European Commission

JRC TECHNICAL REPORT

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JRC Working Papers on Territorial Modelling and Analysis No 05/2022

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2022

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EU Science Hub
https://ec.europa.eu/jrc

JRC128607

Seville: European Commission, 2022

How to cite this report: Gianelle, C., Guzzo, F., Barbero, J., and Salotti, S. (2022). The economic implications of Smart Specialisation governance: a general equilibrium analysis for Italy 2014-2020. JRC Working Papers on Territorial Modelling and Analysis No. 05/2022, European Commission, Seville, JRC128607.

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The economic implications of Smart Specialisation governance: a general equilibrium analysis for Italy 2014-2020

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Abstract. This paper provides insights on the potential macroeconomic impact of the European innovation policy for Smart Specialisation governance. We use original empirical data on the governance of the policy, funded through a dedicated financial envelope of the 2014-2020 EU cohesion policy, in a spatial macroeconomic modelling framework capable of gauging the general equilibrium effects of varying degrees of governance quality. Our contribution aims at narrowing the gap between the abstraction of ex-ante impact assessment exercises based on macroeconomic simulations and the reality of how policy interventions may take place. By using data for all Italian NUTS 2 regions, we find that the measured quality of Smart Specialisation governance could increase the pure investment-related impact of the policy by 23 to almost 40 percent. At the same time, we estimate that further potential GDP gains – in the order of an additional 40-50 percent over what was achieved with current levels of governance – would not materialize because of the comparatively low quality of governance in some regions.

Keywords: Governance, Smart Specialisation, General equilibrium modelling.

JEL Codes: C68, E61, O32.

Executive summary

The ex-ante policy impact assessment literature mostly ignores the quality of governance dimension, which cannot be taken for granted. Governance is a fundamental enabling condition for policy effectiveness, and not taking it into account deprives policy impact evaluations of explanatory power and, ultimately, of value as tools to guide policy action in practice. The policy governance, and more generally the institutional context in which policies are conceived and implemented, acts as a mediating factor in the relationship between ends and means, i.e. in the policy intervention logic, and should be made instrumental to impact assessments.

In this paper, we offer insights on the potential macroeconomic impact of the European innovation policy for Smart Specialisation governance. We use original empirical data on the governance of the policy, funded through a dedicated financial envelope of the 2014-2020 EU cohesion policy, in a spatial macroeconomic modelling framework capable of gauging the general equilibrium effects of varying degrees of governance quality. Our original methodological contribution, based on data for all the NUTS 2 Italian regions, narrows the gap between the abstraction of ex-ante impact assessment exercises based on macroeconomic simulations and the reality of how policy interventions may take place.

We firstly show that the regional quality of Smart Specialisation governance is not related to the amount of cohesion policy of funds received by the regions, nor to the more generic European Quality of Government Index based on citizens’ perceptions. The general equilibrium modelling framework is then used to simulate the impact of the €2.31 billion of cohesion policy funds whose disbursement were related to the implementation of regional innovation strategies for Smart Specialisation. The results suggest that the way in which the Smart Specialisation policy is implemented in the Italian regions could generate between €1.02 and €1.64 billion of GDP over twenty years, depending on the quality of governance in the regions, in addition to the €4.41 billion of pure investment-related effects. At the same time, between €2.17 billion and €2.79 billion of potential GDP gains over twenty years would not materialize due to the comparatively low quality of governance of the policy in some regions.

Our results highlight the potentially huge effects the quality of governance may have on policy outcomes, and call for improvements in the way in which standard macroeconomic policy assessments are carried out, since it appears that the assumption of perfect implementation of the policy may often be unrealistic. The results also suggest that the margins for increasing the impact of innovation policy by means of improving governance quality are substantial. This calls for increasing the quality of innovation policy governance in the least-performing regions.

1. Introduction

Effective policy design and implementation depend on the quality of institutions, which in turn is reflected in governance arrangements (Rodríguez-Pose, 2020). Yet, the ex-ante policy impact assessment literature mostly ignores the quality of governance dimension.

The quality of governance, and more specifically the capacity to design and implement policy interventions according to envisaged timeframes and budget allocations to achieve the expected results, cannot be taken for granted. Governance is a fundamental enabling condition for policy effectiveness (Meuleman, 2015), and not taking it into account deprives policy impact evaluations of explanatory power and, ultimately, of value as tools to guide policy action in practice.

Governance, and more generally the institutional context in which policies are conceived and implemented, acts as a mediating factor in the relationship between ends and means, i.e. in the policy intervention logic, and should be made instrumental to impact assessments. The reality of the implementation phase ought not to be ignored as it is often done in ex-ante impact assessments (Coenen et al., 2012, Christensen et al., 2019).

In the context of the European regional innovation policy called Smart Specialisation[1], evidence shows that often seemingly well-designed policies were not implemented as expected (Gianelle et al., 2020). The reasons behind this include unclear attribution of responsibilities and lack of political support in the implementation phase, ineffective inter-government coordination, weak interaction with (and engagement of) relevant stakeholders, and lack of adequate skills and resources in public administrations and other partners (Capello and Kroll, 2016; Guzzo et al., 2018; Guzzo and Peiranez-Forte, 2019; Guzzo and Gianelle, 2021; Marques and Morgan, 2018).

In this paper, we offer insights on the potential macroeconomic impact of the European innovation policy for Smart Specialisation governance. More specifically, we use original empirical data on the governance of the policy, funded through a dedicated financial envelope of the 2014-2020 EU cohesion policy (European Union, 2013; Barbero et al., 2021), in a spatial macroeconomic modelling framework capable of gauging the general equilibrium effects of varying degrees of governance quality. This framework integrates a notion of the observed quality of policy processes, concerning in particular the strategy design and the early implementation phases.

Our original methodological contribution narrows the gap between the abstraction of traditional ex-ante impact assessment exercises based on macroeconomic simulations and the often bumpy reality of how policy interventions may take place. The objective is twofold. On the one hand, we

[1] Smart Specialisation strengthens the place-based nature of cohesion policy and its goal is for regions to build competitive advantages in high value added activities (Balland et al., 2019; De Noni et al., 2021). The JRC has experience in supporting Smart Specialisation, for instance by managing the S3 Platform.

respond to a real and pressing need in the context of multi-annual, complex policy programmes, that is to provide the policy makers with well-timed impact scenarios that take into account the actual factors influencing the success of the policy. On the other hand, we address a fundamental shortcoming of most policy impact assessment approaches based on ex-ante simulations, i.e. the assumption that the policy will have a good design and actually be implemented in the expected manner and timeframe, which is an arbitrary assumption and one that is quite often disproved in the facts and therefore liable to invalidate the results (Tosun, 2014).

Smart Specialisation is an "ambitious experiment" (Kuznetsov and Sabel, 2017, p. 52) of a policy approach implemented on a continental scale in accordance with a set of common rules and principles, the application of which is guaranteed by the development of specific strategies. The existence of these strategies was a legally binding requirement (*ex-ante* conditionality) for accessing cohesion policy funds for research and innovation in the 2014-2020 period (European Union, 2013). There is an interest in evaluating this programming period which is coming to an end, and just prior to the launch of the programmes of the next period.

