European Commission

Support to SMEs – Increasing Research and Innovation in SMEs and SME Development

Third Intermediate Report
Work Package 2

Ex post evaluation of Cohesion Policy programmes 2007-2013, focusing on the European Regional Development Fund (ERDF) and the Cohesion Fund (CF)

Contract: 2014CE16BAT002

15, December 2015

Submitted by:

CSIL in partnership with CSES and ZEW

Third Intermediate Report
Volume I

December – 2015

CSES Centre for **Strategy & Evaluation Services**

Csil CENTRE FOR INDUSTRIAL STUDIES

ZEW Zentrum für Europäische Wirtschaftsforschung GmbH Centre for European Economic Research

Third Intermediate Report

Volume I

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ADE	Economic Development Agency
BGK	Bank Gospodarstwa Krajowego
BNA	Bayesian Network Analysis
BNS	Bayesian Networks
CMO	Context, Mechanisms and Outcomes
DAG	Directed Acyclic Graph
EIB	European Investment Bank
ERDF	European Regional Development Fund
ERIDI	Regional Scientific Research Technological Development and Innovation Strategy
EU	European Union
EURIBOR	Euro Interbank Offer Rate
EUROSTAT	Statistical Office of the European Communities
GERD	Gross Domestic Expenditure in R&D
ICT	Information and Communication Technology
LHS	Left-hand side
NACE	Nomenclature statistique des Activités économiques dans la Communauté Européenne
NUTS	Nomenclature des Units Territoriales Statistiques
OECD	Organization for Economic Co-operation and Development
OP	Operational Programme
RHS	Right-hand side
R&D	Research and Development
SME	Small and Medium sized Enterprise
DAG	Directed Acyclic Graph
R&D	Research and Development
SME	Small and Medium sized Enterprise

EXECUTIVE SUMMARY

Objective

This is the Third Intermediate Report of the ex-post evaluation of Support to Small and Medium Enterprises (SMEs) – Increasing Research and Innovation in SMEs and SME development. The objective of the evaluation is to assess the effectiveness and the impact of the European Regional Development Fund (ERDF) with regards to support for innovation and the development of SMEs in the European Union over the 2007-2013 programming period.

The report presents the results of Tasks 4, i.e., the three in-depth evaluations of selected policy instruments. The objective is twofold: to assess the effectiveness of different forms of support measures targeting SMEs in different regional and national contexts, and to go in-depth into the mechanisms through which a specific policy instrument produces its effects, so as to improve future policy design. Moreover, this Task tests new methods for the evaluation of business support measure, such as theory-based impact evaluation and Bayesian Network Analysis. The report is organised in two volumes: a main report containing the findings of the evaluation of the three policy instruments (Volume I) and a set of Annexes with more details on the results of the statistical analyses conducted (Volume II).

The findings of the work carried out have enabled the evaluation team to shed some light on the effects produced by ERDF support to SMEs and the conditions that explain if and how a policy instrument achieves its expected objectives, in terms of the characteristics of SMEs targeted, behavioural changes and context-specific features.

Three policy instruments observed

The three policy instruments evaluated well exemplify the most common types of support delivered throughout the European Union in the 2007-2013 programming period and represent one of the most important instruments within their respective Operational Programmes (OP) in terms of financial resources allocated and the number of beneficiaries reached. The selected policy instruments are:

- Support for technological innovation of micro, small and medium enterprises in Poland (the so-called "Technological Credit" measures) included in the OP Innovative Economy.[1] It consisted of a grant to enterprises which undertake an investment for productive technological advancement. The aid was meant to cover a share of the bank credit needed to finance the investment project. The main objectives pursued by the policy instruments were to advance the technological frontier of SMEs, so as to improve their economic performance. As a secondary effect, it aimed to increase SMEs' awareness and confidence in less traditional forms of support to enterprises, such as combinations of loans and grants.

- Aid to investment projects of micro and small enterprises, operating in the craft, commerce and low-tech manufacturing sectors (the so-called "Title II"), included in the OP of the Italian region Apulia.[2] The policy instrument consisted of a combination of interest subsidy and grant to enterprises which take out a bank credit to undertake a business modernisation investment. The instrument was originally intended to encourage the enterprises' development and increase their propensity to invest and access public support funds. As a consequence of the economic crisis, the instrument's aim was shifted to the provision of support to vulnerable business activities in order to mitigate the effects of the negative economic outlook.

---

[1] 2007PL161PO001.
[2] 2007IT161PO010.

- Grants to research and development (R&D) projects undertaken by enterprises of all sizes in the Spanish region of Castile and León.[3] The policy instrument aimed to promote the realisation of risky industrial R&D projects by enterprises, including SMEs. Both individual and collaborative projects, involving SMEs and large enterprises, or SMEs and research institutes, were supported. It also aspired to foster the development of SMEs' abilities to carry out increasingly complex R&D activities, so as to contribute to the evolution of the region towards a knowledge-based economy.

Figure 1   Policy instruments evaluated and geographical areas targeted

Support for industrial R&D and innovation
OP ERDF Castile and Leon
2007ES162PO009
- **N. beneficiaries**: 365 enterprises (299 SMEs)
- **Average value of supported projects**: EUR 417 thousand
- **Average aid intensity**: 33%

Support for technological innovation
OP ERDF Innovative Economy
2007PL161PO001
- **N. beneficiaries**: 586 SMEs
- **Average value of supported projects**: EUR 1.16 million
- **Average aid intensity**: 54%

Aid to investment projects of micro and small enterprises
OP Apulia 2007IT161PO010
- **N. beneficiaries**: 3311 micro and small enterprises
- **Average value of supported projects**: EUR 165 thousand
- **Average aid intensity**: 25%

Source: CSIL.

A novel evaluation approach to open the "black box"

The three policy instruments are evaluated according to the theory-based impact evaluation approach. This is an innovative methodological approach to the evaluation of enterprise support, which is nevertheless considered suitable to both accounting for the effectiveness of the instruments and examining the mechanisms bringing about the effects. To do so, it aims to open the "black box" of the SME and disentangle the different changes, including behavioral changes, provoked within the SME by the policy instrument and that determine its performance. The 'Realist Evaluation' paradigm developed by Pawson and Tilley (1997) was selected among different theory-based methods to explore the theory of the policy instrument, on the grounds that it gives great attention to context variables. Realist Evaluation implies reconstructing the logic (or theory) of intervention of the policy instrument, even when this is not explicitly stated in the programming documents, spelling out the main hypotheses behind the causality chain associated with each instrument expressed in different combinations of context, mechanism and outcome variables, and testing the theory in a subsequent empirical analysis.

The test was carried out by directly asking beneficiary enterprises, through on-line surveys, about the changes they have noticed in their way of doing business and about the effects perceived and produced as a consequence of having been targeted by the policy instrument. A total of 698 valid questionnaires were collected. After a detailed descriptive analysis of the

---

[3] 2007ES162PO009.

responses, the survey results were processed through standard econometric models and by means of the Bayesian Network Analysis, a statistical tool that expresses, also through visual aids, the conditional independence and dependence relationships among the variables. The model resulting from the Bayesian Network Analysis is then compared with the initial theory of the instrument to confirm, deny or qualify the expectations about the causal chain of effects suggested by the theory, but also to find unexpected links between changes within the beneficiary SMEs and outcomes.

Key findings

Key findings from the three theory-based impact evaluations conducted can be summarised as follows:

Appropriateness of the theories of intervention

- A theory of intervention has been identified for all the three policy instruments, by talking with the policy makers and programme implementers. Different stakeholders usually provided slightly diversified, but not conflicting, views about the policy instrument's rationale. For each policy instrument it was possible to identify relevant theoretical and empirical literature supporting the policy maker's expectations and observed results.

- Following a logic of "input support", the three policy instruments were designed to improve fixed and/or human capital in SMEs, with the goal of attaining generically defined economic performance improvement.

- The empirical analysis finds that the policy instrument generally produced the expected outcomes, but the theories that the policy makers had in mind at the moment of designing the instruments, turned out to be generally over-simplistic, failing to account for all the mechanisms and context variables that would have influenced the generation of outcomes.

- The logic behind the design and implementation of the three policy instruments responded to the genuine investment needs of the targeted enterprises. The policy makers and, especially, the implementing agencies, appear to be well aware of the characteristics, capacity, constraints and requirements of the targeted enterprises. Fine-tuning the theory of change during the course of the programming period to react and promptly respond emerging challenges or changed priorities proved to be rewarding.

Effectiveness of the policy instruments on the SMEs' economic performance

- All the three policy instruments achieved positive economic effects on average, mainly in terms of an increase in sales. The share of respondent enterprises which attained non null effects on turnover amount to 95% in Poland, 87% in Apulia and 79% in Castile and León. These effects were at least moderately positive[4] for 77% of Polish SMEs, 61% of Italian ones and only 38% of Spanish respondents (for the remainder the effect is small). However, up to 70% of Spanish beneficiaries believe that this result is likely to increase at least to some extent on the next years, because R&D projects take long to deploy their full effect.

- Additionally, the Apulian instrument was particularly effective at increasing the enterprises' resilience to the crisis (as declared by 82% of surveyed enterprises) and

---

[4] Enterprises declare that they have increased sales 'enough', 'appreciably' and 'very much' thanks to the supported investment.

limiting the risk of unemployment among the beneficiaries: around 12% of beneficiaries have decreased their employment during the years of implementation of the investment, while more than 40% have either maintained the same number of employees or have hired new employees. The Polish policy instrument was effective at increasing the export share for 85% of enterprises.

- While the Italian policy instrument was not meant to reinforce the regional economic competitiveness and produce structural change, it can be argued that the Polish instrument had beneficial effects on the Polish economy, as it succeeded to increase export and the technological intensity level of production systems. Additional studies should be conducted to verify the possible additionality, deadweight and displacement effects of the policy instruments.

Effectiveness of the policy instruments to generate behavioural changes

- The Spanish instrument was the most ambitious in terms of causing behavioural change. The analysis points to positive effects on SMEs' capacity to implement a higher number and increasingly complex R&D projects, in line with the instrument's theory. The level of expenditure in R&D and the propensity to carry out collaborative projects increase along with the experience of the SMEs in carrying out R&D activities.

- The three instruments improved SMEs' opinions about public support measures, which is in turn linked to an increased willingness to apply for other forms of support and to start other investment projects (for 77% of surveyed Polish SMEs, 73% of Apulian enterprises and 75% of SMEs in Castile and León).

- Opinions about other possible changes in SMEs' behaviour or entrepreneurs' mind-set are mixed, with higher shares of SMEs declaring that they have not observed a particular change or not being sure of that. Among the changes most commonly recognised by beneficiaries of the three instruments is the higher value attached to having more skilled employees.

Mechanisms of effectiveness: the type of supported investment projects

- The types of projects funded are linked with the generation of economic effects. Less risky operations are associated with better economic results, particularly in terms of increased turnover, as perceived by beneficiary enterprises. In Castile and León, the high level of risk of R&D projects is one of the reasons why relatively lower economic outcomes have been observed as compared with the other policy instruments. The scenario analysis conducted on the Bayesian Network confirms that a higher R&D risk is associated with lower or more uncertain benefits to sales and exports in the time horizon of the evaluation.

- The result mentioned above can also be explained by the consideration that the economic effects of R&D may take longer to become visible, in contrast with technological innovation and general modernisation investment projects. As revealed by the Bayesian Network the most significant changes activated by the R&D grant within the SMEs is the improvement in the enterprise's reputation. While this change has not caused any observable economic effects for most of the beneficiaries, it is associated with positive expectations about the future.

- Generic investment for business modernisation, even if not intrinsically risky, might not necessarily lead to significant and long lasting economic effects (for example if they consist of the mere renovation of premises). Also, they are unlikely to produce beneficial effects on the competitiveness of the overall economy.

- Investment projects that bring about the widening of the range of products offered or an improvement in products and/or production processes are more likely to produce positive effects on turnover. The technological advancement of production processes, in particular, is usually linked to an increase in the technological intensity level of products put onto the market, which contributes to the goal of reinforcing the regional/national economic competiveness.

Mechanisms of effectiveness: the characteristics of beneficiary SMEs

- The type and intensity of economic effects or behavioural changes produced by the policy instrument vary according to the characteristics of beneficiary enterprises. Size, sector of activity, level of technological intensity are important determinants of the instrument's effectiveness. Some characteristics of the entrepreneur also matter, e.g. his/her educational level with particular reference to R&D projects.

- Not all SMEs are equipped to successfully carry out R&D projects or are interested in it. R&D requires having a high risk propensity, strong managerial capabilities, a scientific and technical knowledge base, the capacity to resist an external shock such as the recent economic crisis. These characteristics are often found in SMEs born as university spin-offs. As more experience in carrying out R&D is gained, the more probable is it for the SME to reach its research objectives, to maintain higher level of expenditure in R&D, and to increase its capacity to carry out more complex and ambitious projects.

- As the Polish case show, low or medium-low tech enterprises can significantly benefit from investment for technological progress. Exporting SMEs seem to be more ready to take advantage of the investment and to build a competitive advantage on innovation. In contrast, generic investment in fixed capital for individual and micro enterprises operating in traditional commerce and craft sector is unlikely to bring significant improvement to the regional competitiveness.

- The effectiveness of the policy instrument can also be explained by mechanisms outside the logic of the instrument itself. For instance, the instrument's capability to have an effect on the export share depends on whether the SME already exported before benefitting from the instrument, and on its initial level of exports (particularly in the Polish case); additionally, the implementation of other simultaneous investment projects, not funded by the instrument under evaluation, increases the probability to have better outcomes (emerged from the analysis of both the Polish and Apulian instruments). While these drivers of change were not explicitly foreseen by the theory as told by the policy makers, they are clearly shown the Bayesian Network Analysis.

The role of the context

- Place-based context characteristics played a great role over the design of the logics of intervention. The logics of the three instruments analysed were strictly dependent upon the features of the macro-economic and industrial context.

- With the eruption of the global financial and economic crisis, the logic of the Apulian policy instrument was revised in response to the changing context conditions. A greater emphasis was placed on backing vulnerable, but financially solid, enterprises, helping them to resist the effects of the crisis, and moving away from the original aim of promoting more ambitious, growth-enhancing, investment projects.

- The economic crisis was particularly strong in Spain too, leading to a significant regional and national budget reduction. No modifications were made to the main features of the Spanish policy instrument, but the crisis resulted in less favourable payment conditions

and in an increased uncertainty about the economic results of R&D. Together with the overall market uncertainty, the crisis put at significant risk the implementation and effectiveness of the R&D projects, forcing some enterprises even to interrupt them. Moreover, we found that at least 8% of firms that benefited from R&D grants and completed the investment projects, already failed or had to change ownership.

- Funds are mostly absorbed by regions and provinces where the highest number of SMEs is located. In Poland, these coincide with the most developed areas of the country (e.g. in terms of GDP growth). However, being located in an area rather than another is not a decisive determinant of the instruments' effectiveness, once it is controlled for other variables of interest.

The role of the ERDF

- The value added of the ERDF took different forms in relation to the three policy instruments. In Castile and León, it enabled the enterprises to overcome the barriers to R&D posed by the limited access to finance, thus stimulating the implementation of costly and risky R&D projects. In Poland, it accelerated the process of technological change and allowed for the experimentation of a new form of business support, different from traditional non repayable grants. In Apulia, the ERDF was used to provide generic aid to enterprises to help them overcome the economic crisis.

- The volume of the public contribution matters in the generation of economic effects: the marginal effect of the support on the probability to record higher improvements in economic performance, both in terms of sales and resilience to the crisis, is positive for the three policy instruments. Statistically, this link can be considered significant in the case of the Polish and Apulian instrument, but not for the Spanish R&D grants.

- By contrast, aid intensity (value of public support as a ratio of investment) is usually not a statistically significant variable to explain the firms' performance. Its effects on SMEs' performance are not straightforward. This issue should be more extensively explored in a dedicated study.

The role of intermediary bodies

- In both the Polish and Apulian cases, commercial banks operate as intermediaries in the delivery of the policy instruments. By binding the eligibility of the public contribution to taking out a loan with the bank, the financial institutes are in fact entitled to carry out the initial screening of potentially beneficiary enterprises on the basis of financial viability criteria. This enables the implementing bodies to select enterprises which are financially robust and not at risk of failure, and thus more likely to successfully complete the investments.

- The regional innovation agency of Castile and León maintained a more direct contact with the beneficiary enterprises after the initial phases of the project implementation up to its completion, when enterprises are visited to verify the successful implementation of the R&D project. The relatively lower number of beneficiaries to deal with and the availability of internal technical skills enable the agency to develop knowledge of the R&D needs and constraints of enterprises.

The role of the monitoring system

- For the three policy instruments very few output and result indicators are collected by the Managing Authorities. These indicators have limited informative value when trying

to understand whether the instrument has achieved the intended effect according to its underlying logic.

- However, Managing Authorities keep record of a diversified set of information about beneficiary (and often applicant) enterprises, and about the projects supported. Whenever it is possible to univocally attribute a project to the implementing enterprise by means of identification codes, it is possible to get a better idea about how the ERDF is used. An on-line application process eases the acquisition of valuable information on beneficiaries and projects. This information should be better exploited in future by the Managing Authorities.

Learning on evaluation methodology

- In consideration of the limitations of the monitoring system, the evaluation of the policy instrument's effectiveness greatly benefitted from a direct survey of beneficiary enterprises. This was crucial to collecting information not only on the economic performance achieved thanks to the supported investment projects, but also to investigating the mechanisms of change explaining the SMEs' performance, particularly the various changes which took place within the firm once benefitting from public support.

- This study has experimented with the theory-based impact evaluation approach and in particular the Realist Evaluation methodology. This has proved to be a valuable and informative methodology of analysis which deserves to be further developed in the evaluation of ERDF programmes and individual policy instruments. From an ex-post perspective, it contributed to guiding the evaluator towards an in depth understanding of the object of analysis and the identification of the causal links, thus leading to clear answers to the evaluation questions.

- Bayesian Network Analysis has been found to be rather intuitive to use, very flexible and providing added value to the evaluation. It was crucial for properly testing the theory and finding hidden or unexpected mechanisms of change. In combination with other analytical methodologies (such as regression analysis), it could ensure that robust results were obtained and led to a clear idea of whether the policy instrument is effective and how.

1 INTRODUCTION

1.1 Objectives

This report has been produced in the framework of the ex-post evaluation study of the ERDF support for SMEs innovation and development delivered during the 2007-2013 programming period. The study has so far involved:

   i.   a review of the literature concerning SME support and policy instruments,

   ii. the scrutiny of 50 Operational Programmes to show how many forms policy instruments to support SMEs can take and provide a preliminary assessment of their effectiveness (First Intermediate Report),

   iii. and the study of eight Operational Programmes to identify the rationale behind the wider policy mix within which policy instruments for SMEs are embedded and assess their achievements on the basis of a broad range of qualitative and quantitative evidence (Second Intermediate Report).

The object of the present report is to go in more depth into the mechanisms through which a specific policy instrument produces effects on beneficiary SMEs. Three policy instruments implemented in three different contexts (regions and countries) are analysed according to the theory-based impact evaluation approach to account for the factors underlying given achievements – be they successes or failures. Specific objectives are to:

  • Outline and test the intervention logic underlying the selected policy instruments;

  • Establish the conditional probabilities between observed behavioural change of a policy instrument and a number of variables, such as the characteristics of SMEs, constraints and market failures faced, and other context-specific features;

  • Derive a conjectural representation of the causal chain triggered by policy instruments and compare it with the policy maker's expectations.

The bulk of the evidence and findings of this and previous reports will flow into the Final Report of the evaluation study, which aims to give an indication of what the support provided to SMEs over the period achieved and to spell out the conditions under which SME business and innovation support deployed in the context of the ERDF is likely to be more effective.

1.2 Policy instruments observed

The three policy instruments subject to in-depth analysis have been selected in consultation with the European Commission according to a set of selection criteria, which are summarised in Box 1. The selected instruments are:

  • Support for technological innovation in Poland ("Technological Credit");

  • Aid to investment projects by micro and small enterprises in Apulia – Italy ("Title II");

  • Support for industrial R&D and innovation in Castile and León – Spain.

More information on each instrument is provided in Table 1.

This report is organised as follows: after describing the methodology of the analysis in Section 2, the results of the theory-based impact evaluation and the empirical test of the theory are presented for each of the three policy instruments: the Polish one in Section 3, the Italian one

in Section 4 and the Spanish one in Section 5. In Section 6 the main findings related to each instrument are summarised and compared.

Table 1.   Three policy instruments compared

Name of the policy instrument	Support for technological innovation	Aid to investment projects by micro and small enterprises	Support for industrial R&D and innovation
Reference name in the OP	"Technological Credit" Measure 4.3 OP Innovative Economy 2007PL161PO001	"Title II" Measure 6.1 OP Apulia 2007IT161PO010	Grants for R&D Idea&Decide Programme, Axis I - OP Castilla y León 2007ES162PO009
Category of the policy instrument[5]	Support for the development of technological and non-technological innovation	Business creation and development	Support for R&D projects
Mode of delivery	Grant, in combination with a bank loan	Combination of interest subsidy and grant, in combination with a bank loan	Grants
Main goal of the instrument	To promote technological change in SMEs in order to increase their competitiveness, through a partial waiving of credit.	To provide generic support for the development and economic stabilisation of micro and small enterprises operating in traditional sectors.	To encourage the implementation of R&D projects particularly by SMEs, so as to increase the number of innovative enterprises, expenditure and personnel in R&D
Area targeted by the policy instrument	Poland	Apulia (Italy)	Castile and León (Spain)
Geographical characteristics	NUTS 0 level Convergence country EU 12	NUTS 2 level Convergence region EU 15	NUTS 2 level - Competitiveness and Employment region EU 15
Context features[6]	- SMEs specialised in low or medium low technology goods - Low innovation propensity - Need of technological advancement to ensure competitiveness - No economic recession due to the crisis - N. SMEs in the country: approx. 1.8 million	- Dualism between less competitive SMEs in traditional sectors and high-tech fast growing SMEs in sector niche - Large number of micro and small enterprises vulnerable to the effects of the economic crisis and credit shrinkage - N. SMEs in the region: approx. 250 thousand	- Strategic emphasis on R&D and vision of a knowledge-based economy - Low private expenditure in R&D - Poor connection with the public research system - Strong impact of the crisis on the regional economy - n. SMEs in the region: approx. 160 thousand
OP public contribution allocated to the policy instrument (approx.)	EUR 430 million	EUR 80 million	EUR 200 million
Beneficiaries[7]	586 micro, small and medium enterprises	3311 micro and small enterprises	365 enterprises (all sizes, of which 299 SMEs)
Volume of investment projects supported	Average EUR 1.16 million Min: EUR 25 thousand Max: EUR 5.17 million	Average: EUR 130 thousand Min: EUR 30 thousand Max: EUR 1.84 million	Average: EUR 417 thousand Min: EUR 9 thousand Max: EUR 6.9 million[8]
Aid intensity[9]	Average: 54% Min: 18% Max: 70%	Average: 25% Min: 11% Max: 40%	Average: 33% Min: 8% Max: 56%[10]
Average share of public contribution over the turnover of beneficiaries[11]	Average: 10% Minimum: Less than 1% Maximum: 48%	Average: 9% Minimum: Less than 1% Maximum: 75%	Average: 12% Minimum: Less than 1% Maximum: 80%

---

[5] According to the taxonomy introduced in Task 1 (see First Intermediate Report).

[6] As illustrated in the case studies (see Second Intermediate Report).

[7] As of March 2015.

[8] Values are referred to R&D projects carried out by SMEs, not large enterprises.

[9] Defined as ration between OP public contribution and volume of investment.

[10] Values are referred to R&D projects carried out by SMEs, not large enterprises.

[11] No information on the assets' value of SMEs is available.

| Monitoring indicators collected[12] | - Number of investment projects supported: 712.
- Number of improved goods or services - 737 (target value 100). | - Number of supported enterprises: 3,311.
- Number of enterprises which have completed the investment: 2,382.
- Investment activated: EUR 525 million. | - Total number of projects: 901.
- Total number of projects involving SMEs: 759.
- Employment generated in SMEs: 2,175.
- Employment generated in SMEs for R&D: 1,488.
- Number of projects involving SMEs in collaboration with research organizations: 204. |

Source: CSIL.

Figure 2   Areas targeted by the analysis of policy instruments
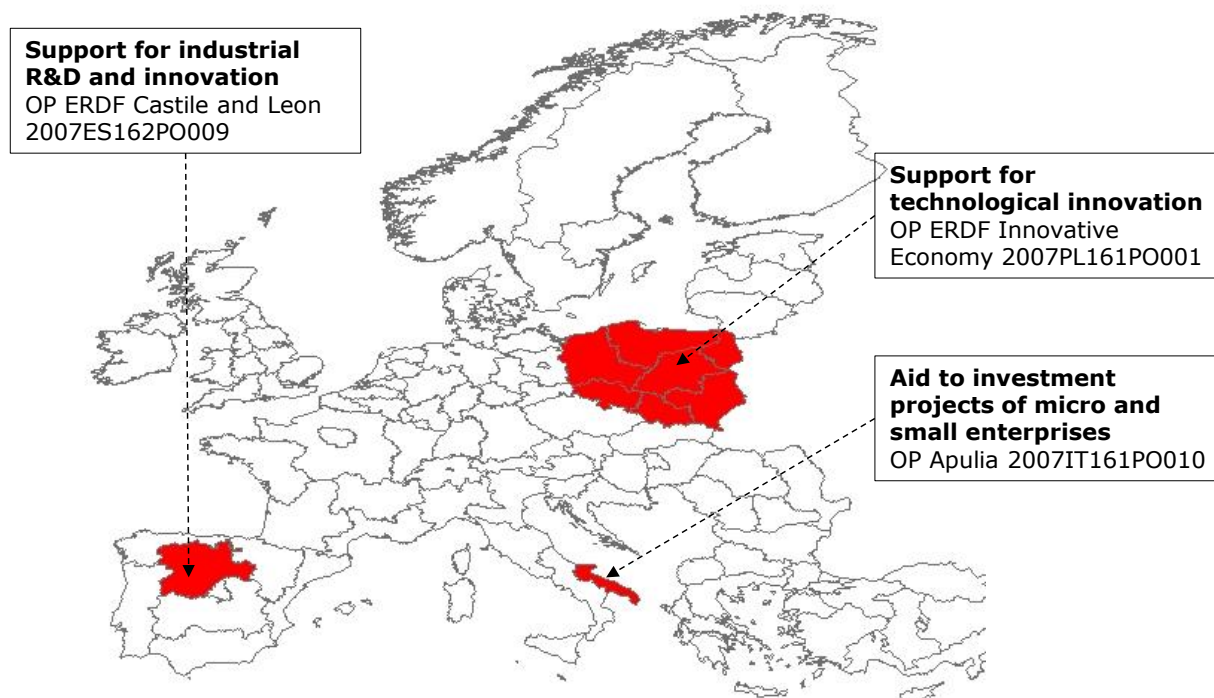
Source: CSIL.

Box 1.   Selection criteria of the policy instruments

The policy instruments to be studied have been selected so as to ensure compliance with the following selection criteria:

- The three policy instruments should be representative of the main typologies of policy instruments used throughout the European Union. As outlined in the First Intermediate Report with reference to 50 OPs, the most significant categories of policy instruments in terms of public expenditure are: i) instruments supporting the development of technological innovation in SMEs, without any R&D activities involved; ii) instruments designed to stimulate investments in the business sector for SME development, without a particular emphasis on R&D and innovation; iii) instruments supporting R&D projects.

- The three policy instruments should have an important role within the policy mix of the OP, in terms of financial resources allocated and/or number of beneficiaries reached.

- In order to properly perform the analysis, the availability of a good amount of information about the policy instruments' logic of intervention, a relatively high share of project completed and the contact details of beneficiary SMEs were necessary. For this reason, the policy instruments have been selected from the OPs already analysed through the case studies.

- The geographical criterion was considered too. The team aimed to ensure geographical balance between Convergence and Competitiveness and Employment regions, Old and New Member States, and regional and national OPs.

- Finally, preference was assigned to instruments on which no other surveys to beneficiaries have been conducted so far, in order not to put an excessive burden on the same SMEs which could undermine their willingness to contribute to our study.

Source: CSIL.

2 METHODOLOGY OF ANALYSIS

2.1 Evaluation perspective

A vast strand of the literature that investigates the effects of public interventions that support enterprises relies on econometric analysis or counterfactual techniques. The logics of these methods is to determine the net impact that can be attributed to a given policy action and, in the case of counterfactual methods, measuring the difference between the output variable recorded by beneficiaries and the output that would have been achieved by the same actors in an hypothetical scenario where they did not benefit from the intervention.

Our evaluation study takes a different perspective. It is focused not only on outcomes, but also, and especially, on the mechanisms that explain the generation of those outcomes. Such mechanisms are generally related to behavioural responses stimulated by the policy impulse and to external context characteristics.

For policy makers willing to learn from past experiences to improve policy design, gaining knowledge about the mechanisms that explain why an instrument achieved its goals is as important as finding quantitative evidence of its effectiveness. To this end, there is a need to look inside the 'black box' of the SME, examining in what way a policy instrument succeeds in addressing the elements constraining SMEs' capacity to innovate and grow, and in stimulating a behavioural change.

The evaluation has been conducted following the theory-based impact evaluation approach, consisting in:

- first, reconstructing the logic of intervention of the policy instrument as designed by policy makers, according to the Realist Evaluation paradigm;

- then, testing the theory by means of the statistical analysis and Bayesian Networks, in order to reject or confirm the expectations about the mechanisms of change and outcomes to be generated by the policy instrument.

Each of the two steps allows specific research questions to be answered, which altogether will paint a detailed picture of the changes produced by the selected policy instruments within SMEs, the drivers of change and the outcomes in terms of innovation and development of the beneficiary SMEs. In what follows the methodology adopted is presented more in details (also summarised in Figure 3).

Figure 3   Evaluation methodology
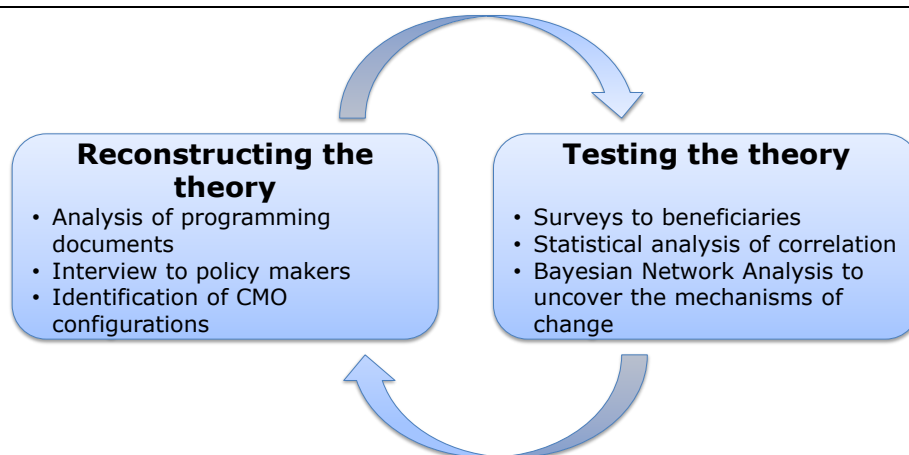
Source: CSIL.

2.2 *Realist Evaluation to disclose the drivers of behavioural change*

Theory-based impact evaluation is a well-established methodology (Astbury and Leeuw, 2010; Weiss 1997 and 1998; Carvalho and White, 2004; Blackman and Reich, 2009) that offers the chance to explore why and how a given intervention has or has not generated some effects. The assumptions of policy makers about the intervention's effects on beneficiaries' behaviour, the expected implications of these changes, but also other possible mechanisms at work which are suggested by the literature, but not necessarily made explicit by the policy makers, are retraced and the causality chains are outlined.

Theory-based evaluation of programmes supporting business is rare (see for example Mole et al, 2009) and the applicability of this method in this field has been relatively unexplored so far (Riché, 2013). In general, theory-based evaluation is used to assess small scale interventions, assessing the behavioural changes of individuals, whereas fewer attempts have been made to evaluate groups of actors, such as enterprises. This implies that the mechanisms of changes to be assessed are more complex, involving both the behavioural changes of the firm as observed from the outside world, and behavioural changes within the firm, taking place in its internal functions and processes and, even more deeply, in the entrepreneur's mind set.

Among different theory-based methods, the Realist Evaluation paradigm, developed in 1997 and further specified in 2004 by Pawson and Tilley, has been identified as the one that best suits the specificities of this analysis, mainly because of the high importance attributed to the role of context variables (in this regard see also Henry et al., 1998 and Astbury, 2013). The intervention logic is considered within existing socio-economic, institutional and cultural frameworks, which influence the mechanisms of change expected to be activated by interventions. The choice to focus on the Realist Evaluation approach was indeed driven by the need to take the context into account when exploring how and whether certain effects generated by the ERDF policy instruments are achieved, given that ERDF interventions take place in highly diversified contexts. This holds true especially when dealing with policies supporting SMEs' innovation and development, which are influenced to a high extent by "place-based" assets.

Realist Evaluation attempts to answer three questions:

- What works for whom?
- In which contexts a particular policy instrument does or does not work?
- Which are the mechanisms triggered by the policy instrument in a given context that determine the instrument's effectiveness?

Answering these questions means assessing the causal relations existing between three dimensions: i) 'Mechanisms', which are changes in the regular patterns of behaviour triggered by the public intervention; ii) the 'Context', i.e. the mix of relevant characteristics of the environment in which the programme is inserted; iii) 'Outcomes' generated by the interaction between mechanisms and the context's conditions. Different outcome patterns stem from specificities of both the context and mechanisms and generative mechanisms can only work if circumstances are right.

Carrying out a Realist Evaluation implies that Context-Mechanisms-Outcomes (CMO) configurations are detailed that identify and explain the instrument's logic, the theory of change underneath it, and describe which effects are expected to be generated by the decision maker. Also, by unpacking the various stages of the causal chain, Realist Evaluation tries to disentangle which bits of an intervention work and which bits do not. The theory may be either explicitly acknowledged by the policy maker or may be based on implicit assumptions that need to be disclosed through interviews. Since different stakeholders can provide diversified

views about the policy instrument's rationale, it is important to put the different perspectives together in order to draw the complete picture about the theory of intervention.

In our analysis, the theory derives from direct interviews to the Managing Authorities and the implementing bodies, a desk analysis of the programming documents and the study of monitoring data about the beneficiaries and projects supported. This evidence adds to the analysis already carried out at OP level in the case studies.[13]

Given the complexity of the instrument's theory, more than one CMO configuration has been outlined for each policy instrument, each one focusing on specific aspects of the theory.

Special attention was paid to reconstruct the logics of intervention and behavioural changes in firms from an ex-ante perspective, trying to minimise the danger of post-hoc rationalisation of the intervention logic. When relevant changes occurred during the programming period (it is the Apulian case), we distinguished between initial and subsequent theories and respective CMO configurations.

The discrimination between context, mechanisms and outcome variables is not always obvious (Jagosh et al., 2012; Dalkin et al., 2015): some variables, for instance, could contemporary operate as exogenous context factors but also mechanisms driving the generation of outcomes. When this was the case, it was pointed out in the analysis.

2.3 Testing the theory through the Bayesian Networks

The ex-post perspective of the evaluation allows us to go beyond the description of the theory to actually test the validity of the assumptions underneath it. Initial expectations about the instrument's causal chain can be checked against the actual changes observed in reality. We did this by directly asking decision-makers inside the firms to express a judgement on the links between the policy instrument which they benefitted from and possible behavioural changes and ultimate outcomes. The evaluation questions that are meant to be answered with this exercise, that add to the already mentioned research questions of Realist Evaluation, are the following:

- Was the theory appropriate, i.e. did expected outcomes and mechanisms expected to be triggered by the policy instrument actually materialise as anticipated by the initial theory?

- Did the policy intervention produce any unexpected outcome?

- If deviations from the theory are recorded, why did they occur?

This exercise has been operationalised by collecting information and opinions through three on-line surveys, one for each instrument to be analysed, and applying different statistical tools to process the bulk of the data derived from the surveys. In more detail, the investigation strategy followed the three steps, set out in the following paragraphs.

2.3.1 Collection of information through on-line surveys

Three surveys were launched in parallel between the end of July/beginning of August and mid-September 2015 to SMEs that had benefitted from the three policy instruments under examination. Contact details of beneficiaries (names, email addresses, size and location as a minimum, in some cases complemented by the name of the contact person, sector of activity and others) were provided by the Managing Authorities or implementing bodies. The questionnaires have been designed after examining the theory of intervention of each instrument, in order to tailor the survey according to the characteristics of the policy instruments under investigation, the objectives they are supposed to achieve and the

---

[13] Please refer to the Second Intermediate Report.

characteristics of the targeted enterprises. They nevertheless rely on a common structure, including a section which collects records on the general features of the enterprise, one on the economic results achieved thanks to the investment, one on the enterprise's opinions about the policy instrument's delivery process or other issues, and another one thought to capture contingent behavioural changes in the way of doing business caused by the policy intervention (see questionnaires at the beginning of Annexes 1, 2 and 3).

A total of 698 valid questionnaires were collected. In particular, the sample size is:

- 200 enterprises in Poland, out of a total number of 586 targeted beneficiaries (response rate: 34.1%);

- 399 enterprises in the Italian region of Apulia, out of a total number of 2,441 targeted enterprises that have already completed the investment project and received the public support payment. Not all beneficiaries could be contacted as email addresses were available for 1,586 enterprises only. This implies a 25.2% response rate.

- 97 enterprises in the Spanish region of Castile and León, out of a total number of 299 targeted enterprises which have already completed the investment project and received grant (response rate: 32.4%).

Most of enterprises filled in the questionnaire on-line, but some preferred to do it on paper or to be interviewed telephonically.

Every survey could be affected by some biases (see Arrow et al., 1993; Kelly and Clinch, 2006; Boynton and Greenhalgh, 2004) and the team has devoted great attention to reduce this risk. The following action were undertaken to address possible biases and ensure the quality of the survey's responses:

- **Risk of low response rate**. The three surveys were launched during the summer break, which increased the probability of obtaining very low response rates. The implementing bodies provided the email addresses of beneficiary enterprises, which was the necessary condition to implement the surveys. After the launch of the survey, up to four reminder emails were sent to enterprises which had not answered the questionnaire yet. Moreover, the on-line surveys were complemented by phone interviews targeted to enterprises which had partially completed the questionnaire, in order to encourage them to finish it, even over the phone if considered more convenient. This method allowed very satisfactory response rates to be achieved for the three surveys.

- **Inability of interviewed people to perfectly understand the questions** ('information bias'). This risk was minimized by testing each questionnaire before launching the survey with 5-10 phone interviews to SMEs, so as to calibrate its structure, the number of questions and the duration, as well as to make sure that the targeted enterprises were capable of interpreting and responding to the questions. The questionnaires were translated into the local language. Moreover, comments were asked to both the European Commission and the implementing bodies of each policy instrument.

- **Getting the questionnaire to the correct person in the business**. This could be a serious issue in surveys, more relevant particularly when the survey is addressed to larger enterprises (medium-size SMEs). The questionnaires were all aimed to the enterprise owner or the managing director or in general the entrepreneur whatever his/her job description. This was easily achieved in the case of Apulia, where the majority of beneficiaries are individual businesses or micro enterprises. In the Spanish and Polish cases, the list of beneficiaries included the contact details of the enterprise legal representative or managing director, which was a significantly advantage. A

question was included in the questionnaires to check the position of respondent. In case of doubts (particularly for Spanish enterprises), some telephonic recalls were made to verify that the questionnaire was actually filled in by the desired person.

- **Distortion of responses resulting from the way particular questions were presented or inconsistent interpretation of questions**. Testing the questionnaires with pilot interviews and circulating them for comments before the launch of the survey was (also) aimed to detect possible leading or unclear questions, which were properly reformulated. Where some uncertainty in the way how a question could be interpreted was detected, notes were added in the questionnaire to clarify how that question had to be interpreted. All survey's responses were then reviewed by the evaluator team and their consistency was checked. In a few cases, some clearly inconsistent responses were detected[14] and the enterprise was contacted again telephonically to obtain clarifications. The responses were then revised accordingly.

- **Distortion of responses resulting from different reactions to the personality of interviewers** ('interview bias'). In those cases where SMEs preferred to provide their opinion by phone, the interviewer was carefully instructed in order to not accidentally lead companies in a particular direction and to be polite if the person interviewed did not want to answer sensitive questions.

- **Identification of the effect directly imputable to the support**. The link between the support received and the reported subsequent increase in economic performance of behavioural changes was not easy to be ensured, as respondents might find difficult to distinguish this from other factors. This problem was reduced, but not necessarily wiped out, by explicitly asking enterprises to focus on the effect achieved thanks to the public support ("*thanks to the technological investment(s) supported by BGK …*", "*thanks to the investment for which you received the contribution of Title II …*", "*thanks to the R&D project for which you received ADE support …*"). The statistical analysis of responses (see below) takes into account a number of other variables which could affect the enterprise performance, so as to pinpoint the effect of public support "net" from other possible determinants.

- **Possibility of social desirability bias** ('strategic behaviour'). When respondents select one answer over others in order not to reveal their true opinion/position a systematic error is introduced into the sampling. In order to deal with this risk, the anonymity of the questionnaire was ensured, so as to reduce suspicions by the respondent enterprise. Indeed, a diversified spectrum of opinions was provided by enterprises, including some sharp negative judgements on the support received.

- **Imbalances in the distribution of the sample of respondents** compared to the total population of beneficiaries. In order to avoid a potential skewness in the distribution of the sample of respondents in terms of firm heterogeneity, while the survey was still ongoing the sample was frequently checked and compared to the population of beneficiaries with regard to pillar variables such as size, sector of activity, location, volume of the investment project and of the public contribution, so as to ensure that the sample was sufficiently representative of the targeted population. In case large deviations were detected, additional invitations to participate in the

---

[14] It was possible to directly compare some responses across each other or with data on projects and beneficiaries provided by the implementing bodies. Inconsistencies could refer, for example, to the number of employees or the number of R&D projects carried out before 2007 (for the Spanish instrument). It was however not possible to check the truthfulness of all answers, such as those related to sales and export growth.

survey were sent to underrepresented groups of enterprises[15] (see the results of the analysis of representatives in Annexes 1, 2 and 3).

- **Bias due to the focus on completed projects**. In the Apulian and Spanish cases, the list of beneficiaries provided by the implementing bodies included only enterprises which had already completed their investment project. As far as the Apulian instrument is concerned, enterprises which have completed the project are the largest majority of all beneficiaries (almost 80%), which reduces the risk of significant bias in the analysis. In the case of the Spanish instrument, the questionnaire asks enterprises how many R&D projects they received public contribution for, including unfinished and interrupted projects and those projects for which no payment had been received yet. When answering questions about the effect of support, enterprises were invited to refer to all the projects supported between 2007 and 2013, included the unfinished ones.

2.3.2 Preliminary analysis of results

After conducting the surveys, we analysed in-depth the information collected through simple statistics descriptive of the responses to each question, but also regression models in order to test well-known associations between the variables identified in previous literature and from experts' knowledge in the field.[16] A similar approach was adopted by Mole et al (2009). In their attempt to use theory-based impact evaluation to assess the effectiveness of an English business support programme for SMEs, they collected data on a large sample of small firms and tested the assumptions that emerged from the programme theory through a Probit model.[17] The authors considered particularly simple evaluation questions related to the factors that could explain the probability of receiving assistance and affecting employment and sales.

While these approaches are suitable when the main interest is to see to what extent a policy intervention has produced the intended effects and the statistical significance of the coefficient for the treatment effect is to be estimated, they have the drawback that they consider the firm as a 'black box' and do not answer the 'why' question. The causal mechanisms and behavioural changes of firms that are exposed to the policy are not discovered.

2.3.3 Bayesian Network Analysis to uncover the causal chain

2.3.3.1 *Main features of the Bayesian Networks*

The Bayesian Network Analysis (BNA) is an advanced but relatively intuitive approach that combines graphical map analysis with statistical analysis to show the nexuses linking variables. A Bayesian Network illustrates the probabilistic relationship among a set of variables and their conditional independences. It provides a compact representation of a joint probability distribution (Murphy, 1998; Horny, 2014).[18]

---

[15] In the case of the Apulian instrument, for instance, greater efforts were made to obtain the participation of individual and micro enterprises.

[16] Regression analysis is a statistical process for estimating the relationships among variables. It includes many techniques for modelling and analysing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables (or 'predictors'). The choice of the model of analysis depended on the nature of the dependent variable of interest. If the variable assumes two discrete values (e.g. 'Yes' or 'No'), we exploited a logistic model (Greene, 2011; Verbeek, 2008); for categorical variables that can take unordered multinomial values, we used a multinomial logit model (Long and Freese, 2006; Greene, 2011); for categorical and hierarchical variables we used the ordered logit model (Greene 2011; McElvey and Zavoina, 1975).

[17] The Probit model is a type of regression where the dependent variable can only take two values.

[18] Thanks to their versatility and modeling power, BNs are now employed across a variety of fields like finance, banking, medicine, robotics, civil engineering, geology, geography, genetics, forensic science, ecology, and industry for the purposes of analysis, simulation, prediction and diagnosis (see for details, Nadkarni and Shenoy, 2001; Kenett, 2012; Kenett and Salini, 2012; Horny, 2014). In particular, Kenett (2012) discusses applications of Bayesian Networks

Bayesian Networks are defined by a network structure, i.e. the directed acyclic graph (DAG), and a set of conditional probability distributions associated with the variables entering the DAG. The DAG is a set of random variables represented by nodes. The main role of the network is to express the conditional independence relationships among the variables in the model through graphical separation. If the arrow goes from node A to node B, the interpretation is that variable A (called 'parent') is correlated with/depends on B (the 'child'). In other terms, the DAG graphically represents a hierarchical arrangement of variables, based on the statistical analysis of joint probabilities (Horny, 2014), which in turn can be broken down in a number of conditional probabilities (Markov property, see Box 2).

The hierarchical arrangement of variables (A is linked to B, which is linked to C, which is linked to D etc.) can be interpreted as a conjecture of causality between these variables. Causal relations however have to be validated by the analyst on the basis of prior knowledge on the variables. The literature, available background information or merely the way how the variables are defined can easily indicate the most reasonable or straightforward causal direction between certain variables. For instance, if the BN finds that:

- variable A 'Public support' is linked to variable B 'Purchase of new technology with public aid',

- and variable B 'Purchase of new technology with public aid' is linked to variable C 'Enterprise sector of activity',

it is clear that the causality relations go from A to B (the public support determines the purchase of new technology) and from C to B (it is the sector that influences the decision to purchase the technology, and not the other way round). The BN automatically links the three nodes by arrows, but the causal direction should be checked by the analyst. In those cases when no definite causal relation is known or can be assumed, the nodes of the network can be simply connected among each other without a specific direction.

In the context of this study, the advantages of resorting to Bayesian Networks are several. First of all, Bayesian Network are helpful when the goal is to identify the multiple and interconnected determinants of a behaviour, or an outcome, and to understand in which way they are linked one to the other. Given the complex nature of SMEs, it is difficult to know a priori the causal mechanisms that link all the possible explicatory and dependent variables under investigation. BNs help untangle the knot and reveal the underlying and, at least partially, unknown causal system by verifying from the data the existence of confounders, i.e. variables which are both dependent and independent variables in the statistical model, and estimating the conditional probabilities for all the variables of the model.

