The Impact of Smart Specialization Strategies in Pomorskie

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Executive summary

Abstract

This report evaluates innovation grants under the Research and Innovation Smart Specialization Strategy (RIS3) financed from the European Union's (EU) Cohesion Fund in the Polish region of Pomorskie. This funding is administered at the national and—to a smaller extent—regional levels. We test a novel approach to analyze the impact of sector-targeted innovation support programs on outcomes at the aggregate region-sector level. Our impact analysis combines difference-in-differences with synthetic control methods to compare outcomes in supported and non-supported region-sectors. A primary contribution of the report is to pilot this methodology to support future evaluation exercises of RIS3 at the region-sector level. A second contribution of the report is the analysis of the impact of RIS3 in the Pomorskie region of Poland. We have two main results. First, we find that RIS3 funding increases gross value added, wages, and employment of supported region-sectors but does not improve labor productivity, at least not in the short term of up to 4 years. Second, we document that the investments administered by the regional government are relatively small compared to those managed by the national government. Possibly for that reason, we only find a statistically significant impact in sectors that receive comparatively large investment sums (for example, computer programming and specific manufacturing sectors). Our results suggest that the grants promote firm growth but do not increase productivity in the short term (mostly 1-3 years). We recommend conducting a follow-up analysis to assess the impact in the longer term (5–8 years).

Introduction and policy context

Smart Specialization is a novel, place-based industrial and innovation policy that is a key component of the EU 2014–20 Cohesion policy. Smart Specialization (Foray et al. 2012) determines funding allocation for research and innovation from the European Regional Development Fund across the EU. It thus drives a significant share of EU investment in research and innovation—amounting to EUR 68 billion in the 2014–20 programming period (including national co-financing). Of the total, Poland received EUR 6.2 billion and Pomorskie EUR 284 million. To receive funding, starting in 2014, each region had to develop its own Research and Innovation Strategies for Smart Specialization (RIS3). Developing the RIS3 involves determining priority sectors as a basis for national and regional European Regional Development Fund (ERDF) Operational Programs. RIS3 envisions building on existing comparative advantages and engaging local stakeholders in a self-governed Entrepreneurial Discovery Process involving the public and private sectors and academia. Moreover, the experimentalist and results-oriented approach of Smart Specialization requires continuously assessing achieved outputs and

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outcomes. These assessments determine changes needed en route to the strategy and, accordingly, to the sectoral prioritization.

Despite the stated focus of Smart Specialization on learning and subsequent policy adaptation, the 2014–20 period closed without providing much rigorous evidence on the effectiveness of the approach. The relevance of RIS3 as a large-scale, innovative policy that still lacks rigorous evidence provides a core motivation for our study. In particular, empirical evidence regarding whether Smart Specialization enhances innovation and growth of firms in the targeted sectors is still lacking, both in Poland and in other EU countries. This report attempts to fill this knowledge gap by providing rigorous evidence on the overall (aggregate) impact of RIS3 funding on firm performance in a specific region for the targeted sectors.

Our study focuses on the Polish region of Pomorskie. This region is considered to have an adequate Smart Specialization implementation (Potter and Smith 2019). Poland implements innovation policies simultaneously and with some coordination at the national level by the central government and by 16 regional governments (Marshall Offices). Therefore, firms in each region have access to two sources of financing: national and regional. Pomorskie region was selected for the ex-post evaluation by regional policy-makers who followed the European Commission's guidelines closely and identified Smart Specialization priority areas by involving local institutions, businesses, and academia in an open and transparent procedure. At the same time, Pomorskie is classified as a "less developed region"[1] by the EU regional funding scheme with a gross domestic product (GDP) per capita as low as EUR 10,000 in 2014, before the introduction of Smart Specialization. It also scored at the "moderate innovator" level in the European Regional Innovation Scoreboard in 2014. The region is thus a good example of an average catching-up region in Europe.

Methodological approach

We combine multiple datasets to adequately study the impact of RIS3 at the aggregated region-sector level. We combine (a) firm-level administrative data on all beneficiaries of EU-funded projects in Poland with (b) firm-level financial and balance-sheet data aggregated at the region-sector level. We merge both datasets using each firm's NACE[2] rev.2 three-digit (NACE3) sector code. Because Poland's data privacy law restricts access to data for NACE3 sectors with a small number of firms, we aggregate the affected sectors into groups we call "pseudo-sectors." Our final dataset covers all 16 Polish regions for the period 2008–20 and encompasses 84 sectors at the NACE3 level (28 existing NACE3 sectors and 56 pseudo-NACE3 sectors, each consisting of combinations of several NACE3 sectors[3]).

The newly combined dataset has four advantages for analyzing EU innovation grants in Poland. First, the data includes information on all different sources of EU funding between 2008 and 2020. This span enables us to consider the effects of EU funding from the previous programming period (2007–13). Second, the data allows us to measure the impact of RIS3 in Pomorskie up to five years after the

[1] GDP per capita in PPP below 75 percent of the EU average.
[2] The Statistical Classification of Economic Activities in the European Community, commonly referred to as NACE (for the French "nomenclature statistique des activités économiques dans la Communauté européenne"), is the standard industry classification system used in the European Union.
[3] See an overview in Table A2.

beginning of treatment for the (small) initial cohort of firms that had already received funding in 2015. Third, we can separately assess the impact of ERDF funding allocated through nationally- and regionally-administered RIS3. Fourth, the data feature a variety of variables to measure the impact on different firm-level outcomes, such as gross value added, wage expenses, employment, and labor productivity. In our primary analysis, we estimate the impact of total (national and regional) RIS3 funds on firm-level outcomes. In our secondary analysis, we assess whether the impact differs when only focusing on regional RIS3 funds and sectors targeted in the region because both the funding value and the chosen sectors vary substantially between the national and regional RIS3 funding.

Our empirical analysis builds on novel methods for quasi-experimental counterfactual impact evaluation (CIE). Our CIE tries to reconstruct a hypothetical world where the RIS3-targeted sectors did not receive RIS3 funds. We do so by comparing changes in aggregate firm-level outcomes in the targeted sectors to that of a valid comparison group of sectors outside the region of Pomorskie. A key challenge for rigorous counterfactual evaluation is that the RIS3-targeted sectors are not randomly chosen. Instead, targeted sectors are typically those with the best growth prospects in the region. As a consequence, the characteristics of RIS3-recipient and nonrecipient sectors differ meaningfully. Hence, simply comparing changes between the groups over time would potentially be biased. To address this "selection bias" and control for differences between targeted sectors and our comparison sectors, we employ two alternative (and complementary) approaches: the two-way-fixed-effects difference-in-differences (TWFE DiD) and the synthetic control method (SCM), with an emphasis on the latter in the main text. Because these approaches have different underlying assumptions, employing both allows us to test whether our results are robust to changes in these assumptions (cf. Athey and Imbens 2021; Ben-Michael, Feller, and Rothstein 2021).

Our counterfactual is constructed from sectors that have never received any RIS3 funding. We estimate the impact of RIS3 funding in Pomorskie by comparing the trajectory of sectors that received RIS3 funding in Pomorskie with the trajectory of sectors that did not receive national or regional RIS3 funds over the entire 2008–20 period. Some sectors receiving RIS3 in Pomorskie also receive non-RIS3 EU funds over the same period, but we account for that in our empirical analysis. Thus, our estimates reflect the impact of being selected as a RIS3-targeted sector *all else equal*, that is, regardless of whether a sector has received any non-RIS3 EU funding before or after the establishment of RIS3. The estimates isolate the impact of being selected for RIS3, comparing sectors receiving (treated) and not receiving (control) RIS3 that are similar across all relevant characteristics.[4]

Findings

An initial descriptive analysis of the combined data yields several findings that are important to put our impact estimates in context.

1) **Pomorskie received relatively little RIS3 funding between 2015 and 2020.** This is true compared to other Polish regions (in absolute terms and relative to regional GDP). However, the region targeted

[4] The setup does not allow us to estimate the impact on a sector being selected because of RIS3 vis-à-vis receiving EU funds through traditional allocation mechanisms (pre-RIS3). This includes the comparison against a scenario where the allocation mechanism used in the previous round of funding would have continued.

a comparatively small number of sectors and thus financed each of the targeted sectors with a relatively high amount. Many sectors received both national and regional funds. Overall, only 42 out of all 84 pseudo-sectors in Pomorskie received some RIS3 funding. Of those 42 funded, 22 received only national funds, 19 received both national and regional funds, and three received only regional funds.

2) **Compared to other EU funds, funds allocated under RIS3 are rather small.** In 2020, total non-RIS3 funding to firms in Pomorskie surpassed €250 million while RIS3 funding was only €80 million. Of all 3,542 EU-funded projects in Pomorskie over the 2014–20 period, only 28 percent were supported under RIS3 programs. Therefore, RIS3 funds reach a smaller share of firms in Pomorskie than non-RIS3 funds (11 percent vs. 14 percent). However, in the few sectors that were targeted by Pomorskie regional RIS3, funding is on par with non-RIS3 funds.
3) **Within RIS3, funds under regional RIS3 allocation are small compared to those under national RIS3 allocation.** National RIS3 funds account for almost all RIS3 funding in Pomorskie. Overall, regional RIS3 reaches only half as many firms as national RIS3 funds (6 percent vs. 15 percent in each sector in 2020).
4) **RIS3 funds increased significantly in recent years,** from €3.7 million in 2015 to €74 million in 2020. Because the funding impact takes time to materialize, our analysis only encompasses the short-term effects for the most relevant years of funding (2018–20). Following up this study in the medium term would be highly encouraged to evaluate the impact beyond the very short term.

Our impact analysis shows that total RIS3 funding has significant positive impact on gross value added (GVA), full-time employment, and wage expenses, but not on labor productivity. Estimates from the TWFE approach suggest that GVA increased by up to 16.4 percent, wage expenses up to 24.1 percent, and employment up to 7.5 percent more in Pomorskie's targeted sectors than in comparison sectors in the 2015–20 period. Estimates from the SCM approach confirm these results. Our back-of-the-envelope cost-benefit analysis shows that RIS3 policy has brought about EUR 3.4 billion additional GVA in Pomorskie's targeted sectors between 2015 and 2020, or EUR 13.2 billion of additional GVA for every euro investment in RIS3 funding.

The impact of regional RIS3 funds is rather small on average and concentrated in those sectors that received the highest amount of funding. To isolate the impact of regional RIS3 funds, we choose the 22 sectors that were funded through regional RIS3 for our treatment group (excluding sectors targeted exclusively by national RIS3). Our results suggest that the impact of regional RIS3 funds (above existing EU funds) in these sectors is small and statistically significant only for GVA and employment. This is not surprising given the small share of RIS funding administered at the regional level compared to total EU funding. However, we find significantly larger impact in four out of 22 sectors.[5] We capture significant impacts for changes in GVA and employment in these sectors, suggesting that regional RIS3 funding led to hiring of new workers. The sectors are among those that received the highest amount of funding in the region.

[5] These sectors are (1) computer programming, consultancy, and related activities; (2) manufacturing of chemical/non-metallic mineral products; (3) manufacturing of fabricated metal products, except machinery and equipment; and (4) manufacturing of wood/products of wood and cork/articles of straw and plaiting materials.

Our impact analysis has some limitations that should be considered in the interpretation of results. First, we can only estimate short-term effects for the most relevant years of funding (2018–20). Second, we have few observations because our analysis is at the region-sector level. This sparseness may result in lack of power to detect impacts even if they exist (for example, on productivity), especially since expected impacts may be small given the low volumes of RIS3 funding. Third, given that almost all sectors received both regional and national RIS3 funding, it is not possible to distinguish whether the measured impact is due to either source of funding or the combination thereof. For those three sectors that received only regional RIS3 funds in Pomorskie, we find no impact on any of our measured outcomes in the sectors. However, this is probably due to the very small sample size available for this analysis.

Policy Conclusions

A key indication from our results is that regional RIS3 may be more effective when aligned with (or supported by) national RIS3 funding, given the much larger magnitude of the latter.[6] In addition, our analysis points to several insights that policy-makers may take into account when redesigning RIS3 policy and learning strategies:

1) Our finding of a positive impact on employment and GVA contrasts with concern that EU funding may be spent in an ineffective way or that firm owners use funds for personal consumption (Mironov and Zhuravskaya 2016, Johnson 2017, ECA 2019).
2) However, the lack of impact for labor productivity suggests that innovation grants and lending may not be able to trigger radical productivity changes. Instead, the fact that impacts on GVA are accompanied by an increase in employment suggests that firms expand their activity without becoming more efficient—at least in the short run. Hereby, however, additional caveats should be considered when interpreting the results as funding primarily expanding activities instead of promoting innovation and productivity. First, innovation and productivity effects may be visible only in the long-term—especially if the investments support early-stage innovation (low Technology Readiness Level (TRL)). Second, if investments were made in high TRL projects (very close to commercial projects), these could translate into expansion of sales and employment (without strong effects on productivity). Future research should also look at innovation outcomes—such as patents, trademarks, or introduced innovation—that were not included in this analysis due to data unavailability.
3) Given that the measured impact increases with the magnitude of (regional and national) RIS3 funding, it may be beneficial to coordinate regional and national sectoral choice and RIS3 policies. However, such coordination should respond to observed regional needs (as opposed to copying national solutions) and should focus on finding economic synergies and transferring knowledge.

[6] However, we did not assess whether there are threshold effects (levels above which the impact of RIS3 become significant).

1. Contents

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2. Introduction

Developing a Smart Specialization strategy is an ex-ante condition for receiving funding from the European Regional Development Fund Specialization (Foray et al. 2012). This report provides a short-term analysis of the implementation of regionally and nationally administered Research and Innovation Smart Specialization Strategy (RIS3) programs in the Polish region of Pomorskie, focusing on the sector-level outcomes of the RIS3-targeted priority sectors. Although we focus on a specific region, our analysis is relevant beyond policy-makers in Pomorskie, both in terms of lessons and in terms of methodology. The report aims to take stock of the changes that occur in sectors that receive Smart Specialization funding while also contributing to the debate on the future of Smart Specialization strategies within the EU.

To investigate the impact of RIS3, we combine balance-sheet data for all small, medium, and large enterprises (SMLEs) aggregated to the region-sector level with data on all EU funding beneficiaries for the period 2008–20. There are two key advantages of our resulting dataset compared to other studies. First, we identify not just the average regional effect of RIS3 but also specific sets of sectors for which RIS3 intervention has been particularly successful. Second, we distinguish between the impact of regional RIS3 and the combined effect of regional and national RIS3. Although policy-makers conceived Smart Specialization as a regional innovation policy, several countries, including Poland, operate regional and national RIS3 programs. In each region of such countries, two RIS3 policies are implemented (with some—limited—coordination): a national policy and a regional one. We explore the impact of regional and total (regional and national together) RIS3 in the Polish region of Pomorskie.

We use the synthetic control method (SCM) and, in addition, two-way-fixed-effects difference-in-differences (TWFE DiD) to compare the outcomes of RIS3-subsidized sectors in Pomorskie with those of unsubsidized sectors in all Polish regions. The most critical challenge for this impact evaluation is that RIS3 sectors are not randomly chosen. Hence, recipient and nonrecipient sectors are likely to differ in both observable and unobservable characteristics that are correlated with the outcomes of interest, which confounds simple comparisons. The two econometric methods employed deal with any differences across region-sectors that receive RIS3 funding and those that do not, making the selected regions that did not receive RIS3 funding a good comparison group (see Athey and Imbens 2021; Ben-Michael et al. 2021).

We find large and statistically significant effects of combined regional and national RIS3 funding on GVA, employment, and wages and marginally significant effects on labor productivity in RIS3-funded sectors. In our preferred specification, GVA in the targeted sectors increases by 16.4 percent, employment increases by 7.5 percent, and wages increase by 24.1 percent compared to selected non-targeted sectors, with a marginally significant labor productivity increase of 5 percent.

When looking at sectors one by one, we find large and positive effects of RIS3 on GVA and employment for the following four sectors: (1) *Computer programming, consultancy, and related activities*, (2) *Manufacturing of chemical/non-metallic mineral products*, (3) *Manufacture of fabricated metal products, except machinery and equipment*, and (4) *Manufacture of wood/products of wood and cork/articles of straw and plaiting materials*. These happen to be also among the highest-funded sectors

in Pomorskie. Because all of these sectors received both regional and national RIS3 funding, it is impossible to say whether the reason for their success is regional RIS3 funds, national RIS3 funds, or the combination thereof.

Summarizing, we find that RIS3 fosters sectoral growth in GVA, employment, and wages. Yet, it is hard to claim that Smart Specialization contributes significantly to sectoral efficiency—we only find weak effects on labor productivity. The most plausible explanation is that, in the short run, sectors grow by expanding their pre-existing activities through increasing the number of workers.

Our report contributes to the joint academic and policy efforts to study the effects of RIS3. A vast literature exists on the conceptual logic of Smart Specialization (Di Cataldo, Monastiriotis, and Rodriguez-Pose 2022; Doussineau, Saublens, and Harrap 2021; Fratesi, Gianelle, and Guzzo 2021; Immaculada and James 2021; Guzzo and Gianelle 2021; Hegyi et al. 2021; Hegyi and Prota 2021). However, to our knowledge, there are hardly any contributions on its implementation and impact. Closest to our setting are two studies focusing on Smart Specialization's impact on a single sector (Doussineau et al. 2020; Post et al. 2021). In contrast, we measure the average effect of Smart Specialization on all funded sectors in Pomorskie.

More generally, the European Commission's RIS3 funding rationale falls within the logic of place-based innovation and industrial policies. Thus, our report also relates to the literature on such policies. Among the existing contributions, several studies find positive effects of EU funding on firm performance in the previous rounds of EU funding (Beņkovskis, Tkačevs, and Yashiro 2019; Einiö 2014; Criscuolo et al. 2019). There is also some support for successful subsidization of innovation activities specifically, with examples from both the EU and the US (Bronzini and Iachini 2014; Howell 2017).

Our study contributes to the existing literature with improved evidence on the impact of RIS3 that can help policy-makers adjust RIS3 for subsequent programming periods. We contribute to the literature in three ways. First, we show that RIS3 funding has scale effects but no impact on efficiency (at least not in the short term). This finding aligns with previous studies on EU grants from earlier funding periods (for example, Beņkovskis, Tkačevs, and Yashiro 2019). Our second contribution is helping to reduce the considerable uncertainty and informational asymmetry around investments in research and innovation (Hall and Lerner 2010). We establish positive effects from Smart Specialization—a funding program linking innovation to regional growth—for selected sectors in Pomorskie.[7] Third, we show that, compared to the more top-down approach of previous EU funding concepts and place-based policies implemented elsewhere in the world, RIS3, with its bottom-up approach and engagement of local stakeholders, can be successful.

[7] These are sectors mapped to the following two Pomorskie Smart Specialisation areas: "Eco-effective technologies in the generation, transmission, distribution and consumption of energy and fuels, and in construction" and "Medical technologies in the area of civilisation and aging-associated diseases."

3. The concept of Smart Specialization

3.1 Theoretical background

Smart Specialization traces its origins to the years immediately after the 2008 global financial crisis, when it first evolved as a concept emphasizing the importance for policy-makers to prioritize a limited number of sectors and technologies to support at the regional level through public funding (Foray, David, and Hall 2011). During the 2007–13 EU programming period, it became clear that the cohesion strategy implemented then did not address the need for a place-based perspective as opposed to a "one-size-fits-all" approach and lacked focus on relevant, carefully selected priorities (Barca 2009).

The EU implemented a reformed cohesion policy with the 2014–2020 Multiannual Financial Framework (MFF). This reformed policy introduced the novel concept of Smart Specialization to strengthen the link between research and development (R&D) activities in society overall and firms' innovation activities in particular (Foray, David, and Hall 2011). The policy pays specific attention to the involvement of various local public and private actors in a so-called Entrepreneurial Discovery Process (EDP). The EDP prioritizes investments in novel activities jointly identified in consultations with businesses, institutions, and universities. Radosevic (2017) labels Smart Specialization an industrial innovation policy to reflect this merger of innovation and industrial policies.

The theoretical underpinnings of Smart Specialization lie in the acknowledgment that the public sector does not possess all-encompassing knowledge of areas of potential comparative strength. This acknowledgment entails a more bottom-up approach toward entrepreneurial discovery. In its evolution, the concept of Smart Specialization draws on Hausmann and Rodrik (2003), who emphasize the importance of involving local businesses and institutions that, through trial and error, discover what can be produced competitively at a given place and time. Thus, local actors should identify the economic activities with potential comparative advantages.