Smart Specialisation represents an ideal case study for the purposes of our research, as the implementation of its defining principles depends crucially on governance structures and processes. In particular, the following governance-related characteristics are all relevant: the ability to carry out selective interventions functional to strategic priorities and pursue them over time (Gianelle et al., 2020); the effective management of a broad stakeholder participation in the definition of those priorities through a search and discovery process (Foray, 2015; Radosevic and Stancova, 2018); and the operationalization of a monitoring system that ensures a continuous feedback of information in the process of policy implementation (Marinelli et al., 2019).

In this paper, we combine two different methods of analysis by using survey data on the nature and quality of Smart Specialisation governance in a spatial general equilibrium model. In particular, we construct a synthetic indicator of the quality of Smart Specialisation governance using the responses to a survey targeted at regional and national administrations responsible for the Smart Specialisation strategies, with data for all the NUTS 2 regions of Italy. We then use the indicator as an input in a spatial dynamic general equilibrium model (based on Lecca et al., 2020, and Barbero et al., 2021) to simulate scenarios quantifying the economic consequences of various levels of governance quality. To the best of our knowledge, there is no available study yet incorporating the quality of governance of Smart Specialisation into policy impact assessments.

The paper is organised as follows. Section 2 presents the conceptual underpinnings of this study. Section 3 introduces the Smart Specialisation governance index we constructed and the survey data on which it is based. Section 4 presents the modelling framework, and Section 5 contains the quantitative results of the analysis. Section 6 concludes.

2. Theoretical background

Policy success and failure depends on many different interrelated components. Some of these elements are internal to the policy context and generally refer to the policy objectives and paradigm, and its underlying logic, formulation and implementation. Others are exogenous to the policy and relate to the wider political and governance setting in which the policy is implemented (Peters 2015).

Policy failure occurs in situations either where good policy designs are not implemented properly; or where, even in the presence of a rigorous design and good execution, expected results are not achieved, due to flaws in the policy paradigm (Howlett et al. 2015). Policies can also have an effect opposite to that intended. Failures also occur when unattainable agendas and goals are set, or when policymakers fail to effectively evaluate policy processes and results and/or fail to learn from present and past policy interventions (Howlett et al. 2015; Hudson, et al. 2019).

The wider context in which the policy takes place also matters for the latter's failure or success. The best policy designs will not lead to the expected results if the governance capacity is not conducive to success (Peters, 2015). Implementation is highly dependent on the political and institutional context, and in particular on the administrative and coordination capacity of bureaucracies, the mechanisms enabling participation and policy learning and the policy capacity of relevant actors. The capacity to engage and negotiate agreements with partners, and to coordinate within and across government organisations, along with arrangements to promote multi-level and multi-actor policy making, are as crucial as the capacity to translate the contents of strategy documents into effective implementation procedures, instruments and results (Hudson et al. 2019; May, 2015; Peters 2018; Wu et al. 2015).

Accordingly, a better assessment of the overall quality of governance can lead to better estimates of the policy effects which could be reasonably expected, compared to the current state of play based on policies assumed to realise their full potential.

The assessment of the likely socio-economic impacts of public policies and reforms is an important component of the policy cycle in the European Union, and it also attracts the attention of academics and scholars. The so-called ex-ante impact assessments are carried out before the implementation of the policy and are usually based on the assumption that the latter will be implemented smoothly and will realise its full potential socio-economic impact (Petrov et al., 2017).

These assessments are seen as necessary in order to guide strategic policy choices over multi-annual horizons, but at the same time they are based on often unrealistic assumptions about the realization of the policy. For example, a number of economic models are routinely used for the assessment of European policies, with recent examples including the dynamic stochastic general equilibrium model QUEST used to evaluate the potential impact of the Resilience and Recovery Facility in the EU (Pfeiffer et al., 2021), and the regional computable general equilibrium RHOMOLO used to study the impact and spillovers of cohesion policy (Crucitti et al., 2022; Monfort and Salotti, 2021).

In this paper, we relax the standard assumption of the aforementioned impact assessments of perfect policy design and implementation strategies. Thus, we compare the potential impact of the policy assuming that the funds are used to the best of their potential with the impact which is more reasonable to expect given the actual quality of Smart Specialisation governance arrangements experienced by the regions emerging from the survey data at our disposal.

Governance structures and processes are the result of existing formal institutional settings (like the distribution of roles and responsibilities between different government levels), the bureaucratic organisation, administrative traditions and capacity, historical public-private interactions, shared norms and values, and the existence of informal networks and participatory processes. These elements are context-specific, so the resulting governance arrangements tend to vary across countries and territories. Given these differences, it is neither possible nor advisable to define in detail a unique model of Smart Specialisation governance, and innovation policy more in general, that could be universally applied to every region or country (Guzzo and Gianelle, 2021). Nonetheless, it is possible to identify two complementary institutional pillars, which are inherent constituents of the Smart Specialisation approach and have general validity across different territories. These two pillars refer respectively to the management component and the inclusiveness dimension of the policy.

Smart Specialisation is a strategic process of medium to long term territorial development through investment in research and innovation activities that takes place in a highly volatile environment, characterized by fundamental uncertainty. In such a world, the theory of change underlying policy action cannot be assumed deterministic, but rather needs be tested empirically and updated based on emerging evidence (Gianelle and Kleibrink, 2016). Therefore, Smart Specialisation implies an experimental and cyclical approach to policy making. After initially setting goals and deciding how to achieve them, new information is generated - captured and codified by monitoring and measurement mechanisms - that need to be used to assess the validity of the previously formulated theory of change, and possibly to updated it.

This requires the integrated management of the policy cycle: from the definition of the intervention logic, spelling out the constituent elements of the end-means nexus, to the implementation of actual measures on the ground, including their assessment and feedback through monitoring and evaluation. In turn, this entails, as a first institutional pillar, the designation of a management authority responsible for overseeing the strategy and that can guarantees coordination within and across public administrations and agencies, and ensures commitment to the strategic rationale and focus throughout the multi-annual financial horizon and across electoral cycles (Radosevic, 2018).

The management authority should have the necessary autonomy along with organisational and analytical capacities to turn the "on paper" strategy into actual interventions. It should also have the capacity and authority to coordinate the action of the multiple actors, administrative entities and government levels involved in the strategy, often at different spatial scales.

As a second pillar, the Smart Specialisation governance requires establishing rules, mechanisms and practices for guaranteeing the inclusion and actual participation of research and innovation actors and the private sector in general in the policy process (Foray, 2015).

Smart Specialisation invokes "setting priorities" (Foray, 2015, p. 6) that is selective intervention focused on particular economic activities, rather than horizontal and spreading across the whole economy and society.

