Article

Difference-in-difference analysis: The EU integration's effect on quality of life through selected economic security indicators from 2005–2022

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Abstract: Quality of life indicators are significant tools to evaluate the individual's well-being. In this sense, economic security measurement is a part of well-being. In achieving a greater level of well-being, countries can get many benefits by joining economic integrations. However, these benefits may not only sometimes be as great as thought. We investigate the changes in (in)security measurements for the new members with the difference-in-difference method. This method is beneficial for analyzing the effects before and after treatment, policy, and implications for different units. Our study aims to detect if there are significant changes or improvements in the security levels of new members of the European Union from 2005 to 2022. The findings figure out that the level of *arrears* was essentially reduced for most members. Still, the integration has no visible impact on *purchasing power parity* for the period. These are critical findings showing a trend not sourced from integration and, at the same time, the inefficiency of policy and implementation of the EU.

Keywords: economic security; difference-in-difference; quality of life; purchasing power parity; *arrears*

1. Introduction

Indicators of quality of life have 8 + 1 dimensions as "material living conditions, productive activity, health, education, leisure and social interactions, economic and physical security, basic rights, living environment, and overall experience of life". Well-being includes all eight dimensions except the last, which is related to personal life satisfaction and success of well-being [1]. While well-being is a more comprehensive concept than income-related measurements and economic security. Economic well-being is a sub-index of economic security [2]. In this context, various studies of Osberg and Sharpe [2–4] focused on the economic (in)security perspective.

After the Cold War, traditional security studies gave way to non-traditional security (NTS) discourses. These studies were beyond the military forces and closely connected to various anxieties about the welfare and safety of individuals. In this regard, human security has a dissimilar concept compared to the NTS, consisting of the dynamics and struggles of daily life and having a definition depending on a specific unit, such as food security, economic security, health security, environmental security, and political security [5]. Following the financial crisis in the late 2000s, millions of people in OECD countries faced significant economic turmoil, including unemployment, income volatility, and sharp declines in various assets. In a word, the crisis made the people more concerned about their "economic security (ES)" and the extent to which they are vulnerable to economic losses that cause hardship. This

growing concern has affected everything from consumer and investment decisions to choices about family formation and geographic mobility to political behavior [6].

It is not similar or homogeneous for all individuals since ES differentiates according to socio-economic characteristics, geography, and age with a wide spectrum [5]. Richiardi and He [7] state that there is no consensus on meaning and measurement, unlike poverty or inequality. However, they give that the definition has two parts; one is related to material source sufficiency [8], and the other is about having feelings about this [7]. Hacker [6] insists that ES is closely related to sensitivity to economic loss, and the security considers the consequences of the loss, not the cause. Furthermore, ES has objective and subjective dimensions such as physical and perceived economic security measurements. Perceived economic security focuses on the psychological response to financial risk and insufficient material sources. Unexpected incidents like unemployment, diseases, and divorces cause a reduction in income and are connected to physical/objective economic security [9]. Hacker [6] classifies the objective measurement ES based on four properties: Financial buffers, shock probabilities, security indexes, and economic (in) stability changes and subjective ES is a kind of reaction or perception to changes in objective ES [2].

On the (in)security side, we have mainly focused on new members since 2004 in the EU. These members are Bulgaria, Croatia, Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia. Because these countries recently joined the EU, most are relatively less affluent than other members. When we use difference-in-difference (DID) estimators, we employ two variables. One variable is *arrears* for the insecurity, and another is purchasing power parity for the security.

