

EU Project Participation and Employment Dynamics among E-commerce Firms in Bulgaria

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Abstract. *This research aims to assess whether participation of Bulgarian e-commerce companies in their first European Union funded projects has had any impact on employment patterns among these companies. Data was obtained via three different data sources: the National Revenue Agency; the Unified Information Platform for European Funds; and the Lakorda platform, all of which provided data on the number of e-commerce registrations, the number of European projects participated in and the number of employees each company employed annually.*

The empirical methodology used in this study was a combination of comparative methodologies, including the use of descriptive statistics, and the use of a staggered Difference-in-Differences model, as well as an event study methodology to compare the levels of employment of companies prior to and subsequent to their first participation in the projects. The results indicate that companies which participate in EU-funded projects have a much larger proportion of formalized activity, such as a higher rate of VAT registration compared to those companies that do not participate in European-funded projects. However, the results show no difference in terms of the geographical distribution of the companies or in terms of the organizational structure of the companies.

However, neither the Difference-in-Differences estimates nor the results of the event study demonstrate any statistically significant increase in employment due to European project participation in the short to medium term. Overall, the results of this study emphasize the need to distinguish between formalization, employment stability and job creation when assessing the impact of European funding at the company level. Additionally, the study provides new evidence using administrative data regarding the labor market effects of European -funded programs on e-commerce companies in Bulgaria.

Keywords: EU project participation; E-commerce firms; Employment dynamics; Policy evaluation; Difference-in-Differences; Bulgaria.

Introduction

The increasing use of digital technologies in economic activity has become a central policy concern in the European Union (EU), particularly in relation to market access, business competitiveness, and cross-border trade. Therefore, although "digital transformation" is a broad term that refers to deeper changes to organizations and institutions, e-commerce is a more specific and formally registrable and monitorable form of digitalization.

The EU policy has been promoting e-commerce as an instrument for improving the functioning of the internal market and competitiveness of firms, especially those that are small and medium-sized (SMEs). At the same time, EU-funded projects financed through the European Structural and Investment Funds, have been playing a key role in supporting economic growth, innovation and development of capacities in member states like Bulgaria. Although both e-commerce and EU project funding are important elements of the EU's economic strategy, there is a lack of research that explores the interactions of the two policy areas at the firm level.

E-commerce in Bulgaria is governed by mandatory rules and regulations, which include obligatory registration in the e-commerce registry of the National Revenue Agency (NRA)¹. The registration serves as a measurable indicator of digitalization in a narrow sense, as it captures the formal participation of firms in commercial activities through the internet, however as discussed in a previous work (Kyosova, 2025), companies that do not have the infrastructure to take online payments, but use third-party courier and delivery services, are not obliged to register. This institutional aspect enables the consistent identification of e-commerce activities using administrative data.

Access to EU-funding represents an essential channel for providing firms with access to financial resources, knowledge and organizational learning. Bulgaria received substantial amounts of EU-funds under a wide variety of initiatives for business development, innovation and institutional capacity-building. Existing evidence indicates however, that access to these funds is not equal and concentrates on firms that have previous experiences with EU-projects and greater administrative capabilities, thus reinforcing initial competitive advantages and not creating equal opportunities (European Commission, 2019; Paliova & Lybek, 2014; Crucitti et al., 2021).

Studies conducted at the European level show that digitalization outcomes, including the adoption of e-commerce, depend on structural factors, such as income levels, education and the quality of institutions (Jula et al., 2024). As these studies demonstrate, digitalization occurs within a broader context of economic and administrative systems and is not isolated. Despite this, the vast majority of studies on digitalization and EU-funding examine them separately. Typically, firm-level studies focus either on the e-commerce adoption as a business strategy (Kyosova, 2025; Vladimirov, 2015), or on the EU-project participation as a matter of policy implementation and fund absorption (Velitchkov et al., 2024; Tiganasu & Lupu, 2023), while little research has examined the relationship between formally digitalized firms and EU-funded projects.