Smart Specialisation is grounded on the Hayekian idea that knowledge about new activities can only be produced by local actors engaged in a (costly) process of discovery (Kuznetsov and Sabel, 2017). Translated into the policy jargon, this means that the identification of policy intervention areas shall result from an interactive process between policy-makers and the private sector, the so-called *entrepreneurial discovery process*, which allows exploration and evaluation of emerging opportunities in terms of socio-economic needs, potential benefits, and risks (Foray, 2015; Foray and Goenaga, 2013).

It is therefore fundamental that the relevant stakeholders (higher education and research organisations, businesses, and the civil society) are involved in the decisions regarding the development and deployment of the strategy, being positively engaged throughout the policy cycle and adequately represented in the formal governance structure. Effective stakeholder participation would also improve the accountability of the public administration responsible for the Smart Specialisation strategy, having always in mind that the right mix of administrative autonomy and accountability ought to be carefully designed according to the characteristics of the political and institutional context and the existing administrative capacities (Guzzo and Gianelle, 2021).

Finally, a crucial enabling factor for both effective strategy management and stakeholder involvement is the presence of adequate skills and resources. This is important for the public administration, in order to design and implement policy measures aligned with the aims of the strategy and able to outreach to the relevant innovation actors, and to monitor policy development and delivery in order to timely steer interventions towards expectations and more in general to support policy learning. Likewise, the stakeholder groups potentially involved in the strategy process should possess the capacities required to guarantee effective contribution to policy processes and long-term commitment to the strategy.

3. Measuring Smart Specialisation governance

3.1 The dimensions of Smart Specialisation governance

Our first goal is to build a single, empirically-grounded measure of the quality of Smart Specialisation governance to be used in numerical simulations of policy scenarios. To this aim, we followed the characterization proposed in the previous section and assessed each of the pillars of Smart Specialisation governance according to a series of elements which can be used empirically. For each of the selected element, we collected primary information through a policy maker's survey targeted at the authorities responsible for the Smart Specialisation strategies in different EU territories (Guzzo et al., 2018).[2]

We define as the *management* pillar the governance dimension concerned with strategy management along the following six dimensions: (i) existence and effectiveness of a body responsible for setting and revising strategic objectives and priorities (definition and update of the logic of intervention); (ii) existence and effectiveness of a body responsible for the development or deployment of policy instruments (implementation); (iii) existence and effectiveness of a body responsible for coordinating the different governance functions and actors; (iv) adequacy of funding for staff recruitment and training; (v) adequacy of the competences in the area of project planning and implementation; (vi) adequacy of the competences in the area of monitoring.

We define as the *inclusiveness* pillar the governance dimension concerned with stakeholder involvement and participation using the following six elements: (i) level of stakeholder contribution to the analysis of the national/regional context and potential for innovation; (ii) level of representation of the business, research and education sectors in the governance system as a whole; (iii) presence of both business and research sector representatives in the group responsible for strategic management; (iv) commitment of the relevant institutional stakeholders in establishing the strategy management team; (v) adequacy of stakeholder engagement overall; (vi) adequacy of skills and capabilities in stakeholder groups. Table 1 summarises the composition of the two Smart Specialisation governance pillars, and the exact survey questions on which this categorization is based can be found in the Annex.

Table 1. Composition of the two pillars of Smart Specialisation governance

Governance pillars	**Elements for assessment**
Management	- Setting and revising strategic objectives and priorities - Developing and deploying policy instruments - Coordinating governance functions and actors Adequacy of competences and resources for: - Staff recruitment and training - Project planning and implementation - Monitoring

[2] The survey questions and the response encoding schemes for each element included in the governance pillars are reported in the Annex.

Inclusiveness	- Contribution of stakeholders to the analysis of the national/regional context and potential for innovation - Representation of the business sector and public research and education organisations in the governance system as a whole - Presence of both business and research sector representatives in the group responsible for strategic management - Commitment of the relevant institutional stakeholders in establishing the strategy management team Adequacy of: - Stakeholder engagement in general - Skills and capabilities in stakeholder groups

3.2 The survey data

In 2018, the European Commission took a first systematic stock of the state of play of the Smart Specialisation policy experience. This exercise was mainly supported by the results of a survey collecting primary information on the development of Smart Specialisation strategies in European regions and countries (Guzzo et al., 2018; Marinelli et al., 2019). The objective of the survey was twofold: identifying areas where the adoption of Smart Specialisation triggered relevant improvement in policy-making practice, as well as understanding emerging critical issues and challenges throughout the policy cycle, and drawing lessons and recommendations to feed the debate on the post-2020 cohesion policy.

The survey was sent to the regional and national contact points for Smart Specialisation. More than 70 valid responses were received, out of more than 120 existing strategies. In the vast majority of cases, the respondents were part of the Smart Specialisation management teams in their respective administrations. In order to avoid self-reporting bias and attain a more complete and accurate representation of the Smart Specialisation experience, the survey was designed for gathering responses collectively agreed upon among the relevant actors and bodies involved in the strategy governance. To this end, the guidelines sent to recipients explicitly recommended consulting and coordinating the response of different bodies, stakeholder groups, and individuals and ultimately returning a single survey for each territory. Respondent anonymity was ensured throughout the data collection and analysis process. The survey used multiple-choice questions, mostly aimed at gathering factual information (e.g. regarding the existence and operational status of a body with specific functions, or the presence of some specific barriers to policy development), in order to further limit respondent bias inherent in the survey data.

It should be noted that, while this study was primarily exploratory and aimed to set a precedent in the combined analysis of policy impact simulation and evidence on governance quality, it was part of an open-ended research agenda to develop more precise and objective measures of governance that are based on different sources of information and therefore are less prone to potential bias of the sort that surveys entail.

The survey has the indisputable advantage of providing data on the quality of governance which are specific to the policy under scrutiny here, compared with the use of more general survey and indicators, such as, for example, the European Quality of Government Index (Charron, 2021).[3]

The survey provided full geographical coverage for Italy at the regional level (21 NUTS2 territorial entities). Given the importance of Italy as recipient of cohesion policy funds, the spread of its regions along the development scale, and the availability of the complete territorial information, we selected it as the case study for our analysis of Smart Specialisation governance and its potential macroeconomic effects.

3.3 The Quality of Smart Specialisation Governance indicator

We introduce here the *Quality of Smart Specialisation Governance* (*QS3GOV*) index constructed as a composite indicator that aggregates into a single numerical value the survey results corresponding to the elements and pillars defined in Table 1, where each element is represented by a dichotomic variable (assuming 0/1 values). The two-pillar structure of Smart Specialisation governance allows to experiment with different hypotheses on the aggregation rule when computing the overall indicator of governance quality.

