

Article

Beyond the EU Structural Funds' Absorption Rate: How Do Regions Really Perform?

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Abstract: Although the EU structural funds aim to alleviate disparities through supporting regional development, their impact on local economies and societies is considered as uneven. As existing studies explore the absorption rate of the EU share of contribution as a point-in-time indicator at the end of the policy cycle, evidence about regional co-finance and the factors dynamically affecting absorption performance is lacking. To that end, this paper aims to provide a new longitudinal investigation of the absorption time series and develop an original indicator, supported by a statistical error analysis, for offering a transparent view of the total funds' absorption. The analysis highlights that undesired regional strategies due to low administrative capacity may increase the absorption rate, though without supporting regional growth. The proposed approach could further facilitate the equitable allocation of political accountability regarding the structural funds' absorption to the EU and the regions. Overall, it is anticipated that this research will support the EU in monitoring actual regional performance for prompting local managing authorities to improve their administrative capacity.

Keywords: structural funds; absorption rate; regional performance; European Union; longitudinal analysis; statistical error analysis

JEL Classification: H72; O52; R58; Y10

1. Introduction

Cohesion policy (CP) constitutes the main, and probably the largest, European Union (EU) project funding scheme (Percoco 2017). Following the partnership principle, it is implemented by member states and local authorities in collaboration with the EU (Yesilkagit and Blom-Hansen 2007), based on complex multilevel governance (Batory and Cartwright 2011), for alleviating existing disparities among European regions (Beugelsdijk and Eijffinger 2005). Within the CP, the European structural funds (SFs) aim to promote sustainable regional development in terms of economic prosperity and quality of life (Caldas et al. 2018). Today, more than ever, the SFs are emerging as a crucial resource for responding to the unprecedented socio-economic ramifications of the COVID-19 pandemic and allowing regions to recover (European Parliament 2020). In fact, quantitative evidence suggests that the SFs improve regional growth (Pellegrini et al. 2013; Cerqua and Pellegrini 2018), while their effectiveness seems to increase over time (Fiaschi et al. 2018). More specifically, regional studies in Italy and the UK showcase that the SFs can potentially have a positive impact on both the gross domestic product (GDP) per capita (Coppola et al. 2020; Di Cataldo and Monastriotis 2020) and employment (Di Cataldo 2017; Giua 2017). On the contrary, although the EU SFs represented the greatest share of public expenditure in Greece

during the economic crisis, there is no indication that they led to regional growth (in terms of GDP per capita) unlike the national funds (Psycharis et al. 2020).

Hence, the actual impact of SFs on regional economies and societies within the EU is far from uniform (Fratesi and Wislade 2017; Crescenzi and Giua 2020), even on regions of the same country (Pîrvu et al. 2018). In fact, the SFs seem to affect positively the growth of wealthier, highly-educated, and innovative regions in contrast to less developed ones which are not able to convert the large amount of allocated funds into investments (Pinho et al. 2015). Indicatively, several member states, such as Greece, Ireland, Portugal, Hungary, Latvia, and Romania, encountered difficulties in spending the SFs' budget (European Parliament 2011a, 2011b). Paradoxically, less developed regions, which need higher financial support for restructuring their economies, experience greater problems in absorbing the SFs mainly due to the low administrative/managerial capabilities of the local authorities (Milio 2007; Zaman and Georgescu 2009; Aiello et al. 2019). In response, some countries (e.g., Hungary, Romania) have debated and implemented strategies, such as reducing their regional share of contribution (i.e., 'regional co-finance reduction') or funding projects already approved within national funding schemes (i.e., 'retrospective projects' use). These strategies aim to increase absorption percentages for avoiding EU decommitments in case of delayed expenditure (European Court of Auditors 2018) and guaranteeing EU funds' allocation in the next policy cycle (Dellmuth and Stoffel 2012). The abovementioned evidence highlights the tension between the two major SFs' political goals, namely the achievement of cohesion by aiding lagging regions and the maximization of funds' absorption (Charron 2016).

Recent research efforts have started to explore the root causes of such impediments, analyzing the extent to which the local managing authorities' (LMAs') administrative capacity is efficient in terms of funds' absorption (Surubaru 2017; Țigănașu et al. 2018). To the best of our knowledge, extant research on LMA performance focuses either on related theoretical aspects (Zaman and Cristea 2011; Mike and Balás 2015) or on quantitative ones, which usually base their reasoning on the funds' absorption rate at the end of the programming period (Cace et al. 2011; Tosun 2014). Notably, this indicator is commonly used by policy-makers and the media to inform citizens about the national/regional performance within the CP. However, this indicator usually reflects only the absorption of the EU share of contribution, without considering regional co-finance. Thus, some LMA strategies that merely aim to increase absorption percentage in case of low performance might not emerge. In addition, the point-in-time expression of absorption at the end of the policy cycle can conceal irregular absorption behaviors especially in the transient phase towards the ending of the period. These uneven patterns may downgrade the CP benefit to regional economies (Gandolfo 2014) by hindering the continuous inflow of resources that allows for planning timely and effective LMA strategies (Wostner 2008). In this respect, the lack of a longitudinal (i.e., over-time) analysis may provide partial, or even misleading, information about regional performance and generate a wrong perception about the LMA absorption efficiency.

To that end, focusing on the NUTS 2 level of analysis, we pose the following question: is the current approach of calculating the absorption rate adequate for assessing the LMA performance and accountability in a transparent manner? This paper discusses the limitations of the absorption rate indicator and its efficiency in evaluating regional performance, using the European SFs during the policy cycle, 2007–2013 as a case. To provide a comprehensive analysis, we study two differentiated (in terms of development) regions of the same country to capture the difficulty of the current absorption indicator in grasping reality properly. In this direction, we then lay the foundations of a new longitudinal approach, as a first effort in the literature, towards exploring LMA performance in a novel fashion. The objectives of this study focus on: (i) highlighting the benefits of analyzing the absorption time series of the total funding (including both EU and regional shares of contribution), (ii) providing an original indicator for calculating and evaluating the actual absorption rate through eliminating the effect of undesired LMA strategies, and (iii) showing how statistics may be adopted to produce user-friendly indicators for comparing longitudinal absorption performances.

Overall, this paper contributes towards providing a new perspective on analyzing, measuring, and evaluating LMA performances that enables policy-makers, researchers and citizens to

have a comprehensive (i.e., including both EU and regional perspectives) and transparent (i.e., uncovering undesired LMA strategies over time) view of the actual SFs' absorption. The proposed approach could further support the equitable sharing of political accountability regarding the funds' absorption between the EU and the LMAs, which constitutes a major concern for several CP practitioners (Polverari 2015). This allocation process could shed light on potential EU policies that may prompt the LMAs to improve their administrative capacity and promote, in practice, regional growth. The paper is structured as follows. The next section describes the methods and materials used in the analysis. Then, the time series of SFs are presented and discussed to scrutinize the limitations of the current absorption rate. Based on the respective findings, a three-phase framework for developing a new original absorption indicator is proposed and a statistical error analysis is performed as a formal approach for evaluating regional performances. Finally, we conclude with a discussion of the major insights, implications, and future research directions.

2. Methods and Data

In this section, the methodological approach of the research and the process of data collection are described. The complete databases are presented in Appendix A (Tables A1–A4).

2.1. Methodological Approach

The final absorption rate of the EU share of contribution is broadly used by the authorities, the media and the research community as an effective indicator for measuring regional (i.e., NUTS 2 level) performances. To investigate if and to what extent the hypothesis of the indicator's effectiveness is true, we follow a falsificationist approach (Poppers 1963) to confirm that the current absorption rate does not offer an optimal assessment of the LMA performance. To maintain the same external national conditions, this study analyses two Italian regions, namely Emilia Romagna (North) and Calabria (South). These regions exhibit different territorial characteristics (Milio 2007); whereas Emilia Romagna is a competitive region acknowledged for having high economic performance, Calabria is economically lagging thus constituting a convergence region with low performance (Marra 2014). However, the CP governance in Emilia Romagna and Calabria is rather similar (Aiello et al. 2019). Rather than comparing the performances of the selected regions, we test the absorption indicator over time against two polar cases, namely a 'virtuous' (i.e., Emilia Romagna) and a 'vicious' (i.e., Calabria), to explore its ability to perceive the existing differences. The study of two cases intends to investigate: (i) the effectiveness of the absorption rate of the EU share as a point-in-time indicator at the end of the programming period, and, (ii) in case this indicator exhibits substantial limitations for measuring LMA performance, the practicability of a new more comprehensive indicator to better capture reality over time.

From a technical perspective, to illustrate the regional performance longitudinally, the annual absorption rates were calculated. In fact, the annual absorption rate of a region constitutes the ratio of the accumulated payments at the end of the year to the commitments allocated to the region for the whole programming period as updated annually. The rate may refer most commonly to the EU share of contribution or to the total funding including regional co-finance. Notably, the total commitments may vary over time, thus the updated ones include any increase or decrease either by the EU (i.e., EU decommitments in case of delayed LMA expenditure) and/or the region (i.e., reduction of regional co-finance). Overall, the absorption indicator provides a normalization of the payments based on the actual commitments allowing for LMA performance assessment and comparison. However, this indicator may conceal strategies of low-performance LMAs to increase absorption that hinder regional growth. Thus, we propose the deconstruction of the absorption rate to shed light on the actual regional performance.

