Financing Research and its Commercialization in Croatia

The RAZUM program was a soft-loan mechanism designed to encourage private expenditure on R&D and its commercialization in Croatia. RAZUM fell under the responsibility of the Business Innovation Centre of Croatia (BICRO) and focused largely on early seed and precommercial financing of knowledge-intensive firms, covering up to 70 percent of new product development costs. The program was initiated by the Croatian government in 2001 and reviewed, expanded, and relaunched in 2005 under the support and guidance of the World Bank. It was completed in 2011.

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Introduction

Amid the general decline in support for science throughout Eastern and Central Europe that followed the end of the Soviet Union, Croatia's scientific and innovative performance deteriorated significantly during the 1990s. Following the breakup of Yugoslavia, production in the manufacturing sector fell by an annual rate of 3.3 percent between 1990 and 2000, and its weight on gross domestic product (GDP) shrank from 28 to 23 percent. Since much of the reduction occurred in large companies with high levels of research and development (R&D), a sizable portion of the country's R&D capacity was dispersed (with total R&D investments corresponding to only about 0.8 percent of the GDP). Public investments in R&D declined substantially, many scientists moved abroad, research infrastructure deteriorated, and the country's overall scientific performance worsened. Additionally, with the privatization of large, state-owned enterprises in the manufacturing sector, business R&D and the link between business and research organizations almost disappeared. Overall, the volume of business R&D remained low, corresponding to 40 percent of total R&D, and very little public sector research was commercialized (World Bank 2008). Eventually, Croatia came to lack both a coherent science and technology (S&T) policy and the appropriate funding mechanisms to implement one.

In general, institutional reform is especially challenging in transition countries like Croatia, as transition implies deep changes in the national science and technology institutions, moving

away from a linear, top-down, science-driven model toward an open, demand-driven and dynamic national innovation system. Inertia, path dependencies, and resistance to change may hamper the rhythms of institutional reform in such a context.

Such conditions spurred a demand in Croatia for a national S&T policy, leading to the introduction in April 2001 of the Croatian Program for Innovative Technology Development (HITRA) by the Ministry of Science and Technology. To create cooperation among entrepreneurs, scholars, and industry in support of economic development, HITRA aimed to encourage the transfer of knowledge (produced internally or acquired externally) to the business sector. The program included two complementary subprograms, one focusing on competitive research (the TEST program) and the other on the development of knowledge-based companies and the commercialization of their R&D (the RAZUM program).

By 2003, however, these programs were regarded as lacking in focus and too small to make a meaningful impact, while their continuation demanded they be expanded and reoriented toward providing more financial support to the private sector (World Bank 2003).

Meanwhile, evaluating the programs became vital to the country's application to join the European Union (EU) in 2003 and its commitment to adopting and implementing the EU framework on R&D in 2004. The World Bank's participation in the proposed Science and Technology Project (STP) offered essential support to the government's growth and reform strategy for EU admission. The reviews conducted by its Operations Evaluation Department confirmed the Bank's potential to contribute significantly in the area of S&T, given its previous experience in the field. The initial project development objectives included (1) the strengthening and restructuring of selected R&D institutions to promote applied research while maintaining their scientific excellence, and (2) an improvement in the ability of enterprises to develop, use, adapt, and commercialize technology (World Bank 2005).

In the course of this reviewing and planning process, the RAZUM program was restructured and remained as the main source of financing for Croatian firms' attempts to carry out and commercialize R&D, addressing primarily the financing difficulties they encountered. The risk inherent in the innovation process had made private spending on R&D insufficient, particularly in the product development stage, and this had held back firms from exploiting newly generated ideas. The program also aimed to strengthen the so far weak links between the research community (including universities and public research institutes) and industry by including researchers and scientists in the project evaluation process and having them advise entrepreneurs on technical matters.

Furthermore, the program was expected to contribute to the development of the knowledge-based small and medium enterprises (SMEs) that were experiencing financial constraints most profoundly and raise the level of competitiveness in Croatia, which had been low since the 1990s. In fact, Croatia's overall purpose in reorienting its S&T policy toward industry needs was to improve its industries' competitiveness in both domestic and foreign markets while upgrading firms' technological capabilities, which was seen as an important step for Croatia's admission to

the EU. To this end, the STP aimed to help Croatia establish the institutions and programs needed to modernize the nation's R&D effort.

Possible barriers to the program's success arose from the prevailing institutional conditions in the country and the failure to set realistic and internationally comparable targets. On one hand, Croatia showed limited appetite for restructuring its research and development institutes (RDIs) (as defined by the self-sufficiency indicator targets—that is, lack of scaling up to international benchmarks). On the other hand, the country expressed a commitment to increased research capacity and the commercialization of the results of publicly funded research that surpassed original expectations and actual capabilities. Indeed, during the initial years of implementation, the project's performance was hindered by local counterparts' insufficient knowledge and lack of readiness. Delays in achieving main covenants, for instance, postponed the project launch. For implementation to happen, several supporting institutions had to be established, staff had to be hired and trained, and procedural rules and analytical frameworks had to be developed, among other tasks.