In this regard, it is worth to highlight that the Bayesian Networks do not necessarily show the same correlations that emerge from regression models. Regression analysis identifies the variables that more significantly influence a previously defined dependent variable. Differently, the Bayesian Network displays which variables are independent of each other, on the basis of their conditional probabilities of occurring. For instance, if a regression shows that the SME economic performance depends on the size of the public support received, the Bayesian Network might show instead that the economic performance depends on the type of change occurred in the enterprise production function (e.g. acquisition of new production technologies), which is turn associated with the public support. Hence, economic performance and public support are independent of each other in the network, once it is controlled for other variables.

---

to: management efficiency, web site usability, operational risks, biotechnology, customer satisfaction surveys, healthcare systems and testing of web services.

Second, the Bayesian Networks can be used for two types of inference support: predictive and diagnostic (Kenett and Salini, 2012). The predictive support, also called 'top-down reasoning', deals with extracting evidence/information from the parent variable and using it to predict the pattern of their children, namely its posterior conditional probability distribution. The diagnostic support, or 'bottom-up reasoning', works in the opposite direction: based on the evidence on child variables, the BN can be used to analyse the distribution of a parent variable.

A third advantage of building BNs rests on their ability to work as *oracles for intervention*. Under the assumption that each parent-child relationship in the network represents a stable and autonomous mechanism of change, organizing the knowledge about a phenomenon, or a policy instrument, in such modular configurations permits the effect of external interventions to be predicted. Thanks to this modularity and the possibility to look at the arcs to carry out top-down or bottom-up reasoning, it is possible to perform simulations and assess various scenarios, by simply changing or setting the value of particular variables and verifying how its respective parent or child variables consequently change. For example, knowing that the level of exports is linked to the size distribution of the enterprise, one could simulate what would happen to the distribution of the outcome variable when the distribution of the size variable changes, e.g. by increasing the number of medium enterprises and decreasing the small ones. A Bayesian Network can therefore be considered an innovative approach to support strategic decisions (Pearl, 2000; Spirtes et al., 2001; Glymour and Cooper, 1999).

Box 2. The analytics of Bayesian Networks in a nutshell[19]

The first systematic presentation of Bayesian Networks (BN) was by Judea Pearl (1987).[20] A Bayesian network, denoted by B = (G,θ), specifies a multivariate probability distribution over a set of random variables, $X = \{X_1, X_2, \ldots, X_n\}$ through two components: a directed acyclic graph (DAG), which is the qualitative component of the network, and a set of local probability distributions (CPDs), the quantitative component, each of them associated to a random variable. In the case of discrete random variables these local distributions are in the form of conditional probability tables (CPTs).

The DAG, G = (V, A), is the structure of the network and it is defined by two sets: the set of nodes (V) and the set of directed edges or arrows (A). Each node on the graph represents a random variable and the edges represent direct dependencies among the variables. Specifically, an edge from node X_i to node X_j denotes a statistical dependence between the respective variables. Thus, the arrow indicates that a value taken by the variable X_j depends on the value taken by the variable X_i. Node X_i is then named 'parent' of X_j and X_j is referred to as the 'child' of X_i. The parents of each node are its direct causes.[21] An extension of these genealogical terms is often used to define the sets of 'descendants', namely the set of nodes from which the node can be reached on a direct path. Formally, the set of parents of X_j is denoted by $Pa(X_j)$ and its set of children by $Ch(X_j)$.

The set of conditional probability distributions on X, denoted by θ, are the parameters of the network. In order to derive a joint probability distribution from a Bayesian Network, the directed Markov assumption is made, according to which each variable is independent of its non-descendants in the DAG given the values of its parents. Consider the set X of random variables $X_1, \ldots, X_n$ and an arbitrary state $x = x_1, \ldots, x_n$ of the variables in X. Let $pa(X_i)$ denote the

state of $Pa(X_i)$, i.e. some specific configuration of the values of the variables in $Pa(X_i)$. Then, the Markov assumption entails the following equality:

$P(\boldsymbol{X} = \boldsymbol{x}) = \prod_{i=1}^{n} P(X_i = x_i | pa(X_i))$

where $P(X_i = x_i | pa(X_i))$ represents the local distributions and are provided by the conditional probability tables.[22] They indicate what is the probability that the variable X_i assume the value x_i, given that its parents are in the state $pa(X_i)$. So, the above equation specifies how the joint probability distribution is computed from a set of CPTs.

The probabilistic inference in a BN is based on the notion of 'evidence propagation', meaning that conditional probabilities $P(X_i = x_i | pa(X_i))$ can be updated continuously. This allows us:

- to calculate again the conditional probability distribution of a variable after having obtained new or more up to date information of other variables in the model;

- to construct hypothetical scenarios, by changing the distribution of a variable to predict the resulting behavioural pattern of its parents and children variables.

Source: CSIL.

2.3.3.2 *Bayesian Network Analysis in practice*

Before the network can be used in real-life applications for either diagnostic or predictive purposes, it needs to be properly validated. When the size of the sample is small, small changes to the data can produce large changes to the learned structure of the network and this can undermine the validity of the network. To deal with this issue, a robustness analysis can be performed using two methods: i) the structure perturbation and ii) a cross-check strategy. In our analysis, we applied both the methods. The structure perturbation, as a means of assessing the network stability, consists in checking the validity of the main relationships in the network by varying some part of it or marginalizing some variables (Peng and Ding, 2003; Daly et al., 2011). In our analysis, for example, we tested the networks upon different sets of variables, and we alternatively included single variables or their principal components.[23] With the cross-check strategy, we further tested the main connections displayed in the network, by using conventional methods such as regression models, so as to test the statistical significance of the correlation.

Sensitivity analysis can also be used to understand how much confidence to place in the network. The sensitivity analysis may be performed either as one-way deterministic sensitivity analysis, i.e. varying one parameter at a time over a specified range, or as a probabilistic sensitivity analysis; namely varying all parameters of the network at once over a specified probability distribution (Horny, 2014). We tested the most important relationships in the network by using the first type of sensitivity.

Finally, it should be said that the external validity of the network can be ensured by the degree of representativeness of the sample of the targeted population. As long as the sample is representative of the entire group of beneficiary enterprises, the causal network based on sample data can be considered to hold for the population as well. As mentioned in section 2.2.1, for the purpose of our study we paid attention to avoiding potential skewness in the distribution of the sample of respondents at least in relation to key variables which were available for both the sample and the population groups. In general, when comparing the distribution of enterprises in the sample and in the population according to their size, sector of activity, geographical location, volume of the investment project and of the public contribution

---

[22] When X_i is a root node, $P(X_i = x_i | pa(X_i))$ refers to the absolute distribution of X_i, i.e. $P(X_i = x_i)$.

[23] The Principal Component Analysis allows a set of observations of possibly correlated variables to be transformed into a set of values of linearly uncorrelated variables, called 'principal components'.

received,[24] we found that the sample represents an overall unbiased approximation of the population (see Annex 1, 2 and 3).

Box 3. How to construct and interpret a Bayesian Network

The procedure for constructing Bayesian maps in the context of our study proceeded in the following stages:

- We first outlined the theory of intervention of the policy instrument, which allowed us to determine the variables of interest needed to test such a theory and to design the survey's questionnaires accordingly. These variables refer to the context in which SMEs operate, the characteristics of the SMEs and their entrepreneurs, features of the policy instrument, activities implemented, possible behavioural changes and outcomes.

- Data were processed using the open source software GeNIe. We constructed discrete Bayesian Networks, where all the variables are defined to be either categorical ('Yes' or 'No') or ordinal (e.g. from 'Very low effect' to 'Very high effect'). In case of continuous variables, these were transformed into discrete variables.[25]

- The DAG was then built and the local probability distribution simultaneously estimated. To this end, it could be decided to let the software freely learn from the data, estimate the probability distribution and set up the corresponding network (automatic learning approach).[26] As an alternative, one may prefer to build the Directed Acyclic Graph using a priori knowledge and assumptions about the dependence of the variables, and then use the data to estimate the local probability distributions. We preferred to use the automatic learning approach, but we also tested the robustness of the network assuming some prior knowledge on selected variables.

At this point the Bayesian Network is fully specified. A rough impression of what this could look like in GeNIe is shown in Figure A.

Figure A. A fully specified Bayesian Network in the GeNIe environment
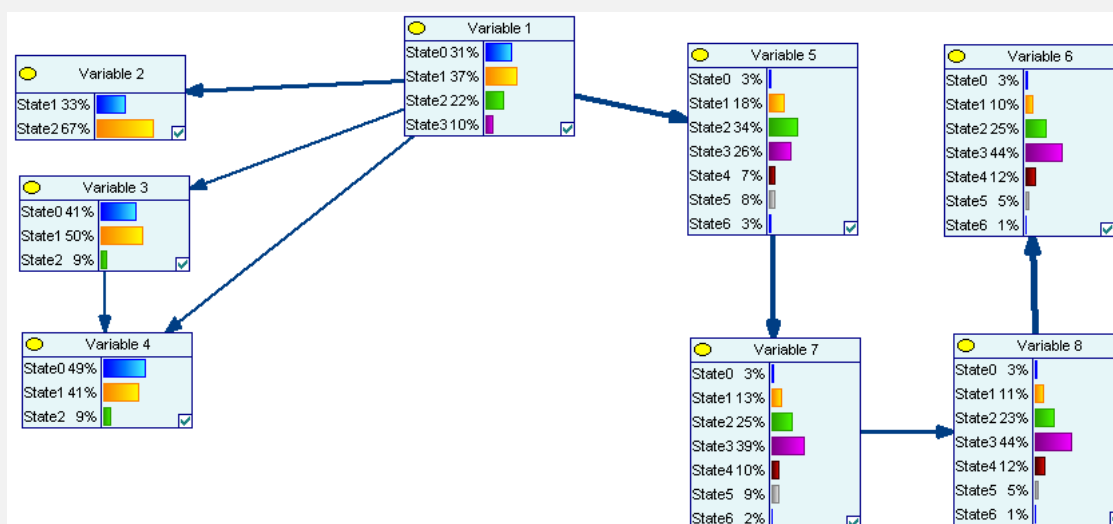
Figure A shows a Bayesian Network with eight nodes and a condition probability table for each node. For example, in this figure we note that, overall in the sample, 31% of those interviewed experienced a very low value of the variable 1; in contrast 10% have a very high value of the same variable. An arrow between two nodes indicates that the two nodes are dependent,

---

[24] These data were provided by the implementing bodies (for the Spanish and Italian instruments analysed) and the Managing Authority (for Polish instrument) upon request.

[25] The hierarchical model was used to obtain the classes.

[26] Example of algorithms of network learning are discussed in Lucas at al. (2004) and in Kalisch and Buhlmann (2014).

meaning that they influence each other. The arrow from variable 1 to variable 2 suggests that a value taken by the variable 2 depends on the value taken by the variable 1.

The thickness of arcs between nodes indicates the degree of influence one node has on the other one (see for details Koiter, 2006). It displays how strong the connection between two variables is: the greater the thickness, the stronger the link.[27] The thickness of arcs is associated to an index which ranges from 0 (the weakest influence) to 1 (the strongest influence), which is automatically estimated by GeNIe.

Note: The different states of a variable can be read depending on how the variable is expressed. For example, a categorical variable such as the gender of the entrepreneurs can take on two states, 'Male' and 'Female'. An ordinal variable about the satisfaction of the enterprise for the smoothness of the application process could go from 'Not satisfied at all' to 'Very satisfied'.

Source: CSIL.

2.3.4 Reassessment of the theory

The results of the BNA, regression models and other analyses of data are combined and interpreted to verify to what extent the initial theory of intervention was implemented according to initial conjectures. Thus, the CMO configurations are re-examined to point out:

- whether the expected links between mechanisms, outcomes and context variables actually materialised;

- whether other mechanisms, outcomes and context variables, not explicitly acknowledged or intended ex-ante, have emerged from the empirical analysis and whether the newly found correlations between variables, at least the strongest ones, are backed by the literature.

The ex-post rationalisation of the theory of the policy intervention is aimed to provide insights on the reasons of success or failure of ERDF support. The triangulation of different sources of evidence and data processing techniques ensures the robustness of results.

---

[27] The thickness of arcs can be calculated in two ways, normalized and non-normalized mode. If the normalized mode is chosen, the thickest possible arc is given to that arc that has the highest strength of influence. The thicknesses of all other arcs are calculated proportionally to the thickest arc. In the non-normalized case, the thickest possible arc will only be given to an influence value of 1 (influence values always range from 0 to 1). We adopted the last option.

3   SUPPORT FOR TECHNOLOGICAL INNOVATION IN POLAND

3.1   Description of the policy instrument

3.1.1   Background context

Since Poland joined the European Union in 2004, it has been successfully catching up with the 'old' EU Member States thanks to its strong economic performance, based on low labour costs and product specialisation towards low or medium-low technology goods. Poland is the only EU country that managed to avoid the recession in 2008-2010, mainly as a result of a rather strong domestic demand. As Poland moves up the income ladder, cost competitiveness is expected to deteriorate. Over the last decade Poland has upgraded its industry by adopting advanced technology and acquiring modern machinery, but the innovation propensity and technological progress of SMEs is still low. Investment in industrial innovation and public R&D are needed to increase productivity and maintain a positive performance.

The OP Innovative Economy (2007PL161PO001) was the widest public programme aimed at supporting innovation in Poland during the programming period 2007-2013. The OP pursued an innovation-led growth, by supporting investment in innovative products and processes, facilitating technology transfer, stimulating the business environment, revamping ICT infrastructure and improving cooperation between academia and the private sector. The majority of its policy instruments were targeted on SMEs. More than 90% of the OP total spending was devoted to R&D, innovation and ICT. Measures for innovation, in particular, were mainly spent on capital investment for technological improvement and absorption.[28] Among these is measure 4.3, called "Technological Credit", which is the policy instrument under evaluation. It consisted of a grant to Polish SMEs that had already obtained a promise of a bank loan for an investment in technology. The grant was meant to cover part of the credit provided by the commercial bank.

This instrument was managed by the Polish National Bank of Economy - Bank Gospodarstwa Krajowego (BGK), designated as the implementing body on behalf of the Ministry of Infrastructure and Development. The instrument's initial public allocation amounted to EUR 409.85 million, which was increased to EUR 432.60 million after reprogramming.

3.1.2   Eligibility and selection criteria

The Technological Credit was targeted at all Polish SMEs (enterprises below 250 employees, as per the European Commission definition), with no regional or sectoral criteria. When launched in 2009, the instrument could finance the following categories of expenses:

- Purchase and leasing of fixed assets, including buildings, on condition that such assets were functionally related to each other and were needed to achieve the objective specified in the contract for Technological Credit;

- Purchase of intangible assets, such as patents and licenses.

In addition to that, while the instrument remained strongly connected with technological progress, in 2011 the following types of expenditure were made eligible for financing in combination with the acquisition of the assets mentioned above:

---

[28] For a complete analysis of the strategy of the OP, see the case study conducted under the same evaluation contract: "Ex post evaluation of Cohesion Policy programmes 2007-2013 financed by the European Regional Development Fund (ERDF) and Cohesion Fund (CF). Work Package 2: Support to SMEs – Increasing Research and Innovation in SMEs and SME Development". Contract number 2014CE16BAT002.

- Construction and expansion of existing structures, buildings, machinery, equipment constituting fixed assets;

- Purchase of land or the right of perpetual usufruct of land, up to 10% of eligible expenditure;

- Purchase of external advisory services for studies, reports and technical projects needed to implement new technology within the framework of the technological investment.

These expenses had to be related to the introduction of a new technology in the SME production process, which had not been present in the world market for more than five years. The law initially specified that only the implementation of patented technology could be supported. The technology could be patented by the buying enterprise (either in Poland or by the European Patent Office) or could have already been patented by somebody else earlier. Since the process of getting a patent was time-consuming and the technology could not be considered new by the time when the process was finished, this requirement was removed in May 2011.

No lower or upper threshold for the total value of the technological investment was set. The public contribution could reach a maximum of PLN 4 Million (about EUR 1.1 Million). The value of the grant was calculated on the basis of the credit, i.e. it had to account for between 40% and 70% of the total value of the credit. After 2011 the grant started to be computed on the basis of the total eligible expenses, in order to align it with the usual practice in EU support, but also as an attempt to increase the popularity of the instrument. The percentage for the grant calculation based on total eligible expenses was the same as when it was based only on the part of eligible expenses financed by the credit.

In order to select the investment projects to be supported, BGK applied both formal and substantive selection criteria. The formal criteria included the submission of the application on time, accuracy and completeness of the application documents and fulfilment of the eligibility criteria. The substantive criteria included creditworthiness of the applicant, having already received a promise of a loan by a bank, and having signed a declaration in which the applicant ensures the sustainability of the results, as shown by some indicators. These indicators included the number of implemented new technologies, number of new products and services created using new technology and/or number of improved products and services thanks to the new technology.

Project applications were evaluated and possibly accepted one at a time on the basis of the selection criteria, up to the depletion of the financial resources allocated by each call (see below).

3.1.3 Delivery process

The following steps had to be carried out for the enterprises to apply and possibly receive the grant:

1. The SME submits an application for investment credit (formally called "Technological Credit") to a commercial bank. In Poland there are 17 commercial banks eligible to give the Technological Credit, which have been selected through an open and transparent procedure.[29]

2. The credit is awarded on regular market basis, i.e. charging the same interest rates as those which the bank offers for other investment credits.

---

[29] All banks could participate in the instrument. All banks that were interested in participating in the instrument and had applied within the deadline were declared eligible to assign the Technological Credit. There were no additional criteria that prevented some banks from participating.

3. The commercial bank verifies the credit capacity and financial credibility of the SME and whether the project is financially attractive; if positive, the bank issues a credit promise.

4. After receiving the promise of a Technological Credit, the bank submits to BGK the application for public support (called the "Technological Premium") on behalf of the client SME.

5. BGK evaluates whether the technological investment is compliant with the selection criteria mentioned above.

6. After a positive evaluation by BGK, the commercial bank signs the technological credit agreement with the entrepreneur and BGK signs the project co-financing agreement with the SME.

7. At that point, the beneficiary can start the implementation of the technological investment project. In 2011, the rules were changed and the SME was allowed to start the investment project after applying for the Technological Premium, thus before signing the agreement with BGK.

8. Upon completion of the project, the SME submits the application for the final payment. BGK checks whether the investment was implemented in compliance with the project co-financing agreement. In particular, the Bank checks that the eligible expenditures promised ex-ante have actually been undertaken. The following other requirements had to be fulfilled in order to receive the grant:

    a. The Technological Credit was disbursed, the project was finished and the new technology was implemented.

    b. Originally the SME had to prove that a certain amount of sales of new products or services had been made thanks to the application of the new technologies, showing the paid invoices of new products or services. In addition, the SME had to submit an independent opinion from a research organisation certifying that those products or services were actually developed with the use of the new technology financed by the Technological Credit. Since 2011 this requirement was removed and the SME simply had to show that the investment project had been implemented.

9. After a positive assessment, BGK transfers the Technological Premium directly to the commercial bank to pay off part of the Technological Credit given to the SME. In 2013 the possibility for SMEs to apply for an interim payment was introduced.

3.2 Theory of change

3.2.1 The logic of intervention explained

The primary objective of the Technological Credit is to sustain investments by SMEs associated with the adoption of new production technologies. By supporting Polish SMEs that want to replace their fixed tangible assets with more modern ones, the policy instrument aims to stimulate technological advancement in firms, involving modifications of existing production processes. In doing so, enterprises are expected to introduce new products or improve their quality, thanks to which an increase in market demand could be observed. By increasing the economic output and performance of the supported companies, at an aggregate level the instrument intends to raise the overall competitiveness of the Polish industrial fabric.

This instrument fits well into the strategy for increasing the innovativeness of the economy set out by the Government for the period 2007-2013, which puts innovation at the centre of political efforts to maintain the fast development of the economy (OECD, 2010). Over the past years, Poland's productivity has grown, but not enough to catch up with more advanced EU

countries. According to Eurostat, in 2013 average productivity per hour worked was around 33% of the EU28 average. The Technological Credit is one of the many instruments implemented in Poland to increase the level of innovative activity in SMEs and, more specifically, to introduce more effective and efficient production technologies.[30] By granting a bonus to SMEs which contract a technological credit with commercial banks, BGK reduces the financial burden entailed by the investment and the SMEs' indebtedness. Thus basically the policy instrument tries to overcome the barriers posed by limited access to finance that generally cause most trouble for SMEs.

The main conditions on which the intervention works and the expected outcome is achieved include: i) the participation of a relatively large number of SMEs, ii) the availability of sufficient financial resources, and iii) the successful implementation of other policy instruments focused on SME innovation.

By linking the public support to bank lending, the Technological Credit aimed to achieve a secondary goal: contributing to creating awareness and experience in the delivery and use of financial instruments[31], which are supposed to increasingly replace the traditional grant support during the 2014-2020 programming period. While not being properly defined as a financial instrument, the Technological Credit takes a step away from traditional grant schemes and pursues the objective of making SMEs, the implementing body and commercial banks more used to new forms of support initiative. This is in line with the European Commission's aim for a best use of EU funds (European Commission, 2012a; European Parliament and Council, 2013), on the basis that financial instruments promote better quality projects, due to (a) an incentive for a better performance on the side of the final recipients who need to repay funds; (b) the expertise and know-how brought in by the private sector during selection and implementation of projects. As such, financial instruments, like soft loans,[32] are considered to be particularly adapted for supporting innovative projects (EIB and European Commission, 2014). The Technological Credit is designed to stimulate the participation of the private sector and ensure a strong commitment from the financial intermediaries, with the view to increasing efficiency in the delivery of public funds.

The two sets of outcomes expected to be produced by the policy instruments as described are associated with two CMO configurations, as illustrated in Figure 4. It is to be noted that the distinction between 'Context', 'Mechanisms' and 'Outcomes' variables may not be clear. Some variables, e.g., could contemporary operate as exogenous factors, but also mechanisms driving the generation of other outcomes. For instance, the variable "Other policy instruments supporting SMEs are successful too" could represent both exogenous context conditions and mechanisms of change, as the OP measures are strictly interdependent.

---

[30] Other relevant policy instruments implemented in the same period are the establishment of the Fund for Innovation Financing (measure 3.3), support to New investments with high potential of innovation (measure 4.4) and support to industrial R&D (measure 1.4).

[31] Financial instruments are defined as ''measures of financial support provided on a complementary basis from the budget in order to address one or more specific policy objectives of the Union. Such instruments may take the form of equity or quasi-equity investments, loans or guarantees, or other risk-sharing instruments, and may, where appropriate, be combined with grants'. Source: Art. 2(p) of Regulation (EU, EURATOM) 966/2012, Financial Regulation.
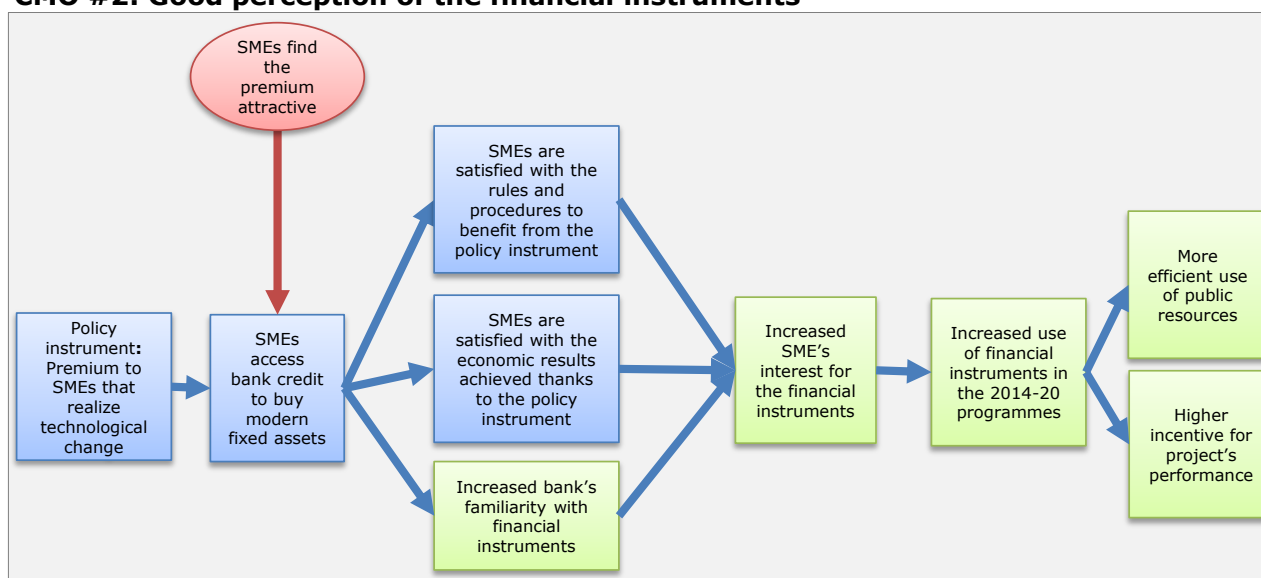
[32] I.e. loans with a below-market rate of interest.

Figure 4   Theory of intervention of the Technological Credit: CMO configurations

CMO #1: Economic effects of the Technological Credit
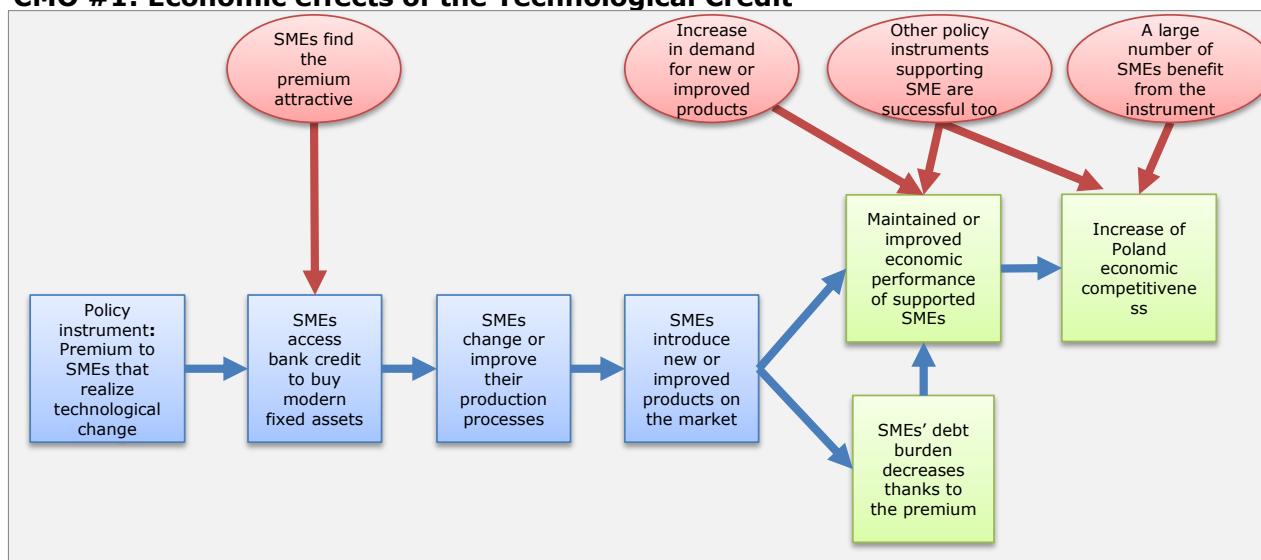
CMO #2: Good perception of the financial instruments

Note: Green-coloured boxes indicate the outcomes pursued by the policy maker; red-coloured circles indicate external conditions (i.e. specifications of context) upon which desired changes occur; blue-coloured boxes indicate the mechanisms at work along the causal chain leading to the outcomes.
Source: CSIL.

3.2.2   Support from the literature to the logic of intervention

The theoretical foundations and empirical findings emerging from the literature and helping us to understand the intervention logic of the instrument, with particular reference to the effects of technological change on the economic performance of enterprises, are now summarised.

The theory behind the policies supporting technological change in firms can be traced back to Solow (1957). In the neo-classical tradition, long-run macroeconomic growth is driven by enhancements of capital and labour inputs; technological innovation embodied in plant and equipment is conceptualised as any improvement in output that cannot be attributed to growth in quantities of inputs, but in productivity. The new growth theory considers technological change as an endogenous determinant of growth, being the result of decisions of profit-maximising agents (Romer (1986, 1990), Grossman and Helpman (1991) and Aghion and

Howitt (1992)). Endogenous growth models emphasise the importance of knowledge and entrepreneurship in the process of economic growth.

At the level of the enterprise, different performance measures can be used to study the outcome of technological innovation, including turnover, number of employees, market shares, profit, return on investment, survival probability (Weinzimmer et al. 1998: 238; Hubbard & Bromiley 1995; Hoy et al. 1992; Venkatraman & Ramanujam 1986; Campbell 1976; Brush & Vanderwerf 1992; Matikka 2002; Storey 1994; Kauranen 1994; Smith et al. 1988; Robinson et al. 1984; Dess & Robinson 1984). Other studies have used subjective assessment of firm performance instead or performance indicators calculated from financial statements (e.g. Powell 1992a; Robinson & Pearce 1988).

Technological innovation is likely to achieve observable economic results for enterprises in manifold ways. Business owners can use the upgraded technology to improve the production process and reduce the business costs. This may be attained thanks to efficiency gains from the production inputs (Perrin, 1997), such as employees' productivity or energy efficiency. When technological change allows a firm's product to be improved and the firm enjoys a better financial performance due to a rise in demand, the enterprise may expand, in terms of employment and fixed capital, and/or it may strengthen its position against rivals (Skuras et al, 2008; Dixit and Pindick, 1994).

A relationship exists between investment in fixed capital (plant, equipment) and product innovation. Smolny (2003) argues that there are complementarities between innovations and capital investments, without assuming a causal relation. For example, a new product requires a new production process and a new production process allows the production of a new good.

Technology has an important relationship also with human capital. Technological change is often associated with a shift in the demand for skills: more advanced technical skills facilitate the absorption of new technology and affect the impact of technological change on the firm's performance (Acemoglu, 2002; Autor, Levy, & Murnane, 2003; Garicano & Rossi-Hansberg, 2006). With specific reference to the ICT, it has been shown that technological change reduces the costs of communication and supervision and fosters organizational innovation (Bertschek & Kaiser (2004; Bresnahan et al. (2002) and Garicano & Rossi-Hansberg, 2006). In turn, organizational learning capability can affect product innovation performance (Hall and Bagchi-Sen 2007; Alegre and Chiva, 2008). Schmidt and Rammer (2007) find that the combination of product and organisational innovation has a positive impact on a firms' return on sales.

When considering exports as a performance indicator, studies like Syverson (2011) and by Gashi et al (2014)[33] show that technology-related factors influence the export behaviour of enterprises. Their estimates indicate that the accumulation of technology promotes exports and is an important source of international competitiveness for enterprises.

The amount of information about the effects of technological progress on variously defined performance indicators is generally not neutral with respect to the enterprise size. Speaking about exports, for instance, Wagner (1994) finds that the probability that a manufacturing German firm is an exporter increases along with firm size. There are numerous empirical studies relating technological change and innovation to firm size (for a review, see Baldwin and Scott, 1987 and Cohen and Levin, 1989). Research suggests that SMEs have understood the importance of innovating to compete in the market place and they possess some advantages for absorbing and generating innovation compared to larger companies. It is argued, for instance, that innovative activity can flourish the most in environments free of bureaucratic constraints and with less resistance to change, as in most SMEs (Scherer, 1988 and 1991; Link and Bozeman, 1991).

[33] The latter with reference to SMEs in transition countries.

At the same time SMEs face higher barriers compared to large-size companies. Financial constraints emerge among the prime barriers to technological innovation in the literature and recent business surveys among European firms. Stiglitz and Weiss (1981) observe that small firms are most likely to face the risk of credit rationing, due to adverse selection in a market with asymmetric information, high transaction costs and limited ability to provide collateral for bank credit. The Observatory of European SMEs revealed that high interest rates and other problems related to access to finance have been reported as the main constraints of innovation by 16% of interviewed SMEs (Flash Eurobarometer, 2007).

As this brief excursus in the literature shows, the rationale behind the Technological Credit measure finds justification in a well-established economic theory. In the following we explore how the theory was effectively put into practice and whether the expected causal chain of effects associated to technological progress actually took place.

3.2.3   Beneficiaries and projects supported

The policy instrument was delivered through five calls between July 2009 and October 2012. As mentioned in the previous section, various changes were made in the eligibility and selection criteria and the delivery process, aimed at increasing the interest of SMEs in the Technological Credit and making it easier and more attractive to apply. Looking at the number of applications received by call, it seems that the aim of simplifying and relaxing the eligibility and selection criteria in order to increase the interest of SMEs in the instrument was fulfilled. In June 2011 BGK received 156 applications in two days only, as compared with 124 applications received for the first call in more than one year. The fourth and fifth call recorded an even higher number of applications (Figure 5).

Figure 5   Number of applications for each call
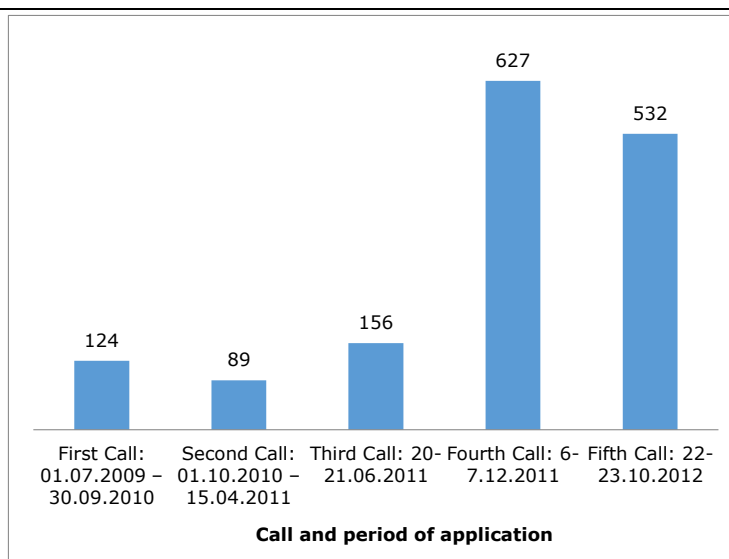
Source: CSIl elaboration of data provided by BGK.

In total 1,528 applications for the Technological Credit were submitted. About 45% of them were rejected by BGK: 13% after formal assessment and 32% after substantive assessment. Out of the number of applications submitted, 9% of them were withdrawn by the applicant SMEs during the selection process and before the signature of the agreement. The number of agreements signed over the entire period was 717.

Figure 6   Number of applications rejected, withdrawn and approved

Applications for which the agreement was signed: 717 (47%)

Withdrawn by the applicant SME after the promise of "Technological Premium": 72 (5%)

Withdrawn by the applicant SME during substantive assessment: 11 (1%)

Withdrawn by the applicant SME during formal assessment: 40 (3%)

Rejected by BGK after substantive assessment: 493 (32%)

Rejected by BGK after formal assessment: 195 (13%)

Note: The total number of applications received is 1,528. Source: data provided by BGK.

Almost 7% of agreements were terminated before the project implementation by both BGK and the beneficiaries. The usual reason why SMEs decided to withdraw from the support programme before or after the signature of the agreement was a change in their strategy, which made the technological investment no longer needed or desired.

In those cases in which BGK terminated the contract, this was due to beneficiaries' failure to submit the required safeguards in a form of a promissory note guaranteeing the realization of the project, their failure to submit the application for final payment on time,[34] or the recognition that the expenses incurred by the SME were ineligible.

The number of projects supported is 712, i.e. 47% of the total number of applications received.[35]

Information on investment projects and beneficiaries as of 31 March 2015 was provided by the Managing Authority and integrated with information on contact details and the sectors of beneficiaries provided by BGK in June 2015. Available data refer to the 712 investment projects supported, 83% of which are already completed and 16% still in progress (information is missing for 1% of projects). Those projects have been realized by a total of 586 different SMEs: actually, while most of beneficiaries carried out one investment project, 82 enterprises (14% of the total) implemented more than one project.

Figure 7   Breakdown of beneficiaries by number of projects implemented

SMEs implementing 2 projects; 12%

SMEs implementing more than 2 projects; 2%

SMEs implementing 1 project; 86%
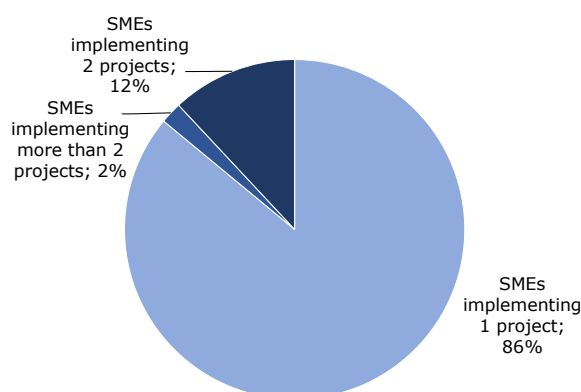
Source: CSIL elaboration of MA data.

---

[34] The agreement indicated that the application for final payment could not be submitted later that the last day of eligibility period, which was specified by the beneficiaries in the agreement.

[35] The number of agreements signed is about 700, lower than the number of projects because more than one projects can be realized from one agreement if they take place in more than one region.

The total financial volume of investment projects supported by BGK amounts to EUR 822.7 million; the total public contribution from the OP amounts to EUR 415.6 million and the total EU financing is EUR 353 million. Aid intensity, defined as the share of public contribution over the total value of the investment ranges from 18% to 70%, with an average of 54%. The average beneficiary received a public contribution amounting to EUR 584, around half of the maximum threshold allowed by the Managing Authority.

Table 2.   Financial accounting for investment projects: value of the investment, value of public support, value of EU financing, aid intensity

	Total for all 712 projects	Average	Minimum	Maximum
Value of the investment project (thousand EUR)	822,737	1,156	25	5,165
Value of public support from the OP (thousand EUR)	415,632	584	12	1,001
Value of EU financing (thousand EUR)	353,316	496	11	851
Aid intensity (public support / value of the investment)	-	54%	18%	70%

Source: CSIL elaboration of MA data.[36]

Table 3.   Financial support to enterprises by size class: value of the investment, value of public support, value of EU financing, aid intensity

	Micro enterprises			Small enterprises			Medium enterprises		
	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum
Value of the investment project (thousand EUR)	1,061	32	2,571	1,192	38	4,302	1,748	25	5,165
Value of public support from the OP (thousand EUR)	609	19	970	641	23	970	814	12	1,001
Value of EU financing (thousand EUR)	518	16	825	545	19	825	692	11	851
Aid intensity (public support / value of the investment)	59%	30%	70%	58%	18%	70%	49%	21%	61%

Note: Figures are at enterprise level. Number of beneficiary micro enterprises: 87; small enterprises: 216; medium enterprises: 283.
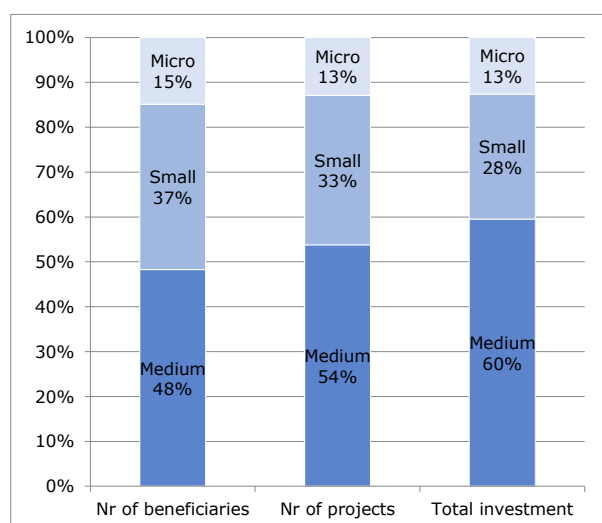
Source: CSIL elaboration of MA data.

Beneficiary enterprises are generally medium-size or small, representing respectively 48% and 37% of all beneficiaries, whereas microenterprises are only 15%. Medium-size companies also accounted for a higher number of projects implemented and for a higher total value of investment. The average value of the investment undertaken by all beneficiaries is approximately EUR 1.16 million, with little variation by size of beneficiary. There is however large variability in the investment volume of each project, which goes from a minimum of EUR 25 thousand to a maximum of EUR 5.16 million. In general, medium-size enterprises are associated with the largest investment projects. The aid intensity is lower for medium-size companies (49% of the investment value on average) and higher for small and micro enterprises (respectively 58% and 59%).

More than 40% of beneficiary enterprises are limited liability companies, often with more than 50 employees; 26% are sole persons running a business and most of the remainder are partnerships.
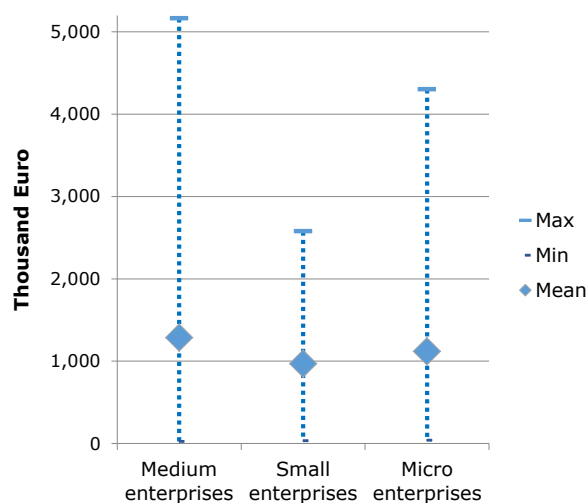
---

[36] No data are available on the volume of the bank credit.

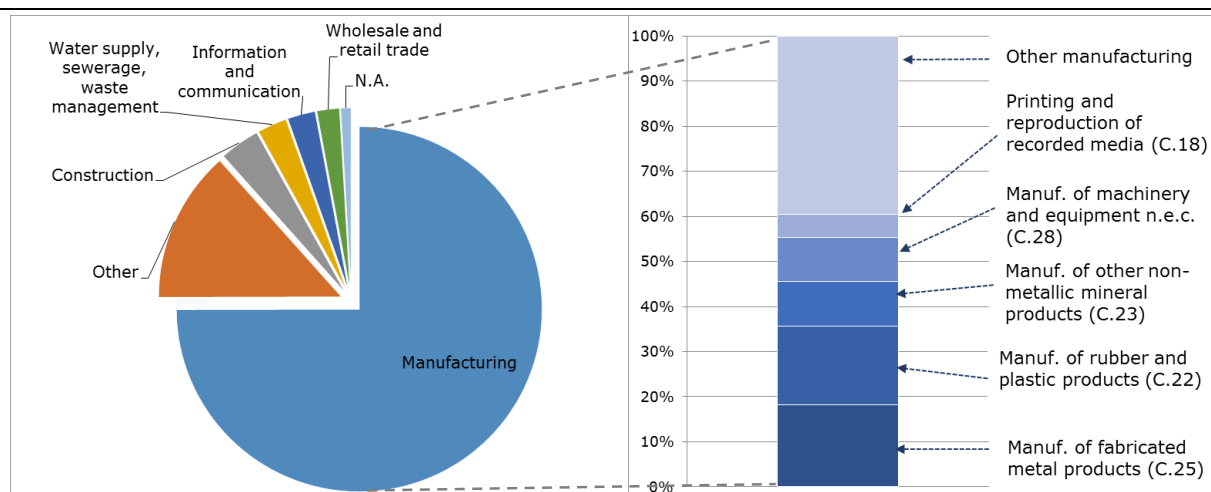**Figure 8   Breakdown of beneficiaries, project and investment by size of the**

Figure 9   Minimum, maximum and average investment by beneficiary enterprise size category

Source: CSIL elaboration of MA data.   Source: CSIL elaboration of MA data.

Figure 10   Breakdown of beneficiaries by NACE sector of activity (left) breakdown by manufacturing sub-sector (right)

Source: CSIL elaboration of BGK data.

As far as sectors are concerned, most of the beneficiaries belong to the manufacturing sector, which accounts for 83% of the total (483 firms). Within the manufacturing sector, producers of metal, plastic, other non-metallic mineral products and machineries together account for more 60% of manufacturing enterprises. The rest of firms in this sector are scattered across a variety of sub-sectors. In terms of technology intensity, 51% of all beneficiary enterprises operates in medium-low tech sectors, another 48% in low tech sectors.[37]

In terms of geographical distribution, the regions from which the largest number of beneficiaries come from are Wielkopolskie (17% of beneficiaries), one of the most important industrial centres in Poland, followed by Śląskie (10%) and Podkarpackie (10%).

The firms from all Polish regions could apply for the support without any privilege for certain regions. If comparing the geographical distribution of the Technological Credit support with the number of employees in SMEs, the distribution looks rather accidental. The number of SMEs in

---

[37] As explained in the First Intermediate Report, the technology intensity variable was defined as the ratio between business R&D expenditure and total value added in each 2 digits NACE sector and for each country.

the region seem to better explain the pattern in the distribution of funds: regions with the higher number of SMEs are generally those absorbing the largest volume of Technological Credit support, with some exceptions (e.g. Mazowieckie - PL 12, the most developed region in Poland). A relation, although weak, can also be found when considering macroeconomic regional statistics such as GDP annual growth and regional unemployment rate, suggesting that rather more developed areas generally absorbed more funds.

**Figure 11   Distribution of beneficiaries by region**
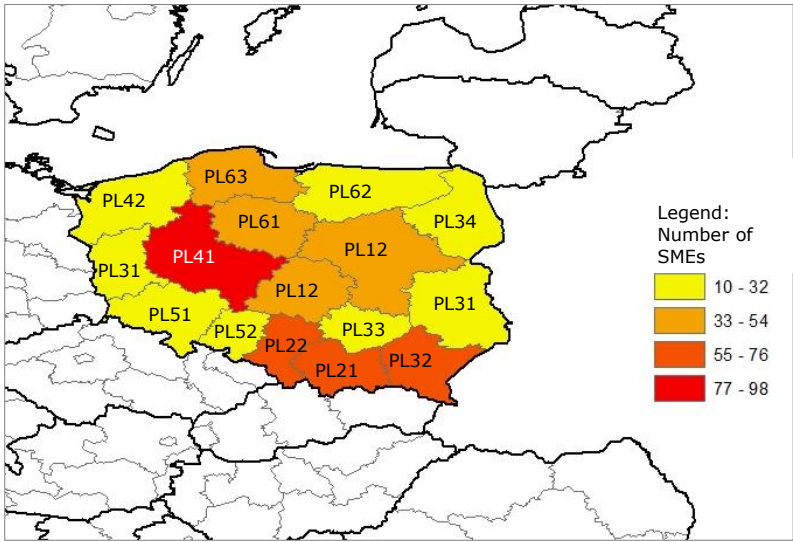
Note: Łódzkie (PL11); Mazowieckie (PL12); Małopolskie (PL21); Śląskie (PL22); Lubelskie (PL31); Podkarpackie (PL32); Świętokrzyskie (PL33); Podlaskie (PL34); Wielkopolskie (PL41); Zachodniopomorskie (PL42); Lubuskie(PL43); Dolnośląskie (PL51); Opolskie (PL52); Kujawsko-pomorskie (PL61); Warmińsko-mazurskie (PL62); Pomorskie (PL63).
Source: CSIL elaboration of MA data.

