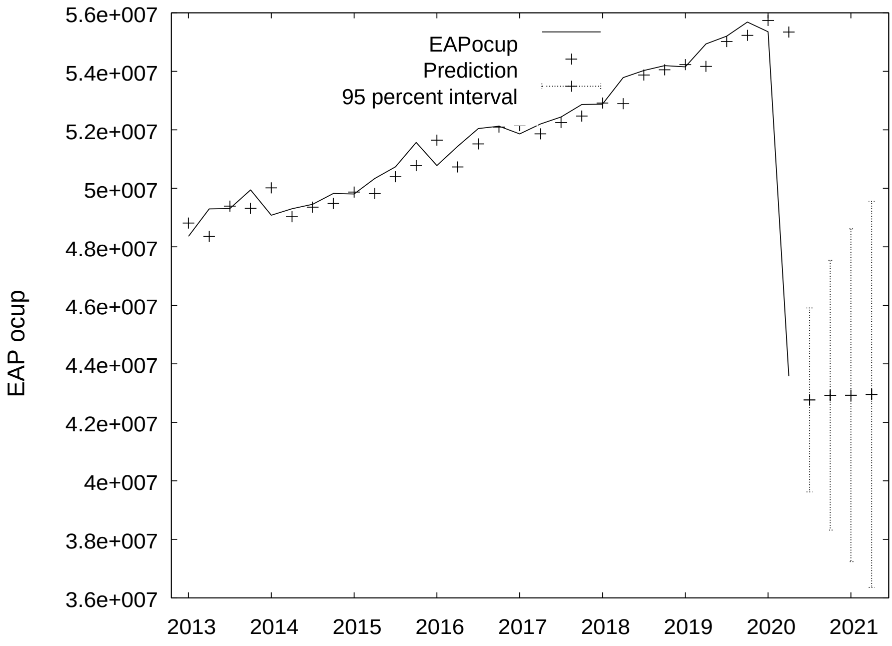

Figure A6. ARIMA EAP forecasts, 2005/01- 2021/02
Source: calculations by the author

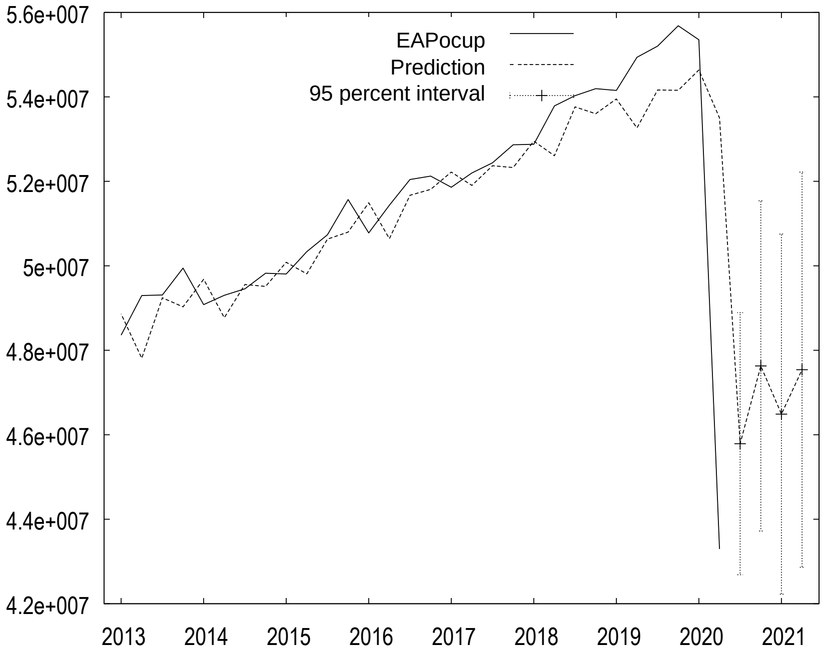

Figure A7. VAR forecasts of the employed EAP, 2005/01-2021/02
Source: calculations by the author