A simple version of the indicator can be constructed by aggregating the scores of all twelve elements comprised in the two pillars by means of a simple, unweighted arithmetic mean. We denote it as $QS3GOV_1$:

$$QS3GOV_1 = \sum_p \sum_i x_{pi}$$

p denotes the two pillars, *i* denotes the individual elements that are assessed through the survey, and x_{pi} is a dichotomic variable encoding each specific element. As a result, the $QS3GOV_1$ index can assume integer values in the interval [0, 12]. This purely additive version of the index assumes perfect substitutability between any of the twelve dimensions comprised in the indicator. This means that elements comprised in the two pillars can compensate each other, and therefore a low score obtained for instance on a management characteristic, can be offset by a high score obtained on an inclusiveness characteristic, and vice versa. In other words, $QS3GOV_1$ disregards the bipartite structure of Smart Specialisation governance we described above and the complementary nature of the management and inclusiveness pillars as well as the need for their simultaneous effectiveness.

[3] The Quality of Government Survey items are based on a broad, multi-dimensional concept of quality of government consisting of high impartiality and quality of public service delivery, along with low corruption. The survey relies on European citizens' perceptions and experiences with corruption, and the extent to which they rate their public services as impartial and of good quality in the area in which they reside (Charron, 2021).

The objective of $QS3GOV_1$ is not to provide a measurement of governance quality that is the closest possible to our theoretical framework, but rather to provide a relatively low order approximation against which to compare the simulation results of a superior measure that we denote $QS3GOV_2$, where we assume only partial compensability between the two pillars (i.e. lower scores in one of the two cannot be fully offset by higher scores in the other). The $QS3GOV_2$ index is constructed in two steps. First, we aggregate the scores of each dimension within a pillar by means of a simple, unweighted arithmetic mean; then, we calculate the product of the scores of the two pillars to obtain the final index that can assume integer values in the interval [0, 36]:

$$QS3GOV_2 = \sum_i x_{p=1,i} \sum_i x_{p=2,i}$$

Notably, when using $QS3GOV_2$, high overall scores can only be achieved if a high score is obtained in both pillars, management and inclusiveness, whereas a low score in one pillar would result in a low overall score, no matter how high the score is in the other pillar. In the extreme case of a null value in one pillar, the entire index would take the value zero. This version of the indicator thus incorporates the idea of complementarity between the two pillars of Smart Specialization governance: both good management and proper stakeholder inclusion are necessary conditions, but neither one of them alone is sufficient for good Smart Specialization governance.

This indicator is closer to the theoretical framework we introduced earlier, but it is also more demanding and restrictive with regard to good governance, since single positive elements are no longer sufficient to guarantee a good score: it is necessary that all the elements constituting the specific framework of Smart Specialisation governance are effectively implemented at the same time.

Due to the confidentiality of the survey responses, we cannot show the exact regional distribution of the *QS3GOV* indicators we constructed using the survey responses as explained above. We can, however, describe them in aggregate terms. From an empirical perspective, the quality of governance indicators resulting from the Italian data used in this paper do not seem to be a mere reflection of the overall degree of development of the regions, and there does not seem to be a trivial correlation with the amount of EU funds received by the regions. The Pearson correlation between the indicators and regional GDP per head in 2014 expressed in PPS is significant but moderate, at 0.28 for $QS3GOV_1$ and 0.33 for $QS3GOV_2$. This points to the fact that the overall level of development of the regional socio-economic system and its institutions may not be a crucial factor explaining the quality of the Smart Specialisation governance. The correlation between the EU funds allocations and the quality of governance indicators is even lower and not statistically significant at standard levels, at −0.11 for $QS3GOV_1$ and −0.09 for $QS3GOV_2$, revealing that the amount of funds available may contribute only to a minor extent to the observed variation in the governance quality of Smart Specialisation strategies.

The correlation with the European Quality of Government Index mentioned above (Charron et al., 2019; Charron, 2021) is 0.06 for $QS3GOV_1$ and 0.15 for $QS3GOV_2$, and neither is statistically significant. This absence of correlation reinforces the importance of using data on the quality of governance specific to the policy under scrutiny, rather than a broad multi-dimensional measure based on European citizens' perceptions about corruption and public services. Overall, we believe the *QS3GOV* indicators introduced here add valuable information to our understanding of how the policy processes unfold in the real world.

4. Quantifying the economic impact of governance

In this section, we take a well-established model used routinely to assess the impact of EU policies, and we employ the information extracted from the survey above to design simulations capable of quantifying the economic consequences of varying quality of innovation policy governance.

4.1 The general equilibrium model

We use a spatial dynamic general equilibrium model calibrated with data for all the NUTS 2 regions of the EU which is routinely used for the impact assessment of EU policies such as, among others, cohesion policy (Crucitti et al., 2022; Di Comite et al., 2018), research and innovation policies (Christensen, 2018), and labour market ones (Sakkas, 2018). The full mathematical representation of the model can be found in Lecca et al. (2018, 2020), and we report here the details of the features which are directly related to the scenario constructed to analyse the effect of Smart Specialisation governance, namely the production function and private investments.

Smart Specialisation strategies focus on regional research and innovation policies, therefore the investments related to them are modelled using the following transmission mechanisms concerning private investments and capital stock accumulation. Additionally, and this is a crucial point of the analysis, there may be supply-side effects materialising through increased total factor productivity (TFP). The key hypothesis on which we are going to construct the scenarios for the analysis is that the existence of these TFP effects depends on the governance of the policy.

In each sector j, and region r, total production $Z_{r,j}$ is a constant elasticity of substitution (CES) combination of the value added $Y_{r,j}$ and intermediate inputs $V_{r,j}$:

$$Z_{r,j} = Ax_{r,j}\left[\delta^{x}_{r,j} \cdot V_{r,j}^{\rho_j^x} + \left(1-\delta^{X}_{r,j}\right) \cdot Y_{r,j}^{\rho_j^x}\right]^{\frac{1}{\rho_j^x}} \qquad (1)$$

where $\delta^x_{r,j}$ is the share of intermediate inputs in sector *j* for region *r* in total production. $Ax_{r,j}$ is a scale parameter, and ρ^x_j is the elasticity parameter obtained from the elasticity of substitution σ^x, according to $\rho^x_j = \frac{\sigma^x - 1}{\sigma^x}$.

$Y_{r,j}$ is defined in equation (2):

$$Y_{r,j} = Ay_{r,j}\left[\left(K^d_{(g)}\right)^{\xi}\left[\delta^Y_{r,j}\cdot KD^{\rho^y_j}_{r,j} + \left(1-\delta^y_{r,j}\right)\cdot LD^{\rho^y_j}_{r,j}\right]^{\frac{1}{\rho^y_j}}\right] - FC_{r,j} \qquad (2)$$

$Y_{r,j}$, is obtained combining private capital $KD_{r,j}$ and employment $LD_{r,j}$ in a CES function, net of fixed costs $FC_{r,j}$. The scale parameter $Ay_{r,j}$ represents the conventional Hicks neutral technical change (TFP) parameter in this production function (in which the elasticity of substitution between capital and labour is set at 0.4).

