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## Working Paper Exploring the drivers of irregular spending in the EU cohesion policy: A fractional regression analysis

JRC Working Papers on Territorial Modelling and Analysis, No. 03/2024

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JRC WORKING PAPER

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No 03/2024



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# Exploring the drivers of irregular spending in the EU cohesion policy: A fractional regression analysis

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## JRC WORKING PAPER

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## INDEX

Executive Summary	4
1. Introduction	6
2. Literature review	8
3. Control system in cohesion policy expenditure: the role of programme authorities	
4. Data and methodological approach	12
4.1. Empirical strategy	
4.2. Data source	14
5. Results and discussion	15
5.1. Analysing the total error rate	15
5.2. Explaining the error rate	17
5. Conclusion	21
References	23
Appendix	25
Appendix A. Explaining the selection of threshold used in the regressions	25
Appendix B. Descriptive Statistics and multi-collinearity diagnostic	26
Appendix C. Robustness test	

## Abstract

The regularity and legality of EU spending, i.e. the conformity of incurred expenditures with relevant legislation, is an important measure of efficiency. It is also a key pre-condition for the effectiveness of EU funds. The present paper aims to understand the main determinants of irregular spending in EU cohesion policy funding: this is a highly important, yet understudied topic, especially given that cohesion policy is the area of the EU budget with the highest levels of irregularities. Using time series data and a fractional regression analysis model, the study provides evidence that the specific governance and structure of cohesion policy programmes can explain the intensity of irregular spending. Overall, the analysis finds that the higher the complexity of programmes (e.g. in terms of number of priorities, multi-fund focus), the higher the risk of irregularities and difficulty to detect them by programme authorities. The paper also shows the relevant role of specific aspects of the implementation, such as the size and number of projects, in influencing the regularity of expenditures. The results suggest that more simplification, greater thematic concentration and funds' rules harmonization could bring benefits in the future.

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## **Executive Summary**

The regularity and legality of EU cohesion policy spending, i.e. the conformity of incurred expenditures with the relevant regulations, is an important measure of its administrative efficiency. It is also a key pre-condition for the effectiveness of the funds. However, despite its policy relevance, academic research on this area has been sporadic, resulting in a limited amount of empirical work. One consequence is that we still have a limited understanding of the determinants of irregular spending in cohesion policy. The main objective of the paper is to contribute to filling this research gap by investigating the effects of the design and implementation of funding programmes on irregular spending.

There is a strong policy rationale for carrying out such an analysis. Despite improvements, cohesion policy funds remain the area of the EU budget with the highest levels of irregularities. In light of recent circumstances (crises, institutional delays, etc.), the increased pressure to absorb large amounts in short periods of time may even have increased the risk of irregular spending. At the same time, there has been a growing call for simplification of audit requirements. Finally, the introduction of more performance-based models in future policy delivery may shift the focus of audit from spending to outcomes and results.

Using a fractional regression analysis model, we examine the impact on error rates (levels of irregular spending) of a series of explanatory variables related to the governance of programmes (regionally or nationally managed programmes), their structure (mono- versus multi-fund programmes; thematic concentration of funds), and implementation (number and size of operations/projects). Despite their importance, the impact of these variables has never been tested.

The results show that the greater the complexity of the programmes – measured by the number of output indicators, the number of projects and the multi-fund dimension of the programmes – the greater the likelihood of an increase in irregular expenditures. This suggests that complex programmes may be more difficult to manage. Similarly, programmes with a higher proportion of large projects, which are also often associated with a higher level of complexity, in terms of both scope and budget, are also more likely to have higher error rates. This complexity is due not only to the size of the budget to be managed, but also to the number of partners or entities involved and the more burdensome bureaucratic and legal procedures.

The thematic concentration of spending is negatively correlated with the error rate of programmes, suggesting that targeting expenditure on a narrower set of thematic objectives may help programme authorities to prevent or tackle irregularities more effectively. Conversely, the number of projects that are financed annually by operational programmes is positively correlated with the overall error rate: in other words, the more fragmented is the expenditure, the higher the share of irregularities. Finally, the relationship between error rates and absorption does not appear to be statistically significant.

The paper shows the crucial role of programme design and governance within cohesion policy in preventing irregularities. The findings suggest that greater simplification, thematic concentration and harmonisation of the funds' rules could bring significant benefits.

## **1. Introduction**

EU cohesion policy is the largest regional development policy in the world, with a budget of EUR 392 billion for the 2021-2027 programming period. Its main objective is to tackle uneven growth between EU regions and to promote their competitiveness. The implementation of the policy is entrusted to national and regional authorities through multi-annual funding programmes with the European Commission playing a supervisory role. Historically, cohesion policy has been the area of the EU budget with the highest rates of irregular spending (ECA, 2021). In general terms, irregular spending is any expenditure that is not in conformity with the legislation. In the context of the EU finances, irregularities are defined as 'any infringement of a provision of a contract or of an EU regulation resulting from an act or an omission, which causes, or might cause, a loss to the EU budget' (ECA, 2024; p. 6). In this paper we will also use the term 'error' as a synonym for irregular spending or expenditure.

Growing efforts to tackle the problem of irregular spending in cohesion policy through legislation and capacity building have led to a significant reduction in the overall percentage of errors in spending over the years (Davies and Polverari, 2011). However, irregularities continue to affect the smooth implementation of the policy and its impact in several territories. Moreover, they contribute to denting its reputation, entrenching negative narratives about EU funds in the public discourse and fuelling arguments in favour of budget cuts (Mendez and Bachtler, 2017).

The regularity and legality of expenditures is an important measure of administrative efficiency of cohesion policy and a key pre-condition for its effectiveness. However, despite its policy relevance, academic research on the subject has been sporadic, resulting in a limited amount of empirical work. One consequence is that we still have a limited understanding of the determinants of irregular spending in cohesion policy. The existing literature has identified in the complexity of the rules and the lack of administrative capacity the two main causes of irregularities in cohesion policy (Meuleman and Brenninkmeijer, 2017; Mendez and Bachtler, 2022). Nevertheless, we lack a comprehensive picture of all the factors at play and additional evidence is certainly needed to disentangle them. In particular, there is a third important dimension whose impact on error rates remains largely unknown, namely the design and implementation of funding programmes. The main objective of this paper is to help fill this research gap by addressing the following questions:

- 1) Does the governance of cohesion policy funding programmes influence their error rate?
- 2) Do the size and structure of these programmes lead to irregular spending?
- 3) Are the number and size of projects predictors of the error rate?

The measure of irregularity used in our paper is the total error rate reported annually by the audit authorities of programmes. This is generally the share of irregular spending that managing authorities have failed to prevent or detect in their control of expenditures, and which is subsequently detected by controls carried out by audit authorities. It is important to clarify that the audit authorities only carry out checks on a representative sample of

total spending. As a result, the overall error rate is an estimate of the predicted irregularities in all expenditure based on the actual errors detected in the audited portion.

