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Economic growth and labour market in the European Union: lessons from COVID-19

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Abstract

Research background: The world has been fighting the new pandemic caused by COVID-19 since March 2020. The subsequent restrictions on economic activity resulted in a supply shock, accompanied by a supply chain disruption, job layoffs, reduced work time and wages and decreased disposable incomes and taxes, which led to a demand shock. However, whether a close link exists between the number of confirmed cases, deaths and economic indicators during the COVID-19 pandemic remains uncertain.

Purpose of the article: The current study aims to analyse the impact of the number of infections and deaths on economic growth and labour market indicators in the member states of the European Union.

Methods: To achieve the main research goal, we conduct a panel data analysis on the quarterly data of 2020. Specifically, we developed three random-effects panel data econometric models to estimate the significance of infection and mortality rates for economic growth as well as employment and unemployment rates.

Findings & value added: This study contributes to the existing literature by analysing the link between the infection and mortality rates of COVID-19 and selecting macro-economic indicators within the European Union. The results show that the infection rate is not a significant variable for economic growth and labour market indicators. However, an increase in the number of confirmed deaths has a significantly negative impact on the economy. Moreover, an increase in the mortality rate has a worse impact on the labour market than on economic growth in general.

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These results can serve as a theoretical basis for future research on the interconnections between pandemics and macro-economic indicators. The findings can also contribute to developing efficient policy instruments for mitigating the negative impact of pandemics in the future, thereby ensuring the cooperation of fiscal, monetary and health policy authorities.

Introduction

Since March 2020, the increase in COVID-19 infections led to governments across the world applying strict measures to mitigate the consequences of the pandemic on their citizens (Caplanova *et al.*, 2021a). These measures included complete lockdowns, the partial closure of borders and social distancing, adversely affecting not only economic activity but also vital spheres for economic growth such as tourism and travel (Carrasco & Tovar-Garcia, 2020; Korzeb & Niedziółka, 2020; Adham, 2021; Zinecker *et al.*, 2021). Consequently, the highly positive economic growth forecasts for 2020 were adjusted to negative values for most countries, indicating a notable phase of economic recession. The macro-economic indicators point to the deepest contraction of the world economy since the Great Recession (Stock, 2020; Li *et al.*, 2021).

The pandemic-related restrictions on economic activity, particularly the lockdowns and forced temporary closures of some business types as well as the cessation of international tourism, resulted in a supply shock, which was accompanied by a supply chain disruption (Gavurova *et al.*, 2021; Dvorsky *et al.*, 2021b; Cortes *et al.*, 2021). This simultaneously led to job layoffs, reduced work time and wages and decreased disposable incomes and taxes (Tu *et al.*, 2021; Tagliacozzo *et al.*, 2021; Dvorsky *et al.*, 2021a; Hlouskova *et al.*, 2017). Moreover, consumer spending behaviour also started changing (Radkte *et al.*, 2021; Gavurova *et al.*, 2020c; Waliszewski & Warchlewska, 2021). First, the lockdown measures limited the possible spending areas (Bhowmik *et al.*, 2021; Carrasco Sierra *et al.*, 2021). Second, negative economic expectations caused people to restrict their spending on the assumption that their income would continue to witness a downward trend in the future (Pan & Yue, 2021; Gavurova *et al.*, 2020a). Thus, the supply shock rapidly turned into a demand shock.

In general, spending is a crucial factor in global economic growth. The most important channels through which COVID-19 has affected consumer spending are consumer confidence, unemployment levels, reduced wages and the cost of living (Gabrielli & Impicciatore, 2021; Rebhun, 2021). The pandemic also has changed the spending structure (Machová *et al.*, 2021; Pimonenko *et al.*, 2021).

Namely, the COVID-19 pandemic has influenced the global economy through a supply shock and disruptions in international and regional supply chains, reduction in incomes, changes in consumer behaviour and a demand shock. However, whether there is a close link between the number of confirmed cases, deaths and economic indicators during the COVID-19 pandemic remains uncertain. Studies have analysed the impact of confirmed COVID-19 cases and deaths on the stock market (Chatjuthamard *et al.*, 2021; Guven *et al.*, 2022), economic growth (Feng *et al.*, 2022), industrial production in selected OECD countries (Apergis & Apergis, 2021) and unemployment in the United States (Matthay *et al.*, 2021) and five European Union (EU) countries (Su *et al.*, 2021). However, no comprehensive investigation has analysed the interconnections between the COVID-19 pandemic and macro-economic indicators in the EU.