Arrears (mortgage or rent, utility bills, or hire purchases) increased in 2021 concerning 2020 with 2.4 and the last decade with 8.3. However, one in three people (30.1%) must face and cannot afford to pay these financial expenses in the EU in **Figure 1**:
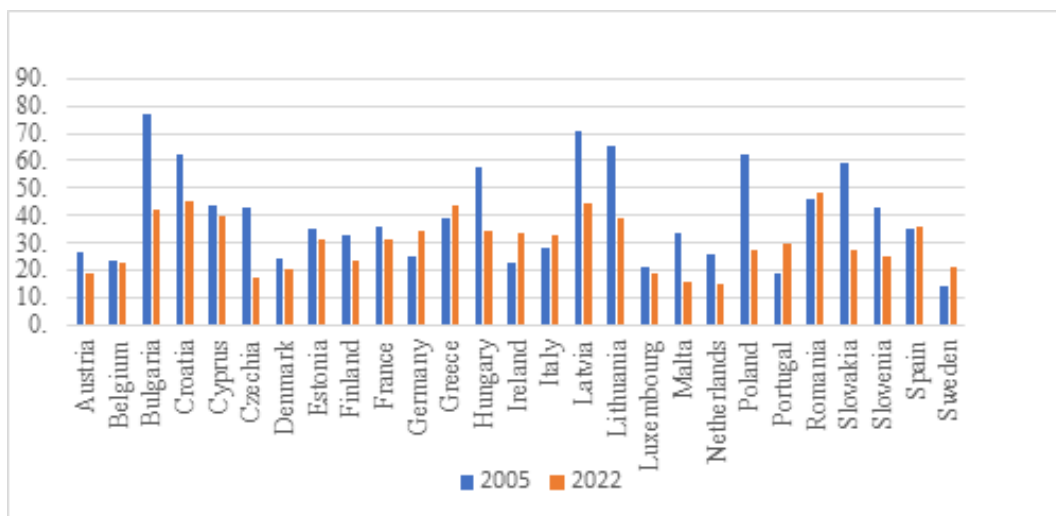

Figure 1. Share of the population unable to face unexpected financial expenses, % of total population [10].
The first values for Romania and Croatia are in 2007 and 2010, respectively.

When we compare 2005 and 2022, this seventeen-year period shows a significant reduction in the rate of inability to meet unexpected financial expenses. Bulgaria, Croatia, Cyprus, Hungary, Latvia, Lithuania, and Poland have the highest level of insecurity rates between 50% and 80%, while Czechia, Estonia, Malta, Slovakia, and Slovenia have an insecurity level of approximately 30%–40% in 2005. The highest rate of countries gained a significant achievement, especially for Bulgaria, Hungary, Latvia, and Lithuania. In the lowest countries, Slovakia and Slovenia have lived appreciable success in diminishing insecurity rates. On the security side, purchasing power parity is a proxy for security analysis. **Figure 2** illustrates *PPP* for 2005 and 2022:
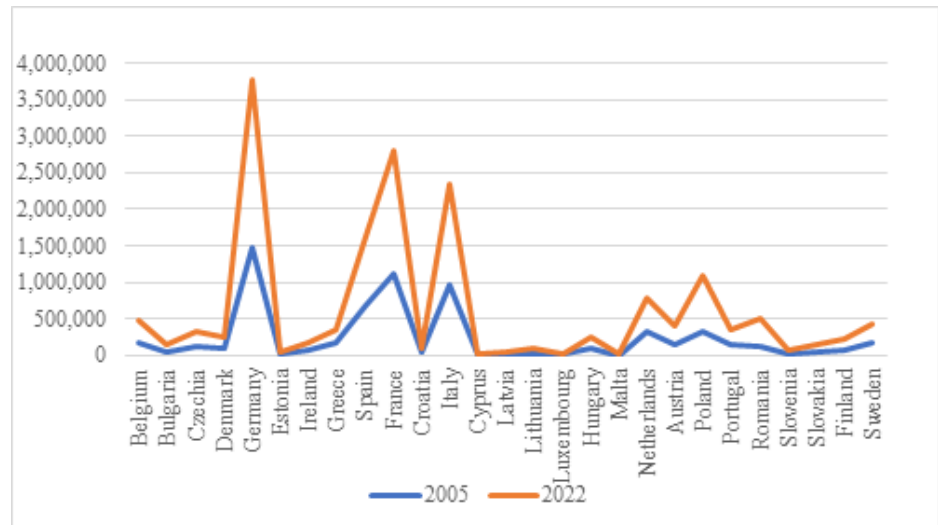

Figure 2. Purchasing power parity, 2010 aggregates [11].