The relevance of the variable 'total error rate' is that it helps capture both the extent to which expenditures are error-prone and the capacity of the programmes management and control systems to detect them. Errors in the context of cohesion policy typically take the form of ineligible costs, lack of supporting documents, infringements of state aid rules, and breaches of public procurement rules. Using a fractional regression analysis model, the paper investigates at programme level the impact on error rates of a series of explanatory variables related to the governance of programmes (regionally versus nationally managed programmes), their structure (mono-fund, multifund; thematic concentration), and implementation (number and size of operations). Despite their importance, the impact of these variables has never been tested.

There is a strong policy rationale for conducting such analysis. Despite improvements, cohesion policy funds remain more error-prone compared to all the other EU instruments. In light of recent circumstances (crises, institutional delays, etc.), the increased pressure to absorb large amounts in short periods of time may even have increased the risk of irregular spending (ECA, 2021). At the same time, there is a growing demand for simplification of audit obligations (Committee of the Regions, 2023), as their current complex and burdensome nature is considered to have unintended negative effects on the strategic performance of the policies (Mendez and Bachtler, 2011). Moreover, for the 2021-2027 programming period, changes to simplify and streamline cohesion policy funds will impact control activities. Regulation (EU) No 1060/2021 introduces three significant innovations: (i) risk-based management verifications, (ii) mandatory use of simplified cost options for operations under EUR 200,000, and (iii) the option to use financing not linked to costs. As managing authorities of the programmes must develop risk-based verification strategies, our study can identify potential macro-level risk factors associated with the characteristics of the programmes, drawing on the experience of fund implementation from the 2014-2020. Finally, the possible adoption of a more performance-based model in the future delivery of the policy (European Commission, 2024) could shift the focus of the audit from actual expenditures to outcomes and results. This is already the case for the Recovery and Resilience Facility. Both the persistent risk of irregularities and a potential scenario of lighter audit rules - as a result of regulatory simplification and performance-based mechanisms - might require additional efforts to identify and tackle upfront the causes of irregular spending. Our paper provides important evidence to support this effort.

The paper is structured as follows. The second section summarises a literature review on aspects relevant to this paper. The third section presents the main variables and the rationale for their selection, while the fourth section describes the econometric model. The fifth and sisth sections presents the results and their policy implications.

7

## 2. Literature review

Public sector audit is a vital activity within states, in that it underpins the relationship between the government and the governed (Ferry et al., 2022). Ensuring financial compliance is therefore critical to ensuring trust in democracies. It is no surprise if this dimension has acquired increasing salience within cohesion policy. This can be primarily ascribed to two reasons: the first is the consequential budget of the policy totalling nearly 1/3 of the EU multiannual financial framework (i.e. the overall EU long-term budget); the second is that the policy has been persistently marked by significant levels of compliance mistakes. To address this problem stricter provisions and mechanisms have been gradually introduced since the 90s (Bachtler and Mendez, 2020), as part of a broader effort to reinforce controls over the execution of the EU budget (Benz et al., 2007).

The theoretical underpinnings of this analysis are derived from various bodies of research, including "audit explosion" theories, multi-level governance theory and studies on the performance of EU structural funds. The theory of the audit explosion refers to the increase in audit and related monitoring practices resulting from public management reform processes in the past forty years (Power, 1994). Multi-level governance theories, originating from EU studies, have specifically examined the participation of local and regional authorities in the decision-making processes of cohesion policy funds (Bache, 2008; Piattoni, 2009). Economic research on the performance of structural funds has increasingly aimed to identify the factors that account for the significant differences in their impact and financial execution (see, for example, Bachtrögler et al., 2020; Fratesi and Wishlade, 2017; Santos et al., 2024).

The emphasis on financial compliance has also been reflected in the political debate on cohesion policy. The Barca report famously noted that, alongside absorption, irregular spending received the most attention in the discussions both at national and EU level, to the detriment of other important aspects of the policy (Barca, 2009). Indeed, irregularities often feature prominently in criticisms of cohesion policy (Salvai and Molica, 2019). As specific features of its implementation can influence perceptions of the policy (Dąbrowski et al., 2019) it seems likely that irregular spending also generates negative views of the policy.

However, despite gaining increasing attention, the issue of financial compliance in the context of EU funds is only marginally addressed in the academic literature. Mendez and Bachtler (2017) highlight that this contrasts with the proliferation of works on legal compliance in the field of EU studies (Mendez and Bachtler, 2017). Overall, there has been very little analysis of the EU audit systems and procedures and their evolution over time with a few exceptions such as Laffan (2013) or Stephenson (2016).

There is even less work on the determinants of non-compliant expenditure (i.e. irregular spending) in the context of EU finances. There seem to be only two quantitative studies, both by Mendez and Bachtler (2017; 2022). Using a mixed methodology based on quantitative and qualitative data, the first study examines the influence of institutional decentralization, funding governance (nationally versus regionally managed funding programmes) and administrative capacity on compliance patterns (Mendez and Bachtler, 2017). The measure that the authors use as

a proxy for financial compliance is the rate of financial corrections<sup>1</sup> made as a result of irregularities in the 2000-2006 period. The authors find that only the administrative capacity variable is significantly correlated with financial compliance patterns, while both the funding governance and the degree of regional autonomy are not.

The second study has a broader scope in that it explores how the quality of institutions influences three different dimensions related to the administrative performance of cohesion policy: the absorption rate, the capacity to achieve the policy objectives (targets) set by the programmes, and the financial compliance expressed by the cumulative residual risk<sup>2</sup> calculated at the end of the programming period (Bachtler and Mendez, 2022). One of the main findings of this analysis is that a higher institutional quality, proxied by the Regional Quality of Government Index (Charron and Lapuente, 2013), affects positively the levels of regular spending. Interestingly, the analysis of Bachtler and Mendez (2022) finds no significant correlation between the total budget size and the share of irregularities.

For its part, gualitative research has focused on the unintended consequences of the audit rules. Meuleman and Brenninkmeijer (2017) argue that the complex and burdensome nature of the audit system, as it has developed since the 2000s, may paradoxically have led to higher error rates. This is because the growing focus on financial compliance has put pressure on national authorities to interpret audit rules more strictly. In addition, the complexity of the rules fuels legal uncertainty for the beneficiaries. The negative effects of the 'audit explosion' (Power, 1994) are also discussed by Mendez and Bachtler (2011) in another paper. Based on interviews with practitioners, the two scholars highlight three risks of excessive auditing for the effectiveness of cohesion policy: the 'draining' of staff from other operational tasks, the selection of projects that 'on paper' are less prone to irregularities, and distrust or frustration among the actors involved in implementing the policy (Mendez and Bachtler, 2011). Taken together, the authors argue, the three can 'distort' the policy's objectives. In the same vein, Polverari (2014) notes that the audit and control system has led programme authorities to increase their focus on financial accountability at the expense of the attention to impact and performance. The problems reported by cohesion policy implementers according to the studies cited above reflect the two general risks of 'decoupling' and 'colonization' discussed by Power (1999) in his work: by which he means respectively the diversion of resources and the change of behaviours in order to meet audit requirements. This is not to say that less control should be the solution. Rather, to reduce the burden of controls and their unintended consequences, it would be important to address the intrinsic shortcomings in the design of the policy, which are often the root cause of the high level of irregularities (Gal, 2015). To this end, it is first essential to identify these causes and understand the extent to which they influence the propensity to commit compliance errors, which is the main objective of this paper.