In this context, the present research aims to analyse the impact of the number of infections and deaths on the economic growth and labour market indicators in the member states of the EU. To achieve the main goal of the study, we conduct a panel data analysis on the quarterly data for 2020. Our research hypothesis is that the COVID-19 pandemic had a negative impact on economic growth and the labour market through mortality rate rather than through infection rate.

The structure of the present study begins with this an introduction, which presents the relevance of the topic and is followed by a theoretical section that provides a comprehensive literature review. Next, the research methodology section explains the methods, sample and methodology used to examine the research hypothesis. The subsequent section presents the results, followed by a discussion that indicates the contributions of the research to the existing literature. In the last section, we introduce the conclusions drawn from the current research.

Literature review

A new economic situation in the world has emerged. The COVID-19 pandemic has already affected almost all countries worldwide. The danger of the pandemic has forced governments in numerous countries to implement unprecedented measures that significantly limit economic activity (Pardal *et al.*, 2020; Kufel, 2020). During the different phases of the pandemic, many countries either stopped or moved to remote working for non-essential economic activities to avoid the collapse of national health systems (Chauhan *et al.*, 2020; Troccoli *et al.*, 2021; Larsen & Schaeffer, 2021; Negură *et al.*, 2021, Caplanova *et al.*, 2021b, Carlotti, 2021). Conse-

quently, the pandemic affected global economic growth and caused widespread job layoffs (Salman, 2021; Kim, 2022; Gavurova *et al.*, 2020b; Stefancik *et al.*, 2021; Vorobeva & Dana, 2021), leading to an increase in unemployment (Barbieri Góes & Gallo, 2021; Su *et al.*, 2021; Svabova *et al.*, 2021), adverse effects on global trade (Espitia *et al.*, 2021; Vidya & Prabheesh, 2020) as well as the tourism and travel sectors (Zhang *et al.*, 2021a; Duro *et al.*, 2021) and reductions in the global flows of foreign direct investments (Giofré, 2021; Kiruba & Vasantha, 2021).

To better understand the possible long-term impacts of pandemics, we should review the literature on the consequences of similar past events that occurred on a global scale. The world has known several periods of epidemics and pandemics. The worst pandemic happened in 1918–1920, namely, the Great Influenza. Subsequently, epidemics occurred in the 2000s, with the first being the SARS outbreak (2003), closely followed by H5N1 (2004–2006), H1N1 (2009), MERS (2012) and H7N9 (2013). These events had a negative impact on the world economy, changing both living standards and socio-economic indicators. However, according to different studies, the economic consequences of these epidemics and pandemics were not as severe as those of the recent COVID-19 crisis (Inegbedion, 2021; Beach *et al.*, 2020; Şerban, 2021; Kabir, 2021).

Barro *et al.* (2020) analysed data from 43 countries and concluded that given the flu and war deaths from World War I in 1918–1920, the typical economic decline had been around 6 percent, with an 8 percent decline in consumption. In addition, Karlsson *et al.* (2014) identified that the Spanish Flu caused an increase in poverty rates, and Almond (2006) found evidence of a long-term adverse effect on productivity. Moreover, Verikios *et al.* (2011) used data from two influenza pandemic periods and concluded that given the case of higher infection rates instead of higher virulence, the negative impact of a pandemic on the global economy would be higher, *ceteris paribus*.

The SARS outbreak resulted in less severe economic consequences. Doan *et al.* (2020) analysed its impact on the economies of China, Hong Kong, Taiwan and Singapore, concluding that its economic consequences were short, and that there was a quick recovery of economic growth in the selected Asian economies. Furthermore, after analysing the behavioural response to the epidemic, Noy and Shields (2019) concluded that a pandemic with a higher mortality rate could result in a catastrophic impact on the global economy because of possible drastic changes in consumer behaviour (Willett *et al.*, 2014; Petrović & Radoman, 2020; Manić & Mirkov, 2020; Horvath *et al.*, 2021; Sivák *et al.*, 2019; Smekalova *et al.*, 2014).