http://dx.doi.org/10.22201/fca.24488410e.2020.3028

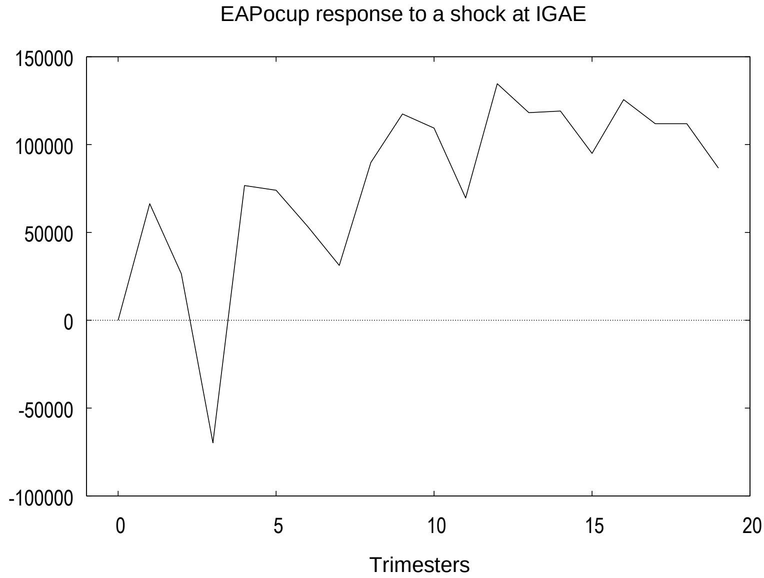

Figure A8. Impulse-response function
Source: calculations by the author

http://dx.doi.org/10.22201/fca.24488410e.2020.3028

Table A1

ARMA, using the observations 2005:1-2020:2 (T = 62)

Estimated using AS 197 (exact MV)

Dependent variable: Employed EAP

Standard deviations based on the Hessian

	coefficient	Standard deviation	z	p-value
Constant	4.66E+07	2.37E+06	19.65	0.00000 ***
phi_1 (AR)	0.906951	0.06539	13.87	0.00000 ***
theta_1 (MA)	0.192394	0.291825	10.6593	0.00006***
Mean of the dependent variable	48301425	D.T. of the dependent variable	3937707	
Mean number of innovations	106874.8	D.T. innovations	1570938	
R-squared	0.839102	Corrected R-squared	0.83642	
Log-likelihood	−973.5838	Akaike's criterion	1955.168	
Schwarz's Criterion	1963.676	Hannan-Quinn Crit.	1958.508	
AR				
Root 1	1.1026	0	1.1026	0
MA				
Root 1	-5.1977	0	5.1977	0.5

Source: calculations by the author

Table A2

Mexico: 4-quarter ARMA, ARIMA, and VAR forecasts of employed EAP

	ARMA		ARIMA		VAR	
	EmployedEAP	Forecast	EmployedEAP	Forecast	EmployedEAP	Forecast
2019/01	54,152,266	53,631,087	54,152,266	54,223,321	54,152,266	53,949,749
2019/02	54,936,719	53,551,967	54,936,719	54,161,885	54,936,719	53,263,693
2019/03	55,201,939	54,429,574	55,201,939	55,016,303	55,201,939	54,162,066
2019/04	55,683,450	54,552,296	55,683,450	55,223,929	55,683,450	54,156,253
2020/01	55,352,304	55,058,032	55,352,304	55,736,133	55,352,304	54,636,493
2020/02	43,294,807	54,596,687	43,294,807	55,333,408	43,294,807	53,499,667
2020/03		41,742,290		42,364,243		45,788,341
2020/04		42,196,453		42,529,486		47,629,679
2021/01		42,608,356		42,523,382		46,487,922
2021/02		42,981,932		42,544,071		47,539,902

Source: calculations by the author

Table A3

ARIMA, using the observations 2005:2-2020:1 (T = 60)

Estimated using AS 197 (exact MV)