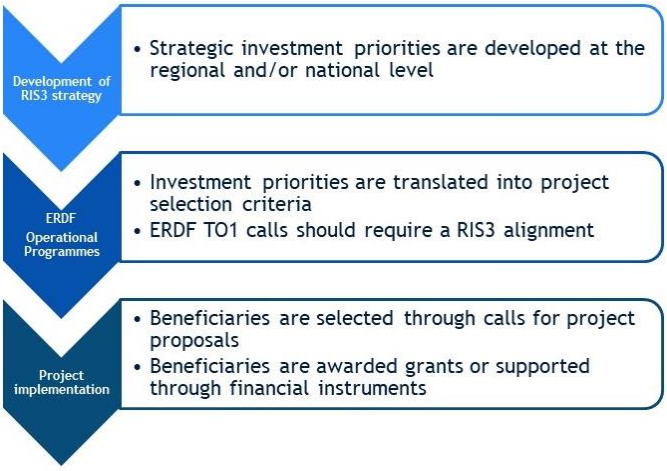
3.2 Implementation within the 2014–2020 EU Multiannual Financial Framework

In practice, Smart Specialization boils down to each territory concentrating development interventions in areas where it holds a significant potential or comparative advantage to sustain productivity growth (Foray, David, and Hall 2009; Di Cataldo et al. 2022. The novelty of Smart Specialization is its focus on the Entrepreneurial Discovery Process—innovation based on the active participation of different stakeholders in an experimental process of identifying and developing new specializations based on specific local knowledge and competencies (Coffano and Foray 2014; McCann and Ortega-Argilés 2015). The process starts with analyzing the regional context by engaging local stakeholders to identify regional competitive advantages. Local stakeholders then select a limited number of regional priorities for specialization. The priorities are translated into so-called Research and Innovation Strategies for Smart Specialization (RIS3).

The European Commission subsequently reviews the RIS3 documents, and regional governments must formally adopt them by incorporating them into the project selection criteria of EU Operational Programs (Figure 1). The funding is provided under two objectives of ERDF: "Research, Technological

Development and Innovation" and, to a lesser extent, "Competitiveness of SMEs."[8] The implementation of the intervention should be continuously monitored, reviewed, verified, and adjusted if needed.

Figure 1: Link between RIS3 strategies, ERDF Operational Programs, and projects



Source: World Bank analysis based on Coffano and Foray (2014) and McCann and Ortega-Argilés (2015)

3.3 Smart Specialization in Poland[9]

For the 2014–2020 MFF, Poland's national government and all 16 Polish NUTS2 regions developed their own RIS3s to fulfill the precondition of obtaining EU funding. At the national level, the Polish government identified 18 national Smart Specialization priorities. (See Table A.1 in Appendix A.4 for a list.) These national priorities are not a separate strategy but are embedded into the guidelines for funding within national and EU funding programs. In practice, for some programs, extra points are allocated in the grant application process for projects that fall under the Smart Specialization agenda; in addition, some of the funds are reserved only for Smart Specialization projects (Piatkowski et al. 2016). At the regional level, each of the 16 Polish regions set their own Smart Specialization priorities and implemented them through the regional ERDF Operational Programs.

Some of the regional Smart Specializations overlap with the national ones, but often this is not the case. Klincewicz and Szkuta (2015) argue that at the beginning of RIS3 implementation (at least until 2015), there was little to no effort to coordinate the national and regional Smart Specialization strategies. Additionally, many regional governments did not understand the Smart Specialization concept well and proceeded indiscriminately listing all technologies and research areas. Their focus was merely supporting already leading sectors and not accommodating an Entrepreneurial Discovery Process. The selection in those regions was top-down, and did not involve local stakeholders (Piatkowski et al. 2016). Only in 2016 did a national-level agency (the National Centre for Research and Development, NCBR) initiate measures to ensure cross-regional alignment of RIS3. It outlined research and innovation topics constructed from overlapping RIS3 priority areas of several regions. The goal was to increase

[8] SMEs are small and medium enterprises. See Appendix A.1 for more details on EU funding.
[9] See Appendixes A.1 and A.2 for detailed descriptions of Smart Specialisation in Poland and Pomorskie, respectively.

interregional awareness of the potential synergies, similarities, and differences between the RIS3 approaches of each region (Kelchtermans, Kardas, and Klincewicz 2021). Just a handful of Polish regions—among them Pomorskie—could implement a truly bottom-up RIS3 approach from the start, where businesses, research institutions, and social organizations are the driving forces, and the local government has a facilitating role. This early approach is also one of the main reasons to study the Pomorskie experience.

The first open calls for firms to apply for funding from 2014–2020 MFF were launched in 2015 (Klincewicz and Szkuta 2015). Beneficiaries of RIS3 measures are firms, public bodies, and non-profits that apply for funding with projects in line with RIS3 priorities. In practice, a firm registered in Poland can apply for both national and regional funding.

3.4 Pomorskie as a case study

Pomorskie has a population of 2.3 million and ranks fifth among 16 regions in Poland in GDP per capita (13,500 EUR in 2019).[10] It has a multi-decade tradition in shipbuilding, shipping, and logistics. Pomorskie is also home to a large cluster of renewable energy companies[11] and has more recently become a front-runner (within Poland) in information and communication technologies.[12] To identify regional Smart Specialization areas, Pomorskie initiated an open competition encouraging participation by local stakeholders from business and academia and let an international panel evaluate the submissions (Reid and Maroulis 2017).

This process led to the choice of two Smart Specializations traditional for the region (PSS1 and PSS2) and two new ones (PSS3 and PPS4):

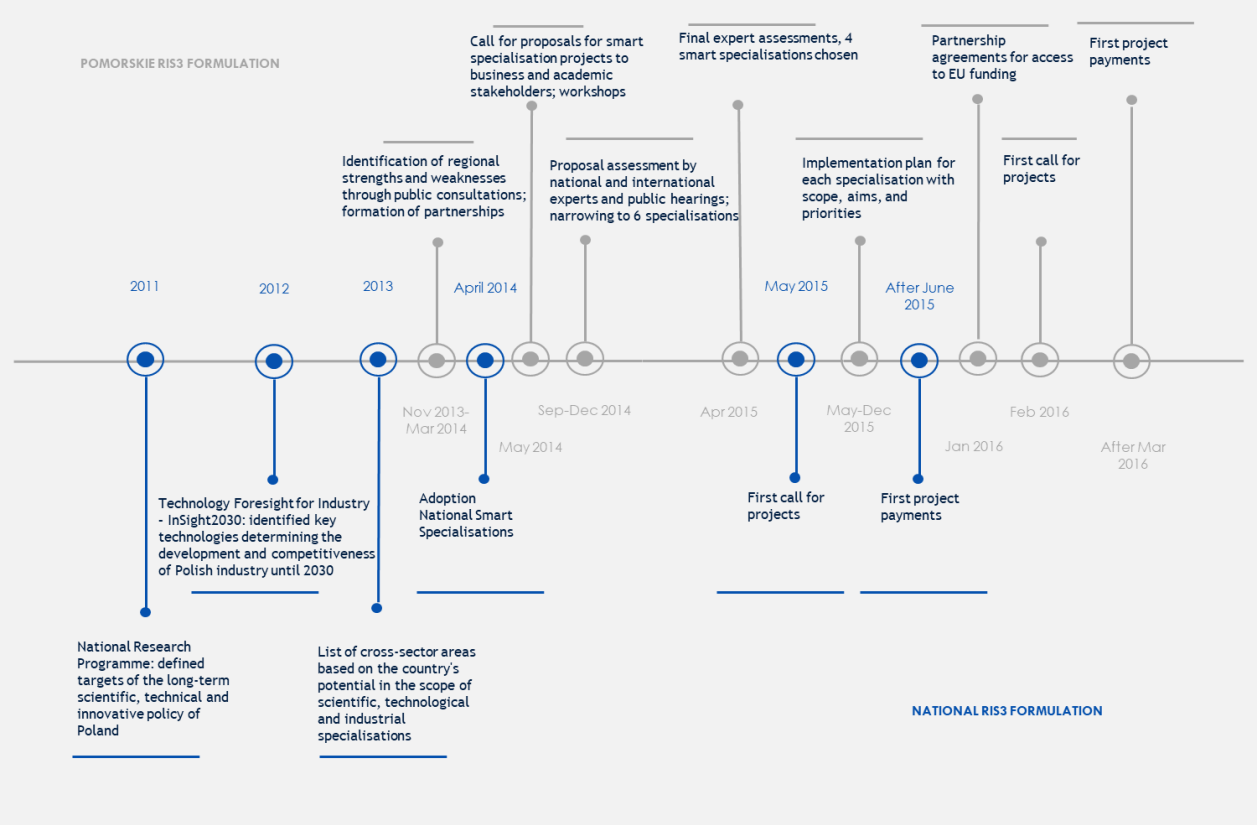
1) PSS1: Offshore, port, and logistics technologies.
2) PSS2: Interactive technologies in an information-saturated environment.
3) PSS3: Eco-effective technologies in the generation, transmission, distribution, and consumption of energy and fuels and in construction.
4) PPS4: Medical technologies in the area of civilization and aging-associated diseases.[13]

During the process, the interested parties in Pomorskie organized themselves in partnerships, and Pomorskie's government acted as a facilitator. In essence, Pomorskie's government and local stakeholders (e.g. regional clusters) implemented Smart Specialization in line with the prescriptions of the European Commission, which is another reason our analysis focuses on this particular region.

At the same time, the Polish government was independently developing national Smart Specializations. Figure 2 charts the main steps in establishing Pomorskie's RIS3 approach and juxtaposes the parallel development of national Smart Specializations.

[10] Data is from Eurostat.
[11] See https://gospodarka.pomorskie.eu/pomorska-platforma-offshore/?doing_wp_cron=1682490149.3447918891906738281250 for the details on Pomerania Offshore Platform
[12] See https://interizon.pl/en/about for the details on ICT Pomeranian Cluster.
[13] https://gospodarka.pomorskie.eu/wp-content/uploads/2022/10/Pomorskie-Smart-Specialisations.pdf

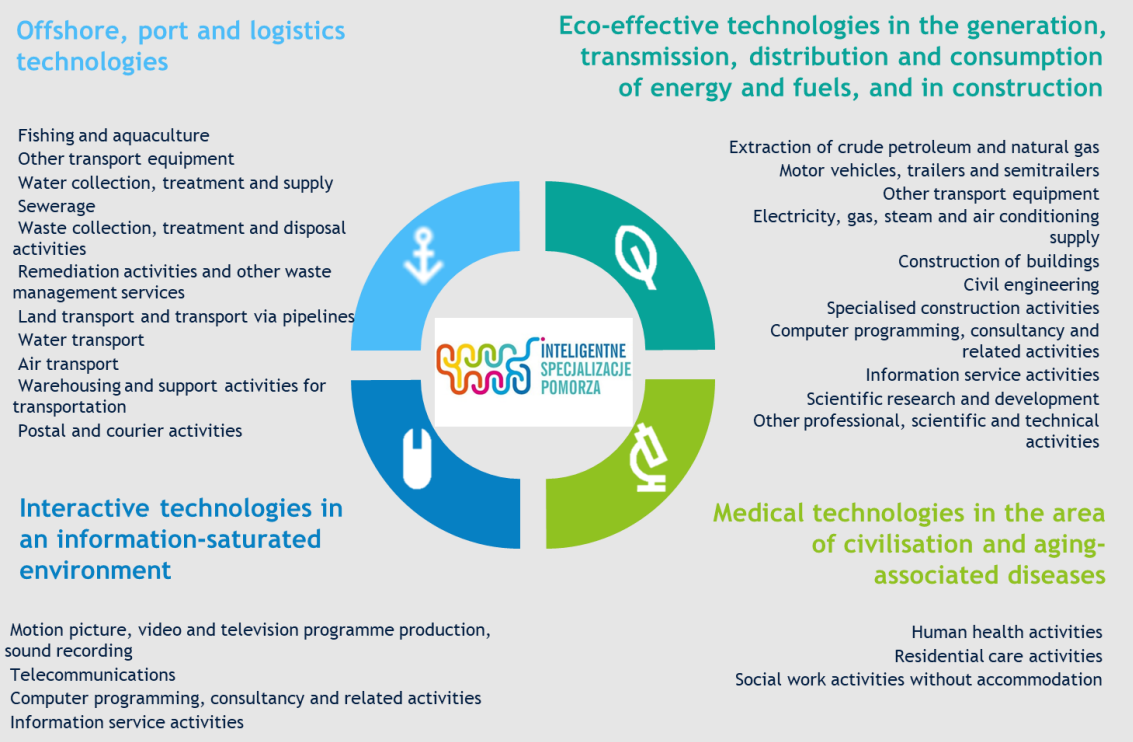
Figure 2: Timeline of national and Pomorskie RIS3 formulation



Source: World Bank analysis based on information provided by Poland's Ministry of Entrepreneurship and Technology and Office of the Marshal of the Pomorskie Voivodeship of the Pomorskie Voivodeship

Although Pomorskie's government and local stakeholders operated independently of the national government, all of Pomorskie's Smart Specializations are also represented at the national level. Because our analysis will proceed at the sector level, we map Pomorskie's Smart Specializations to NACE rev. 2 sectors (Figure 3).

Figure 3: Mapping Pomorskie's Smart Specializations to NACE 2 sectors



Source: World Bank analysis based on information provided by Poland's Ministry of Entrepreneurship and Technology and Marshal's Office of the Pomorskie Voivodeship

3.5 Research questions

This report investigates the impact of RIS3 intervention as part of the 2014–2020 MFF on firm performance, focusing specifically on the Polish region of Pomorskie. We answer three core questions:

1) What is the impact of *total* (national and regional) Smart Specialization funding of targeted firms in Pomorskie on sector-level aggregate firm outcomes (GVA, employment, wages, labor productivity)?
2) What is the impact of *regional* Smart Specialization funding of targeted firms in Pomorskie on sector-level aggregate firm outcomes (GVA, employment, wages, labor productivity)?
3) How does the impact of *regional* Smart Specialization funding in Pomorskie differ by sector?

4. Data

The analysis of the RIS3 impact in Pomorskie combines two distinct datasets:

1) Administrative data on EU beneficiaries in Poland from 2007 to 2020. Poland's Ministry of Development Funds and Regional Policy provided these data.
2) Annual panel data aggregated at the region-sector level based on Poland's Enterprises Statistics from 2008 to 2020. Poland's national statistical agency, Statistics Poland, provided these data. Because the firm-level data is strictly confidential, Statistics Poland performed a data cleaning process, calculated and estimated the variables, and aggregated them to the NUTS2-region-NACE3 level.

We use these two datasets to construct an annual pseudo-panel (repeated cross-sections) at the NUTS-2 (region) by NACE3 (sector) level.[14] Table 1 provides a detailed description of the datasets. Appendix Table A.3 provides summary statistics of the variables.

Table 1: Data Sources

	Administrative data on EU beneficiaries	Annual aggregated panel data from Poland's Enterprise Statistics[a]
Source	Polish Ministry of Development Funds and Regional Policy	Statistics Poland (SP)
Sample	All funded projects 2007–13 and 2014–20	SP – Annual Business Survey, which covers nearly all SMLEs[15], from 2008 to 2020
Variables	• beneficiary • EU co-funding amount • project start and end dates • Operational Program • RIS3 alignment • NACE code associated with funding activity	• firm's legal form and sector of activity • number of persons employed • revenues • wages • sales • profits • tangible and intangible assets • labor productivity • GVA • export share • firm ownership type • firm age • total factor productivity
Remarks		All data is made available at the aggregated region-sector-year level for confidentiality reasons. Also withheld is reporting of any variable with fewer than three firms in a given region-sector-year or if one firm is responsible for more than 75 percent of the variable's value.

Note: SMLEs = small, medium, and large enterprises.
a. Table A3 in Appendix A.4 reports the full list of variables.

4.1 EU beneficiaries

We acquired administrative information on all beneficiaries who received funding from EU-funded national and regional operational programs, including RIS3 funding. The dataset covers the 2007–2013 and the 2014–2020 Multiannual Financial Frameworks. The dataset reports funding for firms as well the NACE Rev. 2 four-digit sector of the project as declared by the applying firm (which may not coincide with the main sector of activity of the firm as recorded in Poland's business register). It also reports the firm's size (micro, small, medium, or large). We restrict our analysis to SMLEs because their balance-sheet information is more reliable.

[14] Or combined NACE3 levels due to confidentiality regulations.
[15] Small, medium-sized, and large enterprises.

4.2 Firm balance-sheet data aggregated to the region-sector level

Statistics Poland provides data on SMLEs collected through an enterprise survey from the whole population of firms employing more than nine employees.[16] In line with Statistics Poland's confidentiality regulations, any firm-level data—on profits and losses and from the firm's balance sheet—is available only in an aggregated form at the NUTS2-region-NACE3-sector level.

Because of data privacy regulations, Statistics Poland cannot share information on region-sector cells with fewer than three firms or when a single firm accounts for more than 75 percent of the value of a variable in a region-sector cell. These restrictions affect a substantial number of region-by-NACE3 cells in the dataset. For this reason, we combine related sectors that fall under this threshold. Specifically, there are 266 NACE3 sectors in total, of which Statistics Poland has not anonymized 28. We combine the remaining 238 NACE3 sectors according to their relatedness. This aggregation of NACE3 sectors sometimes leads to a pseudo-sector equivalent to the NACE2 or NACE1 level. In total, this procedure leads to 84 (NACE3 + aggregated NACE3) sectors. Table A.2 lists all of them.

We, therefore, conduct the analysis at the *region-by-pseudo-sector* level, where regions are the NUTS2 voivodeships of Poland and sectors are NACE2 sectors or combinations thereof. Table 2 provides an example of the aggregation process. In the example, we have aggregated four NACE3 sectors into a single new pseudo-NACE3 sector. We refer to these as *region-sectors*.

Table 2: Example for aggregating anonymized NACE 3 sectors

Aggregated sectors (multiple NACE3)		Original NACE3	
Number	Name	Number	Name
New3	Processing of fish / fruit and vegetables / meats	101	Processing and preserving of meat and production of meat products
		102	Processing and preserving of fish, crustaceans and mollusks
		103	Processing and preserving of fruit and vegetables
		104	Manufacture of vegetable and animal oils and fats

Another concern is that the beneficiaries data contains firms' self-reported sector of investment, whereas Statistics Poland's data reports each firm's actual sector of activity. This mismatch complicates the correct identification of treated sectors because the sector a firm reports may not coincide with the sector of investment of a RIS3 project reported in the beneficiaries dataset. The aggregation of different NACE3 sectors helps alleviate this issue because any discrepancy between the NACE3 sector of operation and the NACE3 sector of investment will likely disappear once sectors are combined to a higher aggregation level.

[16] Statistics Poland does not provide information on the estimated non-response rate to this obligatory survey. Among firms that responded, we estimate the non-response rate to critical questions (e.g., on revenue, profits or employment) is around 30 percent. The firm-level data on SMLEs thus creates an unbalanced panel (with missing information due to firm downscaling to micro, exit from the market, or non-response).

4.3 Dataset construction

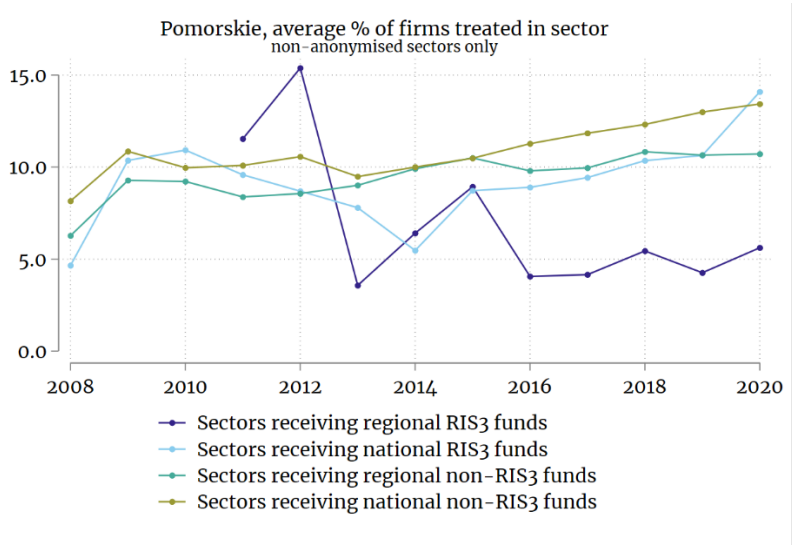
The dataset is constructed at the region-sector level. Statistics Poland identified and categorized all beneficiary firms according to their NACE3 sector of activity using the firm tax identification number of EU beneficiaries. For each region-sector-year combination, Statistics Poland computed the total amount of RIS3 and non-RIS3 funding and aggregate firm-level balance-sheet statistics. Our final dataset consists of firm balance-sheet information and 2007–13 and 2014–20 EU grant recipient information for 84 pseudo-sectors across all 16 Polish regions for 2008–20.

5. Descriptive analysis

5.1 Firm beneficiaries of EU funds in the Pomorskie region

Over the 2014–20 period, firm beneficiaries in the Pomorskie region started with the implementation of 3542 EU-funded projects, of which 28 percent (998) are defined as RIS3-related projects. The average duration of an EU project is two years. Figure 4 shows that (a) RIS3 reaches a smaller share of firms than non-RIS3 funding and (b) *regional* RIS3 reaches only half as many firms as *national* RIS3 funding. In 2020, 6 percent of firms in a given sector received regional RIS3 and 15 percent received national RIS3, compared to 11 percent and 14 percent of firms in a sector receiving regional and national non-RIS3 funds in 2020.