2.2. Data Acquisition

To provide a longitudinal analysis, annual data of both European and regional sources were collected. The EU data were retrieved from the official annual reports during the programming period 2007–2013 for the European Regional Development Fund (ERDF) and the European Social Fund (ESF) (European Commission 2007–2017). As the EU reports constitute internal communication and are not available publicly, they were obtained via e-mailing EU officers. More specifically, the data about EU accumulated commitments and payments were collected and clustered into databases for each region by fund and period. During the period 2007–2013, the time span of payments ranges between 2007 and 2018. Notably, payments often continue after the official ending of the policy cycle. As the last policy cycle, 2014–2020 is not completed and only few data are available, we excluded this period from the analysis. For the period 2000–2006, EU data were also collected but they remain out of the scope of this analysis since no regional data are available before 2007.

Although the EU sets a minimum percentage of regional co-finance that the regions should respect (European Court of Auditors 2018), the Union does not have a view of the absolute amount of regional commitments and payments. Considering this lack of visibility, LMAs can initially set a higher regional co-finance share of contribution to the SFs and then, in case of difficulties in funds' spending, they can decrease this share in accordance with the minimum set by the EU. In fact, the EU control mechanisms seem rather weak as the implementation contract between the Union and the member states does not provide the latter with incentives to stay loyal to the initial EU targets (Blom-hansen 2015). The available regional data were retrieved from a national database (OpenCoesione 2019). As the detailed regional databases are not available publicly, they were obtained via e-mailing the team of OpenCoesione that constitutes an open government initiative on CP in Italy. The respective time series refer to the policy cycle, 2007–2013, as data were not collected during the previous programming periods. As the related data are available from 2009, regional commitments during 2007–2008 were considered as equal to those in 2009, while regional payments were assumed as zero, to facilitate comparisons with the EU data that start from 2007. Once again, although data about the cycle 2014–2020 are available, a relevant analysis is excluded as they are sparse and not officially confirmed.

Notably, the national data do not refer directly to regional co-finance, but they constitute the commitments and the certified accumulated payments of the total funding, both as a sum of EU and regional contributions. Regional commitments were calculated as a subtraction of the total EU commitments from the total commitments on an annual basis. However, the calculation of the regional accumulated payments was a rather complicated process; although the EU data express the actual payments, the OpenCoesione (2019) data refer to the certified expenditure and not the actual one. Practically, the certified expenditure constitutes the total amount of EU and regional payments that the region initially approves. However, this value may: (i) include the LMAs' overbooking practice (the LMAs often claim a greater amount of expenditure than the available budget to have some margin in case cuts are made during the reimbursement process and guarantee a better absorption of the funds) (OpenCoesione 2019) or (ii) not report the EU pre-finance in the initial years of the policy cycle (the EU pays an initial amount of funds to the LMAs, although no certified expenditure has yet occurred, to facilitate the starting and instalment of the policy) (European Commission 2006). Therefore, given that the actual values are unknown, the minimum and maximum values of the payments were calculated. This procedure is described in detail in Appendix B. For the ensuing analysis, we assume that the regional share of contribution equals its maximum value.

3. Time Series Analysis of Expenditure

As the absorption of the EU share of contribution is the most common indicator used, in this section we first present and compare the time series of the EU and regional expenditure during the period 2007–2013. To provide a more comprehensive and transparent analysis, we then follow the same procedure for the total funding that includes regional co-finance.

3.1. EU Expenditure

Figure 1 illustrates the accumulation of the EU payments to the Italian regions under study for the programming period 2007–2013 within the ERDF and ESF scheme. Focusing on the ERDF funds, the payments in Calabria are considerably higher than in Emilia Romagna. In contrast to Emilia Romagna, that follows a regular distribution of the accumulated payments, a stop in payments between 2010–2014 and an ensuing abrupt increase in 2015 are reported in Calabria, indicating a potentially low LMA efficiency in absorbing the ERDF funds. However, the irregular pattern of Calabria could be partially explained by the higher magnitude of funds which entail increased effort in order for them to be managed and spent. In contrast to the ERDF scheme, the final amount of ESF expenditure in the two regions is similar. Emilia Romagna exhibits a slightly more regular distribution of accumulated payments in contrast to Calabria that demonstrates a sudden rise in the payments in 2012 after a ceasing between 2009–2011.

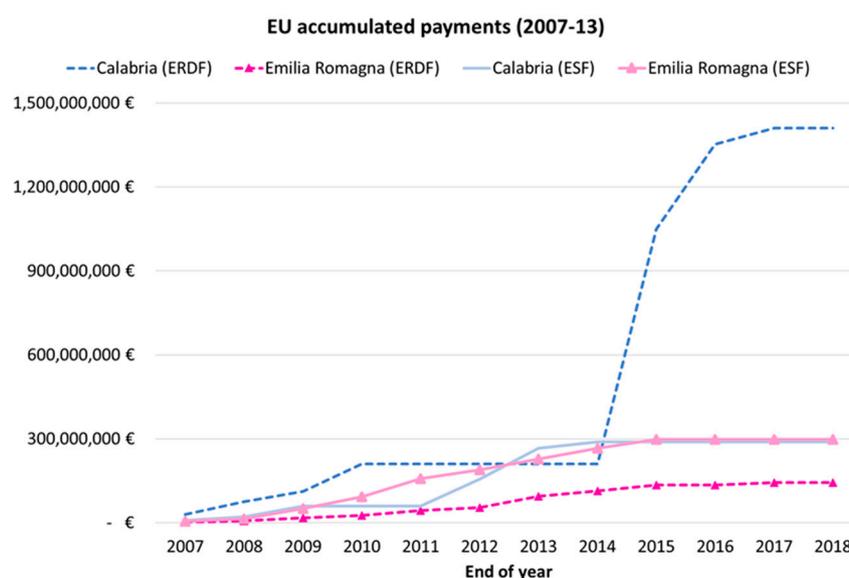


Figure 1. EU accumulated payments of European Regional Development Fund (ERDF) and European Social Fund (ESF) funds during 2007–2013 for Calabria and Emilia Romagna [Based on [European Commission \(European Commission 2007–2017\)](#)].

3.2. Regional Expenditure

Figure 2 presents the accumulated regional payments made by the Italian regions during the programming period 2007–2013 within the ERDF scheme. To facilitate comparisons, the respective EU data (see Figure 1) are also presented ([European Commission 2007–2017](#)). Calabria seems to spend more funds compared to Emilia Romagna, but in a more irregular manner, in line with the EU payments case. However, the difference in the regional payments between the two regions is lower compared to that of the EU payments. It should be noted that although EU payments in Calabria are much greater than the regional ones, the opposite situation occurs in Emilia Romagna. However, this difference follows the different policies implemented in the two regions concerning the predetermined EU and regional contributions; in Calabria, EU commitments are higher (convergence target), while, in Emilia Romagna, regional commitments are greater (competitiveness target).

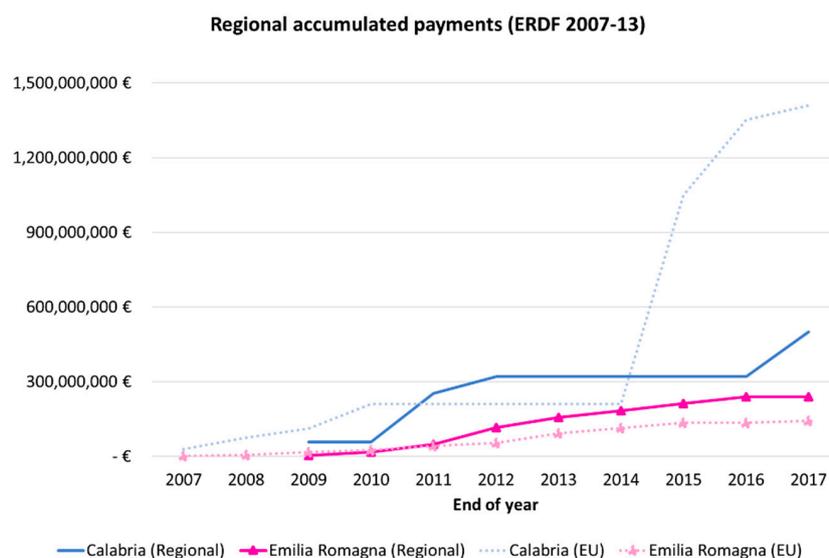


Figure 2. Regional accumulated payments of ERDF funds during 2007–2013 for Calabria and Emilia Romagna [Based on European Commission (European Commission 2007–2017) and OpenCoesione (2019)].

Figure 3 illustrates the accumulated regional payments made by Italian regions during the cycle 2007–2013 within the ESF scheme in comparison to the EU payments (see Figure 1). In this case, Emilia Romagna seems to spend much more funds compared to Calabria. This finding is in contrast with the EU payments, which reach the same final amount of funding for both regions. However, once again in Emilia Romagna, regional payments are more regularly distributed compared to Calabria. As in the ERDF case, although EU payments are greater than the regional ones in Calabria, the opposite situation occurs in Emilia Romagna, following again the different policy targets of the two regions.

