

The Effects of Innovation, IT Advancement, GDP, and Inflation on Unemployment in OIC Countries 2013-2021

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<i>Article Info</i>	<i>Abstract</i>
<p><i>Article history:</i> Received January 31, 2023 Revised July 6, 2023 Accepted July 22, 2023 Available online July 22, 2023</p> <p><i>Keywords:</i> <i>Unemployment, Innovation, IT Advancement, GDP, Inflation</i></p> <p>JEL Classification: R31</p>	<p>Unemployment still becomes a major developmental challenge in some OIC member countries. Thus, employment determinants in those countries need to be investigated through empirical research. This study analyzes the influences of inflation, GDP, IT advancement, and innovation on unemployment in some OIC member countries. We use the purposive sampling method with criteria of countries with the past decade's average unemployment rate lower than 6%. We employ panel data from 20 countries fulfilling the requirements in 2013-2021. The panel data regression method with a fixed effect approach is used to analyze the influence of independent variables on the dependent variable. The results indicate that inflation and GDP significantly and negatively affect unemployment. On the other hand, innovation and ICT advancement have a negative but insignificant effect on the dependent variable. Regarding the results, we believe it is essential for the government as a policymaker to arrange appropriate regulations allowing industries to enhance their productivity to enlarge job opportunities and alleviate unemployment.</p>

INTRODUCTION

Unemployment is one of the most common economic problems that exist in many countries in the world. In general, unemployment can be defined as the proportion of people actively looking for a job at a specific time but are not yet employed. The unemployment rate came from the number of people entering the labor force for the first time and the number of people reentering the labor force after a certain period out of the labor force (Ehrenberg & Smith, 2012). From the individual perspective, unemployment is a disadvantage since unemployed people can't afford various goods and services despite their abundance of leisure time (Borjas, 2020).

One of the significant causes of unemployment is the imbalance of labor supply and demand. The manager's consideration influences labor's demand in determining how much labor is used to produce a specific output. Due to the

limitation of resources, managers must choose the best combination of production factors to deliver goods or services efficiently. Usually, capital and labor are regarded as the most common production factors. The production isoquant curve can depict the variety of both aspects (Pyndick & Rubinfeld, 2013).

In recent years, the utilization of hi-tech machinery in manufacturing processes has become more common. In some cases, such technologies could minimize the role of human labor in their workspace to a certain degree that their tasks can be replaced entirely. A recent study confirmed that industrial robot utilization could reduce the employment-to-population ratio by 0,2 % for one robot in the US (Acemoglu & Restrepo, 2020). Reducing human labor in the workspace is not an extremely complicated decision for managers since their primary concern is only organizational profit. But from the policy makers' perspective, massive technological unemployment is a big deal since the phenomena can cause widespread poverty and generate detrimental effects on the economy.

Unemployment still becomes one of the significant economic problems in some developing countries. No exception occurs in OIC member countries that are comprised of 57 developing countries. As stated in a report published by OIC, OIC countries' average unemployment rate trend has been increasing in recent years. In 2019 or a year before the global pandemic, the average unemployment rate in OIC countries was 6,7%, higher than the worldwide average, amounting to 5,4% (SESRIC OIC, 2020). It means that the unemployment problem should become a significant concern for the governments in the countries.

Some recent studies tried to analyze the determinant factors of unemployment. A Postula (2021) study found that ICT utilization had a limited effect on unemployment. The study by Umam and Wardhana (2020) found that investment negatively and significantly impacted unemployment. At the same time, a study by Majjama'a et al. (2019) resulted in the conclusion that population and currency had a positive impact on unemployment. Then, empirical research from Ruchba and Hadiyan (2019) found that CPI positively and significantly impacted unemployment.

