



Croatia Public Expenditure Review in
Science, Technology and Innovation:
Ex Post Evaluation of Croatia's S3 Policy Framework

EFFECTIVENESS AND OUTCOMES OF S3 INSTRUMENTS

This brief presents a selection of results of the ex post evaluation of Croatia's Smart Specialization Strategy (S3) 2016-20. Conducted in 2022 and 2023, the evaluation used counterfactual analysis to assess the effectiveness of selected S3 investments and to review progress against targets set at the Strategy's launch and midterm review. The first part of the analysis covers seven S3 programs totaling over EUR 400 million, focusing on researcher outcomes (such as research excellence and collaboration with firms), and firm outcomes (such as revenues, expenses, and intangible assets). The second part of the analysis examines the results of S3 instruments against targets set in the S3 monitoring framework, and reviews the recent changes in the S3 governance framework.¹



Researcher Outcomes: Publications, Patenting, and Collaboration

Since the adoption of the S3, there has been an overall positive trend in publications and citations. The number of publications and citations grew for all researchers. However, researchers funded through the analyzed S3 instruments² published at a higher rate compared to non-funded researchers. This difference was not statistically significant at the time of the analysis, but this may change over time as publications and citations take some time to come to fruition.

S3 instruments had a positive impact on patenting among researchers. Researchers supported by S3 instruments produced 70 percent more patent applications compared to researchers that were not funded. The magnitude of the difference must be interpreted with caution due to the small sample size: only 67 researchers (both beneficiaries and non-beneficiaries of S3 instruments) had active patent applications at the time of the analysis.

Collaboration between researchers and firms proved challenging. Researchers report collaborating primarily with other researchers. However, in the STRIP program where collaboration was mandatory, collaborative networks were concentrated among few research organizations. Although this may be a result of a small number of firms with the capacity and willingness to engage in R&D, it may also indicate difficulties for new entrants to become part of established networks.

A note on data collection

Severe data availability challenges limited the analysis of the effects of S3 programs, and its findings cannot be equated to a rigorous evaluation. Several institutions declined to share beneficiary and applicant data, citing data privacy and confidentiality concerns. The data collection exercise conducted for the purpose of this analysis highlights the need to build institutional capacities and raise awareness of data needs for evidence-based policymaking among policy stakeholders.

¹ For more details, please consult: World Bank (2023). [Croatia Public Expenditure Review in Science, Technology, and Innovation: Ex Post Evaluation of Croatia's S3 Policy Framework](#).

² The instruments covered by the analysis include Centers for Research Excellence (CoRE), Science and Innovation Investment Fund (SIIF) and Strengthening Capacities for Research, Development, and Innovation (STRIP).



Firm Outcomes: Revenues, Expenses, Intangible Assets, and Jobs

Firms with more developed capacities and resources had a better chance of receiving funding, possibly indicating the existence of barriers to participation for small and young firms. Funded firms had stronger innovation output, financial performance, and employment levels even before receiving any funding. The overall effort required to prepare the application and collect the necessary documentation may put a strain on the resources of smaller and younger firms. In some cases, program design explicitly favored incumbent firms by strongly emphasizing implementation capacities in the selection criteria.

Firms that received grant funding through S3 instruments³ experience a boost in revenues. Compared to the control group, the revenue of funded firms tends to increase by about 20 percent in the aftermath of the project implementation.

However, beneficiaries also experienced a short-term increase in costs. Costs of goods sold among beneficiaries were about 25 percent higher and operating expenses up to 40 percent higher, compared to non-beneficiaries. Further monitoring is needed to confirm whether this remains a long-term effect. This may reflect initial expansion of operations due to the grant. As efficiency gains may take a while to materialize, these early cost increases should not be seen as clear evidence of inefficiency. However, it would also be important to consider whether the instruments were well calibrated and targeted to incentivize higher productivity. Younger and smaller firms faced barriers to accessing public financing, potentially hindering productivity gains. The application process was also deemed cumbersome by firms, reinforcing the need for simplification.

S3 instruments helped firms increase the value of their intangible assets. As a proxy for innovation, intangible assets increased by about 60 percent overall, with a sustained upward effect in the years following application.

S3 instruments created jobs in the short term, but whether such effects will be sustained remains to be seen. Since the grants provide funding for staff costs and hiring, the number of employees expectedly increased among beneficiaries, by about 15 percent. Further analysis would be needed to confirm that the positive effect on jobs is sustained over the long term.



³ S3 instruments supporting firms covered by the analysis include: Commercialization of Innovations in Entrepreneurship, Innovation in Newly Established SMEs, Innovation Vouchers, Increasing Development of New Products and Services from Research and Development Activities (IRI).