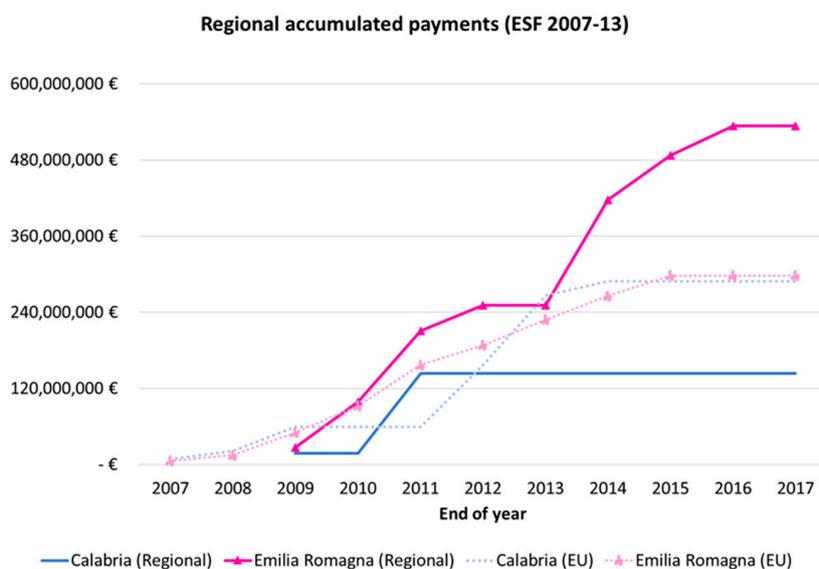


Figure 3. Regional accumulated payments of ESF funds during 2007–2013 for Calabria and Emilia Romagna [Based on European Commission (European Commission 2007–2017) and OpenCoesione (2019)].

3.3. Total Expenditure

The analysis continues with the investigation of total expenditure over time, including both European and regional contributions. Figure 4 portrays the comparison between total accumulated payments and total allocated commitments to Calabria during the programming period 2007–2013

within the ERDF scheme. The total accumulated payments increase slowly in the beginning, exhibiting an irregular increase in 2014, till they almost reach the total commitments. On the other side, the total commitments decrease, potentially due to EU decommitments (i.e., reduction of EU share of contribution in case LMA expenditure is rather delayed) and/or due to the reduction of regional co-finance. In this case, the deconstruction of the total commitments indicates that the EU commitments stay constant (i.e., no decommitments occurred), while the regional co-finance decreases twice in 2012 and 2013.

As mentioned above, the reduction of regional co-finance is a common strategy when low performance exists, used to increase the absorption rate of the total funding by decreasing the total commitments (European Court of Auditors 2018). As absorbing the available EU budget is a prerequisite to ensure that regions will receive equal or even more funding in the next programming period (Dellmuth and Stoffel 2012), a reduction of the regional commitments facilitates LMAs to spend more easily the EU committed funds and reach the imposed target of expenditure on time. However, this strategy undermines CP effectiveness; reducing regional commitments leads to fewer resources for local investments. However, this policy is ‘tolerated’ by the EU, as long as the regional share remains above the minimum imposed by the Union, to assist regions in: (i) meeting their funding capacity (e.g., during economic crisis some regions could not find the initially approved co-financing funds), (ii) absorbing the available EU share of contribution which would otherwise be decommitted if expenditure was delayed (European Commission 2016). In Calabria, after the final reduction of the regional co-finance, the ratio of EU commitments versus regional co-finance reaches 75:25 in contrast to the initial 50:50, leading to investment losses of approximately one billion Euro.

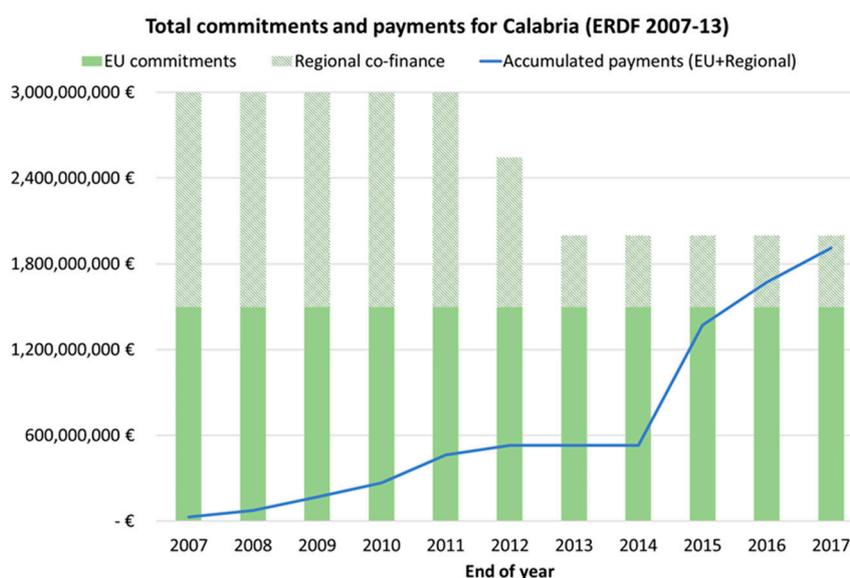


Figure 4. Total commitments and payments of ERDF funds during 2007–2013 for Calabria [Based on European Commission (European Commission 2007–2017) and OpenCoesione (2019)].

Analyzing the ESF scheme, Figure 5 illustrates the comparison between total accumulated payments and total commitments approved in Calabria during 2007–2013. In this case, the total accumulated payments seem more even, potentially due to the considerably lower funding resources managed by the LMA compared to the ERDF scheme. However, the payments fail to reach to a sufficient extent the total commitments available. Once again, the total commitments approved decrease; the EU share of contribution remains constant, whereas the regional co-finance diminishes in 2012, 2014 and, 2015. Similarly to the ERDF scheme, the ratio of EU versus regional contribution reaches 75:25, while the initial ratio was 50:50, generating a loss of about 287 million Euro.

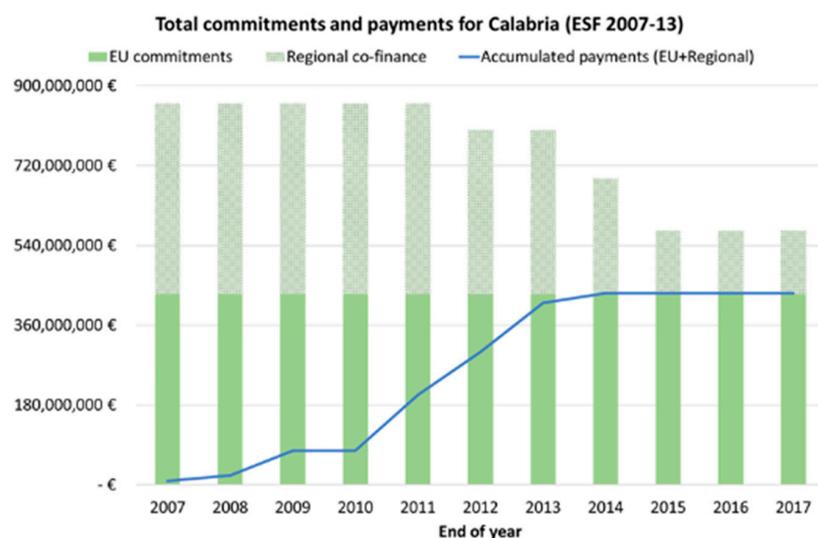


Figure 5. Total commitments and payments of ESF funds during 2007–2013 for Calabria [Based on European Commission (European Commission 2007–2017) and OpenCoesione (2019)].

Moving to Emilia Romagna, Figure 6 shows the comparison between total accumulated payments and total commitments approved in the region during 2007–2013 within the ERDF scheme. In this case, the situation differs significantly compared to Calabria. The total accumulated payments grow with a logistic rate until they reach total commitments, while approved total commitments increase. Usually, total commitments stay constant in regions with high performance. However, in case of unexpected urgent events, such as natural disasters, EU commitments and/or regional co-finance augment to support the reconstruction of regional development. Notably, similar measures have been already proposed to provide exceptional flexibility for the SFs' use in response to the current COVID-19 outbreak (European Parliament 2020). In this case, due to the earthquakes which occurred in Emilia Romagna in May 2012, both the Union and Italy decided to increase the funding budget to support the local community. Deconstructing the total commitments, both EU and regional contributions increase proportionally in 2013. Thus, the ratio between EU commitments and regional co-finance remains constant and equals approximately 63:37.