Figure 12 Comparison between the geographical distribution of expenditure (OP support) and number of SMEs (2012)

Figure 13 Comparison between the geographical distribution of expenditure (OP support) and employment in SMEs (2012)

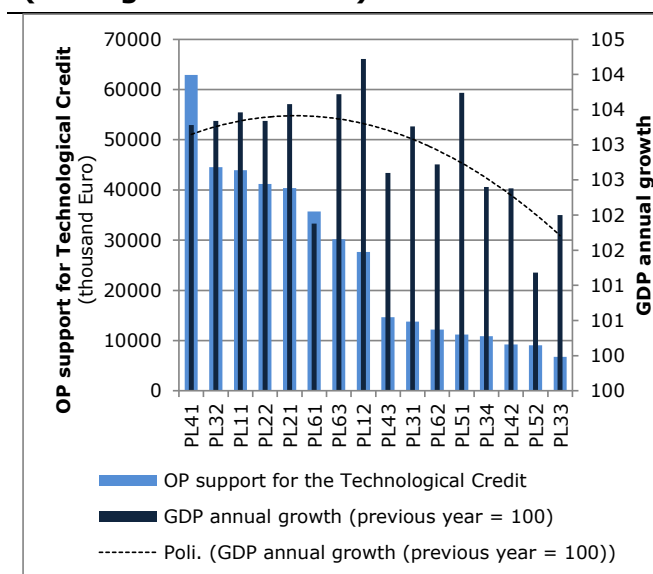Source: CSIL elaboration of MA and Eurostat – Structural Business Statistics data.
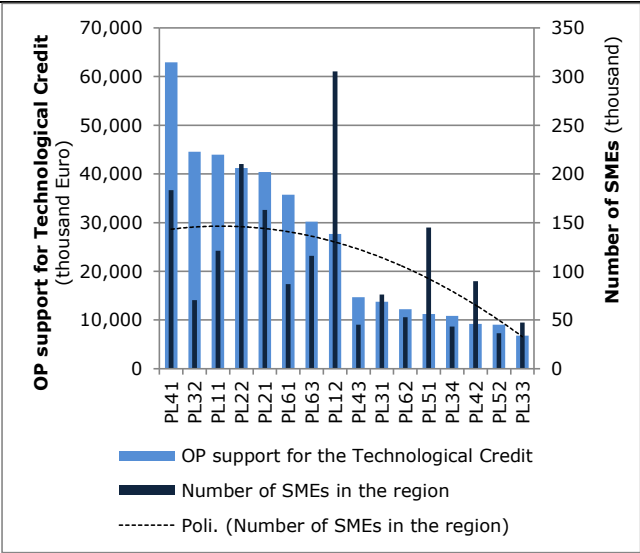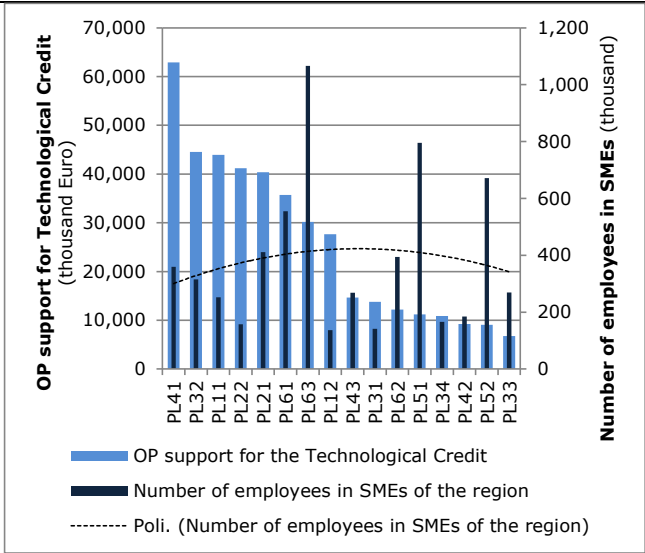
Source: CSIL elaboration of MA and Eurostat – Structural Business Statistics data.

Figure 14 Comparison between the geographical distribution of expenditure (OP support) and GDP annual growth (average 2008 – 2012)

Figure 15 Comparison between the geographical distribution of expenditure (OP support) and unemployment rate (average 2009-2014)

Source: CSIL elaboration of MA and National Statistical Office data.
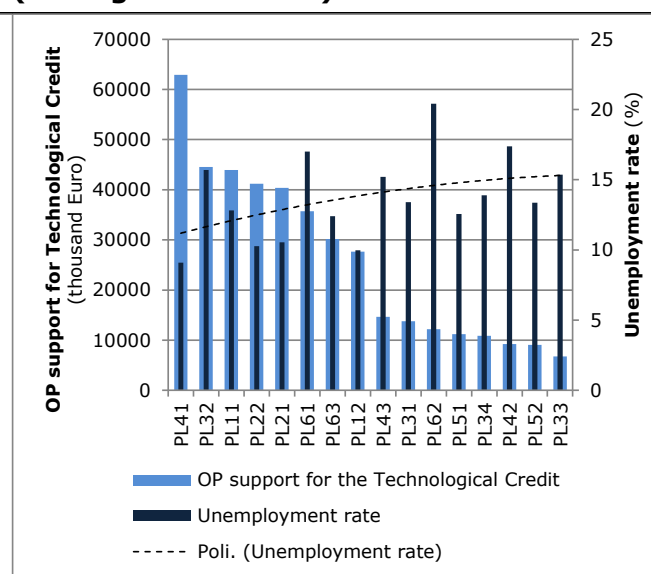
CSIL elaboration of MA and National Statistical Office data.

Box 4.   Examples of beneficiary enterprises and supported projects

- X, a medium-size enterprise, operates in the sector related to the manufacture of rubber and plastic products. It is specialized on the production of self-adhesive material. In 2013 it started an investment involving the purchase of a new technology to produce reinforced adhesive tapes and partial renovation of the production building. The total investment amounted to almost EUR 2 million. In 2014 the enterprise signed an agreement for obtaining the BGK Technological Premium for a value of EUR 500 thousand.

- Y is a small-size enterprise that operates in the manufacturing sector, producing steel and aluminium products for the automotive industry. In 2012 it applied for the BGK Technological Premium in order to start an investment project aimed at introducing a new manufacturing technology of metal parts with complex shapes. The total investment value amounted to EUR 800 thousand and the premium was almost half of it. Thanks to the investment, the enterprises could enlarge the range of offered products and hire new employees.

Source: CSIL based on information provided by the Managing Authority and on survey responses.

3.3 Empirical test of the theory

3.3.1 Research questions and the sample

An on-line survey was designed to test the effects brought about by the instrument and expected from the theory and by policy makers, but also to highlight other possible unintended or overlooked outcomes. The main research questions guiding the analysis of enterprises' responses are strictly linked to the two CMO configurations that describe the logic of the policy instrument. They are:

- *Did the policy instrument succeed in supporting the positive economic performance of beneficiary SMEs? What changes in SME basic activities can explain the observed achievements?*

- *Did the policy instrument succeed in bringing SMEs closer to public support in the form of financial instruments? What factors can explain the observed change?*

- *Are the changes observed in line with the theory of the intervention? If deviations from the theory are recorded, why did they occur?*

- *Did the policy instrument produce other types of behavioural changes in supported SMEs? What factors can explain the observed changes?*

A questionnaire was circulated to the 586 SMEs that benefitted from the Technological Credit between 2009 and 2013. A total of 200 questionnaires have been filled in by a sample of SMEs (34% response rate) which well resembles the distribution of the overall population of beneficiary enterprises with respect to their size, NACE sectors of activity, value of investment project and public support received. The sample and the population seems to be overall similar also in terms of spatial distribution of respondents (NUTS2), in spite of some discrepancies for the region of Podkarpackie (PL32) and Wielkopolskie (PL41), the former being slightly over-represented in the sample and the latter underrepresented. The questionnaire and the analysis of statistical representativeness are presented in Annex 1.

3.3.2 Analysis of results

In this section we summarise the main results derived from the statistical analysis of the survey's responses, matched with information about the enterprise and the investment projects provided by the Managing Authority, with the aim of answering the above research questions. The full set of descriptive statistics for each question of the questionnaire and the results of other statistical analyses are reported in Annex 1.

3.3.3 Economic performance

Within the sample of beneficiary SMEs, 193 enterprises (97%, question C1) declared that they have used the Technological Credit to finance the purchase or lease of new production technologies (machineries, equipment). In half of the cases, enterprises have accompanied the purchase of machineries with other types of expense, such as construction costs to expand or open new production areas, the purchase of patents and/or external consulting services. The few enterprises that have not purchased any machinery or new technology, declared that they had only sustained construction costs, or had financed the purchase of intangible assets (patents and licenses).

When asked about the type of economic results achieved thanks to the technological investment supported by BGK (question D4), 154 respondents (77%) declared that they had increased sales at least to some extent ('enough', 'appreciably' or 'very much'). Half of respondents declared positive effects on exports too, while for the other half the effect was only limited or nil. The decrease of total costs has been indicated by enterprises as the least significant effect brought about by the investment project: 36% have declared that they have accomplished this result only to a limited extent, while 27% not at all.

According to this preliminary analysis, it seems that the policy instrument was relatively more effective in increasing SMEs' turnover, than raising exports or decreasing costs. More than 90% of enterprises however are confident that the economic results attained thanks to the investment project are going to improve in the next 3-5 years (question D5). This is particularly true for enterprises which have more recently completed the investment and have not observed yet significant effects on economic performance.[38]

Even if no causality can be assumed between the policy instrument and the change in the annual turnover disclosed by the SMEs, it is interesting to note that for 37% of respondents[39] turnover passed from a lower to a higher class from the year of application for the Technological Credit until the end of 2014 (question G2). Over the same period 33% of

---

[38] The correlation coefficient between responses to question D5 and the year of project completion is +25%, significant at the 1% level.

[39] 20 companies out of 200 have not provided this information, hence this figure refers to 171 respondents.

respondent enterprises have increased their average export share, among which there are 15 companies that were not exporting when they applied for the instrument, but that do now (question G3). These figures can be read together with the variation in the size class of enterprises (question G1): at the end of 2014, 25% of respondents[40] have increased their size class compared with the year of application for the instrument, five of which have even become large enterprises.

Figure 16   Economic results achieved thanks to the technological investment supported by BGK
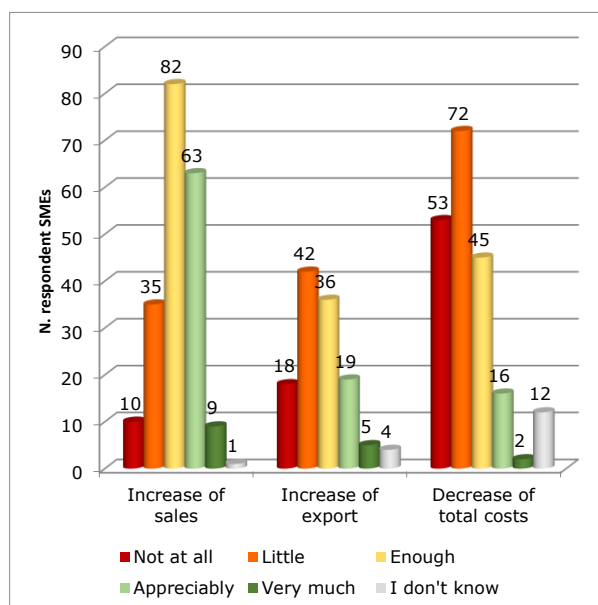
Figure 17   Number of SMEs which have changed the class of employment, turnover and exports between the year of application and the end of 2014

Source: CSIL elaboration of survey responses (question D4).
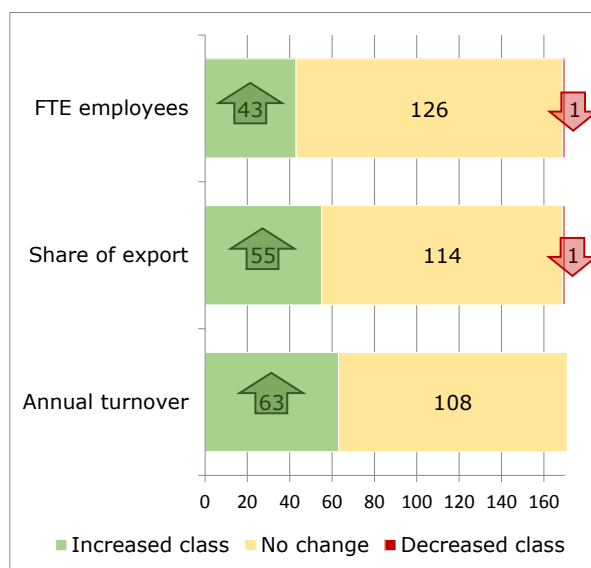
Note: See also figures 27, 28 and 29 in Annex 1.

Source: CSIL elaboration of survey responses (questions G1, G2 and G3).[41]

Regression analysis[42] is used to find the variables which are correlated the most with results in terms of increased sales, exports or reduced costs. We tested three groups of explanatory variables: i) the types of change that SMEs say have occurred because of the implementation of the projects supported, such as the widening of the range of products, improvement of the production process or enterprise reputation, etc. (question D1); ii) characteristics of the investment projects, such as the project value and the year of completion; iii) and features of the beneficiary SME, including their size, sector, technological intensity, region, level of education of the entrepreneur (question A5), initial turnover and share of exports (question G3). We found that:

- The financial support has positively influenced the widening of the range of products or services offered by the beneficiary enterprises. This is positively and strongly correlated also with the upgrading of production processes. These effects are higher for micro and small enterprises as compared to medium size ones.

- The increase of sales is higher for enterprises that have completed the projects earlier and that, thanks to the instrument, have entered new foreign markets. In contrast, there is no statistically significant correlation between sales and the widening of the

---

[40] 30% of companies did not replied to questions G2 and G3, hence the related figures refer to 170 respondents.
[41] Classes of employment are: 0-9; 10-49; 50-99; 100-249; >249. Classes of annual turnover (Million PLN) are: <4; 4-8; 8-20; 20-40; 40-80; 80-200; >200. Classes of export share are: 0%; <10%; 10-30%; 30-50%; >50%.
[42] More specifically, logit and ordered logit models.

range of products and services. A positive and statistically significant correlation is found between the dependent variable and the volume of public support, suggesting that the higher the contribution received, the higher the effect on sales.

- In addition to increasing sales, SMEs which have used the technological change to enter new markets have declared higher effects on exports too. However, the initial export level of the enterprise (share of exports over annual turnover) is also strongly correlated with the performance indicator: SMEs which were already exporting before the start of the investment project are those which have experienced the highest gains in terms of exports.[43]

- Larger decreases in costs are observed in companies that have improved the offered products and work organisation thanks to the Technological Credit. In contrast, those which have widened the range of products and increased employment have witnessed an increase in costs. Also, we see that enterprises operating in sectors classified as the least technology-intensive have experienced larger decreases in costs thanks to the investment project.

It is important to point out that regression models do not show any significant correlation between the performance indicators considered and the SME's sector of activity nor the region (NUTS 2 or NUTS 1) where the enterprises are located (the full results can be found in Annex 1).

We used the Bayesian Network Analysis (BNA) to dig more into the data and search for other the possible correlations among the variables. The resulting Directed Acyclic Graph is presented in Figure 21 at the end of this section.[44] The BNA allows the hidden patterns behind the responses collected to be analysed, without setting one specific independent variable of performance. The following results are found:

- The main changes within the SMEs' production function that are directly generated by the public contribution received are the widening of the range of products offered (D1.1), the upgrading of production processes (D1.3), the possibility to sell products that did not exist in the market earlier (D1.4).

- Some relationships between different types of change emerge too, which demonstrates in how many different but interconnected ways the policy instrument stimulates changes in the firm's basic activities. In particular, the reduction of energy consumption is strongly linked with the improvement of personnel skills (D1.10). The improvement of the enterprise's reputation (D1.6) attained thanks to the investment goes along with the improvement of the employees' skills, the hiring of new employees (D1.11) and with the improvement of the work organisation (D1.7).

- Starting selling in new foreign markets (D1.5) is correlated with an increase of exports (D4.4) more than other changes in the SME's production function. However, the initial export share is confirmed to be a strong determinant of both the export results and the decision to enter new markets. Such a network clearly indicates that the policy instrument affects the export patterns of those companies which are already operating in the foreign markets. Put differently, the higher the SMEs' export share in the year of application for the instrument, the more probable it is for them to use the investment to sell into new foreign markets and to attain an increase of exports.

---

[43] The same result is attained if considering as independent variable the entering in new foreign markets (D1.5).

[44] As explained in Section 2, the results of the BNA are not necessarily equivalent to the results of the regression analysis, so that not all the correlations revealed in the regressions might appear in the network.

- Increasing sales (D4.1) is associated with an increase in the number (D4.2) and types of clients (D4.3), and with the improvement of the firm's capacity to resist the effects of the economic crisis (D4.6). It is interesting to note that the increase of sales does not derive from any specific change within the SME's production function, in contrast with the regressions which suggest that sales depend on the introduction of new products into the market. Instead, the economic effect on sales is channelled through the increase in exports. It is mainly by increasing exports that SMEs attain an increase in sales. Other causes are certainly at work, but they play a much weaker role, which is the reason why it is not highlighted in the Bayesian Network.

- Expectations of future economic results (D5) do not depend on the type and degree of results already achieved, but on the year of project completion: the more recently the project is completed, the higher the expectations that economic results attained thanks to the investment will improve in the next few years. The technology intensity level of the SME also explains the responses about future expectations: it is found that SMEs belonging to lower tech sectors, such as construction and manufacture of other non-metallic mineral products, are relatively less optimistic about the possible improvement of results in the future. On the contrary, sectors like the manufacture of fabricated metal products, rubber and plastic products, machinery and equipment, classified as medium-low tech or medium-high tech in Poland, are more optimistic about the future overall.

Box 5.   Scenario analysis: determinants and effects of increased exports

Figure A.1 shows the prior distribution of the variables linked to the variable 'D4.4 Increased exports'. This variable is related to the extent to which the technological investment has contributed to achieving an increase in exports. Its probability distribution function is a discrete ordered distribution that can take six states: 'I do not know', 'Not at all', 'Little', 'Enough' 'Appreciably' or 'Very much'. A scenario analysis is conducted on the Bayesian Network in order to understand:

i)   how the export variable is influenced by its 'parent' variables, i.e. the initial export share (ordered variable distributed over five classes, from null to more than 50% of export/sales ratio[45]) and whether the investment has helped the enterprise enter new foreign markets (binary variable);

ii)   and how variations in exports influence the effect on sales increase (ordered variables distributed like variable D4.4.).

A simulation is performed exploiting the properties of the Bayesian Networks. We hypothetically increased the share of SMEs which declare that they have increased exports 'enough', 'appreciably' and 'very much'. Changing the distribution of D4.4 automatically provokes a change in the distribution of the other variables. The posterior distributions of the variables according to the new scenario is illustrated in Figure A.2.

The scenario analysis shows that:

- A higher increase in exports is associated with enterprises having a higher initial level of export share (more specifically, above 10%);

- In a scenario where all SMEs enjoy at least 'enough' export increase, the share of SMEs which declare that they have entered new foreign markets would increase (from 26% as in the real sample to 36%);

---

[45] Without considering missing answers.

- If more SMEs experience an increase in exports, the share of SMEs which undergo an increase in sales would enlarge too. It is interesting to highlight that the relationship between exports and sales is not linear: the higher the increase in exports the more probable the distribution of the sales variable would concentrate on the states 'enough' 'appreciably', while less SMEs would select 'very much'.

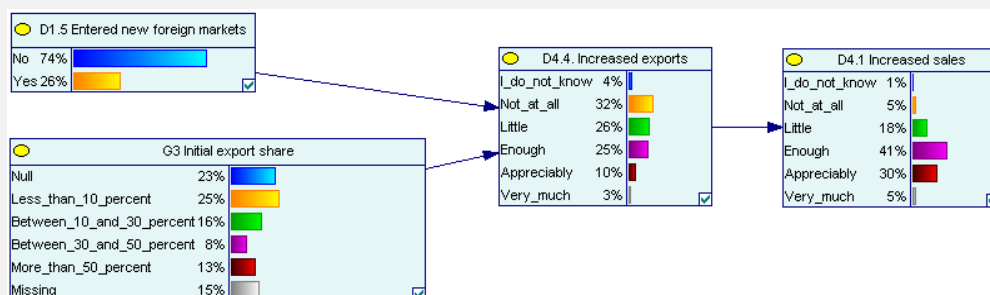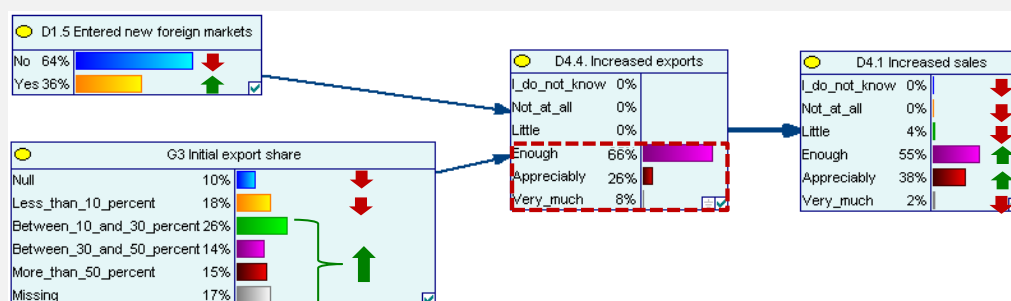Figure A.1: Baseline network

Figure A.2: Posterior network (evidence propagation scenario)

Source: CSIL.

The volume of ERDF support received is positively correlated with the increase in sales (at the 10% significance level).[46] In contrast, no statistically significant correlation can be found between the aid intensity (ratio of support over volume of the investment) and any indicator of economic performance. A detailed analysis of the marginal effect on sales associated with aid intensity revels that:

- Aid intensity is positively (even if not statistically significant) correlated with the increase in sales, variation in employment and turnover; there is no relationship between aid intensity and the increase in export, as this variable is more strongly determined by the initial level of export.

- The higher marginal increase in sales is recorded with an average aid intensity equal to 56%: a unitary increase in aid intensity is associated with a 26% increase in the probability of recording an appreciable increase in sales. A unitary increase in aid intensity is associated with only a 6% probability of increasing sales 'very much'.

3.3.4   Behavioural change with respect to use of financial instruments

Almost 80% of SMEs surveyed agree (or strongly agree) that the combination of the BGK premium and the bank loan is an effective instrument to stimulate technological investment by firms (question E3.1). This opinion is certainly influenced by the generally high satisfaction shown of the application and payment process. 80% of SMEs are satisfied or very satisfied with the type of expenses eligible for the Technological Premium and the time required to receive the premium after the investment completion. Many SMEs believe that the application, selection and payment process was not particularly simple (54%) and many (36%) are

---

[46] See the results of regressions in the Annex.

indifferent to it (question E2). Based on the questionnaires collected, it seems that beneficiary SMEs did not experience particularly difficulties in accessing the BGK Technological Premium.

When considering these results, it is reasonable to think that these enterprises would be ready to access financial instruments in the future, rather than grant schemes. In this respect, it is important to highlight that only 28% of respondents maintain that without BGK aid they would have faced serious financial difficulties (question E1). This suggests that the access to credit was probably not a barrier for enterprises that benefitted from Technological Credit, which could further justify the use of financial instruments.

Figure 18   SMEs' satisfaction for the delivery process
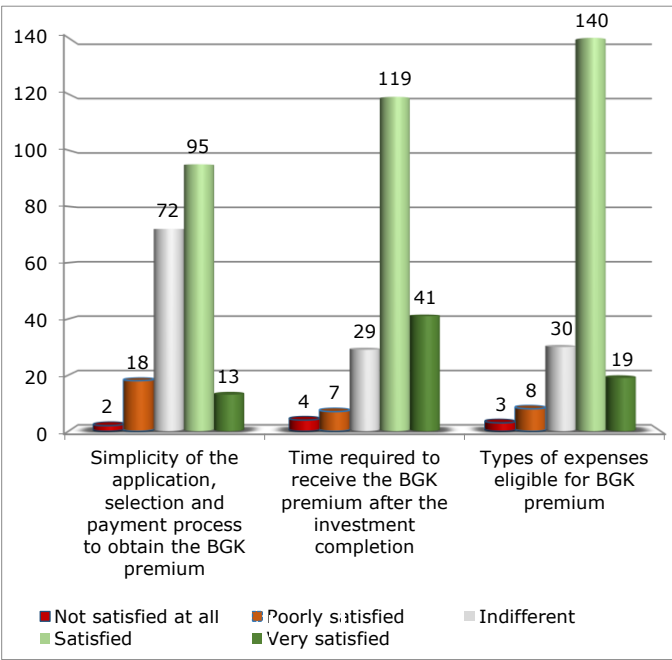
Figure 19   Opinion   about   the policy instrument

Source: CSIL elaboration of survey responses (question E2).
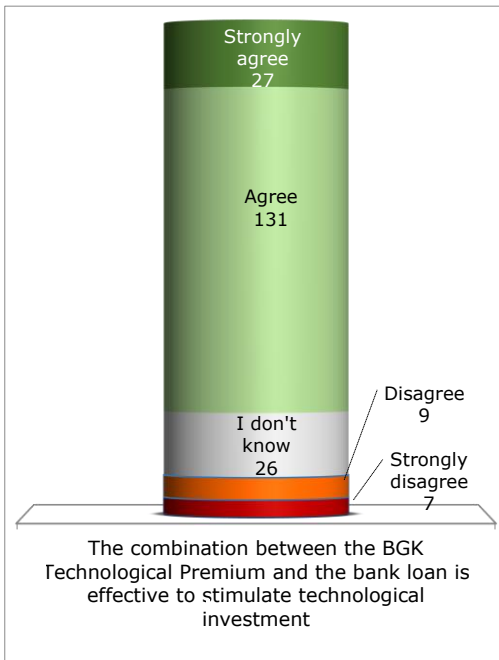
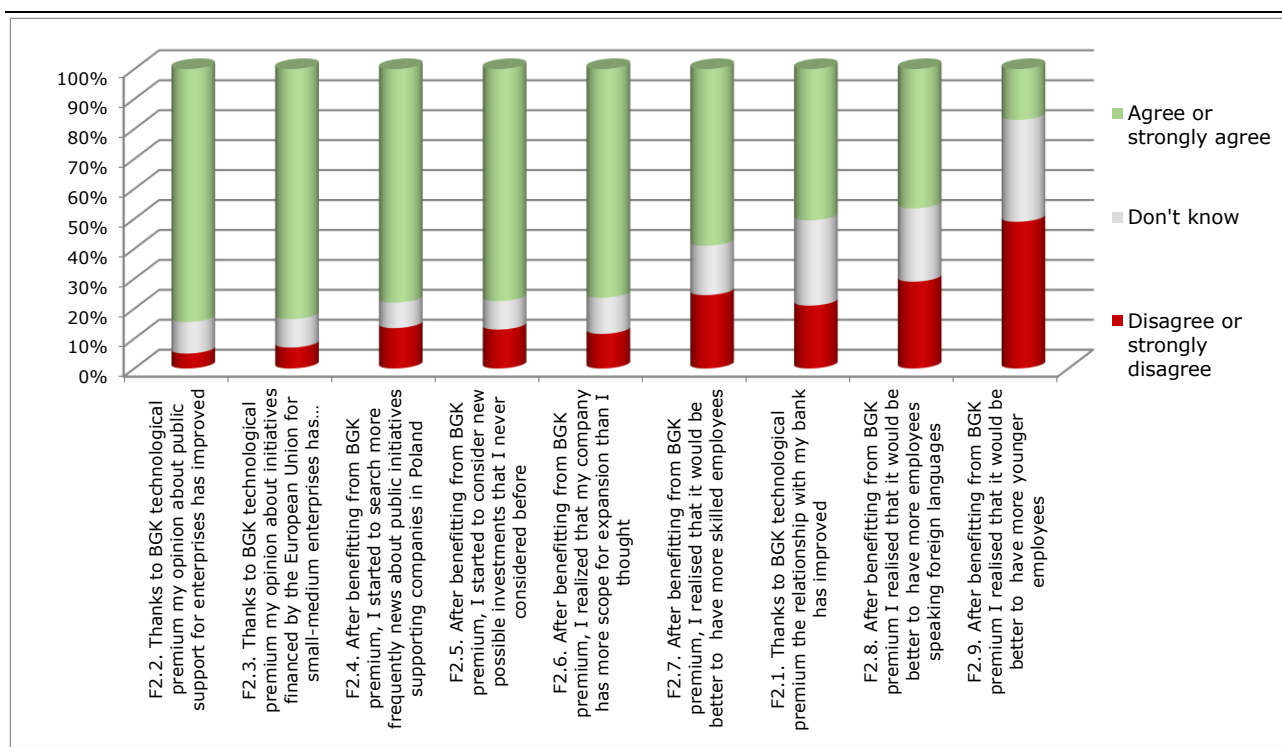Source: CSIL elaboration of survey responses (question E3.1).

3.3.5 Other behavioural changes

The survey tested whether the beneficiary SMEs have experienced other types of behavioural change, not made explicit in the intervention theory of the policy instrument and not necessarily related to quantifiable economic results, but which may lead to relevant outcomes in the future.

After benefitting from the policy instrument, almost 80% of SMEs acknowledge that they have started searching more frequently for news about pubic initiatives supporting SMEs, are considering the idea of venturing into new investments never considered before and have realised that the enterprise has more scope for expansion than previously believed. Thanks to the policy instrument, the opinion about public support initiatives for enterprises financed by Poland and the European Union has improved for around 85% of SMEs surveyed (question F2).

Opinions about other possible behavioural changes tested in the survey are more mixed, with higher shares of SMEs declaring that they have not observed a particular change or not being sure of that (see Figure 17). Only 17% of SMEs admit to attaching a greater value to having younger employees. This is in line with the findings of a recent study by the European Parliament (2015), specifying that Polish employers are generally reluctant to employ young and unexperienced people.

Figure 20   Share of SMEs which have experienced (or not) other possible behavioural changes

Source: CSIL elaboration of survey responses (question F2).

The following considerations emerge when looking at the results of the BNA:

- Behavioural change is neither linked to the economic results already achieved by beneficiaries (question D4) nor to any specific change occurring within the SME (question D1).

- The different possible behavioural changes tested in the questionnaire are strongly related to each other, implying that the behavioural change, when it occurs, is spread and affects the SME's life from various angles. For instance, it is more probable that SMEs that have realised it would be better to have more skilled employees (F2.7), also believe that it would be better to have more employees speaking foreign languages (F2.8). In turn, if foreign languages are considered important, it is probable that reducing the age of employees (F2.9) is considered more valuable too, even if, as mentioned above, the number of entrepreneurs which attach greater value to having younger employees is still rather small. Realising that the enterprise has more scope for expansion than previously thought (F2.6) and considering the possibility of new possible investments (F2.5) are also strongly interlinked.[47]

- More than 80% of enterprises recognise that their opinion about national and European public support initiatives for SMEs has improved thanks to the policy instrument (F2.2 and F2.3). This variable is an important 'node' in the network, as it is linked to all the other behavioural changes, including the willingness expressed by 86% of SMEs to apply again for other public initiatives supporting technological investment (E4).

- In turn, whether SMEs' opinion of public support initiatives improves depends on their satisfaction with the application process (E2.1, E2.2 and E2.3) or the delivery form of the instrument itself, i.e. the combination of grants and loans (E3.1), which are overall quite high.

---

[47] These findings are confirmed by the Principal Component Analysis of questions F2.

- The probability of applying again for similar support initiatives in the future is higher for medium low and medium high-tech sectors, rather than for very low-tech sectors, and for SMEs that have widened their range of products thanks to the technological investment, as confirmed by the multinomial regression model too. A negative and statistically significant correlation is found between the probability of future application (E4) and whether the SME had received public support before 2009 (B2): it is more likely that SMEs which consider applying again for public support have not received support before the Technological Credit, and *vice versa*.

The following chart shows the Bayesian Network of variables related to both economic performance outcomes (variables from D4.1 to D4.6) and other behavioural changes (from F2.4 to F2.9) associated with the Technological Credit. Changes provoked by the investment project supported by public contribution are indicated by variables D1.1-D1.11.[48] A number of other control variables have been included in the model. We recall that the Bayesian Network might not necessary show all the correlations suggested by the regression models (as explained in Section 2.3.3). The network's robustness has been tested by alternatively changing some of the variables, for example by substituting some sets of variables with their principal components so as to reduce the dimensionality of the model. The network presented hereby is strong enough to resist to structure perturbation. The strength of the main connections displayed in the network has been checked through regression models.

---

[48] The definition of all variables can be found in Annex I.

Figure 21   The changed triggered by the Technological Credit according to the Bayesian Network Analysis
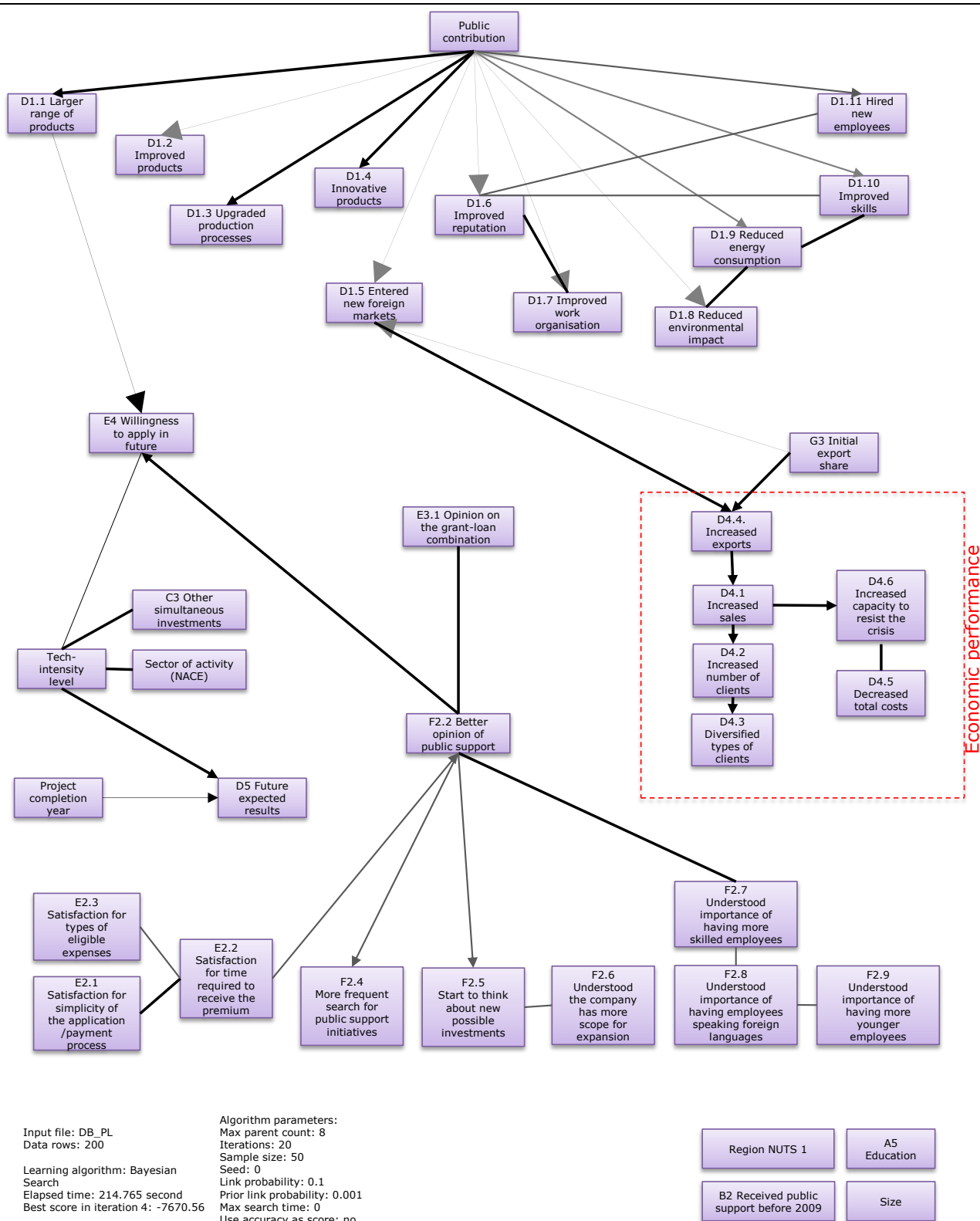
Note: Directed arrows indicate a causal relation; simple links between variables indicate correlation, without any certain causal direction. The thicker the arrow, the stronger the correlation between the variables, as estimated by GeNIe. The graph includes some variables (bottom right) that, in spite of having been controlled for during the construction of the model, do not result to be strongly linked to any other particular variable.

Source: CSIL elaboration based on the results of the Bayesian Network Analysis.

3.4 Conclusions

In this section we summarise the main findings highlighted from the analysis and test of the theory of the Polish policy instrument through the Bayesian Network Analysis and other statistical techniques, which allow us to answer the research questions.

According to the empirical analysis conducted, the policy instrument succeeded in producing the desired effects on beneficiary SMEs in line with its theory of intervention and with the relevant economic literature. More specifically:

- In relation to the first CMO (regarding the economic effects of the Technological Credit), SMEs that benefitted from the Technological Credit and BGK premium have actually used it to modernise their production technologies. This change generally allowed them to experience positive economic results, particularly in terms of an increase in sales and exports.[49] The OP's monitoring system keeps track of more than 700 improved goods and services, far above the initial, and very prudent, expectations (100).

- In relation to the second CMO (regarding the increased awareness and propensity to use financial instruments), it is found that for the majority of enterprises surveyed, benefitting from the Technological Credit appears to have been a positive experience.[50] The combination of bank loans and grants is positively assessed by about 80% of beneficiaries. To achieve this effect, which was an explicit goal of the policy makers, the satisfaction with the overall delivery process has played a major role. Thanks to a smooth application and payment process and a suitable set of eligible expenses, SMEs that benefitted from Technological Credit have improved their opinion of public support initiatives, which in turn explains the positive opinion of the Technological Credit.

The statistical analysis and, especially, the Bayesian Network Analysis turned out to be very useful to better specify the mechanisms which explain how certain effects are produced.

- Economic effects results from specific changes caused by the instrument within beneficiary SMEs. The most effective changes are the widening of the range of offered products, as actually expected by the policy makers, but also the increased capacity to access new foreign markets.

- Economic performance strongly depends on the initial condition of the SMEs. This link was not explicitly acknowledged in the theory of intervention, but turned out to be crucial to explain the mechanism of generation of economic performance. SMEs which were already competing on the international market used the Technological Credit to purchase new machineries that enable them to enter new markets. The increase in export is in turn associated to an increase in sales.

- The large majority of beneficiary enterprises operate in low or medium-low industries. The technological intensity of the SMEs matters when asking about expectation of future economic effects, as well as SME's willingness to apply for other public funds. Medium-low tech SMEs are more optimistic about the future and ready to start other investments as compared to low-tech SMEs. However, the technological intensity level is not associated to any significant difference in terms of current economic performance. Both groups of enterprises are characterised by positive economic outcomes, on average.

---

[49] Some enterprises also achieved a reduction of production costs, usually linked to reduced energy consumption, increase in employment and improvement of employees' skills.
Higher falls in total costs are achieved by enterprises which either reduced the enterprise's energy consumption

[50] Most of respondent entrepreneurs (76%) remember being happy, if not euphoric, when they knew that the application for public contribution had been accepted by BGK (question F1). Also, as shown in Figure 14, SMEs' satisfaction for the delivery process of the policy instrument is generally high.

- Enterprise size is quite important in explaining the mechanisms of change and performance observed, as it is positively and significantly correlated with the initial export share and sectors' technological intensity.

- The policy instrument has contributed to cause other changes in the behaviour or mind-set of entrepreneurs. They more frequently search for other public support initiatives; they have increased the awareness of the potentialities of their firm and have realised it has more scope than expansion than previously believed; in many cases they recognise the importance of having more skilled employees. These could be considered as intermediate effects along a longer-term path of economic performance improvement.

- The Managing Authority, Intermediate and Implementing Bodies worked to ensure the successful implementation of the theory of the instruments. Having identified the high number of beneficiaries as a prerequisite for the attainment of the instrument's macro objective, i.e. the economic competiveness of Polish industry, various changes were made in the eligibility and selection criteria, with the aim of better adapting them to the investment needs of SMEs, increasing the interest of SMEs for the Technological Credit and make it easier and more attractive to apply. The core objective and logic of the instrument, i.e. promoting the acquisition of up-to-date plants and machineries for improving the SMEs' production process, did not change over the years. The financial resources earmarked for the instrument were increased during the programme implementation, so as to address the rising demand for BGK support. The Bayesian Network confirms that the generally high satisfaction for the application, delivery and payment process is linked with the good opinion for the support received and with the willingness to apply in future for other policy instruments.

- Finally, the overall analysis indicates that behind the success of the instrument is also the role of the commercial banks. The screening process of SMEs, based on financial viability (bankability) criteria, enabled BGK to allocate the premium to the enterprises with a higher probability of surviving, developing and completing a substantial investment project.[51]

The analysis conducted at the level of policy instrument could not provide robust evidence to test whether the performance of SMEs benefitting from the Technological Credit contributed to achieve the longer term goals expected at the level of overall economy. With reference to the second CMO configuration, it is not possible to verify whether a reduced use of grants will actually bring more efficiency in the use of public resources and higher projects performance. This is a long term goal which will continue to be pursued during the 2014-2020 programming period.[52]

More importantly, it is not possible to directly asses to what extent the policy instrument contributed to the overall economic competitiveness of Poland. Actually the Polish OP "Innovative Economy" includes a large number of policy instruments focused on SMEs innovation. Even though the Technological Credit received one of the largest volumes of public resources during the 2007-2013 period, the combined action of other initiatives is expected to contribute to increasing the economic performance of SMEs in Poland and comply with the goal of reinforcing the national economic competitiveness through technological advancement. Even if the increase in Polish economic competitiveness cannot be tested by analysing one policy instrument only, we can remind that, as highlighted by the case study on the entire OP,[53] other policy instruments succeeded to increase the innovation and technological intensity level

---

[51] We remind that the average investment volume per company is higher than EUR 1 million.
[52] The increase in the bank's familiarity with financial instrument could also not be directly tested, as the survey was targeted to beneficiary enterprises and not to the banks.
[53] The case study is contained in the Second Intermediate Report of this evaluation study.

of the economy (e.g. instruments supporting the implementation of new innovative solutions, or supporting R&D projects). The evaluation study by WYG PSDB (2014) finds that the ERDF has driven an increase in the share of high-tech products in Polish export. The Technological Credit has contributed to achieve this objective, by supporting the technological advancement of SMEs, most of which operating in foreign markets.

The following chart compares the percentage variation of Polish net export in different NACE sectors during the 2009-2014 period and the degree of export increase declared by SMEs which benefitted from Technological Credit over the same years (question D4.4). Enterprises which declared the highest export increase thanks to the Technological Credit operate in sectors (Q86, C30 and C33) which have not recorded high increase in net export, at least as compared to other sectors. At the same time, there are SMEs which declared a good export increase thanks to the policy instrument and operate in industrial sectors which overall recorded high increase of export over the same years (J62, C32, C24, C18 and C22). Whether the increase in export of beneficiary SMEs occurred at the expense of the export share of other firms in the same sectors, and whether the export increase of beneficiary SMEs was driven by the Technological Credit only, rather than from other factors, cannot be ascertained here but would need to be investigated in a separate study.