This study aims to address the gap in the literature by investigating the link between the participation of Bulgarian firms that are registered as e-commerce traders in EU-funded projects and employment dynamics. For this purpose, the study uses administratively linked data from three sources: the NRA e-commerce registry that lists all legally registered e-commerce firms; the Unified Information Portal for European Union Funds² that contains information about EU-funded projects and firms' involvement; and the Lakorda³ platform, which includes annual employment data for firms. The combination of these data enables the creation of a longitudinal firm-level database that makes possible the observation of the employment paths of firms before and after they entered for the first time into EU-funded projects.

Descriptive comparisons along with a staggered Difference-in-Differences (DID) method and event-study diagnostics allow estimating the average employment effects of participation in EU-funded projects among digitally active firms in Bulgaria. Since participation in EU-funded projects is not randomly assigned, the applied methodology will provide policy relevant evidence regarding whether EU-funded initiatives among digitally active firms are mostly responsible for employment growth, employment stability or other processes of formalization within the Bulgarian e-commerce sector.

¹ <https://portal.nra.bg/details/online-store-nrareg>

² <https://eufunds.bg/bg>

³ <https://www.lakorda.com/bg.html>

Literature review

The impact of the European Union membership on Bulgarian businesses has had a profound effect on how businesses conduct their affairs and operate in today's global marketplace. Through the EU's regulations, and increased access to outside financing, EU membership provided the framework necessary for Bulgarian businesses to operate in a similar manner as their European counterparts. Instead of creating a dramatic change in terms of technology, the changes created through the EU's membership affected the incentives that businesses have, the institutions that businesses function within, and the policies that businesses follow when deciding to engage in digital business models, such as e-commerce (Vladimirov, 2015; Tiganasu & Lupu, 2023).

Research at both the policy and firm level clearly demonstrates that EU-funded programs have significantly influenced the institutional environment in which Bulgarian businesses function and the development trajectory of those businesses. However, the spread of e-commerce and other digital commerce activities, while gaining momentum, continues to occur at different rates and varying degrees across different industries (Vladimirov, 2015; Tiganasu & Lupu, 2023). Early reviews of the effectiveness of EU funds in achieving the goals of increasing productivity, and promoting firm upgrading in Bulgaria demonstrated that the primary limitation to the ability of EU-funded projects to effectively translate into increased productivity and upgraded firms was not the availability of funding, but the administrative capacity of firms to plan, manage, and execute EU-funded projects due to the complexity of procedures and the limitations imposed by governance (Paliova & Lybek, 2014).

Macro-level modeling of EU investment under the 2021-2027 Cohesion Policy indicates that EU funding can contribute to improved productivity, innovation capability, and regional convergence, ultimately contributing to improved business conditions in Bulgaria (Crucitti et al., 2021). At the micro-level, studies have shown that participation in EU-funded projects is positively related to increased innovation activity, however, the positive relationship does not always result in the adoption of digital business models, or job creation (Ma, 2024). Collectively, this body of literature suggests that EU funding primarily results in the accumulation of physical, human, and organizational capital, and does not provide for the adoption of specific digital business models such as e-commerce.

National diagnostic reports confirm the existence of structural barriers to e-commerce adoption in Bulgaria. The Digital Economy and Society Index has consistently ranked Bulgaria below the EU average in terms of digital skills, business digitalization, and the use of digital technologies by firms (European Commission, 2022). Additionally, the SBA Fact Sheet for Bulgaria identifies persistent issues experienced by SMEs in Bulgaria, including limited access to finance, high administrative burden, and limited capacity to internationalize (European Commission, 2019). All of these issues have implications for e-commerce, which require not only technology, but also regulatory compliance, financial resources, and management expertise.

Additionally, research at the firm-level further supports the fact that e-commerce adoption is determined by a firm's organizational preparedness, manager expectations, and perceived risk factors rather than by access to technology or funding. Vladimirov (2015), demonstrated that positive expectations regarding efficiency and market access increase the likelihood of adopting e-commerce, whereas perceived risks and uncertainty act as significant barriers to adoption. Collectively, these findings suggest that formal digital engagement is reflective of a firm's broader organizational abilities and views towards regulation and market participation.