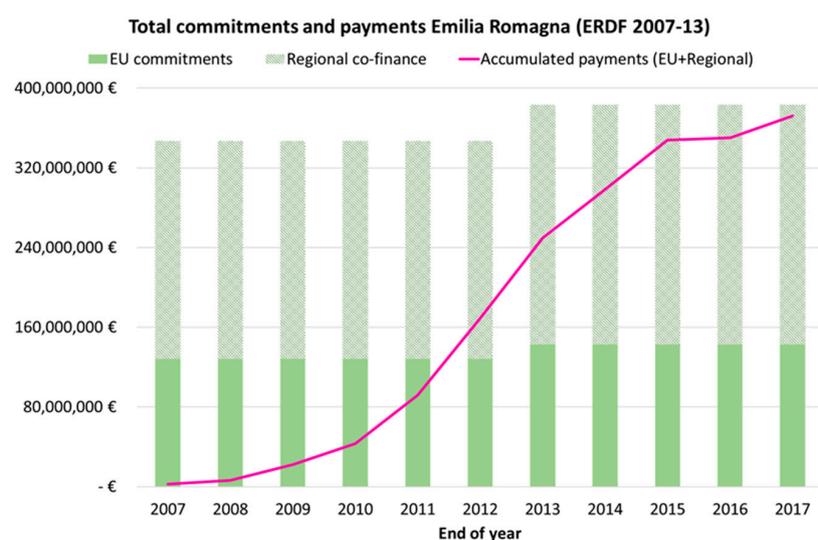


Figure 6. Total commitments and payments of ERDF funds during 2007–2013 for Emilia Romagna [Based on European Commission (European Commission 2007–2017) and OpenCoesione (2019)].

Focusing on the ESF scheme, Figure 7 depicts the comparison between total accumulated payments and total commitments approved in Emilia Romagna during 2007–2013. In this case, following the rise in total commitments, there is an increase in the payments' rate in 2013 that shifts the accumulated payments' distribution away from the logistic growth documented in the ERDF funds. The increase in the total commitments again entails higher funding for the regeneration of the region after the natural disaster. In the same direction as the ERDF scheme, both EU and regional contributions augment proportionally in 2013 and the ratio between them remains 63:37.

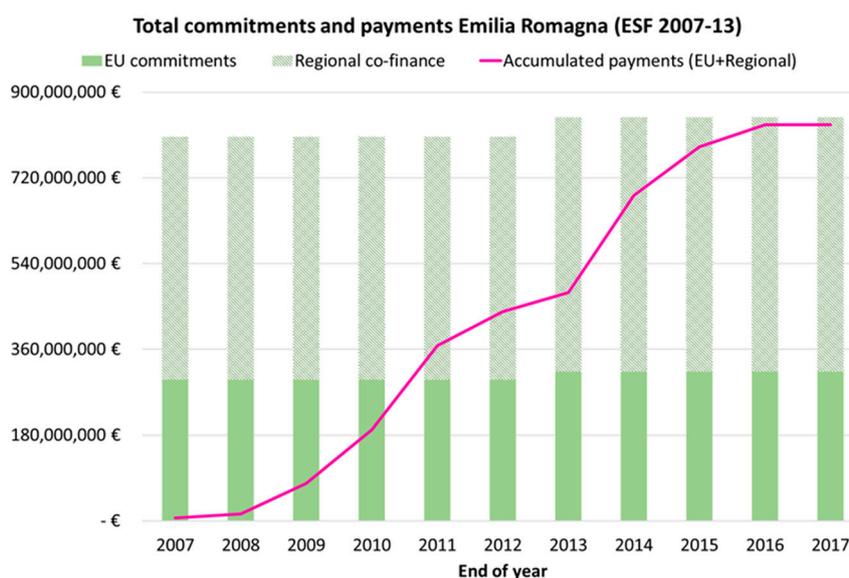


Figure 7. Total commitments and payments of ESF funds during 2007–2013 for Emilia Romagna [Based on [European Commission \(European Commission 2007–2017\)](#) and [OpenCoesione \(2019\)](#)].

4. Towards an Improved Absorption Indicator

According to the expenditure analysis, the actual LMA performance exhibits complex dynamics that cannot be evaluated through a point-in-time indicator at the end of the policy cycle that reflects only the EU share of contribution. Thus, we propose a new absorption rate that allows for a longitudinal evaluation of the regional performance that could showcase possible undesired LMA strategies. We develop a step-by-step framework, including three phases:

1. Calculation of the absorption rate as a ratio of the EU expenditure to the annually updated EU commitments (UEAR), which is commonly used and communicated by policy-makers, researchers, and the media,
2. Calculation of the absorption rate as a ratio of the total expenditure to the annually updated total commitments (UTAR), as a more comprehensive indicator including both EU and regional contributions, and comparison with UEAR,
3. Calculation of the absorption rate as a ratio of the total expenditure to the initially approved total commitments (ITAR), to eliminate the impact of undesired LMA strategies on increasing absorption rate, and comparison with UTAR.

The final step is combined with a formal approach to assess LMA performance that consists of a statistical error analysis of the respective absorption behavior. Figure 8 illustrates the framework concisely, showcasing the new perspective that each additional step provides.

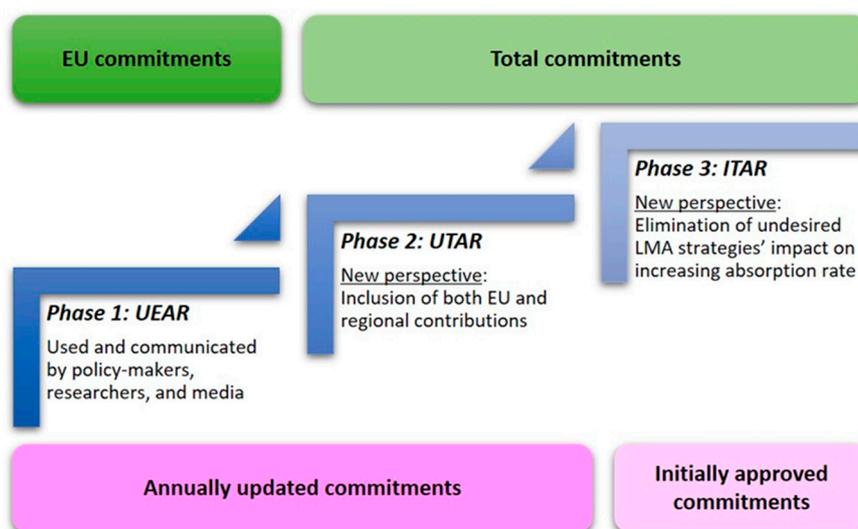


Figure 8. Three-phase framework towards an improved absorption indicator.

4.1. Comparison between Updated EU and Total Absorption Rates

Figure 9 presents the UEAR and UTAR indicators for the ERDF funds during the policy cycle 2007–2013 in both Italian regions. In Calabria, UEAR demonstrates a prolonged period of suspension (2010–2014), following the EU accumulated payments pattern. However, UTAR is suspended only in 2014, indicating the LMA efforts to increase absorption by intervening in regional co-finance. However, both absorption types in Calabria exhibit an abrupt increase in 2015, highlighting an acceleration of both EU and regional expenditure, reaching 94.1 (UEAR) and 95.6% (UTAR). In contrast, in Emilia Romagna, both UEAR and UTAR show similar logistic behavior, following the related expenditure patterns, both reaching 100%. Until 2011, UEAR was constantly higher than UTAR, indicating that the EU share was absorbed with a higher pace than regional co-finance, which slightly slowed down the absorption of the total funds. To provide a comparison between the regions, Emilia Romagna manifests smoother and higher absorption rates compared to Calabria during the whole policy cycle.

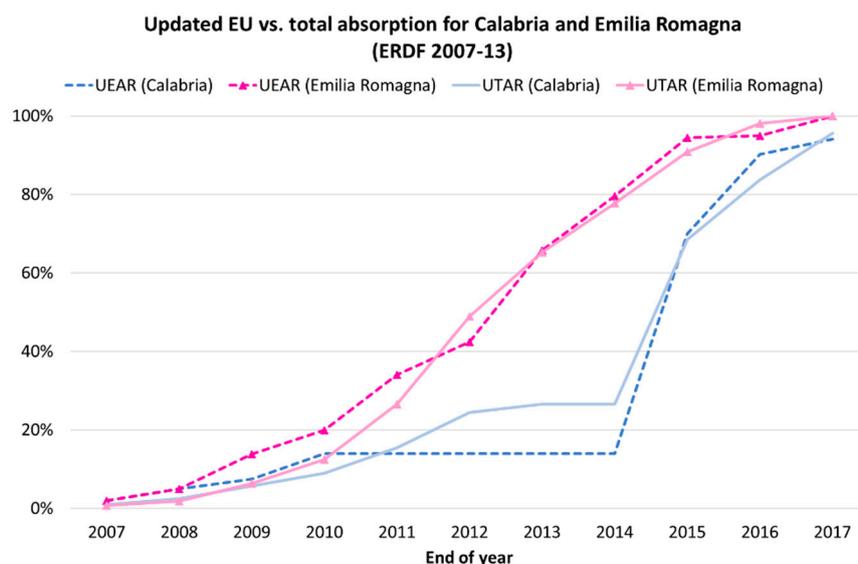


Figure 9. Annually updated EU commitments’ absorption rate (UEAR) and annually updated total commitments’ absorption rate (UTAR) of ERDF funds during 2007–2013 for Calabria and Emilia Romagna [Based on European Commission (European Commission 2007–2017) and OpenCoesione (2019)].