Figure 4: Firms' average exposure to EU funding within sector 2008-2020

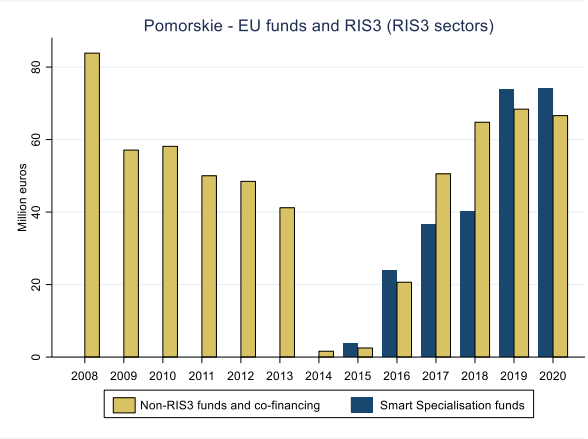


Note: Number of firms weighted by number of employees.
Source: World Bank elaboration based on EU beneficiaries' data and Statistics Poland calculations.

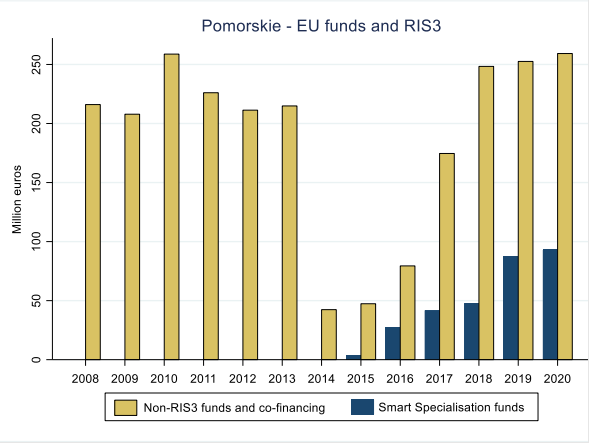
Non-RIS3 funding in Pomorskie has also been much higher than RIS3 funding since RIS3-linked funding started in 2015 (Figure 5a). In 2020, total non-RIS3 funding surpassed €250 million, while RIS3 funding was around €80 million. At the same time, among sectors that have received any Pomorskie regional RIS3 funding (Figure 5b), RIS3 and non-RIS3 funding is almost on par -- €253 million vs. €275 million over the whole of period 2014-2020.

Figure 5: EU Funding

(a) 2007–13 and 2014–20 EU funding in Pomorskie



(b) EU funding to sectors that have received any regional RIS3 funding

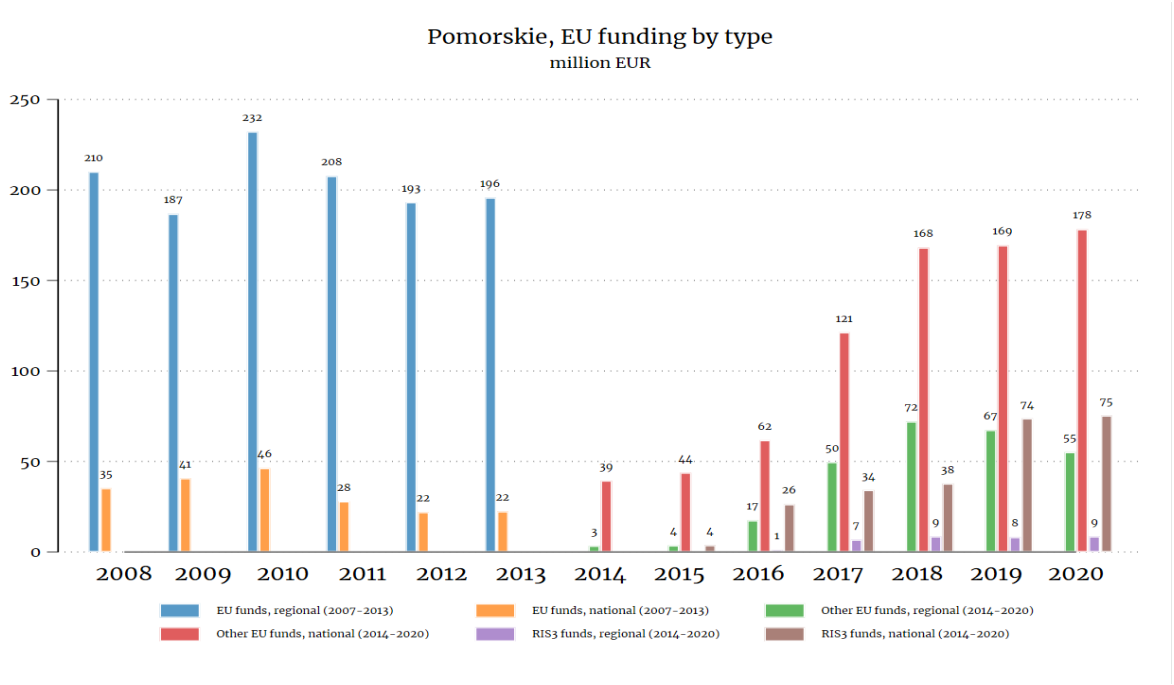


Source: World Bank elaboration based on EU beneficiaries data and Statistics Poland calculations.

Between 2015 and 2020, RIS3 funding increased from €3.7 million to €74 million, which affects our analysis in two ways. First, a significant amount of funding from the 2014–20 program cycle was disbursed after 2020 due to the so-called *n+3* EU rule that allows disbursing funding up to three years after the end of the programming period. Second, due to data availability, our sample ends in 2020. Further, the impact of RIS3 funding may take years to materialize. Considering these facts, any estimated impact should be considered a short-term and, therefore, lower-bound estimate.[17] Second, national RIS3 funds account for almost all RIS3 funding: from €4 million in 2015 to €75 million in 2020 (Figure 6). In contrast, regional RIS3 funds have been quite low, between €1 million in 2016 and a maximum of €9 million in 2020.

[17] Grants are allocated based on open calls of proposals in various national and regional programs, with slightly varying regulations. This footnote describes the most frequent process. Usually, from the moment a call for proposal is open, potential beneficiaries have 1 to 3 months to prepare and submit the application. Proposals go through formal and substantive assessments (that last up to few month) and usually grants are allocated based on a ranking list with threshold based on availability of funding. The project starts after contract signing and usually firms are reimbursed after expenses have been made.

Figure 6: Pomorskie, national vs. regional EU funding



Source: World Bank elaboration based on EU beneficiaries data and Statistics Poland calculations.

5.2 Sector of analysis

Between 2014 and 2020, 42 out of all 84 sectors received national or regional RIS3 funding in Pomorskie (see Figure A.2). Twenty-two of these 84 sectors received only national RIS3 funding in Pomorskie. Of the remaining 22 sectors that received regional RIS3 funds, 19 also received some national RIS3 funding, whereas three sectors received regional RIS3 funds only. Figure 7 provides a list of sectors that received funding from regional and both regional and national RIS3 funds, whereas Figure A.3 provides funding flows to each sector. Regional RIS3 funds are relatively small compared to other funding types. Regional RIS3 targeted sectors are not the focus of the other funding programs (except for national RIS3) (Figure A.4).

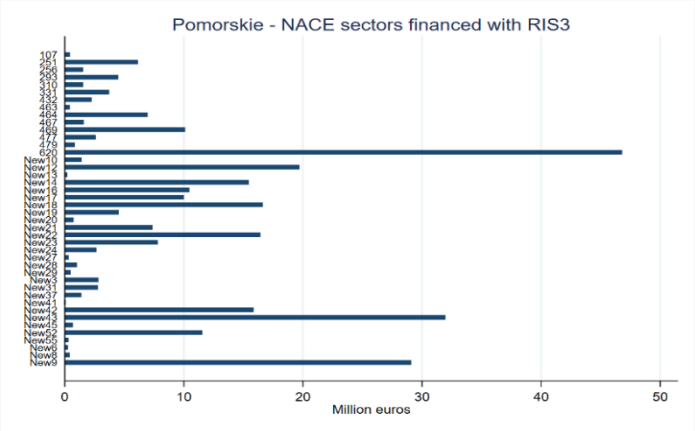
The sector receiving the most regional RIS3 funding in Pomorskie is 'New43,' a pseudo-sector comprising "Scientific research and development," "Advertising and market research," "Other professional, scientific and technical activities," and "Veterinary activities" (Figure 7).[18] This sector has

[18] The list of treated sectors—these that received regional RIS3 funding—is as follows: 463: Wholesale of food, beverages and tobacco, 464: Wholesale of household goods, 469: Non-specialised wholesale trade, 620: Computer programming, consultancy and related activities, New8: Manufacture of leather and related products, New9: Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials, New12: Manufacturing of refined petroleum / basic pharmaceutical / rubber and plastic products, New14: Manufacturing of chemical / non-metallic mineral products, 2, New16: Manufacture of fabricated metal products, except machinery and equipment, New17: Manufacturing of fabricated metal products / electronic components and boards, New18: Manufacture of computer, electronic and optical products, New19: Manufacturing of electric motors / batteries / wiring devices, New20: Manufacturing of lighting / other electrical equipment / domestic appliances, New21: Manufacturing of general-purpose machinery, New22:

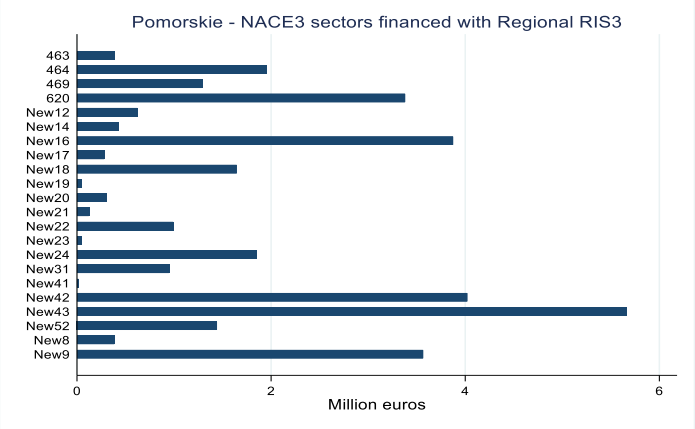
received €5.6 million in total over the 2015–20 period (2.2 percent of the total RIS3 funding in Pomorskie). Figure 7 also shows the large differences in funding that exist between sectors. However, there is no relationship between sector-level innovation intensity and regional RIS3 funding. That is, the sectors receiving more regional RIS3 funds were not more innovative before funding (Figure A.5).

Figure 7: Regional versus national + regional RIS3-funded sectors in Pomorskie

(a) Pomorskie, total RIS3-funded sectors



(b) Pomorskie, regional RIS3-funded sectors



Source: World Bank elaboration based on EU beneficiaries data and Statistics Poland calculations.

How does this compare to the rest of Poland? To account for the fact that regional economies and labor markets vary in size in different Polish regions, we divide total and regional RIS3 funding in a sector by

Manufacturing of motor vehicles and trailers / other transport equipment, New23: Other manufacturing, New24: Electricity, gas, steam and air conditioning supply, New31: Wholesale trade, except of motor vehicles and motorcycles, New41: Activities of head offices; management consultancy activities, New42: Architectural and engineering activities; technical testing and analysis, New43: Scientific R&D / Advertising and market research / Other professional activities / Veterinaries, New52: Human health activities.

the total number of active firms in a sector.[19] Pomorskie is among the regions with the least total RIS3 and regional RIS3 funds (Figure A.1). At the same time, Pomorskie has selected relatively few sectors to target compared to other regions. As a result, each of the targeted sectors receives a relatively large amount of funds.

6. Research design and empirical strategy

6.1 Treatment and counterfactual definition

The analysis aims to estimate the causal impact of RIS3 funding (the '*treatment*') that was disbursed in Pomorskie, starting in 2015, on top of other EU funding. We focus on firm outcomes aggregated at the sectoral level in the Pomorskie region. That is, we examine the performance of RIS3-funded sectors in Pomorskie before and after the start of RIS3 funding and compare them to a pool of region-sectors not funded with RIS3.

We define three treatments:

1) **Whether a sector has received *any* RIS3 funding** (regional, national, or both). By this definition, there are 42 (of 84 possible) treated sectors in Pomorskie (see section 4.).
2) **The *actual* value of RIS3 funding received**, computed as the log of RIS3 funding per firm.
3) **Whether a sector has received any *regional* RIS3 funding**. By this definition, Pomorskie has 22 (of 84 possible) treated sectors (see section 4). Some of these sectors have received some national RIS3 funding as well.

A few remarks on the treatment definition are in order.

First, for each sector implementing one or more RIS3 projects, the *counterfactual* for treated Pomorskie sectors is constructed from sectors that have never received *any* RIS3 funding (never-treated region-sectors).

Second, although RIS3 funding flows were staggered throughout 2014–20, the national and regional governments had already determined the RIS3-funded sectors in 2014 or 2015. Firms in RIS3-targeted sectors may have changed their behavior *in expectation* of future funding. To avoid potential *anticipation effects*, throughout our analysis, we consider all sectors targeted with RIS3 as "treated" starting in 2015, even if funding flowed to those sectors only later.

Third, and crucially, RIS3 is not the only policy potentially influencing the outcomes of interest in a given sector. Contemporaneous policy interventions– most importantly other non-RIS3 measures financed by European Structural and Investment Funds (ESIF)—may also affect firm performance. Therefore, we control for any effect produced by non-RIS3 funding in different ways depending on the estimation method so that any estimated effect from RIS3 funds will be *net* of non-RIS3 funding (details follow in

[19] Although ideally this variable should be computed by dividing RIS3 funds per *beneficiary* firms rather than RIS3 funds per *total* firms, the low number of beneficiary firms per sector entails that, in most cases, information on the number of beneficiary firms is missing from Statistics Poland, due to the fact that Statistics Poland cannot share information on region-sector cells that have fewer than 10 firms (because of its data privacy policy).

section 6). Still, our impact estimate could be biased if the sectoral allocation of RIS3 funds were (positively or negatively) correlated with the allocation of these other funds.

Table 3 Overview of treatment and control units

	Sectors	Treated if
Treatment units	• 42 Pomorskie sectors receiving any amount of RIS3 funding	• any RIS3 funding (regional, national, or both) has been allocated to that sector in Pomorskie
	• 22 Pomorskie sectors receiving any amount of regional RIS3 funding	• any RIS3 regional funding has been allocated to that sector in Pomorskie
Control units	• Selected from sectors not receiving any form of RIS3 funding (never-treated region-sectors), of which: - Pomorskie sectors not receiving any RIS3 funding: 42 region-sectors - Sectors from other Polish regions not receiving any RIS3 funding: 489 region-sectors	

6.2 Outcomes of interest

RIS3 interventions aim at boosting firms' productivity and efficiency. Accordingly, the outcomes of interest are firm performance variables aggregated at the region-sector level. We use:

1) **Labor productivity**, measured as log average GVA in region-sectors divided by average employees in region-sector
2) **Gross Value Added**, measured as log average GVA (output minus internal consumption) in region-sector
3) **Wages**, measured as log average costs for salaries and remunerations in region-sector
4) **Employment**, measured as the log of total full-time employees in region-sector[20]

These variables were chosen both for their relevance and for their relatively larger data availability than other potential outcomes. The descriptive statistics in Table A.4 reveal that the treated and control region-sectors differ meaningfully on all firm-level characteristics except for firm age.

6.3 Selection bias

Smart Specialization strategies aim at identifying and supporting those sectors within a region that offer the best growth prospects. Hence, RIS3 project applications are generally approved precisely based on their potential for regional development in sectors selected under RIS3. If this is not properly accounted for, any difference between beneficiary (treated) and control region-sectors during the intervention period may be due to the pre-conditions that made a sector 'treated' in the first place (e.g., if the selected sectors had higher growth potential).

We test whether treated and control region-sectors are statistically different by examining RIS3-targeted sector performance in the years before program implementation (pre-treatment). The results are in Table A.4 in the Appendix. The pre-treatment period sectors receiving RIS3 funding were, on average, more productive, had higher GVA, and had a larger number of firms than untreated sectors. Interestingly, treated sectors were also growing in terms of GVA, whereas untreated sectors were not, consistent with the idea that RIS3 identified successful sectors with high growth potential for targeting.

[20] All relevant variables in the sample have been deflated.

This better pre-treatment performance among the treated sectors implies that our analysis needs to deal with a selection bias which we address in the next subsection.

6.4 Empirical strategy

The goal of the empirical strategy is to identify a valid counterfactual. The counterfactual is the hypothetical scenario that would have happened without RIS3 funding being available to firms in a certain region-sector in that year. Our empirical strategy encompasses two methodologies. First, difference-in-differences combined with propensity score matching (DiD-PSM) identifies existing comparison region-sectors based on (a) pre-treatment firm characteristics and (b) amounts of non-RIS3 funding before and during the RIS3 funding period. Second, a synthetic control method (SCM) generates a pseudo comparison region-sector based on pre-treatment firm characteristics and non-RIS3 funding. As SCM allows us to both confirm our difference-in-differences results and additionally offers analysis for each sector separately, we focus in the main text on the SCM and present our difference-in-differences strategy in the Appendix A.4.

Synthetic control method

The synthetic control method (SCM) entails constructing counterfactuals for each Pomorskie sector receiving RIS3 funds from sectors in other Polish regions that do not receive funding (for method description see Abadie and Gardeazabal 2003; Abadie, Diamond, and Hainmueller 2010; 2015; Doudchenko and Imbens 2016; Abadie 2021).

In our case, the control pool for constructing counterfactuals consists of those region-sectors, for which the sectors have received RIS3 funding in Pomorskie but not in any other region (119 in total, see Table A.5 for a full list). SCM then exploits a wide set of firm characteristics for the period 2008-2014 - labor productivity, GVA, wages, full-time employees, revenues, tangible fixed assets, average age of firms, share of domestic firms, share of small firms – in logs and aggregated to the region-sector level, to construct synthetic region-sectors with pre-treatment (i.e., pre-2015) trends in the outcome variables of interest as close as possible to the pre-treatment trends of the treated Pomorskie sectors. We also include non-RIS3 funds per firm measured over the full 2008–20 period to control for other funding sources.

As we have multiple treated units (all region-sectors receiving RIS3 funds in Pomorskie), we perform the analysis in two different ways, both very common in the SCM literature:

- Synthetic control method 1: treated units as the average of all treated sectors. We first take the average of all treated units and then estimate synthetic control weights for this average (Kreif et al. 2016; Robbins et al. 2017; Ben-Michael, Feller, and Rothstein 2021). As a result, rather than having multiple treated sectors, we only have one pooled unit representing their average evolution. We label treated units constructed in this way *Average-Treated-Sectors* (ATS). We then construct synthetic controls for the ATS using the donor pool and set of covariates discussed above[21].
- Synthetic control method 2: repeated sector-specific estimations. We produce individual synthetic control estimates and then average over all synthetic controls results to yield the average

[21] Tables A6 and A7 show that covariates of the ATS and the synthetic control units are matched very well.

treatment on the treated (Gobillon and Magnac 2016; Abadie and L'Hour 2021; Crescenzi, Di Cataldo, and Giua 2021). That is, we construct a synthetic control for each sector and obtain sector-specific estimates. We then average over these sector-specific estimates to arrive at a single estimate.

We use the first approach to estimate the impact of total RIS3 funding (as in the DiD model) and regional RIS3 funding and the second approach to estimate the impact of regional RIS3 for each specific funded sector.

7. Impact evaluation analysis

7.1 Synthetic control method 1: treated units as the average of all treated sectors

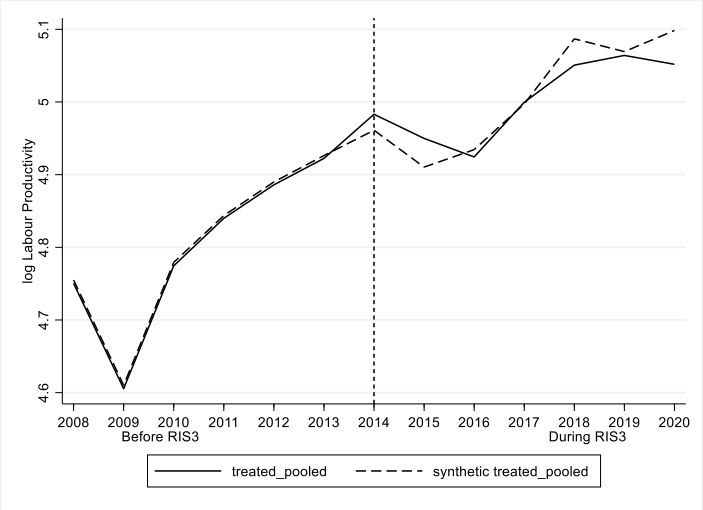
We use synthetic control method 1 (SCM1) to estimate the impact of total RIS3 funding and regional RIS3 funding in Pomorskie. Table A.6 shows that treated and synthetic control region-sectors receive very similar amounts of non-RIS3 funds per capita. Thus, we can interpret the SCM result as the *additional* impact of total RIS3 funds over and above the potential non-RIS3 funding effects.

Figure 8 reports the results of SCM 1 estimates using total RIS3 funds as the treatment. For all four outcomes, the synthetic control represents a valid counterfactual in that it matches well the 2008–14 trend of the ATS unit. The root mean square prediction error (RMSPE) describing the margin between treatment and synthetic control in the prediction period is extremely low (close to zero in all cases, see Table A.10).