Regional and cross-country analyses have identified the role of institutional quality in determining both digitalization outcomes, and access to EU funding. Tiganasu and Lupu (2023), demonstrated that regions with higher institutional quality and larger amounts of digitalization are more successful in receiving European funds, indicating a cumulative advantage mechanism. Therefore, firms in less institutionalized environments may experience a double limitation: lower access to EU funding, and lower capacity to adopt digital technologies including e-commerce.

Collectively, the literature indicates that EU funding will have a greater influence on the development of e-commerce in Bulgaria through improvements to the institutional and structural environment, rather than through the direct technological upgrading of firms (Crucitti et al., 2021; Paliova & Lybek, 2014; European Commission, 2022). Additionally, firm-level e-commerce adoption is dependent upon a firm's organizational readiness, and managerial capacity; however, the degree to which firms can access EU funding is contingent upon a firm's administrative competence and the institutional context in which they exist (Vladimirov, 2015; Tiganasu & Lupu, 2023).

A significant empirical gap exists in spite of the wealth of policy and academic literature. Most existing studies fail to link firm-level data on formal e-commerce engagement, with detailed data on firm-level participation in EU-funded projects, and employment outcomes. The combination of administrative data on e-commerce registration, EU project participation, and employment outcomes, provides an opportunity to study the relationship between EU-funded initiatives among digitally active firms and employment growth, employment stability, and formalization in the Bulgarian context, where both EU funding and digitalization are critical to economic development.

Methodology

The first part of the empirical analysis will use a comparative method to show how firms that participate in EU-funded projects differ from those that don't. The main items to compare are: formalization; regional distribution; management structure; and the dynamics of size for each type of firm over time. The purpose of the descriptive part of this stage is to provide some contextual information about the potential structural differences in both treated and non-treated firms prior to moving to the second stage of the research where we will use econometrics to estimate the relationship between participation in EU-funded projects and the level of employment per firm.

The second part of the empirical analysis is based on the estimation of the impact of EU project participation on employment at firm level using a staggered Difference-in-Differences (DID) framework. Since firms start their participation in EU-funded projects at different points in time, the study will follow the group-time DID approach proposed by Callaway and Sant'Anna (2021). This method will compare treated firms to suitable control groups composed of never-treated and not-yet-treated firms. Annual employment data will be analyzed from 2007 onwards; treatment will be measured through the first year of EU project participation. An estimate of the average treatment effect on the treated (ATT) will be carried out for periods starting in 2014, when EU project participation can be identified in the dataset. Finally, standard errors will be clustered at firm level.

In order to investigate how the firms react dynamically to the EU project participation, an event-study specification will be applied. The event time will be defined in relation to the first year of EU project entry, so it will be possible to identify employment trajectory both before and after the treatment. Therefore, it will be possible to analyze the pre-treatment trends, short-run and

medium-term post-treatment responses and the variation in employment volatility, including the transition from employment to zero-employment status and vice versa.

It is also important to retain in the analysis the firms that report no employee. Indeed, in the case of Bulgarian e-commerce firms, the state of having no employee, could represent an owner-managed operation, a temporary decrease in production during an economic downturn, a dependence on external workers instead of internal workforce. Therefore, excluding them from the sample, will be introducing a bias towards larger and more stable firms. By retaining these firms, we will be able to analyze employment volatility and adjustment at the extensive margin and assess the ability of the firms to maintain employment and adapt to the labor market dynamics triggered by EU project participation.

The identifying assumption of the DID framework is that, in the absence of EU project participation, treated and comparison firms would have followed the same employment trends. The validity of this assumption will be evaluated analyzing the pre-treatment coefficients obtained by the event-study specifications. In fact, across all the analyses, the pre-treatment estimates oscillate around zero and they are statistically not significant, thus supporting the parallel trend assumption.

All the statistical analyses were made in R, whereas Microsoft Excel was used for preliminary data inspections, construction of variables and verification of coherence to guarantee the transparency and the reproducibility of the results.

Results and Discussions

Firm characteristics and descriptive patterns

This section presents descriptive evidence on differences between firms that participated in EU-funded projects and those that did not, focusing on formalization, regional distribution, managerial gender structure, and employment dynamics. These comparisons provide context for the subsequent causal analysis.