Figure 10 presents the UEAR and UTAR indicators for the ESF funds during the policy cycle 2007–2013 in both Italian regions. In Calabria, UEAR shows a period of suspension (2009–2011), followed by a considerable rise in absorption in the following years. UTAR is suspended only in 2010 and, in general, follows a more regular trend, highlighting the LMA efforts to regulate absorption by intervening in regional co-finance. Notably, both absorption rates reach a rather low level, namely 67.1% and 75.3% for UEAR and UTAR, respectively. In contrast, in Emilia Romagna, both UEAR and UTAR show better behavior (i.e., higher absorption over time) compared to Calabria. UEAR follows a rather regular logistic curve, reaching 95%, while UTAR demonstrates an initially lower pace followed by an increase in 2013. Although UTAR is lower compared to the UEAR during the lengthiest period, this sudden increase leads to a final UTAR of 98.2%, indicating the increased LMA efforts to improve absorption.

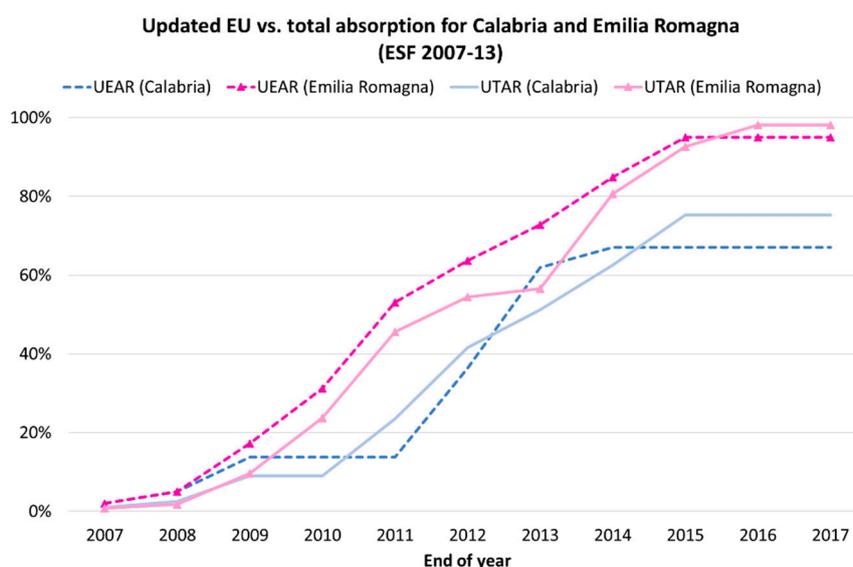


Figure 10. UEAR and UTAR of ESF funds during 2007–2013 for Calabria and Emilia Romagna [Based on European Commission (European Commission 2007–2017) and OpenCoesione (2019)].

4.2. Comparison between Updated and Initial Total Absorption Rates

According to the analysis performed, we advocate that the calculation of UTAR could offer a more comprehensive view of both EU and regional expenditure. However, this approach still impedes the understanding of the actual regional performance due to the variations in the total commitments. Consequently, we propose the development of ITAR based on the initial commitments approved at the beginning of the programming period by the EU and the LMA. This new approach allows for the elimination of the effect of the EU decommitments and/or the co-finance reduction, which entail the paradox of increasing the final absorption percentage and supposedly improving performance by subtracting allocated resources.

Figure 11 presents the UTAR and ITAR indicators for the ERDF funds during the policy cycle 2007–2013 in Calabria. Figures 11–14 further illustrate the ideal proportional absorption rate that will be used in the statistical analysis in Section 4.3. Obviously, at the beginning of the period, both rates are equal as they are calculated based on the initial commitments before the reduction of regional co-finance. At the end of the cycle, ITAR is much lower compared to UTAR, which is now calculated based on the reduced total commitments (thus reaching a sufficient 95.6%) due to the decrease in regional co-finance. In fact, the ITAR equals 63.7%, highlighting that the actual absorption of the initially approved commitments is rather low. Therefore, the lower regional performance compared to the initial expectations is evident, probably due to the LMA's administrative and/or managerial

incapacity of absorbing funds (Milio 2007; Zaman and Georgescu 2009; Aiello et al. 2019). This low absorption efficiency indicates the reduced SFs’ spending, impeding actual regional growth.

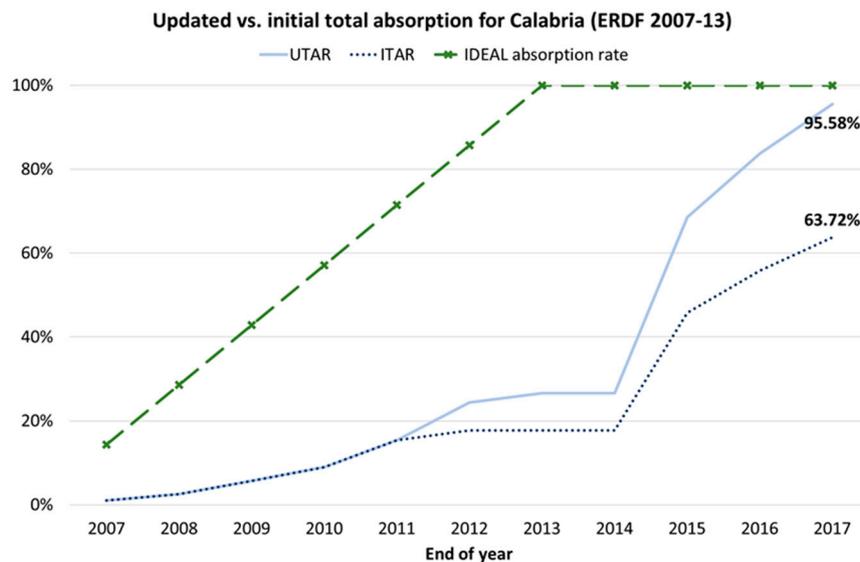


Figure 11. UTAR and initially approved total commitments’ absorption rate (ITAR) of ERDF funds during 2007–2013 for Calabria [Based on European Commission (European Commission 2007–2017) and OpenCoesione (2019)].

Figure 12 shows the UTAR and ITAR indicators for the ESF funds during the policy cycle 2007–2013 in Calabria. At the end of the cycle, ITAR (50%) is lower compared to UTAR (75%), as in the ERDF case. In fact, although UTAR is already insufficient, the even lower ITAR sheds light on the inadequate LMA performance in terms of funds’ absorption.

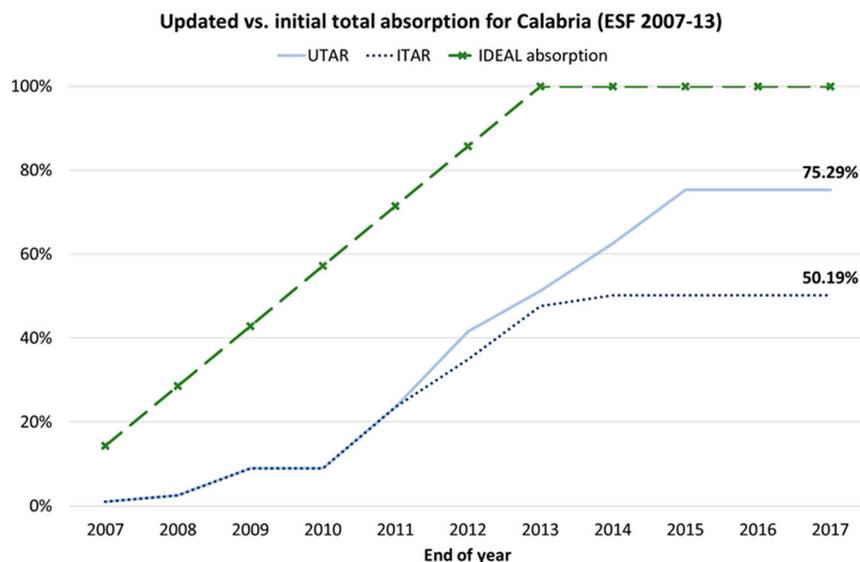


Figure 12. UTAR and ITAR of ESF funds during 2007–2013 for Calabria [Based on European Commission (European Commission 2007–2017) and OpenCoesione (2019)].

Figure 13 portrays the UTAR and ITAR indicators for the ERDF funds during 2007–2013 in Emilia Romagna. In contrast to Calabria, considering the increase of the initial commitments due to the natural disaster, ITAR at the end of the cycle is higher compared to UTAR, which reaches the optimal

level of 100%. Thus, the final ITAR equals 110.5%, as the initial commitments are less than the finally allocated ones.