Figure 22   Export increase by NACE sector in Poland
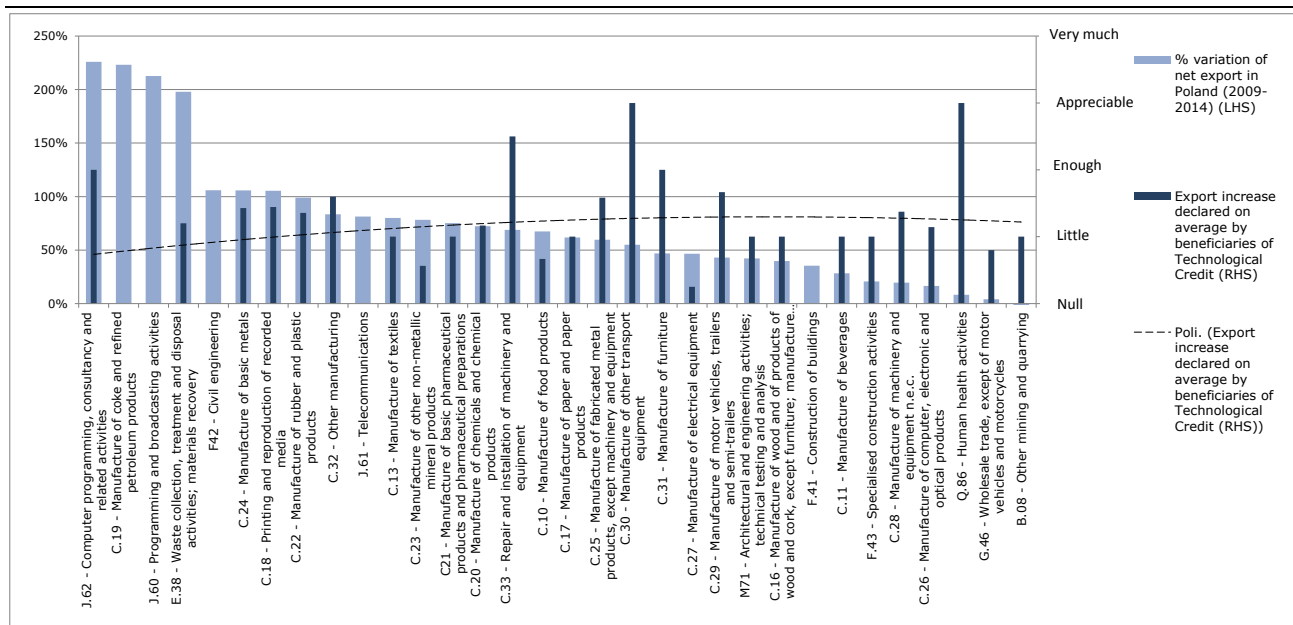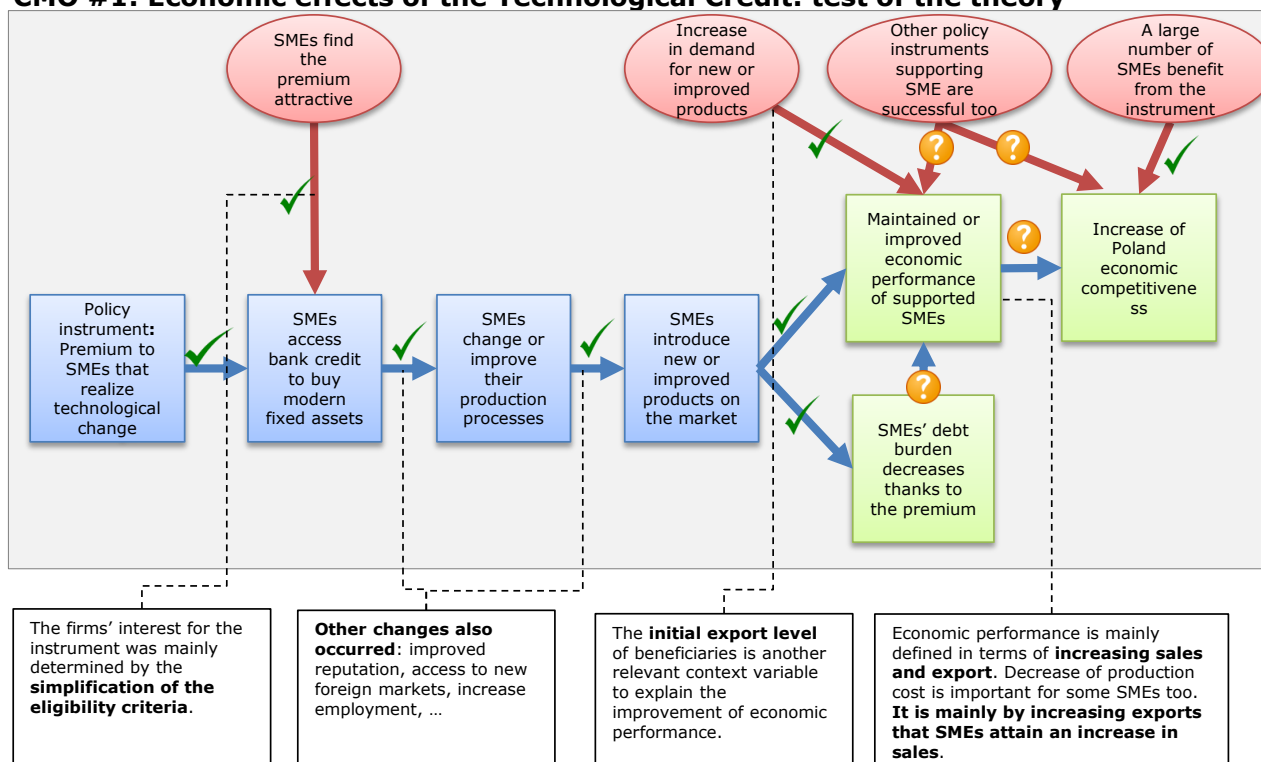

Source: CSIL elaboration of survey responses (question D4.4) and data from the Polish Statistics Institute (Net revenues from exports).
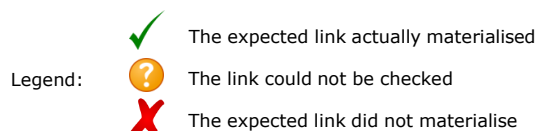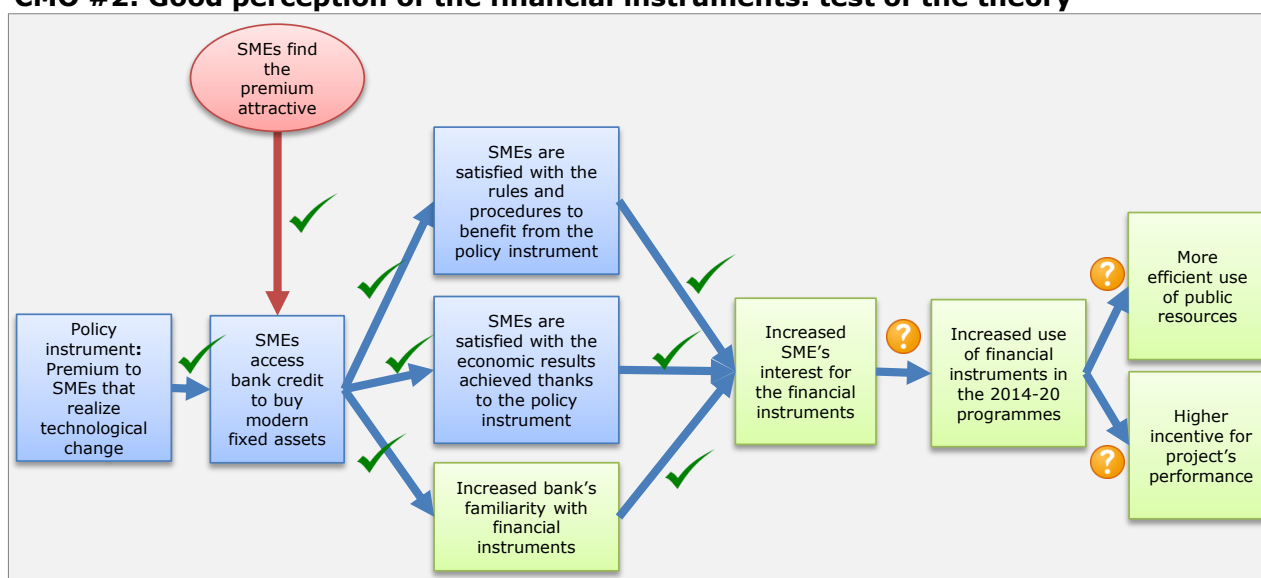
The next diagrams summarise the results of the empirical test of the theory of the Technological Credit, and highlight which of the expected links between mechanism, contexts and outcome variables actually materialize as originally planned or not.

Figure 23   Test of the theory of intervention of the Technological Credit

CMO #1: Economic effects of the Technological Credit: test of the theory

SMEs find the premium attractive

Increase in demand for new or improved products

Other policy instruments supporting SME are successful too

A large number of SMEs benefit from the instrument

Policy instrument: Premium to SMEs that realize technological change

SMEs access bank credit to buy modern fixed assets

SMEs change or improve their production processes

SMEs introduce new or improved products on the market

Maintained or improved economic performance of supported SMEs

Increase of Poland economic competitiveness

SMEs' debt burden decreases thanks to the premium

The firms' interest for the instrument was mainly determined by the **simplification of the eligibility criteria.**

Other changes also occurred: improved reputation, access to new foreign markets, increase employment, …

The **initial export level** of beneficiaries is another relevant context variable to explain the improvement of economic performance.

Economic performance is mainly defined in terms of **increasing sales and export**. Decrease of production cost is important for some SMEs too. **It is mainly by increasing exports that SMEs attain an increase in sales**.

CMO #2: Good perception of the financial instruments: test of the theory

SMEs find the premium attractive

Policy instrument: Premium to SMEs that realize technological change

SMEs access bank credit to buy modern fixed assets

SMEs are satisfied with the rules and procedures to benefit from the policy instrument

SMEs are satisfied with the economic results achieved thanks to the policy instrument

Increased bank's familiarity with financial instruments

Increased SME's interest for the financial instruments

Increased use of financial instruments in the 2014-20 programmes

More efficient use of public resources

Higher incentive for project's performance

Legend:

✓   The expected link actually materialised

?   The link could not be checked

✗   The expected link did not materialise

Note: Green-coloured boxes indicate the outcomes pursued by the policy maker; red-coloured circles indicate external conditions (i.e. specifications of context) upon which desired changes occur; blue-coloured boxes indicate the mechanisms at work along the causal chain leading to the outcomes.
Source: CSIL.

To conclude, the analysis reveals that the logic of the Technological Credit was in line with the goal of the OP, i.e. making innovation a new competitive advantage of Polish firms, but also with the economic literature. The policy instrument promoted technological progress among SMEs with the view of increasing the technological intensity of their products and making them more competitive. Funds were allocated to low or medium-low tech enterprises because they are expected to benefit the most in terms of productivity gains from absorbing technologies developed elsewhere. As pointed out by the EBRD (2014), this is particularly true for economies still far from the technological frontier, such as Poland.

The policy instrument was targeted to financially solid enterprises which showed that they were more ready to take advantage of the investment and to produce tangible and quick effects for the Polish economy. It is interesting to note that this focus was not explicitly acknowledged in the instrument's theory of intervention, at least as articulated by policy makers interviewed and documents consulted. It was nevertheless implicitly pursued when deciding to entrust the initial screening process to the commercial banks mainly on the basis of financial solidity criteria.

Moreover, the analysis found that the policy instrument especially benefitted those SMEs which were already operating in the international markets, helping them reinforce their competitive position and access new foreign markets. This outcome was not explicitly pursued by the policy instrument. Should the instrument have targeted the already exporting SMEs only, its effectiveness might have been larger.

Finally, the analysis confirms that financial instruments would be adapted to support enterprises such as those which obtained the Technological Credit. As suggested by responses to the questionnaire (question E1), almost 60 beneficiaries believe that would not have faced any serious financial difficulty without BGK aid, while more than 70 declared that, without the aid, they would either have not started the investment, or would have postponed it, or would have implemented a smaller investment, or a combination of the previous options.[54] In the light of these answers, access to finance may have not been the main barrier preventing these SMEs from undertaking the investment. By granting a premium to SMEs which initiated investment for technological change, in some cases BGK may have accelerated a process of development which was already at work. To substantiate this argument, we recall that 79% of beneficiary SMEs have other investments in their enterprise's development since 2009, different from those supported by BGK technological premium (question C3).

The experience gained with the Technological Credit during the 2007-2013 programming period could well justify a progress towards other forms of financial instruments, such as soft loans,[55] in order to support technological investment of SMEs with a solid financial background and market position.

---

[54] Enterprise could provide more than one answer to question E1.
[55] As indicated by the EIB and European Commission (2014).

4 AID TO INVESTMENT PROJECTS BY MICRO AND SMALL ENTERPRISES IN APULIA (ITALY)

4.1 Description of the policy instrument

4.1.1 Background context

The peripheral and Convergence region of Apulia, in the South of Italy, is characterised by a prevalence of micro enterprises operating in traditional sectors, most of which are individual firms in the 0-2 persons employed class. A few large companies have played a pivotal role in the development of some industrial and high-tech districts, particularly in the aerospace, automotive and mechatronics field. The Apulian economy recorded positive growth between 2004 and 2007. However, the financial and economic crisis caused a significant fall in the level of growth and employment. In 2009 GDP decreased by 4.5% compared to the previous year. The unemployment rate recorded a peak in 2012 and 2013. At the end of 2013, the number of unemployed persons in the region was more than 70% higher than in 2007.[56] The crisis had a negative effect on fixed capital formation, exacerbated by the severe cost of access to credit.[57] Enterprises which exhibited a better performance over the 2007-2011 period are small and medium-sized enterprises, rather than micro firms.

As a consequence of the global recession and in order to restrict the national public deficit, national co-funding of Cohesion Policy instruments, and also national policy instruments directed to enterprise support, were severely cut, especially in Southern regions.[58] Under such circumstances, regional funds were called upon to offset the trend.

The goal of the regional OP ERDF 2007-2013 was twofold: to promote R&D and innovation according to the regional innovation strategy (priority axis I) and to support the competitiveness of the productive system and employment (priority axis VI), in order to favour a sustainable convergence of the region in terms of growth and employment. The OP includes more selective instruments targeting excellence in innovation and supporting more ambitious investment plans and structural change, and others addressing more generic and small scale investment projects. Among the latter group is the policy instrument object of our theory-based impact evaluation: the so-called 'Title II', providing aid to investment by micro and small enterprises (below 50 employees, as per the EC definition). The instrument consisted of a combination of an interest subsidy and a grant to micro and small enterprises that had incurred a bank debt to start an investment project, of different sorts.

The Title II received the highest volume of committed public funds among the set of SME-related instruments of the OP (almost EUR 120 million). The regional agency Puglia Sviluppo was given responsibility for its implementation.

4.1.2 Eligibility and selection criteria

The policy instrument was launched in April 2009 and remained open until June 2014 with a one-stop-shop approach. It was targeted at micro and small enterprises located in Apulia. The eligible sectors have been widened over the years. The call indicated at first the following sectors as eligible:

- craft enterprises,

---

[56] Eurostat data.

[57] The cost of access to credit is more significant in Southern regions compared to the rest of Italy. For more details about the socio-economic context and industrial specificities of Apulia, see the case study (First Intermediate Report, pilot case study).

[58] In 2011, the amount of state aid as a percentage of GDP was far below the EU 27 average (see the case study).

- commerce enterprises, including retailers and food service enterprises (e.g. bar and restaurants),
- and other firms in the manufacturing, construction and information and communication sectors.

During the subsequent months of the same year new categories of activity within the commercial sector, and some health and social work activities (e.g. 'services for nursery schools') were added. The perimeter of the eligible businesses was progressively enlarged in the following years, ultimately also including activities in the green sector (e.g. plastic recycling).

The instrument could finance six types of expense:

- purchase of land,[59]

- cost of construction and renovation works,

- purchase of infrastructure,

- purchase of machinery, equipment and vehicles,

- purchase of computer programs,

- purchase of patents and license rights.

These expenses had to be to one of the following investment objectives:

- opening of new production units,

- extension or upgrade of existing production units,

- diversification of existing production units for new, additional products,

- substantial change in the production process of existing production units.

In general terms, Title II was supposed to promote business modernisation activities, including both generic types of expense (e.g. renovation works or purchase of new equipment, including furniture for commercial or administrative spaces), and others more geared to innovation (e.g. purchase of patents for the introduction of innovative production processes). In this regard, it is worth mentioning that the 'perfect substitution' of physical assets was not eligible, a criterion intended to push enterprises to purchase more up-to-date assets.

The criteria defining the thresholds of the aid were revised on different occasions during the programming period (see Table 4 below). The aim was to make the instrument more attractive to enterprises and to increase the economic benefits brought about by the public aid to enterprises in a period of worsening macro-economic conditions.

A minimum investment threshold was set at EUR 30,000. As to the maximum threshold, the reference was not to the investment cost, but to the bank's credit, which had to be EUR 400 thousand for micro enterprises and EUR 700 thousand for small enterprises. In November 2009, these thresholds were raised to EUR 600 thousand and EUR 1 million respectively.

Aid consisted of a grant which was intended to pay back part of the interest on the debt incurred to finance the investment. The aid was computed as a percentage of the interest due on the credit, assuming the Euribor 6 months commercial interest rate increased by 1% up to 2011, and then raised to 3% in 2012 and 4% in 2013. Micro enterprises could benefit from an additional grant computed as a share of the machinery and equipment costs. Seven months after the launch of the instrument, this contribution was extended to small enterprises too.

---

[59] Up to 10% of total expenses in physical assets.

During the next years, it was significantly enlarged, from a maximum of EUR 15 thousand (or 10% of total investment costs) to EUR 200 thousand (or 20% of total investment costs).

The maximum aid intensity (share of the total public contribution over investment volume) increased over the years, going from 40% and 30% for micro and small enterprises respectively in April 2009, to 45% for both the types of firm at the beginning of 2011.

Puglia Sviluppo was in charge of screening the applications received mainly on the basis of the coherence of the financial plan and the expenses. Applicant firms had to include indicators on the employment expected to be generated by the investment, distinguishing between male and female employees at the time of applying to Title II and expected by the end of the investment project. However, these indicators were not binding and were not used to rank the projects. Investment projects were selected or refused individually one at a time, with no competition among different projects.

Table 4. Change of the criteria defining the thresholds of the aid

Variable	Type of enterprise	April 2009	November 2009	January 2011	February 2012	February 2013
Maximum aid intensity	Micro	40%	45%	45%	45%	45%
	Small	30%	35%	45%	45%	45%
Computation of the aid to interest: Euribur 6 months plus an additional %	Micro & small	+ 1%	+ 1%	+ 1%	+ 3%	+ 4%
Maximum bank credit for the computation of the aid to interest (EUR, 000)	Micro	EUR 400	EUR 600	EUR 600	EUR 600	EUR 600
	Small	EUR 700	EUR 1,000	EUR 1,000	EUR 1,000	EUR 1,000
Maximum contribution to machinery costs – % of the investment	Micro	10%	20%	20%	20%	20%
	Small	0%	20%	20%	20%	20%
Maximum contribution to machinery costs - EUR, 000	Micro	EUR 15	EUR 50	EUR 100	EUR 100	EUR 200
	Small	EUR 0	EUR 50	EUR 100	EUR 100	EUR 200

Source: CSIL elaboration based on Apulia Region official documents - "Bollettino Ufficiale della Regione Puglia - n. 62 del 23-4-2009"; "Bollettino Ufficiale della Regione Puglia - n. 190 del 26-11-2009"; "Bollettino Ufficiale della Regione Puglia - n. 15 del 27-01-2011"; "Bollettino Ufficiale della Regione Puglia - n. 28 del 23-02-2012"; "Bollettino Ufficiale della Regione Puglia - n. 37 del 07-03-2013".

4.1.3 Delivery process

In order to benefit from Title II, micro and small enterprises had to go through the following steps:

1. The firm asks a private bank for a loan aimed at financing a new investment, and the bank assesses the financial viability of the investment and the solidity of the firm. The loan is granted using commercial interest rates.

2. After agreeing to provide the loan, the bank checks that the firm is eligible for the grant, in terms of size, sector, volume and objective of the investment. If eligible, the bank fills in the application form for Title II on behalf of the enterprise, and forwards it to Puglia Sviluppo. All banks operating in Apulia were entitled to submit the grant application.

3. Puglia Sviluppo verifies if the application form is properly filled in and if the investment meets the criteria of eligibility for Title II.

4. If there is a positive outcome, Puglia Sviluppo informs the enterprise about the volume of the contribution to which it is entitled. The firm has 12 months to realize the investment from the moment that the bank disburses the loan.

5. After completing the investment, the firm (or its business consultant on his behalf) has to submit to Puglia Sviluppo the relevant documentation to provide evidence of the types of purchases made, along with other supporting documents (e.g. the tax compliance certificate). Puglia Sviluppo checks that the investment is in line with the project idea described in the application form and that all the documentation needed has been provided. It could ask for missing documents.

6. If this final appraisal is positive, the regional administration pays the contribution directly to the firm. The final payment cannot be higher than the volume of the contribution initially estimated by Puglia Sviluppo (step 4 above). The contribution is lower if the firm has not incurred all the expenses originally envisaged.

4.2 *Theory of change*

4.2.1 The logic of intervention explained

The Region Apulia designed Title II with the idea of supporting the categories of enterprises which, "although constituting the backbone of the regional economy in terms of number of business units, are often disregarded by more selective public support instruments".[60] The ERDF OP Apulia 2007-2013 was supposed to complement measures aiming to promote regional innovation, R&D and economic restructuring, and aid to sizeable productive investments undertaken by medium-sized enterprises and consortia (clusters) of SMEs. By targeting individual micro and small enterprises in traditional and not particularly innovative sectors, the rationale of having Title II within the OP's policy mix was to meet the investment needs of these SMEs. Interviews with policy makers and the call's specifications point to two main expected outcomes: to maintain or increase the current level of employment, and to promote the modernisation and innovation of businesses, by co-funding expenses for various sorts of goods with the purpose of favouring business expansion or the introduction of innovative products and processes, but without any ambition of structural change.

The policy instrument under evaluation was designed in 2008 and launched in April 2009. With the eruption of the economic crisis and its negative consequences in the form of a fall in final consumption, an increase in unemployment, a credit crunch, and the rationing of national public aid to enterprises, Title II became the most tangible tool to help Apulian micro and small enterprises resist the crisis, reduce the risk of unemployment and access bank credit.[61]

Thus, the policy instrument became more focused on ensuring an anticyclical and stabilisation effect for vulnerable, but financially viable, micro and small enterprises, but not necessarily in generating employment and stimulating business growth. It is not a coincidence that the indicators of jobs expected to be generated after the investment completion were not regarded as relevant selection criteria for the projects.

Such a shift in priorities results in two different CMO configurations (CMO #1a and #1b in the figure below), the latter explicitly focused on counteracting the effects of the crisis and reducing the risk of unemployment. As a matter of fact, the mechanisms leading to the outcomes are quite vague, due to the broad types of eligible investment projects that, in turn, might lead to a large and unspecified variety of effects in terms of business performance.

In the policy-maker's perspective, the condition under which the policy instrument could achieve its maximum benefits was to obtain massive participation of micro and small enterprises and, concurrently, to ensure a suitable absorption of dedicated funds. While the

---

[60] Source: direct interview to the Managing Authority.

[61] Actually, according to a report by the Bank of Italy in South Italy access to credit is more costly than the Italian national average, due to a greater credit risk (Bank of Italy, 2009), and Apulia was not an exception. In the same vein, other reports stress that the high cost of the required guarantees and the length of bank procedures have been bringing about a serious credit rationing especially in the South (Fondazione impresa, 2014; Unioncamere, 2013).

types of eligible expenditure and the investment objective were already broadly defined, in order to make the policy instrument more attractive to enterprises, sectoral eligibility criteria were widened and the volume of the public contribution increased over the years. Moreover, Puglia Sviluppo expected the commercial banks to play a proactive role in the promotion of the policy instrument among enterprises asking them for credit, thus contributing to improving the entrepreneurs' awareness of the available financing opportunities.

Figure 24   Theory of intervention of Title II: CMO configurations

CMO #1a: Economic effects of the Title II (initial theory)
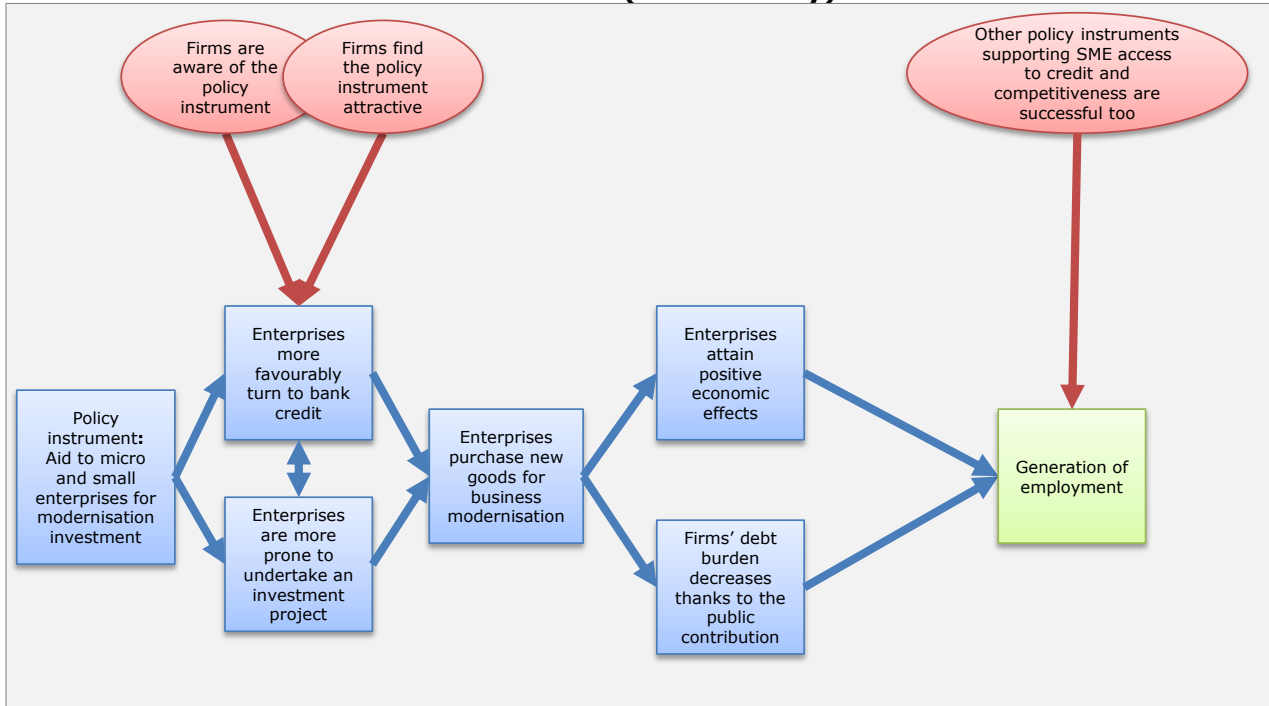
CMO #1b: Economic effects of the Title II (focus of the theory during the crisis)
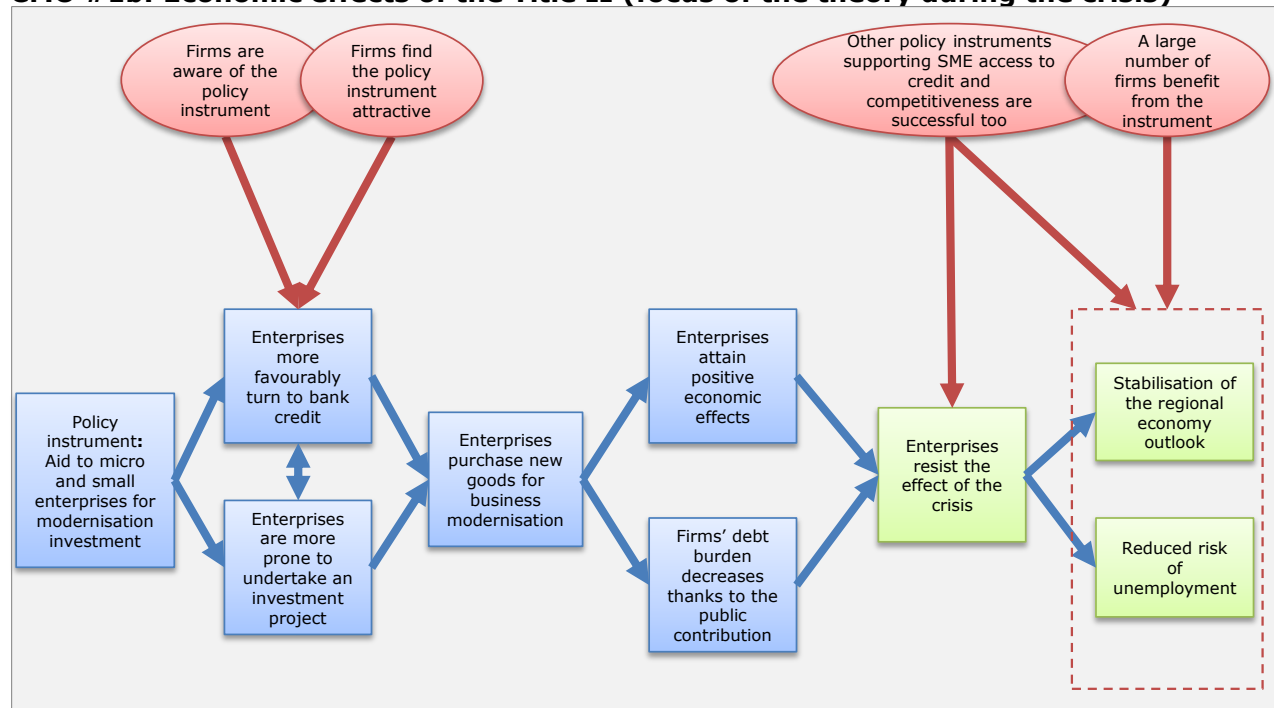
CMO #2: Improved opinion about and confidence in the public support initiatives
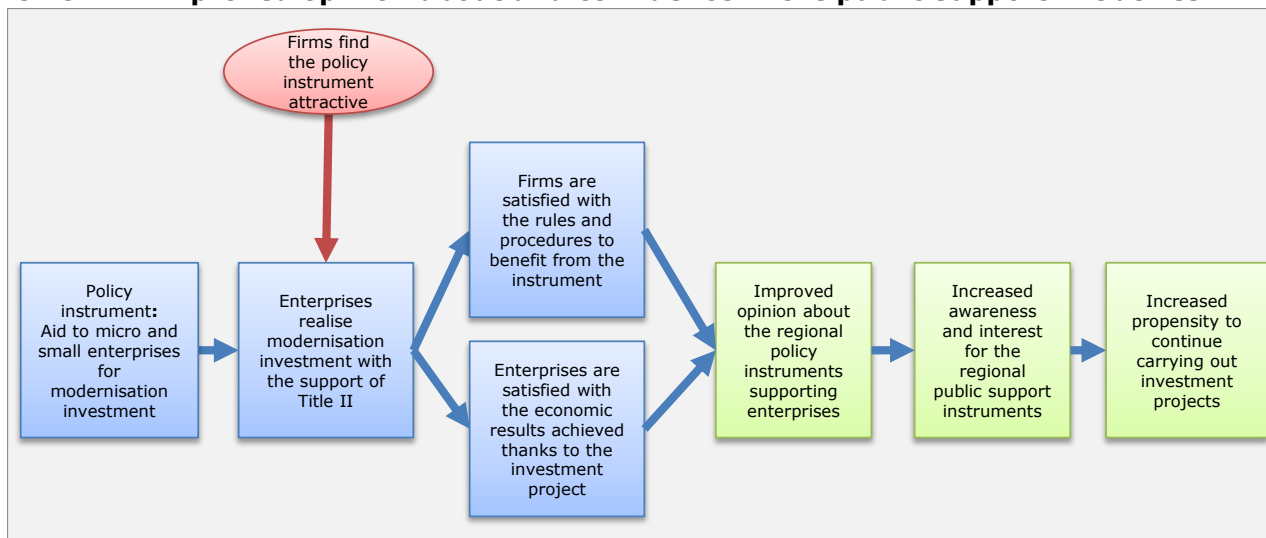
Note: Green-coloured boxes indicate the outcomes pursued by the policy maker; red-coloured circles indicate external conditions (i.e. specifications of context) upon which desired changes occur; blue-coloured boxes indicate the mechanisms at work along the causal chain leading to the outcomes.

Source: CSIL.

As emerged during the interviews with the regional authorities but not explicitly stated in the programming documents, the policy instrument responded to another aim (see CMO #2): to get a wide number of enterprises which have never been targeted by or benefitted from specific support tools of the Region, closer to the regional system of public assistance. Put differently, the instrument tried to bridge the gap between the Region's preference for having a catalogue of various policy instruments targeted at different types of enterprise and enterprise needs,[62] and the fact that many micro and small enterprises were either not aware of forms of public support available or did not believe in their potential. By doing so, Title II had the ambition of improving the enterprises' consideration of the regional administration and European initiatives for business support (this can be regarded as both an outcome or a mechanism in the CMO configuration). The relative simplicity of the eligibility criteria giving access to Title II support and the smoothness and rapidity of its application and selection process were deemed to contribute positively to this objective.

The ultimate goal was to encouraging entrepreneurs to undertake new investment, and also participate in other public support calls. It is acknowledged that many entrepreneurs may be reluctant to undertake new investment because of the fear of the risks attached to it, particularly in a bad macroeconomic context, but also because they may not be used to conceiving of new development paths for their business. Title II therefore had the ambition to trigger a behavioural change in enterprises', by increasing their propensity to invest and innovate.

4.2.2 Support from the literature of the logic of intervention

Like other countries in Southern Europe, Italy has a very high number of micro, small and medium enterprises as well as the highest number of employees in micro-sized enterprises (Lopriore, 2009; also see the First Intermediate Report produced in the framework of this evaluation study). The performance of very small enterprises or sole-proprietorship enterprises in Europe is hindered by both external and internal challenges. Among the former is difficult access to finance due to limited financial resources and collateral, and the more costly credit because of the application of higher interest rates (Berger and Udell, 1998; Galindo and

---

[62] For an analysis of the set of policy instruments addressing SMEs included in the ERDF OP 2007-2013, see the case study produced by this evaluation study (First Intermediate Report).

Schiantarelli, 2003; Beck and Demirguc-Kunt; 2006; Lopriore, 2009). On the other side, internal challenges refer to barriers that are more focused on human-centric issues such as limited managerial competencies, lack of education, lack of entrepreneurial spirit, resistance to change, and failure to produce innovation (Romouzy Ali, 2013; Excelsior Survey, Unioncamere, 2009; Harrison, 2008).

The external and internal challenges of micro and small enterprises make them more vulnerable during an economic crisis. They are the most affected and the first to be hit by the effects of a prolonged negative cycle (Robbins and Pearce, 1993; Gertler and Gilchrist, 1991; Domac and Ferri, 1999; Beck at al., 2005; Butler and Sullivan, 2005; Hodorogel, 2009; Bourletidis and Triantafyllopoulos, 2014). Moreover, SMEs' high exposure to an adverse economic climate is due to their dependence on fewer customers and suppliers, making SMEs more susceptible to demand shock (Nugent and Yhee, 2002; OECD, 2008; 2009; Papaoikonomou et al, 2012).

Several EU Member States have launched support packages to mitigate the negative impact of the recent financial and economic crisis on micro and small enterprises, supporting business activity and safeguarding employment. The rationale is that micro and small enterprises, thanks to their small scale of organisation and their flexibility, can significantly contribute to stabilizing the economy after a shock (Sava and Zugravu, 2008; Hodorogel, 2009).

4.2.3 Beneficiaries and projects supported

The total number of applications for the grant amounted to around 3,800 – 4,000, and slightly more than 10% of them were rejected by Puglia Sviluppo.[63] Detailed information on almost 3,600 applications (updated at March 2015) were collected from various monitoring sources.

As illustrated by the data on the number of applications received by year, the instrument started to gain popularity in 2010, when more than 800 applications were submitted. The number of applications started to decrease in 2011 because of the impact of the economic crisis, but it increased again in 2014, when the macroeconomic scenario started to improve.

Figure 25   Number of applications submitted by year
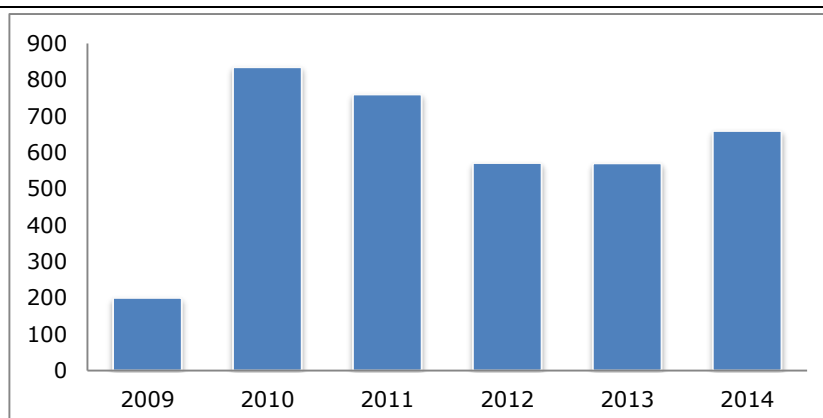
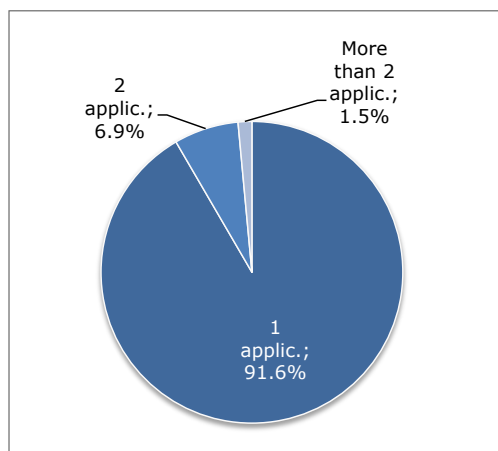Source: CSIL elaboration of monitoring data.

A total of 3,311 micro and small enterprises benefitted from Title II, with a total amount of investment approved of EUR 524.74 million. Puglia Sviluppo provided us with the list of 2,441 enterprises that benefitted from Title II, and that have already implemented the investment and for which the Region has already authorised the payment of the support.[64] The list has been matched with the database of investment projects where a request for a public

---

[63] No more precise figures on rejection rates are available.
[64] Data are updated at the beginning of August 2015.

contribution was submitted, in order to retrieve details on the types of projects implemented by the beneficiary firms included in the list.

**Figure 26   Breakdown of beneficiaries by number of proposed projects**

A group of 2,441 beneficiaries has received a public contribution in order to implement 2,626 different investment projects. 92% of enterprises carried out one project only and 8% conducted two projects, or more.

As to the type of proposed investment, 73% of projects consisted of the extension or upgrading of existing production units, followed by investment for the establishment of a new production unit. A residual share of projects (and investment) was meant to introduce innovative products or production processes. Thus, enterprises took advantage of Title II mainly to cover part of the costs for business modernisation or expansion, rather than supporting more innovatory investment plans.

Source: CSIL elaboration of monitoring data.

**Figure 27   Breakdown of applications by type of project**
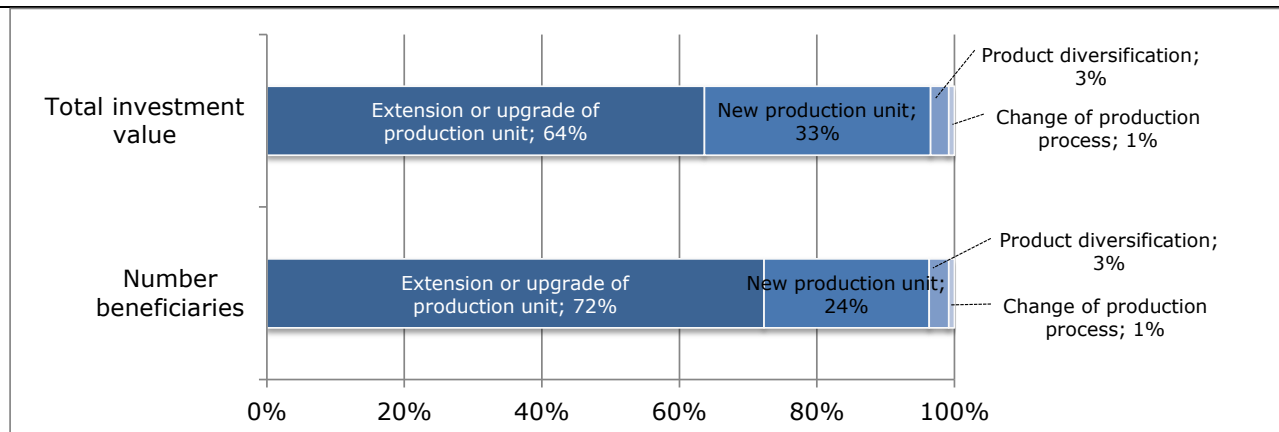
Source: CSIL elaboration of monitoring data.

Micro enterprises represented the widest group of beneficiaries for the policy instrument: more than eight projects out of ten were carried out by this type of firm. The average volume of the investment carried out by micro enterprises and leveraged by the grant amounted to around EUR 130,000, against an average of EUR 290,000 for small enterprises. Overall, a large variation in the volume of investment can be observed, from a minimum of EUR 30,000 (the minimum threshold to benefit from Title II), to EUR 1.84 million.

The aid intensity was almost equal across different beneficiary sizes, being about 25% and 26% for projects implemented by micro and small enterprises respectively. The average aid intensity per project (share of total public contribution over the investment volume) slightly increased over the years, from 23% on 2009 to 26% in 2013 and 2014.

Figure 28 Breakdown of beneficiaries, beneficiaries' applications and investment by size of the enterprise
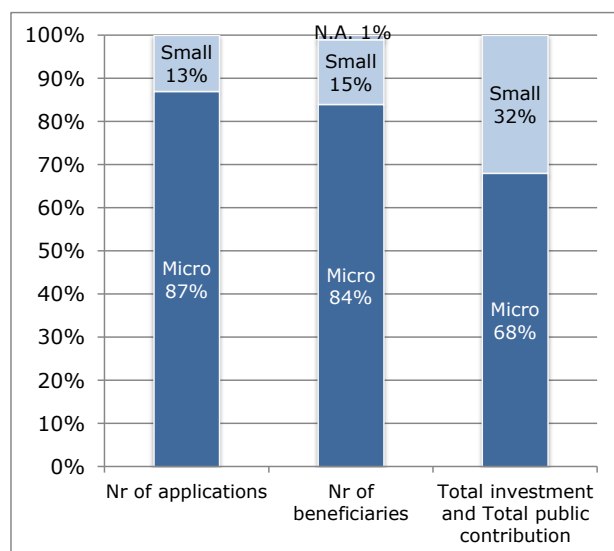
Figure 29 Minimum, maximum and average proposed investment by beneficiary size

Source: CSIL elaboration of monitoring data.
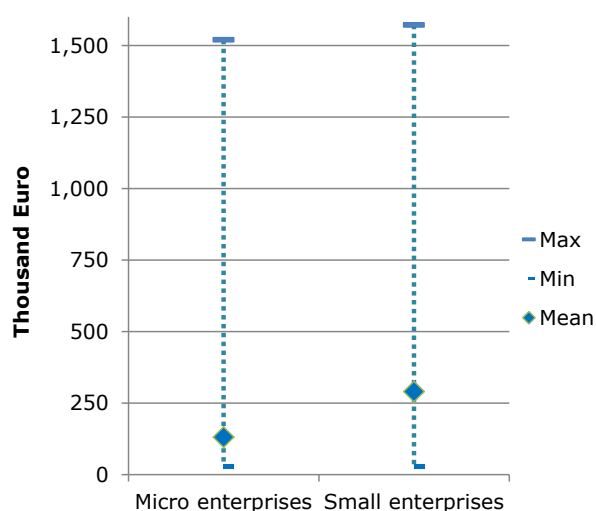
Source: CSIL elaboration of monitoring data.

The composition of beneficiaries is heterogeneous in terms of the business sector. The majority of them were engaged in the manufacturing (29%), wholesale and retail trade/repair of vehicles (27%) and construction (14%) NACE sectors. The most represented business activities at NACE 2 digit level are small retail (with about 450 beneficiaries) and restaurant and bars (more than 300 beneficiaries), followed by manufacturing firms in the agro food industry, such as bakeries, or manufacturing of metal products, vehicle wholesale and wholesale of other goods, construction of buildings, and personal services, such as hairdressing.

In terms of technological intensity, the vast majority of beneficiaries belong to sectors that are traditionally regarded as low-tech,[65] and 14% of firms operate in medium-low tech sectors, such as manufacturing of basic metals and non-metallic mineral products. A tiny share (2%) operates in high-tech sectors, such as manufacturing of machinery and equipment, or of computer, electronic and optical products.

When considering the macro-aggregation of business activities mentioned by Puglia Sviluppo in the call of Title II (craft, commerce and other firms), it is clear that hand-craft businesses have benefitted the most from the policy instrument. Craft enterprises, most of them with none or very few employees operating in the manufacturing (of food or metal products) and building construction NACE sectors, represent 50% of the beneficiaries which have already received the public contribution. According to interviews in the field, craft firms are already accustomed to public measures of business support: actually, for many years, they have been entitled to national support tools handled by the credit institute "Artigiancassa". Their previous experience with this sort of aid measure probably made them more ready to apply to Title II.

The commercial sector recorded high participation too. This type of enterprise, usually micro-sized and operating in the small retail and food service sectors, represent 32% of the enterprises that have already received the public contribution. They are usually not targeted by any national and regional public support measure, which made them particularly interested in Title II.

---

[65] The methodology used to proxy the technological intensity level of different sectors of activity in each country is explained in the First Intermediate Report.

The residual category of firms covers non-artisan enterprises mainly operating in the construction of buildings and specialised construction activities, and in the manufacturing of metal products. They represent 18% of supported enterprises. While operating in similar sectors to those of many artisans, they are generally greater in size: 64% of them are small-sized and 36% micro-sized.
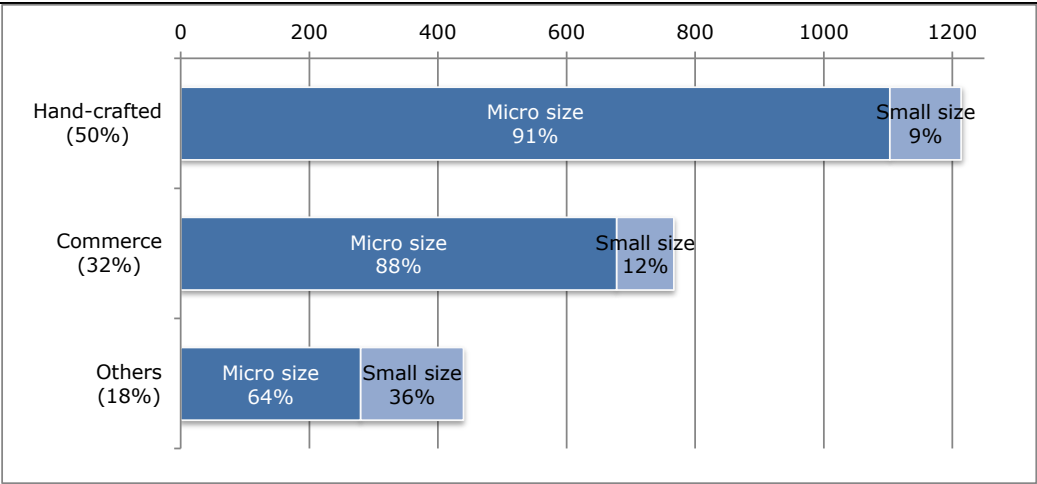
Figure 30   Breakdown of beneficiaries by NACE sector of activity

Figure 31   Breakdown of beneficiaries by technological intensity level
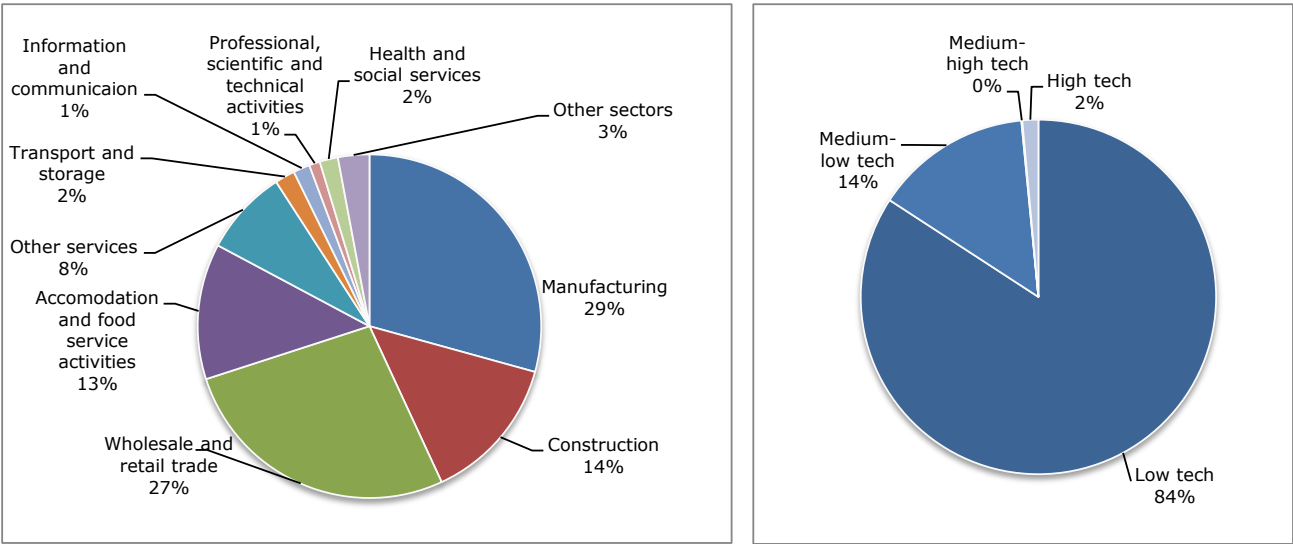
Source: CSIL elaboration of monitoring data.

Source: CSIL elaboration of monitoring data.