Formalization

Table 1 reveals large differences in the formalization levels between the two groups of firms. EU-funded projects are much more formalized than non-project firms. For example 92.8% of firms who participated in at least one EU-funded project are registered for VAT, while only 69.0% of firms which did not participate in an EU-funded project were registered for VAT. On the other hand, over a quarter of firms (24.2%) which did not participate in an EU-funded project had never registered for VAT, while less than 0.25% of firms which had participated in an EU-funded project had never registered for VAT. It can also be noted that deregistration rates were significantly larger for non-participant firms.

Table 1. Percent of firms registered for VAT

	N of Companies	VAT (%)	Deregistered (%)	Never registered (%)
With EU projects	3,592	92.82	2.06	0.25
Without EU projects	15,897	69.01	6.75	24.24

Source: Author's own research.

The differences in formalization rates found in Table 1 indicate that firms which received EU funding are structurally integrated into the formal economy. The findings indicate that

participation in EU-funded projects is positively related to having sufficient administrative capacity and regulatory compliance rather than being a randomly selected group of firms.

Regional distribution

Although the data suggests that the regional distribution of firms (Figure 1) is largely unaffected by whether firms have participated in EU projects, the South-West region appears to be disproportionately affected when considering the proportion of firms participating in EU projects (approximately 42.0% vs approximately 45.0% in the case of firms that have not participated in such projects), equally, there appears to be slightly higher proportions of firms participating in EU projects in the North-Central and South-Central regions. These regional differences are relatively small, however, they provide evidence that EU project participation does not create new geographic patterns for where firms operate. Rather, it seems likely that EU project participation largely follows established regional economic patterns and does not result in large firm redistribution from one region to another.

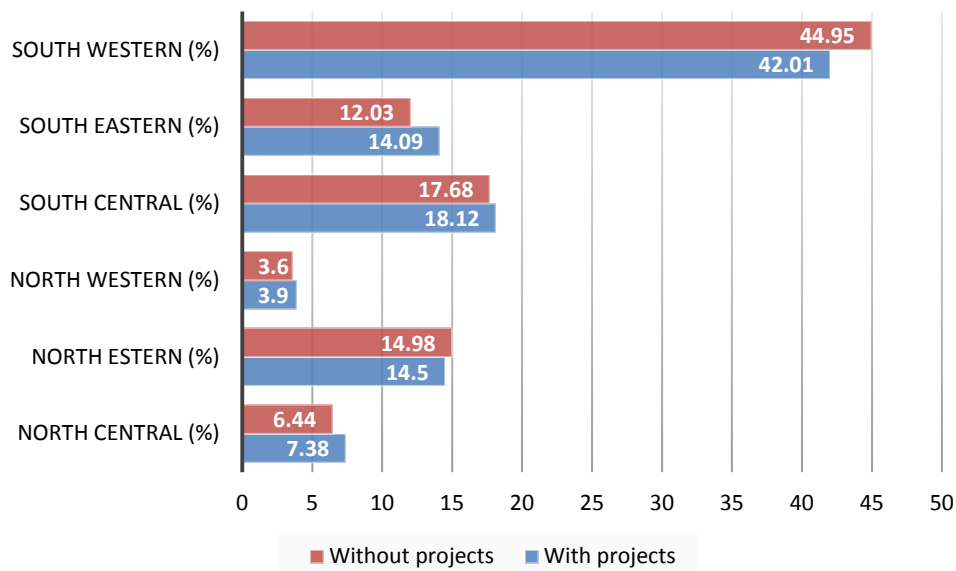


Figure 1. Regional distribution of firms with and without EU project participation

Source: Author's own research.

Managerial gender composition

The gender composition of the managers of firms that participate in EU projects and those that do not (Figure 2). In both cases, the majority of firms are managed by mostly male managers (approximately 49%), however, the results show that the proportion of firms in each region is relatively similar regardless of EU project participation. The firms that participate in EU projects are somewhat less likely to be managed by women only (i.e., 26.5% vs. 28.8%) and are somewhat more likely to be managed by teams (i.e., 22.3% vs. 20.8%). The "Undetermined" category, which reflects gender-neutral and/or foreign names, is more prevalent among firms that participate in EU-funded projects.