However, academic and empirical studies have argued that the COVID-19 pandemic has caused an unprecedented economic crisis in the modern world (Altig *et al.*, 2020; McKibbin & Roshen, 2021). The current research takes its cue from the literature mentioned herein and other prominent papers on the topic, including Mavroudeas (2020), Priya (2020), Ruiz Estrada (2021), Jawad *et al.* (2021), Pinilla *et al.* (2021), Gavrilovic and Vucekovic (2021) and Zhang *et al.* (2021b).

Khan *et al.* (2021) used descriptive analysis to investigate the impact of the COVID-19 pandemic on economic variables and concluded that the pandemic has transformed into an economic and labour market crisis and will have a long-run impact on the labour market. Using a sample of 100 countries, Feng *et al.* (2022) analysed the vulnerability of economies to the COVID-19 pandemic. Their results indicated that income level, income inequality and population density are significant factors.

Upon analysing the growth potential in the EU, Halmai (2021) argued that the recent coronavirus crisis will have a long-term impact on gross domestic product (GDP) because of a decrease in investments and labour market hysteresis. The latter is confirmed by Apergis and Apergis (2021), who argued that the COVID-19 pandemic and other similar shocks could lead to a significant decrease in the industrial production. In addition, adverse effects in the long-term spillover are expected on the real sector of the economy. Moreover, comparing the pandemic-caused crisis to the global financial crisis of 2008, another investigation emphasised that the recent crisis caused an immediate shock in the real sector, leading to a supply-side shock in the economy (Babović, 2020).

COVID-19 also disrupted the labour market (Ancillo *et al.*, 2021; Belás *et al.*, 2021). Although the labour demand rebounded in the short term, Krumel *et al.* (2021) showed that there is a labour shortage because of the decreases in salaries and in the quality of required skills. Exploring the impact of COVID-19 cases and deaths on five EU countries, Su *et al.* (2021) concluded that the pandemic has caused unemployment in three of the selected countries. The aforementioned authors also argued that an increase in the number of confirmed cases has a more significant impact on the labour market than an increase in the number of deaths. Jordà *et al.* (2022) used data on 15 significant pandemics, which resulted in more than 100,000 deaths. Their investigation focused on the long-term effects of pandemics, that is, the macro-economic indicators during the post-pandemic years, and concluded that significant macro-economic effects can be found in up to 40 years following a pandemic.

Regarding the policy responses to the COVID-19 pandemic, Guven *et al.* (2022) argued that state aid programmes in selected emerging econo-

mies have positively influenced the stock market and effectively reduced the negative impact of the daily growth of confirmed infections and deaths. Moreover, analysing the effects of the pandemic on financial markets, Chatjuthamard *et al.* (2021) argued that an increase in infections negatively influences stock market returns, whereas the impact is more substantial in the countries with a higher financial risk. Wang *et al.* (2021) found a negative correlation between government responses and infection rates. The latter was also supported by the research outcomes of Chisadza *et al.* (2021). However, several studies have argued that stringent government policies in response to the COVID-19 pandemic have a stronger negative impact on global value chains, leading to a deeper recession and significant long-term negative consequences (Ravi Kumar & Babu, 2021; Pla-Barber *et al.*, 2021; Zhao & Kim, 2021).

Given the absence of a comprehensive analysis of the transmission mechanisms of the pandemic in relation to the macro-economic performance in the EU and in accordance with the predetermined research hypothesis, the present study contributes to the existing literature by analysing the link between the infection and mortality rates of COVID-19 and selected macro-economic indicators within the countries of the EU.

Research method

This study aims to test the significance of the impact of COVID-19 infection and mortality rates on economic growth and labour market indicators. To this end, quarterly panel data on the EU countries (including Switzerland) from 2020 were used. Despite the short time period of available data, the panel data approach provides sufficient observations for the regression model. The estimation of the panel data regression model was carried out in the program EViews 10. Performing a panel data regression is a common approach to test the influence of selected variables on key economic indicators, particularly during a short period (see de la Fuente-Mella *et al.*, 2021).