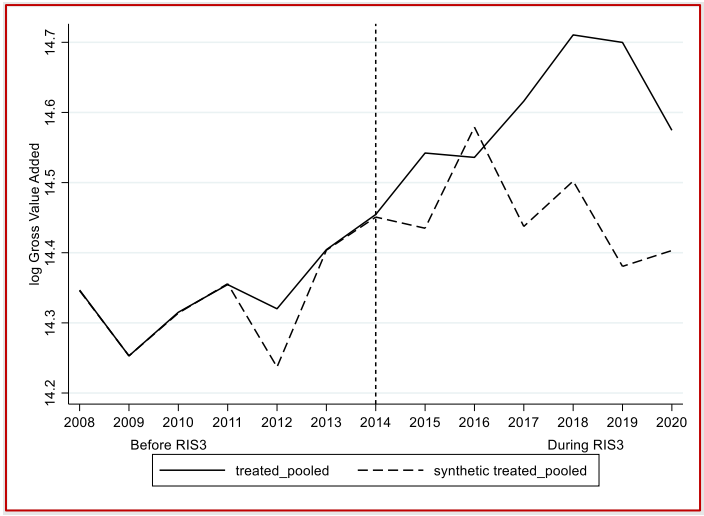
Funded by the European Union

Figure 8: Synthetic control method 1 results, treatment: total RIS3 funds

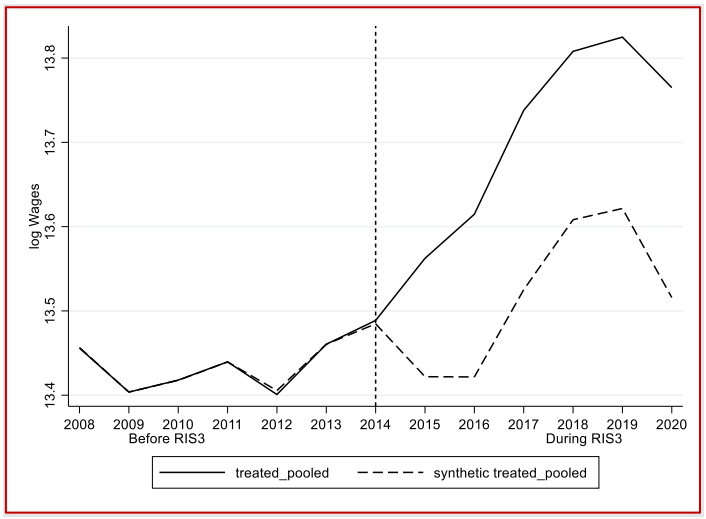
(a) Labor productivity



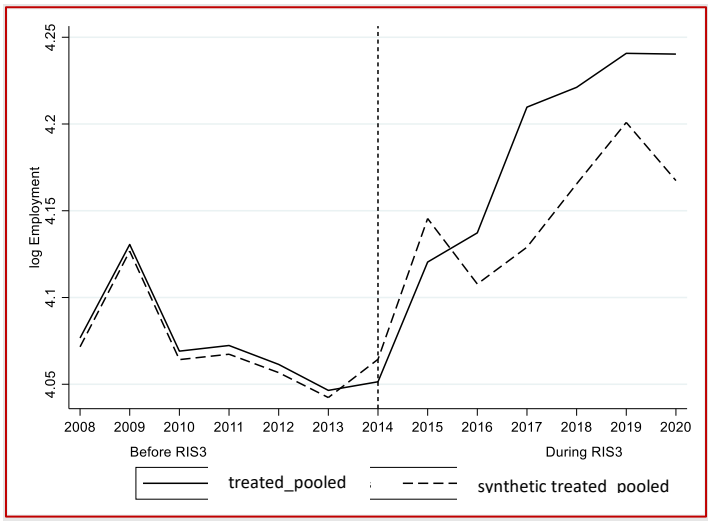
(b) Gross value added



(c) Wages



(d) Employment



Moving to the estimated impact of total RIS3 funds, we do not observe a notable gap between the treated and synthetic control units' trajectories for labor productivity during the post-treatment period 2015–20 (Figure 8, Panel a). In contrast, the gap is large for the other three outcomes—GVA, wage expenses, and employment (Figure 8, Panels b, c, and d). This confirms the results obtained with difference-in-differences estimates (Appendix A.4), i.e., firms in sectors receiving some form of RIS3 funds in Pomorskie reached higher GVA, spent more resources for salaries, and increased their full-time employees more than firms in similar sectors that did not receive RIS3 funds.

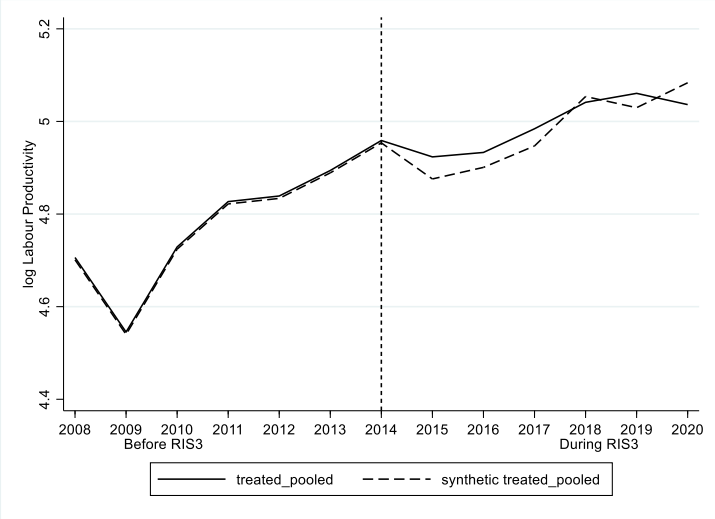
At the end of the treatment period (2020), the GVA of firms operating in sectors receiving RIS3 funds is, on average, 15.6 percent higher than that of firms in sectors not receiving any RIS3 financial support. Similarly, the wage bill is, on average, 22.9 percent and the total number of full-time employees up to 7.04 percent higher than that of firms in sectors not receiving any RIS3 financial support.

Funded by the European Union

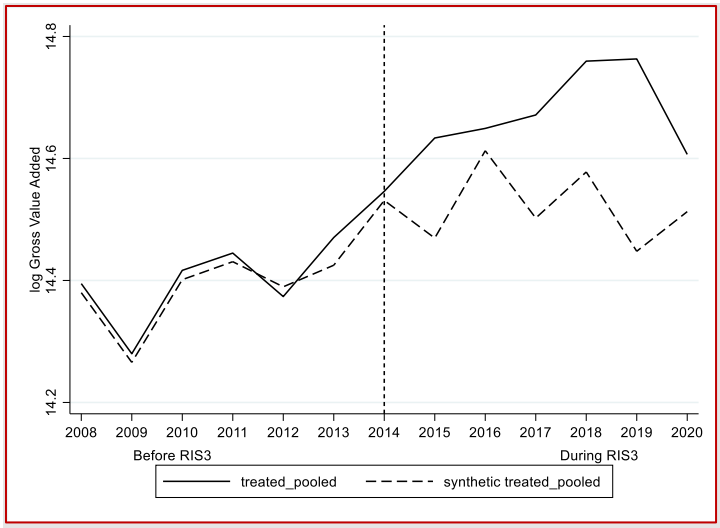
Next, we examine the performance of sectors in Pomorskie that received regional RIS3 funds (Figure 9). Again, we begin by observing that we have computed valid counterfactuals -- the synthetic control matches well the 2008-2014 trend of the ATS unit and the RMSPE is close to zero (Table A.10).

Figure 9: Synthetic control method 1 results, treatment: regional RIS3 funds

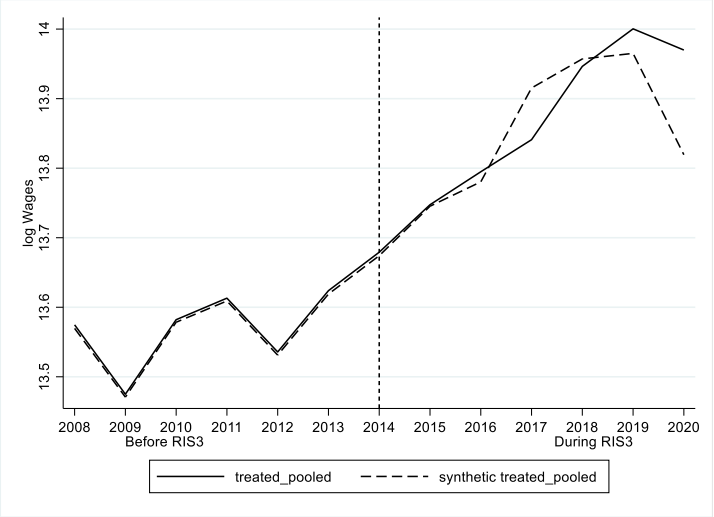
(a) Labor productivity



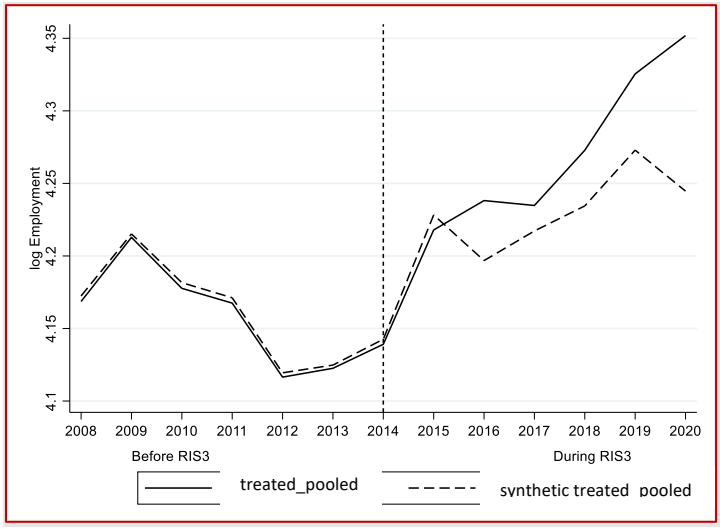
(b) Gross value added



(c) Wages



(d) Employment



For regional RIS3 funds, we observe a notable gap between the trajectory of treated and synthetic control during 2015-2020 only for GVA and employment (Figure 9). At the end of the sample period (2020), the GVA of firms in sectors receiving regional RIS3 funds is, on average, 9 percent higher and the number of total full-time employees is up to 10.2 percent higher than that of firms in sectors not receiving any RIS3 financial support.

In interpreting these results, it should be noted that 19 of 22 sectors composing the ATS unit for regional RIS3 treatment also received national RIS3 funding. It would therefore be inaccurate to interpret the

observed gaps in Figure 9 as the full impact of regional RIS3 funding in Pomorskie. Due to this, in what follows, we apply the synthetic control method to each sector having received regional RIS3 separately.

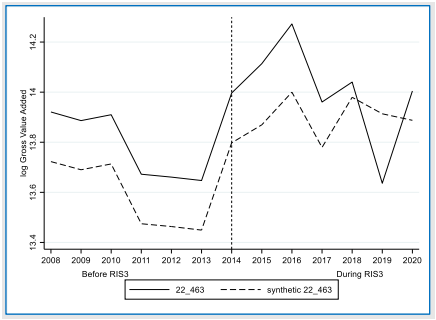
7.2 Synthetic control method 2: repeated sector-specific estimations

With the second SCM approach, we estimate the impact of regional RIS3 funding in Pomorskie by producing specific SCM estimates for each of the 22 treated sectors receiving regional RIS3 funding. Figure 10 shows the results for GVA. In most, the synthetic counterfactuals accurately match the pre-treatment trajectories of treated sectors. In four of 22 sectors – (i) *Computer programming, consultancy and related activities* (Figure 10, Panel d); (ii) *Manufacturing of chemical / non-metallic mineral products* (Figure 10, Panel f); (iii) *Manufacture of fabricated metal products, except machinery and equipment* (Figure 10, Panel g); and (iv) *Manufacture of wood / products of wood and cork / articles of straw and plaiting materials* (Figure 10, Panel v) – we find a statistically significant gap in GVA between firms in the treated sectors and firms in the synthetic controls, after treatment.[22] All those sectors received both regional and national RIS3 funding.

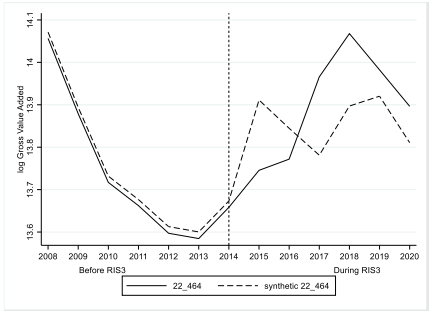
[22] The statistical significance of synthetic control estimates is generally inspected through post-pre-treatment RMSPE ratio of treated unit and comparison with donor units, and comparison of treated vs. placebo gaps ('spaghetti graph') for all untreated units. SCM2 is obtained from a large set of treated units, hence performing placebo estimates for each treated sector and then combining them all together would become cumbersome. Our goal with SCM2 is to give a suggestive indication of what sectors may be driving the overall effect and test the robustness of SCM1 and DiD estimates.

Figure 10: SCM2: Sector-specific SCM estimates with GVA as outcome

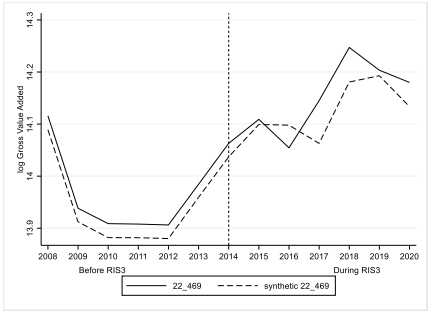
(a) Wholesale of food, beverages and tobacco



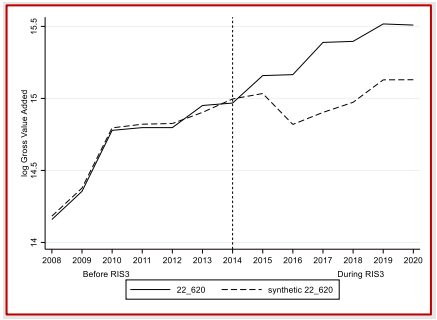
(b) Wholesale of household goods



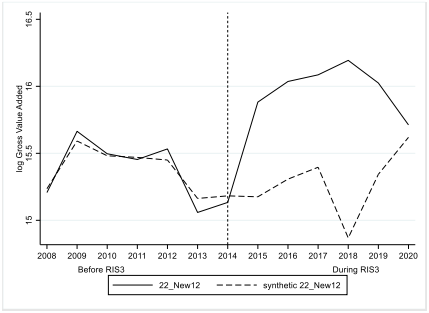
(c) Non-specialized wholesale trade



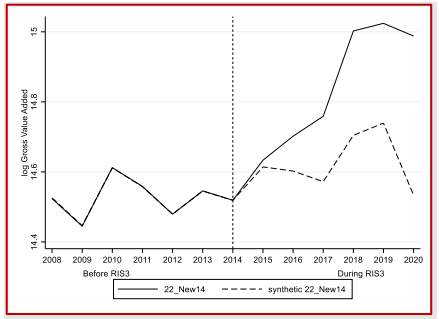
(d) Computer programming, consultancy and related activities



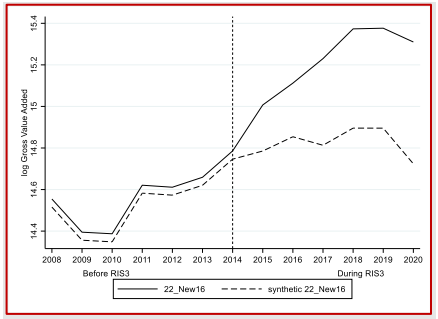
(e) Manufacturing of refined petroleum / basic pharmaceutical / rubber and plastic products



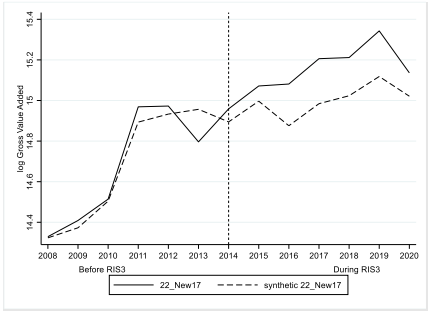
(f) Manufacturing of chemical / non-metallic mineral products



(g) Manufacture of fabricated metal products, except for machinery and equipment



(h) Manufacturing of fabricated metal products / electronic components and boards



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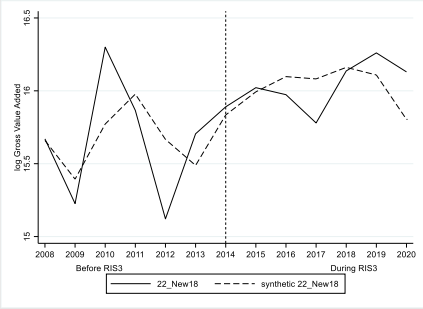
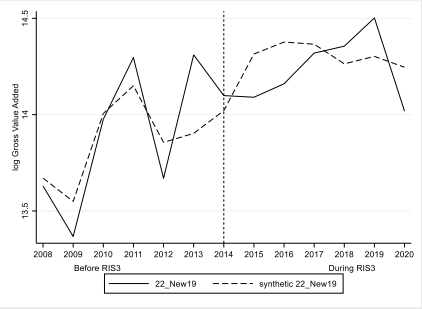
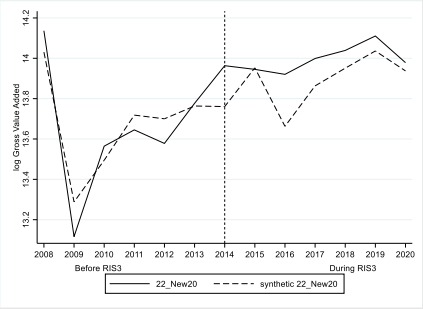
(i) Manufacture of computer, electronic and optical products



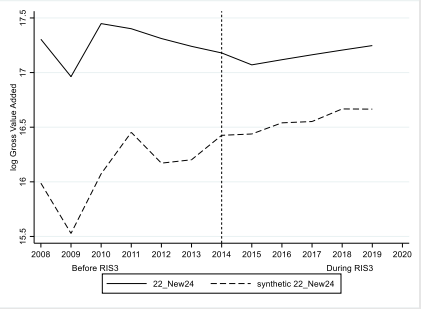
(j) Manufacturing of electric motors / batteries / wiring devices



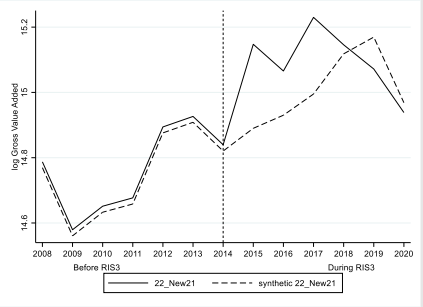
(k) Manufacturing of lighting / other electrical equipment / domestic appliances



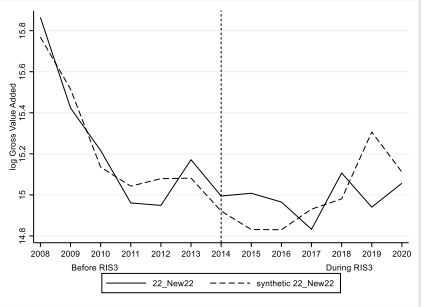
(l) Electricity, gas, steam and air conditioning supply



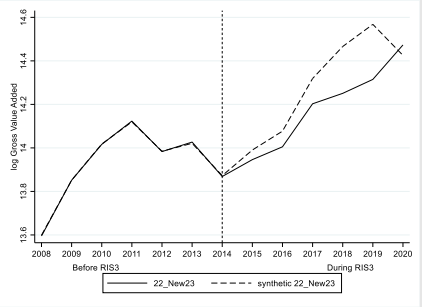
(m) Manufacturing of general-purpose machinery



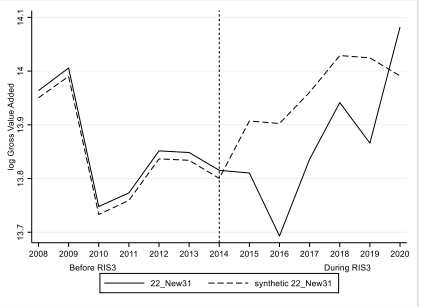
(n) Manufacturing of motor vehicles and trailers / other transport equipment



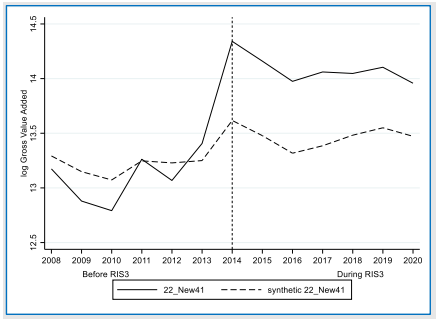
(o) Other manufacturing



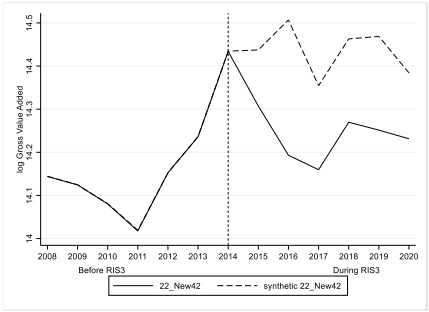
(p) Wholesale trade, except of motor vehicles and motorcycles



(q) Activities of head offices; management consultancy activities

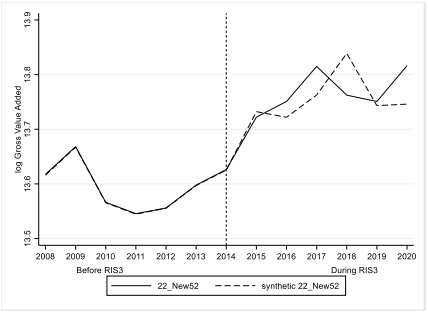


(r) Architectural and engineering activities; technical testing and analysis

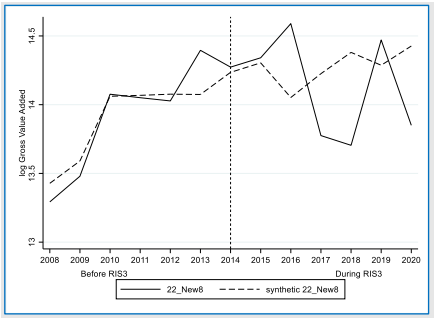


(s) Advertising and market research / Other professional activities / Veterinaries

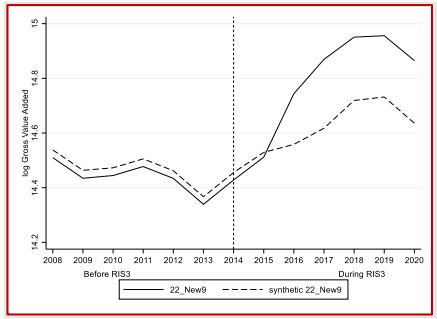
(t) Secondary / Higher / Other Education



(u) Manufacturing of beverages / tobacco products / textiles



(v) Manufacture of wood / products of wood and cork / articles of straw and plaiting materials



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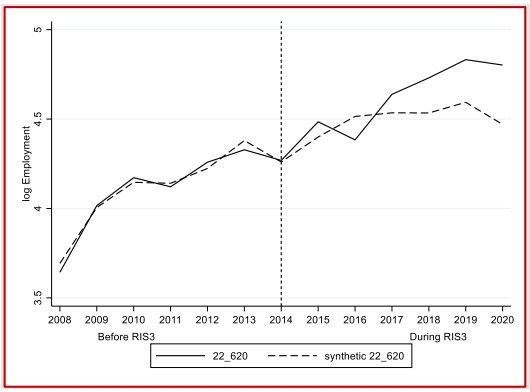
Interestingly, *Computer programming, consultancy and related activities,* is the most financed sector through RIS3 in Pomorskie, and the 5th most financed in terms of regional RIS3 funds. The sector has received €46.8 million in RIS3 funds, of which €3.6 are regional RIS3 funds. *Manufacture of wood / products of wood and cork / articles of straw and plaiting materials* is the third most financed through RIS3, having received €29.1 million in RIS3 funds, of which €3.8 -- in regional RIS3 funds. *Manufacturing of chemical / non-metallic mineral products* and *Manufacture of fabricated metal products, except machinery and equipment* are also among the most financed sectors in the region, with €15.5 million and €10.5 million in total, respectively, of which €4.6 million and €4.1 million respectively from regional RIS3 funds. *Manufacture of fabricated metal products, except machinery and equipment* which shows the largest impact from RIS3 funds, received 40 percent regional and 60 percent national RIS3 funds in the period 2015–20. The percentage of regional RIS3 funds is lower in the other three sectors.