<sup>&</sup>lt;sup>1</sup> Financial corrections considered by the authors represent the amount of EU funding removed from the accounts because of irregular spending detected by audit bodies (EU, Member States).

<sup>&</sup>lt;sup>2</sup> The residual risk rate (RRR) used by the authors refers to the estimated residual risk of error after the application of the relevant financial corrections.

# 3. Control system in cohesion policy expenditure: the role of programme authorities

The implementation of economic policies financed by cohesion policy is based on multi-level governance involving several layers of public decision-makers (Foglia, 2023). In the context of shared management between the European Commission and national authorities, European legislators have entrusted the implementation of operational programmes and control activities to national or regional authorities. On the other hand, the European Commission has a supervisory role. In addition to its responsibilities for monitoring programmes and disbursing funds, the European Commission assesses the functioning of the management and control systems, as well as the reliability of the reported audit results, and if necessary, applies financial corrections and requests corrective measures from the programme authorities to improve the systems. To this end, a reinforced shared management assurance framework ensures the legality and regularity of expenditure (Kulh, 2020).

The control system for cohesion policy funds is built up at different levels, each of which can rely on previous controls carried out by other bodies, after carrying out their own checks on the effectiveness of these controls. Given the nature of expenditure in the EU's multiannual programmes, errors can be detected at any point in the programming period. However, the programme authorities are required to prevent irregularities by not declaring expenditure found to be irregular in interim payment claims submitted to the European Commission during each accounting year.

As shown in Figure 1, during each accounting year (from 1 July of one year (n) to 30 June of the following year (n + 1)), the programme authorities declare a volume of expenditure to the Commission, carry out a series of checks before validating the expenditure submitted by beneficiaries (e.g. small and medium-sized enterprises, public bodies, universities, citizens) and report the results of these checks to the European Commission.





Source: Own elaboration.

The Managing Authority (MA) or an Intermediate Body (IB) of the programmes shall carry out management verifications by checking that expenditure declared by beneficiaries has been incurred, paid and complies with the

applicable laws, the operational programme, and the conditions of eligibility of the operation. These checks include: (a) administrative checks on all claims for reimbursement submitted by beneficiaries and (b) on-the-spot checks on a sample of projects. All irregular expenditure detected by administrative checks is excluded from expenditure declared to the Commission.<sup>3</sup>

The Certifying Authority (CA) certifies, before submitting payment claims, that the expenditure has been verified by the managing authority and results from a reliable accounting system.

Thereafter, in addition to verifying the reliability of the management and control system, the independent Audit Authority (AA) (an AA can be appointed for one or more programmes) carries out audits of operations on a statistical and representative sample of operations/projects on the basis of expenditure declared to the Commission during the accounting year.

The total error rate, which is the main variable of our paper, is the extent of irregular spending detected by the audit authority which had not been spotted by the first level checks carried out by the Managing Authority. Thus, the programme authorities correct any irregularities found by the Audit Authority during this stage before submitting the accounts.

Subsequently, by 15 February n + 1 (or exceptionally by 1 March n + 1) each year, Member State authorities report on their controls over the use of EU funds at national and regional level and on the sound financial management of these programmes. This is done by means of an assurance package comprising: the accounts, a management declaration, and an annual summary of controls by the managing authority, an annual control report with the calculations of a total error rate based on representative samples and a residual error rate, and an audit opinion on the legality and regularity of expenditure by the audit authority.

This reporting is the basis for the Commission's acceptance of the programme accounts and the basis for building assurance.

For the 2021-2027 programming period, the framework of the management and control system remains essentially the same (with the exception that the role of the certifying authority, which is replaced by an accounting function). However, some changes aimed at simplifying and streamlining the implementation of cohesion policy funds will have an impact on control activities. Indeed, from a management perspective, the Common Provisions Regulation for 2021-2027 (Regulation (EU) No 1060/2021) introduced at least three<sup>4</sup> major innovations: (i) risk-based management verifications (Article 74(2)); (ii) the compulsory use of Simplified Cost Options (SCOs) for certain operations under EUR 200 000 (Article 53) and (iii) the possibility of using the financing not linked to costs scheme (Article 95). As managing authorities are required to develop and implement risk-based verification strategies to

(https://ec.europa.eu/regional policy/sources/guidance/guidance management verifications en.pdf)

<sup>&</sup>lt;sup>3</sup> Relevant information may be also find on the EC Guidance for Member States on management verification for 2014-2020 Note EGESIF\_14-0012\_02 dated 17/09/2015

<sup>&</sup>lt;sup>4</sup> In addition, in accordance with Article 83 CPR 2021-2027 the Member State may apply, at certain conditions set by Article 84, the enhanced proportionate arrangements (e.g., reduced statistical sample for audits of operations, application of national rules for management verifications).

determine the scope and scale of first-level controls, our study can help identify potential macro-level risk factors<sup>5</sup> associated with the programme characteristics, drawing on the experience of implementing funds in the 2014-2020 period.

## 4. Data and methodological approach

## 4.1. Empirical strategy

To answer to our research questions, we use an econometric model where the dependent variable corresponds to the total error rate ( $TER_{it}$ ) reported by the Audit Authorities<sup>6</sup> of cohesion policy programme *i* in year *t*, as reported in (1). The programme *i* may have a geographical scope at national or regional level, depending on its governance model in the 2014-2020 cohesion policy framework. The observation period covers six accounting years from the accounting year 2015-2016 to the accounting year 2020-2021, for around 300 regional or national operational programmes from 27 EU Member States.<sup>7</sup> The panel dataset is unbalanced because programmes are independent of each other and do not necessarily start or certify expenditure to the Commission at the same time from a given accounting year onwards.

$$TER_{it} = \alpha + \varphi X_{it} + \sum_{i} \gamma_i \, OP_i + \sum_{i \in c} \gamma_c \, CTRY_i + \tau_t + \epsilon_{it}$$
(1)

The total error rate represents the percentage of expenditure affected by irregularities in relation to its accounting value and is used in this work as a proxy for both error propensity by beneficiaries and error detection capacity by programme authorities.<sup>8</sup> As explained above, the terms "error" and "irregularity"<sup>9</sup> should therefore be considered as synonymous.

<sup>&</sup>lt;sup>5</sup> Risks and example for reflection and illustrative purposes are reported in the EC's reflection paper: "Risk based management verifications Article 74(2) CPR 2021-20271" (Ares(2023)3757159 of 31/05/2023

<sup>&</sup>lt;sup>6</sup> or recalculated by the European Commission. For the purpose of the study, we used the "*confirmed total error rate after EC assessment*" as reported in the Annual Activity Reports' annex (e.g., Annex 7B)

<sup>&</sup>lt;sup>7</sup> Data from UK operational programmes and European territorial cooperation (ETC) programmes have not been reported for the purpose of this study.