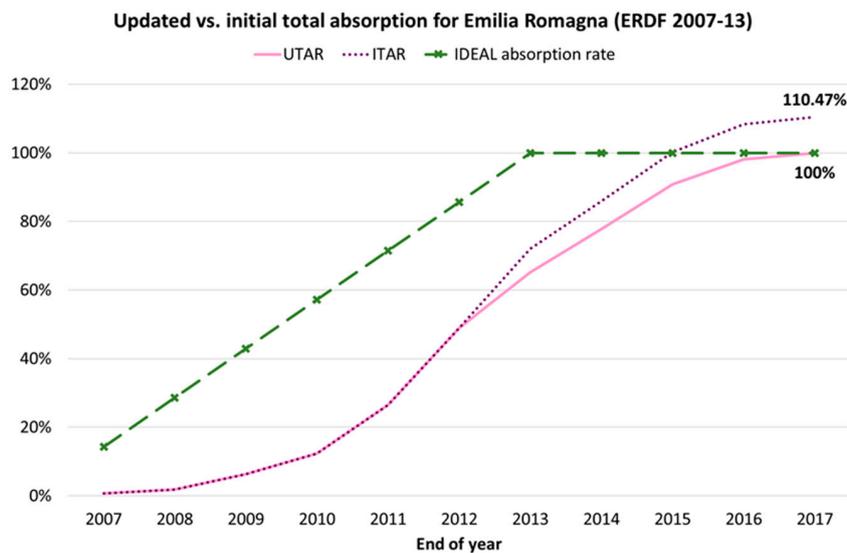


Figure 13. UTAR and ITAR of ERDF funds during 2007–2013 for Emilia Romagna [Based on European Commission (European Commission 2007–2017) and OpenCoesione (2019)].

Figure 14 depicts the UTAR and ITAR indicators for the total ESF funds during 2007–2013 in Emilia Romagna. Once again, following the increase of the initial commitments due to the earthquake, ITAR at the end of the cycle (103%) is higher than UTAR (98%). Obviously, as the final accumulated payments are greater than the initial total commitments, ITAR is more than 100%.

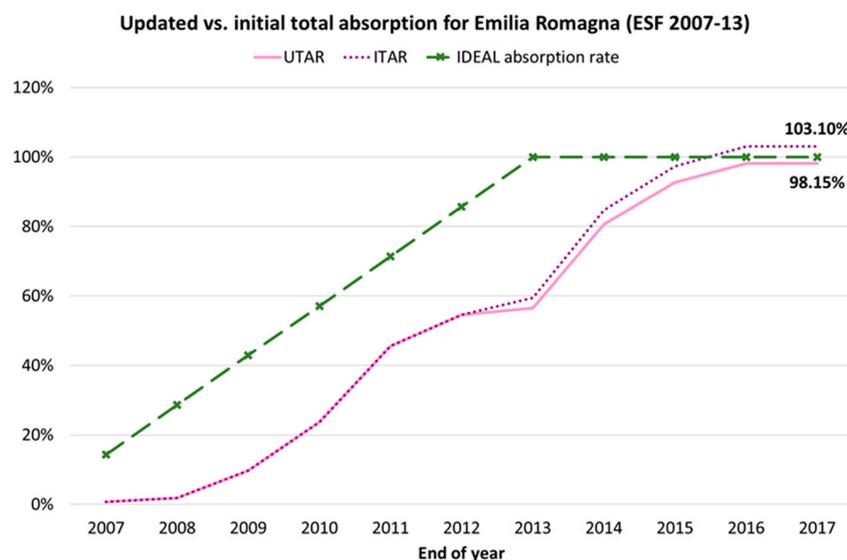


Figure 14. UTAR and ITAR of ESF funds during 2007–2013 for Emilia Romagna (Based on European Commission (European Commission 2007–2017) and OpenCoesione (2019)).

Notably, these indicators can be further filtered. In fact, the absorption rate considers also so-called ‘retrospective’ projects. According to the European Court of Auditors (2018, p. 5), “retrospective projects or operations are those which have incurred expenditure from national sources or are completed before EU co-financing has been formally applied for or awarded, i.e., they are financed retrospectively”. They are used in extreme cases by the LMAs to increase expenditure and improve absorption

when deadlines become closer and funding cuts (i.e., EU decommitments) may occur. Therefore, these projects reflect the low performance of an LMA, which was unable to absorb the EU funds under the normal procedure.

EU regulations do not explicitly prohibit retrospective projects. However, “in the 2014–2020 program period, projects or operations that are physically completed or fully implemented before the beneficiary applies for funding are not eligible for EU funding” (European Court of Auditors 2018, p. 5). The member states are not obliged to provide reports on expenditure declared retrospectively (European Court of Auditors 2018). As a result, the EU is unaware of the volume and the financial impact of these projects; however, it highlights the risks of missing the added value of EU financial support and creating a deadweight, since these projects could have been implemented even without EU funding. Thus, the retrospective projects may limit the CP economic benefits by violating the additionality principle based on which the EU funds should not replace national or local expenditure (Tosun 2014). Interestingly, the resources previously allocated to retrospective projects could potentially be available for financing projects under non-EU frameworks. However, there is no evidence that these ‘released’ resources are reused (Gandolfo 2014); in case an LMA is unable to absorb the SFs without retrospective projects, it is unlikely to be capable of spending the released resources in new projects.

In this context, we could distinguish the gross (currently used) and net absorption rates, namely in the case that retrospective projects are accounted and eliminated, respectively. Although regions do not provide official information about retrospective projects, the Italian Court of Audit states that on average 44% (longitudinal data are missing) of the total expenditure of the ERDF scheme in Calabria during 2007–2013 comprised retrospective projects (Corte dei Conti 2017). Hence, if retrospective projects’ expenditure is discounted from the gross UTAR and ITAR, the respective net rates will equal 54% and 36%. The latter value provides a new point of view on the state of LMA efficiency. In fact, although official documents mention that Calabria’s final UEAR equals 94% (indicating a considerably sufficient performance), the actual net ITAR hardly reaches 36% (due to regional co-finance reduction and retrospective projects use). The low actual absorption suggests that the region has clearly missed most of the potential resources for investments.

4.3. Formal Analysis of Regional Performance

To provide a formal method to evaluate longitudinal regional performances, we perform a statistical error analysis of the discrepancies between actual and ideal absorption rates. Ideally, the absorption of the CP funds should be uniformly distributed during each policy cycle (Wostner 2008); the annual expenditure should be constant, generating a linear absorption function (Figures 11–14), to guarantee a continuous inflow of resources supporting LMAs to build their strategies on time. To evaluate the fit of the actual absorption rate to the ideal one, statistical measures used for comparing real data with model (e.g., forecasting, simulation) outputs (Makridakis and Hibon 1979; Sterman 1984) can be adopted. The most common measure is the mean squared error (MSE), which is defined as:

$$\text{MSE} = \frac{1}{n} \sum_{t=1}^n (R_t - I_t)^2 \quad (1)$$

where n is the number of observations and R_t and I_t are the real (or observed) and ideal (or modelled) values at time t , respectively. The different sources of error could be further explored. Theil’s inequality statistics offer a decomposition of the MSE into the following components (Sterman 1984):

$$\frac{1}{n} \sum_{t=1}^n (R_t - I_t)^2 = (\bar{R} - \bar{I})^2 + (S_R - S_I)^2 + 2(1 - r)S_R S_I \quad (2)$$

where \bar{R} and \bar{I} are the means of R_t and I_t , S_R and S_I are the standard deviations of R_t and I_t , while r is the correlation coefficient between real and ideal data, defined as:

$$r = \frac{\frac{1}{n} \sum_{t=1}^n [(R_t - \bar{R})(I_t - \bar{I})]}{S_R S_I} \quad (3)$$

The term $(\bar{R} - \bar{I})^2$ measures the bias (i.e., the difference in the mean), the term $(S_R - S_I)^2$ measures the difference in the variances, while the term $2(1 - r)S_R S_I$ measures the incomplete covariation (i.e., the degree to which real data changes fail to match ideal ones in a point-by-point manner). By dividing each component by the total MSE, the Theil's indicators are derived:

$$U^M = \frac{(\bar{R} - \bar{I})^2}{\frac{1}{n} \sum_{t=1}^n (R_t - I_t)^2} \quad (4)$$

$$U^S = \frac{(S_R - S_I)^2}{\frac{1}{n} \sum_{t=1}^n (R_t - I_t)^2} \quad (5)$$

$$U^C = \frac{2(1 - r)S_R S_I}{\frac{1}{n} \sum_{t=1}^n (R_t - I_t)^2} \quad (6)$$

$$U^M + U^S + U^C = 1 \quad (7)$$

The analysis of the MSE and the Theil's indicators of the gross UTAR and ITAR in the context of ERDF scheme during 2007–2013 for both regions is provided in Table 1. Notably, the net rates cannot be studied as longitudinal data about the retrospective projects are not available. The different types of absorption rate, along with the ideal one, are already depicted in Figures 11 and 13 for Calabria and Emilia Romagna, respectively.

Table 1. Mean squared error (MSE) and Theil's indicators of UTAR and ITAR of ERDF funds during 2007–2013 for Calabria and Emilia Romagna.

Statistical Measure	UTAR		ITAR	
	Calabria	Emilia Romagna	Calabria	Emilia Romagna
MSE	0.2138	0.0854	0.2917	0.0797
U^M	0.7521	0.7122	0.8512	0.5303
U^S	0.0012	0.0654	0.0333	0.1760
U^C	0.2467	0.2223	0.1154	0.2937

Overall, Calabria exhibits a higher MSE compared to Emilia Romagna, indicating a lower fit to the ideal absorption rate. Thus, although both regions showcase a sufficient UTAR at the period ending (95.6% and 100% for Calabria and Emilia Romagna, respectively), the difference in the volume of MSE confirms that Calabria has a considerably lower performance over time than Emilia Romagna, whose longitudinal performance is evidently more efficient and closer to the ideal one. In addition, the higher deviation between UTAR and ITAR in Calabria, compared to the lower one in Emilia Romagna, leads to a higher range in the volume of the respective errors. Indicatively, MSE ranges between 0.2138 (UTAR) and 0.2917 (ITAR) in Calabria, while the same indicator in Emilia Romagna has a range of 0.0797 (ITAR) and 0.0854 (UTAR). UTAR has a better fit to the ideal compared to ITAR in Calabria. A contradicting situation is evident in Emilia Romagna where the best fit to the ideal absorption rate is attributed to ITAR, followed by UTAR.