Yet, the statistically significant sectors from this analysis do not receive more regional RIS3 funding per worker (Table A.5). In the pre-treatment periods, firms in these sectors have, on average, lower GVA, revenues, and capital per worker. However, they pay higher wages and tend to more often be foreign-owned or engage in exporting activities in the pre-treatment years. This implies that regional RIS3 funding may drive those firms' growth by letting them expand their pre-existing foreign operations.

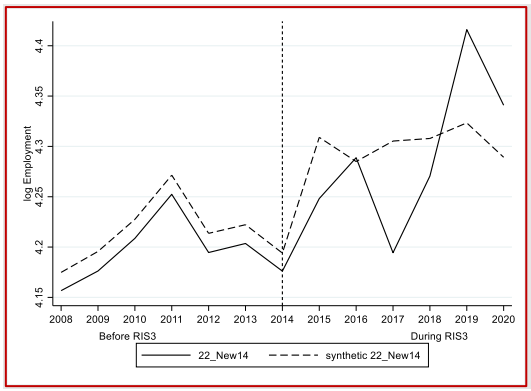
Across all sectors, only three sectors have received regional RIS3 funds only -- (i) *Wholesale of food, beverages and tobacco* (Figure 10, Panel a), (ii) *Activities of head offices; management consultancy activities* (Figure 10, Panel q), and (iii) *Manufacture of leather and related products* (Figure 10, Panel u). These sectors are the ideal setting to test the impact of regional RIS3 more precisely. Unfortunately, the treatment in these sectors is very low: the amounts of RIS3 funds disbursed to these sectors are among the lowest. Hence, the fact that we find no statistically significant impact from regional RIS3 policies is not evidence of a failure of these interventions. Rather, it confirms that very low funding is unlikely to produce immediate impacts.

Figure 11: SCM2: Employment outcome in key sectors

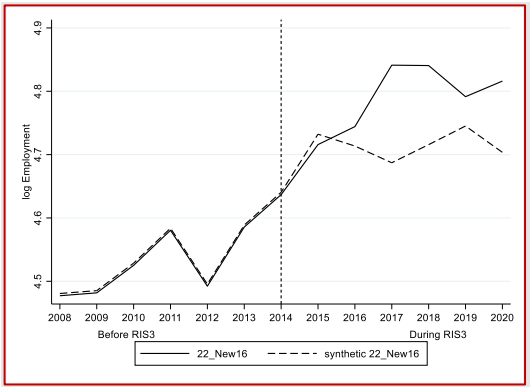
(a) Computer programming, consultancy and related activities



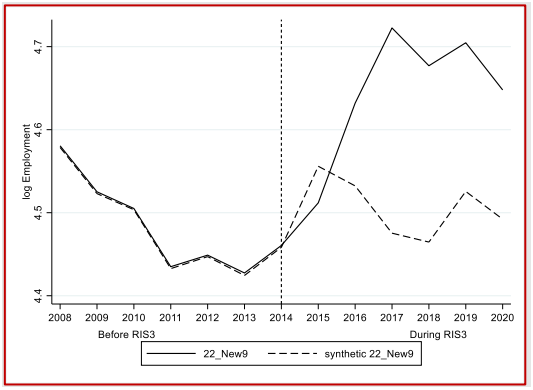
(b) Manufacturing of chemical / non-metallic mineral products



(c) Manufacture of fabricated metal products, except machinery and equipment



(d) Manufacture of wood / products of wood and cork / articles of straw and plaiting materials

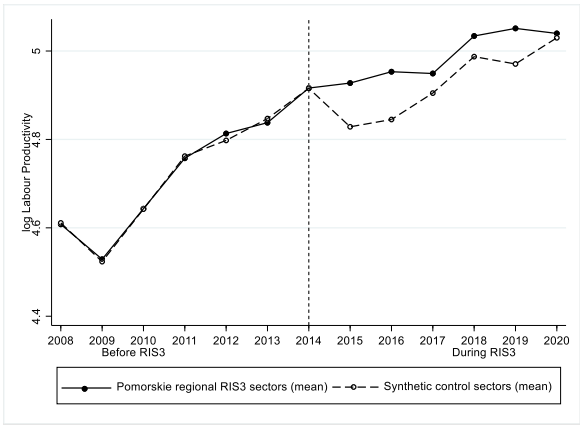


Given that our SMC1 estimation in section 6.2 showed that sectors that received regional RIS3 funding appeared to have improved their performance in terms of GVA and employment, Figure 11 reports the sector-specific SCM2 estimates for employment in the four sectors with the largest GVA impact: (i) *Computer programming, consultancy and related activities* (Figure 11, Panel a); (ii) *Manufacturing of chemical / non-metallic mineral products* (Figure 11, Panel b); (iii) *Manufacture of fabricated metal products, except machinery and equipment* (Figure 11, Panel c); and (iv) *Manufacture of wood / products of wood and cork / articles of straw and plaiting materials* (Figure 11, panel d). Interestingly, for all four sectors, a positive gap between funded sectors and synthetic counterfactuals is visible in 2020, suggesting that the higher GVA comes with higher employment and is not due to an increase in labor productivity.

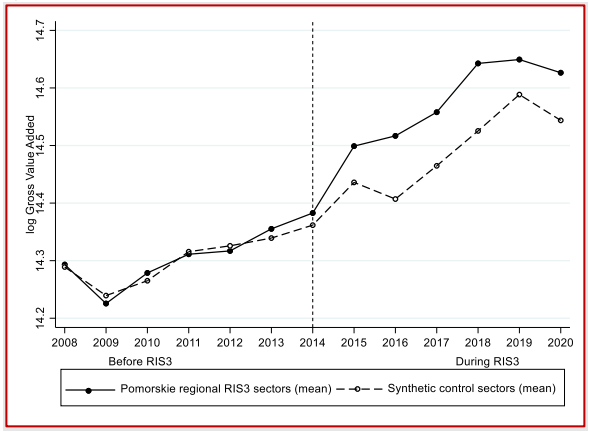
We conclude this section by performing an "averaged" estimation comparable to that obtained with SCM1 using regional RIS3 as the treatment, i.e., we pool together all 22 sector-specific estimates from sectors receiving regional RIS3 in Pomorskie. The results align with our SCM1 estimation -- a gap between treated and synthetic control sectors is visible in 2015–2020 for GVA and employment only (Figure 12). The impact on GVA may be due to hiring new workers without making these firms more productive.

Figure 12: SCM 2: pooled sectors results

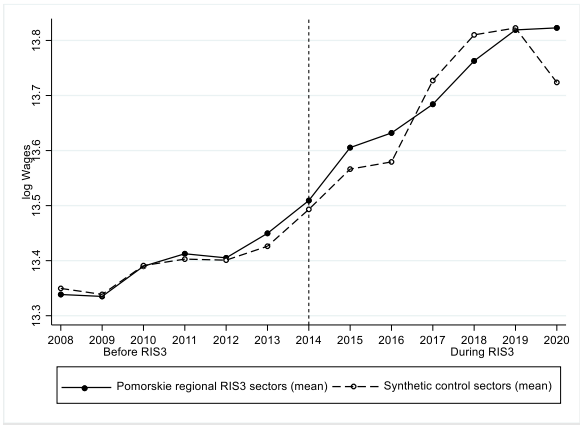
a) Labor productivity



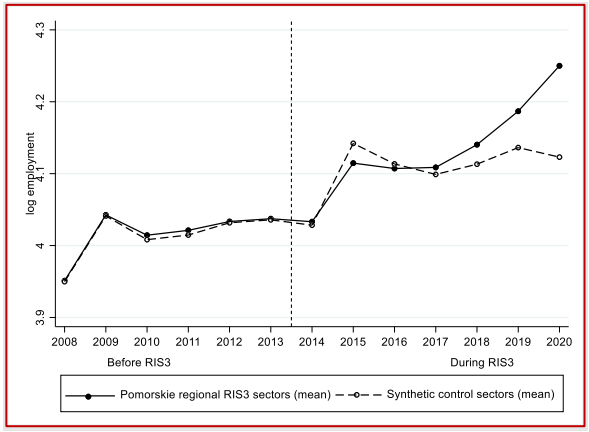
b) Gross Value Added



c) Wages



d) Employment



8. Cost-benefit analysis

Our results suggest that total (regional and national) RIS3 succeeds in increasing GVA, wages, and employment. However, it might come at a cost. We use the treatment effect coefficient to conduct a back-of-the-envelope cost-benefit analysis to compare the costs and benefits from total RIS3. The policy's benefits go to firm owners, but the costs are the actual costs from the RIS3 subsidies. In what follows, we provide all numbers in terms of 2015–20 totals.

We proxy benefits with the increase in GVA in the treated sectors in Pomorskie. We use our treatment effect coefficient for gross value added (β) from the TWFE difference-in-difference specification (Appendix A.4) to calculate the total treatment effect. The total treatment effect equals the difference between the actual total GVA and the counterfactual total GVA between 2015 and 2020. The actual total GVA is the sum of the GVA in treated sectors in Pomorskie, and its counterfactual equals $\frac{Actual\ total\ GVA}{1+\beta}$.

As shown in Table 4, the total impact on GVA from RIS3 equals 3.75 billion EUR. The costs from investing in total RIS3 in Pomorskie equal 0.28 billion EUR. Comparing the costs and the benefits gives us 3.46 billion EUR benefit from RIS3 policy implementation for 2015–20. This is equivalent to 13.2 EUR of additional GVA per one euro investment in total RIS3 policy.

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Table 4: Total benefits from RIS3

	Actual total benefits in 2015-2020 (bill EUR)	Treatment coefficient	Counterfactual total benefits in 2015-2020 (bill EUR)	Total impact in 2015-2020 (bill EUR)	Costs of RIS3 (bill EUR)	Benefits from RIS3 (bill EUR)	Additional GVA per EUR invested
Gross value added	38.78	0.11	35.03	3.75	0.28	3.46	13.18

9. Conclusions

This report has analyzed the impact of Smart Specialization in the Polish region of Pomorskie in the period 2015–20. Since 2014, Smart Specialization has been an ex-ante condition for funding from the European Regional Development Fund, and all EU regions must develop a Research and Innovation Strategy for Smart Specialization (RIS3). Although our analysis is specific to a single region, the findings contribute to the debate on the future of Smart Specialization strategies within the EU. Like many other EU Member States, Poland runs regional and national Smart Specialization programs. Our study explores the impact of both regional and total (regional and national) Smart Specialization in the Polish region of Pomorskie.

We combine administrative databases on SMLEs with information on all approved EU grants for the period of 2008–20. Our analysis draws on data about the performance of firms in terms of labor productivity, GVA, wage expenses, and employment aggregated at the region-sector level.

We combine state-of-the-art counterfactual methodologies to estimate the impact of RIS3 strategies in Pomorskie. Smart Specialization sectors are not randomly chosen for funding. Rather, they offer the best growth prospects in the region. Therefore, RIS3-recipient and nonrecipient sectors differ in observable and unobservable characteristics correlated with the outcomes of interest. We minimize the potential selection bias from this selection mechanism by comparing counterfactuals based on region-sectors not receiving RIS3 funds similar across relevant characteristics (*control* units) to region-sectors receiving Smart Specialization funds (*treated* units)

Results from the estimations indicate that total (regional and national) RIS3 funds positively impacted GVA, wages, and employment but not labor productivity. When comparing 2015–20—the period of RIS3 financing—with 2008–14, firms in RIS3-funded sectors in Pomorskie have GVA up to 16.4 percent higher, wage expenses up to 24.1 percent higher, and full-time employment up to 7.5 percent higher than firms in sectors not financed through RIS3. This indicates that Smart Specialization has not made firms more productive, but it has let them increase their GVA by increasing their number of employees. Our cost-benefit analysis shows that RIS3 policy has brought about 3.4 billion EUR additional GVA in Pomorskie's targeted sectors between 2015 and 2020, or 13.2 EUR of additional GVA for every euro investment in RIS3 funding.

We add two points on the broader picture when interpreting the results. First, we assessed changes in firms' outcomes by comparing the outcomes in the program group to the outcomes in a control group. It is beyond the scope of this study to make a detailed assessment regarding the original intention of

the funding. We assess the results at the firm level and focus on averages across firms, with some benefiting more and others less. Second, there could be three reasons that lead to the observed changes: (a) impact on productivity takes time, (b) the investments could have been for high-commercial support, and (c) the investments could have been in very low TRL—that is, uncertain—projects, and here again specific firm-level changes (such as productivity) could take a long time to realize.

We also examine the performance of the Pomorskie sectors that received regional RIS3 funds (many of which received national RIS3 funds too). The results show that Pomorskie sectors that have received regional RIS3 funds perform better on GVA and employment than firms in sectors that received no RIS3 funding. This difference suggests that *regional* RIS3 may contribute to the significant GVA increase of RIS3-funded companies in Pomorskie. Results from sector-specific SCM estimation indicated that four out of 22 sectors observe a large positive effect of RIS3 policies on GVA and total full-time employment of firms operating in those sectors.[23] Our findings indicate that a *combined effort* of regional and national Smart Specialization programs can boost firms' performance by increasing their employment, which translates into higher GVA in these firms.[24]

Our results also suggest that regional RIS3 *alone* has hardly made a difference. We find no effect from Smart Specialization policies in the three sectors that received exclusively regional RIS3 funds and no national RIS3 funds. However, this should not be interpreted as evidence for the failure of all sorts of regional RIS3 interventions because the Smart Specialization funding received by these sectors is extremely low. Instead, these results indicate that insufficient funds are unlikely to produce immediate impacts. An alternative reason may be that our analysis lacks the statistical power to detect small impacts.

These results should be taken with caution for several reasons. To begin with, they are specific to a single region in Poland, and RIS3 policies may have very different impacts in different contexts. Second, we cannot fully separate regional from national RIS3 funding because very few sectors in Pomorskie receive *exclusively* regional RIS3 funds, and in those cases, the funds are extremely low. It may just as well be that regional RIS3 funds can *independently* affect regional and firm-level outcomes if they are above some "intensive margin" threshold. Third, our observation period (2015–20) corresponds to the beginning of Smart Specialization policies. Funding has grown in the following years and will grow in the coming years, with higher chances of producing a visible and persistent impact. Fourth, data availability issues prevent us from focusing specifically on firms receiving RIS3 funds. We use aggregated outcomes at the region-sector level, such that sectors receiving RIS3 funding comprise both financed and non-financed firms. A firm-specific analysis looking at the performance of firms financed through RIS3 would produce much more credible estimates of the impact of the policy. Fifth, the presence of other funding

[23] The sectors are: (1) Computer programming, consultancy and related activities, (2) Manufacturing of chemical/non-metallic mineral products, (3) Manufacture of fabricated metal products, except machinery and equipment, and (4) Manufacture of wood/products of wood and cork/articles of straw and plaiting materials.
[24] As all of these sectors received both regional and national RIS3 funding, our analysis however does not allow us to unbundle whether the reason for their success is regional RIS3 funds, national RIS3 funds, or the combination thereof.

and its potential interaction with RIS3 funds limit the ability to fully disentangle the impacts of the RIS3 funds alone.

Summarizing, we find that Smart Specialization can foster sectoral growth in GVA, wages, and employment. Yet, it is hard to claim that Smart Specialization has contributed significantly to sectoral efficiency because we only find weak effects on labor productivity in the analyzed period. If these results were confirmed by more advanced estimates adopting individual beneficiaries as units of analysis, exploiting longer periods, and focusing on multi-regional contexts, it would imply that the policy is only partly effective in its goal. A task for future studies would therefore be to determine whether it is the process of sector-targeting, the whole policy concept, or the implementation stage that is responsible for the partial failure of interventions when trying to enhance labor productivity.

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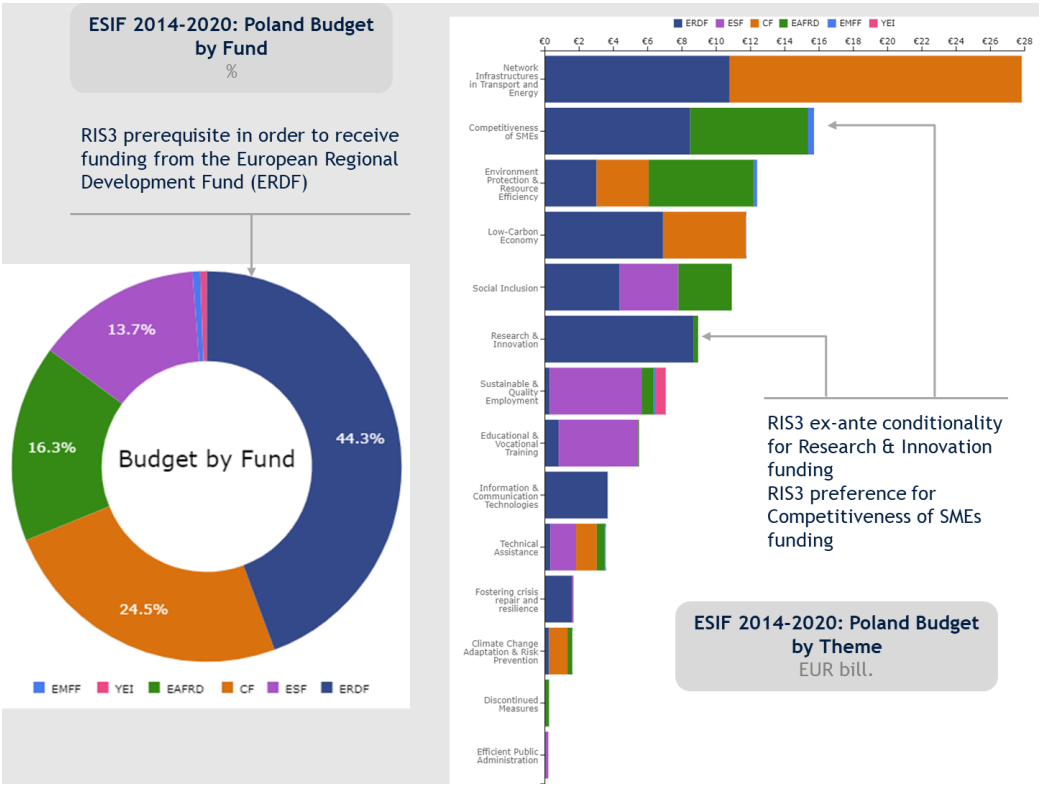
Appendix

A.1 Smart Specialization interventions in Poland

Poland is among the largest beneficiaries of the EU Cohesion Policy. Mazowieckie is the only transition region; the 15 other regions are less developed. This implies that most of the Polish territory has a GDP per capita lower than 75 percent of the EU average. To give a quantitative idea, €77.6 billion of EU Cohesion investments were allocated to Poland for 2014–20. Those funds were mainly dedicated to four investment priorities: building an innovation-friendly environment for businesses, creating modern network infrastructures, enhancing labor market participation, improving education policies, and social inclusion (European Commission 2021).