Figure 32   Breakdown of beneficiaries by macro category of business and size
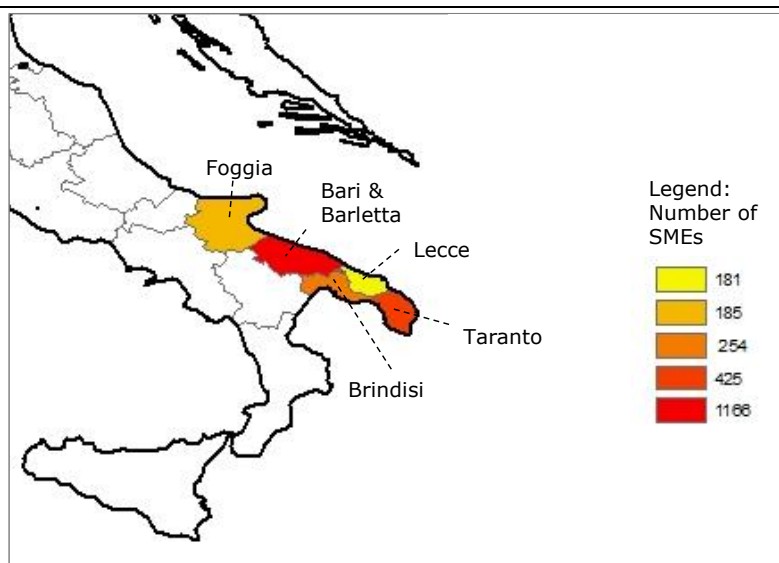

Source: CSIL elaboration of monitoring data.

The geographical distribution of beneficiary SMEs was as follows: around 50% of projects were carried out in the regional capital city of Bari. In interpreting this figure, Puglia Sviluppo explained that this province holds the majority of enterprises of the region, but also that the diffusion of information from business associations and consultants about public support tools is more fluid in this area. The link between the geographical distribution of public support and the distribution of enterprises at province (NUTS 3 level) is also shown in Figure 34 and 35 below: provinces with the highest number of micro enterprises or people employed in micro enterprises[66] are those from which the highest number of applications were submitted and, thus, which ultimately received the highest volume of public support. The unemployment rate,

---

[66] The same result holds if the total number of enterprises is considered.

per capita GDP or GDP growth do not vary significantly from one province to another and thus do not explain the differences in the distribution of beneficiaries and public funding.

**Figure 33   Distribution of beneficiaries by province**

Source: CSIL elaboration of monitoring data.

Figure 34 Comparison between the geographical distribution of public contribution and number of micro enterprises (average 2008-2010)
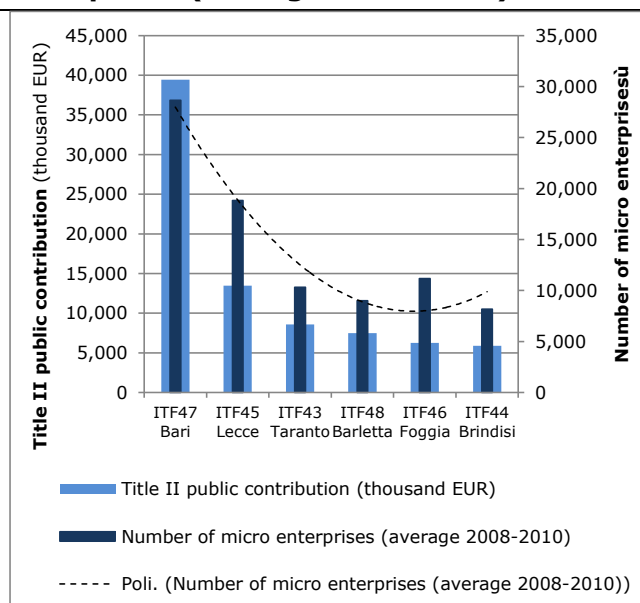
Figure 35 Comparison between the geographical distribution of public contribution and employment in micro enterprises (average 2008-2010)

Source: CSIL elaboration of monitoring data and Eurostat.
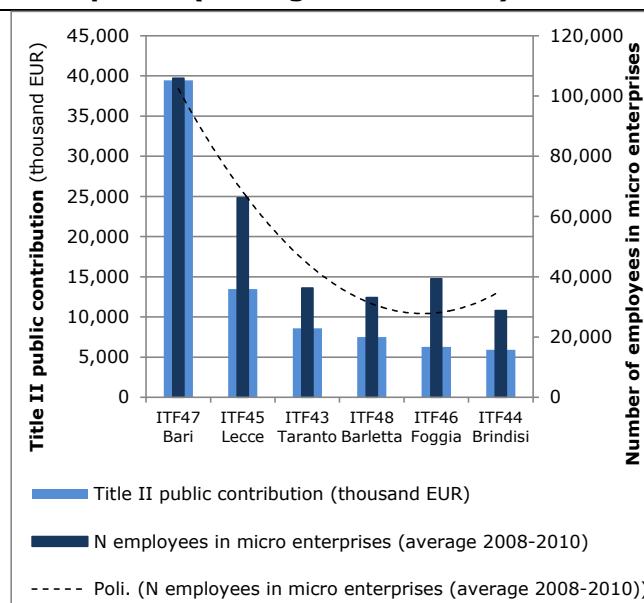
Source: CSIL elaboration of monitoring data and Eurostat.

Box 6.   Examples of beneficiary enterprises and supported projects

- The small-size firm X operates in the commerce sector. It is a small shop of household products. In 2011 the business owner decided to renovate a building close to its shop in order to open up new retail activity. The volume of the investment amounted to slightly more than EUR 30 thousand. Thanks to Title II, the enterprise received a public contribution of about EUR 7 thousand. The investment allowed the entrepreneur to attract different types of customers.

- The small-size firm Y operates in the manufacturing sector, producing and selling kitchen furniture. It applied to receive a Title II contribution in order to purchase new production machinery, for a total investment value of more than EUR 80 thousand. It received around EUR 25 thousand in public contribution, 30% of which as a contribution to the credit interest and 70% as a contribution to the cost of the machinery.

- Z is an artisan producing bakery products. He benefitted from approximately EUR 15 thousand to finance the purchase of new production machinery to increase the productivity of his work. The total investment cost amounted to EUR 50 thousand.

Source: CSIL based on interviews and monitoring data.

4.3 Empirical test of the theory

4.3.1 Research questions and the sample

The theory of the policy instrument, outlined by the two CMO configurations previously presented, has been tested empirically. The goal was to verify whether the expected outcomes materialised as expected by the policy maker, and through which mechanisms or drivers of change within beneficiary enterprises. The analysis was guided by the following research questions:

- *Did the policy instrument succeed in maintain the employment of beneficiary micro and small enterprises? What changes in the firms' basic activities or other factors can explain the observed achievements?*

- *Did the policy instrument succeed in stimulating an increase in the enterprises' propensity to invest? What changes in firms' basic activities or other factors can explain the observed achievements?*

- *Are the changes observed in line with the theory of the intervention? If deviations from the theory are recorded, why did they occur?*

- *Did the policy instrument produce other types of behavioural change in supported micro and small enterprises? What factors can explain the observed changes?*

To answer these questions, a survey was launched and sent to 2,441 small and micro enterprises which had completed the investment project and had already received the regional public contribution. Unfortunately email addresses (not always valid) were available for less than 1,600 enterprises, since many micro enterprises do not have their own email addresses. A total of 399 questionnaires have been filled in by a sample of firms, which represents a 25% response rate over the number of enterprises we were actually in contact with. The sample well represents the distribution of the overall population of beneficiary enterprises with regard to their geographical distribution (at NUTS 3 level). The sample over-represents small enterprises classified as neither 'craft' nor 'commerce' enterprises, and characterised by an average higher value of the investment and public support. These discrepancies were due to the higher difficulty to reach single entrepreneurs or micro enterprises for which no valid email contacts were available.

To deal with these issues, the statistical analysis controlled for the effect of enterprise size, category/sector, investment value and public contribution. Also, the sample was trimmed at the 99th percentile of the distribution of the investment value and of public support value. The questionnaire and the analysis of statistical representativeness are presented in Annex 2.

4.3.2 Analysis of results

In this section we summarise the main results derived from the statistical analysis of the survey's responses, matched with information about the enterprise and the investment projects retrieved from the monitoring system, with the aim of answering the research

questions set out above. The full set of descriptive statistics for each question of the questionnaire and the results of other statistical analyses are reported in Annex 2.

4.3.3 Economic performance

Since the impact of the economic crisis became visible, the main intention for the policy instrument was to help enterprises overcome the impact of the crisis, including by reducing the risk of unemployment. When looking at responses about the economic results achieved thanks to the supported investment project (question D2), 80% of enterprises believe that the project actually allowed them to better resist the effects of the economic crisis at least to a limited or moderate extent. 13% of enterprises consider this benefit as particularly relevant.

As far as the employment level is concerned, 12% of enterprises maintain that among the most relevant changes observed after the investment on their production function is the safeguarding of existing employment. 22% of enterprises (question D1) declared that their level of employment has increased. If comparing the number or persons employed in the year of application to Title II and in the end of 2014 (question H1)[67], we find other evidence indicating that beneficiary enterprises have either maintained (47% of respondents) or increased (41%) the number of employees. There are also a number of enterprises (31, i.e. 12% of the respondents) which decided to reduce the number of persons employed.

Among other economic outcomes, it can be observed that a great proportion of the enterprises (85%) have recorded an increase in sales, although this increase was generally moderate for most enterprises: only 55 respondent enterprises have achieved at least appreciable effects (16% over the number of enterprises which experienced at least some effect). An increase in sales has not always coincided with an increase in the entrepreneur's income. 71% of enterprises has experienced this sort of benefit. An even lower proportion of enterprises (62%) has enjoyed a reduction in total costs, for half of which it was only limited. The level of exports is not considered a relevant performance indicator for this type of enterprise, as the majority of them (around 80-85%) do not export at all (question H3).

Figure 36   Economic results achieved thanks to the investment supported by Puglia Sviluppo
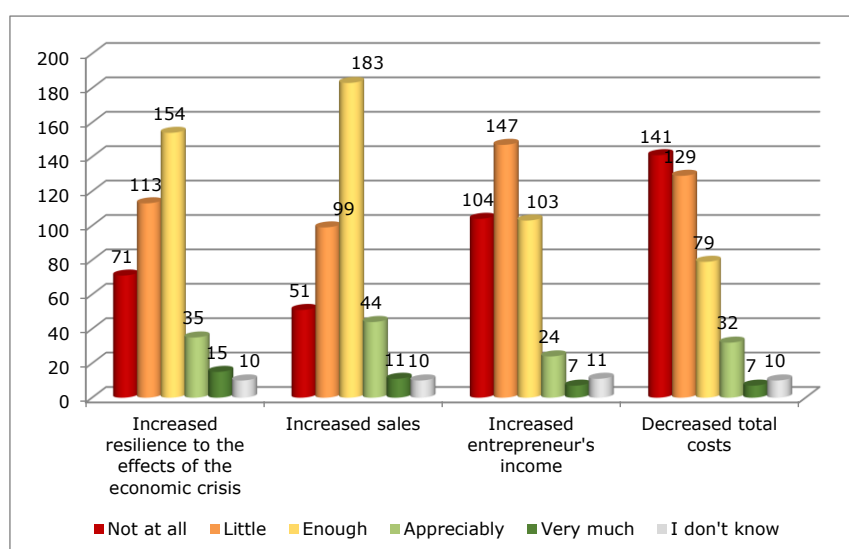
Figure 37   Variation in the number of employees from the year of request of public contribution to the end of 2014

Source: CSIL elaboration of survey responses (question D2).
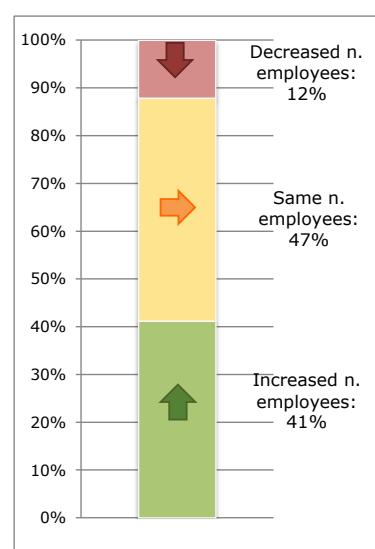
Source: CSIL elaboration of survey responses (question H1).

[67] 255 enterprises responded to question H1.

In order to understand the mechanisms explaining such economic results, the type of investment carried out should be considered first of all. Title II could finance a very diversified spectrum of investments, generally labelled as 'modernisation works' and broadly distinguished by their objective (opening of new production units, extension or upgrade of existing production units, diversification of existing production units for new, additional products, and a substantial change in the production process of existing production units). Figure 32 presented in Section 4.3, based on monitoring data, indicates that the majority of supported projects aimed to achieve a general expansion of the business activity, rather than product or process innovation. In order to point out the specific changes produced within beneficiary enterprises, the survey attempted to go further this broad classification and better specify the type and aim of the expenses incurred.

Surveyed enterprises have used the Title II contribution primarily to purchase new assets for production purposes (as indicated by 31% of respondents) or commercial activities (as indicated by another 27%). The support has been more limitedly used to finance restructuring works or the construction of new buildings and offices (around 5% of respondents). 29% of enterprises purchased more added-value goods, like information systems, equipment or robots for automation, patents and license rights (question C1).[68]

As to the changes in the firm's internal activities, a total of 204 enterprises have improved the existing products or services offered thanks to the investment. The widening of the range of products, the improvement of work organisation and productivity improvements have been indicated as relevant changes that have occurred in the firm's production function by more than one respondent in three.[69] Title II helped 36 entrepreneurs to start a new activity.

Different types of change have been contemporaneously indicated by most of the respondent enterprises. In Box 7 we present the combination of changes selected with more probability by enterprises, to give a clearer idea of the types of transformation the enterprise made thanks to the investment project.

Figure 38   Types of changes caused by the investment project
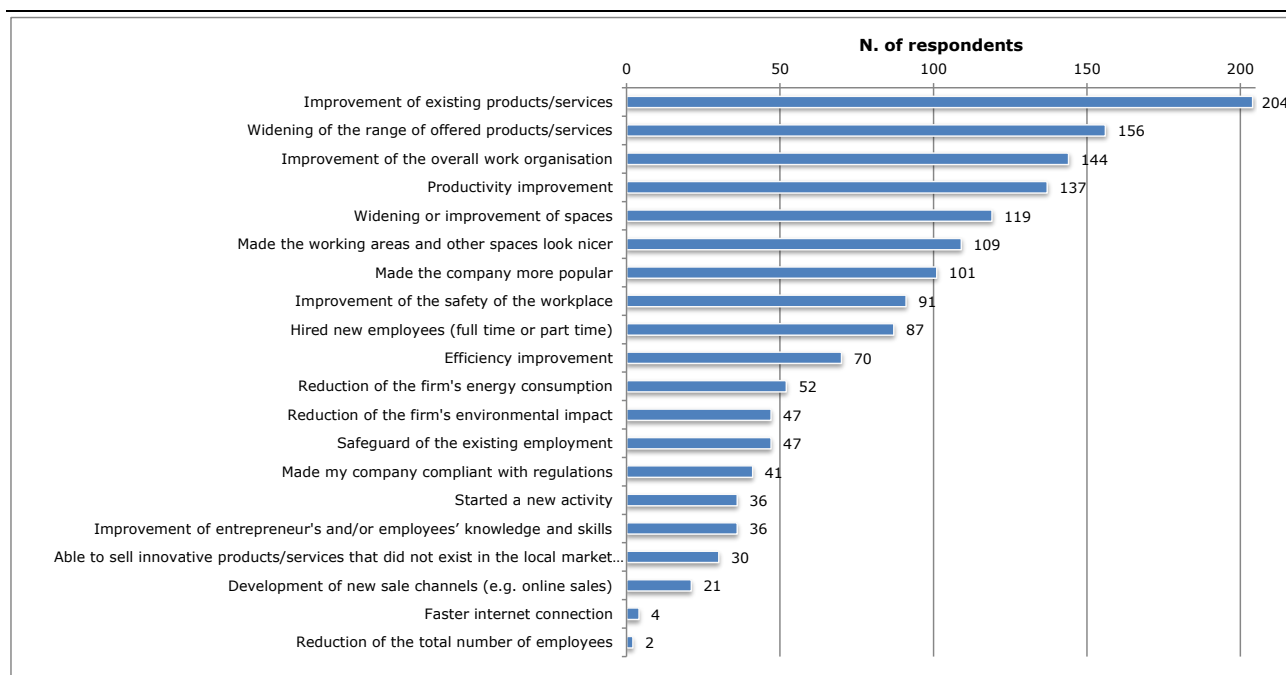
Note: Each respondent could select more than one option.

69

Source: CSIL elaboration of survey responses (question D1).

Box 7.   Principal Component Analysis of the changes caused by the investment

Since each enterprise could indicate more than one change caused by the investment, we used the Principal Component Analysis to reveal the internal structure of the data and find clusters of responses relating to the internal change caused by the investment (question D1). The analysis discovered six groups of respondents based on the type of change observed:

- enterprises which have either started a new activity or have improved the existing products/services (D1.1 and D1.3);[70]

- enterprises which have widened the range or offered product, have produced innovative products and have developed a new sales channel, thus making their enterprise more popular (D1.2, D1.6, D1.7 and D1.8);

- enterprises which have modernised the work space and made them look nicer, and have improved the overall work organisation (D1.9, D1.11 and D1.12);

- enterprises which hired new employees and improved their productivity (D1.4, D1.18 and D1.19);[71]

- enterprises which have improved the safety of the work place, reduced energy consumption and the enterprise environmental impact, making it compliant with regulations (D1.13, D1.14, D1.15, D1.16);

- and enterprises which have reduced the total number of employees, but increased the knowledge and skills of the current employees (D1.17 and D1.20).

Source: CSIL.

Despite the underlying theory of change of the policy instrument left the beneficiary relatively free to choose its own path for investment plans, not surprisingly the statistical analysis found that the type and level of economic effects achieved strongly depend upon the type of changes produced within the SME as part of the investment projects. More specifically:

- The increase in the enterprise resilience to the crisis is positively and significantly correlated with investments which increase the popularity of the enterprise (D1.8) and the number of employees (D1.17) and reduced energy consumption (D1.16).

- The increase in sales is positively correlated with the widening of the products and services offered (D1.2), productivity gains (D1.4) and the hiring of new employees (D1.18), but a negative association with the widening or improvement of work spaces (D1.9) is found, when controlling for other variables such as the enterprise's sector, size and category (craft, commerce or other).

- Entrepreneurs who started a new activity or have improved the existing products/services and those who widened the range or offered new products, have developed new sales channels and made their enterprise more popular could benefit from an increase in their income more than others.[72]

- Higher falls in total costs are achieved by enterprises which either reduced the enterprise's energy consumption (D1.16) or improved the work organisation (D1.12) or achieved an improve efficiency in other ways (D1.5).

---

[70] The two variables have the opposite sign in the principal component, meaning that enterprises which have selected one answer are more likely not to have selected the other one.

[71] Variables D1.18 and D1.19 have opposite sign in the principal component, since enterprises which declared they had increased employees have not declared they have maintained the same number of employees.

[72] In this case, the principal components are more helpful in explaining the variation in the dependent variable D2.7.

- Enterprises which either increased or maintained employment (D1.18 and D1.19) have widened the range of offered products and increased their popularity. This result is also positively and significantly correlated with the implementation of contemporary other investment projects.

The Bayesian Network Analysis confirms these findings and adds other ones on the mechanisms by which economic results are generated (see the network in Figure 44 at the end of this section). In particular:

- Whether the enterprise perceives that its capacity to resist the economic crisis has improved mainly depends upon the acquirement of a higher number of clients, which in turn is positively associated with an increase in sales and with the implementation of other contemporary investment projects, different from the one for which the Title II contribution was received (C3). Actually, enterprises which have carried out other investment projects over the past years (there are 144 in our sample, one in four of which has received other public forms of support for their investment) are positively correlated with better outcomes in their resilience to the crisis.

- The increase in sales directly determines the increase in income of the entrepreneurs, and is strongly linked with an increase in the number and type of clients.

- The employment of new persons, hence the growth of the business size is the most relevant determinant of sales; the increase in the type of clients, on the other hand, is caused by the increase in popularity.

In addition to the types of change produced by the investment project, the characteristics of the beneficiary enterprise are important explanatory variables of the economic results. More specifically, while average economic results seem positive overall if the full sample of respondents is considered, a disaggregated analysis which distinguishes among different types of enterprise allows new and interesting findings to come to light.

- Enterprises operating in the food service sectors (mainly, restaurant owners) recorded very positive and statistically significant effects over most of the economic result variables, namely the capacity to resist to the crisis, the increase in income, sales and the probability of increasing the number of employees. This is not completely surprising if considering that tourism is an important sector in the region, which was only limitedly affected by the economic crisis.

- Enterprises operating in the manufacturing sector also achieved positive economic results (with statistical significance), particularly in their capacity to resist the crisis, increase the number of employees and decrease costs, usually by achieving efficiency and productivity increases (also shown in the Bayesian Network).

- Construction enterprises experienced significant and negative variation in sales as it could be expected from the bad economic scenario which hit the Italian real estate market very hard.

- No meaningful results are found with regard to the economic results achieved by the retail sector, to which a large number of beneficiary enterprises belongs.

- Size is linked with the volume of public contribution received (see the Bayesian Network), but the difference in results achieved by micro and small-sized enterprises is usually not statistically significant. However, we observe that small enterprises record slightly better outcomes in terms of resilience to the crisis and employment generated, while micro enterprises benefit the most from an increase in the entrepreneur's income.

The following Table summarises the main findings on the economic results achieved by different types of enterprise and in relation with the type of investment project implemented. There are three main considerations worth to be stressed. *First*, manufacturing non-craft enterprises implemented on average more costly investment, which enable them to attain substantial changes in the production process. These enterprises, while not representing the majority of beneficiaries, have achieved important benefits that result in their higher resilience to the crisis and higher generation of employment. Thus, it seems that this category of enterprises is actually going through a real development path, as also suggested by their higher propensity to continue on investments (see next section).

Second, commerce enterprises have more often used the Title II to purchase furniture and new assets for the commercial activity, so as to make the spaces larger or nicer. A large share of beneficiaries believe that these changes brought positive increase in turnover. However, as mentioned above, improving the working spaces is not as effective as widening the range of products and increasing productivity.

Third, craft enterprises, which represent the majority of enterprise supported (almost all of which being single entrepreneurs or micro enterprises), have achieved mixed results, but overall lower than those recorded by other categories. Crafters operating in the construction sectors greatly suffered from the crisis and limited help was provided by the Title II. Those operating in the manufacturing sectors attained more positive benefits, but not as high as those enjoyed by small-size enterprises.

The value of public contribution received, and thus of the value of investment project implemented, is positively correlated with results in terms of employment generation and conservation. On the other hand, aid intensity is negatively and significantly correlated with the increase of full-time equivalent (FTE) employees recorded since the start of the investment project up to 2014 (question H1): the higher the aid intensity, the lower the probability that the enterprise has increased its number of FTE employees.[73] Also, aid intensity is positively correlated with the increase in sales declared to be achieved thanks to the policy instrument (question D2.1).[74] In particular, the probability for beneficiary enterprises to having increased their sale enough, appreciably or very much, increases along with aid intensity. No particularly strong correlation is found between aid intensity and other outcome variables (e.g. export, resilience to the crisis).

---

[73] At the 5% significance level.
[74] At the 10% significance level.

Table 5.   Comparison of information and answers regarding the economic effects achieved by different categories of beneficiary enterprises

Type of enterprise	Share of beneficiaries	Average investment volume	Average aid intensity	Types of investment projects generally carried out *(two most selected options within the considered type of enterprise)*	Types of changes generally observed in the enterprise's basic activities *(two most selected options within the considered type of enterprise)*	Economic effects achieved *(main highlights as compared with other types of enterprises)*
Category						
Craft	50%	EUR 133.3 th	26%	• Purchase of assets for the production - machineries and equipment (72%) • Purchase/construction of buildings - for production purposes (16%)	• D1.3. I improved the existing products/ services (56%) • D1.2. I widened the range of offered products/services (43%)	• Higher resilience to the crisis • Higher decrease of costs • Higher increase in personal income
Commerce	32%	EUR 160.7 th	23%	• Purchase of assets for commercial activity - furniture and assets for commercial/ exposition/ • catering areas (58%) • Restructuring of commercial/ exposition/ catering areas (43%)	• D1.10. I made the working areas and other spaces look nicer (55%) • D1.9. I widened or improved the spaces (48%)	• Higher increase in sales
Other	18%	EUR 225.7 th	26%	• Purchase of assets for the production - machineries and equipment (74%) • Purchase of assets for the production - purchase of informatics systems (16%)	• D1.3. I improved the existing products/ services (52%) • D1.4. I am able to produce /offer more products/services in a given amount of time (productivity improvement) (37%)	• Higher decrease of costs • Higher increase in personal income • Higher generation of employment
Size						
Micro-sized	85%	EUR 131.2 th	25%	• Purchase of assets for the production - purchase of other machinery and equipment (60%) • Purchase of furniture and assets for commercial/ exposition/ catering areas (24%)	• D1.3. I improved the existing products/services (50%) • D1.2. I widened the range of offered products/services (38%) • D1.12. I improved the overall work organisation (37%)	• Higher increase in personal income
Small-sized	15%	EUR 396.7 th	26%	• Purchase of assets for the production - purchase of other machinery and equipment (73%) • Purchase of assets for the production - purchase of systems, equipment, robot for automation (18%) • Purchase of assets for the production - purchase of informatics systems (17%)	• D1.3. I improved the existing products/services (54%) • D1.4. I am able to produce /offer more products/services in a given amount of time (productivity improvement) (43%)	• Higher resilience to crisis • Higher generation of employment
Main sectors						
C – Manufacturing	29%	EUR 187.4 th	27%	• Purchase of assets for the production - purchase of other machinery and equipment (80%) • Purchase of assets for the production - purchase of systems, equipment, robot for automation (19%)	• D1.3. I improved the existing products/services (59%) • D1.4. I am able to produce /offer more products/services in a given amount of time (productivity improvement) (57%)	• Higher effect on resilience to crisis • Higher generation of employment

Type of enterprise	Share of beneficiaries	Average investment volume	Average aid intensity	Types of investment projects generally carried out *(two most selected options within the considered type of enterprise)*	Types of changes generally observed in the enterprise's basic activities *(two most selected options within the considered type of enterprise)*	Economic effects achieved *(main highlights as compared with other types of enterprises)*
F – Construction	14%	EUR 120.4 th	25%	• Purchase of assets for the production - purchase of other machinery and equipment (71%) • Purchase/construction of buildings - for the warehouse/deposit (15%)	• D1.12. I improved the overall work organisation (49%) • D1.3. I improved the existing products/services (42%)	• Much less effect on sale • Decrease in employment
G – Wholesale and retail trade	27%	EUR 165 th	23%	• Purchase of assets for commercial activity - purchase of furniture and assets for commercial/exposition/ catering areas (48%) • Restructuring of commercial/ exposition/ catering areas (34%)	• D1.9. I widened or improved the spaces (53%) • D1.10. I made the working areas and other spaces look nicer (52%)	• Lower effect on personal income
I – Accommodation and food service activities	13%	EUR 138.2 th	25%	• Purchase of assets for commercial activity - purchase of furniture and assets for commercial/exposition/ catering areas (64%) • Purchase of assets for the production - purchase of other machinery and equipment (60%)	• D1.10. I made the working areas and other spaces look nicer (51%) • D1.3. I improved the existing products/services (47%)	• Higher effects on sales • Higher generation of employment

Source: CSIL elaboration of survey responses (questions C1, D1 and D2) and data available in the monitoring system.

4.3.4 Behavioural change with respect to the propensity to invest

Besides the main goal of generically providing micro and small sized enterprises with aid as an anticyclical effect to the crisis, the policy instrument had the ambition to stimulate a behavioural change in the enterprises, consisting of an increased propensity to realise investment projects. The instrument aimed to be a stimulus for many enterprises which had never carried out significant investments before, encouraging them to be more determined in undertaking more investment projects.

290 respondent enterprises (73% of the total) admitted that after benefitting from Title II, they started to consider the idea of implementing new investment projects never considered before (question F2.5). Responses to this question are strongly correlated with the enterprises' willingness to apply again in the future for a public contribution (E3), expressed by 75% of respondents. It is interesting to highlight that out of the number of enterprises which had never benefitted from public support before receiving Title II, 70% will probably apply again for public contribution in the future.[75]

In turn, the statistical analysis points out that intentions to make application in the future are stronger if the enterprises have positively assessed the support received by their consultants and Puglia Sviluppo during the whole procedure of application to Title II (E2.2 and E2.3). Enterprises are actually satisfied with the great support received from either private consultants or the regional implementing body itself, and, to a lesser extent, from the banks at the moment of submitting the application for aid (see Box 8 for other information about the role played by the banks and business consultants). Positive opinions on these aspects offset the generally lower satisfaction with the administrative burden, difficulties of procedures and time required to submit the application or obtaining the public contribution after the project's completion. In the Bayesian Network it is possible to see in which way the enterprises' inclination to think about other possible investment projects is strongly associated with their opinion on the overall delivery process of the policy instrument. It also points out that behavioural change aspects are not strongly linked with the economic results achieved in the investment project, as instead indicated by the theory.

Box 8.   The role of the banks and of business consultants

In the logic of intervention of Puglia Sviluppo, the role of the banks was particularly important for the delivery of the policy instrument. They were entitled to inform entrepreneurs, who turned to them asking for credit, about the possibility to benefit for Title II, and to submit an application to Puglia Sviluppo. However, within the sample of enterprises which participated in the survey, only 20% had heard about Title II from the bank when asking for financing. The majority of entrepreneurs were informed about Title II by their own business consultants (as indicated by 63% of respondents) or other sources, such as the business representative associations or word of mouth from other enterprises. Therefore, it is reasonable to think that the majority of enterprises which asked for bank credit to finance their investment project, already knew about Title II before getting to the bank.

58% of enterprises positively assessed the support received by the bank during the application phase (mainly in terms of information provided about Title II), while almost 30% were not or were poorly satisfied with it (the remainder are indifferent). Their level of satisfaction with the support received from business consultants is higher: it is positive for 72% of respondents and negative for 14% only. Based on these figures we could argue that the role played by the banks in the delivery process of the policy instrument turned out to be less significant than expected by Puglia Sviluppo. According to anecdotal evidence collected from direct interviews, in a number of cases enterprises found their banks not properly aware of the features of Title

---

[75] 21% of enterprises is still uncertain and 9% will not apply again.

II or not proactive enough in advertising Title II among enterprises, particularly in the first years of existence of the policy instrument.

Source: CSIL elaboration of survey responses (question B1, E2.1 and E2.2).

Figure 39   Enterprises which are considering the idea of starting other investment projects

Figure 40   Beneficiaries' satisfaction with the delivery process
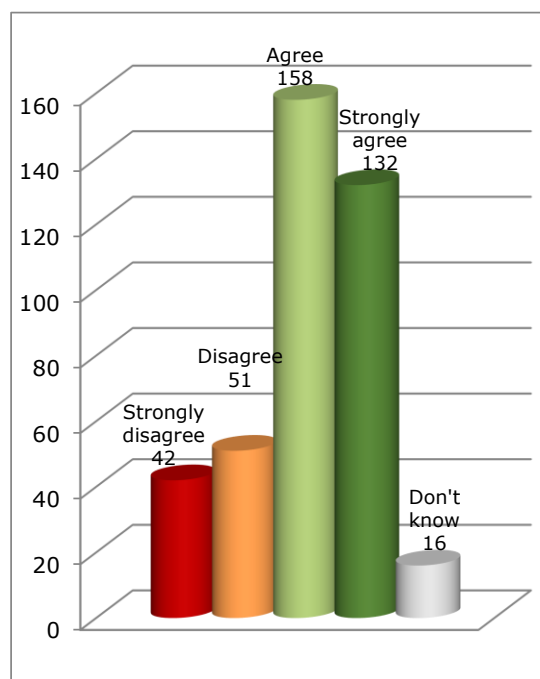
Source: CSIL elaboration of survey responses (question F2.5).
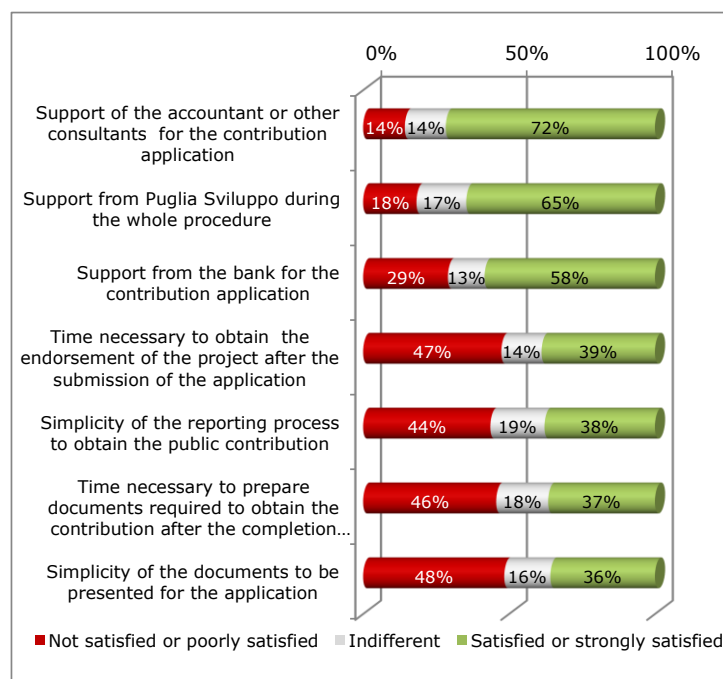
Source: CSIL elaboration of survey responses (question E2).

However, some doubts about the behavioural additionality effect of the policy instrument emerge.[76] 25% of enterprises maintains that the investment project would never have be taken place if they had not benefitted from the Title II contribution. Without the aid, slightly less than 40% of enterprises would either have postponed or implemented a smaller and less ambitious investment (question E3). 14% of enterprises stress that without the public contribution they would have faced problems of liquidity and 3% admit that they would have carried out the investment project anyway, perhaps resorting to other sources of financing.

When considering the characteristics of beneficiary enterprises, available evidence shows that the pure additionality effect (i.e. the investment that would not have started without the aid) estimated on the basis of the enterprises responses,[77] seems stronger for craft (micro) companies as compared with commerce and other enterprises. At the same time, it is less likely that craft and commerce enterprises are thinking about new possible investment projects as compared with the other types of enterprise, and that will apply again in future for other forms of public support.[78] Figures 41 and 42 provide a snapshot of the different types of answer given by enterprises belonging to three categories of beneficiary targeted by the policy instrument and by different size class. While it is true that all three types of enterprise declare that they are thinking about undertaking other investment projects, non-artisans and non-commerce enterprises are relatively more ready to invest. Also, even in the same years when the investment project financed by Title II was carried out, half of them has implemented other investment projects, a higher share than for the craft and commerce sectors. The

---

[76] There might also be displacement effects, but these should be better investigated with a separate evaluation study.

[77] A more robust and sounder analysis would require counterfactual techniques of analysis to be adopted.

[78] These results are statistically significant at the 10% level.

differences are pronounced even when comparing micro-sized and small-sized enterprises, with the latter being characterised by a generally higher propensity to investment.

Figure 41 Comparison of answers regarding the propensity to invest by category of beneficiary enterprises
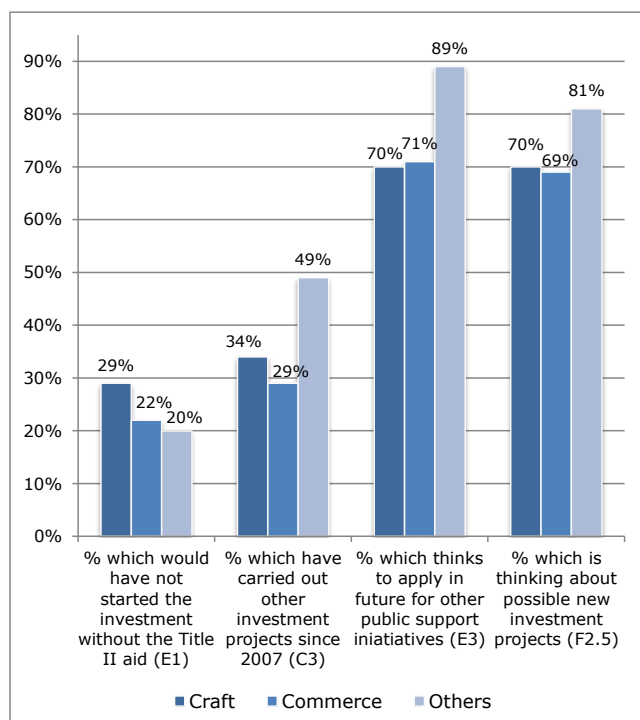
Figure 42 Comparison of answers regarding the propensity to invest by size of beneficiary enterprises

Source: CSIL elaboration of survey responses (questions C.3, E.3 and F2.5).
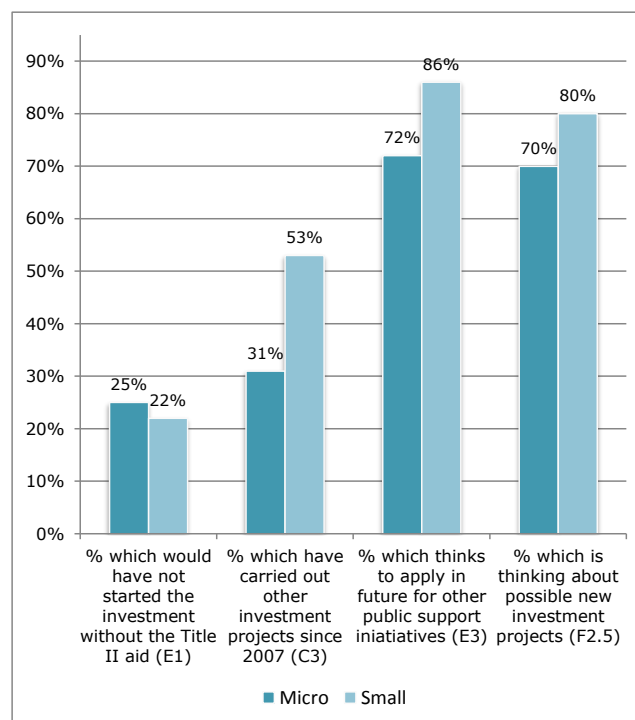
Source: CSIL elaboration of survey responses (questions C.3, E.3 and F2.5).

4.3.5 Other behavioural changes

The increased propensity to think about starting other investment project is the most significant behavioural change observed among the sample of respondent enterprises. Around half of respondent enterprises believe that, after benefitting from Title II, it would be better to have more skilled employees or to create/improve the website of the company. Lower proportions of enterprises are considering the possibility of having younger employees or to make other changes.

Figure 43   Share of enterprises which have experienced (or not) other possible behavioural changes
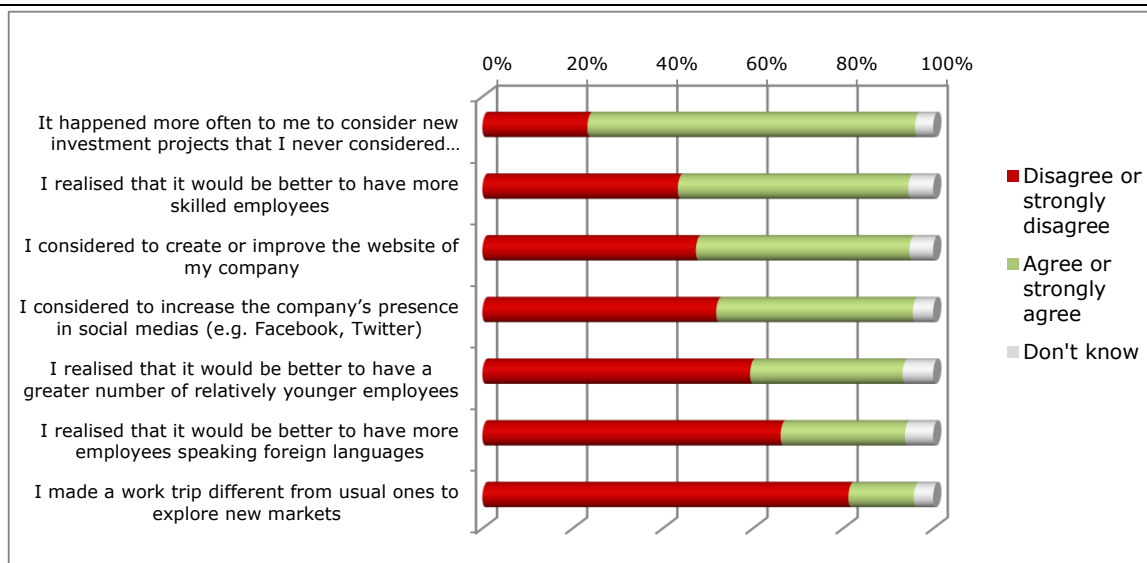
Source: CSIL elaboration of survey responses (questions F2.6 - F2.12).

The next Figure presents the Bayesian Network related to Title II. It shows the links connecting the different activities implemented by beneficiary enterprises, changes caused by Title II on their production model, characteristics of enterprises (e.g. size, sector, whether they have implemented other investment projects in the same years, etc.), their economic performance (variables from D2.1 to D2.7) and their behavioural change (from F2.1 to F2.10).

We recall that the Bayesian Network might not necessary show all the correlations suggested by the regression models (as explained in Section 2.3.3). The network's robustness has been tested by alternatively changing some of the variables, for example by substituting some sets of variables with their principal components so as to reduce the dimensionality of the model. The network presented hereby is strong enough to resist to structure perturbation. The strength of the main connections displayed in the network has been checked through regression models.

Figure 44   The changed triggered by Title II according to the Bayesian Network Analysis

Note: Directed arrows indicate a causal relation; simple links between variables indicate correlation, without any certain causal direction. The thicker the arrow, the stronger the correlation between the variables, as estimated by GeNIe. The graph includes some variables (bottom right) that, in spite of having been controlled for during the construction of the model, do not result to be strongly linked to any other particular variable. Asterisks indicate principal component variables.

Source: CSIL elaboration based on the results of the Bayesian Network Analysis.

4.4 Conclusions

In a regional context where the majority of enterprises are individual entrepreneurs or micro-size businesses, operating in traditional and low-tech sectors, suffering from the shrinkage of both consumption levels and bank credit, Title II was seen by enterprises as an important support opportunity. Designed as an instrument of employment generation, business growth and investment promotion, the Managing Authority made it the main tool to mitigate the effect of the crisis on the most vulnerable categories of enterprise, the ones that are not the main target of more selective Structural Funds measures. The policy instrument was delivered in combination with a bank loan, which implies that only financially viable enterprises, for which it was possible have access to bank credit, could be supported. In parallel, the policy instrument attempted to increase the firms' propensity to access public funds and, thus, to undertake new investment projects in the future.

The OP monitoring system keeps record of the number of beneficiaries and total volume of the investment activated, but these indicators are not helpful to analyse the effects of the policy instrument. The empirical analysis we conducted found that:

- the policy instrument was generally effective at generating positive economic results, particularly in terms of increased sales, capacity to resist the effects of the crisis, and reduced risk of unemployment (first CMO configuration). Actually, the majority of beneficiary enterprises has either maintained or increased the number of employees.

- It is not possible to verify whether the instrument succeeded to stabilise the regional economy. To that purpose, the analysis should be extended to other policy instruments of the OP which were expected to contribute to this goal. It is however unlikely that the policy instrument alone was able to have any effect in terms of stabilising the regional economy, also for lack of critical mass in terms of reach. The case study, analysing the effectiveness of the OP to support enterprises, found that the ERDF played an anti-cyclical role in Apulia in coping with the crisis. Yet, a control group of enterprises should be considered to find out what would have been their performance without the public support and whether any displacement effect occurred.

- In terms of behavioural change in the propensity to undertake other investment projects (second CMO configuration), the policy instrument has succeeded in increasing the interest of enterprises in public support initiatives: the number of enterprises willing to apply for other public support is much higher than the number of those which had already benefitted from some forms of public support before Title II. In turn, this is positively correlated with the willingness to start other investment projects in the future.

- The analysis also reveals that other behavioural changes can be observed among some beneficiary enterprises, for example concerning their preferences over the types of employees needed (e.g. more skilled or younger), but these usually regard only half of enterprises, or even less.

- The conditions and mechanisms expected to play a role on the generation of the desired effects were fulfilled. Thanks to broad eligibility criteria and increasingly favourable aid conditions, a large number of enterprises (more than three thousand) have actually submitted an application for the policy instrument. The number of beneficiaries was very wide (the rejection rate of Puglia Sviluppo was around 10% only), which was seen as a precondition to reach the desired effects.

- The only causal association that the Bayesian Network Analysis disproves is the expected link between the enterprises' willingness to apply for other public support and

their satisfaction for the simplicity of the application and delivery process of the instrument and for the economic results attained. Instead, it is the important support received by Puglia Sviluppo and private business consultants throughout all the delivery process that made the enterprises more willing to apply again.

Besides this, the theory of the policy instrument is not particularly clear in describing the mechanisms behind the generation of the desired effects, mainly due to a large variety of eligible expenses and types of investments supported. The investment could in fact determine different changes in the SMEs and on the economic effects produced, depending on whether it consisted, for instance, of the renovation of commercial premise and furniture, product and process innovation, the start of a new business activities or others. The CMO configurations illustrate the logic of the instrument as it was in the mind of policy makers, but they appear quite simplistic and too generic, failing to truly describe the way how different outcomes took place (see Figure 45 below).

The Bayesian Network Analysis confirms the existence of diversified effects and helps better specify the mechanisms and conditions behind the generation of outcomes. There are the following considerations:

- In spite of the variety of expenses made by the enterprises that were eligible for the Title II contribution, only a subset of them brought direct and positive economic effects. In particular, after controlling for different characteristics of enterprises, higher effects on turnover are reached by investments which enable the enterprise to widen the range of products, improve productivity and hire new employees. Investments which boost the enterprise's popularity increase its resilience to the crisis.

- The type and intensity of the effects varied significantly according to the characteristics of the beneficiaries. Small enterprises operating in the manufacturing sector carried out on average more costly investments aimed to acquire new production assets. Thanks to the investment they achieved productivity gains and improve the quality of products offered, which enable them to enjoy large economic benefits.

- The commerce sector, particularly enterprises operating in food service activities, have generally used Title II to renovate the furniture and spaces of the business premises. This type of expenses, while being associated with minor effects on turnover as compared with other types of investments, enabled the beneficiary enterprises to increase their sales. The positive performance of this sector could be also explained by the positive trend of the tourism sector in the region.

- Title II could not bring any significant benefit to enterprises operating in the construction section, which suffered more than others from the bad macroeconomic trend and unemployment.

- Whether enterprises achieve positive effects also depends on the implementation of other contemporary investment projects. These have been more often initiated by small manufacturing (non-craft) enterprises, which prove to be more dynamic than other types of enterprises in applying for public support measures and more willing to start other investments in the future. Nevertheless, this category of enterprises represents a minor share of the instrument's beneficiaries.

In brief, this analysis shows that, when the initial theory is poorly specified and the policy instrument does not point to a precise path towards the achievement of the desired effects, as in the case of the Apulian Title II instrument, the way how this policy instrument can achieve its goals is not straightforward. The evidence indicates that Title II managed to accomplish its expected outcomes at least in general terms, but when considering the types of projects

implemented and enterprises supported, many different stories can be told about the conditions explaining the project success. Due to its limited selectivity in the types of investment supported and changes triggered, it is even more difficult to assess the effectiveness of this policy instrument.