When we compare the countries from 2005 to 2022, *PPP* has grown during the period. However, Bulgaria, Croatia, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Slovakia, and Slovenia had a slight increase. In Czechia, Romania, and Poland, *PPP* showed a meaningful rise. When we investigate descriptive statistics in **Table 1**, we can evaluate the properties of variables.

Table 1. Descriptive statistics.

	PPP	*arrears*
Mean	312,961.41	11.43
Standard Error	65,509.33	1.14
Median	135,201	8.75
Std. Deviation	481,393.32	8.20
Variance	2.3174×10^{11}	67.30
Kurtosis	6.07	5.26
Skewness	2.45	2.03
Maximum	5246	2.7
Minimum	2,302,196	45.5

In **Table 1**, the mean is greater than the median, meaning that both *PPP* and *arrears* are skewed to the right. The standard deviation shows the positive and negative spread among the data. The symmetry of the data distribution, skewness, is in a reasonable range. Kurtosis, the scale of sharpness/flatness, shows that two variables are too peaked because of a greater than 2 value [12].

Economic security differs across most fields, such as the environment and energy, well-being, the business world, health, food, and institutional arrangements. In economic (in)security, we mention the studies done by Bağlıtaş and Atik [13], Carton et al. [14], Cantó et al. [15], Banks and Bowman [16]. Cantó et al. [17], Khadzhynova et al. [18], Gryshova et al. [19], Romaguera-de-la-Cruz [20], Bossert et al. [21], Ignatov [22], Korovchenko and Kraftová [23], D'Ambrosio and Rohde [24], Hacker et al. [25], Osberg and Sharpe [26], Berloffa and Modena [27], Goul Andersen [28], Osberg and Sharpe [4]. These studies have mainly worked with the same concept as us.

Bağlıtaş and Atik [13] focus on the EU's economic security and physical safety. They employ principal components and cluster methods to analyze the relative and changing performance of the old and new member countries for 2008 and 2021. They concluded that other members, such as Luxembourg, Netherlands, Czechia, Germany, and Sweden, had drawn a successful picture, while Greece had the lowest level. Furthermore, the cluster method reveals four clusters. New members belong to heterogeneous clusters, with five in the first, six in the second, and two in the third cluster.

Carton et al. [14] approach the topic of financial well-being and subjective practices in Ireland. Their focus group is 12 households counted, and the method is the survey for October 2020. Subjective behaviors differ from saving patterns to money management. The results suggest the significance of self-discipline characteristics for controlling unseen financial expenses. Cantó et al. [15] accept economic insecurity as a significant part of well-being and investigate measuring economic insecurity in Spain. They studied the indicators of insecurity and decided that indices using subjective and objective variables might be a better alternative.

Khadzhynova et al. [18] detected that Finland, Denmark, and the Netherlands have the highest level while Bulgaria and Romania have the lowest level of economic security in the EU. They took the time to escape during 2010–2019 and various indices connected to economic, social, political, and environmental variables.

Banks and Bowman [16] focused on the economic insecurity aspects under riskscape and timescape contexts for Australia. Risks relevant to unreliable jobs and income uncertainty cause financial lives to be unstable. Risk escapes and time escapes make transitory and economic insecurity noticeable. Cantó et al. [17] studied the EU with a multi-dimensional approach in 2008 and 2016. They use objective and subjective indicators together. They find that being less educated and unemployed are the most effective variables. Moreover, objective indicators also have more influence on well-being in post-transition Eastern European administrations than long-life capitalists.

In the paper of Gryshova et al. [19], they focused on Ukraine and the EU members for the length of three years (2016–2018). They made a composite index for economic security with the help of economic, social, political, and ecological sub-indicators of

sustainable development. The findings showed that there was a remarkable enhancement but changeable in orders for five countries (Denmark, Luxembourg, Finland, Sweden, and the Netherlands) in the EU. Ukraine does not make any improvement. They also conducted a clustering analysis for the countries and revealed three clusters: (1) The best; (2) middle; (3) the worst economic security. Eight of the new members are in the third cluster, and five of them are in the second cluster.