S3 Performance Against Policy Targets: Outputs and Outcomes

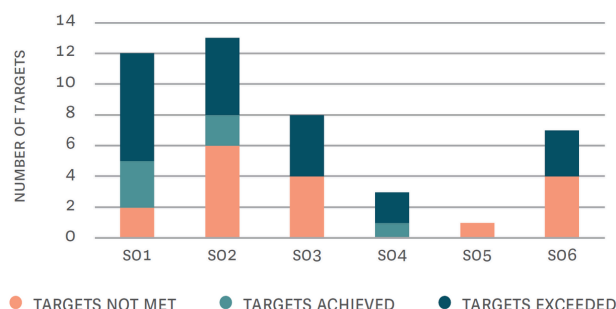
Around 60 percent of S3 target outputs have been reached or exceeded. Across all strategic objectives, the S3 set 44 target outputs. Sixty-two percent of them have been met or surpassed. The strongest performers were SO1 (research excellence), SO2 (industry-science collaboration) and SO4 (internationalization). In contrast, SO5 (social innovations) was de facto abandoned during implementation and recorded no progress. Over half of SO6 (smart skills) targets and half of SO3 targets (private investments in RDI) were unmet (Figure 1). Similarly, out of 20 outcome targets, 65 percent of the target values were not achieved, or the outcome was unclear due to missing data (Figure 2).

The progress recorded within S3 thematic priority areas (TPAs) is difficult to contextualize due to lack of data on the relative size of each TPA and lack of targets. TPA Energy and Sustainable Environment seems to dominate in most indicators, especially related to industry-science collaboration and introduction of new products. TPA Health and Quality of Life recorded notable results in research outcomes, having been a dominant recipient of funding under the Centers of Research Excellence program as well as research infrastructure investments. However, lack of baseline TPA data and targets impede more accurate conclusions.

Indicators measuring the performance of the national innovation system show improvement. The progress of Croatia's innovation system was tracked in the S3 through context indicators. Compared to 2016, Croatia improved its ranking in the Summary Innovation Index (from 23rd to 22nd) and the Global Innovation Index (from 47th to 44th). Gross expenditures on R&D (0.85 percent of GDP in 2016 to 1.24 percent in

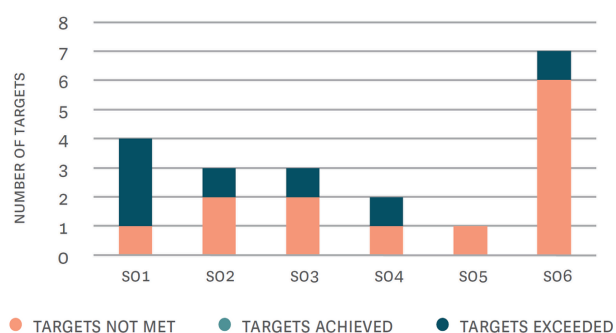
2021) and business expenditures as a percent of GDP (0.39 percent in 2016 to 0.58 percent in 2021) have also gone up. Finally, the share of human resources in the population remained stable, while the quality of projects and scientific outputs improved markedly.

Figure 1. Number of output targets achieved for all strategic objectives



Source: Staff elaboration.

Figure 2. Number of outcome targets achieved for all strategic objectives



Source: Staff elaboration.

⁴ SO1 denotes Strategic Objective 1: Increased capacities of RDI sector to perform excellent research and to serve the needs of the economy; SO2 – Strategic Objective 2: Overcoming the fragmentation of innovation value chain and the gap between research and the business sector; SO3 – Strategic Objective 3: Modernizing and diversifying Croatian economy through increasing private investments into RDI; SO4 – Strategic Objective 4: Upgrading in global value chain and promoting internationalization of Croatian enterprises; SO5 – Strategic Objective 5: Working in partnership to develop social innovations (not covered by the revised policy mix); SO6 – Strategic Objective 6: Development of Smart Skills.