Because RIS3 is a conditionality of EU Cohesion Policy 2014–2020, European regions must have this innovation strategy in place before obtaining EU investments. Sources of funding for RIS3 are provided mainly under the thematic objectives "Research, Technological Development and Innovation" and, to a lesser extent, "Competitiveness of SMEs" of ERDF (Figure A.1.1). These thematic objectives also received (non-RIS3) funding during the 2007–13 programming period. Because the effect of the 2007–13 funding may take years to materialize, we explicitly account for it when estimating the impact of RIS3 policy during the 2014–20 programming period.

Figure A.1.1: RIS3 funding just a part of total EU funding



Note: European Structural and Investment Funds (ESIF) includes European Social Fund (ESF), European Regional Development Fund (ERDF), European Agricultural Fund for Rural Development (EAFRD), Cohesion Fund (CF), European Maritime and Fisheries Fund (EMFF), and Youth Employment Initiative (YEI).
Source: European Commission 2022.

Basing EU regional innovation policy on RIS3 is very relevant for Poland because it is a "modest innovator" country with huge diversity in regional innovation performance (European Commission 2012). The European Innovation Scoreboard finds that Poland has its main innovation challenges in three main areas. The first is the intensity of small innovation activities: few firms are innovative, and R&D cooperation is only rudimentary. The second is related to framework conditions. The third is the high cost of innovation, which appears to be the main reason that one in four firms do not invest in innovation (World Bank 2019).

In Poland, Smart Specialization policies during 2014–20 were promoted both by regions and by the national government. The Marshal's Office within each region is responsible for designing and implementing regional RIS3 strategies under the supervision of the Managing Authority, namely Poland's Ministry of Funds and Regional Policy. In other words, each of the 16 Polish regions has a separate entity promoting RIS3 implementation. Universities made a considerable effort to create academic incubators, departments supporting businesses, and patent units. However, those efforts may have been unsuccessful because of too few competent experts, a high bureaucracy burden, and weak communication. Besides, the complex relationship between the Marshal's Office and the metropolitan authorities of Poland's largest cities adds more difficulties to the RIS3 implementation. Because major Polish cities are the main locations of leading research capacity and infrastructure, metropolitan authorities might be essential stakeholders in the RIS3 implementation (Miller Mroczkowski, and Healy 2014).

A.2 Smart Specialization interventions in Pomorskie

Pomorskie has identified four main areas of RIS3 intervention that are "most likely to deliver growth and jobs in the region" (Office of the Marshal of the Pomorskie Voivodeship n.d.).

Offshore port and logistic technologies

The objective of this first area of Smart Specialization is to encourage the growth of maritime economy enterprises through investment in R&D. This is to be achieved through creating vehicles and vessels for the marine and coastal environment, elaborating a universal solution for the exploitation of marine resources, providing tools for cleaning and monitoring of the marine environment, developing technologies to use the unique natural compounds produced by marine organisms, and providing tools to improve the efficiency and safety of logistics and transport services in the port and its hinterlands.

Interactive technology in an information-saturated environment

Here, the goal is to help information and communications technology (ICT) enterprises grow through R&D and building intellectual potential for new products and services. More specifically, this area involves implementing multimodal human-machine interfaces; embedding systems for smart spaces; fostering data transmission, data security, and big data processing; and applying space and satellite engineering.

Eco-effective technologies in construction and the generation, transmission, distribution, and consumption of energy and fuels

This area promotes the competitiveness of firms involved in reducing negative environmental impacts. This objective is to be reached through the provision of energy storage, the improvement of energy

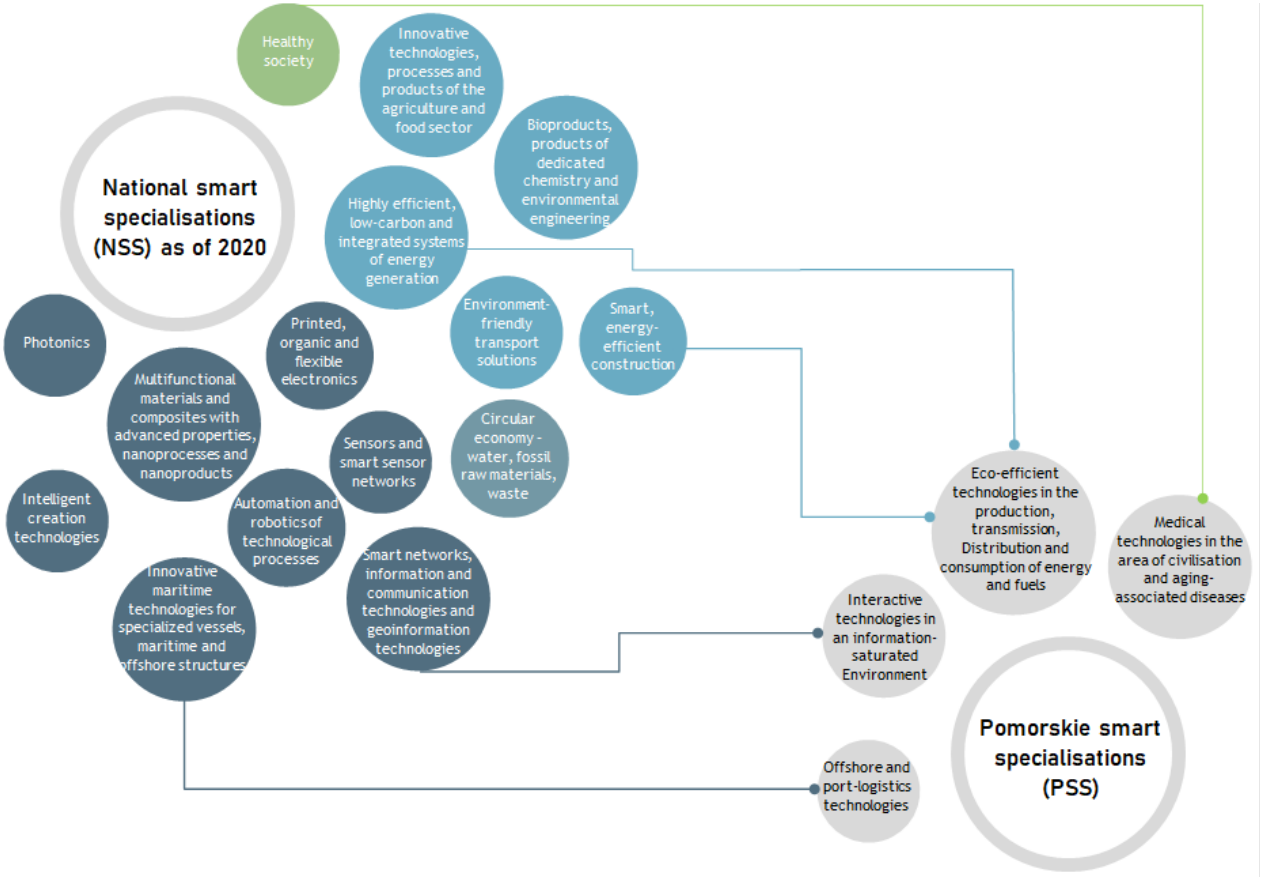
efficiency in sectors such as industry and construction, the renewal of energy sources, the application of "smart grid" technologies in energy distribution, the creation of new ways to extract and process energy resources, and the construction of means of transport with alternative drive.

Medical technologies in civilization and aging-associated diseases

This area focuses on creating an international health competence center that will enhance the attractiveness of companies in the health sector through investments in R&D, competence building, and the development of new products.

Figure A.2.1 illustrates the overlap between national Smart Specialization areas and Pomorskie's Smart Specialization areas.

Figure A.2.1: Mapping national Smart Specializations to Pomorskie's Smart Specializations



Source: World Bank analysis based on information provided by Poland's Ministry of Entrepreneurship and Technology and Marshal's Office of the Pomorskie Voivodeship

A.3 Literature on Smart Specialization in Poland

The empirical evidence on RIS3 is still very limited due to its novelty and relatively recent implementation in the context of the EU Cohesion Policy. In the following, we review the (empirical) evidence on the choice and impact of Smart Specialization strategies.

Gianelle, Guzzo, and Mieszkowski (2019) explore the identification of RIS3 priorities in Italian and Polish regions. They observe that in at least 11 of 39 regions, the innovation areas prioritized in RIS3 strategies do not reflect the expected RIS3 criteria. Far from providing clear targets, policy-makers have identified way too many priorities covering basically all economic areas, contradicting the basic RIS3 principle of selective intervention.

Di Cataldo, Monastiriotis, and Rodríguez-Pose (2022) investigate the distribution and selection of investment priorities across European regions, including Poland, among other countries in their sample. They note that Polish regions have reported a relatively high number of targeted sectors. Of the 16 voivodships in Poland, all but five list strategies with over 30 'scientific domains' (RIS3 targeted scientific sectors), and most of them report over 20 'economic domains' (RIS3 targeted economic sectors). Pomorskie has included 36 scientific domains and 26 economic domains in its RIS3 strategy.

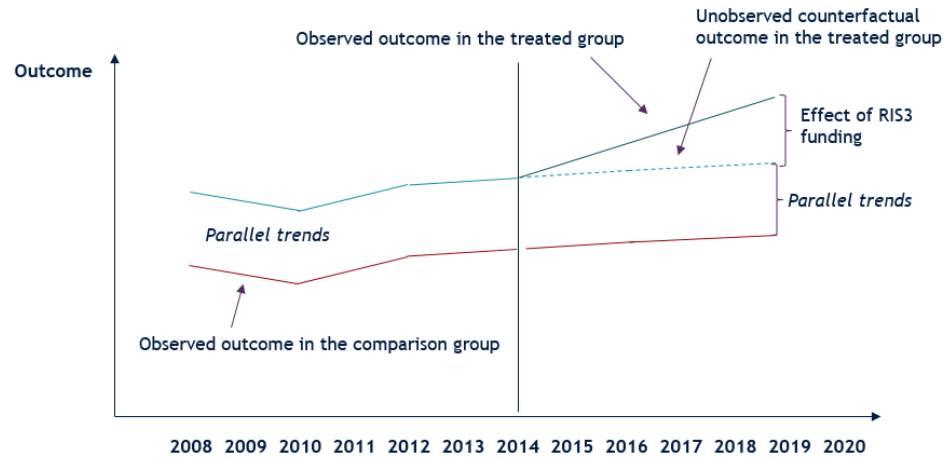
Finally, Miller et al. (2014) focus on the pre-RIS3 period. Examining Poland's innovation strategies before the implementation of RIS3 and assessing the opportunities and challenges of RIS3 for Poland, they claim that most of the Polish regions failed to develop good local innovation systems before 2014. Their findings also point to two critical challenges for RIS3: (1) involving enterprises, researchers, and local governments in 'entrepreneurial discovery' and implementing evaluation and monitoring systems.

A.4 Difference-in-differences and matching

Difference-in-differences (DiD) allows for comparing the changes in outcomes over time between region-sectors that were funded with RIS3 (treated group) to changes in region-sectors that were not funded with RIS3 (control group) but received other EU funding.

This methodology rests on the parallel trends assumption (Figure A.4.1). That is, it assumes that treated and control region-sectors would have followed parallel trajectories after the beginning of the treatment period (2014) *in the absence of RIS3 treatment* (i.e., if RIS3 did not exist). Any estimated difference between the trend in the absence of treatment (observed in the control group) and in the presence of treatment (observed in the treatment group) corresponds to the effect of RIS3 funding.

Figure A.4.1: Difference-in-differences model



Because RIS3 treatment is assigned at the region-sector level, we exploit the within-region-sector variability of RIS3 funding in our identification strategy. We include region-sector fixed effects in the model to make sure that the estimated RIS3 funding effects are not reflecting time-invariant omitted variables that may be correlated with RIS3 funding at the region-sector level (e.g., if one sector had strong lobbying power in a specific region). The region-sector fixed effects imply that we identify the effects of treatment from region-sectoral changes in RIS3 funding over time. We also control for year-specific shocks with year fixed effects. Effectively, we are estimating a two-way-fixed-effects model or difference-in-differences with staggered treatment adoption. The treated units are the sectors of Pomorskie receiving RIS3 funds, and the control units are drawn from the region-sectors receiving no RIS3 funds (more details below).

The empirical specification is as follows:

$$y_{r,s,t} = \beta\ Pomorskie\ RIS3_{r,s,t} + \gamma\ non\ RIS3_{r,s,t} + \delta\ X'_{r,s,t} + \tau_t + \varphi_{r,s} + \varepsilon_{r,s,t}$$

The treatment variable, $Pomorskie\ RIS3_{r,s,t}$, is an indicator equal to one for sectors receiving any RIS3 funding (regional RIS3, national RIS3, or both) and the year being 2015-2020 (i.e., after treatment), otherwise it is zero. In an alternative specification, we estimate the same model replacing the binary treatment variable with the actual amount of RIS3 funding per firm received in sector *s* at time *t*. The standard errors are clustered at the region-sector level.

The difference-in-differences model is estimated in four versions using different control variables and samples. These are:

1) Model with fixed effects (FE) only: sample of sectors receiving any RIS3 funding in Pomorskie and region-sectors receiving no RIS3 funding (inside and outside of Pomorskie); inclusion of year and region-sector fixed effects.
2) Model with FE and non-RIS3 funding control: as in 1) and additionally controlling for non-RIS3 funds ($non\ RIS3_{r,s,t}$) received in each region-sector-year. These funds are the most serious potential time-varying confounder at the region-sector level, because they derive from related yet not identical policies.

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3) **Model with FE, non-RIS3 funding control, and firm controls**: as in 2) and additionally including a set of firm characteristics[25] aggregated at the region-sector-year level which account for evolving enterprise environment in a given region-sector.
4) **Model with FE and non-RIS3 funding control, PSM-matched sample**: as in 2), however, the sample is restricted to those sectors receiving any RIS3 funding in Pomorskie and their matched sectors. This allows us to deal with selection bias by using only those control region-sectors that are most similar to the treated ones based on observable variables.

For the restricted sample in model 4), we employ 1-to-1 propensity score matching (PSM) without replacement to match each targeted RIS3 sector in Pomorskie to a region-sector that did not receive any RIS3 funding. The propensity score is the probability of receiving the treatment, estimated through a logit model as a function of baseline characteristics. Table A.4.1 shows that the region-sectors selected as control units through PSM are not significantly different from the treated ones on several important characteristics.

Table A.4.1: Test of difference in means on pre-treatment characteristics after matching (without replacement)

T-TEST OF DIFFERENCE IN MEANS	MEAN (2008-2013)		
Variable	*Treated*	*Control*	*p>t*
Log labor productivity	4.793	4.773	0.792
Log wages	13.406	13.396	0.950
Log gross value added	14.332	14.31	0.888
Number of firms	60.707	70.155	0.980
Log full-time employees	4.0616	4.059	0.986
Share domestic firms	0.8626	0.8448	0.586
Firms' age	14.395	14.014	0.507
Log revenues	10.038	9.8402	0.368
Δ log labor productivity	0.3414	0.0435	0.582
Δ log wages	0.0016	-0.0008	0.902
Δ log GVA	0.0115	0.0266	0.488
Δ number of firms	-0.3726	1.0466	0.248
Δ log full-time employees	-0.0054	-0.0039	0.923
Δ share domestic firms	-0.0063	-0.0031	0.314
Δ firms' age	0.4008	0.3534	0.591
Δ log revenues	0.0352	0.0291	0.789

Difference-in-differences TWFE model results

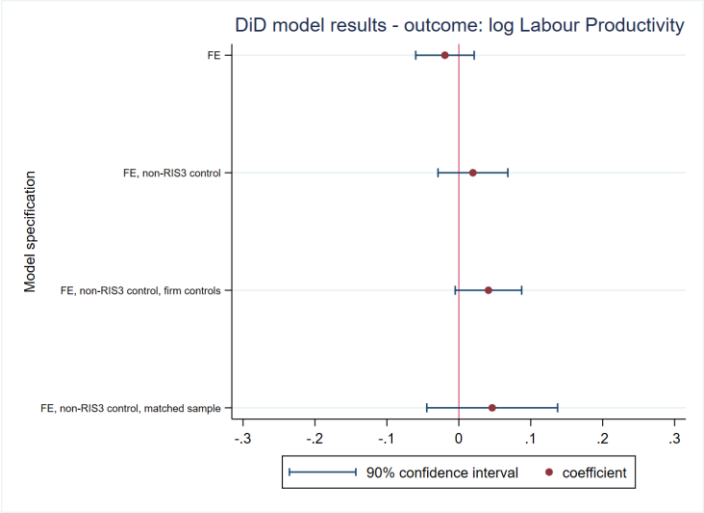
We use the DiD TWFE model to estimate the impact of total RIS3 funding in Pomorskie on labor productivity, GVA, wage expenses, and employment. Figure A.4.2 shows the estimation results. The plot shows point estimates and 90 percent confidence intervals of the RIS3 dummy variable capturing

[25] These include the age of firms, the share of small companies, tangible fixed assets (machinery and equipment), and the share of domestic companies.

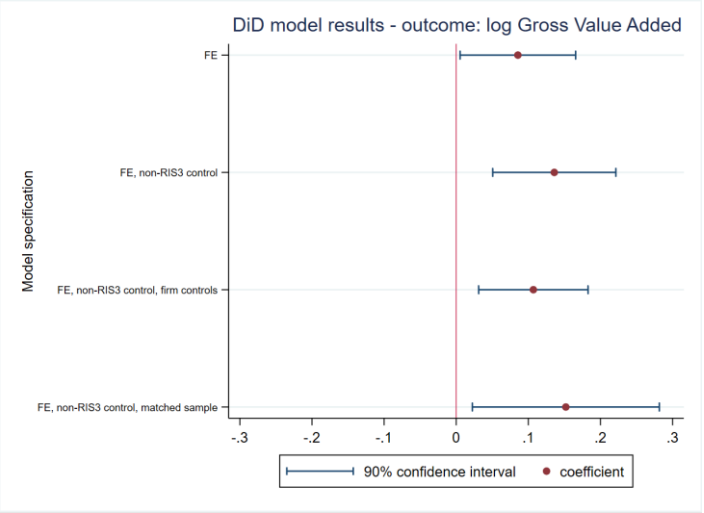
the impact of total RIS3 funds. Appendix A.5, Table A.8 reports point estimates, standard errors, observations, and R-squared for all estimates.

Figure A.4.2: Difference-in-differences estimation results

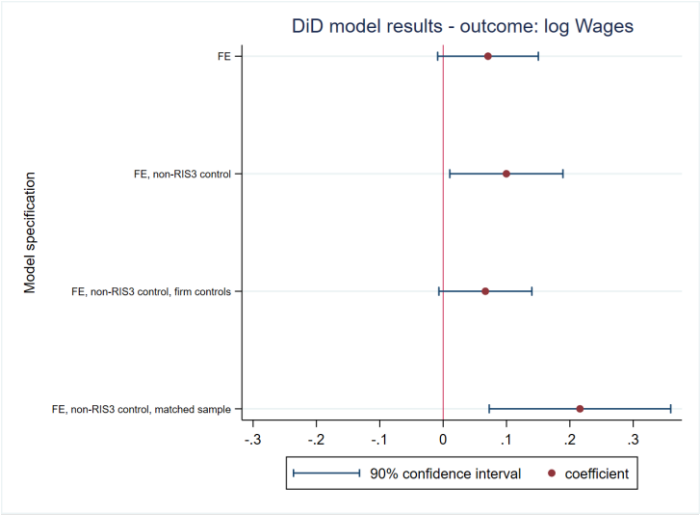
(a) Labor productivity



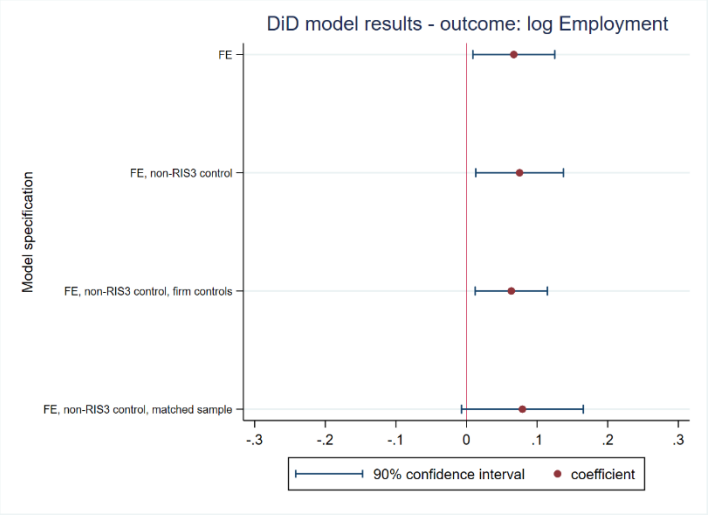
(b) Gross value added



(c) Wages



(d) Employment



Impact on labor productivity: statistically insignificant (Figure A.4.2, Panel a). In all four DiD specifications, the treatment dummy variable is statistically insignificant. This implies that, if we compare the 2015–20 and 2008–14 periods, Pomorskie sectors receiving RIS3 funds performed in the same way as those not receiving RIS3 funds.