As for investments, the optimal path of private investments I^P is consistent with the neoclassical firm's profit maximisation theory and defined as in Uzawa (1969):

$$I^P_{i,r} = \delta_r K^P_{i,r}\left(\frac{rk_{i,r}}{uck_r}\right)^v \qquad (3)$$

v is the accelerator parameter and δ is the depreciation rate. Thus, the investment capital ratio ($\varphi = I^P_r/K^P_r$) is a function of the rate of return to capital (rk) and the user cost of capital (uck), allowing the capital stock to reach its desired level in a smooth fashion over time, where: $\frac{\partial\varphi}{\partial rk} > 0$; $\frac{\partial\varphi}{\partial uck} < 0$.

The user cost of capital, *uck*, is derived from Hall and Jorgenson (1967) as a no arbitrage condition, where:

$$uck_r = (r + \delta_r)p^I_{EU} + \Delta p^I_{EU} + rp_r \qquad (4)$$

r, δ_r, p^I_{EU} and rp_r denote the interest rate, the depreciation rate, the EU investment price index, and an exogenous risk premium respectively. Δp^I_{EU} is the change of the investment price index defined between two subsequent periods.

Combining equations (4) and (2), the desired level of capital $K^*_{j,r}$ is as follows:

$$K^*_{j,r} = N_{r,j}\left(\left(\left(K^d_{(g)}\right)^{\xi} Ay_{r,j}\right)^{\rho^y_j}\cdot\delta^y_{r,j}\cdot\frac{uck_{r,j}}{Py_{r,j}}\right)^{\frac{1}{1-\rho^y_j}}\cdot Y_{r,j} \qquad (5)$$

The gap between the desired level of capital and the actual level of capital determines the expected profit in the economy and drives investment in a given period (governed by the differences between *uck* and *rk*).

The interest rate and the depreciation rate are fixed and equal for all regions (4% and 15%, respectively), while the risk premium is a region-specific fixed calibrated parameter. Thus, changes in uck are only driven by changes in the cost of capital in the whole EU, p^I_{EU}. This is given as the price index over the Armington price weighted by the capital matrix KM:

$$p_{EU}^{I} = \frac{\sum_{i,j,r} KM_{i,j,r} P_{r,i}}{\sum_{i,j,r} KM_{i,j,r} \overline{P}_{r,i}} \tag{6}$$

As in equation (3), the allocation of investments between regions is driven by the differences between regional and EU average returns, thus resulting in capital flow mobility between regions. In the long-run, the capital returns will be the same in all regions.

The private capital stock in each region evolves due to new investments, adjusted by depreciation:

$$\Delta K_{j,r}^{P} = I_{j,r}^{P} - -\delta_r K_{j,r}^{P} \tag{7}$$

The demand for investments $I_{j,r}^{P}$ in sector j is translated to the production of investment goods produced by sectors i, $I_{j,r}^{S}$, through the capital matrixes $KM_{i,j,r}$ as follows: $I_{i,r}^{S} = \sum_j KM_{i,j,r} I_{j,r}^{P}$

4.2 Modelling strategy

We simulate the impact of the European Regional Development Fund (ERDF) resources devoted to the Thematic Objective (TO) 1 "Strengthening research, technological development and innovation" of the 2014-2020 European cohesion policy. Those financial resources can only be accessed by regional authorities in the presence of a Smart Specialisation strategy and must be devoted to the strategy's implementation, therefore we take them as the basis for the construction of a scenario investigating how the quality of Smart Specialisation governance affects the economic impact of these investments in Italian regions.

We retrieved financial figures from the official data platform of the European Commission giving access to updated information on financing and achievements under the European Structural and Investment Funds in 2014-2020.[4] We focused on the resources allocated to the ERDF-TO1 at the beginning of the financial cycle; the first year for which the ERDF regional Operational Programmes (i.e. the main strategic documents defining the use of European funds) are available for all 21 Italian regions was 2016, hence we took it as reference year. In the analysis we only consider the investment which is financed directly through the EU budget, which for the ERDF-TO1 of Italian regions was almost €2.31 billion. Those resources are entirely devoted to the priorities and interventions provided by the Smart Specialisation strategies through investment in six main fields: (i) enterprise R&I projects including environmental-transition (30.5% of total investment); (ii) public and private R&I infrastructure (11.2%); (iii) R&I projects in public and private research centers (13%); (iv) technological transfer and university-SME cooperation (16.4%); (v) advanced services and support to business development (12%),

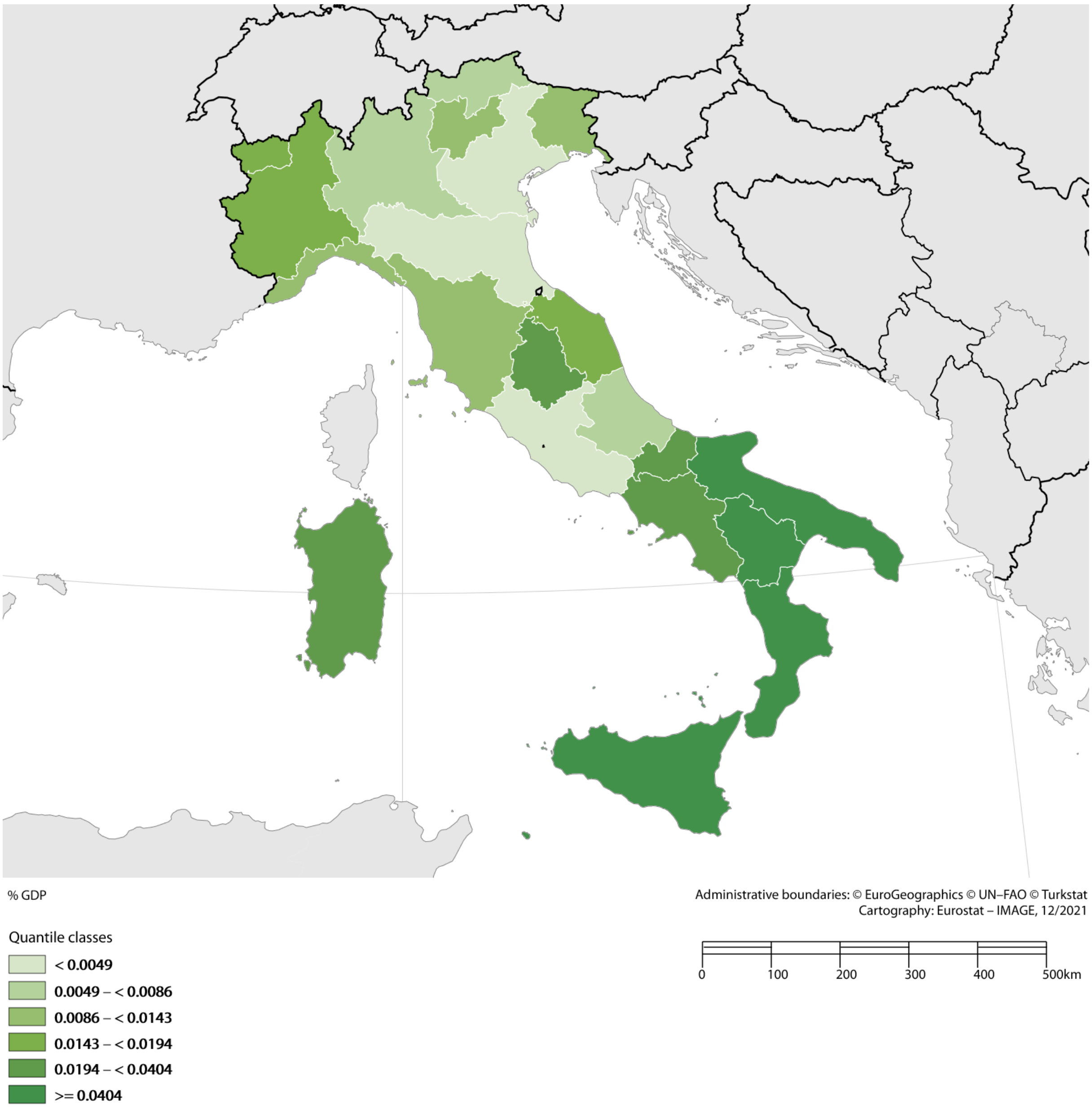
[4] The data platform provides aggregated information on finances (planned and implemented), EU payments made to the Member States and Interreg programmes, and achievements (targets, decided and implemented) under the five European Structural and Investment Funds, including the ERDF; it is available at: https://cohesiondata.ec.europa.eu/.