Dependent variable: Employed EAP

Standard deviations based on the Hessian

	coefficient	Standard deviation	z	p-value
constant	220,316	6,002	36.75000	0.00000***
phi_1 (AR)	0.49267	0.11633	4.23500	0.00000 ***
theta_1 (MA)	-1.00000	0.06152	10.65930	0.00000***
Mean of the dependent variable	2,328,538	D.T. of the dependent variable	511,769	
Mean number of innovations	-2,929	D.T. innovations	1,570,938	
R-squared	0.98680	Corrected R-squared	0.98665	
Log-likelihood	−865.98	Akaike's criterion	1,740	
Schwarz's Criterion	1,748	Hannan-Quinn Crit.	1,743	
AR				
Root 1	2.0298	0	2.0298	0
MA				
Root 1	1	0	1	0.5

Source: calculations by the author

Table A4

Unit root tests: employed EAP variable and Global Index of Economic Activity

	Augmented Dickey-Fuller	KPPS	Augmented Dickey-Fuller	KPPS
	First difference	First difference	First difference	First difference
Estimated value (a-1)	-1.51728	0.149	-8.76072	0.115261
Contrast statistic	-3.65517	0.11899	-2.69134	0.149
P-value	0.007379	p > 0.10000	0.00000	p > 0.10000

DFA null hypothesis: a = 1. KPPS null hypothesis: a = 0. At 1% confidence level.

Table A5

Johansen's cointegration test

Number of equations = 2. Order of delay = 4						
Estimation period: 2006:1 - 2020:1 (T = 57). Restricted constant						
Log-likelihood = 519.035 (Including a constant term: 357.276)						
Range		Equity value	Trace std.	p-value	Lmax Std.	p-value
	0	0.39185	31.985	[0.0005]	28.348	[0.0002]
	1	0.061813	3.6369	[0.4805]	3.6369	[0.4795]
Corrected for sample size (gl = 48)						
Range		Trace std.	p-value			
	0	31.985	[0.0007]			
	1	3.6369	[0.4814]			
Equity value		0.39185	0.061813			
Beta (cointegrating vectors)						
l_IGAE		-11.546	44.802			
l_EmployedEAP		13.751	-48.107			
constant		-189.63	636.84			

Source: calculations by the author

Table A6

VAR system, delay order 3				
OLS estimates, observations 2005:2-2020:2 (T = 57)				
Log-likelihood = -1069.9866				
Portmanteau contrast: LB (15) =	51.5406,	gl =	56 [0.6442]	
Equation 1: IGAE				
	Coefficient	Standard deviation	t-statistic	p-value
Constant	51.7303	21.4424	2.413	0.0191**
IGAE_1	0.944052	0.0930105	10.15	2.17e-014 ***
EmployedEAP_1	−1.09134e-06	5.59E-07	−1.951	0.0559 *
Time	0.255111	0.115001	2.218	0.0305 **
Sum of squares residuals	225.5182	D.T. of regression	1.989085	
R-squared	0.969493	Corrected R-squared	0.967888	
F (3, 57)	603.8125	P-value (of F)	3.84E-43	
Zero-constraint F contrasts:				
All IGAE delays	F (1, 57) =	103.02 [0.0000]		
All lags of EmployedEAP F (1, 57) = 3.8078 [0.0559].				
Equation 2: EmployedEPA				
	Coefficient	Standard deviation	t-statistic	p-value
Constant	3.52E+07	1.67E+07	2.107	0.0395 **
IGAE_1	139038	72557.5	1.916	0.0604 *
EmployedEAP_1	−0.170014	0.436288	−0.3897	0.6982
Time	151400	89712.7	1.688	0.0970 *
Sum of squares residuals	1.37E+14	T.D. of regression	1551686	
R-squared	0.847651	Corrected R-squared	0.839632	
F (3, 57)	105.7133	P-value (of F)	2.90E-23	
Zero-constraint F contrasts:				
All IGAE delays	F (1, 57) =	3.6720 [0.0604]		
All EmployedEPA delays	F (1, 57) =	0.15185 [0.0698]		

Source: created by the author