Impact on GVA: positive and significant (Figure A.4.2, Panel b). In all four specifications, the treatment dummy variable is positive and statistically significant, implying that if we compare the 2015–20 period with the 2008–14 period, Pomorskie sectors receiving RIS3 funds have performed better than those not receiving RIS3 funds. The GVA of firms operating in sectors receiving RIS3 funds is, on average,

16.4 percent higher[26] in the post-treatment period than that of firms in sectors not receiving any RIS3 financial support.

Impact on wages: positive, statistically significant in some specifications (Figure A.4.2, Panel c). The treatment dummy variable is always positive and statistically significant in two specifications. The wage bill of firms operating in sectors receiving RIS3 funds is, on average, 24.1 percent higher than that of firms in sectors not receiving any RIS3 financial support.

Impact on employment: positive, statistically significant in some specifications (Figure A.4.2, Panel d). The treatment dummy variable is always positive. It is statistically significant in three specifications and insignificant at the margin in the fourth one (*p*-value: 0.135). During the RIS3 funding period relative to the pre-funding period, the number of full-time employees in firms in sectors receiving RIS3 funds was up to 7.5 percent higher than in firms in sectors not receiving any RIS3 financial support.

Table A.9 in Appendix A.5 reports alternative specifications with the amount of RIS3 funds received per firm in region-sector-year instead of a treatment dummy. The findings obtained with a DiD TWFE model are broadly confirmed.

[26] From a pre-treatment average of EUR 2,533,606.

A.5 Appendix tables and figures

Table A.1 - Smart Specialization at the national level in Poland

Fields	National Smart Specializations
Healthy society	1. Medical engineering technologies, including medical biotechnologies 2. Diagnosis and treatment of civilization diseases and personalized medicine 3. Production of medicinal products
Agri-food, forestry-timber and environmental bioeconomy	4. Innovative technologies, processes and products of the agri-food and forestry-timber industry 5. Healthy food (high quality and organic production) 6. Biotechnological processes and products of household chemistry and environmental engineering
Sustainable energy	7. High efficiency, low-emission and integrated energy production, storage, transmission and distribution systems 8. Smart and energy efficient construction 9. Environmentally friendly transport solutions
Natural resources and waste management	10. Modern technologies for sourcing, processing and use of natural resources and production of substitutes thereof 11. Minimizing waste, including waste unfit for processing and use of waste for material and energy purposes (recycling and other recovery methods) 12. Innovative technologies for processing and recovery of water and reducing its consumption
Innovative technologies and industrial processes	13. Multifunctional materials and composites with advanced properties, including nanoprocesses and nano-products 14. Sensors (including biosensors) and smart sensor networks 15. Smart grids and geo-information technologies 16. Electronic based on conducting polymers 17. Automation and robotics of technological processes 18. Optoelectronic systems and materials

Source: Department of Innovation, Ministry of Entrepreneurship and Technology, https://smart.gov.pl/images/pdf/Krajowa-inteligentna-specjalizacja_eng.pdf

Table A.2 – Combinations of NACE3 sectors in Statistics Poland data

Non-aggregated sectors - NACE3	NACE 2	NACE 1	Aggregated sectors - multiple NACE3	NACE3	NACE2	NACE 1
107	10	C	New1	11-17,21-24,31-32	01-03	A
141	14	C	New2	51-52,61-62,71-72,81,89,91,99	05-09	B
251	25	C	New3	101-104	10	C
256	25	C	New4	105-106	10	C
293	29	C	New5	108-109	10	C
310	31	C	New6	110,120,131-133	11-13	C
331	33	C	New7	139,142-143	14	C
332	33	C	New8	151-152	15	C
421	42	F	New9	161-162	16	C
432	43	F	New10	171-172	17	C
451	45	G	New11	181-182	18	C
452	45	G	New12	191-192, 211-212,221-222	19,21	C
461	46	G	New13	201-203	20,23	C
462	46	G	New14	204-206, 236-239	20	C
463	46	G	New15	241-245	24	C
464	46	G	New16	252-257	25	C
467	46	G	New17	259,261	26	C
469	46	G	New18	262-268	26	C
471	47	G	New19	271-273	27	C
472	47	G	New20	274-274,279	27	C
473	47	G	New21	281-282	28	C
475	47	G	New22	283-284,289-292,301-304,309	28-30	C
477	47	G	New23	321-325,329	32	C
479	47	G	New24	351-353	35	D
494	49	H	New25	360,370, 390	36-37,39	E
620	62	J	New26	381-383	38	E
683	68	L	New27	411-412	41	F
861	86	Q	New28	422,429	42	F
			New29	431,433,439	43	F
			New30	453,454	45	G
			New31	465-466	46	G
			New32	474,476,478	47	G
			New33	491-493, 495,501-504, 511-512	49-51, 53	H
			New34	521-522	52	H
			New35	531-532	55	I
			New36	561-563	56	I
			New37	581-582,591-592,601-602,611-613,619,631,639	57-61,63	J
			New38	641-643,649,651,661-663	64-66	K
			New39	681-682	68	K
			New40	691-692	69	M
			New41	701-702	70	M
			New42	711-712	71	M
			New43	721-722, 731-732,741-743,749-750	72-75	M
			New44	771-773	77,79	N
			New45	781-783	78	N
			New46	801-803	80	N
			New47	811-813	81	N
			New48	821-823,829	82	N
			New49	841-842	84	O
			New50	851-852	85	P
			New51	853-856	85	P
			New52	862,869	86	Q
			New53	871-873,879,881,889	87-88	Q
			New54	900,910,920,931-932	90-93	R
			New55	941,949,951-952	94-96	S
			New56	982,990	98-99	T

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Table A.3 – list of variables measured at region-sector-year level (2008-2020)

Variable	Obs	Mean	Std. Dev.
Total RIS3 funding (million euros)	17472	0.354	1.64
regional RIS3 funding (million euros)	17472	0.097	0.55
National RIS3 funding (million euros)	17472	0.257	1.39
Non-RIS3 funding (million euros)	11739	3.9	27.32
Total RIS3 funding per firm	15980	0.0090	0.05
regional RIS3 funding per firm	15980	0.0027	0.02
National RIS3 funding per firm	15980	0.0063	0.04
Non-RIS3 funding per firm	11399	0.0704	0.26
Total RIS3 funding per full-time employee	16492	117	601.07
regional RIS3 funding per full-time employee	16492	44	332.39
National RIS3 funding per full-time employee	16492	73	440.69
Non-RIS3 funding per full-time employee	11399	0.070	0.26
Total RIS3 funding dummy	17472	0.20	0.40
regional RIS3 funding dummy	17472	0.14	0.34
National RIS3 funding dummy	17472	0.16	0.36
Revenues	15980	56000000	150000000
Number of firms	15980	60	70.45
Number of Full-time employees	16492	4124	8347.72
Wages, mean	16019	863893	1400000
Transport equipment, mean	15742	1281	7463.7
Machinery and equipment, mean	15202	7811	23555.2
Livestock, mean	14564	1	19.73
Land, mean	14488	825	1848.8
Tools and Instruments, mean	14784	763	1901.1
Civil engineering works, mean	11450	1179	7066.9
Buildings, mean	15264	5229	9478.2
Revenues, mean	15980	35059	69835.6
Sales, mean	15454	23666	50881.5
Gross profit, mean	12329	2018	5612.57
Net profit, mean	12059	1745	4866.65
Net profit/Revenues, mean	11480	0.035	0.02
Gross profit/Revenues, mean	11998	0.039	0.03
Labor productivity, log, mean	16433	129	61.21
GVA (output - internal consumption), mean	15989	2100000	3700000
Small firm: employers >= 10 and employers < 50, share	16300	0.7	0.16
Small firm: employers >= 10 and employers < 50, sum	16300	43	52.98
Private domestic, share	16387	0.81	0.17
Private domestic, sum	16387	49	59.33

Source: World Bank elaboration based on EU beneficiaries data and Statistics Poland calculations.

Table A.4 – summary statistics for the treated and controls groups, pre-treatment (2008–13)

T-test of difference in means	*Mean (2008-2013)*		*t-test*	
Variable	Treated	Control	t	p>t
Log labor productivity	4.796	4.591	-3.35	0.001
Log wages	13.43	12.707	-4.4	0.000
Log GVA	14.332	13.735	-4.75	0.000
Number of firms	69.707	36.157	-4.55	0.000
Log full-time employees	4.076	3.715	-3.05	0.003
Share domestic firms	0.862	0.947	5.6	0.000
Firms' age	14.428	13.620	-1.3	0.203
Log revenues	10.039	9.157	-4.8	0.000
Δ log labor productivity	0.035	0.016	-1.1	0.269
Δ log wages	0.01	-0.030	-1.45	0.145
Δ log GVA	0.011	-0,022	-1.9	0.059
Δ number of firms	-0.372	0.524	1.65	0.098
Δ log full-time employees	-0.006	-0.015	-0.6	0.552
Δ share domestic firms	-0.007	-0,003	1.6	0.113
Δ firms' age	0.394	0.501	1.	0.239
Δ log revenues	0.036	0.013	0.21	0.253

Table A.5 - Synthetic control donor pool

Region	*Sectors*										
Dolnoslaskie	479	New27	New28	New29	New45	New52	New55	New8			
Kujawsko-Pomorskie	463	477	New19	New23	New45	New55	New6	New8			
Lodzkie	432	New28	New41	New45	New55	New8	New9				
Lubelskie	New20	New37	New45	New55							
Lubuskie	107	293	331	463	464	467	477	479	New13	New16	New19
	New20	New24	New28	New29	New3	New31	New37	New42	New45	New55	New8
Malopolskie	New55										
Mazowieckie	New8										
Opolskie	107	331	432	463	477	New16	New17	New18	New24	New28	New29
	New3	New37	New41	New55	New6	New8					
Podkarpackie	New45	New6	New8								
Podlaskie	331	New20	New24	New41	New43	New45	New55	New6	New8		
Slaskie	463	New8									
Swietokrzyskie	107	463	464	New18	New19	New20	New23	New24	New31	New45	New52
	New6	New8									
Warminsko-Mazurskie	293	New18	New23	New24	New37	New41	New45	New55	New6	New8	
Wielkopolskie	New45	New55	New8								
Zachodniopomorskie	293	432	477	479	New16	New18	New20	New24	New29	New41	New42

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Table A.6 – Predictor variables, synthetic control method 1

Treatment: Total RIS3 funds

Outcome: Labor productivity	Treated	Synthetic
Log Labor productivity (2008)	4.75	4.75
Log Labor productivity (2009)	4.61	4.60
Log Labor productivity (2010)	4.77	4.77
Log Labor productivity (2011)	4.84	4.83
Log Labor productivity (2012)	4.89	4.88
Log Labor productivity (2014)	4.98	4.98
Log GVA (2008-2014)	14.35	14.34
Log Wages (2008-2014)	13.44	13.30
Log Employment (2008-2014)	4.07	4.07
Log revenues (2008-2014)	10.05	10.20
Log tangible fixed assets (2008-2014)	6.30	6.25
Age of firms (2008-2014)	14.60	14.28
Share domestic firms (2008-2014)	0.86	0.87
Share of small firms (2008-2014)	0.64	0.65
Log non-RIS3 funds per firm (2008-2020)	6.88	6.85

Outcome: GVA	Treated	Synthetic
Log GVA (2008)	14.35	14.35
Log GVA (2009)	14.25	14.25
Log GVA (2010)	14.32	14.31
Log GVA (2011)	14.35	14.36
Log GVA (2013)	14.40	14.40
Log GVA (2014)	14.45	14.45
Log Wages (2008-2014)	13.44	13.39
Log Labor productivity (2008-2014)	4.82	4.79
Log Employment (2008-2014)	4.07	4.07
Log revenues (2008-2014)	10.05	10.05
Log tangible fixed assets (2008-2014)	6.30	6.29
Age of firms (2008-2014)	14.60	14.37
Share domestic firms (2008-2014)	0.86	0.92
Share of small firms (2008-2014)	0.64	0.65
Log non-RIS3 funds per firm (2008-2020)	6.88	6.99

Outcome: Employment	Treated	Synthetic
Log Employment (2008)	4.08	4.07
Log Employment (2009)	4.13	4.13
Log Employment (2010)	4.07	4.06
Log Employment (2011)	4.07	4.07
Log Employment (2012)	4.06	4.06
Log Employment (2013)	4.05	4.04
Log Employment (2014)	4.05	4.06
Log GVA (2008-2014)	14.35	14.10
Log Labor productivity (2008-2014)	4.82	4.61
Log Wages (2008-2014)	13.44	13.12
Log revenues (2008-2014)	10.05	9.65
Log tangible fixed assets (2008-2014)	6.30	5.84
Age of firms (2008-2014)	14.60	13.21
Share domestic firms (2008-2014)	0.86	0.85
Share of small firms (2008-2014)	0.64	0.64
Log non-RIS3 funds per firm (2008-2020)	6.88	4.85

Outcome: Wages	Treated	Synthetic
Log Wages (2008)	13.46	13.46
Log Wages (2009)	13.40	13.40
Log Wages (2010)	13.42	13.42
Log Wages (2011)	13.44	13.44
Log Wages (2013)	13.46	13.46
Log Wages (2012-2014)	13.45	13.45
Log GVA (2008-2014)	14.35	14.35
Log Labor productivity (2008-2014)	4.82	4.69
Log Employment (2008-2014)	4.07	4.08
Log revenues (2008-2014)	10.05	10.03
Log tangible fixed assets (2008-2014)	6.30	6.29
Age of firms (2008-2014)	14.60	14.53
Share domestic firms (2008-2014)	0.86	0.88
Share of small firms (2008-2014)	0.64	0.62
Log non-RIS3 funds per firm (2008-2020)	6.88	7.42

Table A.7 - Predictor variables, synthetic control method 1

Treatment: Regional RIS3 funds

Outcome: Labor productivity	Treated	Synthetic
Log Labor productivity (2008)	4.71	4.70
Log Labor productivity (2009)	4.55	4.54
Log Labor productivity (2010)	4.73	4.72
Log Labor productivity (2011)	4.83	4.82
Log Labor productivity (2012)	4.84	4.83
Log Labor productivity (2014)	4.96	4.95
Log Labor productivity (2008-2014)	4.79	4.78
Log GVA (2008-2014)	14.42	14.02
Log Wages (2008-2014)	13.58	12.91
Log full-time employees (2008-2014)	4.16	3.79
Log revenues (2008-2014)	10.16	9.66
Log tangible fixed assets (2008-2014)	6.18	5.80
Age of firms (2008-2014)	14.84	13.75
Share domestic firms (2008-2014)	0.83	0.90
Share of small firms (2008-2014)	0.63	0.69
Log non-RIS3 funds per firm (2008-2020)	7.81	5.11

Outcome: GVA	Treated	Synthetic
Log GVA (2008)	14.39	14.38
Log GVA (2009)	14.28	14.27
Log GVA (2010)	14.42	14.40
Log GVA (2011)	14.44	14.43
Log GVA (2014)	14.55	14.53
Log GVA (2011-2014)	14.46	14.44
Log Wages (2008-2014)	13.58	13.52
Log Labor productivity (2008-2014)	4.79	4.74
Log full-time employees (2008-2014)	4.16	4.15
Log revenues (2008-2014)	10.16	10.16
Log tangible fixed assets (2008-2014)	6.18	6.17
Age of firms (2008-2014)	14.84	14.52
Share domestic firms (2008-2014)	0.83	0.91
Share of small firms (2008-2014)	0.63	0.63
Log non-RIS3 funds per firm (2008-2020)	7.81	7.84

Outcome: Wages	Treated	Synthetic
Log Wages (2008)	13.57	13.57
Log Wages (2009)	13.47	13.47
Log Wages (2010)	13.61	13.61
Log Wages (2011)	13.54	13.53
Log Wages (2012)	13.62	13.62
Log Wages (2014)	13.68	13.67
Log Wages (2010-2014)	13.61	13.60
Log GVA (2008-2014)	14.42	14.54
Log Labor productivity (2008-2014)	4.79	4.58
Log full-time employees (2008-2014)	4.16	4.47
Log revenues (2008-2014)	10.16	10.11
Log tangible fixed assets (2008-2014)	6.18	5.98
Age of firms (2008-2014)	14.84	13.06
Share domestic firms (2008-2014)	0.83	0.76
Share of small firms (2008-2014)	0.63	0.54
Log non-RIS3 funds per firm (2008-2020)	7.81	5.17

Outcome: Employment	Treated	Synthetic
Log Employment (2008)	4.17	4.17
Log Employment (2009)	4.21	4.22
Log Employment (2010)	4.18	4.18
Log Employment (2011)	4.17	4.17
Log Employment (2013)	4.12	4.12
Log Employment (2014)	4.14	4.14
Log Employment (2010-2014)	4.14	4.15
Log GVA (2008-2014)	14.42	14.21
Log Labor productivity (2008-2014)	4.79	4.63
Log Wages (2008-2014)	13.58	13.26
Log revenues (2008-2014)	10.16	9.86
Log tangible fixed assets (2008-2014)	6.18	5.94
Age of firms (2008-2014)	14.84	13.44
Share domestic firms (2008-2014)	0.83	0.82
Share of small firms (2008-2014)	0.63	0.62
Log non-RIS3 funds per firm (2008-2020)	7.81	4.80

Table A.8 – TWFE Difference-in-differences estimates: RIS3 dummy as treatment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Labor productivity				*GVA*			
RIS3 funds dummy	-0.0193	0.0196	0.0412	0.0464	0.0855*	0.136***	0.107**	0.152*
	(0.0247)	(0.0295)	(0.0281)	(0.0553)	(0.0487)	(0.0519)	(0.0461)	(0.0788)
Region-sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Non-RIS3 funds control		Yes	Yes	Yes		Yes	Yes	Yes
Firm characteristics controls			Yes				Yes	
Matched sample				Yes				Yes
Observations	6,726	4,448	4,159	853	6,586	4,362	4,123	850
R-squared	0.686	0.716	0.721	0.751	0.877	0.902	0.919	0.904

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Wages				*Employment*			
RIS3 funds dummy	0.0708	0.0998*	0.0667	0.216**	0.0670*	0.0752**	0.0635**	0.0792
	(0.0482)	(0.0543)	(0.0446)	(0.0871)	(0.0353)	(0.0378)	(0.0311)	(0.0524)
Region-sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Non-RIS3 funds control		Yes	Yes	Yes		Yes	Yes	Yes
Firm characteristics controls			Yes				Yes	
Matched sample				Yes				Yes
Observations	6,514	4,343	4,095	855	6,491	4,362	4,123	850
R-squared	0.898	0.927	0.945	0.913	0.878	0.902	0.919	0.903

*Clustered standard errors at region-sector level in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Table A.9 – TWFE estimates: Log RIS3 funds per firm as treatment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Labor productivity				*GVA*			
Log RIS3 funds per firm	-0.00163	0.00146	0.00313	0.00184	0.00770	0.0118**	0.00718	0.00910
	(0.00274)	(0.00300)	(0.00312)	(0.00399)	(0.00477)	(0.00514)	(0.00503)	(0.00631)
Region-sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Non-RIS3 funds control		Yes	Yes	Yes		Yes	Yes	Yes
Firm characteristics controls			Yes				Yes	
Matched sample				Yes				Yes
Observations	6,583	4,448	4,159	853	6,491	4,362	4,123	850
R-squared	0.685	0.716	0.721	0.751	0.878	0.902	0.919	0.903

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Wages				*Employment*			
Log RIS3 funds per firm	0.00872**	0.00832*	0.00310	0.0135**	0.00751**	0.00682**	0.00435	0.00508
	(0.00407)	(0.00446)	(0.00405)	(0.00643)	(0.00293)	(0.00304)	(0.00272)	(0.00388)
Region-sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Non-RIS3 funds control		Yes	Yes	Yes		Yes	Yes	Yes
Firm characteristics controls			Yes				Yes	
Matched sample				Yes				Yes
Observations	6,440	4,343	4,095	855	6,491	4,362	4,123	850
R-squared	0.900	0.927	0.945	0.912	0.878	0.902	0.919	0.903

*Clustered standard errors at region-sector level in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Table A.10 – Synthetic control method 1: RMSPE and donor region-sectors

Treatment	*Outcome*	*RMSPE*	*Nr of non-zero weights (region-sectors)*
Total RIS3			
	Labor productivity	2.64e-12	73
	GVA	0.03377	14
	Wages	0.00190	12
	Employment	2.71e-12	73
Regional RIS3			
	Labor productivity	2.25e-11	73
	GVA	0.01787	14
	Wages	1.81e-09	73
	Employment	1.84e-11	72

Table A.11 - Sectoral characteristics comparison, by statistical significance

Statistically significant	*No*	*Yes*
GVA per worker p.a.	28404.7	26512.3
Revenues per worker p.a.	127351.7	79600.2
Capital per worker p.a.	52574.0	24721.9
Wages per worker p.a.	10445.8	12255.8
Export share p.a.	0.33	0.46
Foreign-owned share p.a.	0.10	0.16
Regional RIS3 funding per worker p.a.	130.2	129.1

Note: Firm characteristics averaged over the pre-treatment period (2008–13), regional RIS3 funding per worker averaged over the funding period (2016–20). p.a. = per annum (per year).