With respect to the Theil's indicators, in the case of UTAR, both regions exhibit errors with a rather similar proportion among the MSE components. More specifically, U^M has a range between 0.71 (Emilia Romagna) and 0.75 (Calabria), while U^C ranges between 0.22 and 0.25, respectively. The rather

high U^M highlights that there is a significant difference between the means of UTAR and the ideal absorption, indicating a rather systematic deviation between the related values. A structural element that produces the deviation captured by U^M lays in the fact that the ideal absorption assumes the completion of the absorption at the end of the seven-years period, whereas the actual payments usually extend beyond this deadline. In addition, other factors may negatively affect UTAR (e.g., reduction of regional co-finance and/or use of retrospective projects), shifting it away from the ideal. The moderate U^C highlights that there is a difference in the covariance, meaning that the point-by-point values of the ideal and the actual time series do not perfectly match. This fact may imply that there are certain factors (e.g., low LMA performance) that may cause a delay between ideal absorption and UTAR. Finally, the values of U^S are rather low (in Calabria U^S is almost negligible due to higher U^M and U^C), indicating a small difference in the variation between the two data series.

On the contrary, in the case of ITAR, the proportion among the components of the MSE errors is rather dissimilar between the two regions. More specifically, U^M dominates the MSE (0.85) in Calabria, indicating a considerably high and systematic difference between the ideal absorption and ITAR, while U^S and U^C are rather low. However, in Emilia Romagna, there is a more proportional distribution of the components of the MSE error; U^M covers half of the error (0.53), followed by a moderate U^C (0.30) that captures the divergence between the linear shape of the ideal benchmark and the logistic curve of the actual absorption rate, and a rather low remaining U^S . In fact, the low LMA performance in Calabria, which also forces the reduction of regional co-finance, leads to a considerably low ITAR rate that is away from the ideal one (higher U^M). In contrast, the high LMA performance in Emilia Romagna, together with the increase of the total funding due to the natural disaster, lead to a higher ITAR that is closer to the ideal one (more even distribution of error's sources).

Table 2 presents the analysis of the MSE and the Theil's indicators of the gross UTAR and ITAR in the context of the ESF scheme during 2007–2013 for both regions. The two types of absorption rate, as well as the ideal one, are already illustrated in Figures 12 and 14 for Calabria and Emilia Romagna, respectively.

Table 2. MSE and Theil's indicators of UTAR and ITAR of ESF funds during 2007–2013 for Calabria and Emilia Romagna.

Statistical Measure	UTAR		ITAR	
	Calabria	Emilia Romagna	Calabria	Emilia Romagna
MSE	0.1289	0.0644	0.1988	0.0606
U^M	0.9251	0.6381	0.8958	0.7261
U^S	0.0558	0.0955	0.0015	0.0488
U^C	0.0191	0.2664	0.1028	0.2251

As in the ERDF case, Calabria exhibits higher errors compared to Emilia Romagna, indicating a lower fit to the ideal absorption rate. The detailed analysis of the MSE follows a similar logic with the analysis of the ERDF absorption errors. In addition, ESF errors are lower than the ERDF errors for both regions and absorption types, highlighting a better LMA performance in absorbing ESF funds.

Focusing on the Theil's indicators, in the case of UTAR, Calabria demonstrates a considerably high U^M component and rather low U^S and U^C ones, while Emilia Romagna exhibits a high U^M component, a moderate U^S one and a low U^C one. In the case of ITAR, both regions show a rather high U^M component, a lower U^C , and an almost negligible U^S . In general, the prevalent U^M indicator in all cases indicates that there is a systematic deviation between the ideal and the actual absorption rates, highlighting that the extension of the payments beyond the seven-year programming period and the changes in the total commitments can shift absorption away from the ideal one. The moderate U^C indicator in most of the cases reveals that the point-by-point values of the ideal and the actual time series do not match, indicating that the low LMA performance may delay the actual absorption to some extent.

5. Discussion and Conclusions

To provide a more transparent view of the CP system, this research offers a new perspective on calculating and communicating the SFs' absorption through: (i) providing a first-effort longitudinal analysis of the absorption time series of the total funding that includes both the EU share and the regional co-finance, (ii) developing a new absorption indicator for a more comprehensive analysis at the NUTS 2 level to highlight the LMA strategies that impede regional growth, and (iii) performing a complementary statistical error analysis between ideal and real absorption behaviors to assess and compare regional performances formally. In this light, we discuss the key insights of the analysis, along with the research contribution and implications, and we recommend directions for future research.

5.1. Major Insights

Although the absolute commitments and payments are important for investigating regional performances, the calculation of the absorption rate, which offers normalization of the expenditure, is essential for a comparative comprehension and the communication of regional performances. In general, the absorption rate is provided as a point-in-time indicator of the EU share of contribution at the end of the programming period based on the updated commitments (Tosun 2014). However, this calculation can conceal common undesired LMA practices, such as the regional co-finance reduction and/or the retrospective projects' use, which are supposedly used to improve absorption when regional performance is low (European Court of Auditors 2018). In fact, a seemingly high final absorption rate does not necessarily guarantee that the initially allocated funds are spent, undermining regional growth. The analysis further points out that competitiveness regions (Emilia Romagna) may perform better than convergence ones (Calabria); however, given that this outcome refers to specific regions of the same country (Italy), a cross-national analysis is expected to confirm (or potentially reject) this preliminary indication.

Hence, this study reveals that the manner in which absorption rate is calculated and diffused can influence the perception and evaluation of regional performance and, as a result, the allocation of the respective political accountability between the regions and the EU. On the one hand, low-performance LMAs can be held accountable for the strategies that they follow to increase absorption percentages instead of fostering their administrative capacity. On the other hand, though, the EU may be considered as responsible for avoiding the monitoring of the actual regional expenditure and tolerating the undesired LMA practices. Both behaviors can lead either directly (LMA accountability) or indirectly (EU accountability) to fewer resources for local investment and thus fewer benefits for regional development. In this respect, the CP should promote targeted interventions that drive expenditure towards specific well-prioritized objectives that cover the actual regional needs (Crescenzi et al. 2017); in fact, scattered spending without concrete planning (e.g., retrospective projects' use) may result in resources' misallocation and reduced regional wealth creation.

5.2. Research Implications

As irregular absorption patterns due to low LMA administrative capacity may hinder the economic benefits of the SFs (Gandolfo 2014), the dynamic analysis of the absorption rate could provide profound insights into actual LMA efficiency over time. Notably, the time series of expenditure and absorption at a regional level are presented for the first time explicitly in public, thereby allowing for information sharing between the EU and the local authorities; the related data were available only as internal communications within the EU and the LMAs, while the European policy-makers did not have visibility of the data reported by their regional counterparts. This holistic viewpoint could support the Union in allocating the SFs of the next programming period to the regions based on their actual spending of the total funds and not only of the EU budget. Thus, the EU could mitigate the risk of committing funds in regions that do not have sufficient capacity to absorb them (Charron 2016). This policy could consequently: (i) prevent LMAs from implementing undesired short-term strategies to increase the

absorption rate for avoiding EU decommitments, and (ii) prompt them to work towards long-term capacity improvements to increase expenditure and support growth. In addition, the EU could urge the low-performance LMAs to spend a higher share of the regionally allocated SFs to monitor and improve their administrative capacity (e.g., through optimizing process times).

As fiscal decentralization (e.g., financial autonomy/responsibility of the regions) could reinforce citizens' support for European integration (Tselios and Rodríguez-Pose 2020), the development of a new absorption indicator, namely the net absorption rate of the total funding based on the initial total commitments (net ITAR), is vital for offering a transparent view of the actual performance not only to practitioners but also to common citizens. The proposed indicator is generic; thus, it can be utilized to measure absorption rates and evaluate regional performances in any member state where the SFs are managed by LMAs. As the EU is commonly blamed for deficiencies in the CP implementation (Bauer 2006), this novel indicator could highlight regional political accountability regarding the inefficient SFs' absorption and pave the way for a more fruitful political debate at local and EU levels. The proposed indicator is filtered from any potential use of retrospective projects (i.e., net) and reduction of regional co-finance (i.e., based on the initial commitments approved). Thus, the over-time calculation and diffusion of the proposed indicator could contribute towards: (i) allowing for improved internal EU monitoring of the LMAs performance, (ii) increasing public transparency of EU and regional accountabilities, and (iii) providing a complete analysis for all regions as a useful tool for practitioners and researchers in the CP field.