Moreover, a study by Wulandari et al. (2019) concluded that inflation significantly affected unemployment. At the same time, a study from Metu (2019) found that cellphone utilization negatively and significantly impacted youth unemployment in Sub-Saharan Africa. Empirical research from Sitompul and Simangunsong (2019) found that GDP and minimum wage positively and significantly reduced unemployment. Then, an empirical study by Matuzeviciute et al. (2017) found that technological innovation's effect on unemployment is non-existent. In South Korea, a study from Shin (2017) found that intellectual property registration significantly affected provincial-level unemployment in the country. Lastly, a study from Ebaidalla (2016) found that GDP growth, inflation, domestic investment, and population growth significantly affected youth unemployment in OIC member countries.

Unemployment is such an important topic for further research since the condition of human resources in a country could determine the country's economic performance. For example, a recent study indicates that human resource-related variables like life expectancy rate, population growth, and labor force proportion significantly influence the GDP per capita in some ASEAN countries (Wibowo, 2019). We believe that the solution to the unemployment problem in developing countries like OIC member countries also needs to be investigated through empirical research. However, the empirical studies examining unemployment in OIC countries are relatively limited, and the results are still inconsistent. Thus, we study this topic empirically to investigate factors influencing unemployment in OIC countries.

This study examines the effects of innovation, IT advancement, GDP, and inflation on unemployment. Some existing theories have underpinned our consideration in selecting such variables. First, we are intrigued to examine the effects of innovation and technological advancement on employment since Schumpeter argued that development is a historical process of structural changes driven by innovation, and the innovation itself will cause different kinds of work (Sledzik, 2013). Thus, we plan to use innovation and IT advancement as independent variables. Moreover, Phillips's curve explains that there is a negative relationship between inflation and unemployment (Mankiw, 2010). Higher inflation will be associated with lower unemployment and vice versa. Thus, we will use inflation as one of the independent variables in this study to examine such a theory, mainly when applied to developing economies like OIC member countries. Then, Okun's law explains that national output and unemployment have an inverse relationship (Okun, 1962). So, GDP will be included as the proxy in national production as the independent variable.

RESEARCH METHODS

Our study will use data from OIC member countries with the past decade's average unemployment rate lower than 6%. We assume that such countries have relatively succeeded in tackling the unemployment problem, so the factors causing their relatively low unemployment must be analyzed. We will employ data from 20 countries from 2013 to 2021. Secondary data that will be used in this study include a) unemployment rate as the proxy of unemployment, b) consumer price index as the proxy of inflation, c) GDP per capita as the proxy of GDP, d) internet user percentage as the proxy of IT advancement, and e) global innovation index as the proxy of innovation. The data of the global innovation index are collected from WIPO co-organized <https://www.globalinnovationindex.org> website, while data for CPI, GDP per capita, internet user percentage, and unemployment rate are obtained from <https://data.worldbank.org>.

We will analyze the data using panel data regression methods consisting of common effect, fixed effect, and random effect approaches. The best among the three models above is selected by carrying out panel data specification tests comprised of Chow, Breusch-Pagan, and Hausman tests. The Chow test chooses the best model between the common and fixed effect models. The

Breusch-Pagan test is used to identify the better model between the common and random effect models. At the same time, the Hausman test is employed to determine the reliability between fixed effect and random effect models. In addition, we would carry out classical assumption tests to ensure that our model is valid as an estimator. Classical assumption tests consisted of normality, heteroscedasticity, multicollinearity, and autocorrelation tests.

The panel data regression equation model in this study is as follows:

$$\log Y_{it} = \beta_0 + \beta_1 \log X_{1it} + \beta_2 \log X_{2it} + \beta_3 \log X_{3it} + \beta_4 \log X_{4it} + \varepsilon_{it} \dots \dots \dots (1)$$

With, Y = unemployment; X₁ = inflation; X₂ = GDP; X₃ = IT advancement; X₄ = innovation β_{1,2,3,4} = coefficient; i = 20 OIC member countries (cross-section); t = 2013-2021; ε_{it} = Error term.

RESULT AND DISCUSSION

1. Best Model Selection

Panel data regression consists of common, fixed, and random effect approaches. The estimation results of the three models aforementioned above are shown in the following table.