Program design

Although the importance of financing to the development of new technology is commonly recognized, financing schemes tend to overemphasize the research component and abandon the development aspect of the R&D process. In response to this gap, and to speed up product development and increase the scale of innovative projects, the RAZUM program aimed to focus more on precommercial and early seed financing.

The decision to do so followed an evaluation of the whole national STP in 2003 by the Ministry of Science, Education, and Sport in collaboration with the World Bank and was based on evidence that new ideas for products and technologies could not be channeled to the market. The problem was attributed to the common reluctance of private firms to invest in R&D, either due to lack of funds or because of the limited appropriability potential and the difficulty of obtaining access to capital under prevailing economic and political conditions.

With such conditions keeping Croatian firms uncompetitive, uncovering the unexploited potential of SMEs seemed a promising means of addressing the situation. To this end, the program sought to help SMEs invest in R&D by financing the development, use, and adaptation of new technologies, the growth of technology-rich companies, and the improved quality of the products manufactured. Finally, recognizing the need to use and adopt innovations and new technologies developed outside of industrial sectors, the program included the scientific community in the evaluation processes supporting the initiative.

This approach was first applied in October 2002, when the ministry started to prepare a broad-based technology program whose purpose was to prioritize the needs of the economy in a systemic way. This work was supported by the World Bank and resulted in the proposed Science and Technology Project (STP), preliminary to a more systematic revision of the STP in 2003. The strengths and weaknesses of the then existing RAZUM program were identified, resulting in a redesign of the program's objectives to ensure greater impact and the introduction

of international best practices, including better governance, transparency, and monitoring (World Bank 2012). Next, in July 2005, the World Bank approved a loan of €31 million to the Republic of Croatia (De Daruvar and Jean-Charles 2005; World Bank 2012). The Business Innovation Centre of Croatia (BICRO) was allocated €17.1 million (of which €14 million came from the loan) for programs seeking to upgrade firms' technological capabilities by financing the development, use, and adaptation of new technologies and improvement in the quality of products, ultimately making Croatian firms more competitive.

In 2009 the objectives of the project, along with the associated outcome indicators, were once again revised to maintain the relevance and attainability of targets and deadlines. The objective of restructuring research and development institutions was removed and the project refocused on enabling the commercialization of public research and fostering private sector R&D (World Bank 2009). This second revision highlighted the importance of RAZUM's contribution to enabling SMEs to invest in R&D activities and directed efforts toward the implementation of publicly supported programs to finance innovation through competent management and transparent application processes (World Bank 2009). Further changes included the extension of the project's closing date from November 30, 2009, to May 31, 2011, and the reallocation of loan funds among disbursement categories, increasing the allocation to programs that directly and indirectly supported business R&D (including the RAZUM program). The expenditure from loan proceeds for the RAZUM program was also increased from 80 to 100 percent, while the program's budget allocation rose to €6,593,124 (in 2009) and €7,193,124 (in 2011). The total loan amount was reduced to €30 million.

As far as the official administration of the program was concerned, the terms of the loan from the World Bank to the Republic of Croatia were agreed upon, and the overall responsibility for implementing the STP was delegated to the Ministry of Science, Education, and Sport (MSES). MSES established subsidiary finance agreements with the implementing agencies for each of the programs, and the RAZUM program continued to fall under the responsibility of BICRO, the implementing authority of the program since 2001.

With respect to the design of the initiative, the RAZUM program fell under the BICRO component of the national STP, which deals with R&D financing and the development of knowledge-based companies. RAZUM was a seed-stage and early commercialization program, focused on co-financing development costs of new products. A soft-loan mechanism rather than an equity investment, it was designed to encourage the private sector to spend more on R&D, particularly in the later stages of product development. The program provided loans covering up to 70 percent of product development costs, with repayment conditional on success.

The RAZUM program ensured initial financing of newly established enterprises or of the development of new products or services in existing SMEs (BICRO 2011). It provided financial assistance for the setup, development, and expansion of companies that used new technologies to develop products with high value added. Eligible expenditures encompassed many activities, including patent applications. The selection process aimed to identify projects with a high likelihood of commercial success and assessed both technical feasibility and market potential.

Finally, in addition to direct co-financing, the implementing agency benefited from the support of the STP for upgrading its institutional capabilities, including its managerial and technical skills, human resources system, marketing, business development, management information system, financial management and planning, monitoring and evaluation functions, and procurement.