(vi) support to business networks linked to the Smart Specialisation priorities (16.4%). In the simulations, the investments are assumed to take place over ten years (2014-2023), with the bulk of them being made in the second half of the period (according to the time profile expected by the financing organisation).

In absolute terms, the distribution of the EU funds allocated to regional Smart Specialisation strategies in Italy for the whole financial cycle 2014-2020 appears to be quite dispersed as a consequence of a combination of factors: the level of regional development, the overall allocation of EU resources to each region, the thematic concentration rules set by the Cohesion policy, and the autonomous decision of the regional administration on how much resources to allocate to research and innovation policies compared to other competing policy areas within the ERDF. The southern, less developed regions of Campania, Sicily and Apulia receive the most, more than 300 million euros each; on the opposite side of the spectrum, the Autonomous Province of Bolzano, Molise and Aosta Valley receive the least amount of funds, less than 20 million euros each, mostly because of their small size.

Figure 1 shows the allocations of EU funds to ERDF-TO1 for the whole financial cycle in percentage of 2014 regional GDP, divided by 10 which corresponds to the ten-year horizon over which investment is assumed to take place. The data hence are an approximation of the average annual investment over GDP, showing a clear territorial pattern: less developed regions, mostly located in the southern and insular part of the country exhibit the highest investment intensity, with Apulia, Calabria, Basilicata and Sicily scoring higher than 0.04; more developed regions, mostly in the northern part of the country have the least investment intensity, with Lombardy, Emilia-Romagna, Veneto and the capital region of Lazio scoring less than 0.005, almost one tenth of the figures in less developed regions.

Figure 1. Smart Specialisation strategies fund allocation (annual average as % of 2014 GDP)



Source: DG REGIO, Cohesion policy portal, and own calculations.

ERDF-TO1 research and innovation investments are used by regional governments to support investors who want to engage in risky activities that can have a high growth potential. The effects on private investments, and therefore on private capital stock, are simulated through a change in the risk premium which in turns affects the user cost of capital presented in equation (4). The information on research and development investments is translated into the needed change in the risk premium in the model by starting from the relationship with the ratio between private investments and the capital stock:

$$\frac{I^P}{k^P} = \delta \cdot \left(\frac{rk}{uck}\right)^{\rho} \tag{8}$$

where ρ is is an elasticity parameter that governs the magnitude of the gap between the rate of the return to capital, rk and the user cost of capital, uck. When investments increase due to the policy shock x, we obtain a new value for the user cost of capital which can be calculated as follows:

$$\frac{I^P + x}{k^P} = \delta \cdot \left(\frac{rk}{uck'}\right)^{\rho} \tag{9}$$

$$(uck')^{\rho} = (rk)^{\rho} \cdot \frac{\delta\, K^P}{I^P + x} \tag{10}$$

The difference between uck' and uck yields the change in the risk premium which is introduced in the model to obtain the desired increase in investments due to the Smart Specialisation interventions.

This constitutes the baseline scenario for our analysis, producing an economic impact on the Italian economy solely based on the increased private investments (which in turn increase temporarily the private capital stock). We hypothesize that a good policy governance may yield additional supply-side effects via TFP-enhancing effects (increasing the parameter *A* in equation (2)). In order to translate the money injection into TFP shocks in RHOMOLO, we use a simple accounting approach according to which the amount of investments is directly augmenting the total output in the economy. The TFP improvement is then calculated as follows:

$$\dot{A} = \frac{\delta}{Y} x \tag{11}$$

where $\dot{A}$ represents the change in TFP, that is the scale parameter of the production function, x is the R&D expenditure of the policy, *Y* is the output while δ is the R&D output elasticity. We base the values of the parameter δ on the study on Italian regions made by Bronzini and Piselli (2009). In particular, we assume an elasticity of research and development investments to productivity of 0.026 when the policy is well implemented (equal to the baseline estimate contained in Table 3 of Bronzini and Piselli, 2009, p. 192), which can get as high as 0.065 (that is, the highest estimate reported in Table 3, p. 192) when the policy is implemented in an exceptionally good way. We distinguish between the regions implementing well/exceptionally well based on the quantitative indicator on governance obtained with the survey data as explained above. On the other hand, we assume that when the Smart Specialisation policy suffers from poor governance, no TFP-enhancing effects materialise at all.

We devise three scenarios depending on the simulated TFP effects related to Smart Specialisation and its governance. The first scenario has no TFP effects, which is equivalent to saying that the elasticity of investments to productivity is zero. In this scenario, the policy only has investment effects both on the demand side, and via a temporary increase in the private capital stock, but no structural (productivity) effects. Then, we simulate a Hypothetical scenario in which the maximum elasticity is assigned to all regions irrespective of their Smart Specialisation governance, in order to have an admittedly unrealistic scenario in which the policy is implemented exceptionally well everywhere thus maximizing its productivity effects.

Finally, the Governance scenario uses the survey scores to assign the maximum elasticity 0.065 to the best performers within the country, a 0.026 elasticity to the middle group of regions, and zero to the worst performers. There are two different Governance scenarios depending on the indicator used for the simulations: $QS3GOV_1$ or $QS3GOV_2$, as shown in Table 2.

Table 2. Scenario-specific RnD investments elasticity to productivity

		$QS3GOV_1$		$QS3GOV_2$	
Policy governance	**Elasticity**	**Survey score**	**N. of regions**	**Survey score**	**N. of regions**
Exceptionally good	0.065	9-12	5	25-36	3
Well implemented	0.026	5-8	11	13-24	6
Poor	0	0-4	5	0-12	12

Source: Own calculations and assumptions.