Some concerns emerge also with reference to the long-term sustainability of the economic effects. Even if applicant enterprises were required to indicate the expected employment effects generated by the investment for which public support was required, no system of ex-post verification was in place.

Moreover, while the policy instrument generally produced the desired positive effects, from a broader perspective it was not completely coherent with the OP strategy. The ambition of the ERDF strategy for the period 2007-2013 was, at least initially, to accompany structural change in the economic and productive fabric of the region, by facilitating the emergence of high-tech sectors and strengthening the innovation capacities of traditional sectors. A generic policy instrument such as Title II was not intended (and had no chance) to contribute to economic competitiveness and structural change. It can be justified by the sole need to mitigate the effects of the economic crisis and, presumably, to ensure adequate absorption of ERDF funds.[79] The role for the ERDF to provide such a generic type of aid in the place of national industrial policy measures should be called into questions.

If more restrictions on the sectors addressed and the type of investment to be supported were introduced, so as to narrow the scope of the policy instrument on enterprises and activities with the highest potential to grow and contribute to the regional economic competitiveness, the effectiveness of Title II would have been higher, and the instrument more in line with the genuine aim of ERDF in the region.
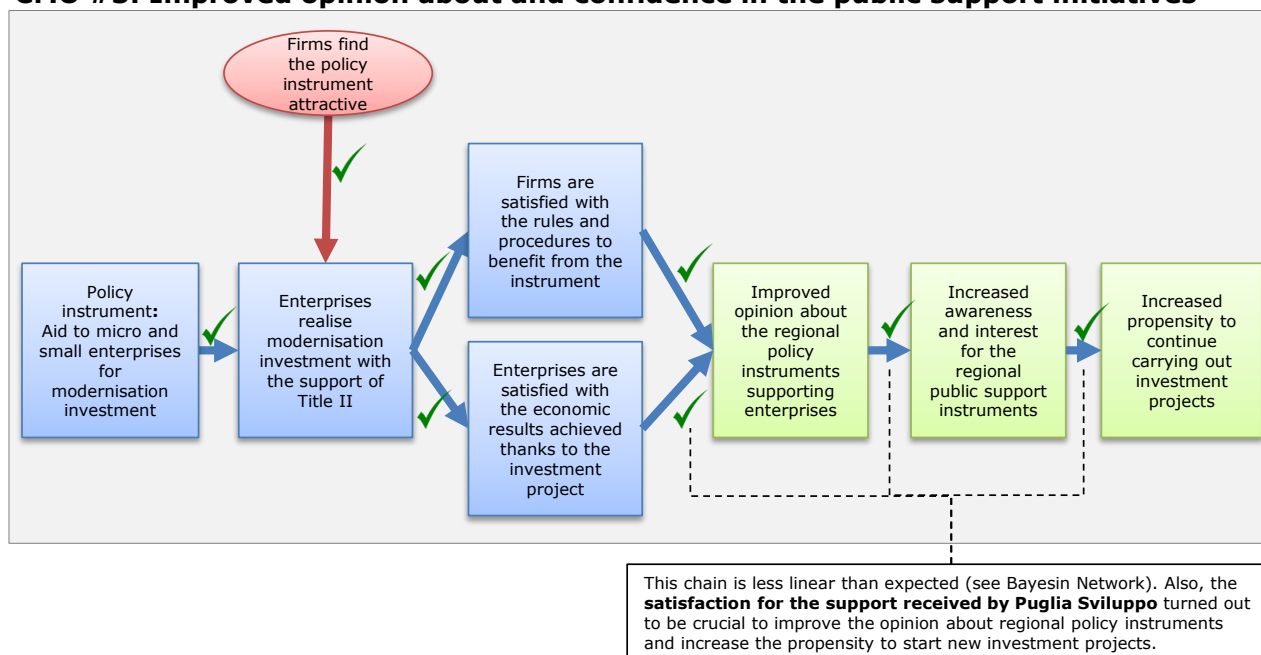
---

[79] We recall that Title II is the instrument which received the highest share of funding among all measures addressed to SMEs.

Figure 45   Test of the theory of intervention of the Title II

CMO #2: Economic effects of the Title II (focus of the theory during the crisis)
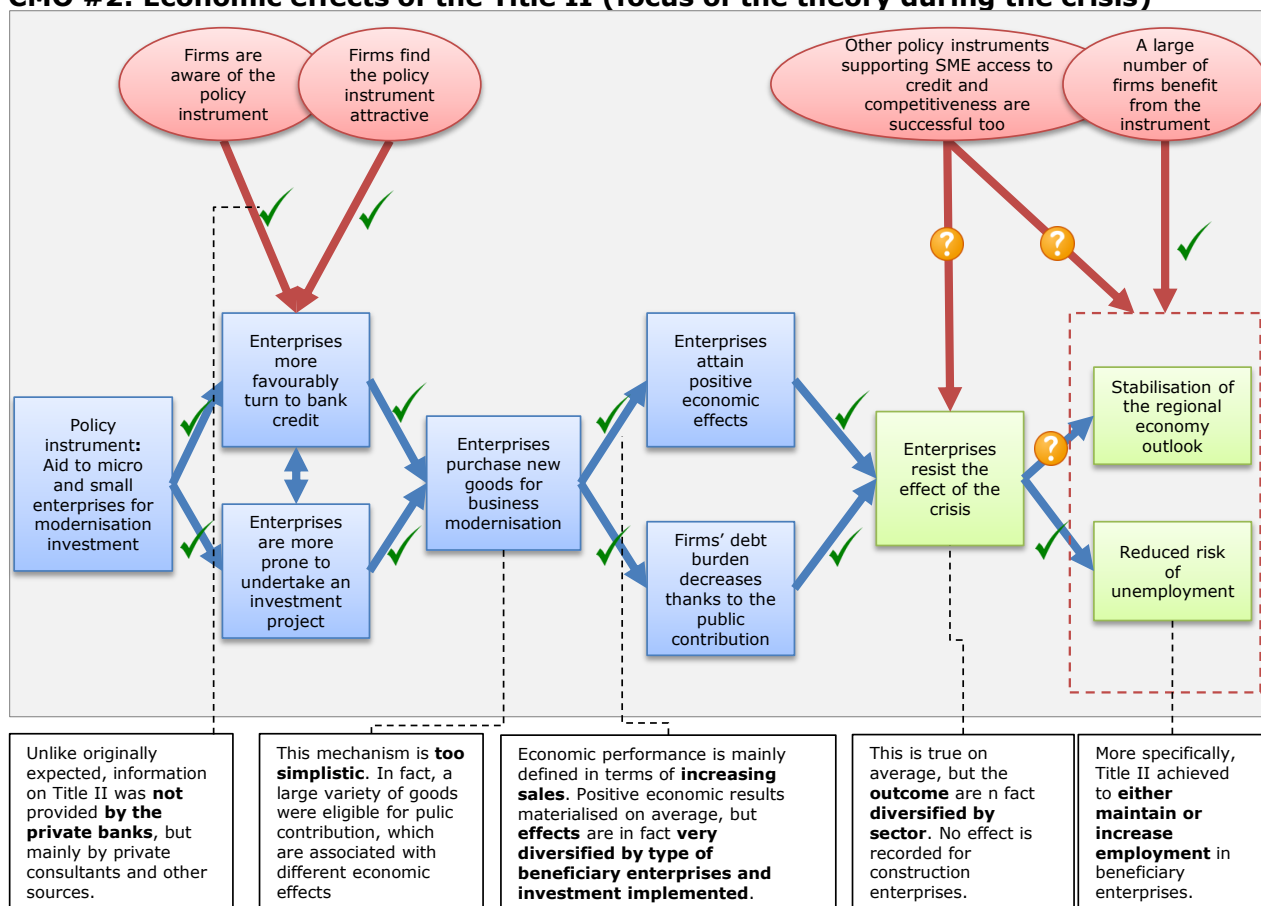
CMO #3: Improved opinion about and confidence in the public support initiatives

Note: Green-coloured boxes indicate the outcomes pursued by the policy maker; red-coloured circles indicate external conditions (i.e. specifications of context) upon which desired changes occur; blue-coloured boxes indicate the mechanisms at work along the causal chain leading to the outcomes.
Source: CSIL.

5 SUPPORT FOR INDUSTRIAL R&D IN CASTILE AND LEÓN (SPAIN)

5.1 Description of the policy instrument

5.1.1 Background context

As other Spanish regions, Castile and León is marked by low productivity and a low level of innovation activity in SMEs. The regional economy is based on traditional industrial activities in the agro-food and metal machining sectors, but also in the automotive sector. The region is increasingly concentrating on the development of a knowledge-based economy by promoting high tech sectors, such as the aerospace industry, renewable energy and information and communication technologies. SMEs show poor connection with the educational system and R&D centres, that are particularly numerous in this region, as well as having an undeveloped culture of business cooperation. In terms of R&D performance, the region is still lagging behind compared to national and EU averages. However, since the 1990s, the region has made important progress. Gross Domestic Expenditure in R&D (GERD) grew until 2008 to reach 1.26%, although in 2010 and 2011 there was a setback, attributable to the financial crisis. Indeed, the crisis severely affected the regional economy, especially in terms of job destruction.

In 2007 the Regional Community of Castile and León launched the Regional Scientific Research, Technological Development and Innovation Strategy (ERIDI), with the aim of fostering R&D and innovation activities in the region between 2007 and 2013. In particular, the strategy's objective was to contribute to building the competitive advantage of Castile and León (CyL) through a stronger commitment to research, technological development and innovation, thus contributing to shaping a knowledge-based economy that is competitive and capable of generating employment and wealth.

Under this strategy a series of intervention programmes were designed, among which is the Idea&Decide Programme. This programme, managed by the regional Economic Development Agency (ADE), included different action lines, such as: support to R&D projects and employment of highly-qualified personnel, support to young technology-based companies, advice on innovation, support to intellectual property protection and adoption of ICT, etc. Intervention lines 1.4 and 1.7, providing support for R&D and support for ICT respectively, were co-financed by the CyL regional ERDF Operational Programme 2007-2013.

Our analysis is focused on intervention line 1.4, whose objective was to tackle barriers preventing firms from undertaking R&D investment. While being open to all enterprises operating in Castile and León, the instrument was especially meant to support SMEs. It has been delivered in five annual calls launched between 2007 and 2011. The public expenditure for this line amounted to more than EUR 200 Million.

5.1.2 Eligibility and selection criteria and delivery mechanisms

The mode of delivery of the instrument consisted of a grant disbursed by ADE to the enterprises which undertake a R&D project.

The following types of projects were eligible for financing under line 1.4:[80]

- Individual projects, i.e. R&D projects proposed and carried out by one enterprise, being either an SME or a large enterprise. ADE's support was targeted at enterprises which had already some experience with R&D but also small companies which had never

---

[80] Source "Disposiciones Especificas Programa Idea+Decide2008", "Disposiciones Especificas Programa I+D+i 2009", "Disposiciones Especificas Programa I+D+i 2010", "Convocatoria Plan Adelanta Y Modificación 2011".

undertaken any R&D project before (funded by the dedicated subline "Learning to innovate").

- Collaborative R&D projects, presented by at least two companies which committed to cooperating to achieve a common R&D objective. Collaborative projects had to include at least one SME among the participants.[81] In the partnerships no participant could account for more than 70% of the total eligible costs.

- So-called "PRIMER" projects, - particularly complex and ambitious projects with the following characteristics: (a) the project had to involve at least three independent companies, at least one of which had to be an SME, and at least two research centres as subcontractors of the firms, with a contribution of at least 25% of the total budget (lowered to 15% in 2009); (d) the total fundable expenses had to amount at least EUR 6 Million (lowered to 4 in 2009 and 3 in 2010); (e) the project had to last at least two years; (f) the R&D activities had to concern a sector defined as strategic by the Region.[82]

Line 1.4 included also a subline dedicated to young innovative companies, co-funded by the national NEOTEC Program, which aimed to support the initial stages of development of high-technological intensity firms, without being solely focused on R&D. Since this subline has a different intervention logic from the other types of project mentioned, it is in fact to be considered as a different policy instrument, and therefore it is not part of our evaluation.

The sectoral boundaries of the instrument were very wide, excluding only the coal, rail, road and waterways transport sectors. For most of the calls no minimum investment value was set for SMEs, in order not to discourage them from applying. A minimum threshold of EUR 100,000 was introduced in 2011 only: in that year another policy instrument co-funded by the national OP was launched to support innovative and smaller projects funded by the SMEs (maximum EUR 25,000). Hence, in order to avoid overlapping of resources, made even scarcer by the economic crisis, ADE preferred to concentrate the regional funds on larger projects.

Funds were earmarked through a competitive tender process run by ADE, on the basis of a set of selection criteria concerning the technological ability and experience of the enterprise, the quality and technical interest of the project, the degree of external collaboration, the applicability of the produced R&D, i.e. its patentability and industrialisation, and only for PRIMER projects, their degree of contribution to the wider goals of regional development. Selection criteria remained the same overall across the years. Additional points were attributed to projects considered to be of higher priority, i.e.:

- collaborative projects;

- projects of small enterprises which had never received any support for R&D from ADE;

- only from 2009, projects related to diversification activities in the automotive or construction sector, or any other sector strongly affected by the economic crisis.

The eligible types of expenditure covered by the R&D grant were:

- personnel costs (researchers, technicians and other auxiliary staff), directly participating in the project;

- costs of instruments and equipment to the extent and for the period used for the research project;

---

[81] Unless the project entailed cross-border collaboration between large firms.
[82] Automotive and Components, Aeronautic and Aerospace, Information and Communication Technology, Biotechnology and Biomedicine, Nanotechnology and New Materials, Environment and Sustainable Development, Renewable Energy, Defence and Security. Source: Convocatoria Plan Adelanta Y Modificación 2011.

- cost of contractual research, technical knowledge and patents bought or licensed from outside sources at market prices;
- additional overheads incurred directly as a result of the research project;
- other operating expenses, including costs of materials, supplies and similar products, derived directly from the research activity.

The aid intensity varied across beneficiaries' size and the type of project. As shown in Table 6 the aid intensity scheme designed by ADE privileged smaller firms, collaborative projects and research projects (as opposed to experimental development projects), since these were relatively more risky.

The grant was disbursed to the beneficiary enterprises after the project completion and after a visit on the field conducted by ADE staff to verify the actual realisation of the project (e.g. the existence of the developed prototype). Before the economic crisis impacted on public budgets, the final payment was received on average 3-4 months after the end of the project. The narrowing of the regional agency's budget entailed a considerable delay in the final payments, even of some years.[83]

Up to 2009, beneficiaries could ask for an anticipation of the grant, on the condition that a bank guarantee was provided. Then, as a consequence of the shrinkage of public resources, the possibility to receive an anticipated payment remained available for PRIMER projects only.

Table 6.   Maximum eligible share of financing (grant over project's value)

	Small enterprises	Medium enterprises	Large enterprises
R&D project	70%	60%	50%
R&D project in collaboration	80%	75%	65%
Experimental development project	45%	35%	25%
Experimental development project in collaboration	60%	50%	40%

Source: Disposiciones Especificas Programa I+D+i 2010.

5.2 Theory of change

5.2.1 The logic of intervention explained

Research, development and innovation are at the centre of the regional development strategy aiming to make Castile and León a strong knowledge-based economy. Since its establishment in 1994, the regional agency ADE has been focused on supporting micro, small and medium enterprises, which represent the backbone of the regional economy and are generally not the specific target of other national programmes for R&D (such as the 'Technology Fund' ERDF OP).

The rationale for supporting the R&D projects is extensively explored in the economic literature (see next section). It is meant to address barriers such as incomplete information and lack of capacity to embark on R&D and innovation activities, and the high risk related to R&D, particularly in the pre-competitive phase, which are particularly pressing for smaller companies. High risks attached to the investments and the limited collateral usually offered by SMEs are associated with higher difficulties in accessing bank credit, thus creating the scope for public intervention. By helping SMEs overcome the barriers which prevent them from implementing ambitious and risky R&D projects, ADE expects to increase the private expenditure on R&D and, in turn, to achieve diversified economic effects: development of new and better products, optimisation of production processes, higher productivity, and, in general, increased sales and reduced costs for enterprises.

---

[83] As of July 2015 ADE still had to pay some projects dating back to 2011.

The policy instrument supports both individual and collaborative projects (involving SMEs, large companies and research organisations), and puts higher emphasis on the latter in terms of premiums in the selection process. This decision finds justification in the light of the greater difficulties attached to collaborative R&D, but also the advantages that may derive from collaboration. In addition to the above mentioned barriers, collaborative R&D projects may face the risk of misappropriation of research results and a lack of protection of the know-how and business information among the research partners. Furthermore, their usually greater complexity requires greater managerial capacities. Collaboration among enterprises and between enterprises and research centres could help firms access leading edge research knowledge, research infrastructure and services they lack, and help them develop in-house capabilities thanks to mutual learning processes, but also share the cost for particularly costly and risky projects.

The logic of intervention explaining how positive economic effects are expected to be achieved thanks to the implementation of either individual or collaborative R&D projects can be described by one Context-Mechanism-Outcome configuration (Figure 46), even if the two types of projects are not associated with exactly the same risks. The availability of skills to implement R&D projects is another condition that is acknowledged to influence the outcomes. It can be considered as both a context factor and a mechanisms of change, since it is likely to be directly affected by the project too.

In parallel to this logic, the policy instrument has another ambition: to accompany potentially innovative SMEs along a growth path in relation to their R&D abilities and attitudes. More specifically, ADE has designed the instrument and its different support lines with the idea of softly pushing the SMEs along a pattern of behavioural change, tailored to the specificities and potentialities of enterprises. Newly innovative enterprises, with no previous experience in implementing R&D projects, are encouraged to undertake an R&D project and are duly supported through the sub-line "Learning to Innovate". Enterprises which have already implemented previous R&D projects are encouraged to continue with their R&D activities, but also, when deemed ready, to take a step forward and to attempt to implement larger, more complex, risker and possibly collaborative projects. At the end of this trajectory SMEs turn out to have enough capabilities and experience to embark on large collaborative projects at national and European level.

For this logic of implementation to be successfully put in place (second CMO in the Figure below), ADE acknowledges that it needs to take a proactive role. The dialogue with applicant enterprises is important to understand their motivation for the project and agree on the best way to achieve the research objectives. In the case of R&D and innovation beginners, special efforts are devoted to ensuring that enterprises have a sufficiently clear idea of the R&D project and possible outcomes, in some cases they even discuss the technical details of the project and the business model for the commercialisation of the products resulting from the research and experimentation. When similar project ideas are submitted for co-financing, a dialogue is started to explore the scope for collaboration as a way to reach the research objectives in a more effective and efficient way. The underlying condition for such a dialogue is that ADE has the technical skills necessary to interact with SMEs on the R&D ground, as well as the mandate to take on such a role.

Figure 46   Theory of intervention of R&D support: CMO configurations
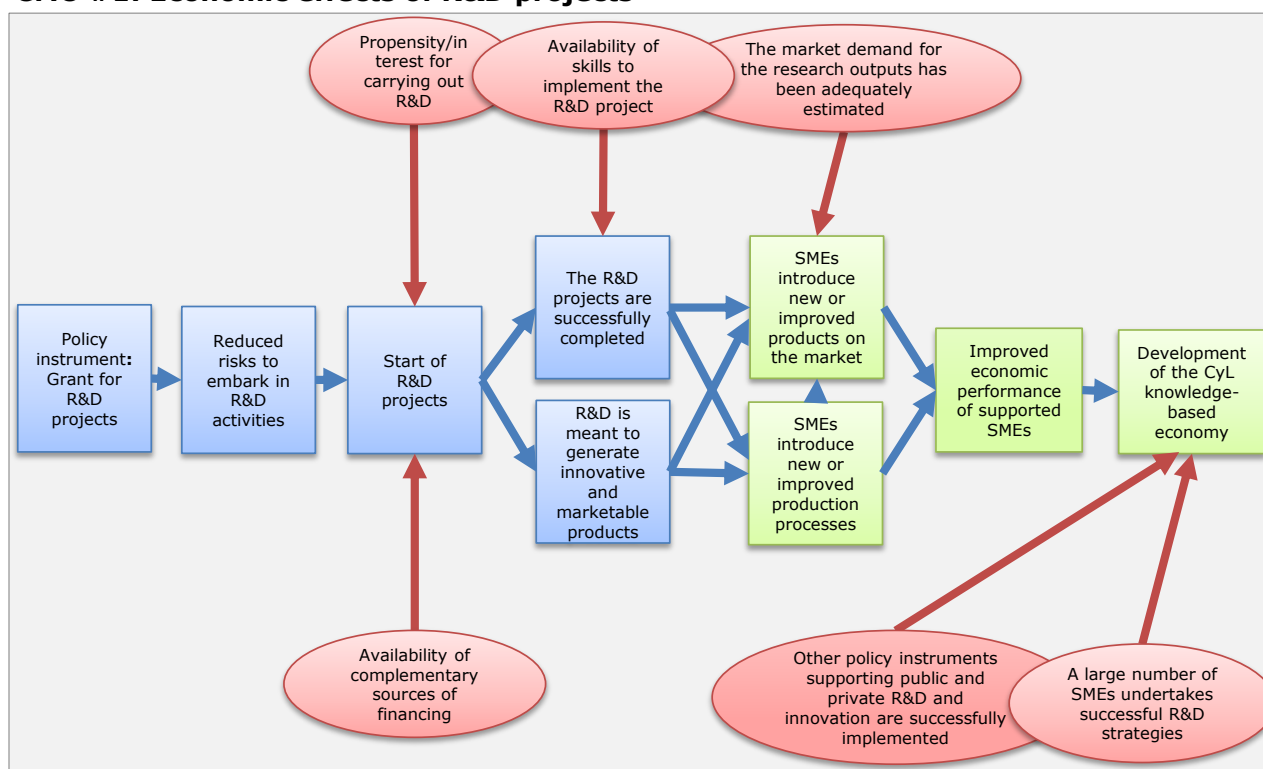
CMO #1: Economic effects of R&D projects

CMO #2: Advancement of R&D ambition and capacities
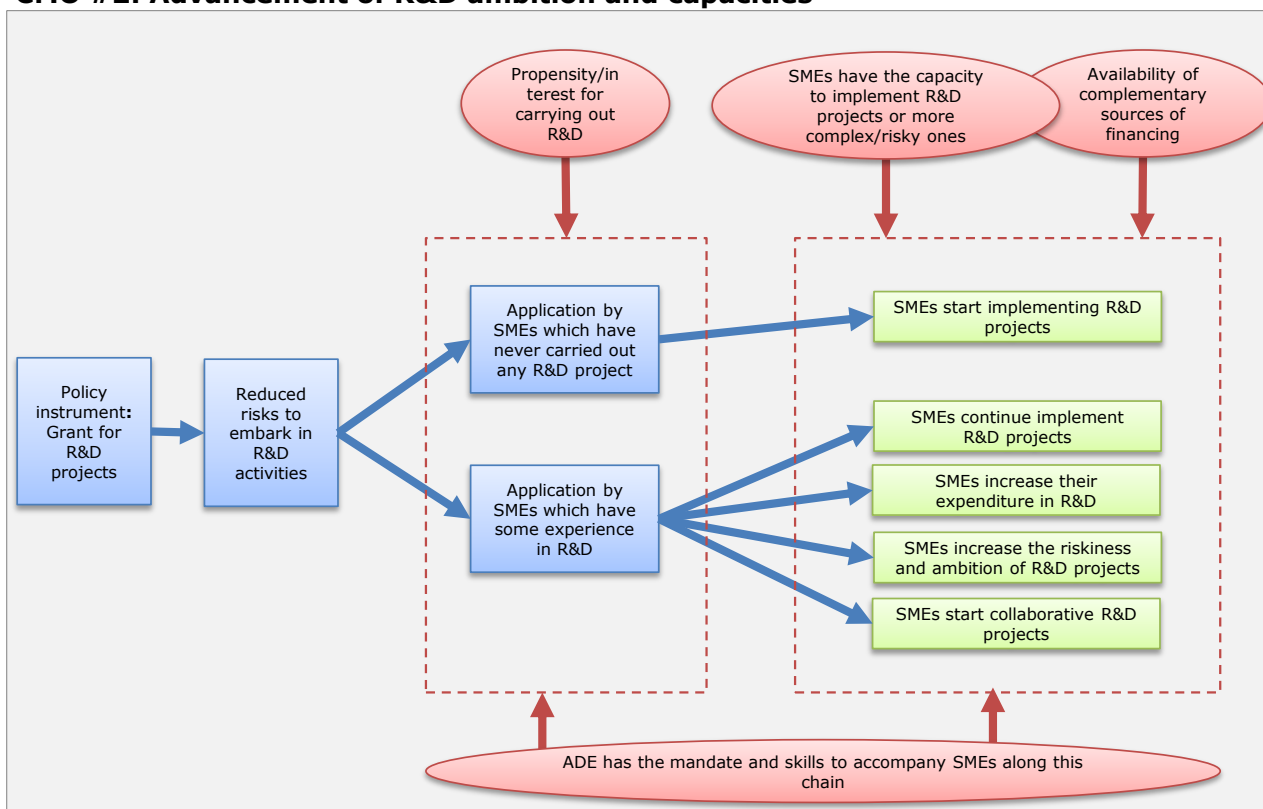
Note: Green-coloured boxes indicate the outcomes pursued by the policy maker; red-coloured circles indicate external conditions (i.e. specifications of context) upon which desired changes occur; blue-coloured boxes indicate the mechanisms at work along the causal chain leading to the outcomes.
Source: CSIL.

5.2.2 Support from the literature for the logic of intervention

The role of private R&D investment by firms has been recognized as a fundamental engine for economic growth both at the macro and microeconomic levels (Baumol 2002; Jones 2002). The idea of using public procurement as a vehicle for supporting firms' R&D investments and innovation is rooted in the recognition that there exists a gap between the optimal social level of R&D investment and the private level, causing a systematic underprovision that could hamper the development of a region or country (OECD, 2008; Bronzini and Piselli, 2014; Fantino and Cannone, 2014). This gap is due to the difficult appropriability of returns to investment by innovators. Since the primary output of R&D activities is knowledge, which is a non-rival good, its spread cannot be avoided by the innovators and as a consequence the returns from the acquisition of new knowledge cannot be completely appropriated by the firm undertaking the R&D investment with the result that there is underinvestment by firms in this field (Arrow, 1962; Nelson, 1959). An additional gap between the private rate of return and the cost of financial capital may exist with imperfect financial markets, entailing borrowing constraints for risky projects such as the R&D ones (Jensen and Meckling, 1976; Hubbard, 1998).

The market failure stemming from financial market imperfections is more severe for SMEs and younger companies (Hall and Lerner 2009). Among other reasons why larger enterprises may find it easier to embark on R&D activities as compared to small firms, is the possibility that they have a diversification strategy which allows them to spread the risk over a large number of R&D projects (Ortega-Argilés et al., 2009).

From a theoretical perspective, when investigating how R&D activities may affect the performance of firms, two rationales are usually assumed (Ortega-Argilés et al., 2009). First, R&D activities lead straight to the development and the commercialization of a new product and/or production process, which, in turn, could lead to increasing turnover. Second, formal R&D raises the enterprise's knowledge base and absorptive capacity along with the technological awareness of the employees and therefore boosts the firm's innovative spirit. Thus, the latter highlights behavioural changes within the enterprise.

The empirical evidence on the effects of R&D policies is huge but the findings are mixed. Most papers assess whether R&D activities have additional effects on firm innovation output, e.g. on in-house R&D expenditure (Fantino and Cannone, 2013), employment (Entorf and Pohlmeier, 1990; Zimmermann, 1991; Peters, 2004; Harrison et. al 2005), patents (Bronzini and Piselli, 2014; Cappellen et al., 2012) or proxies of firm performance, such as productivity and efficiency (Crepon et al., 1998; van Leeuven and Klomp, 2006; Hall et al., 2009) or sales (Bérubé and Mohnen, 2009; Harris et al., 2009; Czarnitzki et al., 2011; Foreman-Peck, 2013).[84] Some papers investigate the pathway linking R&D investments and exports (Roberts and Tybout, 1997; Bernard and Jensen 1999, 2004; Geroski et al. 1997). Here, is worth mentioning the paper by Aw et al. (2011) which shows that past productivity and exports raise expected returns of engagement in R&D (see also Esteve-Perez and Rodriguez, 2013).

The cognitive approach to the firm, namely the knowledge-based view of the firm, provides a complementary rationale for the positive interaction between R&D investment and intangible output indicators, such as behavioural changes. The cognitive dimension of R&D has been well known since the seminal paper of Cohen and Levinthal (1989). Formal R&D and output indicators do not capture all aspects of innovation, which can occur via other channels, especially in SMEs. For example, Rammer at al. (2009) argue that formal R&D can be coupled

---

[84] On this issue see also: Lerner (1999), Busom (2000), Wallesten (2000), Lach (2002), Almus and Czarnitzki (2003), Gonzalez et al. (2005), Gorg and Strobl (2007), Merito (2007), Hussinger (2008), Clausen (2009), Takalo et al. (2010), de Blasio et al. (2011), Bronzini and Iachini (2014).

or even replaced by innovation management tools such as training, cooperation, networking, contracting external knowledge and R&D.

The greater effectiveness of the public support for smaller firms, with respect to large enterprises, is a result in the literature on R&D (Busom, 2000; Taymaz, 2005; Lööf and Heshmati, 2007; Baghana and Mohnen, 2009; Bronzini and Iachini, 2011); however its success depends on firms' characteristics and the context in which they operate. For example, empirical evidence shows that SMEs are important sources of innovation in the sectors characterized by high-tech intensity, high entry rates and lower appropriabilty conditions. The opposite is true for large firms (Winter, 1984; Levin et al., 1985; Cohen et al., 1987; Malerba and Orsenigo, 1995; 1996; Colombo and Grilli, 2007; Santarelli and Vivarelli, 2007; Lin and Huang 2008). Yet, according to the paper by Holzl (2009), R&D is more important to high growth SMEs, the so called 'gazelles' which operate at the technological frontier.

Limited capabilities seem to be a major concern for SMEs involved in R&D activities. SMEs generally tend to underinvest or fail to invest in R&D because of a lack of knowledge about how and where to acquire the necessary competences; likewise technological suppliers often highlight a poor understanding of SMEs' actual competence needs (Czarnitzki, 2006; Garcia-Quevedo and Mas-Verdù, 2008; Ortega-Argilés et al., 2009).

Another strand of the literature focuses on the connection between collaborative R&D, innovation, and SMEs' success. Collaboration in R&D both with other companies and universities is becoming important in creating knowledge that makes businesses more competitive (Lipnack and Stamps 2000; Agrawal, 2001; Samela and Lukka, 2004; Ebrahim, 2010; Cunningham and Gök's, 2012). Many researchers have looked at the effects of collaborative R&D on effectiveness and efficiency of SME innovation activity. Collaboration reduces time-to-market, which is generally admitted to be one of the most important keys for success in manufacturing (Sorli at al., 2006). Wagner and Hoegl (2006) argue that automotive equipment manufacturers have formed partnerships with suppliers to take advantage of their technological expertise in development, design and manufacturing. As product development becomes more complex, firms need to collaborate more closely than in the past (Anderson at al., 2007; Ebrahim, 2010).

5.2.3 Beneficiaries and projects supported

Between 2007 and 2011, 1,182 applications submitted by both SMEs and large enterprises for the R&D grant were approved out of 2,090 requests received, corresponding to an approval rate of 56%. These figures include applications for the two previous calls, launched in 2005 and 2006. No specific figures for the 2007-2011 calls are available, but the approval rate has not changed significantly.

The regional monitoring system keeps a record of each application submitted by each enterprise. With partnerships, each partner is required to submit an application for the activities that it is going to implement and to indicate whether these activities are part of a collaborative project. The activities carried out by each partner within a collaborative project are in fact treated as separate projects in the monitoring system and no detailed data have been provided by ADE. According to aggregate figures, projects carried out by SMEs in collaboration with other enterprises are around 18% of the total number of R&D projects; projects with subcontracted R&D to research organisations (universities in or outside CyL or technology centres) are approximately 20%. Five PRIMER projects were supported.

Information on investment projects and beneficiaries was made available to us by ADE in June 2015. Available data refer to 540 projects approved between 2007 and 2011, that were already completed and for which the grant has been already disbursed and certified. 78% of these projects (equal to 422) have been carried out by SMEs, the remainder by large

enterprises. Beneficiary SMEs amount to 299,[85] 35% (106) of which received support for more than one project (up to seven, as shown in Figure 47). No information is available on the projects which have not received a payment yet. According to interviews with ADE, because of the bad macroeconomic scenario, some beneficiary companies had to cut investments and, in some cases, to interrupt the project activities; other firms went bankrupt. In case of collaborative projects, the bankruptcy of one partner meant the interruption of the entire project, since it was not allowed either for one partner to take over the project activities for which the failed enterprise was previously responsible, or for a single project partner to be replaced by another enterprise.

A few SMEs changed their size class over the period from one project to another, three of them moving from small to medium, and one from small to micro. If considering the last available size class, the sample includes 206 small enterprises, 91 medium enterprises and only two micro enterprises.

Figure 47   Breakdown of beneficiary SMEs by number of projects implemented
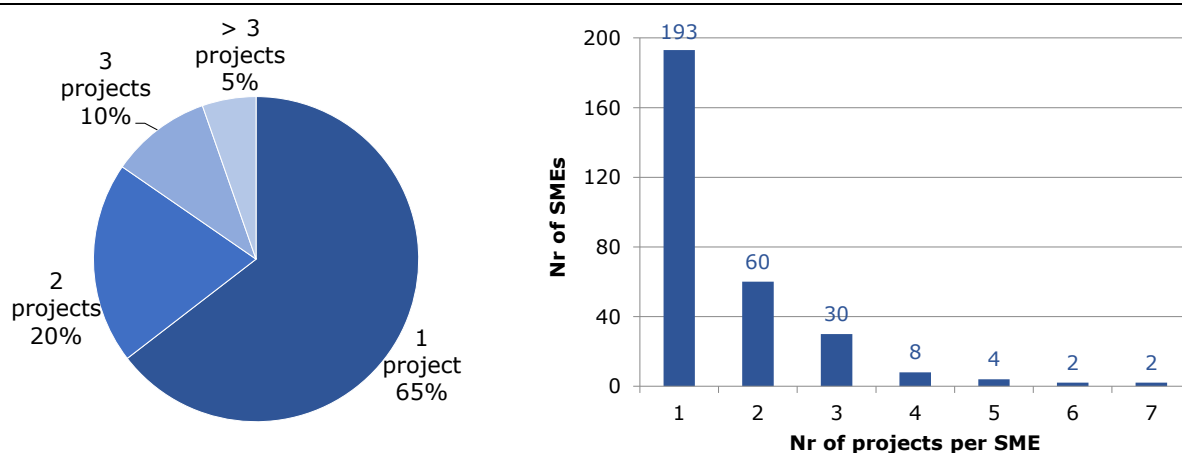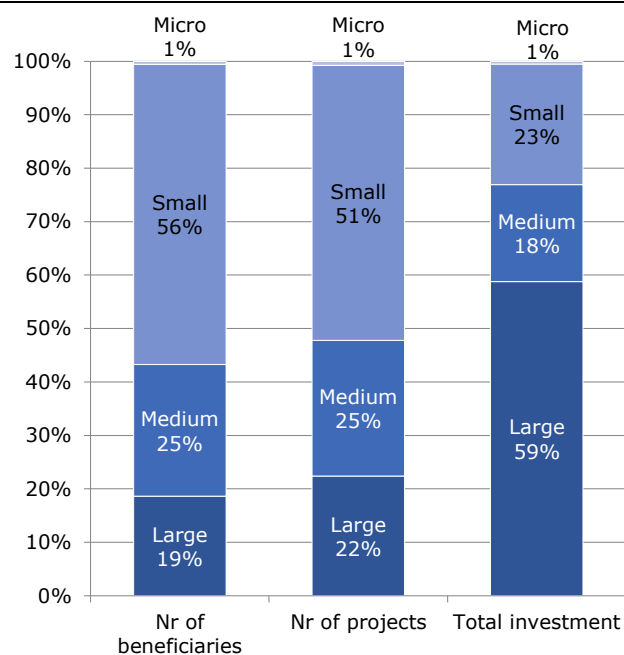

Source: CSIL elaboration of ADE data.

Large companies accounted for 59% of the value of total investment activated thanks to ADE support (almost EUR 290 million), because of the greater size of their projects (EUR 1.4 million on average). Among SMEs, the average investment for medium-size firms (EUR 397 thousand) almost doubled that of small-size ones (EUR 237 thousand), whereas the two micro enterprises of the sample are associated with very different investment volumes: around EUR 200 thousand for one and more than EUR 800 thousand for the other one.

In line with the eligibility criteria, the average aid intensity is inversely proportional to the firms' size, amounting to 42% for micro enterprises and progressively decreasing for small (36%) and medium (33%) enterprises.

The city and province of each enterprise are included in ADE's database. Calls were open to all companies that were either based in Castile and León or that have got at least one operational unit in the region. Almost half of beneficiaries (43%) are located in the province of Valladolid, capital city of the region. Many beneficiaries are concentrated in the other major cities of the region, Burgos (20%) and León (15%). ADE encouraged enterprises in the relatively less industrialised and peripheral areas of Zamora and Ávila to apply for funding, but a small share of companies in those provinces actually benefited from R&D support (respectively 4% and 1%).
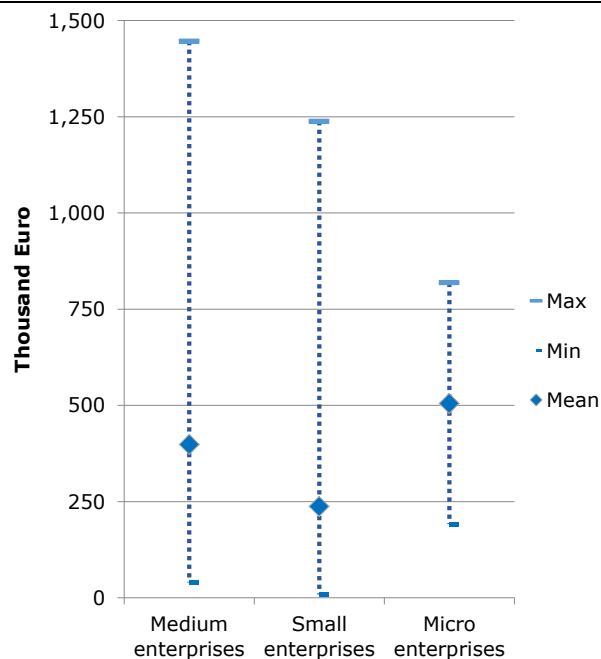
---

[85] Large enterprises are 66.

Figure 48   Breakdown of beneficiaries, project and investment by size of the enterprise
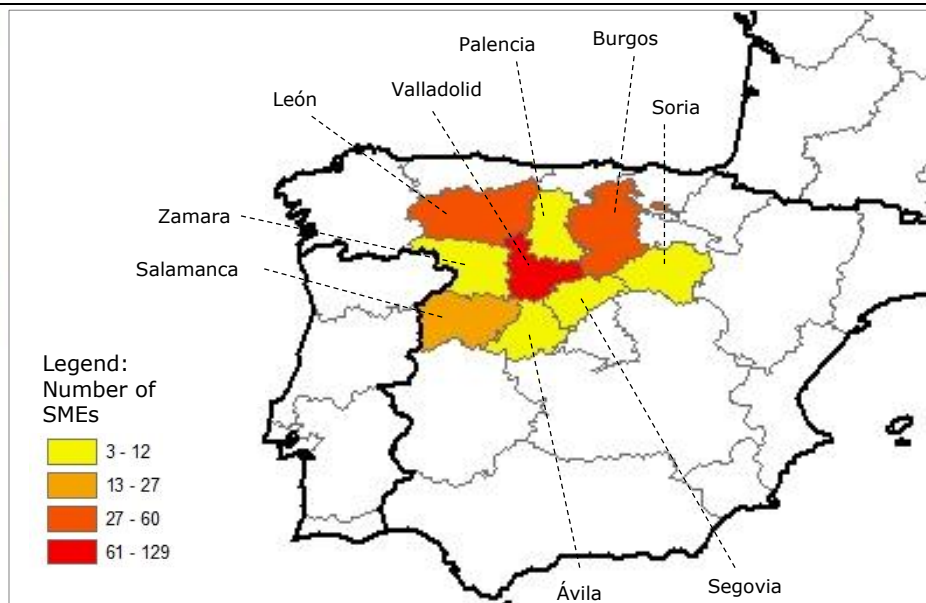
Figure 49   Minimum, maximum and average investment by beneficiary size

Source: CSIL elaboration of ADE data. Note: the latest available size of enterprises has been considered.

Source: CSIL elaboration of ADE data.

**Figure 50   Distribution of beneficiaries by province (NUTS 3)**

Source: CSIL elaboration of ADE data.

As shown in the next Figures, the ERDF tends to concentrate in provinces with the higher number of small and medium enterprises or employees in small and medium enterprises.[86] Macroeconomic indicators such as GDP growth or GDP per capita are less effective at explaining the geographical distribution of public funds, also due to relatively limited differences from one province to another.

---

[86] The same trend is observed if all enterprises of any size are considered.

Figure 51 Comparison between the geographical distribution of expenditure (OP support) and number of small and medium enterprises (average 2008-2010)
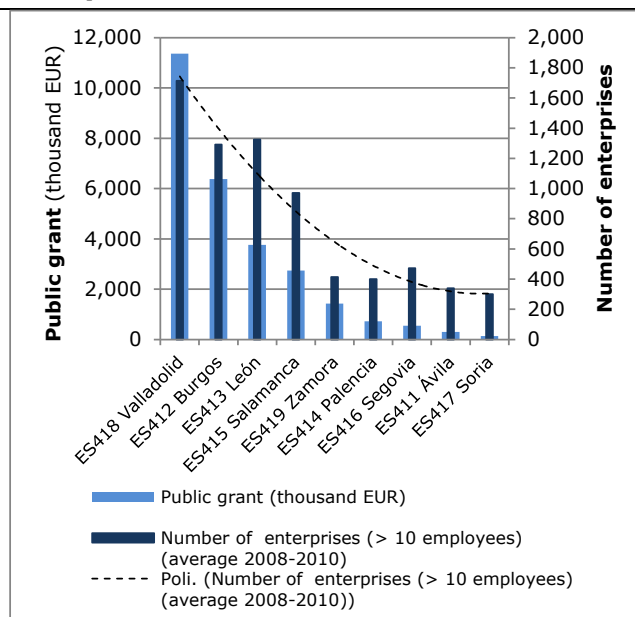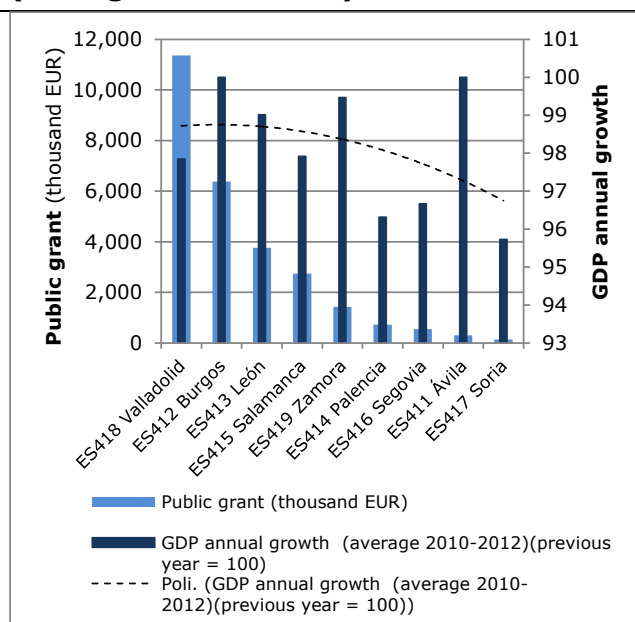

Source: CSIL elaboration of ADE and Eurostat data.

Figure 52 Comparison between the geographical distribution of expenditure (OP support) and employment in small and medium enterprises (average 2008-2010)
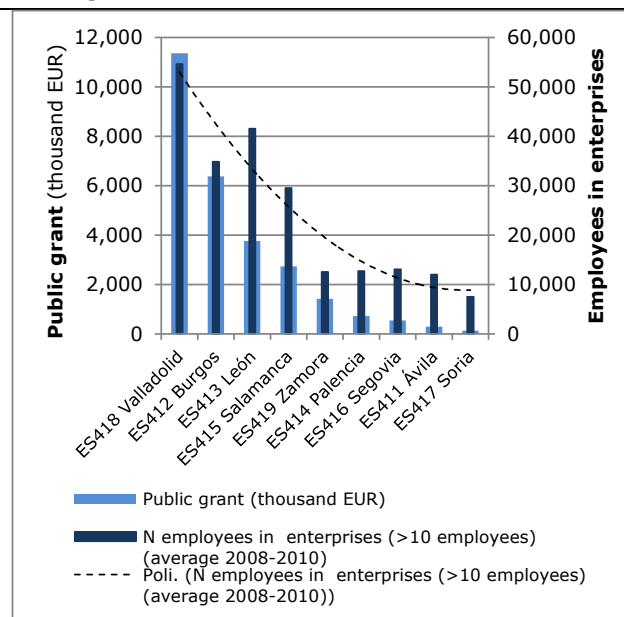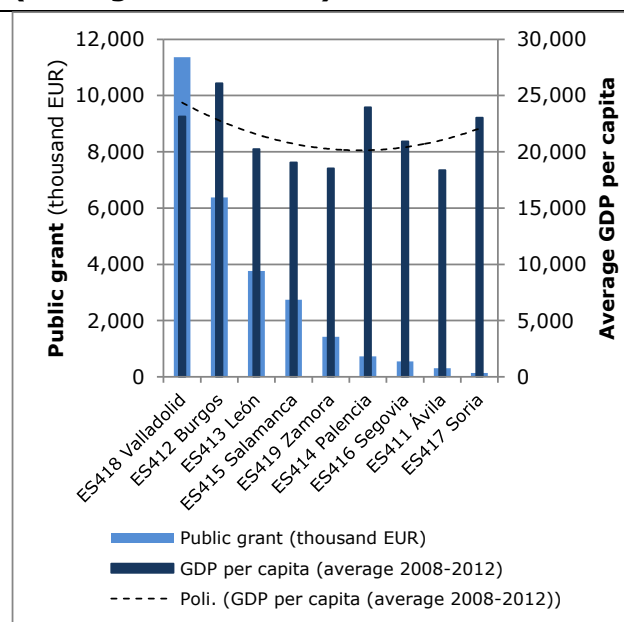

Source: CSIL elaboration of ADE and Eurostat data.

Figure 53 Comparison between the geographical distribution of expenditure (OP support) and GDP annual growth (average 2008 – 2012)

Source: CSIL elaboration of ADE and Eurostat data.

Figure 54 Comparison between the geographical distribution of expenditure (OP support) and GDP per capita (average 2008-2012)

Source: CSIL elaboration of ADE and Eurostat data.