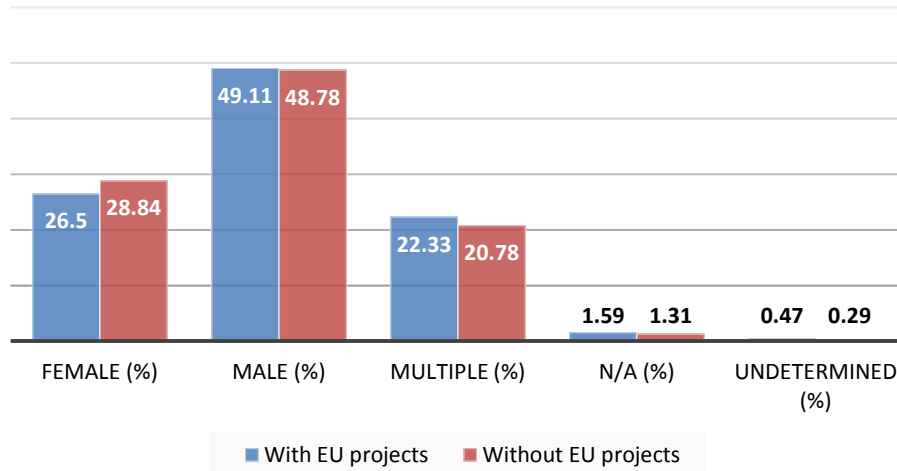


Figure 2. Managerial structure by gender

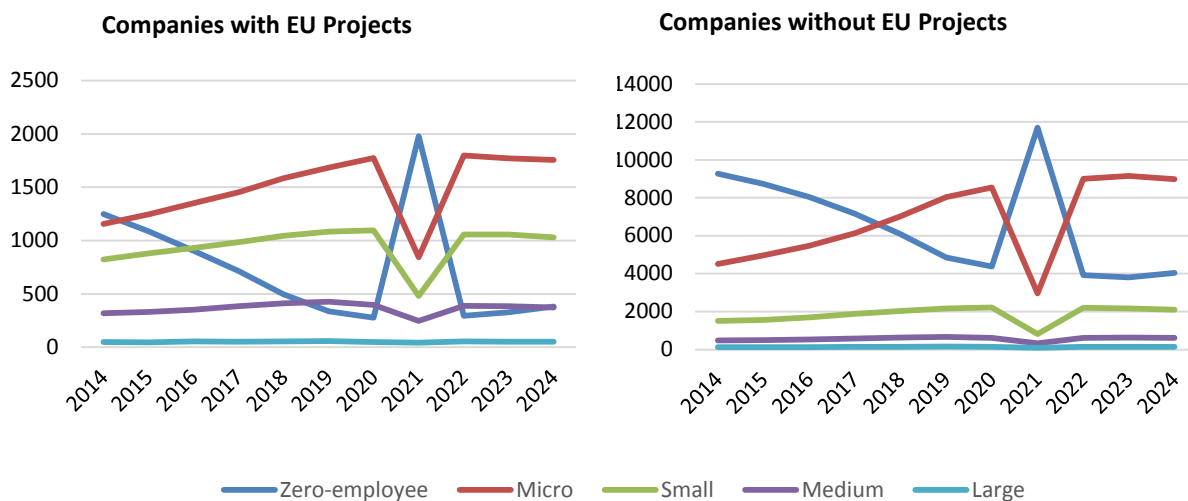
Source: Author's own research.

The differences identified between the two types of firms are relatively small, leading to the conclusion that the gender composition of firms' managerial teams is unlikely to play a major role in determining the likelihood that firms will engage in EU project participation. Additionally, it can be observed that EU project participants are somewhat more likely to be managed by multiple individuals, this can be related to the need for increased organizational complexity that arises when firms implement EU project activities.

Employment trends

As shown in Figures 3, the proportion of firms in various employment categories has changed over time for firms that participate in EU projects and those that do not.