Out of the 21 NUTS 2 regions of Italy, in the $QS3GOV_1$ Governance scenario, five have indicator values above 8 (and therefore are characterized by the maximum elasticity), and for eleven more the values of the indicator lie between 5 and 8 (and they are assigned a 0.026 elasticity). Consequently, only five regions do not enjoy any TFP effect in this scenario. Things are different in the case of the more demanding $QS3GOV_2$ Governance scenario, in which the maximum elasticity is assigned to only three regions, the medium elasticity is assigned to six regions, and no TFP effects are assumed for the remaining 11 regions, whose policy governance was not effective in the two governance pillars. We expect these differences among scenarios to be reflected in the quantitative results of the analysis presented in the next Section.[5]

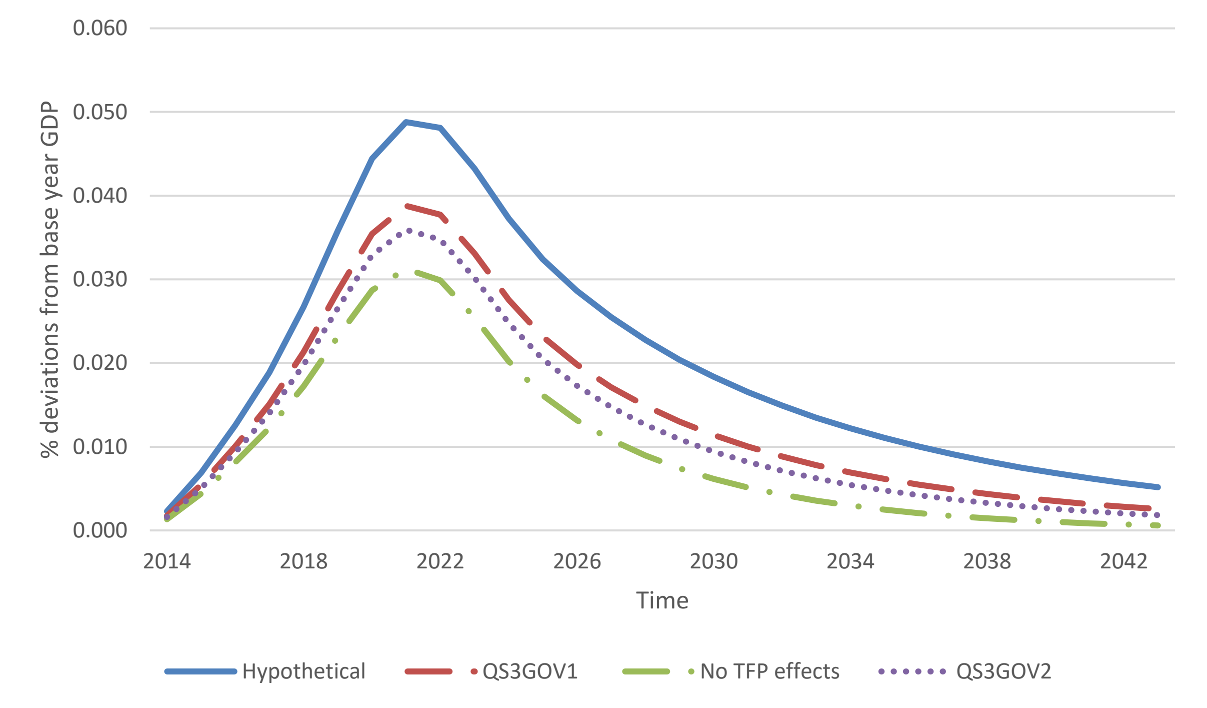
5. The results of the analysis

Figure 2 shows the impact of ERDF-TO1 investments on the Italian GDP according to the four different scenarios described above. The results of the simulations are presented as discounted percentage deviations from the baseline values in the absence of the policy that is, in the absence of any Smart Specialisation-related investment.[6]

[5] A scenario with an elasticity resulting from a linear interpolation between 0 and 0.052 based on the regional score would also be a possibility, but the results would be very close to the ones based on the scenarios illustrated in Table 2.

[6] All quantities are discounted using the model interest rate of 4%.

Figure 2. Policy impact on Italian GDP - four different scenarios



Source: RHOMOLO simulations.

The green dotted-and-dashed line refers to the scenario in which only investment effects are associated with the regional structural investments, with increased demand due to the policy investment temporarily increasing the private capital stock (which then depreciates at 15% yearly). Obviously, the impact on GDP is the lowest of the four scenarios, with a peak reached towards the end of the implementation period (+0.031% of GDP, equivalent to €496 million, eight years after the start of the policy implementation). The effects slowly disappear as the accumulated private capital stock gets reabsorbed by means of depreciation. By year 30, the policy has hardly any impact on Italian GDP. Cumulatively, the Italian GDP is higher than in the absence of the policy by 0.28% over twenty years, or €4.41 billion. This makes it for a discounted GDP multiplier of 1.90 after twenty years, which means that each euro invested in ERDF-TO1 generates €1.90 of GDP.

However, this scenario is particularly conservative in estimating the potential impact of the policy, since investments in research and development are likely to generate increases in TFP. The two Governance scenarios introduce TFP effects with the hypothesis that a good implementation of the policy may lead to additional beneficial effects of the investments. The red dashed line refers to the $QS3GOV_1$ indicator and shows that in this case the GDP impact is much higher than in the no TFP effects scenario, with a peak of +0.039% (€615 million) in 2021, and a cumulative impact of +0.38% (€6.04 billion) over twenty years. The latter implies a discounted multiplier of 2.61, which means that for every euro invested in the policy, GDP increases by more than two euros. Moreover, by the end of the thirty years simulated here, the Italian GDP is above the no policy scenario GDP by almost 0.003%, since TFP effects last longer than the mere investment effects (despite assuming that the TFP improvements decay at a yearly rate of 5%).

The use of the stricter definition of the governance indicator, that is $QS3GOV_2$, would reduce the estimated benefits associated with good governance with respect to the previous case: +0.036% in 2021 (€570 million), for a cumulative impact of +0.27% (€5.42 billion) after twenty years.

It is interesting to compare the Governance scenarios not only with a scenario in which there are no supply-side effects associated with the policy, but also with the Hypothetical scenario in which the productivity-enhancing effects of the policy are maximized in all regions (that is, the 0.065 elasticity is applied everywhere). The GDP impact in the Hypothetical scenario is represented by the blue line in Figure 1, and it is clearly above the other two. The twenty year cumulative impact in this case is +0.52% (€8.22 billion), with an implied discounted GDP multiplier of 3.55.

These numbers suggest that the way the Smart Specialisation policy was implemented in the Italian regions could generate between €1.02 and €1.64 billion of GDP over twenty years (that would be the difference between the Governance scenarios and the No TFP effects one), increasing the pure investment-related impact of the policy by 23 to almost 40%. At the same time, we could say that between €2.17 billion and €2.79 billion of potential GDP gains over twenty years will not materialize due to the insufficiently good governance of the policy in some of the regions (calculated as the difference between the Hypothetical scenario and the Governance ones).