Finally, the related statistical error analysis provides further quantitative evidence to assess regional performance. Specifically, the calculation and decomposition of the MSE aim to evaluate the distance between the actual absorption and the ideal one. This approach could support policy-makers and researchers in: (i) validating that certain factors hinder actual absorption, shifting it away from the ideal one, and (ii) comparing the absorption time series among different regions, policy cycles, and SFs formally and rigorously. This comparative analysis may further facilitate the identification of potential discrepancies in the performance between competitiveness and convergence regions.

Notably, this study evaluates the regional performance under normal or at least constant (e.g., economic crisis) conditions during the 2007–2013 programming period, focusing on internal LMA impediments (e.g., low administrative capacity) and the related undesired strategies that affect absorption. Obviously, abrupt external shocks, such as the recent COVID-19 outbreak, may affect the EU strategy by offering greater flexibility (e.g., temporary 100% EU financing, transfers among funds and categories, changes in funding priorities, simplified implementation procedures) to the regions hit by the socio-economic ramifications of the pandemic (European Parliament 2020). However, even in this emergent case, the visibility of the actual regional expenditure and absorption could be essential for allowing the EU to provide tailor-made assistance and opportunities to the affected regions in the long term.

5.3. Future Directions

Overall, the process of adequately capturing absorption behavior over time emerges as a key preliminary step for adopting a systemic and dynamic approach towards evaluating the real connection between LMA administrative capacity, EU monitoring, and SFs' absorption. Until now, only few articles have attempted to study the dynamic relations between administrative capacity and CP implementation, at national (Incaltarau et al. 2020) or regional levels (Milio 2007; Kersan-Škabić and Tijanić 2017). In addition, recent evidence highlights that, although low capacity is an important factor of absorption problems, it may be an insufficient explanation; in fact, political instability (i.e., alternating parties) could worsen the absorption performance (Aiello et al. 2019), mainly due to changes in local priorities and staff in the management and control systems (Hagemann 2019). As regional political behavior could determine the CP outcome (Dettmer and Sauer 2019), the quantification of the regional accountability effect on the SFs' absorption efficiency, becomes even more imperative. In this respect, the analysis of several EU regions belonging to different countries and along multiple

policy cycles may shed more light on the temporal, spatial and/or political factors that determine the diverse absorption rate patterns. This approach could potentially investigate whether regions in the same geographic location or with similar socio-economic characteristics exhibit comparable performance behaviors.

In addition, the proposed time series analysis could act as a base to ensuing research efforts for developing more accurate macro-economic and simulation models to explore the key parameters (e.g., concerning LMA capabilities) that determine the regional absorption performance. With respect to statistical models, the open-access availability of high-quality EU and regional data is a prerequisite for igniting an evidence-based CP debate (Crescenzi and Giua 2017). In terms of simulation, the models should take into consideration the whole CP system and the related cause-effect links, starting from the EU budget allocation until the implementation of locally oriented projects, to support holistic policy-making and planning (Cunico et al. 2020). In this case, the provided real-world data could be used for validating the robustness of the modelling procedure and the reliability of the related results. The formal models, along with the analysis of a wider spectrum of regions, are anticipated to enhance the understanding of the CP system across member states, through highlighting the factors that may affect the SFs' absorption rate, as well as the EU decisions and actions that could improve LMA performances. The related insights could support regional growth and build a stronger European identity (Méndez et al. 2006; Capello 2018), especially now that the COVID-19 crisis has cast doubt on EU solidarity and European integration (Tselios and Rodríguez-Pose 2020).

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A Data on EU Contribution and Total Funding

Tables A1–A4 present the data of the EU share of contribution and total funding, as retrieved from the EU reports (European Commission 2007–2017) and the OpenCoesione (2019) databases. The data refer to the total commitments and accumulated payments that the Italian regions of Calabria and Emilia Romagna received in the context of ERDF and ESF schemes during the 2007–2013 programming period.

Table A1. EU contribution data of ERDF and ESF funds during 2007–2013 for Calabria [Source: European Commission (European Commission 2007–2017)].

Policy Cycle	Year	Calabria				
		ERDF		ESF		
		Total Commitments	Accumulated Payments	Total Commitments	Accumulated Payments	
2007–2013	2007		29,982,401 €		8,604,988 €	
	2008		74,956,001 €		21,512,469 €	
	2009		112,434,002 €		59,329,905 €	
	2010		210,039,914 €	430,249,377 €	59,329,905 €	
	2011		210,039,914 €		59,329,905 €	
	2012	1,499,120,026 €		210,039,914 €		156,368,480 €
	2013			210,039,914 €		266,472,454 €
	2014			210,039,914 €		288,502,959 €
	2015			1,049,533,783 €		288,502,959 €
	2016			1,351,965,570 €	407,169,176 €	288,502,959 €
	2017			1,410,714,105 €		288,502,959 €
	2018			1,410,714,105 €		288,502,959 €

Table A2. EU contribution data of ERDF and ESF funds during 2007–2013 for Emilia Romagna [Source: European Commission (European Commission 2007–2017)].

Policy Cycle	Year	Emilia Romagna				
		ERDF		ESF		
		Total Commitments	Accumulated Payments	Total Commitments	Accumulated Payments	
2007–2013	2007		2,562,158 €		5,918,584 €	
	2008		6,405,394 €		14,796,461 €	
	2009	128,107,883 €		17,740,454 €	295,929,210 €	50,909,929 €
	2010			25,507,847 €		92,348,537 €
	2011			43,573,130 €		157,039,820 €
	2012			54,410,476 €		188,407,237 €
	2013			93,854,812 €		228,289,970 €
	2014			113,555,516 €		266,000,409 €
	2015	142,733,765 €		134,759,130 €	313,496,873 €	297,822,029 €
	2016			135,597,077 €		297,822,029 €
	2017			142,733,765 €		297,822,029 €
	2018			142,733,765 €		297,822,029 €

Table A3. Total funding data of ERDF and ESF funds during 2007–2013 for Calabria [Source: OpenCoesione (2019)].

Policy Cycle	Year	Calabria				
		ERDF		ESF		
		Total Commitments	Certified Accumulated Payments	Total Commitments	Certified Accumulated Payments	
2007–2013	2009		179,531,375 €		54,122,403 €	
	2010	2,998,240,052 €	267,775,035 €	860,498,754 €	77,177,593 €	
	2011		462,754,585 €		218,324,317 €	
	2012	2,544,740,052 €	621,229,324 €	800,498,754 €	332,627,566 €	
	2013		729,332,500 €		476,735,617 €	
	2014	1,998,826,702 €		1,192,478,111 €	690,649,167 €	523,400,109 €
	2015			1,381,893,491 €		524,565,391 €
	2016			1,672,920,953 €	573,665,836 €	591,655,657 €
2017			2,067,533,008 €		534,638,491 €	

Table A4. Total funding data of ERDF and ESF funds during 2007–2013 for Emilia Romagna [Source: [OpenCoesione \(2019\)](#)].

Policy Cycle	Year	Emilia Romagna			
		ERDF		ESF	
		Total Commitments	Certified Accumulated Payments	Total Commitments	Certified Accumulated Payments
2007–2013	2009		22,022,664 €		78,257,081 €
	2010	346,919,699 €	43,056,980 €	806,490,114 €	191,188,910 €
	2011		91,978,267 €		367,490,806 €
	2012		169,550,047 €		479,339,543 €
	2013		249,975,318 €		479,339,543 €
	2014		298,115,487 €		682,894,158 €
	2015	383,234,345 €	347,912,035 €	847,204,199 €	784,965,284 €
	2016		471,078,233 €		876,074,726 €
	2017		508,896,547 €		875,600,057 €

Appendix B Estimation of Regional Accumulated Payments

The regional data provided retrieved from [OpenCoesione \(2019\)](#) refer to the certified accumulated payments, which can include the overbooking practice by the LMAs to guarantee a higher absorption of the funds, but they exclude any potential EU pre-finance at the beginning of the policy cycles. The analytical steps to calculate the minimum (MIN) and maximum (MAX) values of the actual regional accumulated payments' range on an annual basis are presented below:

1. Certified regional accumulated payments were calculated as a subtraction of the EU accumulated payments from the total certified accumulated payments.
2. In case that, in the initial years, certified regional accumulated payments are negative (due to EU pre-finance not reported), the actual regional accumulated payments were assumed as zero.
3. In case that, in a certain or the final year, certified regional accumulated payments are considered as normal (i.e., positive and lower than those in the next year or the final regional commitments), the actual regional accumulated payments are assumed as equal to them even if a marginal percentage of overbooking may exist.
4. In case that, in a certain year, certified regional accumulated payments are higher than those of the next year (due to LMA overbooking practice included), the MIN actual regional accumulated payments are assumed as equal to the actual ones of the previous year, while the MAX regional accumulated payments as equal to the actual ones of the next year.
5. In case that, in the final year, certified regional accumulated payments are higher than the final regional commitments (due to LMA overbooking practice included), the MIN actual regional accumulated payments are assumed as equal to the actual ones of the previous year, while the MAX regional accumulated payments as equal to the final regional commitments.
6. In case that, in consecutive years, certified regional accumulated payments include overbooking, the range of the actual regional accumulated payments is the same for all of them with the MIN value equaling to the actual one of the last previous year without overbooking and the MAX value equaling to the first next year without overbooking (or the final regional commitments in case the last year of the certified regional accumulated payments' sequence is the final one).

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