Figure 3. Employment trends for ecommerce companies with and without EU funding



Source: Author's own research.

There is little evidence of a difference in how the employment categories of firms that participate in EU projects and those that do not have evolved over time. Both samples are dominated by micro and small firms, and medium and large firms are relatively rare. Although firms that participate in EU projects are somewhat more likely to be small and/or medium-sized firms, the most common employment category remains that of micro firms.

Both samples show a structural break in 2021 characterized by a rapid rise in the number of firms with no employees and a corresponding decline in micro and small firms. However, the magnitude of this structural break is much larger in the sample of firms that did not participate in EU projects than in the sample of firms that did.

Firms that participate in EU projects appear to have had less dramatic employment changes in response, showing more resilience to the 2021 shock, than firms that did not participate in EU projects. This is consistent with evidence that innovation-oriented engagement in Bulgaria strengthens organizational capacity without generating proportional job growth during periods of crisis (Yalamov, 2021).

The employment returns to pre-shock levels in both samples for micro firms, however, the number of firms with zero employees remains elevated in the sample of firms that did not participate in EU projects. This can be interpreted as evidence that firms that do not participate in EU projects experience greater variability in employment and are more vulnerable to future employment shocks than firms that do.

Correlation Analysis

The beginning of this analysis involves the examination of the associations among the e-commerce companies with or without EU project participation, the number of projects and employment outcomes through the use of correlation analysis. The data provided within Table 2 represent the descriptive statistics used for the initial diagnostic purpose and indicate why a causal analysis was warranted after the correlation analysis.

Table 2. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max	N
Companies with EU projects	0.16	0.37	0	1	18,307
Number of EU projects	0.29	0.92	0	18	18,307
Average employment	11.8	47.3	0	4,300	18,307
Employment growth (treated firms)	4.2	61.5	-312	1,548	3,179

Source: Author's own research.

Pearson correlation for the full sample and for firms that participate in EU projects are presented in Tables 3 and 4.

Table 3. Correlation matrix of all firms

	Firms with project	N. projects	Avg. employment
Firms with project	1	0.453	0.051
N. projects	0.453	1	0.059
Avg. employment	0.051	0.059	1

Source: Author's own research.

Table 4. Correlation matrix of EU project participants only

	N. projects	Avg. employment	Employment growth
N. projects	1	0.078	0.153
Avg. employment	0.078	1	0.126
Employment growth	0.153	0.126	1

Source: Author's own research.

The largest correlation found in the full sample is that between whether an e-commerce company has ever been involved in an EU project and the total number of EU projects that have been completed by that company ($\rho=0.453$). All other correlations found are extremely low. In addition to this, the positive but low level of association between EU project participation and average employment and the near zero correlation between registered e-commerce and employment levels provides further evidence that there is a weak connection between employment and the characteristics of companies.

Reducing the focus of the analysis to those companies that have engaged in EU projects only results in a slightly greater level of correlation between project intensity and employment growth ($\rho=0.153$), and between e-commerce registration and employment outcomes; nonetheless, both of these correlations are extremely low.

Therefore, the correlation analysis indicates that neither EU project participation nor project intensity is significantly correlated with firm size or employment growth, which supports the need for a causal analysis.

Difference-in-Difference Results

Because simple correlation does not address time trend or selectivity issues in choosing to enter an EU-funded project, this study uses a difference-in-differences (DID) method based on the staggered timing of the first EU funding. Comparing the treated firm's pre- and post-treatment employment trajectory to appropriate controls' employment trajectories at each point in time.

The average treatment effects on the treated (ATT), as shown in Table 5, are the results of estimating the group-time difference-in-differences model.

Table 5. Difference-in-Differences results

Specification	Sample	ATT	Std. Error	95% Confidence Interval
Baseline DID	All firms (treated + never treated)	0.403	1.051	-1.657 ; 2.462
Event-study DID (± 5 years)	Treated firms and controls	-0.514	1.521	-3.496 ; 2.467
Event-study DID (balanced pre/post)	Treated firms and controls	2.064	1.492	-0.860 ; 4.988

Source: Author's own research.