6. Conclusions

That governance is a key condition for policy effectiveness is an established fact in the literature. This is especially true in the case of research and innovation policy, which takes place in a highly volatile environment, where the means-end relationship that characterizes policy action is crucially mediated by governance, and more in general by the institutional context in which policies are conceived and implemented. Not taking into account the reality of policy governance therefore deprives any innovation policy impact evaluation of explanatory power and, ultimately, of value as a tool to guide policy action in practice.

In this paper, we seek to link in a systematic way the empirical assessment of the quality of innovation policy governance with policy impact assessment based on macroeconomic modelling. We apply our methodology to the case of the European regional innovation policy for Smart Specialisation.

We construct a synthetic indicator of the quality of Smart Specialisation governance using the responses to a survey targeted at regional and national administrations, using data for all the NUTS 2 regions of Italy. We then use the indicator as an input in a spatial dynamic general equilibrium model to simulate scenarios quantifying the economic consequences of various levels of governance quality.

We find that the measured quality of Smart Specialisation governance in Italian regions could increase the pure investment-related impact of the policy by 23 to almost 40 percent over the entire time horizon we consider. At the same time, we estimate that further potential GDP gains – in the order of an additional 40-50 percent over what was achieved with current levels of governance - would not materialize because of the comparatively low quality of governance in some regions.

These results hint to a dramatic variation in policy outcomes depending on the quality of governance. Our contribution hence narrows the gap between the abstraction of traditional ex-ante impact assessment exercises based on macroeconomic simulations and the reality of how policy interventions take place. Our results highlight the importance of all the phases of the policy cycle, from planning to implementation and monitoring. They also call for improvements in the way in which standard macroeconomic policy assessments are carried out, since it appears that the assumption of perfect implementation of the policy may often be unrealistic.

At the same time, the results suggest that the margins for increasing the impact of innovation policy by means of improving governance quality are substantial. This begs the crucial question of whether and how it is possible to increase the quality of innovation policy governance in the least-performing regions in order for them to converge towards the more virtuous models already experienced in some territories.

We argue that achieving such convergence would be helped by the interplay of three factors: (i) an improved knowledge about how innovation policies operate in their systemic contexts and institutional environment (Tödtling and Trippl, 2005; Rodríguez-Pose and Di Cataldo, 2015), allowing for a more customised design of intervention measures and programmes; (ii) mechanisms favouring trans-regional and transnational policy transfer (Wink, 2010; Stone et al., 2020), which can be public initiatives and services; (iii) the build-up of policy capacity (Howlett, 2015; Wu et al., 2015) both in the territorial public administrations and in the network of innovation actors and intermediary bodies that participate in the development of the territory.

These factors tend to be addressed in different strands of literature, ranging from the economics and policy of research and innovation, to regional sciences, through political science and administrative studies. To the best of our knowledge, they have seldom been treated in an integrated manner; for example, policy transfer and policy capacity have been touched on only marginally in the mainstream research and innovation policy literature. An interesting avenue for future work might therefore be the attempt to create a more systematic bridge between these research areas.

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Annex

Inclusiveness pillar

Q1: In the following table, please tick the main challenges/problems with respect to the RIS3 exercise in your country/region: Lack of stakeholder engagement. Binary response.

Q2: In the following table, please tick the main challenges/problems with respect to the RIS3 exercise in your country/region: Lack of skills and capabilities in some groups of stakeholders. Binary response.

Q3: Who has contributed, and to what extent, to the analysis of the national/regional context and potential for innovation? (5 = major contribution, 1 = little or no contribution): Stakeholders (universities, entrepreneurs' association, cluster organisations, etc.). Response given on a 1-5 scale, then binary encoded (1-3=0; 4-5=1).

Q4: Please assess the level of stakeholder representation in the RIS3 governance system (different economic sectors, small and large firms, domestic and multinational companies, different research groups, different associations, etc.) (5 = fully represented, 1 = not represented): (i) Business sector, and (ii) Public research and education (universities and public research organisations). Response given on a 1-5 scale separately for (i) and (ii), then averaged over (i) and (ii) and binary encoded (1-3=0; 4-5=1).

Q5: The strategic functions [of the RIS3 governance structure] are carried out by a group comprising: (Tick all that apply): (i) Private sector representatives, (ii) Research sector representatives. Responses binary encoded 1 if both (i) and (ii) are ticked, 0 otherwise.

Q6: Did you face any of the following obstacles in building the RIS3 management team in your country/region?: Lack of interest/engagement by the necessary institutional stakeholders (e.g. businesses, academia etc.). Three possible responses: Yes, No, Somewhat; binary encoded 1 if No, 0 otherwise.

Effectiveness pillar

Q7: Please indicate whether the RIS3 governance structure is effective at performing the following strategic functions: Setting and revising strategic objectives and priorities. Available options: (i) A body with this function is operating and effective, (ii) A body with this function is operating, but it is not fully effective, (iii) A body with this function is planned, but not operating yet. Binary response given separately for (i), (ii), and (iii), then binary encoded [(i)=1, (ii) and (iii)=0].

Q8: Please indicate whether the RIS3 governance structure is effective at performing the following management functions: Coordinating the different RIS3 governance functions and actors. Available options: (i) A body with this function is operating and effective, (ii) A body with this function is operating, but it is not fully effective, (iii) A body with this function is planned, but not operating yet. Binary response given separately for (i), (ii), and (iii), then binary encoded [(i)=1, (ii) and (iii)=0].

Q9: Please indicate whether the RIS3 governance structure is effective at performing the following management functions: Supports the development or deployment of instruments for implementation (i.e. supports different departments that issue calls). Available options: (i) A body with this function is operating and effective, (ii) A body with this function is operating, but it is not fully effective, (iii) A body with this function is planned, but not operating yet. Binary response given separately for (i), (ii), and (iii), then binary encoded [(i)=1, (ii) and (iii)=0].

Q10: With respect to the skills and capabilities available within the team responsible for the RIS3 implementation, please rate the adequacy of the various competences listed below (5 = needs fully met, 1 = needs not met, N.R. = not relevant): Project planning and management/implementation. Response given on a 1-5 scale and binary encoded (1-3=0; 4-5=1).

Q11: With respect to the skills and capabilities available within the team responsible for the RIS3 implementation, please rate the adequacy of the various competences listed below (5 = needs fully met, 1 = needs not met, N.R. = not relevant): Executing or coordinating monitoring activities. Response given on a 1-5 scale and binary encoded (1-3=0; 4-5=1).

Q12: Did you face any of the following obstacles in building the RIS3 management team in your country/region?: Lack of funding for staff recruitment and training. Three possible responses: Yes, No, Somewhat; binary encoded 1 if No, 0 otherwise.

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