<sup>&</sup>lt;sup>8</sup> However, the detection capability should be distinguished from the ability to correct the identified irregularities. To this end, the European regulatory framework (ANNEX IX Footnote 84 of Commission Implementing Regulation (EU) 2015/207) foresees to calculate a residual total error rate (RTER), as the difference between the total errors and the financial corrections implemented before sending the accounts to the Commission, compared to total expenditure. This residual total error rate, which is continuously monitored by the European Commission, is considered tolerable up to the materiality threshold of 2 % of expenditure as defined in Article 28 (3) of Commission Delegated Regulation (EU) No 480/2014.

<sup>&</sup>lt;sup>9</sup> The notion of irregularity is defined in Article 2 (36) of Regulation (EU) No 1303/2013 as follows: 'irregularity means any breach of Union law, or of national law relating to its application, resulting from an act or omission by an economic operator involved in the implementation of the ESI Funds, which has, or would have, the effect of prejudicing the budget of the Union by charging an unjustified item of expenditure to the budget of the Union'.

To explain the total error rate, we include in the model a vector of time-varying ( $X_{it}$ ) and non-time-varying variables ( $OP_i$ ) associated with different specific programme characteristics, a vector of country dummy variables ( $CTRY_i$ ), allowing to control for country-specific effects of programme *i* associated with each EU Member State *c*, year dummies ( $\tau_t$ ) used to control for time-specific fixed effects. The  $\epsilon_{it}$  denotes the error term.

The time-varying vector  $X_{it}$  includes five variables: (i) value of spending (absorption) and (ii) the number of operations (projects) associated with the expenditures, (iii) the thematic concentration of annual spending, (iv) a measure of programme complexity, captured by the number of programme output-indicators, and (v) the share of small (or large) projects. In turn, the vector " $OP_i$ " captures two important aspects of operational programmes: if the programme is multi- or mono-fund (i.e. if it is financed by one or more of the 3 cohesion policy funds) and whether the programme is managed at a national or regional level. Both variables are non-time-varying and are binary. More details on the explanatory variables can be found in Table 1. By including all these variables, we follow an approach similar to that of Mendez and Bachtler (2024) or Santos et al. (2024), where programme performance is explained by a set of programme characteristics, including the governance model, the thematic concentration of the funds, the share of large projects and the budget (or spending).

Variable name	Variable description
Number of operations (projects)	Annual number of the operations associated with the expenditures, expressed in thousands (1.000)
Cumulative spending (absorption)	Cumulative volume of spending associated with the expenditures, expressed in log
Thematic concentration of annual spending	Thematic concentration of annual spending by thematic objective is estimated using a similar methodological approach to the Herfindahl (1950) and Hirschman (1945) index, and following Santos et al. (2024). The measure captures the extent to which the funds are spread over different priorities.
Number of indicators over median (weighted)	Number of output indicators of programme $i$ over the median of output indicators in all the EU27 programmes, weighted by the programme budget. This indicator is time-variant as programme authorities can add or remove output indicator over time. This higher the number of indicators, the higher the types of measures planned in a programmes and thus its complexity.
Cumulative share projects by specific thresholds	Cumulative share of small projects (total project's expenditure below EUR 200,000) or the cumulative share of big projects following regulations governing cohesion policy/state aid (above EUR 431.000, EUR 1 Million or EUR 5,3 Million). For more details about the thresholds see Appendix A.
National programme	= 1 if the programme is managed at a national level, and 0 if managed at a regional level
Multi-fund programme	= 1 if the programme is supported by different funds, such as the European Regional Development Fund and the European Social Fund, and 0 when covered by a single fund

#### Table 1. Description of the explanatory variables

Source: Own elaboration.

To estimate equation (1) we use a fractional probit regression model. This choice is justified by the characteristics of the dependent variable: a proportion or fraction that lies between 0 and 1. Since a traditional linear model can predict values outside this range, the use of a fractional regression model provides more accurate predictions within the constraints of our data (Papke, 1996; Papke & Wooldridge, 2008).

### 4.2. Data source

For our analysis, we extracted data from several sources. Data on the total error rate at operational programme level were extracted from the Annual Activity Reports (AARs)<sup>10</sup> of the Directorates-General for Regional and Urban Policy (REGIO) and Employment, Social Affairs, and Inclusion Policies (EMPL) of the European Commission. These

<sup>&</sup>lt;sup>10</sup> The repository of the EC Annual Activity Reports is available on: https://commission.europa.eu/strategy-and-policy/strategy-documents/annual-activity-reports\_en

public documents are the main tools to indicate whether the control procedures in place in the Member States can provide reasonable assurance on the legality and regularity of expenditure. The total error rates reported each year represents the most conservative and up-to-date<sup>11</sup> estimate of the total error rate, before any financial corrections are applied and not taking into account any recalculation by the European Commission services after the audit cycle.<sup>12</sup>

Data about the annual number of operations, volume spending and output indicators are extracted from European Commission's Cohesion Open Data Platform. The share of projects by thresholds is estimated using beneficiary-level data from the European Commission's Kohesio webpage.<sup>13</sup> More specifically the number of operations and the volume of spending comes from the dataset titled "ESIF 2014-2020 categorisation ERDF-ESF-CF planned vs implemented".<sup>14</sup> The number of output indicators is derived from two datasets including common and specific indicators.<sup>15</sup>

## 5. Results and discussion

## 5.1. Analysing the total error rate

Between 2015 and 2020, the average total error rate<sup>16</sup> is 3% (Table B1 in Appendix). Over this period, the total error rate tends to increase until 2018 and then to decrease (Figure 2). In 2015, the average total error rate was recorded at 0.5%, which is relatively low compared to the error rates of the following years from 2016 to 2021. This initial lower error rate is mainly due to the early stage of the programming cycle where very low amounts of funds are spent. Moreover, by the end of 2015, only 115 programmes from our sample had received formal approval, with an average implementation rate of just 0.60%.

Programmes managed at regional-level and multi-fund programmes have a higher value of error rate than national programmes and mono-fund programmes, respectively, in almost all years (Figure 2). This finding is also confirmed by the kernel density estimation (Figure 3), and the results of the two-sample t-test with equal variances (Table B2 and Table B3 in the Appendix).

<sup>&</sup>lt;sup>11</sup> For instance, based on the information of the 2022 AARs published in 2023, we included in our dataset the confirmed total error rates pertaining to the accounting year 2020-2021 and we updated, as needed, the total error rates for the previous accounting periods.

<sup>&</sup>lt;sup>12</sup> i.e., thorough desk verifications of all annual control reports and on-the-spot compliance audits by the Commission and the European Court of Auditors for a sample of programmes, when risks were identified.