Here, GDP was chosen as an indicator of economic growth. The data from 2020Q1 to 2020Q4 have been logged on a natural basis. To estimate the economic growth (recession) during the quarter and avoid seasonality, the first difference against the same period of the previous year was calculated. The data were checked against outliers and seasonality and adjusted appropriately. Furthermore, corresponding tests for stationarity and heteroscedasticity were conducted.

The following indicators were chosen to test the impact on the labour market: employment (EMP) and unemployment (UNEMP). The aforemen-

tioned data processing was applied for these indicators. The three dependent variables follow the rules of normal distribution. The data of the selected economic indicators were obtained from the Eurostat database.

The infection rate (IR) and mortality rate (MR) for COVID-19 comprise the independent variables of the developed panel data models; we acquired the data on the confirmed infections and deaths per million inhabitants from the ourworldindata.org database. The data processing described earlier was applied to the independent variables. The first differences were calculated against the previous period. Hence, the first quarter of 2020 was dropped for the models. Table 1 shows the descriptive statistics of GDP, employment, unemployment, IR and MR.

Per the aforementioned research hypothesis, the current research contributes to the literature by evaluating the impact channels of the pandemic on the economic and labour market performance of EU member states. The expected outcomes are the significance of the impact of IR and MR in the selected macro-economic indicators.

Equations (1), (2) and (3) present the three panel data econometric models that were developed:

$$GDP_{it} = C + \alpha IR_{it} + \beta MR_{it} + u_i + \varepsilon_{it} \quad (1)$$

$$Emp_{it} = C + \alpha IR_{it} + \beta MR_{it} + u_i + \varepsilon_{it} \quad (2)$$

$$Unemp_{it} = C + \alpha IR_{it} + \beta MR_{it} + u_i + \varepsilon_{it} \quad (3)$$

where $i = 1, \dots, N$ are the countries included in the panel data; $t = 1, \dots, T$ are the periods observed in the model; IR_{it} is a vector of time-varying explanatory variables for IRs across 29 countries; MR_{it} is a vector of time-varying explanatory variables for MRs across 29 countries; GDP_{it} , Emp_{it} and $Unemp_{it}$ are the dependent variables and ε_{it} is the error term. The panels are balanced because all the data on quarterly observations among the selected countries are included. The total number of observations is 87.

u_i is the individual residual that depends on which of the coefficients of each of our three models can be best estimated through one of the following three models: pooled ordinary least squares (OLS), fixed effects and random effects.

The following section presents the results and a discussion of the estimation of the econometric models. The ordinary coefficients covariance and Swamy–Arora random-effects methods were used for the estimation.

Results

The estimation results for the GDP model are presented in Table 2, the employment model in Table 5, and the unemployment model in Table 8. The left section of the tables shows the pooled-OLS model estimation results. The probability values of both regressors in the GDP model are less than 0.05. Given the 5% significance level, there is strong evidence to reject the null hypothesis of coefficients equal to 0. Hence, both IR and MR are considered significant. The adjusted *R*-square equals 0.23, which indicates that the regressors can explain 23% of the change in economic growth. However, the aim herein is to test the significance of independent variables. In the case of the (2) model, neither IR nor MR is significant, with an adjusted *R*-square of 0.0124. The same holds in the model (3) with an adjusted *R*-square of -0.0076 .

The middle section of the table shows the estimation output in the case of the fixed-effects method. In model (1), both regressors are significant, whereas in models (2) and (3), only MR is significant. The same holds for the random-effects method presented at the right side of the corresponding tables.

To determine the most appropriate model, two primary tests were applied: the Lagrange multiplier (LM) test for panel data and a correlated random-effects test or the Hausman test. The LM test compares whether the pooled-OLS or random-effects method is more appropriate for the model under consideration. Tables 3, 6 and 9 show that the *P*-value of all the performed tests is less than 0.05 for all three models. Hence, the null hypothesis of the model having no random effects is rejected, which means that the pooled-OLS model is not appropriate. Subsequently, we proceed with the Hausman test to ascertain whether the random- or fixed-effects method is better. Tables 4, 7 and 10 show the results. The null hypothesis is that there are cross-section random effects. The chi-square value and *P*-value show that we do not have reason to reject the null hypothesis and that the cross-section random-effects method is the most appropriate one to estimate the coefficients in models (1), (2) and (3). Thus, we have chosen the random-effects model in all three cases. Subsequently, we will discuss the estimation results of the random-effects model for GDP, employment and unemployment in detail.