Beginning with the baseline DID, it appears as though there may be a very slight, but statistically insignificant positive relationship between the employment status of the firms in this study and whether they participated in an EU funded project. However, due to the large standard error, the data cannot reject the null hypothesis of no impact of EU funded project participation on the employment status of these firms. Additionally, similar to the baseline DID, the employment dynamics around the time of the first EU project participation examined in the event-study DID specifications do not provide any statistically significant differences from zero.

This result suggests that EU funded project participation has not generated systematic employment growth among the firms included in this study. The findings in this study align with

previous studies of EU funded projects conducted in Bulgaria, where it was found that EU funded projects have been shown to contribute to technological upgrading, innovation activity, and organizational development; however, such projects have not contributed to the creation of jobs immediately upon project initiation (Ma, 2024).

Dynamic Effects and Event-Study Analysis

As part of the robustness analysis, an event-study DID framework is employed to examine pre-treatment trends and post-treatment dynamics in employment.

In order to examine the nature of employment changes during the time surrounding the receipt of EU funding by firms, an event-study difference-in-differences methodology is applied. In addition, Figure 4 illustrates the estimated employment impacts at each event-time relative to the initial EU funded project. Specifically, the figure contains results for three event-study difference-in-differences models: a fixed-effect event-study model, the main dynamic difference-in-differences model, and a filtered-sample difference-in-differences model utilized as a robustness test.

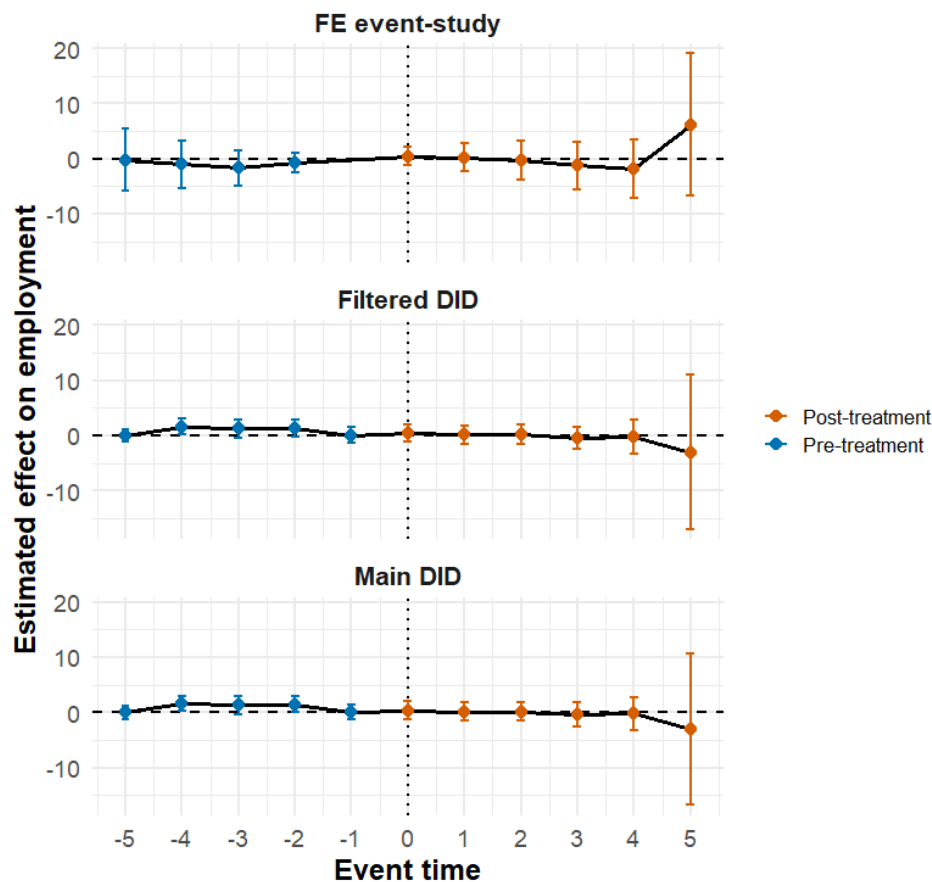


Figure 4. Employment effect by years since first EU project participation

Source: Author's own research, visualized using R.