No data about the activity sector is available for all the beneficiary enterprises, as this information is not collected by ADE's monitoring system. Based on the NACE activity sector declared by SMEs which have participated in our survey (97 SMEs), the most represented sectors are: computer programming, consultancy and related activities (J62), architectural and engineering activities, technical testing and analysis (M71) and scientific research and development (M72) and manufacturing of machineries and equipment (C28).

When considering the technological intensity level of sectors of activities (at NACE 2 digit level), [87] a high variability can be noted, from sectors traditionally defined as low-tech (e.g. the agro-food industry) to more high tech ones (mainly in the service sector).

Figure 55   Sector   of   activity   of   a
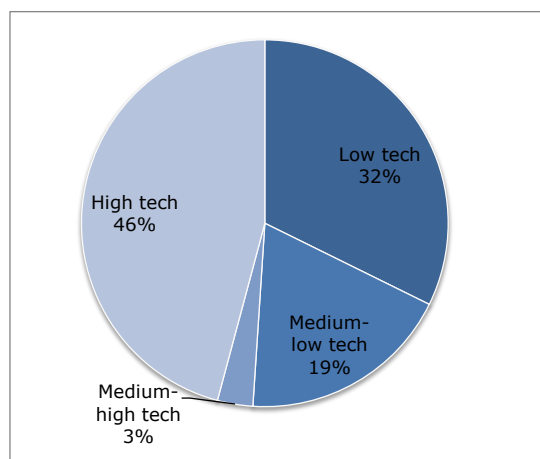**sample of beneficiaries**
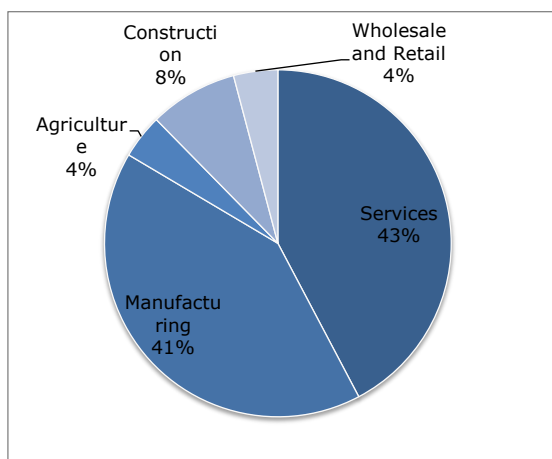
Source: CSIL elaboration of questionnaires to a sample of beneficiary SMEs.

Figure 56   Technological intensity of a
sample of beneficiaries

Source: CSIL elaboration of questionnaires to a sample of beneficiary SMEs.

Box 9.   Examples of beneficiary SMEs and R&D projects

- Firm X is a small-size engineering service company which operates in the sector of acoustic isolation products and systems. It has large experience with R&D projects. During the 2007-2013 period it started four R&D projects for a total value of almost EUR 300 thousand. The projects involved the preparation of feasibility studies and/or experimental activities with the aim of developing and eventually selling innovative services. ADE contribution to these projects amounted to slightly more than EUR 100 thousand.

- The small-size and recently established firm Y produces high-tech products to test the quality and security of metal equipment adopted in a variety of sectors. Y has implemented two R&D projects since 2007, for a total investment value of almost EUR 500 thousand. ADE support amounts to almost 50% of the projects value.

Source: CSIL based on interviews.

5.3 Empirical test of the theory

5.3.1 Research questions and the sample

The logic of intervention of the specific policy instrument under analysis in Castile and León has been tested through a questionnaire designed to answer the following main research questions:

- *Did the policy instrument succeed in stimulating the implementation of R&D projects by SMEs and thence to support their economic performance? What changes in SME basic activities or other factors can explain the observed achievements?*

- *Is it possible to affirm that beneficiary SMEs are undergoing a process of increasing capabilities and complexity with reference to R&D activities? Is ADE playing an active role in this regard?*

---

[87] As explained in the First Intermediate Report, the technology intensity variable was defined as the ratio between business R&D expenditure and total value added in each 2 digits NACE sector and for each country.

- *Are the changes observed in line with the theory of the intervention? If deviations from the theory are recorded, why did they occur?*

- *Did the policy instrument produce other types of behavioural change in supported SMEs? What factors can explain the observed changes?*

The questionnaire was submitted to the 299 SMEs which benefitted from ADE support for R&D between 2007 and 2011 and have already received the grant. A total of 97 questionnaires have been filled in (corresponding to a 34% response rate). Phone calls and in-depth research on the internet led to the identification of other 24 SMEs which either have become bankrupt, or have changed ownership due to financial difficulties or are currently in liquidation and which therefore could not fill in the questionnaire.

The representativeness of the sample has been checked with reference to the size, province, value of investment project and public support received. No major differences are found between the distribution of the sample and of population. The questionnaire and the analysis of statistical representativeness are enclosed in Annex 3.
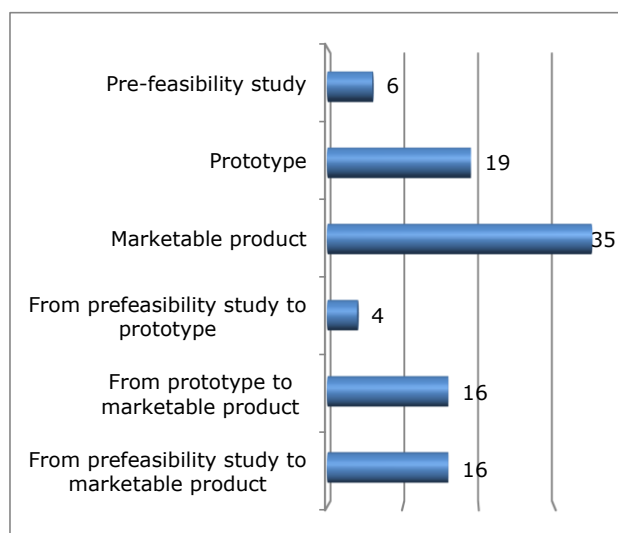
5.3.2 Analysis of results

In this section we summarise the main results derived from the statistical analysis of the survey's responses, matched with information about the enterprise and the investment projects provided by ADE, with the aim of answering the above research questions. The full set of descriptive statistics for each question of the questionnaire and the detailed results of other statistical analyses implemented are reported in Annex 3.

5.3.3 Economic performance

The majority of firms have been involved in R&D projects with a strong innovative component, aiming to produce new products ready for commercialisation (questions C1.1 and C2.1). It could be expected that implementing experimental activities in order to complete an innovative and marketable project is more likely to achieve quantifiable economic effects, rather than a pre-feasibility study or a prototype. SMEs declare that almost 70% of projects started from 2007 onwards have been completely successfully and only 6% turned out to be unsuccessful or were interrupted (questions C1.2 and C2.2).

The share of SMEs which have already achieved positive economic results thanks to the R&D project(s) is not particularly high as compared with the other policy instruments evaluated in this report (question D4). No increase in sales has been reported by 21% of respondents. Among those that have reported some effects, the majority declare that they were 'little' or 'moderate'; only 8% declared that they have at least achieved an appreciable increase in sales. The share of respondents which succeeded in increasing exports is slightly larger, with around 13% of respondents having reported at least an appreciable effect. Almost 40% of SMEs did not observe any decrease in costs as a consequence of the project implementation, but, as one may argue, this might not necessarily be the main objective of an R&D project.

Figure 57   Number of SMEs by objective of the R&D project(s) supported

Pre-feasibility study — 6
Prototype — 19
Marketable product — 35
From prefeasibility study to prototype — 4
From prototype to marketable product — 16
From prefeasibility study to marketable product — 16

Source: CSIL elaboration of survey responses (questions C1.1 and C2.1).
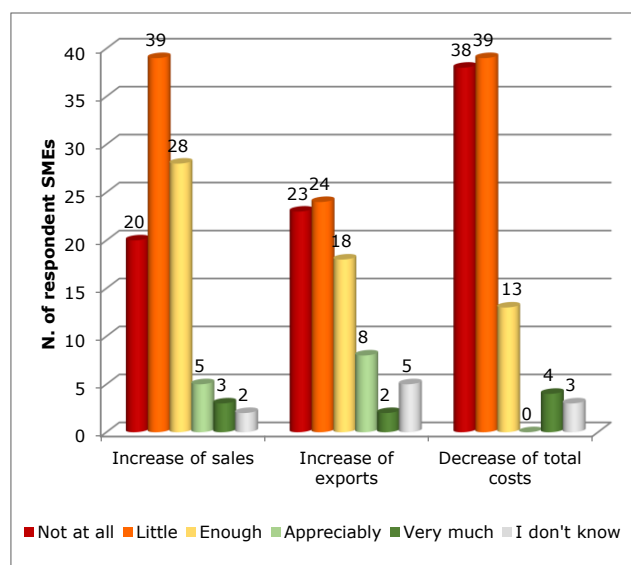
Figure 58   Share of projects by degree of achievement of the intended R&D objectives
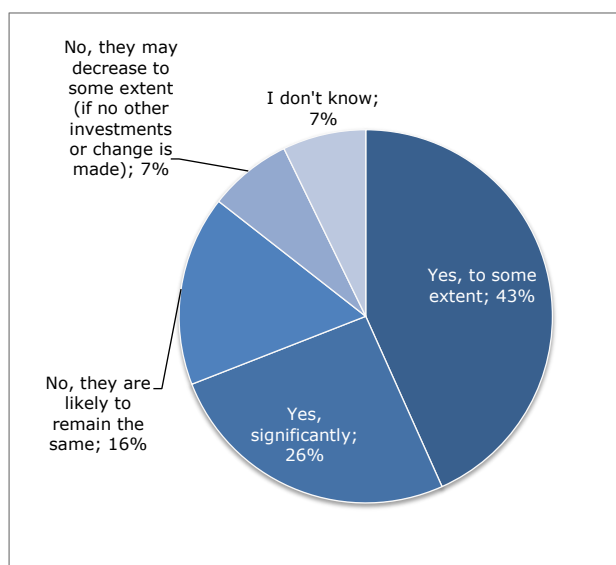

The project was unsuccessful; 5%
Interrupted projects; 1%
Still on-going projects; 3%
The project was partially successful; 22%
The project was completely successful; 69%
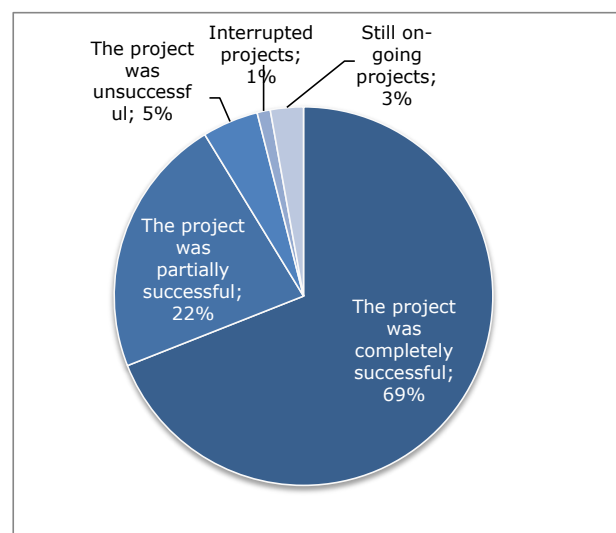
Source: CSIL elaboration of survey responses (questions C1.2 and C2.2).

Figure 59   Economic results achieved thanks to the R&D project(s) supported

N. of respondent SMEs

Increase of sales: 20, 39, 28, 5, 3, 2
Increase of exports: 23, 24, 18, 8, 2, 5
Decrease of total costs: 38, 39, 13, 0, 4, 3

■ Not at all ■ Little ■ Enough ■ Appreciably ■ Very much ■ I don't know

Source: CSIL elaboration of survey responses (questions C1.1 and C2.1).

Figure 60   Expectations about the future economic results

No, they may decrease to some extent (if no other investments or change is made); 7%
I don't know; 7%
No, they are likely to remain the same; 16%
Yes, to some extent; 43%
Yes, significantly; 26%

Source: CSIL elaboration of survey responses (question D4). Note: the pie illustrates the shares of respondent SMEs by type of answer.

The econometric analysis suggests that the project's objective (pre-feasibility study, rather than prototype or innovative product) is not a significant explanatory variable of the economic outcomes. In contrast, economic results find a better explanation when considering the types of change that occurred in the SME's production functions as a consequence of the R&D projects, as well as the enterprise's characteristics. Better results in terms of sales are achieved by SMEs which have widened the range of products offered, have not changed the number of employees, which are born as university spin-offs, are subsidiaries in an industrial group, and operate in manufacturing sectors. SMEs' which entered new foreign markets have increased exports more than others. R&D activities implemented by university spin-offs and aimed at upgrading the production process are positively correlated with a decrease in total costs; medium-size enterprises are generally more effective than small enterprises in decreasing total costs.

10% of respondent enterprises have increased the number of employees thanks to the project (D1.8). This result is positively and significantly correlated with other improvements in the enterprises' production function, such as the increase of the R&D equipment, the widening of the offered products, the access to new foreign markets and the improvement of the work organisation.

On the face of the restricted economic outcomes achieved so far by beneficiary SMEs, 69% of respondents expect at least some improvement over the next 3-5 years (question D5). Actually, R&D projects usually take longer to produce visible economic effects. Future outlook is positive particularly for firms born as spin-offs from universities, of small size, and those that have improved their R&D equipment thanks to ADE support (question D1).

Anecdotal evidence and direct interviews with policy makers and other stakeholders (see case study) indicate that the hard economic crisis in which Spanish SMEs found themselves has significantly affected their economic performance and investment strategies. Out of the 299 beneficiaries considered, at least 8% (24 firms) already failed or had to change ownership. Moreover, the time needed to receive the grant after the project's completion has considerably increased due to the shrinkage in the regional budget,[88] and this has exacerbated the problems associated with the uncertain market scenario. It is thus reasonable to wonder whether the crisis has constrained the economic results of the R&D projects implemented. The answer has been researched with the Bayesian Network Analysis (see Figure 51 at the end of this section).

The network shows that the increases in sales and exports are strongly determined by the risks connected to R&D, and particularly the risk of not fully achieving the research objectives, the uncertainty about the potential for commercialization of the R&D outputs, uncertainty about future market conditions due to the economic crisis and the fear of having insufficient managerial experience and skills in the enterprise to achieve/maximise the project objectives (options 3, 4, 5, and 6 of questions C1.5 and C2.5). The combination of these risks[89] strongly influences the generation of economic outcomes, specifically the increase of sales and exports: the higher the risk, the lower the effect on sales, whereas the outcome is more uncertain in its effect on exports (see Box 10).

Interestingly, the strongest risk component affecting the economic results is not the market risk associated with the crisis, but the possibility of not having sufficient skills and experience to complete the project. Hence, the analysis indicates that, while the crisis has certainly played a role in the determination of economic effects, the intrinsic risk of R&D has been a strong determinant too.

The risks of not finding complementary external financial resources to start the project, or that the project would turn out to be more costly than forecast (options 1 and 2 of questions C1.5 and C2.5) do not directly affect the R&D results, but are linked to the volume of the grant. The analysis of the conditional probabilities reveals that the volume of the R&D grant is larger for SMEs which perceived a higher finance risk (both ex-ante or during the project implementation).[90] Since the grant is strongly and positively correlated with the size of the project, it is clear that the difficulties in co-funding the R&D project are higher for larger projects, which is however balanced by larger public support.

Besides risks, when looking at the network another possible explanation of the limited economic results can be found. The thickness of the arrows reveals that the most significant change activated by the R&D grant within the SME is the improvement in the enterprise's

---

[88] This has been pointed out as a critical factor by SMEs (question E2.3).

[89] The strong relationship between these variables has been revealed by the principal component analysis.

[90] Another finding is that the volume of the grant, and then of the project implemented is higher for firms born as spinoff from universities of other companies.

reputation (D1.5). While this change has not caused any observable economic effects for most of the beneficiaries, it is associated with positive expectations about the future. To complete the picture, it should be said that future expectations are strongly influenced by the economic results already achieved and, in particular, by the extent to which they contributed to reinforcing the firm's capacity to resist the effects of the economic crisis.

SMEs' characteristics in terms of size and sector are both significant in explaining the probability of enterprises facing serious financial difficulties that may lead to bankruptcy. A logit model comparing the 97 firms which have replied to the questionnaire with the 24 firms that we know have failed in the years after implementing the R&D project, indicates that medium-size enterprises are almost 20% more probable to become bankrupt than small companies. When analysing the answers to question D6, asking enterprises if they are currently facing the risk of closure/bankruptcy or if they are actually closing, it is confirmed that medium-size enterprises feel that they are more at risk of closure. Conversely, small enterprises, especially university spinoffs, are less likely to face the risk of closure in the immediate future. Enterprises operating in the construction and wholesale and retail sectors are more at risk than the others, and particularly than the manufacturing sector. The probability of bankruptcy increases also along with the project risks.

Size and sectors are also correlated with some variables of economic performance and internal change. Specifically, the widening of offered products (D1.1), the access to new foreign markets (D1.6) and positive expectations about the improvement of economic results (D5) are higher for small enterprises rather than medium-size ones. Conversely, as already mentioned, medium enterprises are more strongly associated with the decrease of production costs. The increase in sales and export are not affected to a significant extent by the size of beneficiary enterprises. The manufacturing sector generally performs better than other sectors, particularly as far as the increase in sales and employment are concerned.

Box 10.   Scenario analysis: the role of the project risk

The Bayesian Network shows that the results in terms of sales and exports achieved by beneficiaries thanks to the investment directly depend on the risk connected to R&D. The variables 'D4.1 Increased sales' and 'D4.4 Increased exports' refer to what extent the R&D investment has led to an increase in sales and exports respectively. They are distributed according to a discrete distribution that takes on six states: 'I do not know', 'Not at all', 'Little', 'Enough', 'Appreciably' and 'Very much'. The variable 'R&D Risk' was obtained by performing a principal component analysis of answers to the set of questions C1.5 and C2.5. It embodies the risk of not fully achieving the research goals, the uncertainty about the potential for commercialization of the R&D outputs, uncertainty about future market conditions due to the economic crisis, and the fear of having insufficient managerial experience and skills to achieve and/or maximise the project objectives.[91] 'R&D Risk' is thus an indicator variable ranging from a minimum of -3 (the project was not affected by these risks at all) to a maximum of 5 (the project was highly affected by the above risks).

In order to detect the impact of the R&D risk on sales and exports, we propose a scenario analysis where the two highest states of the distribution of R&D risk are maximized. This means that we are looking at what would happen to sales and exports if the risk in commercialising and managing the R&D project are higher. Figure 1A illustrates this hypothetical situation.

The scenario exercise reveals three notable facts:

---

[91] It should be noted that the variable 'R&D risk' does not include risks stemming from financial difficulties to fund R&D project as those expressed in the options 1 and 2 of questions C1.5 and C2.5. As a consequence, this variable only refers to market and management risks linked to R&D.

- As expected, a higher risk is associated with an increase in the uncertainty about the declared outcomes by firms. The percentage of firms falling in the category 'I do not know' rises from 8% to 14% in the case of exports and from 3% to 4% in the case of sales.

- The higher the risk, the higher the share of enterprises that declare no effect at all on sales as a consequence of the R&D project (the share of SMEs falling in the state 'not at all' increases from 22% to 25%). Also, the share of enterprises which would declare 'little' effects on sale would decrease (from 38% to 32%).

- The influence of risk is much more limited, if not negligible, for those firms that enjoy at least a moderate ('enough') increase in sales and an 'appreciable' increase in exports. This result suggests that fast-growing SMEs are less affected by managerial and commercial risk linked to the R&D activities than their less performing counterparts.

- Finally, it can be noticed that a variation in the level of the market and managerial risk only affects the volume of the R&D grant to a limited extent. The Bayesian Network actually points out that the latter is more strongly linked to other types of risks, i.e. the lack of finance to start or carry on the R&D project.
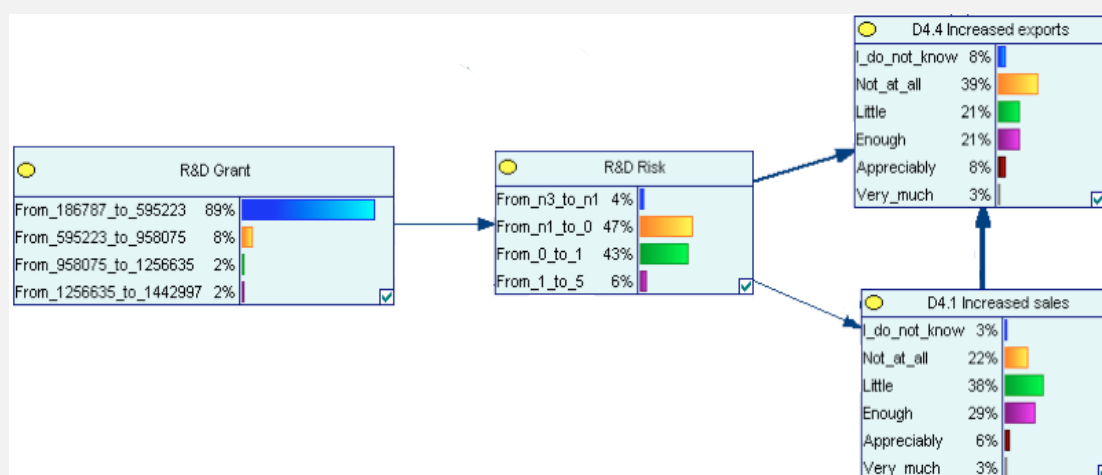
Figure 1A: Baseline network

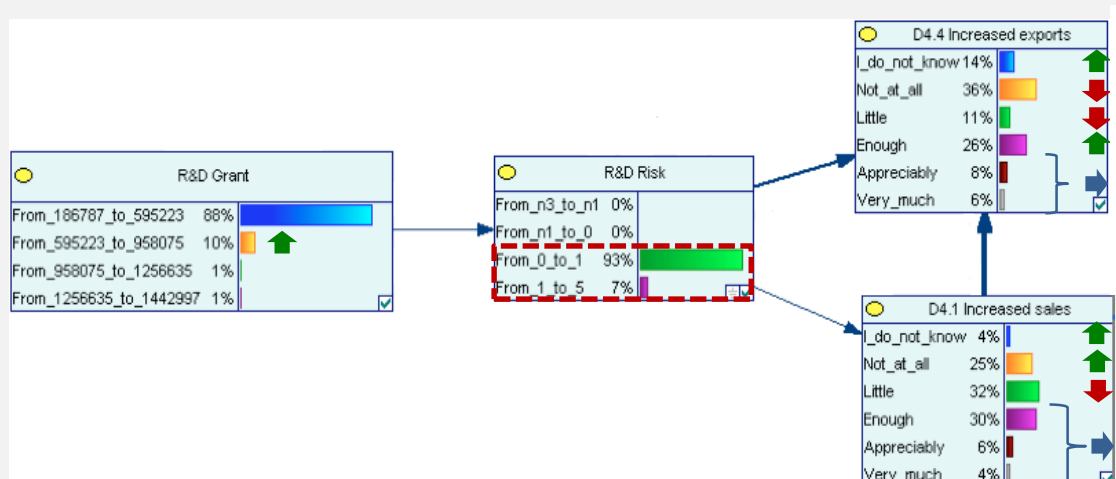Figure 1B: Posterior network (evidence propagation scenario)

Source: CSIL.

Finally, the role of the volume of ERDF support on beneficiaries' economic performance is not clear. The value of support received by each enterprise (measured either in terms of value of ERDF or of number of R&D projects[92]) is not statistically significant to explain the economic

---

[92] The two variables are collinear.

impact of the projects. Neither the intensity of aid (value of R&D grant divided by the value of the investment) is significant. It can be noted, however, that as aid intensity increases the probability that the beneficiary enterprise has hired new employees since the start of the project to 2014 increases too. Yet, sales, export and the capacity to resist the crisis decrease when aid intensity increases. This is reflected in the fact that enterprises which declared higher economic effects ('enough', 'appreciably' and 'very much') have received a lower aid intensity on average; in parallel, upon a unitary increase in aid intensity the probability for enterprises to achieve only 'little' effects raises (see Annex 3).

Non-repayable aid is the most favoured form of support for R&D. Almost 90% of respondent enterprises appreciate grants and are interested in this type of support for their future R&D projects. One enterprise out of two would also be interested in a combination of different forms of support, presumably grants and financial instruments, like guarantees and loans.

5.3.4 Behavioural change with respect to R&D ambitions and capacities

As above outlined, one of ADE's expectations is to accompany SMEs along a process of behavioural change, encouraging innovative SMEs to increase their level of R&D expenditure and stimulating the implementation of increasingly collaborative and complex projects. Of the total number of SMEs which have benefitted from the policy instrument during the 2007-2013 period, 44% have never carried out any R&D project previously (question B0). Among the remainder are enterprises which have implemented one project before 2007 (20% of the total sample) or more than one (36%) (question B1.1).

Many firms which carried out R&D projects before 2007 have been involved at least once in R&D projects in collaboration with universities (63%). In contrast, only 33% have carried out R&D projects in partnership with other companies before 2007 (questions B1.3 and B1.4).

Figure 61   Changes   in   the   R&D   activities occurring over the last years (2010-2013)
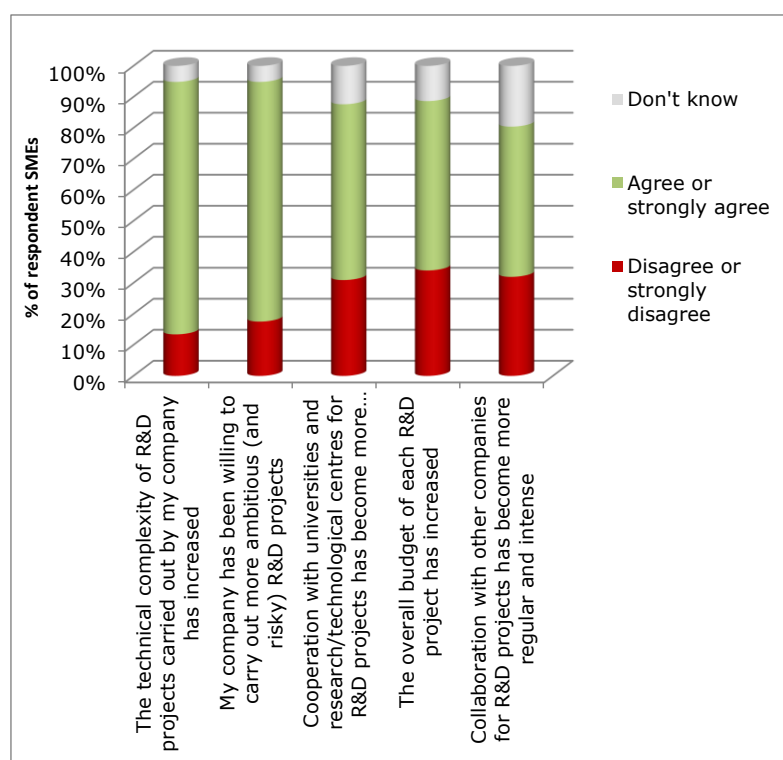
Source: CSIL elaboration of survey responses (question C4).

Over the period from 2000 to 2013 most SMEs (more than 75%) have increased the complexity and level of ambition of the R&D project undertaken. The overall budget spent for R&D and the propensity to collaborate with other enterprises or with universities have increased for around half of the enterprises (question C4).

After the implementation of the R&D project(s) supported by ADE from 2007 onwards, more than 70% of SMEs have realised that the enterprise has more scope for expansion than previously thought and started to consider the possibility to carry out R&D projects never considered before. 64% of respondent SMEs declare that the R&D expenditure is likely to remain higher than before (question F2).

The level of expenditure in R&D increases along with the experience of the SMEs in carrying out R&D activities. SMEs which have already implemented some projects before 2007 have

carried out on average much larger R&D projects during the 2007-2013 years, two times bigger than the group of 'new innovators':[93] the value of the investment project is around EUR 600 thousand against EUR 300 thousand; the average grant is EUR 230 thousand, against EUR 133 thousand.

The Bayesian Network Analysis shows that the grant directly affects the future level of R&D expenditure: the higher the grant received, and thus the size of the R&D project(s) implemented during the 2007-2013 period, the higher the probability that the enterprise will maintain a higher level of R&D than before. Moreover, the ordered logit model indicates that spinoff enterprises, small size enterprises, and enterprises belonging to a group are more likely to maintain or increase their R&D expenditure.

As far as SMEs' propensity to collaborate, around half of respondents believe that their level of collaboration with universities or other enterprises might increase in the future (question F2). The share of enterprises which have carried out a collaborative project during the 2007-2013 period is higher for those that have already carried out some R&D before 2007 rather than not (58% vs 42% in case of collaborative projects with enterprises, and 56% vs 44% in case of collaborative projects involving universities). This could indicate that a learning process is in place and that collaboration is more likely when the SME is already familiar with R&D projects.

Figure 62   Behavioural changes observed after implementing the R&D projects supported by ADE (2007-2013)
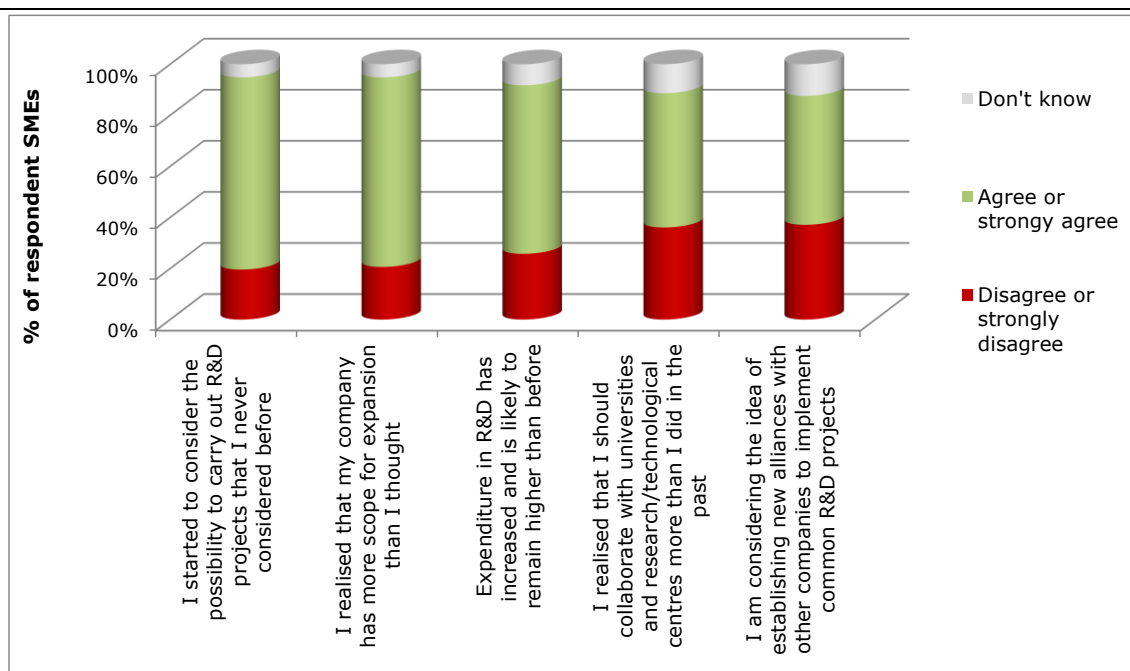
Source: CSIL elaboration of survey responses (question F2).

The difference between the two groups is not statistically significant, but the finding seems to be confirmed when looking at the correlation between the number of R&D projects implemented between 2005 and 2006[94] and the readiness to collaborate with other enterprises in future (question F2.7), which is significant at the 10% level.

Besides the learning process, some firms' characteristics make collaboration more probable, *ceteris paribus*. Cooperation with universities happens more often to enterprises born as university spinoffs, as they clearly keep strong relationships with the academic environment. Entrepreneur's education matters too: the higher the level of education the more probable

---

[93] The difference between the two groups is statistical significant at 1%.
[94] Data about projects implemented between in 2005 and 2006 were provided by ADE.

they are to start R&D projects in collaboration with universities. The same correlations cannot be found with reference to collaboration with enterprises.

To summarise these findings, it is possible to affirm that some trajectories of change are in place as to the type of R&D projects implemented, in line with the theory of the policy instrument. The degree to which such changes are caused by ADE is more unclear, but it is reasonable to think that it contributed to sustaining this process of behavioural change.

In the logic of the instrument, ADE's technical skills were seen to be a condition to ensure the right support to SMEs and encourage them to be more ambitious. This conditions seems to being fulfilled on the evidence in the survey's responses: 73% of SMEs were satisfied or highly satisfied about ADE's capacity to establish a dialogue on the R&D themes (question E2.2). Moreover, around 80% of respondent enterprises admit that, thanks to the R&D project supported by ADE, they have improved their opinion of public support initiatives for small-medium enterprises, in particular those financed by the European Union (questions F2.1 and F2.2). These variables influence the probability of maintaining a higher level of R&D expenditure in the future (F2.8). The important role of public support in sustaining R&D investment seems therefore to be confirmed.

Figure 63   Satisfaction for ADE's skills
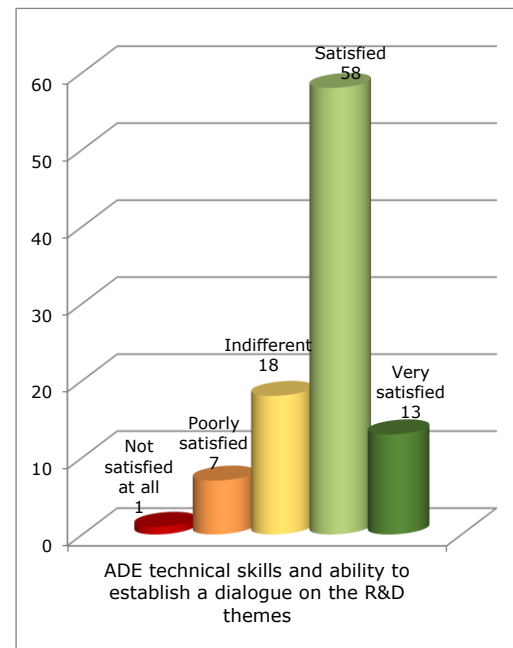
Source: CSIL elaboration of survey responses (question E2.2).

As stressed by the economic literature and confirmed by our analysis, specific features of the enterprises, or even of the entrepreneur (such as the educational level) play a role too, influencing the enterprise track record in R&D and its future trajectories.

### 5.3.5   Other behavioural changes

Besides looking at the changes forecast by the theory of the instrument, the questionnaire tries to shed some light on other possible behavioural changes already triggered by the policy instrument or which might occur in the near future. It should be pointed out that 57% of beneficiary SMEs think that it would be better to have more skilled employees (F2.9). This variable is quite strongly correlated with the idea of starting new R&D projects (F2.3),[95] but a causal link cannot be ascertained. One could think that as the SME plans to undertake some R&D activities the need for more skilled employees increases; alternatively, the SME could decide to improve the quality of its human capital because it would like to increase its expenditure in R&D. SMEs which believe they do not need to increase their internal skills at all are usually those which have longer experience in R&D (having already carried out some projects before 2007); in contrast, SMEs with shorter experience tend to agree on the importance of having more qualified human resources. This confirms the strong relationship between the capacities within SMEs and their ability to realize R&D.

Finally, it is interesting to point out that the willingness to apply again in the future for public support is neither influenced by the economic results achieved thanks to the R&D project nor by satisfaction with the policy instrument itself or other behavioural changes, as is the case

---

[95] The coefficient of correlation is 0.40.

with the Polish and the Italian instruments. The share of SMEs which intend to implement other R&D projects in the future and to apply again for ADE support is 78%; 18% of SMEs are more uncertain and 8% do not intend to apply again for support (question E3). The future intentions of these SMEs probably depend on very diversified factors, different from enterprise to enterprise but also affected by expectations of the macroeconomic outlook.

Figure 64   The changed triggered by the policy instrument according to the Bayesian Network Analysis
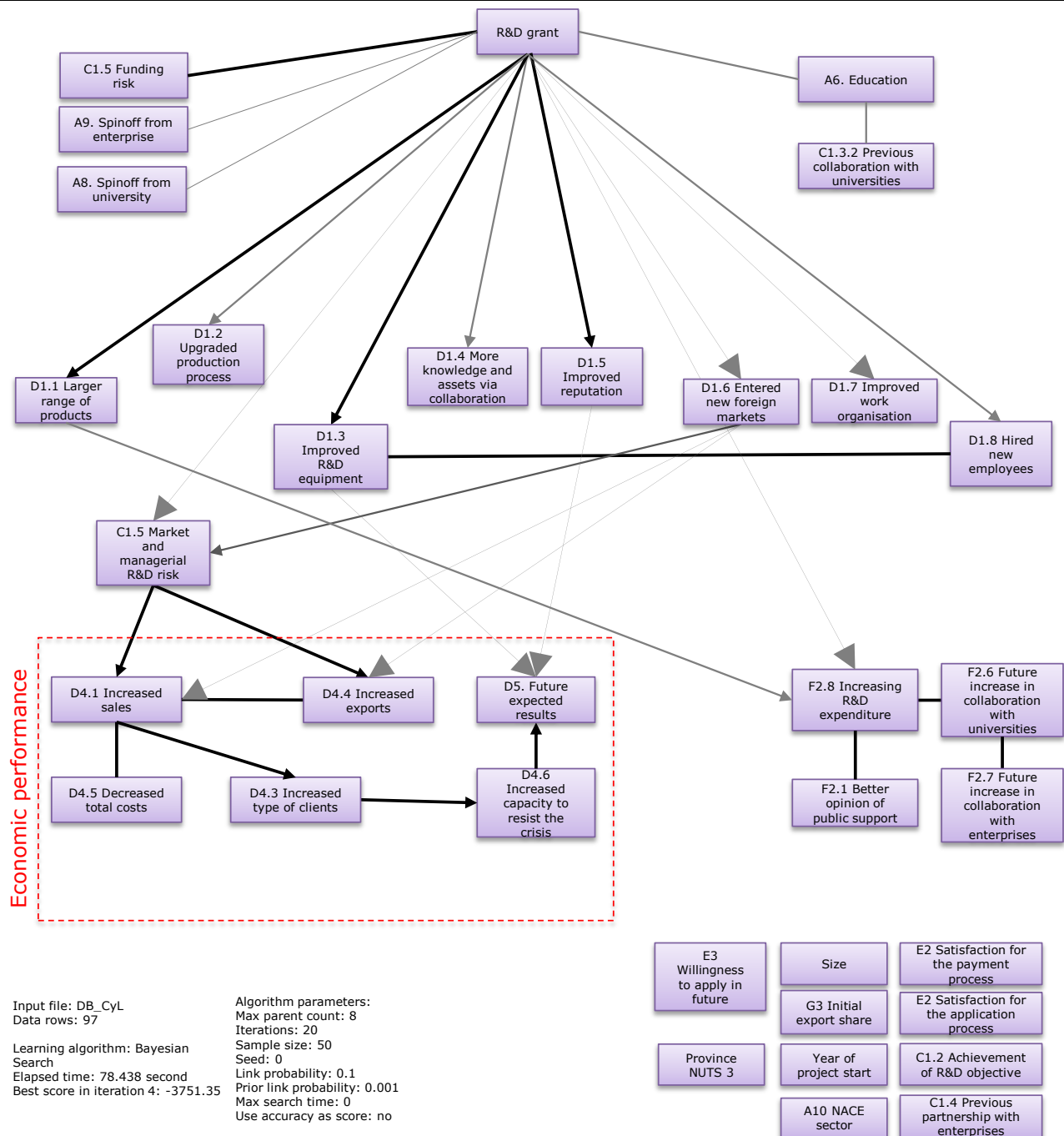
Note: Directed arrows indicate a causal relation; simple links between variables indicate correlation, without any certain causal direction. The thicker the arrow, the stronger the correlation between the variables, as estimated by GeNIe. The graph includes some variables (bottom right) that, in spite of having been controlled for during the construction of the model, do not result to be strongly linked to any other particular variable.
Source: CSIL elaboration based on the results of the Bayesian Network Analysis.

To conclude this section, the Bayesian Network which describes the dependence and independence relations between variables associated with the instrument's logic of intervention

is presented in the Figure above. It includes variables related to the economic performance of the beneficiary enterprises (from D4.1 to D4.6), behavioural change (from F2.6 to F2.8), characteristics of enterprises and projects (e.g. the related risks) and changes produced by the R&D grant on the input of the SMEs' production function (from D1.1 to D1.8). The network's robustness has been checked upon different specifications of the model and various changes in the set of considered variables. In spite of the relative small sample of respondent enterprises, the network illustrated hereby can be considered overall valid and strong enough to resist to structure perturbation.

5.4 Conclusions

The way how ADE has supported R&D investment in Castile and León is fully in line with the theory and with the theoretical and empirical literature in this field. The decision to concentrate efforts on sustaining SMEs' R&D activities is grounded on the awareness that these enterprises face higher barriers to R&D than large enterprises; paying attention to supporting investment in R&D and innovation activities that are close to the market complies with the European Commission's strategy for a more competitive knowledge-based EU economy; using non-repayable grants rather than financial instruments to address suboptimal investment situations in the R&D field is generally considered appropriate given the significant challenges in terms of risk and funding requirement (EIB and European Commission, 2014), and is greatly appreciated by surveyed enterprises.[96]

The logic of the policy instrument follows a very traditional approach to R&D support. The empirical analysis conducted generally confirms the validity of the instrument's theory of intervention as outlined by the two CMO configurations. According to the analysis of the results declared by a sample of beneficiary SMEs which successfully completed the R&D projects, it is found that:

- With regard to the first CMO (describing the generation of economic effects of the R&D projects), the majority of beneficiary SMEs (around 70%) have successfully completed the R&D projects,[97] most of which were meant to generate innovative and marketable products, and led to the development of new or improved products or processes. Some positive economic effects have been achieved by SMEs, particularly in terms of increasing sales and exports. These results cannot be compared with any quantitative indicators on the effects produced by the policy instrument, as they are not collected by the regional authority.

- With regard to the second CMO (advancement of R&D ambition and capacities), in designing and implementing the policy instrument, ADE actually took a long-term perspective and pursued the goal of accompanying beneficiary enterprises along a path of increasing capacities and experience in R&D, in order to sustain the transformation of the regional economy into a knowledge-based economy. Information collected by the survey indicates that SMEs' capacity to implement a higher number and increasingly complex R&D projects is actually growing. Positive effects are recorded both within the group of enterprises which have never carried out any R&D project before 2007 and among SMEs which already had some experience in R&D. Enterprises are largely satisfied with ADE's skills and ability to establish a dialogue with SMEs on R&D themes. According to the theory, this was considered a condition to select promising projects, tailored to the needs, features and potential of the beneficiaries.

---

[96] SMEs' responses to question E4 of the survey confirm that grants are the preferred type of support for R&D projects, rather than guarantees for bank credit, loans and venture capital. Some SMEs would however be interested in a combination of grants with other modes of support.
[97] Other 22% has only partially achieved the R&D objectives.

- Among other changes produced by the policy instrument on beneficiary SMEs is the higher importance attributed to having skilled employees, but this seems to be related to the ongoing improvement in capacity and propensity to carry out R&D projects (as confirmed by the literature).

While the overall logic of intervention appears appropriate to generate the intended outcomes, the empirical analysis reveals that the economic effects have not been particularly high as compared with the other two policy instruments analysed, but only been limited or moderate for most of the respondents. We found this is due to a combination of reasons:

- First, the economic effects deriving from the R&D projects are likely not to be visibleyet, but could become more significant in the next few years. As highlighted by the Bayesian Network, if the R&D project achieves to reinforce the enterprise, also by improving its reputation on the market, it is more likely to enjoy higher economic effects in the near future.

- Second, R&D projects are affected by high risks, with the possibility of not fully achieving the research objective (as happened with almost 30% of SMEs), the uncertainty about the potential for commercialization of R&D outputs, and the fear of lacking managerial experience and skills to carry out the project. The Bayesian Network Analysis has confirmed that these types of risk directly affect the economic results.

- Third, the policy instrument had to face an unforeseen change in the context conditions, i.e. the burst of the financial and economic crisis. The bad macroeconomic scenario and uncertain market conditions added to the intrinsic difficulties of R&D and contributed to undermining the effectiveness of the projects, making even more uncertain the commercialization of the R&D outputs, and increasing the risk of starting an R&D project. Around 8% of SMEs that have successfully completed the project do not exist anymore and an unknown number of SMEs had to interrupt the R&D project.

The evidence indicates that the economic crisis has led to a sort of selection process among SMEs. While the instrument was targeted at all potentially innovative enterprises and ADE ensured a proper assessment of the quality of each project, its technical viability and the financial plan, the ex-post analysis points out that not all SMEs are strong enough to embark on R&D activities and take advantage of them. The positive and strong relation between the volume of the grant and the challenges in terms of funding requirements confirms that the policy instrument was effective at addressing the high financing barriers, but less powerful in the face of other risks with R&D and the instability of the economic scenario.

This argument finds support in the fact that university spinoffs have achieved better economic results that other types of enterprise. Spinoffs can rely on a strong background in scientific knowledge and generally high technological intensity,[98] which seems to make them better equipped than other SMEs to conduct R&D. As it emerged from the survey, university spinoffs have a higher probability of increasing their R&D expenditure in the future, and of increasing their collaboration with research institutes. Furthermore, out of the number of enterprises which successfully completed their project and that have already received payment from ADE, only two are micro enterprises (below 10 employees). This could indicate that a minimum business size is needed to carry out R&D activities. As a matter of fact, SMEs were responsible for only around 40% of the considered investment supported, the remained was carried out by large enterprises.

---

[98] Spinoffs included in the surveyed samples operate in the service sector (J62 - computer programming, consultancy and related activities and M72 - scientific research and development).

Hence, it is not possible to confirm that a sufficiently large number of SMEs undertook successful R&D projects (unlike initially theorised, see the first CMO): even if no data on the number of applications submitted and of projects interrupted are available and no targets were formally set ex-ante, it is reasonable to believe that the economic recession has discouraged many SMEs from undertaking R&D projects or has led many SMEs to interrupt investment, so that the number of SMEs which actually benefitted from the R&D grants turned out to be lower than expected.