Equations (4), (5) and (6) show the estimated random-effects models for GDP, employment and unemployment, respectively.

$$GDP_{it} = -0.0607 + 0.0414IR_{it} - 0.0401MR_{it} \quad (4)$$

$$Emp_{it} = -0.019 + 0.0034IR_{it} - 0.0031MR_{it} \quad (5)$$

$$Unemp_{it} = 1.089 + 0.0549IR_{it} + 0.2069MR_{it} \quad (6)$$

The estimation results of model (1) show that the *P*-values for both IR and MR are lower than 0.05, which indicates sufficient evidence to reject the null hypothesis. The coefficient of MR is negative, which means that an increase in MR by 1% will lead to a 4% decrease in GDP, *ceteris paribus*, during a quarter. However, the coefficient of IR is positive. Although the initial stage of the pandemic was a shock for healthcare systems and governments applied strict lockdowns, countries adjusted to the new circumstances over time. Given the help of digital technologies, most people could switch to remote working even with mild cases of COVID-19, thereby mitigating the impact of IR on the economy. Moreover, the economy started to recover closer to the end of the year. The Durbin–Watson (DW) statistic is 1.97, indicating that no autocorrelation can be observed in the model.

The estimation results of model (2) show that the *P*-value for the coefficient of IR is more than 0.05, which indicates that there is insufficient evidence to reject the null hypothesis at a 5% significance level. Hence, IR does not influence the employment rate in EU member states. By contrast, because there is substantial evidence to reject the null hypothesis, MR is a significant factor. The coefficient of MR is negative, which means that an increase in mortality rate by 1% will lead to a 0.3% decrease in employment, *ceteris paribus*, during a quarter. The DW statistic is 1.73, indicating that no autocorrelation can be observed in the model.

The estimation results of model (3) show that the *P*-value for the coefficient of IR again is more than 0.05, which indicates that there is insufficient evidence to reject the null hypothesis at a 5% significance level. Hence, IR does not influence the unemployment rate in EU member states. Conversely, MR is a significant factor, as there is strong evidence to reject the null hypothesis. The coefficient of MR is positive, which means that an increase in mortality rate by 1% will lead to a 20% increase in unemployment, *ceteris paribus*, during a quarter. The DW statistic is 2.19, indicating that no autocorrelation can be observed in the model.

In summary, the results show that IR is not a significant variable for economic growth and labour market indicators. However, an increase in the

number of confirmed deaths has a significant negative impact on the economy. These findings are in line with our assumptions and confirm our initial hypothesis. Moreover, the results show that given the case of high vaccination rates that lead to a lower number of severe COVID-19 cases and fewer deaths, the further development of the pandemic will not affect the economy and labour market significantly. The economic recovery in 2021 and the prospect of economic growth in 2022 (IMF, 2022) serve as evidence and confirm these research results. In 2021, the average world economic growth was 5.9%, and the economic growth in the Euro area accounted for 5.2%. The economic growth in the Euro area in 2022 and 2023 is projected to account for 3.9% and 2.5%, respectively.

Discussion

To the best of our knowledge, there is no research paper that analyses the impact of MR on the economy and labour market in the EU. However, some studies have estimated the effect of a pandemic IR on the economy. De la Fuente-Mella *et al.* (2021) used a panel data econometric analysis to assess the impact of the COVID-19 IR, the global health security index and belongingness to OECD on the GDP growth percentage in 2020. The aforementioned authors concluded that an increase in IR by 1,000 cases per million people leads to a 3% decrease in the GDP. Using research on Germany, Italy, France, Spain and the United Kingdom, Su *et al.* (2021) argued that an increase in the number of confirmed cases has a more significant impact on the labour market than an increase in the number of deaths. The latter goes against our hypothesis and results, according to which the IR is not a significant factor in terms of the labour market performance. It can be assumed that such results primarily arise because the negative impact of the IR was mitigated by the availability of remote working because of modern technologies and the high volume of state aid provided by the member states of the EU. This is confirmed by Guven *et al.* (2021), who found that state aid policies effectively reduce the negative impact of the daily growth of confirmed infections and deaths. Nevertheless, policymakers should ensure the efficient cooperation of fiscal, monetary and health policy responses to achieve a better recovery (Apergis & Apergis, 2021).