Three EU countries—Spain, France, and Sweden—in Romaguera-de-la-Cruz [20] contributed to the different sides of insecurity, such as higher levels of education and changeable job contrasts, as individuals rise. He uses cross-section data for the households in Spain, France, and Sweden from 2008 to 2016. Spain and France show the same pattern related to diminishing, but not Sweden.

Among the political studies, Bossert et al. [21] tried to analyze the relationship between economic insecurity (EIS) and political preferences in the United States, the United Kingdom, and Germany with panel surveys from 1991 to 2008. They found that EIS leads to more political activism and in favor of votes for the rights. Moreover, the steady significant influence of ES depends on per-capita income, homeownership, and employment status in the current and past.

In ten years from 2007 to 2017, Ignatov [22] analyzed economic threats for the EU. He used different parameters to catch the condition of economic security. These parameters are debt, income growth rate, fixed capital accumulation, factor productivity, and technical and institutional improvement. When all parameters are evaluated, the overall value indicated that economic security declined during the period. Thus, the qualitative and quantitative methods revealed the ineffectiveness of the European Union.

In the context of economic and personal safety, Korovchenko and Kraftová [23] studied the period of 2010–2015. They use various indicators for these two dimensions, such as material deprivation rate and depth, youth unemployment rate, assault, and theft. They found that the economic and individual security situation generally did not progress and was volatile during the period.

Osberg and Sharpe [26] revised the economic security index by using datasets of poor and rich countries. They first investigated the index for wealthy countries in the OECD and later compared it with 70 countries that have various income levels. It is concluded that the modified/augmented index should include nutrition production volatility, healthcare costs, and single-parent poverty, and old age poverty [7,20].

Berloffa and Modena [27] worked with income volatility and intergenerational inequality in Italy from 1995 to 2007 for citizens. They use a well-being index consisting of consumption flows, wealth stocks, employment security, and equity. This augmented index reveals that well-being growth rates are much lower than income, and well-being reductions are higher, particularly for the private sector.

Goul Andersen [28] focused on economic security and well-being throughout labor market integration for Danis people between 1994 and 1999. He constructed the economic hardship index with three dimensions. The results reveal that economic hardship is more effective in well-being reduction than unemployment and causes an increase in job seeking. However, this hardship does not have any positive influence on labor market integration.

Unlike the other studies, Osberg and Sharpe [4] tried to construct a better index of well-being. They used different variables for the United States, United Kingdom, Canada, Australia, Norway, and Sweden from 1980 to 1999. They concluded that a better index should consider economic security besides other variables such as income distribution and per capita spending streams. Moreover, there are various indexes in the context of ES, Bossert et al. [21], Mutchler et al. [29], D'Ambrosio and Rohde [24], Hacker et al. [25], Rohde et al. [30], and Bossert and D'Ambrosio [31]. They worked with different and common variables for the indexes.

Our paper's subject is to investigate the effects of the EU on relatively new members for economic security related to well-being concepts. This paper aims to analyze the periodic effect of EU integration on new members in an economic security context. These new members have a relatively low level of development. A union offers various benefits such as socioeconomics, security, stability, and a business environment for the members. Thus, new members might move to a higher level of development. We can detect the changes throughout the related indicators. In this sense, we will analyze the changes in *arrears* and *PPP* using the DID method. This method is barely unique relative to other studies focusing on the connectedness between well-being and economic security. To summarize the literature, we want to depict that there is any significant difference in the EU for relatively new members. We could not find any comparative studies in the literature. For this reason, our study sheds ight from another perspective for economic security with a different analyzing method. Thus, we find out whether the influence of the EU is valid on new members or whether there is a general tendency for the variables beyond the union. The following chapters set forth DID methodology and empirical results.

2. Difference-in-difference methodology

Implemented policies (such as financial and income), programs (such as diets and treatment processes), and crises (such as financial, structural, lockout, and pandemic) faced by countries have impacts on different decision units. Various methods are developed to measure effectiveness or consequences. These methods, called impact assessment, are included and are related to outcomes and impact steps in the monitoring and evaluation processes. In this context, we apply the DID method as an impact evaluation method [32].