<sup>&</sup>lt;sup>13</sup> Available here: https://kohesio.ec.europa.eu/. Data extracted on 04/02/2024.

<sup>&</sup>lt;sup>14</sup> Available here: <u>ESIF 2014-2020 categorisation ERDF-ESF-CF planned vs implemented | Data | European Structural and Investment Funds (europa.eu)</u>. Data extracted on 04/02/2024

<sup>&</sup>lt;sup>15</sup> Available here: <u>ESIF achievement details on common indicators</u> and <u>ESIF achievement details on specific indicators</u>. Data extracted on 04/02/2024.

<sup>&</sup>lt;sup>16</sup> It is important to highlight that the error rates may, in some cases, include flat-rate and, where contradictory procedures for compliance audits are still ongoing at the moment of the adoption of the Annual Activity Reports, a prudent approach is taken when re-calculating the error rates, i.e. using the most conservative results at that stage of the audit process.



Figure 2. Average total error rate (%) by year and fund characteristics: (a) national versus regional operational programmes (left) or (b) multi-fund versus mono-fund operational programmes (right)

Figure 3. Univariate kernel density estimation by fund characteristics: (a) national versus regional operational programmes (left) or (b) multi-fund versus mono-fund operational programmes (right)



Source: Own elaboration

The results of the two-sample t-test for programme characteristics by governance model (Table B2 in the Appendix) also show that, compared to regional programmes, national programmes have a higher share of large projects, a higher thematic concentration of annual spending and are more complex (higher number of indicators, number of operations and spending). Multi-fund programmes are more diverse compared to mono-fund programmes, particularly in terms of the thematic concentration of spending and the higher number of output indicators (Table B3 in the Appendix). Multi-funds programmes also have a higher proportion of large projects when considering the three thresholds used in the analysis.

## 5.2. Explaining the error rate

Table 2 shows the results of the estimation of the fractional probit regression model<sup>17</sup>, where the dependent variable is the error rate. Due to multicollinearity problems between the variables capturing the concentration of large (and

<sup>&</sup>lt;sup>17</sup> The rationale for the choice of this particular model in the context of our analysis is given at the end of section 4.1.

small) projects in each programme (see Table B5 in the Appendix), we estimated equation (1) including each of the four different variables separately. Column (1) reports the results including the share of projects with total expenditure below EUR 200.000, column (2) above EUR 431.000, column (3) above EUR 1 million and column (4) above EUR 5,382 million. After imposing this restriction, the results reported in Table 2 do not reveal multi-collinearity issues when looking at the correlation matrix (Table B4 in Appendix) and the variance inflation factor (Table B5 in Appendix). Tables C1, C2 and C3 in the Appendix also report a sensitivity analysis, carried out by adding and removing the various explanatory variables, as well as removing the observations P(95) and P(99), as an additional robustness test.

These additional complementary estimations show that the results are robust. Table 2 shows that the greater the complexity of the programmes – measured by the number of output indicators above the median, the number of operations (i.e. projects) and the multi-fund dimension of the programmes – the greater the likelihood of an increase in the error rate. This suggests that complex programmes may be more difficult to manage. More specifically, programmes with more and different types of operations as well as covering different funds require additional effort and expertise from the Managing Authority to verify expenditures and procedures. Monitoring and processing large amounts of data and information can be overwhelming for Managing Authorities, increasing the risk that irregularities will not be detected and dealt with.

Similarly, programmes with a higher proportion of large projects (columns 2 to 4 in Table 2), which are also often associated with a higher level of complexity, both in terms of scope and budget, are also more likely to have higher error rates. This complexity is due not only to the budget to be managed, but also to the numbers of partners or entities involved and the more burdensome bureaucratic and legal procedures (for instance in terms of public procurement). Large projects tend to require significant resources, including time, financial investment, and human capital and their implementation may involve more complicated operational and procedural steps. This can make it more difficult for the beneficiaries to ensure full compliance with all aspects of the projects and for the Managing Authorities to ensure more accurate checks, leading to higher total error rates as a result of audit work.

Conversely, the results in column (1), reporting the share of projects with a total expenditure below EUR 200 000 (the opposite situation of having a greater share of large projects), reveals a negative correlation with the error rate, corroborating previous results. The thematic concentration of spending is negatively correlated with error rates, suggesting that targeting expenditure on a narrower set of thematic objectives may help Managing Authorities to prevent or tackle irregularities more effectively. This is consistent with previous findings that simplification reduces the error rates. It also suggests that a more focused thematic approach may be easier to follow, thereby reducing the complexity of audits. In addition, specialized expertise in a more limited number of thematic objectives may allow Managing Authorities to develop deeper expertise, which can lead to more efficient and effective checks of expenditures and its legality and regularity, thereby reducing the risk of error.

Table 2. Results Fractional Probit regression, dependent variable: Total error rate

	(1	.)	(2	)	(3	)	(4)	
Variables	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx
Cumulative spending – Log	0.00992	0.0006	0.00890	0.0005	0.00880	0.0005	0.00835	0.0005
	(0.0110)	(0.0007)	(0.0107)	(0.0006)	(0.0107)	(0.0006)	(0.0107)	(0.0006)
Yearly nr. operations (x 1,000)	0.00278***	0.0002***	0.00245***	0.0001***	0.00237***	0.0001***	0.00211**	0.0001**
	(0.000969)	(0.0001)	(0.000901)	(0.0001)	(0.000905)	(0.0001)	(0.000898)	(0.0001)
National programme (Yes/No)	-0.0820	-0.005	-0.102	-0.0062	-0.108*	-0.0065*	-0.0973	-0.0059
	(0.0629)	(0.0038)	(0.0628)	(0.0039)	(0.0628)	(0.0039)	(0.0648)	(0.004)
Multi-fund programme (Yes/No)	0.134***	0.0082***	0.111**	0.0067**	0.116**	0.007**	0.131***	0.008***
	(0.0479)	(0.003)	(0.0472)	(0.0029)	(0.0472)	(0.0029)	(0.0476)	(0.003)
Cumulative share proj. <u>below</u> 200k	-0.413**	-0.0251**	-	-	-	-	-	-
	(0.180)	(0.011)	-	-	-	-	-	-
Cumulative share proj. > 400k	-	-	0.289***	0.0176**	-	-	-	-
	-	-	(0.112)	(0.007)	-	-	-	-
Cumulative share proj. > 1M	-	-	-	-	0.265**	0.0161**	-	-
	-	-	-	-	(0.115)	(0.0071)	-	-
Cumulative share proj. > 5M	-	-	-	-	-	-	0.194*	0.0118*
	-	-	-	-	-	-	(0.110)	(0.0068)
Thematic concentration of annual spending	-0.188**	-0.0114**	-0.161*	-0.0098*	-0.172**	-0.0105**	-0.191**	-0.0116**
	(0.0885)	(0.0054)	(0.0863)	(0.0053)	(0.0859)	(0.0053)	(0.0867)	(0.0053)
Nr indicator over median (weighted)	0.0134*	0.0008*	0.0149**	0.0009**	0.0156**	0.0009**	0.0149**	0.0009**
	(0.00695)	(0.0004)	(0.00688)	(0.0004)	(0.00694)	(0.0004)	(0.00710)	(0.0004)
Year dummy	Ye	25	Ye	S	Ye	s	Ye	25
Country dummy	Ye	25	Ye	S	Ye	s	Ye	es
Constant	-2.63	6***	-2.88	1***	-2.83	4***	-2.74	45***
	(0.1	78)	(0.20	D1)	(0.19	96)	(0.1	82)
Observations	1,4	87	1,48	87	1,48	1,487		87
Log pseudolikelihood	-178	3.13	-178	8.06	-178.07		-178.18	
Pseudo R2	0.04	171	0.04	74	0.04	74	0.04	468
Wald test joint significance (p-value)	0.00	000	0.00	00	0.0000		0.0000	

Source: Own elaboration.