However, our results are supported by Keogh-Brown *et al.* (2010), who evaluated the potential economic costs of a modern pandemic using panel data for selected countries during and after the previous SARS, H1N1 and H5N1 outbreaks. Their results indicate that the GDP losses triple in light of strict lockdowns as well as the absence of vaccinations and prophylactic

measures. Their findings are in line with our results and confirm that in the case of an effective vaccination process, the negative economic impact is mitigated because it is more related to severe disease cases than to IR. The early analysis of Havrlant *et al.* (2021) confirmed that the most harmful aspect for the economy is not the rate of confirmed cases but the measures that are applied, such as lockdowns.

Our conclusions on the impact on employment rate indicate a far higher negative impact of the pandemic on the labour market than on economic growth and align with Marti and Puertas' (2021) findings, who studied the link between the negative impact of pandemics on health, social and labour market indicators and EU member-states' wealth levels. Their results show that although countries with higher income levels are less vulnerable in health and social spheres, these countries are equally vulnerable in terms of the labour market.

Conclusions

This research aimed to explore the influence of the COVID-19 IR and MR on economic growth and the labour market. The results show that the IR is not a significant variable for economic growth and labour market indicators (employment and unemployment) in the short term. However, an increase in the number of confirmed deaths has a significantly negative impact on the economy, as hypothesised. Moreover, an increase in MR has a worse impact on the labour market than on economic growth in general.

Given the results, it can be assumed that if high vaccination rates enable a lower number of severe COVID-19 cases and fewer deaths, the further spread of the virus and possible future waves of the pandemic will not affect the economy and labour market significantly. It is preferable for policymakers to not apply future strict lockdown measures given the successful vaccination of the population. Furthermore, it is not advisable for policymakers to apply strict lockdowns for future pandemic-related situations, and avoiding the same will help mitigate the negative short- and long-term effects on countries' economic performance.

The crucial factor for the economic recession was the disrupted global and national value and supply chains, which will have a negative long-term impact on the worldwide economy in the future. This disruption resulted from governments' strict protectionist measures. Although state aid mechanisms significantly mitigated the negative impact on the business environment and labour market in the short term, the long-term consequences of the pandemic have yet to be seen in the upcoming years. Thus, policymak-

ers should focus on rebuilding pre-pandemic economic ties and recovering the global and national value chains to alleviate the long-term effects of the pandemic. Considering the multifaceted nature of the COVID-19 crisis, an efficient economic recovery in the long perspective requires the cooperation of fiscal, monetary and health policy authorities.

The results and conclusions herein regarding the impact channels of the COVID-19 pandemic on the economic and labour market performance can serve as a theoretical basis for research on the interconnections between pandemics and macro-economic indicators as well as the development of policy instruments during such situations in the future. This study provides significant insights concerning policy implications for the labour market and economic performance.

The main limitations of the current research are that most of the countries studied have a high level of development and that a short-term analysis was performed given the data availability. Further research should be conducted to confirm these preliminary results and conclusions, with a consideration of other regions with some emerging and transition market countries and a longer time period. Moreover, future research is required to investigate the link between economic recovery and vaccination rates in the EU and other areas.

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Annex

Table 1. Descriptive statistics of the variables

	GDP	EMP	UNEMP	IR	MR
Mean	-0.056	-0.0184	1.07126	1.464	1.408
Median	-0.044	-0.183	1	1.429	1.275
Maximum	0.080	0.0194	3.3	3.410	3.796
Minimum	-0.237	-0.0576	-1.9	0.269	-0.075
Std. Dev.	0.064	0.015	0.887	0.747	1.114
Skewness	-0.661	0.117	-0.231	0.512	0.378
Kurtosis	3.153	3.490	4.19	2.699	1.934
Jarque–Bera	6.431	1.070	5.91	4.122	6.193
Probability	0.040	0.585	0.052	0.127	0.045
Observations	87	87	87	87	87

Source: own calculation based on data from Eurostat and ourworldindata.org.