DID has two critical assumptions about the units that have time-invariant and unobserved heterogeneity in characteristics. The evaluation process consists of two different groups: Participants and non-participants [32]. Furthermore, time data is also considered as two subgroups for the absence and existence of an action such as treatment, intervention, application, or policy implementation. This kind of discrimination reveals the impact of the actions [33]. Thus, we can compare the differences in pre- and post-action results in terms of focus and control groups [34]. The equation, where Y_i represents the result [35].

$$Y_i = \alpha + \beta T_i + \gamma t_i + \delta(T_i t_i) + \varepsilon_i \tag{1}$$

where α, β, γ, and δ, respectively are constant term, focus group-specific effect (or intervention), time trend, and true effect of an action (intervention $\times$ time). Our

purpose is to estimate a valid value of δ [35]. Y_i is an outcome when we formulate the logic of DID [36].

$$DID = (\bar{y}_{T,t-a} - \bar{y}_{T,t-b}) - (\bar{y}_{C,t-a} - \bar{y}_{C,t-b}) \tag{2}$$

where the average value of the outcome variable ($\bar{y}$) before and after treatment (T) is represented as $\bar{y}_{T,t-b}$ and $\bar{y}_{T,t-a}$ respectively. The average values of control variables before $\bar{y}_{C,t-b}$ and after $\bar{y}_{C,t-a}$ are in the second part of the Equation (2). These parts compute the difference between participants and non-participants before and after the implementation/program [32].

In this method, there is a significant criterion assuming the parallel trend of outcome and control variables. Parallel trend refers that the tendency lines have different beginning points but are parallel for participants and non-participants before treatment. This assumption clarifies the net effect of treatment on participants [33]. In **Figure 3** we can illustrate all effects.
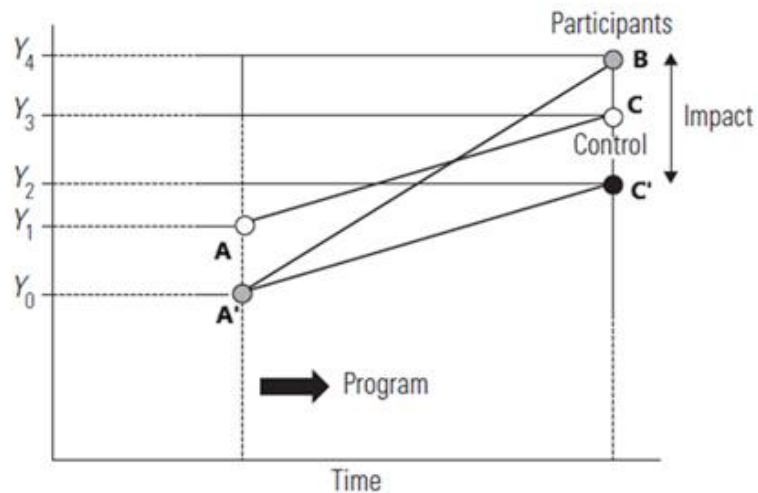

Figure 3. The illustration of treatment effect [32].

Before treatment, we can depict the parallel trend assumption with lines of AC//A′C′. The change in time for participants is |BC′| distance, and for non-participants, is |CC′| distance. DID estimation revealed whether the distance between |BC′| is statistically significant or not. Otherwise, being or non-being participants in the treatment are indifferent.

The DID method has some limitations/disadvantages, particularly associated with before-after treatment/policy periods. Only two periods give effective results, but multiple periods may lead to confusing findings. The expected positive sign may turn to the negative or vice versa [37]. Another limitation is about the parallel trend assumption. The critical factor is to obtain two groups (control and treatment) that are parallel and absent of intervention. The last limitation is for undetectable variables, which are changeable, not fixed in time. Because this method can catch fixed and undetectable variables [34,38,39].