Funded by the European Union

Figure A.1 – total and regional RIS3 sectors funding per firm in Polish regions

a. *b.*

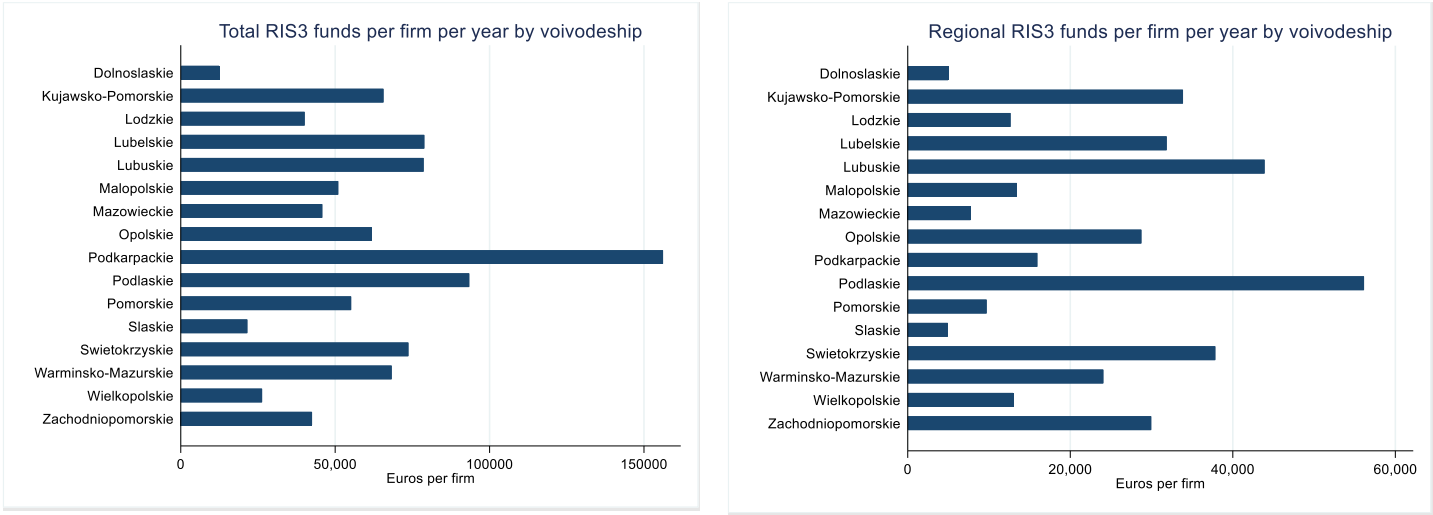
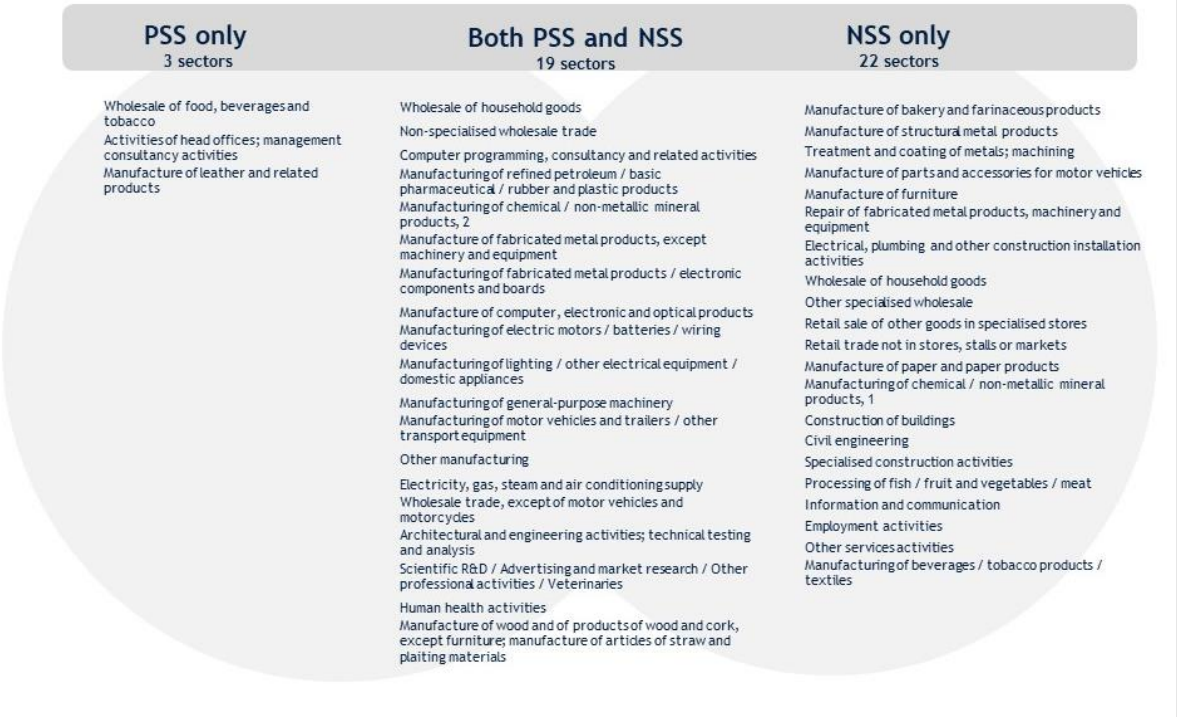


Figure A.2: Multiple sectors overlap in terms of RIS3 Funding. PSS stands for Pomorskie Smart Specialization areas, whereas NSS -- for national Smart Specialization areas.



Source: World Bank elaboration based on information provided by Poland's Ministry of Funds and Regional Policy and Marshal's Office of Pomorskie

Figure A.3: RIS3 funds are relatively small compared to other funding types

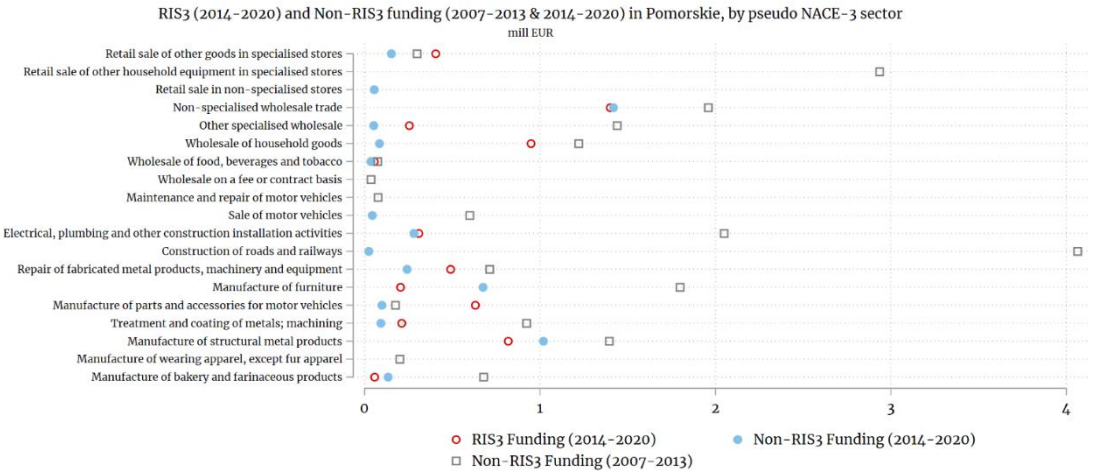
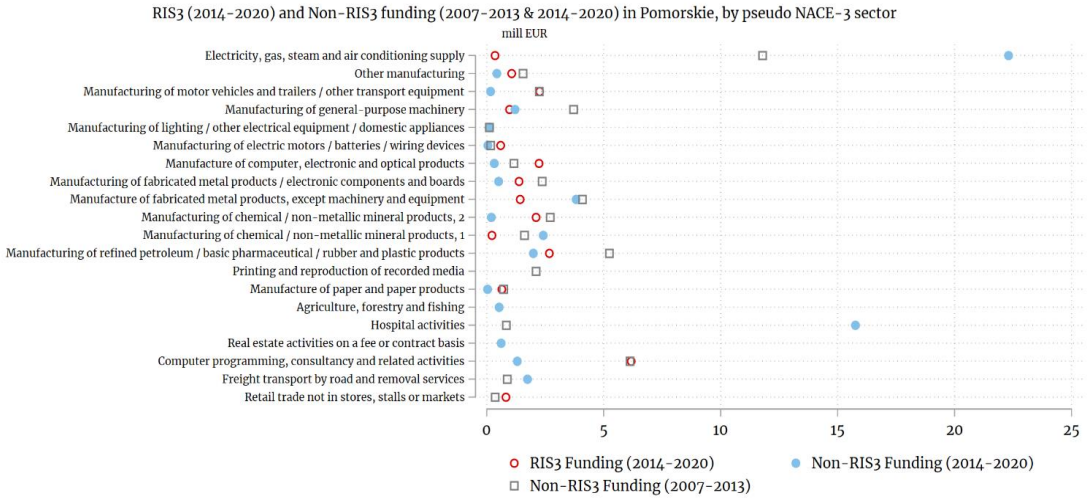


Figure continued from above



Source: World Bank calculations based on EU beneficiaries data

Figure continued from above

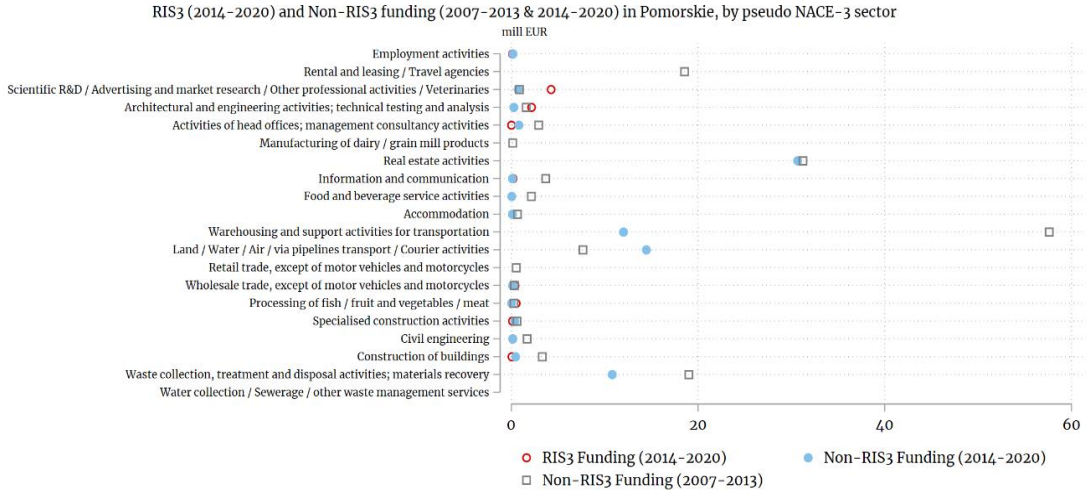
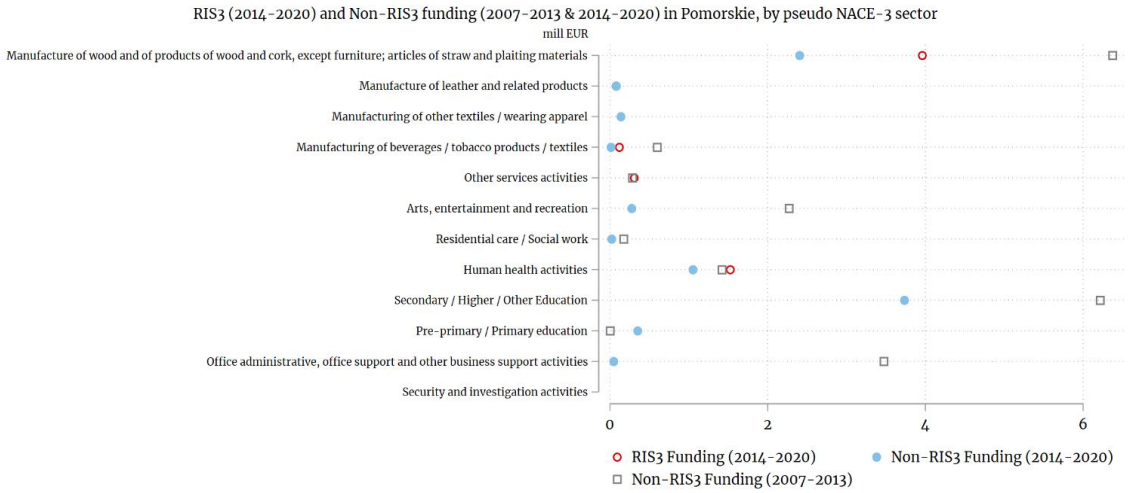


Figure continued from above



Source: World Bank calculations based on EU beneficiaries data

Figure A.4: Funding by type (regional vs. national, RIS3 vs. Other funding), over 2014-2020. Sectors ordered by amount of regional RIS3 received

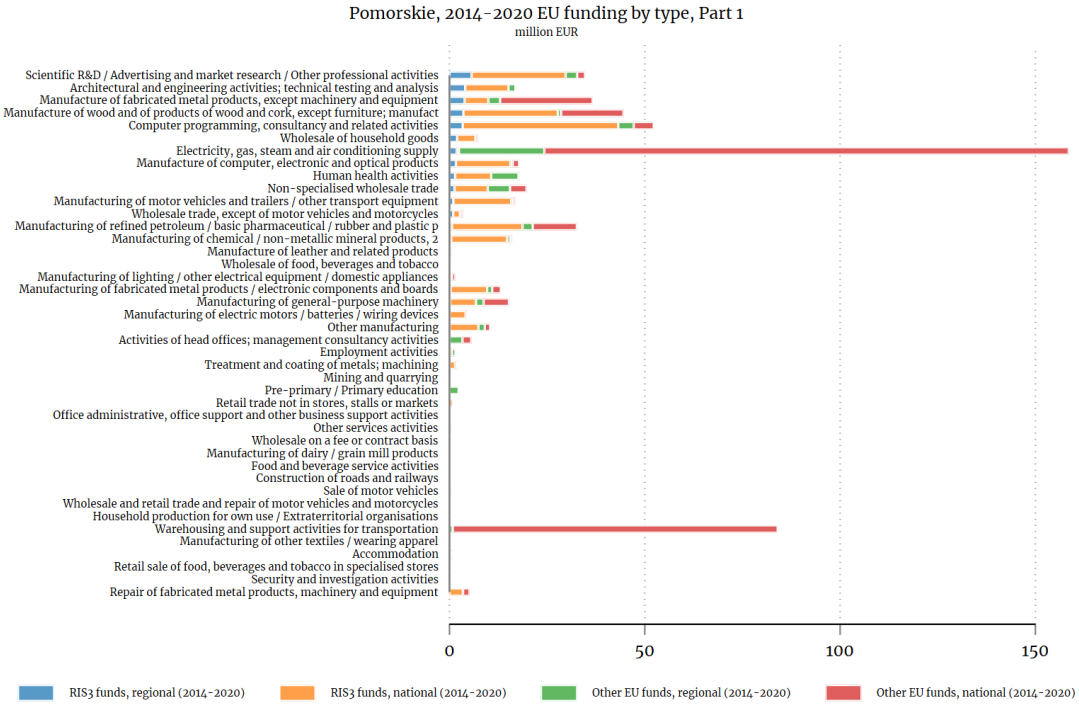


Figure continued from above

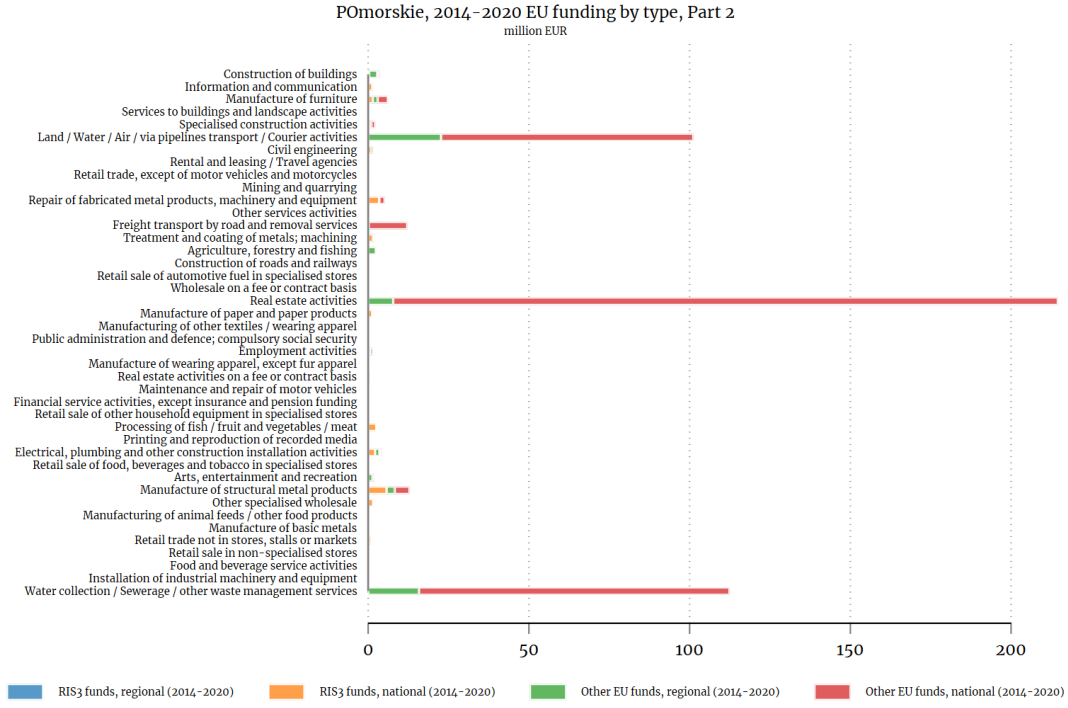
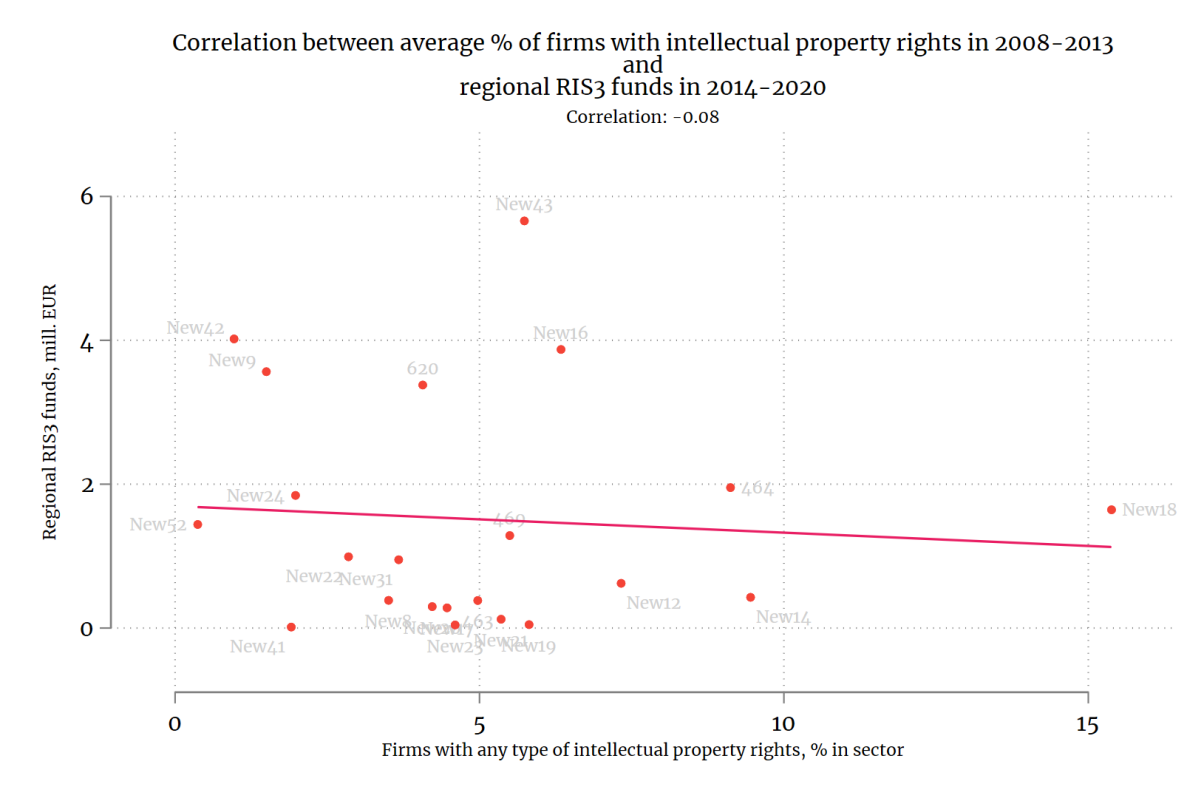


Figure A.5: Relationship between sector-level innovation intensity and disbursement of regional RIS funding in Pomorskie



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