Table 2. Estimation results for GDP

Regressor	Pooled OLS		Fixed effects (FEM)		Random effects (REM)	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
IR	0.042	0.0002	0.0409	0.0000	0.0414	0.0000
MR	-0.038	0.0000	-0.0406	0.0000	-0.0401	0.0000
C	-0.065	0.0000	-0.0593	0.0000	-0.0607	0.0000
R-square	0.2517		0.7934		0.4498	
R-square adj.	0.2339		0.6827		0.4367	
DW statistic	1.1990		2.6776		1.9745	

Source: own calculation based on data from Eurostat and ourworldindata.org.

Table 3. Lagrange multiplier (LM) test for GDP

Null (no rand. effect)	Cross-section	Period	Both
Alternative	One-sided	One-sided	
Breusch–Pagan	29.3277 (0.0000)	1.5206 (0.2175)	30.84827 (0.0000)
Honda	5.4155 (0.0000)	1.2331 (0.1088)	4.7013 (0.0000)
King–Wu	5.4155 (0.0000)	1.2331 (0.1088)	2.5896 (0.0000)

Source: own calculation based on data from Eurostat and ourworldindata.org.

Table 4. Hausman test for GDP

Null (no rand. effect) Alternative	Chi-sq. statistic	Degrees of freedom	Prob.
Cross-section random	0.6685	2	0.7159

Source: own calculation based on data from Eurostat and ourworldindata.org.

Table 5. Estimation results for employment

Regressor	Pooled OLS		Fixed effects (FEM)		Random effects (REM)	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
IR	0.0029	0.3486	0.0034	0.0726	0.0034	0.0701
MR	-0.0019	0.3552	-0.0033	0.0083	-0.0031	0.0109
C	-0.0201	0.0000	-0.0188	0.0000	-0.0190	0.0000
R-square	0.0124		0.8065		0.0763	
R-square adj.	-0.0111		0.7028		0.5426	
DW statistic	0.9126		2.2912		1.7305	

Source: own calculation based on data from Eurostat and ourworldindata.org.

Table 6. Lagrange multiplier (LM) test for employment

Null (no rand. effect) Alternative	Cross-section One-sided	Period One-sided	Both
Breusch–Pagan	42.3600 (0.0000)	0.2214 (0.6380)	42.5814 (0.0000)
Honda	6.5084 (0.0000)	-0.4705 (0.6810)	4.2695 (0.0000)
King–Wu	6.5084 (0.0000)	-0.4705 (0.6810)	1.2259 (0.0000)

Source: own calculation based on data from Eurostat and ourworldindata.org.

Table 7. Hausman test for employment

Null (no rand. effect) Alternative	Chi-sq. statistic	Degrees of freedom	Prob.
Cross-section random	1.3957	2	0.4976

Source: own calculation based on data from Eurostat and ourworldindata.org.

Table 8. Estimation results for unemployment

Regressor	Pooled OLS		Fixed effects (FEM)		Random effects (REM)	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
IR	0.0243	0.8897	0.0579	0.6122	0.0549	0.6243
MR	-0.1121	0.3419	-0.2281	0.0033	0.2069	0.0060
C	1.2003	0.0000	1.3144	0.0000	1.0890	0.0000
R-square	0.0158		0.7706		0.1079	
R-square adj.	-0.0076		0.6478		0.0867	
DW statistic	1.2504		2.8202		2.1891	

Source: own calculation based on data from Eurostat and ourworldindata.org.

Table 9. Lagrange multiplier (LM) test for unemployment

Null (no rand. effect) Alternative	Cross-section One-sided	Period One-sided	Both
Breusch–Pagan	42.3600 (0.0000)	0.2214 (0.6380)	42.5814 (0.0000)
Honda	6.5085 (0.0000)	-0.4705 (0.6810)	4.2695 (0.0000)
King–Wu	6.5085 (0.0000)	-0.4705 (0.6810)	1.2259 (0.1101)

Source: own calculation based on data from Eurostat and ourworldindata.org.

Table 10. Hausman test for unemployment

Null (no rand. effect) Alternative	Chi-sq. statistic	Degrees of freedom	Prob.
Cross-section random	3.4992	2	0.1738

Source: own calculation based on data from Eurostat and ourworldindata.org.