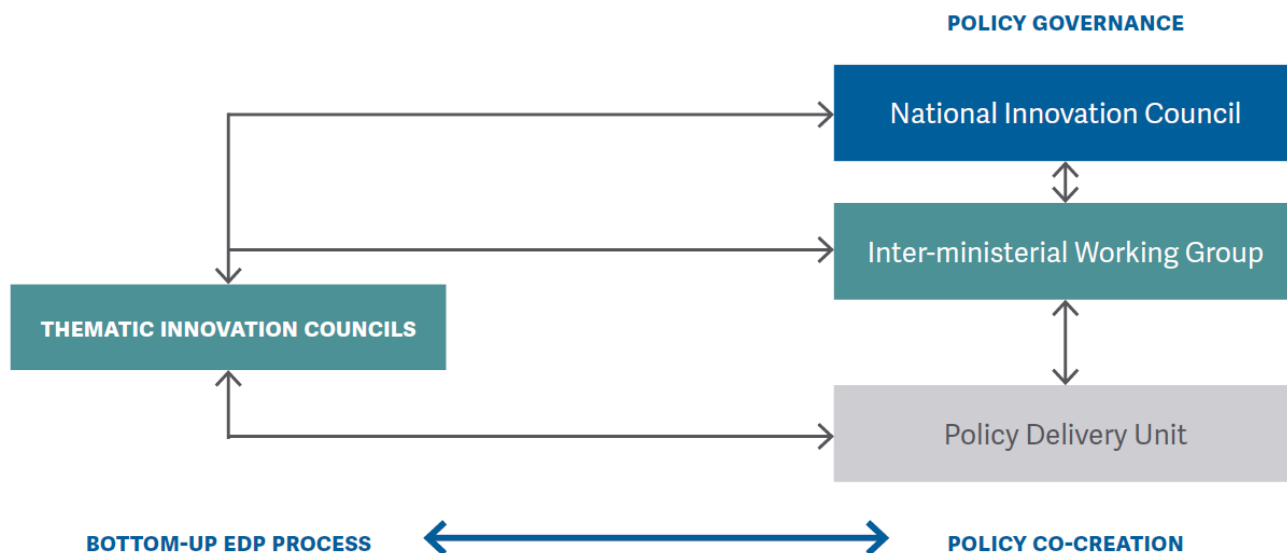


S3 Governance Reforms: Work in Progress

Some advances in streamlining the governance structures are planned, especially at the policy governance level, but have been slow to take off (Figure 3). The National Innovation Council took longer than expected to be formed and the Policy Delivery Unit has yet to materialize. The Ministry of Science, Education, and Youth (MSEY) implemented many improvements in monitoring and evaluation (M&E), particularly by introducing new instruments that feature revamped results frameworks and theories of

change and by upgrading the tracking of TPA-level progress. However, implementation governance, which refers to the governance of funding instruments remains fragmented, with frictions in program design and lack of flexibility in application and selection processes. The momentum gained in the EDP⁵ during S3 preparation seems to have dissipated and the level of continued policy co-creation remains uncertain. The S3 adoption process has yet again been lengthy, taking nearly two years longer than intended.

Figure 3. The planned governance structure for S3 2029 has been partially achieved



Source: Staff elaboration.

⁵ The Entrepreneurial Discovery Process (EDP) involves coordination between policy makers, social, industry, and research stakeholders to create and design specific investments and reforms that respond to the needs of each Thematic Priority Area.



Recommended Actions: Gearing the Policy Mix Towards Better Monitoring and Results



The results of the counterfactual analysis have implications for policy design as well as S3 data collection, monitoring, and evaluation practices:

- **Distinguish research excellence, applied research, and market-oriented outcomes.** Policymakers should prioritize intellectual property outcomes in market-oriented programs. Programs supporting research excellence might be better suited to increasing the quality and quantity of publications.
- **Reduce barriers for applicants and beneficiaries to participate in public support programs.** Policymakers should have programs in their portfolios that are accessible to smaller and younger firms, with appropriate selection criteria for their capacity levels and simplified application and selection processes.
- **Invest in supporting industry-science collaboration.** Research organizations and firms tend to develop collaborations within organization type but not with each other. Efforts to establish closer connections between researchers and firms should be intensified.
- **Collect more and better-quality data.** More data will allow more sophisticated analysis and provide precise and granular information for policymakers to consider in their decision-making.
- **Define a clear protocol allowing the use of confidential data for evaluation purposes.** Expert evaluators should receive access to data from application forms, supporting documentation, and scoring results. The MSEY has introduced informed consent for data use and survey participation in their calls for proposals. This practice could be expanded to other funding institutions.



S3 monitoring results show a need to harmonize monitoring practices across institutions and update the monitoring framework clearly and transparently:

- **Introduce clearer definitions and uniform measurement practices.** To streamline M&E processes, facilitate data aggregation, and enable policy-level monitoring, it would be beneficial if connected indicators applied consistent rules and definitions.
- **Introduce a clear and transparent process for updating the S3 regularly, including revising the monitoring framework.** Targets should be reexamined and revised when appropriate, for example, following any budget or policy mix revisions and when original targets appear mismatched with performance during implementation.



S3 governance reforms are ongoing, but action is needed to address outstanding challenges:

- **Simplify the design of application and selection processes.** Implementing bodies should have more flexibility in designing the calls for proposals, application forms, and selection processes to reduce administrative and bureaucratic burdens to applicants.
- **Expedite the implementation of the S3 to kickstart a more effective governance system.** The new S3 2029 should formalize the proposed changes to the S3 governance structure and address the main governance challenges identified in the midterm evaluation.




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