The analysis could not test some of the links presented in the CMO diagram, particularly:
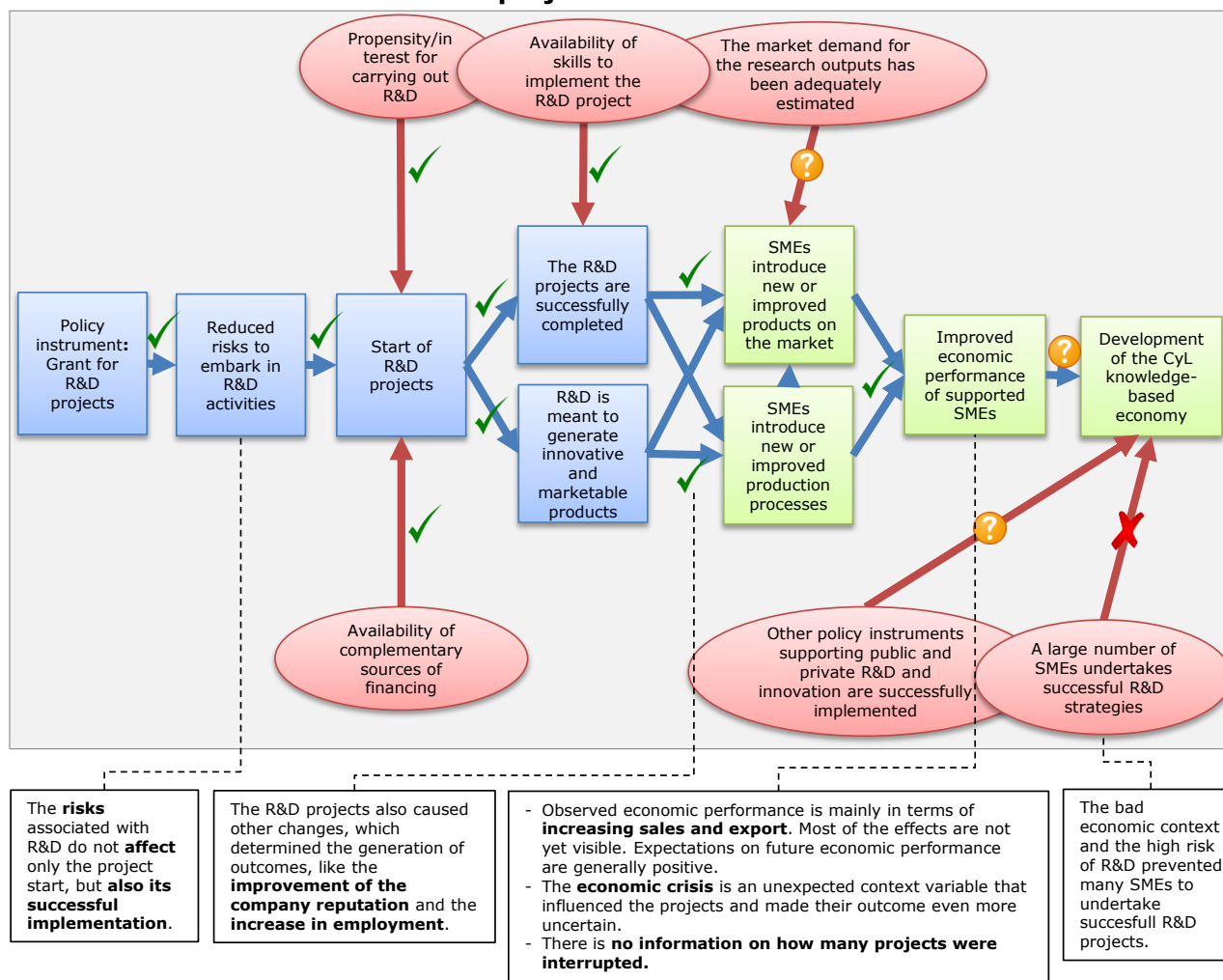
- it is uncertain whether the market demand for the research outputs has been adequately estimated by enterprises, as the crisis certainly made demand more difficult to be predicted. Considering that some enterprises selected for the grants went bankrupt or had to interrupt their project, but lacking precise figures on the failure rate, it is not easy to determine to what extent this condition was actually fulfilled.

- The contribution given by other policy instruments to the increase of the R&D level in the region cannot be ascertained, as the analysis is focused on one policy instrument only. The case study finds evidence that the regional OP was quite effective at addressing SMEs key barriers in the area of R&D and innovation, but the lack of data on impacts make it impossible to actually confirm and quantify the effects.

- The development of a knowledge-based economy is a goal which could become visible only in a long-term time span.

In order to increase the effectiveness of the policy instrument in a transformed macroeconomic context, it could have been worth to consider the need to revise some of its characteristics, perhaps experimenting a more targeted approach, focused on enterprises with the highest probabilities to succeed and contribute to a sustainable strengthening of regional knowledge based economy. One possibility could have been to focus on manufacturing enterprises only, since the other sectors are associated with relatively worse economic results, or on young and dynamic enterprises with already strong connections with universities (e.g. spin-off).

An improved and more informative monitoring system would be extremely helpful to monitor the project's results and steer the use of the ERDF towards more beneficial projects and enterprises. There is need, in particular, for a monitoring system collecting information on the industrial sector of beneficiary enterprises, allowing collaborative projects to be easily recognized and keeping track of projects not selected or not completed.

Figure 65   Test of the theory of intervention of the R&D grants

CMO #1: Economic effects of R&D projects

CMO #2: Advancement of R&D ambition and capacities

Note: Green-coloured boxes indicate the outcomes pursued by the policy maker; red-coloured circles indicate external conditions (i.e. specifications of context) upon which desired changes occur; blue-coloured boxes indicate the mechanisms at work along the causal chain leading to the outcomes.
Source: CSIL.

6 MAIN FINDINGS FROM THE THREE THEORY-BASED IMPACT EVALUATIONS

6.1 Findings on the effectiveness and mechanisms of change of policy instruments

This section pulls together the findings derived from the theory-based impact evaluations and summarises the main results and conditions for the effectiveness of the three analysed policy instruments targeted to SME growth and/or innovation. In what follows we highlight and discuss the main similarities and differences across the instruments.

6.1.1 Theories of intervention

- A theory of intervention has been identified for all the three policy instruments. It was generally not illustrated in programming documents, but could only be grasped by talking with the policy makers and programme implementers. Different stakeholders usually provided slightly diversified, but not conflicting, views about the policy instrument's rationale. By putting the different perspectives together it was possible to draw the complete picture about the theory of intervention. This has been illustrated by different combinations of Context-Mechanisms-Outcomes configurations, (at least) one of which outlying the logic behind the generation of economic effects and one focused on other types of changes affecting the SMEs behaviour.

- The three policy instruments responded to a logic of input support. They provide financing directly aimed to increase the SMEs' production inputs, such as fixed capital and human capital, in the expectation that this will positively affect the economic performance. Economic outcomes to be pursued were in general very vaguely defined.

- The identified theories of change were generally in line with relevant theoretical and empirical literature, indicating that policy maker's expectations about the type of change expected to be generated within the SME and the type of related outcome were pertinent and robust.

- The implementing bodies appear to be well aware of the characteristics, constraints capacities and requirements of the targeted enterprises. The logic behind the design and implementation of the three policy instruments responded to relevant investment needs of the targeted enterprises, as suggested by the overall degree of satisfaction of enterprises for the support received and the high number of applications received (in the cases of the Polish and Apulian instruments).

- The empirical analysis finds that the theories of intervention generally produced the expected outcomes, thus confirming the appropriateness of the instrument to produce the desired changes in the reality. The theories that the policy makers had in mind at the moment of designing the policy instrument, turned out to be generally over-simplistic, failing to account for all the mechanisms and context variables that would have influenced the generation of outcomes. Thanks to the Bayesian Network Analysis it was possible to further dig into the chain of mechanisms and effects, allowing the evaluator to highlight new links or drivers of change, even unexpected or not contemplated by the policy maker at the moment of design the instrument, but also to better specify the way how the outcomes are generated (more reflections on the value added of the Bayesian Network Analysis are presented in the section 6.2). These links are generally confirmed by the literature.

- At the same time, as highlighted by the case of Apulia, theories of change can be adjusted and fine-tuned within the course of the programming period to react and promptly respond emerging challenges or changed priorities. The capacity to adapt with

flexibility along the programme implementation proved to be a successful aspect in the implementation of the Apulian policy instrument. The Polish instrument underwent some changes in its eligibility and selection criteria to better accommodate the needs of SMEs, without changing its focus on promoting technological progress. This turned out to be decisive to ensure the effectiveness of the instrument. In contrast, in spite of the changing macroeconomic conditions severely hampering SMEs' capacity to undertake R&D projects, no change was made on the Spanish policy instrument.

- While the empirical analysis finds that the theories of intervention generally worked out as expected, it would be however important to consider also the appropriateness of the policy instrument with respect to the overall regional or national development priorities (for example in terms of share of funds allocated to them as compared to other existing instruments). This was done to some extent in qualitative terms in the case studies and relevant findings have been recalled in this report where appropriate. It is clear however that assessing the theory of change of an individual policy instrument is somehow limited if it is not combined with the assessment of the theory of change of the programme or strategy which it is expected to contribute to.

6.1.2 Effectiveness of the policy instruments: economic performance of beneficiary SMEs

- All the three policy instruments achieved on average positive economic effects, mainly in terms of increase in sales. At least moderate turnover increases were reported by 77% of Polish beneficiaries, 61% of Apulian ones and only 38% of Spanish enterprises. Up to 70% of Spanish enterprises believe that this results is likely to increase in the next few years since the R&D projects take longer to deploy their full effects.

- Additionally, the Apulian instrument was particularly effective at increasing the enterprises' resilience to the crisis (as perceived by 82% of beneficiaries) and limiting the risk of unemployment among the beneficiaries (only 12% of enterprises reduced the number of persons employed during the years of implementation of the investment). The instrument had no ambition to trigger structural change in the region and enhance the competitiveness of the industrial fabric. For many Polish enterprises the instrument was quite effective at increasing exports: 85% of them declared a non-null effect on export, and 50% assessed this effect as at least moderate.

- Additional analyses would be needed to detect, and possibly quantify, any displacement and/or additionality effects of public support.

- Economic performance variables are directly associated with changes occurred in the SMEs' basic activities, related to their production model, internal organisation, capacities, number of employees, fixed capital, etc. The analysis has shown that the policy instruments stimulated various changes in the firm in many different but interconnected ways and these are in turn linked to the enterprise economic performance.

6.1.3 Effectiveness of the policy instruments: behavioural changes generated

- Evidence indicates that the three policy instruments are generally associated with the generation of behavioural changes in SMEs initially expected by the policy maker. In particular, both the Polish and Apulian instruments improved SMEs' opinions about public support measures, which is in turn linked to an increased willingness to apply for other forms of support and to start other investment projects.

- The Spanish instrument was the most ambitious in terms of behavioural change to be set off. The analysis points to positive effects on SMEs' capacity to implement a higher

number and increasingly complex R&D projects, in line with the instrument's theory. For this change to actually took place, the implementing body had to establish a close dialogue with beneficiary enterprises and accompanying them towards the whole path of change (see more on the role of intermediaries below).

- Opinions about other possible changes in SMEs' behaviour or the entrepreneur's mind-set are mixed, with higher shares of SMEs declaring that they have not observed a particular change or not being sure of that. Among the changes most commonly recognised by beneficiaries of the three instruments is the higher value attached to having more skilled employees. This change is generally associated with the intention to pursue other investment plans in the next years.

6.1.4 Mechanisms of effectiveness: the type of supported investment project

- The types of projects funded are related to the type of change produced within the SME, particularly on its production function, which is in turn linked with the type and intensity of economic effects generated.

- Less risky projects are associated with more immediate and less significant economic results, if any. In Castile and León, the high level of risk of R&D projects is one of the reasons why relatively lower economic outcomes have been observed so far as compared to the other policy instruments.

- The economic effects of R&D may take longer to become visible, particularly if projects are not immediately aimed to put innovative products onto the market. Also, R&D projects can help the company reputation to improve, with limited economic benefits attributable to it in the short term, but positive future expectations of improvement. In contrast, technological advancement projects, like the Polish ones, are more likely to produce observable effects soon after their completion.

- Broadly speaking, investment projects aimed at expanding the range of offered products or at improving products and/or production process are more likely to generate positive effects on turnover than more generic investment for business modernisation. The latter, in spite of being not particularly risky, might not necessarily lead to significant and long lasting economic effects if they consist, for example, of the mere renovation of the business premises.

6.1.5 Mechanisms of effectiveness: the characteristics of beneficiary SMEs

- The type and intensity of economic effects or behavioural changes produced by the policy instrument vary according to the characteristics of beneficiary enterprises. Size, sector of activity, level of technological intensity are important determinants of the instrument's effectiveness. Some characteristics of the entrepreneur also matter, e.g. his/her educational level with particular reference to R&D projects. On this basis, it is advisable that policy instruments are targeted at enterprises with the highest potential and capacity to attain the desired economic and behavioural change.

- Not all SMEs are equipped to successfully carry out R&D projects or are interested in it. R&D requires having a high risk propensity, strong managerial capabilities, a scientific and technical knowledge base, the capacity to resist an external shock such as the recent economic crisis. As more experience in carrying out R&D is gained, the more probable is it for the SME to reach its research objectives, to maintain a higher level of expenditure in R&D, and to increase its capacity to carry out more complex and ambitious projects. The analysis of the Spanish policy instrument indicates that SMEs

born as university spin-off, thus characterised by high internal competences and linked with the research world, are better equipped to successful carry out R&D projects.

- As shown by the analysis of the Polish policy instrument, technological progress attains the largest productivity gains in low or medium-low tech enterprises. Exporting SMEs, in particular, seem to be more ready to take advantage of the investment and to build a competitive advantage on innovation.

- Both economic performance and behavioural change brought about by Title II in Apulia strongly depend on the characteristics of beneficiary enterprises. Enterprises with the highest potential to grow, to continue investment and contribute to the regional competitiveness are manufacturing enterprises, which are however a small share of beneficiary enterprises. Support to commerce and craft entrepreneurs and micro enterprises is prevalent, justified by the need to temporary mitigate the effects of the crisis. It is however not coherent with a long-term development strategy oriented to structural change.

- The effectiveness of the policy instrument can also be explained by mechanisms outside the logic of the instrument itself. For instance, the instrument's capability to have an effect on the export share depends on whether the SME already exported before benefitting from the instrument, and on its initial level of exports; additionally, the implementation of other simultaneous investment projects, not funded by the instrument under evaluation, increases the probability to have better outcomes.

6.1.6 The role of the context

- Place-based context characteristics played a significant role over the design of the logics of intervention. The logics of the three instruments analysed were strictly dependent upon the features of the macro-economic and industrial context. The Spanish policy instrument was designed in coherence with it ambitious regional development and innovation strategy; the Polish one stems from the acknowledgment that greater efforts should be done by enterprises to catch up with the productivity levels of Western Europe; the Managing Authority of the OP Apulia acknowledges that low-tech micro and small enterprises are structurally vulnerable to economic shocks and show resistance to change.

- With the burst of the global financial and economic crisis, the logic of the Apulian policy instrument was revised in response to the changing context conditions. A greater focus was attached to backing vulnerable, but financially solid, enterprises resist the effect of the crisis, away from the original aim of promoting more ambitious, grow-enhancing, investment projects. Thanks to these changes, Puglia Sviluppo aimed at increasing the support given to enterprises, in the view of reinforcing the anticyclical and stabilisation role of the policy instrument.

- The economic crisis was particularly strong in Spain too, leading to a significant regional and national budget reduction. No modifications were made to the main features of the policy instrument of Castile and León, but the crisis resulted in less favourable payment conditions and in an increased uncertainty of the economic results of R&D, which added to already high intrinsic riskiness of R&D projects. In fact, the crisis forced the implementing body to interrupt the possibility of receiving an interim payment and resulted in significant delays in the payment of the aid to beneficiaries. Summed with the overall market uncertainty, the crisis put at risk the implementation and effectiveness of the R&D projects, forcing some enterprises to even interrupt them. The Bayesian Network show that the risk regarding the market conditions are one of the

determinant of the economic outcomes: increasing risks lead to more uncertain or lower economic effects.

- The three instruments tend to favour certain parts of the territory. More specifically, when considering the regions of Apulia and Castile and León, the number of beneficiaries and the volume of ERDF paid are concentrated in provinces with the highest number of enterprises and the highest number of employees. In Poland, regions with the largest number of SMEs, but not with the largest number of employees in SMEs, also absorbed more funds. A weak relation is found between the distribution of the Polish Technological Credit and macroeconomic regional statistics, such as GDP annual growth and regional unemployment rates, which differ significantly from one region to another: rather more developed areas tend to absorb more funds (although with some exceptions). In principle, this could provoke a widening of regional disparities in the long-term. However, this issue could be confirmed only by analysing the combined effect of other available support measures.

- However, being located in a province rather than in another (in the case of Apulia and Castile and León), or in a region rather than another (in the case of Poland) is not a decisive determinant of the instruments' effectiveness, once it is controlled for other variables of interest.

6.1.7 The role of the ERDF

- In Castile and León, the ERDF grant enabled the enterprises to overcome the barriers to R&D posed by limited access to finance, thus stimulating the implementation of costly and risky R&D projects. Higher funding risks are associated with greater investment volumes and related grant, pointing to a positive role of the policy instrument to address the funding risk of R&D projects. The grant is however less effective at addressing other intrinsic risk of R&D, such as managerial capacities and the heavy instability of the macroeconomic scenario.

- In Apulia, the ERDF was used to provide vulnerable but financially viable enterprises with generic aid to help them overcome the economic crisis. While the instrument proved to mostly fulfil this goal, it could do little to counteract the effects of the crisis for the construction sector, which were much stronger than for other sectors. The decision to allocate a significant share of the ERDF to provide generic aid to traditional enterprises, with limited potential to grow, rather than to other instruments more coherent with the regional long-term innovation and competitiveness strategy, is questionable.

- In Poland, the ERDF accelerated a process of technological development that was probably already started or about to start in beneficiary enterprises. Furthermore, the ERDF allowed for the experimentation of a new form of business support, different from traditional non repayable grants, thus stimulating learning effects among enterprises but also banks and the implementing body (BGK) about the delivery process and effectiveness of less traditional forms of support, such as financial instruments. The analysis revels that financially solid enterprises such as those supported by the Technological Credit are ready to access more sophisticated forms of financial instruments, rather than pure grants.

- The volume of the public contribution matters in the generation of economic effects. It is positively and significantly correlated with SMEs' performance in terms of sales (particularly in Poland) and employment (in Apulia). The economic performance of Spanish SMEs positively depends on the volume of grants for R&D projects or the

number of projects implemented, but these variables are usually not statistically significant.

- By contrast, aid intensity (value of public support as a ratio of investment) is usually not a significant variable to explain the firms' performance. It can however be noticed that higher aid intensity ratios are associated with higher effects on sales in the case of the Polish and the Apulian instrument, but negative ones for the Spanish one. However, the increase in employment enjoyed by enterprises benefitting from R&D grants is larger upon higher levels of aid intensity. The opposite is true in Apulia: enterprises which benefitted from higher aid intensity are those which have increased less their employment. The effects associated to the intensity of ERDF support are not straightforward and should be more extensively explored in a dedicated study. In addition, it should be considered that aid intensity may be more relevant to explain the decision to start the investment.

6.1.8 The role of intermediary bodies

- In both the Polish and Apulian cases, commercial banks operate as intermediaries in the delivery of the policy instruments. By binding the eligibility of the public contribution to taking out a loan with the bank, the financial institutes are in fact entitled to carry out the initial screening of potentially beneficiary enterprises on the basis of financial viability criteria. This enables the implementing bodies to select enterprises which are financially robust and not at risk of failure, and thus more likely to successfully complete the investments.

- The regional innovation agency of Castile and León maintained a more direct contact with the beneficiary enterprises after the initial phases of the project implementation up to its completion, when enterprises are visited to verify the successful implementation of the R&D project. The relatively lower number of beneficiaries to deal with and the availability of internal technical skills enable the agency to develop knowledge of the R&D needs and constraints of enterprises.

6.2 Findings on the methodology to evaluate business support

6.2.1 The contribution given by the monitoring systems

- For the three policy instruments very few output and result indicators are collected for the purpose of the monitoring duties of the OP managing authorities. These indicators are poorly informative to understand whether the instrument has achieved the intended effect according to its underlying logic.

- In contrast, monitoring data on beneficiaries and projects supported are particularly helpful. Managing Authorities keep record of a diversified set of information about beneficiary (and often applicant) enterprises, such as their size, legal status, region/province, sector of activity, and about the projects supported, such as their objective, total financial value, amount of public contribution received and others. Whenever it is possible to univocally attribute each project to the implementer enterprise by means of identification codes, an interesting analysis can be made to get a better idea about how the public funds were used and to complete the understanding about the policy instrument's logic of intervention. As a matter of fact, it is believed that these data should be better exploited by the Managing Authorities themselves.

- For the purpose of our study, matching data on beneficiaries and data of projects was easy in the case of the Polish and Spanish instrument. For Italy, this was not obvious, but we managed to do the matching with low probability of error. Sometimes relevant

information were missing, such as the sector of enterprises and whether the R&D projects were carried out in collaboration or not (Castile and León). An on-line application process would certainly ease the acquisition of valuable information on beneficiaries and projects.

6.2.2 Learning on the evaluation methodology

- In consideration of the limitations of the monitoring system, the evaluation of the policy instrument's effectiveness greatly benefitted from a direct survey of beneficiary enterprises. This was crucial to collecting information not only on the economic performance achieved thanks to the supported investment projects, but also to investigating the mechanisms of change explaining the SMEs' performance.

- Realising the evaluation of better specified and not too open or generic policy instruments was easier. In the case of the Apulian policy instrument, which left beneficiaries more free to decide the type of investment to be implemented out of a long list of eligible expenses, the mechanisms of change could be so varied that their proper assessment proved to be relatively more challenging.

- This study has experimented with the theory-based impact evaluation approach and in particular the Realist Evaluation methodology. This has proved to be a valuable and informative methodology of analysis which deserves to be further developed in the evaluation of ERDF programmes and individual policy instruments. From an ex-post perspective, it contributed to guiding the evaluator towards an in depth understanding of the object of analysis and the identification of the causal links, thus leading to clear answers to the evaluation questions.

- Bayesian Network Analysis has been found to be rather intuitive to use, very flexible and providing added value to the evaluation if used in combination with regression models to check the statistical significance of correlations among variables. It was crucial for properly testing the theory and finding hidden or unexpected mechanisms of change: for instance, it reveals that the positive performance of Polish enterprises comes through the increase in export; or that the improvement of company reputation achieved thanks to the R&D project is the main determinant of the future improvement of economic results. In combination with other analytical methodologies, the Bayesian Network Analysis could ensure that robust results are obtained and lead to a clear idea of whether the policy instrument is effective and how.

- The theory-based impact evaluation could be beneficially combined with other types of quantitative studies, for example adopting counterfactual approaches of analysis. These would help verify the additionality of public support.

LIST OF REFERENCES

Acemoglu, Daron. (2002). "Directed technical change." *The Review of Economic Studies* 69.4: 781-809.

Aghion, P. and Howitt, P. (1998). Endogenous Growth Theory. *MA: MIT Press*.

Agrawal A. (2001). "University-to-industry knowledge transfer: literature review and unanswered questions". *International Journal of management reviews*, 3, 285-302.

Ale Ebrahim N., Ahmed S., Taha, Z. (2010). "SMEs; Virtual research and development (R&D) teams and new product development: A literature review". *International Journal of the Physical Sciences*, 5(7), 916-930.

Alegre, J., & Chiva, R. (2008). Assessing the impact of organizational learning capability on product innovation performance: An empirical test. Technovation, 28(6), 315-326.

Almus M. and D. Czarnitzki (2003). "The effects of public R&D subsidies on firms' innovation activities: The case of Eastern Germany". *Journal of Business & Economic Statistics*, 21(2), 226-236.

Anca-Ştefania, Sava, and Zugravu Bogdan-Gabriel. "The Role Of State Aids In The Current Financial And Economic Crisis." *Official Journal of the European Union* (2008).

Anderson A. H., McEwan R., Bal J., Carletta, J. (2007). "Virtual team meetings: An analysis of communication and context". Computers in Human Behavior, 23(5), 2558-2580.

Arrow K. (1962). "Economic welfare and the allocation of resources for invention". In The rate and direction of inventive activity: Economic and social factors (pp. 609-626). *Princeton University Press*.

Arrow, Kenneth J., Solow R. S., Learner E., Portney P., Rodner R. and Schuman H. (1993). "Report of the NOAA-Panel on Contingent Valuation". Federal Register 58(10): 4601-4614.

Art. 2 (p) of Regulation (EU; Eurotam) 966/2012, Financial Regulation, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32012R0966

Astbury B. (2013). "Some reflections on Pawson's Science of Evaluation: a realist manifesto". Evaluation, 19(4,) pp. 383-401

Astbury B., Leeuw F. L. (2010). "Unpacking black boxes: mechanisms and theory building in evaluation". *American Journal of Evaluation*, 31(3), 363-381.

Autio, Erkko, and Ilkka Kauranen. (1994). Technologist-entrepreneurs versus non-entrepreneurial technologists: analysis of motivational triggering factors. Entrepreneurship & Regional Development 6.4: 315-328.

Aw B. Y., Robert M. J., Winston T. (2005). The complementary role of exports and R&D investments as sources of productivity growth, No. w11774. National Bureau of Economic Research.

Aw BY, Roberts MJ, Xu DY. 2011. R&D investment, exporting, and productivity dynamics. American Economic Review, 101:1312–44

Baghana R., Mohnen P. (2009). "Effectiveness of R&D tax incentives in small and large enterprises in Québec". Small Business Economics, 33(1), 91-107.

Baldwin, William L., Scott J.T., (1987). Market Structure and Technological Change, London and New York: Harwood Academic Publishers.

Baumol W. J. (2002). "The free-market innovation machine: Analyzing the growth miracle of capitalism". *Princeton University press*.

Beck T., Demirguc-Kunt A. (2006). "Small and medium-size enterprises: Access to finance as a growth constraint". *Journal of Banking & Finance*, 30(11), 2931-2943.

Beck T., Demirgüç-Kunt A., Maksimovic V. (2005). "Financial and legal constraints to growth: does firm size matter?". *The Journal of Finance*, 60(1), 137-177.

Berger A. N., Udell G. F. (1998). "The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle". *Journal of Banking & Finance*, 22(6), 613-673.

Bernard A. B., & Jensen, J. B. (1999). "Exceptional exporter performance: cause, effect, or both?". *Journal of international economics*, 47(1), 1-25.

Bertschek I., Kaiser U. (2004). "Productivity effects of organizational change: microeconometric evidence". Management science 50.3 (2004): 394-404.

Bérubé C., Mohnen P. (2009). "Are firms that receive R&D subsidies more innovative?". *Canadian Journal of Economics/Revue canadienne d'économique*, 42(1), 206-225.

Blackman, Leonard, and Stephanie Reich. (2009). "Randomized control trials: a gold standard with feet of clay?." *What counts as credible evidence in applied research and evaluation practice*.

Bourletidis K., Triantafyllopoulos Y. (2014). "SMEs Survival in Time of Crisis: Strategies, Tactics and Commercial Success Stories". Procedia-Social and Behavioral Sciences, 148, 639-644.

Boynton P. M., Greenhalgh T. (2004). "Selecting, designing, and developing your questionnaire". *Bmj* 328.7451: 1312-1315.

Bresnahan T.F., Brynjolfsson E., Hitt M.L. (2002). "Information technology, workplace organization and the demand for skilled labor: Firm-level evidence". *Quarterly Journal of Economics*, 117(1), 339–376.

Bronzini R., E. Iachini (2014). "Are Incentives for R&D Effective? Evidence from a Regression Discontinuity Approach". *American Economic Journal: Economic Policy*.

Bronzini R., Piselli P. (2014). "The impact of R&D subsidies on firm innovation". Bank of Italy Temi di Discussione. Working Paper no. 960.

Brush, Candida G., and Pieter A. Vanderwerf. (1992). "A comparison of methods and sources for obtaining estimates of new venture performance." *Journal of Business venturing* 7.2: 157-170.

Busom I. (2000). *An empirical evaluation of the effects of R&D subsidies*. Economics of Innovation and New Technology, 9(2), 111-148.

Butler J., Sullivan J. (2005). "Crisis response tactics: US SMEs' responses to the Asian financial crisis". *Journal of Business and Entrepreneurship,* 17(2), 56.

Campbell, Angus, Philip E. Converse, and Willard L. Rodgers. (1976). *The quality of American life: Perceptions, evaluations, and satisfactions*. Russell Sage Foundation.

Cappelen Å., Raknerud A., Rybalka M. (2012). "The effects of R&D tax credits on patenting and innovations". Research Policy, 41(2), 334-345.

Carvalho, S., & White, H. (2004). Theory-based evaluation: the case of social funds. *American journal of evaluation*, 25(2), 141-160.

Clausen T.H. (2009). *Do subsidies have positive impacts on R&D and innovation activities at the firm level?*. Structural Change and Economic Dynamics, 20(4), 239-253.

Cohen W. M., Levin R. C., Mowery, D. C. (1987). "Firm size and R&D intensity: A Re-examination". *The Journal of Industrial Economics*, 35, 543-565.

Cohen W. M., Levinthal D. A. (1989). "Innovation and learning: the two faces of R&D". *The economic journal*, 569-596.

Cohen, Wesley M., Levin R., (1989). "Empirical Studies of Innovation and Market Structure" in Schmalensee R., Willig R. (eds.), Handbook of Industrial Organization, Volume II, Amsterdam: NorthHolland, 1059-1107.

Colombo M. G., & Grilli, L. (2007). *Funding gaps? Access to bank loans by high-tech start-ups*. Small Business Economics, 29(1-2), 25-46.

Crépon B., Duguet E., Mairessec J. (1998). *Research, Innovation And Productivi [Ty: An Econometric Analysis At The Firm Level*. Economics of Innovation and new Technology, 7(2), 115-158.

Cunningham P. N., Gök, A. (2012). Compendium of Evidence on the Effectiveness of Innovation Policy Intervention. NESTA/MIOIR: London/Manchester.

Czarnitzki D. (2006). "Research and development in small and medium-sized enterprises: The role of financial constraints and public funding". *Scottish Journal of Political Economy*, 53(3), 335-357.

Czarnitzki D., Hanel P., Rosa J. M. (2011). "Evaluating the impact of R&D tax credits on innovation: A micro econometric study on Canadian firms". Research Policy, 40(2), 217-229.

Dalkin, S.M., Greenhalgh J., Jones D., Cunningham B, and Lhussier M. (2015). *What's in a mechanism? Development of a key concept in realist evaluation*. Implementation Science, 10:49.

Daly R., Shen Q., Aitken S. (2011). "Learning Bayesian networks: approaches and issues". *The knowledge engineering review* 26.02, 99-157.

De Blasio G., Fantino D., Pellegrini G. (2011). Evaluating the impact of innovation incentives: evidence from an unexpected shortage of funds. Bank of Italy. Working paper n. 792

Ding C., & Peng, H. (2005). Minimum redundancy feature selection from microarray gene expression data. *Journal of bioinformatics and computational biology*, 3(02), 185-205.

Dixit A.K., Pindyck R.S. (1994). Investment Under Uncertainty. Princeton University Press, Princeton, NJ.

Domac I., Ferri G. (1999). "Did the East Asian crisis disproportionately hit small businesses in Korea?". Economic Notes, 28(3), 403-429.

EBRD – European Bank for Reconstruction and Development (2014).

EIB - European Investment Bank and European Commission. (2014). "Ex-ante assessment methodology for financial instrument in the 2014-2020 programming period – Strengthening research, technological development and innovation (Thematic objective 1)", Volume II, study assigned to the consortium led by PwC under the 'Framework Agreement for the provision of technical assistance and advisory services, within the context of the JESSICA initiative 37th assignment contract No CC3912/PO62604'.

Entorf, Horst, and Winfried Pohlmeier. (1990). "Innovation, employment and export activity: evidence from firm-level data."

Esteve-Pérez S., & Rodríguez, D. (2013). "The dynamics of exports and R&D in SMEs". Small Business Economics, 41(1), 219-240.

European Commission. (2012a). "Financial instrument in Cohesion Policy". Commission Staff Working Document, SWD(2012)36 final.

European Parliament and Council (2013). Regulation (EU) No 1303/2013 of the European Parliament and of the Council of 17 December 2013 laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repealing Council Regulation (EC) No 1083/2006.

European Parliament. (2015). Differential Treatment of Workers under 25 with a View to their Access to the Labour Market. Study for the EMPL Committee, Policy Department A – Economic and Scientific Policy, DG for Internal Policies.

Fantino D., Cannone G. (2014). "Evaluating the efficacy of European regional funds for R&D". RIV Rassegna Italiana di Valutazione.

Foreman-Peck J. (2013). "Effectiveness and efficiency of SME innovation policy". Small Business Economics, 41(1), 55-70.

Galindo A. J., Schiantarelli F. (Eds.) (2003). Credit constraints and investment in Latin America. IDB.

García-Quevedo J., Mas-Verdú, F. (2008). "Does only size matter in the use of knowledge intensive services?". Small Business Economics, 31(2), 137-146.

Garicano L., Rossi-Hansberg E. (2006). Organization and inequality in a knowledge economy. Quarterly Journal of Economics, 121(4), 1383–1435.

Gashi, P., Hashi, I., & Pugh, G. (2014). Export behaviour of SMEs in transition countries. Small Business Economics, 42(2), 407-435.

Geroski P. A., Van Reenen J., Walters C. F. (1997). "How persistently do firms innovate?". Research Policy, 26(1), 33-48.

Gertler M., Gilchrist S. (1991). Monetary policy, business cycles and the behavior of small manufacturing firms (No. w3892). National Bureau of Economic Research.

Glymour C., Cooper, G. (1999). "Causation, computation and discovery." Cambridge, MA: MIT/AAAI Press.

Gonzalez X., Jaumandreu J., Pazo C. (2005). "Barriers to innovation and subsidy effectiveness". RAND Journal of Economics, 36(4), 930-950.

Görg H., Strobl E. (2007). "The effect of R&D subsidies on private R&D". Economica, 74(294), 215-234.

Greene W. H. (2011). Econometric analysis 7th Edition. New Jersey: Pearson-Prentice Hall.

Grossman, G., & Helpman, E. (1991). Innovation and growth in the world economy. MIT Press, MA.

Hall B. H., Lotti F., Mairesse, J. (2009). "Innovation and productivity in SMEs: empirical evidence for Italy". Small Business Economics, 33(1), 13-33.

Hall, Bronwyn H., and Josh Lerner. (2010). "The financing of R&D and innovation."*Handbook of the Economics of Innovation* 1: 609-639.

Hall, L. A., & Bagchi-Sen, S. (2007). An analysis of firm-level innovation strategies in the US biotechnology industry. Technovation, 27(1), 4-14.

Harris R., Li Q.C. (2009). « Exporting, R&D, and absorptive capacity in UK establishments". Oxford economic papers, 61(1), 74-103.

Harrison P. (2008). "Training needs for women-owned SMMEs". Education and Training, 50(8): 687-697.

Harrison R., Jaumandreu J., Mairesse J., Peters B. (2005). "Does Innovation Stimulate Employment? A Firm-Level analysis Using Comparable MicroData from four European Countries". Mimeo, Department of Economics, University Carlos III, Madrid.

Henry G., Julnes G.W., Mark M.M. (Eds.) (1998). "Realist evaluation: An emerging theory in support of practice". New directions for evaluation, No. 78, San Francisco, CA: Jossey-Bass.

Hodorogel R.G. (2009). "The economic crisis and its effects on SMEs". Theoretical and Applied Economics, 5(5), 79.

Hölzl W. (2009). "Is the R&D behaviour of fast-growing SMEs different? Evidence from CIS III data for 16 countries". Small Business Economics, 33(1), 59-75.

Horný M. (2014). "Bayesian Networks". Technical Report No.5. Boston University. Available at: http://www.bu.edu/sph/files/2014/05/bayesian-networks-final.pdf

Houck, J. R., et al. (1984). "Unidentified point sources in the IRAS minisurvey.". *The Astrophysical Journal* 278: L63-L66.

Hoy, Frank, Patricia P. McDougall, and Derrick E. Dsouza. (1992). "Strategies and environments of high growth firms." *The state of the art of entrepreneurship*: 341-357.

Hubbard, G., and P. Bromiley. "Researchers and top managers: How do they measure firm performance." *University of Minnesota: Working Paper* (1995).

Hubbard, R. G. (1998). "Capital-market imperfections and investment". Journal of Economic Literature, 36, 193-225.

Hussinger K. (2008). "R&D and subsidies at the firm level: an application of parametric and semiparametric two-step selection models". Journal of Applied Econometrics, 23(6), 729-747.

Jagosh J., Macaulay A., Pluye P., Salsburg J., Bush P.L., Henderson J., et al. (2012). 'Uncovering the benefits of participatory research: implications of a realist review for health research and practice', *Milbank Q.*, 2012; 90(2): 311–46.

Jensen M. C., Meckling W.H. (1976). "Theory of the firm: Managerial behavior, agency costs and ownership structure". Journal of financial economics, 3(4), 305-360.

Jones C. I. (2002). "Sources of US economic growth in a world of ideas". American Economic Review, 220-239.

Kalisch M., Bühlmann P. (2013). "Causal Structure Learning and Inference: A Selective Review". Quality, Technology & Quantitative Management 11, 3-21, 2014 ;11:3–2.

Kelly J. A., Clinch J.P. (2006). "Influence of varied parking tariffs on parking occupancy levels by trip purpose." Transport Policy 13.6: 487-495.

Kenett R. S. (2012) Applications of Bayesian Networks. Available at SSRN: http://ssrn.com/abstract=2172713 or http://dx.doi.org/10.2139/ssrn.2172713 Daly

Kenett R., Salini S. (2011). Modern analysis of customer surveys: with applications using R. Vol. 117. John Wiley & Sons.

Koiter J. R. (2006) Visualizing inference in Bayesian networks. Diss. University of Pittsburgh.

Koiter, J. R. (2006). Visualizing inference in Bayesian networks (Doctoral dissertation, University of Pittsburgh).

Lach S. (2002). "Do R&D subsidies stimulate or displace private R&D? Evidence from Israel". Journal of Industrial Economics, 50(4), 369-390.

Lerner J. (1999). "The government as venture capitalist: The long-run impact of the SBIR program". Journal of Business, 72(3), 285-318.

Levin R. C., Cohen W. M., Mowery D. C. (1985). R"&D Appropriability, opportunity, and market structure: new evidence on some Schumpeterian hypotheses". The American Economic Review, 20-24.

Levy, Frank, and Richard Murnane. "How computerized work and globalization shape human skill demands." *Learning in the global era: International perspectives on globalization and education* (2007): 158-174.

Lin P. C., Huang, D. S. (2008). "Technological regimes and firm survival: Evidence across sectors and over time". Small Business Economics, 30(2), 175-186.

Link, A. N., & Bozeman, B. (1991). Innovative behavior in small-sized firms. Small Business Economics, 3(3), 179-184.

Lipnack J., Stamps, J. (2000). Why The Way to Work. Virtual teams: People Working across Boundaries with Technology. Second Edition ed. John Wiley & Sons, New York

Lööf, H., & Heshmati, A. (2005). The impact of public funds on private R&D investment: New evidence from a firm level innovation study, in Heshmati, A., Sohn, Y-B, and Kim, T-R (eds), Commercialization and Trasper of Technology : Major Country Case Studies, Nova science Publishers.

Lopriore M. (2009). "Supporting enterprise development and SME in Europe". Eipascope, 2009(2), 31-36.

Lucas P. J. (2004). "Restricted Bayesian network structure learning". Advances in Bayesian Networks, 217-234. Springer Berlin Heidelberg.

Malerba F., Orsenigo L. (1996). "Schumpeterian patterns of innovation are technology-specific". Research Policy, 25(3), 451-478.

Malerba F., Orsenigo, L. (1995). "Schumpeterian patterns of innovation". Cambridge Journal of Economics, 19(1), 47-65.

McKelvey R. D., Zavoina, W. (1975). "A statistical model for the analysis of ordinal level dependent variables." Journal of mathematical sociology, 103-120.

Merito M., Giannangeli S., Bonaccorsi A. (2007). "Gli incentivi per la ricerca e lo sviluppo industriale stimolano la produttività della ricerca e la crescita delle imprese?". L'Industria, 27(2), 221-241.

Mole, K. F., Hart, M., Roper, S., & Saal, D. S. (2009). Assessing the Effectiveness of Business Support Services in England Evidence from a Theory-Based Evaluation. International small business journal, 27(5), 557-582.

Murphy K. (1998) "A Brief Introduction to Graphical Models and Bayesian Networks". Available at: http://www.cs.ubc.ca/ murphyk/bayes/.html

Nadkarni S., Shenoy P. P. (2001). "A Bayesian network approach to making inferences in causal maps." European Journal of Operational Research 128.3: 479-498.

Nelson R.R. (1959). "The Simple Economics of Basic Scientific Research". The journal of political economy 67, 297-306.

Nugent J. B., Yhee S. J. (2002). Small and medium enterprises in Korea: Achievements, constraints and policy issues (pp. 85-119). Springer US.

OECD (2008). Science, technology and industry outlook, Paris.

OECD (2009). The Impact of the Global Crisis on SME and Entrepreneurship Financing and Policy Responses. Available at: http://www.oecd.org/dataoecd/40/34/43183090.pfd

OECD. "SMEs and entrepreneurship Poland 2010. Key issues and policies. Series: OECD Studies on SMEs and entrepreneurship

Ortega-Argilés R., Vivarelli M., Voigt P. (2009). "R&D in SMEs: a paradox?". Small Business Economics, 33(1), 3-11.

P. Spirtes, P., C. Glymour, and R. Scheines. (1993) ,Causation, Prediction, and Search. New York: Springer Verlag.

Papaoikonomou E., Segarra P., Li X. (2012). "Entrepreneurship in the Context of Crisis: Identifying Barriers and Proposing Strategies". International Advances in Economic Research, 18(1), 111-119.

Pawson R., Tilley N. (1997). Realistic evaluation. London: Sage Publications.

Pawson R., Tilley N. (2004). Realist Evaluation. Paper funded by the British Cabinet Office. Available at: http://www.communitymatters.com.au/RE_chapter.pdf

Pearl J. (2000). "Causal inference without counterfactuals: comment." Journal of the American Statistical Association: 428-431.

Peng, Hanchuan, and Chris Ding. (2003). "Structure search and stability enhancement of Bayesian networks." *Data Mining, 2003. ICDM 2003. Third IEEE International Conference on*. IEEE.

Perrin, R.K. (1997). "The Impact of Technological Change on a Competitive Industry", Journal of Agricultural and Resource Economics, 22(2): 345-355.

Peters B. (2004). "Employment effects of different innovation activities: Micro econometric evidence". ZEW-Centre for European Economic Research Discussion Paper, (04-073).

Petersen, Mitchell A., Raghuram G. Rajan (1992). "The Benefits of Firm-Creditor Relationships: Evidence from Small Business Data". University of Chicago Working Paper #362.

Rammer C., Czarnitzki D., Spielkamp A. (2009). "Innovation success of non-R&D-performers: substituting technology by management in SMEs". Small Business Economics, 33(1), 35-58.

Riché, Marielle. (2013) "Theory Based Evaluation: A wealth of approaches and an untapped potential." *Capturing effects of projects and programmes. Lund: Studentlitteratur*.

Robbins D. K., & Pearce, J. A. (1993). "Entrepreneurial retrenchment among small manufacturing firms". Journal of business venturing, 8(4), 301-318.

Roberts M. J., Tybout, J. R. (Eds.) (1997). What makes exports boom?. World Bank Publications.

Romer, P. (1990). Endogenous technological change Journal of Politcal Economy, 98 (5), 71-102

Romer, P. M. (1986). Increasing returns and long-run growth. The journal of political economy, 1002-1037.

Romouzy A. M., Noroozi S., Sewell P., Humphries-Smith, T. (2013). "Adopting Rapid Prototyping Technology within Small and Medium-Sized Enterprises: The Differences between Reality and Expectation". International Journal of Innovation, Management and Technology, 3(4), 427-432.

Salmela, E., & Lukka, A. (2004). Value added logistics in supply and demand chains. Smile. Part 1. eBusiness between global company and itslocal sme supplier network. Tutkimusraportti/Research report-Lappeenrannan teknillinen yliopisto, Tuotantotalouden osasto.

Santarelli E., Vivarelli M. (2007). "Entrepreneurship and the process of firms' entry, survival and growth". Industrial and Corporate Change, 16(3), 455-488.

Scherer, F. M. (1988). Corporate takeovers: The efficiency arguments. The Journal of Economic Perspectives, 69-82.

Scherer, F. M. (1991). Changing perspectives on the firm size problem. Innovation and technological change: An international comparison, 24-38.

Schmidt, T., & Rammer, C. (2007). Non-technological and technological innovation: strange bedfellows?. ZEW-Centre for European Economic Research Discussion Paper, (07-052).

Skuras D., Tsegenidi K., Tsekouras K. (2008). "Product innovation and the decision to invest in fixed capital assets: Evidence from an SME survey in six European Union member states". Research Policy.

Smolny, Werner. (2003). "Determinants of innovation behaviour and investment estimates for West-German manufacturing firms." *Economics of innovation and new technology* 12.5: 449-463.

Solow, M.R. (1957). "Technical change and the aggregate production function."The review of Economics and Statistics (1957): 312-320.

Sorli M., Stokic D., Gorostiza A., Campos A. (2006). "Managing product/process knowledge in the concurrent/simultaneous enterprise environment". Robotics and Computer-Integrated Manufacturing, 22(5), 399-408.

Spirtes, Peter. (2001). "An anytime algorithm for causal inference." *Proc. of the Eighth International Workshop on Artificial Intelligence and Statistics*.

Stiglitz, Joseph E., Weiss A., (1981). "Credit Rationing in Markets with Imperfect Information". American Economic Review 71, 393-410.

Storey, David J. (1994). *Understanding the small business sector*. Cengage Learning EMEA.

Syverson C. (2011). "What determines productivity?" Journal of Economic Literature, XLIX(2), 236–365.

Syverson C. (2011). "What Determines Productivity?" Journal of Economic Literature, Vol. 49, No. 2 (JUNE 2011), pp. 326-365

Takalo T., Tanayama T., Toivanen O. (2010). Expected benefits of innovation policy, mimeograph.

Taymaz E. (2005). "Are small firms really less productive?". Small Business Economics, 25(5), 429-445.

Unioncamere (2009). Excelsior survey. (http://excelsior.unioncamere.net)

Van Leeuwen G., Klomp L. (2006). "On the contribution of innovation to multi-factor productivity growth". Economics of Innovation and New Technology, 15(4-5), 367-390.

Venkatraman, Natarjan, and Vasudevan Ramanujam. "Measurement of business performance in strategy research: A comparison of approaches."*Academy of management review* 11.4 (1986): 801-814.

Verbeek M. (2008). A guide to modern econometrics. John Wiley & Sons.

Wagner S. M., Hoegl, M. (2006). "Involving suppliers in product development: Insights from R&D directors and project managers". Industrial marketing management, 35(8), 936-943.

Wagner, J. (1994). The post-entry performance of new small firms in German manufacturing industries. The Journal of Industrial Economics, 141-154.

Wallsten S.J. (2000). "The effect of government-industry R&D programs on private R&D: the case of the Small Business Innovation Research program". RAND Journal of Economics, 31(1), 82-100.

Weinzimmer, Laurence G., Paul C. Nystrom, and Sarah J. Freeman. "Measuring organizational growth: Issues, consequences and guidelines."*Journal of management* 24.2 (1998): 235-262.

Weiss C. H. (1997). "How can theory-based evaluation make greater headway?" Evaluation Review, 21(4), 501-524.

Winter S. G. (1984). "Schumpeterian competition in alternative technological regimes". Journal of Economic Behavior & Organization, 5(3), 287-320.

WYG PSDB Sp. z o.o. (2014). "Ocena wpływu Programu Operacyjnego Innowacyjna Gospodarka na zwiększenie innowacyjności przedsiębiorstw. Raport końcowy", *in Polish*.

Zimmermann K. F. (1991). "The employment consequences of technological advance, demand and labor costs in 16 German industries". Empirical Economics, 16(2), 253-266