Note: Robust standard errors in parentheses. Significance level: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1





(c) Cumulative share proj. > 1M Predictive margins with 95% CIs .035 Conditional mean of total error rate Conditional mean of total error rate .03 .025 02 .015 6 .3 .5 .6 .9 ò .2 .4 .8 Cumulative share of EU amount: project expenditure > EUR 1 million

(d) Cumulative share proj. > 5M





(f) Thematic concentration of annual spending







#### Source: Own elaboration.

Note: The graphs report the predictive margins conditional mean of total error rate. Graph (a) uses the results of the model in column (1) in Table 2, graph (c) the ones in column (3), graph (d) from column (4) graphs (b), (e), (f) and (g) from column (2).

Conversely, the number of projects that are financed annually by operational programmes is positively correlated with the total error rate. As the management verifications are generally<sup>18</sup> carried out on all the projects, the control burden is likely to become 'heavier' as the number of projects to be checked increases. This may result in some irregularities not being spotted by managing authorities and being detected only at the subsequent levels of control (i.e. by the audit authority on a sample basis), thus contributing to the total error rate.

The relationship between the error rates and the cumulative value of the programmes' expenditure does not appear to be statistically significant in all the estimations in Table 2, and this result is robust to different model specifications, as reported in Table C1 and Table C2 in the Appendix. Similar results, in terms of magnitude, sign and statistical significance, were observed when considering other specifications of the expenditure variable certified annually by each programme. This result also suggests that high levels of spending do not necessarily lead to higher total error rates (and vice versa): in other words, a higher absorption does not result in more irregularities.

With regard to the correlation between the governance models of the programmes, in most cases we don't observe a significant correlation with the error rates, suggesting that the other variables explain the model better.

## 5. Conclusion

Our paper highlights the crucial role of the programmes' design and implementation within cohesion policy in influencing financial compliance by focusing on the total error rates observed during the 2014-2020 programming period. Using an innovative dataset that combines different public data sources, we developed an econometric

<sup>&</sup>lt;sup>18</sup> During the programming period 2014-2020, all applications for reimbursement by beneficiaries, whether intermediate or final, shall be subject to administrative verifications, as per Article 125(5) Regulation EU 1303/2013.

strategy using fractional regression analysis and incorporating some unconventional variables whose influence on error rates has not been previously studied. Our analysis suggests a number of policy implications.

First, we find that certain characteristics associated with programmes' complexity, such as the thematic concentration of expenditure and the number of output indicators, have a significant impact on error rates. Programmes with fewer priorities may lead to management and control systems that favour specialisation processes which in turn allow for more effective error detection. Conversely, programmes with more objectives face an increased risks of non-compliance due to the diverse and complex legal requirements linked to different types of projects. This suggests that it may be beneficial in the future to further enhance thematic concentration requirements and, more generally, to encourage programmes authorities to avoid spreading their resources across too many priorities. It light be also helpful to consider strengthening the control system to ensure the effective identification and mitigation of any related risks that may arise from this specific complexity.

Second, our analysis shows that multi-fund programmes tend to have a higher proportion of irregular expenditure than mono-fund programmes: it is possible that this is related to different rules and procedures governing the funds creating more complexity. One implication of these results is that greater regulatory harmonization between funds could also have a positive effect on the error rate. Third, the empirical results of our study provide macro-level elements that could improve managing authorities' strategies for carrying out risk-based management checks. In particular, the results suggest that the financial size of the funded projects plays a significant role in the risk associated with the total error rate. Specifically, a higher proportion of fund spent on small-scale projects (below 200 000 EUR) is associated with lower error rates. This suggests that introducing lighter audit requirements on smaller projects, a course of action already embraced in the current programming period, may not have negative implications.

Despite all the contributions of the study, we have to acknowledge some limitations. The first one is that it covers only a limited time frame, namely in the context of a single programming period. Future analysis should seek to extend the focus to more successive periods, where data availability allows so, for instance in order to explore whether relevant changes to programmes over time affect the error rates. The second is that the paper does not test the influence on financial compliance of "exogenous" variables relative to the territorial context in which the programme is implemented (e.g. socio-economic or institutional indicators). The third limitation concerns the unavailability of detailed information on the audits carried out by the audit authorities and additional audit levels, including the sampling strategies and methodologies used. This information would allow the testing of additional variables at an even more granular level. This aspect is therefore left for future research. Finally, the results of the paper could be best contextualised with more qualitative information, for example through interviews with managing and audit authorities or by looking into specific case studies.

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## Appendix

## Appendix A. Explaining the selection of thresholds used in the regressions

The choice of threshold values for the financial volume of projects has been mainly driven by some relevant regulatory provisions in the regulation governing cohesion policy and in the public procurement directives, which could possibly have implications for control, audit, and risk policies.

The selection of the EUR 200 000 threshold was guided by a twofold rationale: on one hand, in the context of simplification of the cohesion policy, the provision<sup>19</sup> outlined in the Common Provisions Regulation for the 2021-2027 programming period establish as a general principle that if the total cost of an operation does not exceed EUR 200 000, the contribution to beneficiaries shall take the form of simplified cost options (SCOs), with the exception of operations for which support constitutes State aid. This aspect is particularly relevant, given that the European Court of Auditors (2017) has also confirmed that projects using SCOs are less error-prone than reimbursements of actual costs. On the other hand, the threshold of EUR 200 000 represents, during the reference period studied, the maximum amount of aid in the form of a "*De minimis*"<sup>20</sup> contribution, which is exempt from the scope of EU State aid control because they are deemed to have no impact on competition and trade in the internal market, which can benefit from an undertake over a period of 3 years.

We apply the EUR 431 000 threshold derived from the Directive 2014/25/EU governing supply and service contracts procurement by entities operating in the water, energy, transport, and postal services sectors.

The threshold value of EUR 5,3 million represents the average value above which the European directives<sup>21</sup> for public procurement for works contracts apply.

Finally, the threshold value of EUR 1 million represents the minimum value from which certain types of operations which are subject to phased implementation, may, under certain conditions<sup>22</sup>, be eligible for support from the funds in the period 2021-2027, even if selected and started by the end of the accounting year 2021-2022.