With respect to all three panels illustrated in Figure 4, the estimated coefficients of the pre-treatment period fluctuate near zero and are statistically indistinguishable from zero. These patterns

provide evidence in support of the parallel trends assumption inherent in the difference-in-differences methodology, which indicates that firms that received EU funded projects in the future were not located on systematically different employment paths before receiving such funding.

Reviewing the post-treatment coefficients, the magnitude of these coefficients remains relatively small and statistically indistinguishable from zero across all three specifications. While some of the coefficients in the later periods exhibit slightly larger point-estimates, the confidence intervals are quite broad, indicating diminished precision due to the fewer numbers of observations present farther from the treatment-date. It is important to note that the overall pattern illustrated in Figure 4 remains constant regardless of the three different methodologies employed, which indicates that the results of this study are robust to variations in both specification and sampling.

Collectively, the findings from the dynamic analysis suggest that EU project participation does not lead to long term, systematic increases in employment among firms participating in the projects. It appears that the employment adjustments made by participating firms are relatively modest in magnitude and duration, and that no identifiable long-term treatment effects exist in the observed time frame.

Summary of the findings

The results of the analyses, described above, point to several key findings.

Firms that participate in EU projects are more formalized and better administratively embedded than firms that do not participate in EU projects. At the same time, the regional distribution of e-commerce firms is largely unaffected by whether or not firms participate in EU projects.

During the 2021 shock, e-commerce companies that do not participate in EU projects experienced more employment volatility than firms that do participate in EU projects, while EU project participants experienced greater resilience during the same period.

However, both correlation and causal impact (DID) analyses indicate that EU project participation does not generate significant average employment effects. This result is consistent with evidence from Bulgaria showing that EU-funded projects are more strongly associated with innovation and organizational upgrading than with systematic job creation, even among technologically active firms (Ma, 2024).

Conclusion

The main aim of this study is to determine how participation in EU funded projects affects the employment and other business aspects of companies. To address this issue, we employed a matched administrative dataset of all firms formally registered in Bulgaria as e-commerce traders and linked registration as an e-commerce trader to EU project participation and to the employment of the firms. We employed a combination of descriptive statistical methods and methodologies of Difference-in-Differences (DID) and Event-Study to assess whether there are differences in the employment outcomes and the business practices of firms due to the EU funding.

According the descriptive findings, the e-commerce firms participating in the EU-funded projects appear to be more formal and better administratively established than the non-participating firms; thus they exhibit higher rates of VAT registrations, lower rates of deregistration and lower levels of informality. At the same time, however, the descriptive findings do not indicate any systematic link between EU project participation and the geographical distribution of firms' managers and their gender composition. In general, therefore, the EU funding appears to strengthen

the existing structural and institutional characteristics of the firms rather than generate new types of configurations of firms.

Concerning employment, the descriptive findings have shown that firms participating in EU-funded projects experienced lower employment contractions than firms that did not participate in EU-funded projects during the 2021 economic crisis. These findings indicate that firms participating in EU-funded projects had more stable employment than firms that did not. However, once a causal framework, employing both the DID and the Event-Study methodologies, was used the findings indicate that there is no statistically significant difference in the average employment effect of EU project participation. Both methodologies reveal that the employment effects of EU project participation over the short to medium term are small, heterogeneous and statistically indistinguishable from zero.

In conclusion, the findings suggest that, in general, EU-funded projects do not lead to the generation of jobs in e-commerce firms. Nevertheless, EU funding is connected to the formalization of firms, to their higher administrative capacity and to their capacity to resist economic shocks. From a policy perspective, therefore, the expectation that EU-funded projects will directly generate jobs may be considered to be unrealistic. Even though EU funding improves the institutional environment of firms, additional policies should be adopted to support the development of managerial skills and to stimulate the demand for labor so as to obtain long-term employment effects.

Since we focused on a legally observable form of digitalization, the study offers new evidence based on administrative data regarding the limitations and possibilities of EU-funded initiatives to affect the employment dynamics of e-commerce firms in Bulgaria.

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