A robustness check is possible with placebo or additional control groups. In the first situation, we duplicate the analysis with placebo groups that are not included in

treatment or not affected by policy intervention. Therefore, if we could not detect any effect of this group, the model robustness becomes more powerful. Another check method is to add one more control group having similar properties to the original control group. We expect that this group indicates the equal treatment effect with the original [40].

3. Data and econometric analysis

3.1. A-data

This variable has binary values for two different domains; one is the time domain before implementation as "0" and after implementation as "1"; the other is the cross-section domain as "1" for new members and "0" for old members in the EU. Thus, we produce a new variable by using time and implementation dummies. This transaction gives information about the EU making a significant contribution to the economic security of relatively new members. We accept the countries that joined the union after 2004 as new members and the others as old members. The logic behind choosing new members rather than old members is mainly related to the economic power of countries. In this line, old members, particularly first members, illustrated gorgeous development for a long time. Although the new members are smaller in accordance with their population, income, financial strength, and other economic indicators.

The toughest struggle is to determine before and after time domains. Due to lack of data, we chose the starting point as 2005, and the end point was determined as 2022, which is the last date we can access the yearly data. The longer the time interval, the more accurate it will be to measure the effect.

Besides that, we use two indicator variables related to economic security. These variables are purchasing power parity (*PPP*) and *arrears*. *PPP* is actual individual consumption and is based on 2010 measurements. *Arrears* are a measurement for the inability to face unexpected financial expenses, the percentage of income, and are relevant to mortgage or rent, utility bills, or hire purchase retrieved from the Eurostat website belonging to the European Commission (EC). We chose these variables from the report on quality-of-life indicators: Economic security and physical safety statistics published by the EC.

3.2. B-econometric analysis

In **Table 2,** time is a dummy for the time domain, and tcall is another dummy representing the member. The time variable gets "0" for the regime-shifting 2005 year and "1" for the time long after the regime, as 2022. Tcall gets "0" for the old and "1" for the new members. Moreover, DID is a mixed variable for time and call. It takes "1" for the new members and the year 2022; otherwise, "0". After the regression estimation, we calculate the significance of the period for the new members for *arrears* and *PPP*. Regression results for *arrears* in **Table 2**.

Table 2. Linear regression results for *arrears*.

arrears	Coef.	Std. Err.	t	P > |t|	[95% Conf. Interval]
time	1.0612	3.196835	0.33	0.741	−5.366491, 7.488844
tcall	6.72	2.814143	2.39	0.021	1.061786, 12.37821
did	−10.8513	3.866286	−2.81	0.007	−18.62487, −3.077487
cons	10.38	2.009217	5.17	0.000	6.340199, 14.4198

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

In the first step of the process, we make an estimation with the DID variable. Later we detect that there is a significant change between the old (control group) and new (treatment group) members. The second step illustrates that the duration of being members for the new countries is beneficial to diminish the quantity of *arrears*. In **Table 3**, the value of DID is statistically significant and negative. It means that the debt of new members decreases throughout the union.

Table 3. Difference-in-differences estimation results for *arrears*.

	Control	Treated	Diff (T-C): t-b	Control	Treated	Diff (T-C): t-a	Diff-in-Diff
Coef.	10.38	17.1	6.72** (−3.187)	11.441	7.31	−4.131 (−3.111)	−10.851** (−4.453)

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$, Standard errors are in parenthesis.

After *arrears*, we want to focus on *PPP*. While the *arrears* variable is a kind of negative event in life, *PPP* positively affects life during rising. For this reason, the expected coefficient is positive and statistically meaningful. The procedure is to estimate the general regression model and later detect significant differences between the periods for the new members. Linear regression and DID estimations are in **Tables 4** and **5**.

Table 4. Linear regression results for *PPP*.

PPP	Coef.	Std. Err.	t	P > |t|	[95% Conf. Interval]
time	186,191.9	193,743.8	0.96	0.341	−202,954, 575,337.8
tcall	−274,891.1	110,829.2	−2.48	0.017	−497,498.1, −52,284.19
did	−113,442.9	208,037.6	−0.55	0.588	−531,298.7, 304,412.9
cons	342,684.9	106,776.6	3.21	0.002	128,217.8, 557,152

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table 5. Difference-in-differences estimation results for *PPP*.