<sup>&</sup>lt;sup>19</sup> Article 53 of Regulation EU 1060/2021

<sup>&</sup>lt;sup>20</sup> Article 3 of Commission Regulation (EU) No 1407/2013 of 18 December 2013 on the application of Articles 107 and 108 of the Treaty on the Functioning of the European Union to de minimis aid. It should be noted that starting from 1<sup>st</sup> January 2024 the new "De minimis" Commission Regulation (EU) 2023/2831 increased the threshold to EUR 300 000.

<sup>&</sup>lt;sup>21</sup> Article 4 of Directive 2014/24/EU, and Article 16 of Directive 2014/25/EU.

<sup>&</sup>lt;sup>22</sup> Article 118a Regulation EU 1060/2021

## Appendix B. Descriptive Statistics and multi-collinearity diagnostic

Variable	Obs	Mean	Std. dev.	Min	Max
Error rate	1,487	0.03	0.05	0.00	1.00
Cumulative spending – Log	1,487	17.40	4.82	0.00	23.62
Yearly nr operations (x 1,000)	1,487	3.38	14.81	0.00	230.2
National programme (Yes/No)	1,487	0.31	0.46	0	1
Plurifund programme (Yes/No)	1,487	0.37	0.48	0	1
Cumulative share proj. <u>below</u> 200k	1,487	0.12	0.16	0.00	1
Cumulative share proj. > 400k	1,487	0.78	0.24	0.00	1
Cumulative share proj. > 1M	1,487	0.66	0.26	0.00	1
Cumulative share proj. > 5M	1,487	0.40	0.26	0.00	1
Thematic concentration of annual spending	1,487	0.39	0.24	0.10	1
Nr indicator over median (weighted)	1,487	0.76	2.06	0.00	26.79

Table B1. Descriptive statistics: mean, standard deviation, minimum and maximum

Source: Own elaboration.

Table B2. Results two-sample t-test with equal variances, programmes' characteristics by governance mode
national versus regional

Variables	Ob	S.	Mea	n	Difference	CE	P-value.	
Vallables	National Regional National Reg		Regional	of means	J.E.	i value		
Error rate	460	1027	0.022	0.030	-0.008	0.003	0.011	
Cumulative spending – Log	460	1027	18.39	16.96	1.430	0.268	0.000	
Yearly nr operations (x 1,000)	460	1027	4.927	2.688	2.239	0.829	0.007	
Plurifund programme (Yes/No)	460	1027	0.352	0.378	-0.026	0.027	0.345	
Cumulative share proj. <u>below</u> 200k	460	1027	0.093	0.130	-0.037	0.009	0.000	
Cumulative share proj. > 400k	460	1027	0.829	0.752	0.077	0.013	0.000	
Cumulative share proj. > 1M	460	1027	0.745	0.625	0.120	0.014	0.000	
Cumulative share proj. > 5M	460	1027	0.517	0.345	0.172	0.013	0.000	
Thematic conc. of annual spending	460	1027	0.544	0.320	0.224	0.012	0.000	
Nr indicator over median (weighted)	460	1027	1.663	0.361	1.302	0.111	0.000	

Source: Own estimation.

	Ob	Obs.		ean	Difference	6.5	Durahua	
variables	Pluri	Mono	Pluri	Mono	of means	S.E.	P-value	
Error rate	550	937	0.035	0.023	0.012	0.003	0.000	
Cumulative spending – Log	550	937	17.47	17.36	0.104	0.259	0.685	
Yearly nr operations (x 1,000)	550	937	1.859	4.274	-2.415	0.793	0.003	
National programme (Yes/No)	550	937	0.294	0.318	-0.024	0.025	0.345	
Cumulative share proj. <u>below</u> 200k	550	937	0.069	0.148	-0.079	0.009	0.000	
Cumulative share proj. > 400k	550	937	0.838	0.739	0.099	0.013	0.000	
Cumulative share proj. > 1M	550	937	0.723	0.627	0.096	0.013	0.000	
Cumulative share proj. > 5M	550	937	0.447	0.369	0.078	0.013	0.000	
Thematic conc. of annual spending	550	937	0.354	0.410	-0.056	0.013	0.000	
Nr indicator over median (weighted)	550	937	1.133	0.547	0.586	0.11	0.000	

Table B3. Results two-sample t-test with equal variances, programmes' characteristics by fund characteristics: plurifund versus mono-fund

Source: Own estimation.

#### Table B4. Correlation matrix

#	Variable	1	2	3	4	5	6	7	8	9	10
1	Cumulative spending – Log	1									
2	Yearly nr operations (x 1,000)	0.13	1								
3	National programme (Yes/No)	0.14	0.07	1							
4	Plurifund programme (Yes/No)	0.01	-0.08	-0.02	1						
5	Cum. share proj. <u>below</u> 200k	0.04	0.33	-0.10	-0.24	1					
6	Cum. share proj. > 400k	0.04	-0.21	0.15	0.20	-0.66	1				
7	Cum. share proj. > 1M	0.02	-0.19	0.22	0.18	-0.66	0.95	1			
8	Cum. share proj. > 5M	0.03	-0.15	0.31	0.14	-0.50	0.70	0.83	1		
9	Them. conc. of annual spending	-0.04	0.07	0.44	-0.11	-0.02	-0.08	0.00	0.08	1	
10	Nr indicator over median	0.18	0.07	0.29	0.14	-0.09	0.10	0.10	0.12	-0.07	1

Source: Own elaboration.

#### Table B5. Variance Inflation Factor (VIF)

Variable	(1)	(2)	(3)	(4)	(5)
Cumulative spending – Log	1.08	1.07	1.07	1.07	1.07
Yearly nr operations (x 1,000)	1.17	1.16	1.08	1.08	1.06
National programme (Yes/No)	1.59	1.46	1.50	1.53	1.58
Plurifund programme (Yes/No)	1.10	1.09	1.07	1.07	1.06
Cumulative share proj. <u>below</u> 200k	2.03	1.21	-	-	-
Cumulative share proj. > 400k	16.09	-	1.14	-	-
Cumulative share proj. > 1M	25.68	-	-	1.14	-
Cumulative share proj. > 5M	4.59	-	-	-	1.17
Thematic concentration of annual spending	1.39	1.33	1.35	1.34	1.33
Nr indicator over median (weighted)	1.20	1.20	1.20	1.19	1.19
Mean VIF	5.59	1.22	1.20	1.20	1.21

Source: Own elaboration.