Table 1. Estimation Results of Panel Data Regression

Variable	Common Effect		Fixed Effect		Random Effect	
	t-stat	p-value	t-stat	p-value	z-stat	p-value
C	1,372	0,172	3,679	0,000	1,419	0,156
Log X ₁	0,145	0,885	-1,971	0,050	0,085	0,932
Log X ₂	-2,600	0,010	-4,389	0,000	-2,661	0,007
Log X ₃	-0,838	0,403	-1,880	0,062	-0,856	0,391
Log X ₄	-2,049	0,042	-1,623	0,107	-2,046	0,040

To begin with, we must select the best model among common effect, fixed effect, and random effect models through model specification tests consisting of the Chow test and Hausman test. The results of model specification tests are as follows.

a. Chow Test

Based on the results of the Chow test, the Chi-square cross-section probability value is 0,022, which is less than the significance threshold (α) of 0.05. Thus, H₀ is rejected and H₁ is accepted, and we conclude that the fixed effect model is preferred over common effect model.

b. Breusch-Pagan Test

Based on the results of the Breusch-Pagan test, the probability (prob. chi-square) value is 0,596, which is greater than the significance threshold (α) of 0.05. Thus, H₀ is rejected and H₁ is accepted, and we conclude that the random effect model is preferred over common effect model.

c. Hausman Test

Based on the results of the Hausman test, it can be seen that the probability (prob. chi-square) value is 0,000, which is smaller than the significance level (α) of 0.05. Thus, H₀ is rejected and H₁ is accepted, and we

can conclude that the fixed effect model is more consistent than the random effect model.

According to the results of model specification tests, we decided that our fixed effect model is the most reliable one. We could use it to estimate the effect of inflation, GDP, IT advancement, and innovation on unemployment in OIC member countries.

2. Classical Assumption Test

Before we analyze the model, we must conduct classical assumption tests to ensure the model is valid as an estimator. Classical assumption tests consist of normality, heteroskedasticity, multicollinearity, and autocorrelation tests. Based on the normality test results, we got a Jarque-Bera probability value of 0,576, which is more significant than the significance level ($\alpha = 0.05$). So it can be concluded that the data in this study were normally distributed. A multicollinearity test is performed to decide whether there is a high correlation between the independent variables. The multicollinearity test in this study was carried out by evaluating the VIF values.

Table 2. Multicollinearity Test

Variable	VIF Value
Log X ₁	1,021
Log X ₂	1,170
Log X ₃	1,084
Log X ₄	1,077

Based on the results of the multicollinearity test, it can be seen that the VIF values of all independent variables are less than 10,0. So, there is no multicollinearity problem in the four independent variables we use in this study. A heteroscedasticity test is performed to decide whether there are variance similarities among residual observations. We will use the White test to detect the presence of a heteroskedasticity problem.

Table 3. Heteroscedasticity Test

White-test Statistical Value	Probability Value
14,293	0,428

Based on the White test results, we got a probability value of 0,4281, higher than the significance level of 0.05. So we can conclude that there's no heteroskedasticity problem in the model. Then, we will use the Durbin-Watson value to detect the presence of autocorrelation. The result shows that the DW value is 2,017, between dU of 1,802 and 4-dU of 2,198. Thus, we can conclude that the model has no autocorrelation problem.

We can assume that the model is valid as an estimator based on the results of classical assumption tests comprised of normality, multicollinearity, heteroscedasticity, and autocorrelation tests.

3. Regression Model Output

Model specification test results suggest that the fixed effect model is the best among the three. Therefore, the estimation result of fixed effect model will be analysed further in this study. The following equation can estimate the panel data regression model for the fixed effect approach:

$$\log Y_{it} = 0,101 - 1,149\log X_{1it} - 2,438\log X_{2it} - 0,199\log X_{3it} - 0,236\log X_{4it} + \varepsilon_{it}.(2)$$

4. Hypothesis Test

a. F-statistics

The estimation results show that the value of the F test statistic is 2.356, and the probability value of the F test is 0.001, which is smaller than the significance level of 0.05. Thus, it can be concluded that all independent variables simultaneously significantly affect unemployment at a significance level of 0.05.

b. Coefficient of Determination Test (R^2)

The R-squared value of the model is 0.285; This means that a model can explain the relationship between the independent and dependent variables at 28.5%. Meanwhile, the remaining 71,5% is explained by other variables outside the model.

c. T-statistics

The partial effect of the independent variables on the dependent variable was carried out by comparing the p-value and significance level (α) of 0.05.