	Control	Treated	Diff (T-C): t-b	Control	Treated	Diff (T-C): t-a	Diff-in-Diff
Coef.	3.40×10^5	6.80×10^4	-2.7×10^5 (1.8×10^5)	5.30×10^5	1.40×10^5	-3.9×10^5** (1.8×10^5)	-1.1×10^5 (2.6×10^5)

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$, Standard errors are in parenthesis.

Table 5 demonstrates that the DID coefficient δ is not statistically significant. Meaning that the EU does not make any difference in purchasing power parity of the relatively new members. The reason for this result is probably the natural rising trend

of welfare of individuals. These new member countries could show a rising rate of *PPP* in time beyond the union.

4. Discussion and conclusion

Quality of life indicators have been the most popular subject in recent years. Eurostat [1] determines these indicators based on these categories: Material resources, leisure time, social connections, economic security and physical safety, governance and fundamental human rights, environmental conditions, and life experience. In this study, we evaluated economic security apart from physical safety. Economic security is a tool that rates the ability to cope with unforeseen financial struggles using material resources and the perception of the struggles.

Moreover, the European Union listed the benefits for the members as a peaceful environment, political stability, mobility of individuals, single market facilities, support for development, cultural diversity, safety, and other advantages [41]. However, there are general benefits for the members, and the capability of getting benefits differs. This capability depends on many factors, such as how big the country's economy was when it became a member. Besides that, a country facing a financial struggle or crisis might experience a more severe form because of being in a union. On the other hand, our study also investigated the changes in *arrears* and *PPP* variables. The analysis illustrates the contradictory role of EU policies and integration in shaping economic indicators and, consequently, the economic security and quality of life of its members. While the *arrears* decreased significantly, the *PPP* variable did not show a significant increase despite the integration from 2005 to 2022.

When we look at detail in DID findings, arrears reduced from 2005 to 2022 with 17.100 and 7.310. This reduction is not sourced from time-variant factors but also the union. Besides this, the EU does not have a significant effect on *PPP*. However, this variable increased from the period with 2.1×10^4 and 4.1×10^4, respectively; this increase is not related to the EU. We can interpret this result as coming from the natural upward movement of *PPP*.

In literature, there are two kinds of study. One of them is related to the connection between well-being and economic security and the determinants of ES. The other tries to measure progress and the state of economic security. If we compare our findings with the second piece of literature, the general outlook of new members does not depict a successful process in accordance with economic security. Bağlıtaş and Atik [13] made a clustering analysis and revealed heterogeneous grouping for economic security and physical safety. The second and fourth clusters consist of only new members; the first and third clusters include old and new members.

A similar study made by Gryshova et al. [19] illustrated a worse finding for economic security. They employed a composite index for all components of sustainable development. There are three clusters for the EU members. Moreover, they discovered that more than half of the members have had the worst economic security for three years. Ignatov [22] analyzed the EU during an eleven-year time frame (2007–2017) with various indicators. The result of the analysis depicted diminishing value of economic security. Korovchenko and Kraftová [23] evaluated ES and physical security (PS) together with different variables. ES and PS are not enhanced and fragile

from 2010 to 2015. Khadzhynova et al. [18] found the lowest value of economic security for Bulgaria and Romania and the highest value for Finland, Denmark, and the Netherlands. This finding is supportive evidence for our study.

To sum up, we infer from the findings of associated studies that the impact of the EU on the economic security of new members is not so glorious for different periods. Although some indicators might make a considerable improvement. The European Union may not be so effective in spilling over to new and less wealthy countries.

In economic security, further studies can analyze the impact of unions using different variables and indexes. Moreover, microdata comparing different periods could give more precise results for evaluation. Other econometric/statistical techniques measuring structural breaks or regime shifts could be alternative methods. Furthermore, if possible, adding a placebo or more control groups could make the analysis more robust. This analysis is particularly possible with questionnaire data and multiple periods with the same treatment and control groups.

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