## Appendix C. Robustness test

						(-)				
Fable C1. Results Fractional Probit regression (mono-regression), dependent variable: error rate										

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Cumulative spending - Log	0.0122	-	-	-	-	-	-	-	-	-
	(0.0110)	-	-	-	-	-	-	-	-	-
Yearly nr operations (x 1,000)	-	0.00138*	-	-	-	-	-	-	-	-
	-	(0.000780)	-	-	-	-	-	-	-	-
National programme (Yes/No)	-	-	-0.102**	-	-	-	-	-	-	-
	-	-	(0.0513)	-	-	-	-	-	-	-
Plurifund programme (Yes/No)	-	-	-	0.186***	-	-	-	-	-	-
	-	-	-	(0.0468)	-	-	-	-	-	-
Cumulative share proj. <u>below</u> 200k	-	-	-	-	-0.267*	-	-	-	-	-
	-	-	-	-	(0.158)	-	-	-	-	-
Cumulative share proj. > 400k	-	-	-	-	-	0.265***	-	-	-	-
	-	-	-	-	-	(0.101)	-	-	-	-
Cumulative share proj. > 1M	-	-	-	-	-	-	0.220**	-	-	-
	-	-	-	-	-	-	(0.104)	-	-	-
Cumulative share proj. > 5M	-	-	-	-	-	-	-	0.133	-	-
	-	-	-	-	-	-	-	(0.0998)	-	-
Thematic concentration of annual spending	-	-	-	-	-	-	-	-	-0.293***	-
	-	-	-	-	-	-	-	-	(0.0864)	-
Nr indicator over median (weighted)	-	-	-	-	-	-	-	-	-	0.0114**
	-	-	-	-	-	-	-	-	-	(0.00459)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-2.760***	-2.662***	-2.561***	-2.760***	-2.659***	-2.900***	-2.846***	-2.746***	-2.504***	-2.678***
	(0.178)	(0.145)	(0.153)	(0.145)	(0.145)	(0.175)	(0.171)	(0.157)	(0.146)	(0.144)
Observations	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1.487

Source: Own elaboration.

Note: Robust standard errors in parentheses. Significance level: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cumulative spending – Log	-	0.0103	0.00780	0.00951	0.00954	0.00974	0.00987
	-	(0.0109)	(0.0104)	(0.0109)	(0.0111)	(0.0108)	(0.0107)
Yearly nr operations (x 1,000)	0.00260***	-	0.00229**	0.00261***	0.00169**	0.00233***	0.00251***
	(0.000868)	-	(0.000905)	(0.000897)	(0.000851)	(0.000889)	(0.000895)
National programme (Yes/No)	-0.0918	-0.0878	-	-0.127**	-0.0400	-0.162***	-0.0702
	(0.0623)	(0.0621)	-	(0.0609)	(0.0629)	(0.0605)	(0.0563)
Plurifund programme (Yes/No)	0.114**	0.118**	0.124***	-	0.150***	0.123**	0.109**
	(0.0463)	(0.0468)	(0.0449)	-	(0.0482)	(0.0480)	(0.0471)
Cumulative share proj. > 400k	0.292***	0.238**	0.243**	0.339***	-	0.311***	0.278**
	(0.111)	(0.106)	(0.109)	(0.113)	-	(0.112)	(0.111)
Thematic concentration of annual spending	-0.172**	-0.149*	-0.242***	-0.188**	-0.206**	-	-0.193**
	(0.0849)	(0.0855)	(0.0845)	(0.0875)	(0.0886)	-	(0.0855)
Nr indicator over median (weighted)	0.0166***	0.0161**	0.00818	0.0139**	0.0119*	0.0194***	-
	(0.00623)	(0.00692)	(0.00608)	(0.00673)	(0.00704)	(0.00686)	-
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-2.823***	-2.875***	-2.889***	-2.828***	-2.682***	-2.946***	-2.872***
	(0.183)	(0.201)	(0.198)	(0.201)	(0.181)	(0.198)	(0.203)
Observations	1,487	1,487	1,487	1,487	1,487	1,487	1,487
Log pseudolikelihood	-178.12	-178.21	-178.13	-178.20	-178.34	-178.14	-178.11
Pseudo R2	0.0471	0.0466	0.0471	0.0467	0.0460	0.0470	0.0472
Wald test joint significance (p-value)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table C2. Results Fractional Probit regression (sensitivity analysis), dependent variable: error rate

Source: Own elaboration.

Note: Robust standard errors in parentheses. Significance level: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

	Table C3. Results Fractional Probit re	oression (sensitivity analysi	is). dependent variable: Total error rate
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	Removing P(95)				Removing P(99)			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative spending – Log	0.0300***	0.0290***	0.0290***	0.0290***	0.0256***	0.0245***	0.0244***	0.0243***
	(0.00790)	(0.00796)	(0.00797)	(0.00812)	(0.00727)	(0.00722)	(0.00721)	(0.00731)
Yearly nr operations (x 1,000)	0.00224***	0.00172***	0.00168***	0.00157***	0.00309***	0.00255***	0.00250***	0.00233***
	(0.000598)	(0.000594)	(0.000597)	(0.000608)	(0.000806)	(0.000788)	(0.000782)	(0.000782)
National programme (Yes/No)	0.00815	0.0185	0.0182	0.0251	-0.0493	-0.0494	-0.0530	-0.0448
	(0.0412)	(0.0420)	(0.0427)	(0.0449)	(0.0449)	(0.0461)	(0.0468)	(0.0492)
Plurifund programme (Yes/No)	0.0816**	0.0807**	0.0820**	0.0877**	0.0841**	0.0752*	0.0773*	0.0873**
	(0.0349)	(0.0359)	(0.0360)	(0.0361)	(0.0392)	(0.0396)	(0.0400)	(0.0408)
Cumulative share proj. <u>below</u> 200k	-0.329***	-	-	-	-0.396***	-	-	-
	(0.106)	-	-	-	(0.112)	-	-	-
Cumulative share proj. > 400k	-	0.112*	-	-	-	0.182**	-	-
	-	(0.0679)	-	-	-	(0.0785)	-	-
Cumulative share proj. > 1M	-	-	0.0993	-	-	-	0.170**	-
	-	-	(0.0628)	-	-	-	(0.0696)	-
Cumulative share proj. > 5M	-	-	-	0.0621	-	-	-	0.116*
	-	-	-	(0.0616)	-	-	-	(0.0666)
Thematic concentration of annual spending	-0.129**	-0.127**	-0.133**	-0.141**	-0.157**	-0.146**	-0.154**	-0.166**
	(0.0610)	(0.0620)	(0.0616)	(0.0613)	(0.0666)	(0.0677)	(0.0671)	(0.0668)
Nr indicator over median (weighted)	0.00270	0.00253	0.00260	0.00212	0.00594	0.00649	0.00688	0.00629
	(0.00487)	(0.00492)	(0.00503)	(0.00517)	(0.00523)	(0.00521)	(0.00532)	(0.00548)
Year and country dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,405	1,405	1,405	1,405	1,472	1,472	1,472	1,472
Log pseudolikelihood	-128.84	-128.91	-128.92	-128.93	-158.66	-158.73	-158.73	-158.78
Pseudo R2	0.0359	0.0354	0.0353	0.0352	0.0431	0.0427	0.0427	0.0424
Wald test joint significance (p-value)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: Robust standard errors in parentheses.

Significance level: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

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