Table 4. Fixed Effect Model t-statistics

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Log X1 (Inflation)	-1,149	0,582	-1,971	0,050
Log X2 (GDP)	-2,438	0,555	-4,389	0,000
Log X3 (IT Adv.)	-0,199	0,106	-1,880	0,062
Log X4 (Innovation)	-0,236	0,146	-1,623	0,107

First, we will examine the effect of inflation on unemployment in the countries observed. As shown in the table above, the estimation results indicate that the inflation variable has a regression coefficient value of -1,149, a t value of -1,971, and a probability value of 0,050. The probability value of 0,050 is equal to the significance level of 0.05. With a regression coefficient of -1,149, it can be concluded that inflation has a negative and significant effect on unemployment at a significance level of 0.05.

Then, we examine the relationship between GDP and unemployment. As shown in the table, estimation results show that the GDP per capita has a regression coefficient value of -2,438, a t value of -4,389, and a probability value of 0.000. The probability value of 0.0000 is smaller than the significance level of 0.05. With a regression coefficient of -2,438, it can be concluded that the GDP has a negative and significant effect on unemployment at a significance level of 0.05.

Furthermore, we analyze the influence of IT advancement on unemployment. The estimation results show that the information technology advancement has a regression coefficient value of $-0,199$, a t value of $-1,880$, and a probability value of $0,062$. The probability value of $0,062$ is higher than the significance level of 0.05 . With a regression coefficient of $-0,199$, it can be concluded that information technology advancement has a negative but insignificant effect on unemployment at a significance level of 0.05 .

Finally, we try to examine the effect of innovation on unemployment. As shown in the table, the estimation results show that the innovation variable has a regression coefficient value of $-0,236$, a t value of $-1,623$, and a probability value of $0,107$. The probability value of $0,107$ is greater than the significance level of 0.05 . With a regression coefficient of $-0,236$, it can be concluded that the innovation variable has a negative but insignificant effect on unemployment at a significance level of 0.05 .

The Effect of Inflation on Unemployment

It seems that the COVID-19 pandemic directly impacted inflation in many OIC member countries. Based on a report from [SESRIC OIC \(2021\)](#), average inflation in OIC member countries had increased from $7,5\%$ in 2019 to $9,1\%$ in 2020. Some scholars believe some relationships exist between inflation and other macroeconomic variables like unemployment. In 1958, Phillips discovered empirical records confirming a stable and robust inverse relationship between unemployment and inflation in the UK throughout past centuries ([Romer, 2012](#)). This empirical fact can be used to support the argument that there is a trade-off between unemployment and inflation.

Based on our estimation results, it can be concluded that inflation has a negative and significant effect on unemployment at a significance level of 0.05 . This finding is consistent with Philips' theory which states that decreasing unemployment, and vice versa, will accompany increasing inflation. The results also refute the conclusion in the study from [Ruchba and Hadiyan \(2019\)](#), which found that inflation has a positive and significant effect on unemployment in Indonesia. This phenomenon is understandable, considering that according to the law of supply, when companies can sell their products at a higher price, they will undoubtedly try to increase production capacity to maximize profits. Consequently, it will generate inflation due to the increasing cost of products the firms sell.

The Effect of GDP on Unemployment

GDP condition in OIC member countries varies greatly among high-income and low-income countries. Based on a dataset updated by World Bank in 2023, a middle eastern oil-rich country like Qatar had a GDP per capita of USD 63.782 in 2022. While a low-income developing country like Somalia only had a GDP per capita of USD 434 in the same year. Some scholars also argue that there are some relationships between national output, as reflected by the GDP, and other macroeconomic indicators like unemployment Okun's study ([1962](#)), found a connection between national work and unemployment.

It means that the increases in national production will be followed by decreases in unemployment, and vice versa.

From the estimation results we have carried out, it can be concluded that GDP, which reflects national output, has a negative and significant effect on unemployment at a significance level of 0.05. This finding follows Okun's law, which explains that an increase in a country's national output (reflected in gross domestic product) will be accompanied by a decrease in the unemployment rate. This finding is also consistent with the results of research from [Sitompul and Simangunsong \(2019\)](#), which state that gross domestic product significantly reduces unemployment. This phenomenon can be explained by considering that the more productive a country produces output, the more labor will be absorbed, so unemployment will also decrease.

The Effect of IT Advancement on Unemployment

In terms of the development in information technology, the OIC countries, especially those in the Middle East, can be said to be quite advanced. In fact, according to data published in the article by [Hanis and Zeki \(2016\)](#), Bahrain occupied the top position in the ICT Index ranking. However, when viewed as a whole, the average ICT Index score for OIC member countries only reached 3.18, which was still below the world average, reaching 4.16. Some scholars tried to explain the relationship between technological advancement and unemployment. [Feldmann \(2013\)](#) argued that faster technological changes would increase unemployment substantially. This argument was supported by Schumpeter, who argued that more rapid technological advancement would increase unemployment, especially in the transition period. Radical information and communication technology advances in recent decades have significantly changed production processes in many manufacturing, retail, and service industries. We argue that using ICT and hi-tech machinery in some sectors will replace human labor tasks. As a result, such phenomena could reduce employment and job openings to a certain degree.

Our estimation results for the fixed effect model indicate that advances in information technology have a negative but insignificant effect on unemployment at a significance level of 0.05. This finding is consistent with the results of a study by [Metu et al. \(2019\)](#) which found that information technology advancement proxied by internet use did not significantly affect unemployment in sub-Saharan African countries; This may be because the effect of information technology advancement on the unemployment rate will be observable only after a long-time period so that this relationship phenomenon cannot be captured in a model that only uses data from nine years.

The Effect of Innovation on Unemployment

The innovation performance of OIC member countries also varies significantly among nations. Based on Global Innovation Index 2022, United Arab Emirates became the most innovative among OIC member countries, ranked 31st among 132 nations. At the same time, Guinea became less creative than all countries worldwide. Some researchers analyzed the effect of innovation on unemployment. [Vivarelli \(2015\)](#) argued that process innovations

can reduce job opportunities, while product innovation will lead to new businesses, industrial sectors, and job opportunities. The labor market mechanism will compensate for the reduction of job opportunities driven by process innovation.

Based on our estimation results, it can be concluded that innovation has a negative but insignificant effect on unemployment at a significance level of 0.05. This finding is inconsistent with the results of the study by Shin (2017), who found that innovation proxied by intellectual property rights significantly affects provincial-level unemployment in South Korea; This may be because the OIC countries that we observed are not innovation-rich industrial countries so that the effect of innovation on unemployment in these countries cannot be marked.

CONCLUSION

Based on the study results, we concluded that inflation and GDP had adverse and significant effects on unemployment in OIC member countries. In contrast, IT advancement and innovation had an insignificant impact. We think it is essential for the government as policymakers to create appropriate regulations allowing industries to enhance their productivity to enlarge job opportunities and alleviate unemployment. We also suggest that government needs to encourage product innovation by the firms through their policies. More innovative products will generate more new markets, and new markets will generate new jobs, as mentioned in previous relevant studies.

REFERENCE

- Acemoglu, D. & Restrepo, P. (2020). Robots and Jobs: Evidence from US Labor Markets. *Journal of Political Economy*, 2020, 128(6)
- Borjas, G. J. (2020). Labor Economics 8th Edition. *McGraw-Hill Education*
- Ebaidalla, M. (2016). Determinants of Youth Unemployment in OIC Member States: A Dynamic Panel Data Analysis. *Journal of Economic Cooperation and Development*, 37(2) 81-102
- Ehrenberg, R. G. & Smith, R. S. (2012). Modern Labor Economics: Theory and Public Policy 11th Edition. *Pearson Education Inc.*
- Feldmann, Horst. (2013). Technological Unemployment in Industrial Countries. *Journal of Evolutionary Economics* 23(5) 1099-1126
- Hanis, F. N. & Zeki. A. M. (2016). ICT Readiness and Information Security Policies in OIC Countries. *International Journal of Scientific and Research Publication* 6(1)
- <https://data.worldbank.org>
- <https://www.globalinnovationindex.org>
- Majjama'a, R. et al. (2019). Impact of Population Growth on Unemployment in Nigeria: Dynamic OLS Approach. *Journal of Economics and Sustainable Development* 10(22)
- Mankiw, N. G. (2010). Macroeconomics 7th Edition. *New York. Worth Publishers*

- Matuzeviciute, K. et al. (2017). Does Technological Innovation Affect Unemployment? Some Empirical Evidence from European Countries. *Economies* 5(48)
- Metu, A. G. et al. (2019). Ending Youth Unemployment in Sub-Sahara Africa: Does ICT Development have any Role? *The 2019 African Economic Conference*
- Okun, A. M. (1962). Potential GNP: Its Measurement and Significance. *Cowles Foundation Paper* 190
- Postula, M. et al. (2021). The Impact of Information and Communication Technologies (ICT) on Energy Poverty and Unemployment in Selected European Union Countries. *Energies* 14(6110)
- Pyndick, R. S. & Rubinfeld, D. L. (2013). *Microeconomics* 8th Edition. *New Jersey. Pearson Education Inc.*
- Romer, David. (2012). *Advanced Macroeconomics* 4th Edition. *New York. McGraw-Hill Irwin*
- Ruchba, S. M. & Hadiyan, F. (2019). Analysis of Unemployment and Inflation in Indonesia for 1980 -2016 using the Philipps Curve Approach. *Proceeding of the 3rd International Conference on Accounting, Business & Economics*
- Schumpeter, J. A. (1934). *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and The Business Cycle.* *New Brunswick. Transaction Publishers.*
- SESRIC OIC. (2020). *OIC Labour Market Report 2020. Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC)*
- SESRIC OIC (2021). *OIC Economic Outlook 2021. Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC)*
- Shin, Soon Ho. (2017). The Impact of Intellectual Property on Provincial Unemployment Rates in South Korea. *MPA/MPP/MPFM Capstone Projects.* 282
- Sitompul, T. & Simangunsong, Y. (2019). The Analysis of the Impact of GDP, FDI, and Minimum Wage on Employment in Indonesia. *International Journal of Management, Entrepreneurship, Social Science and Humanities (IMESH)* 2(2) 53-62
- Sledzik, Karol. (2013). Schumpeter's View on Innovation and Entrepreneurship. *SSRN Electronic Journal* DOI. 10.2139/ssrn.2257783
- Umam, A. K. & Wardhana, O. H. P. (2020). Investment, Debt Instruments, and Economic Growth: Their Impact on The Unemployment Rate of OIC Countries in the Asian Region. *Journal of Islamic Economics Lariba* 6(2) 1-18
- Vivarelli, Marco. (2015). Innovation and Employment. *IZA World of Labor* 154
- Wibowo, M. G. (2019). Human Capital Relation with Welfare in Indonesia and ASEAN Countries. *Economic Development Analysis Journal* 8(1)
- Wooldridge, J. M. (2013). *Introductory Econometrics: A Modern Approach* 5th Edition. *Ohio: Cengage Learning*
- Wulandari, D. et al. (2019). Nexus between Inflation and Unemployment: Evidence from Indonesia. *Journal of Asian Finance, Economics and Business* 6(2) 269-275