Implementation

The RAZUM program was implemented by BICRO, which identified the firms to be supported and evaluated their capabilities based on technical and financial criteria. Interested firms prepared business plans for their projects and submitted them to BICRO for review, together with other materials (see BICRO's website for information about the application package: http://www.bicro.hr/index.php?option=com_content&view=article&id=65&Itemid=172, in Croatian).

RAZUM provided financial assistance primarily to technology-oriented, knowledge-based enterprises; selection criteria included level of technological innovation, quality of management, commercial potential, competitive advantage, viability of the project, and quality of the business plan. BICRO developed and applied consistent prescreening, evaluation, and monitoring standards to all its projects, irrespective of financing sources, while seeking technical expertise from the research community. Only those projects that largely complied with the predetermined criteria were selected for financing. They were placed into two categories:

- *Precommercial projects* were financed through conditional loans, requiring 70 percent of the total value of the project to be financed from the RAZUM program, while the remaining 30 percent was to be provided by the user from private sources. The terms of the conditional loan obliged the user to repay it when the project reached the commercialization stage.
- *Commercial projects* covered investment in the production stage or the development of service capacities. They were evaluated and financed by BICRO.

BICRO was responsible for all stages of processing RAZUM projects, including all financial matters (for instance, carrying out checks and balances and preparing payment orders). The implementation agency repaid its loans directly to the government, while beneficiaries repaid theirs to BICRO. Firms' repayment was conditional on success; companies began to repay loans when the projects started generating revenues from sales resulting from the innovations (repayment amount ranged 3–5 percent of these sales). Support was limited to a maximum of €1.5 million per project for a maximum of three years per project.

The main benefit of such an implementation design rests on the role of the specific program in a national STP, which to a great extent ensures the government's commitment to success. Planned this way, the program was expected to (1) increase the likelihood and the magnitude of commercialization of research and private sector innovation, thereby aiding Croatia's transition to a knowledge economy, and (2) extend the availability of funds for private R&D in an environment of illiquid financial markets. This would help mitigate the effects in the country of

the 2007–08 global economic crisis. In addition, the program offered synergies with EU programs and policies, hence decreasing the distance between Croatian innovation policy and EU means.

Finally, the implementation agency's proactive role in nurturing and developing ideas into financeable projects was critical for the development of a sound pipeline—a result that countries without equivalent organizations often fail to achieve. The filling of this role, combined with the provision of different financing instruments at different stages of the innovation chain, may be the main advantage of organizations dedicated to promoting knowledge-driven startups and R&D in SMEs.

Implementation did not come without challenges. At its design stage, the program was confronted with (1) a renewed resistance on the part of the RDIs to market-oriented reforms for the commercialization of research outputs, and (2) a potential lack of counterpart funding, resulting from the tightening of fiscal policy in Croatia. These challenges were alleviated by the support of newly appointed administrations and the agreement between the government and the World Bank to increase the financing ratio from loan proceeds. The proposed restructuring increased the value of the project to the government by better addressing its needs, particularly in the context of the then ongoing global crisis.

The actual implementation of the program proved challenging as well, as institutional and other project requirements seem to have been underestimated, resulting in delays:

- Stakeholder consultations on the allocation of administrative tasks, the availability of human resources, and the appropriateness of the existing institutional structure took longer than expected.
- The level of capacity building required of the implementing agency was greater than originally conceived. For example, BICRO had a team of about five people and a single program in the beginning; by the end of the project, these had expanded to about thirty people and at least four programs, and the portfolio of beneficiaries had increased tenfold.
- Fine-tuning the program manuals, obtaining approvals from government bodies, training personnel, and developing the pipeline of applicants also took longer than originally expected.

However, there is no evidence that these circumstances affected project outcomes. Rather, after the initial years, as the projects started disbursing heavily, they received funds reallocated from underperforming components and ended the program with higher investment levels than originally planned.

Results

Part of the national monitoring and evaluation framework of the Science and Technology Project consisted of reporting the progress of its implementation. The government formally introduced

most of the measures for success in the "Action Plan for Increasing the Level of Investment in Research and Development" (2008) and commissioned the Zagreb Institute of Economics (ZIE) to conduct a first assessment of BICRO.

Generally speaking, the proposed outcome of the RAZUM program (in 2009) was an increase in the ability of enterprises (particularly SMEs) to invest in R&D activities, as measured by the number of SMEs financed and the amounts of financing provided. More specifically, the program was expected to produce the following outcomes:

- More innovation and private R&D, as measured by the share of small and medium-size companies introducing new products to the market (maintaining the precrisis level of roughly 7 percent by 2011) and a volume of R&D expenditures by SMEs of €9.2 million during the period 2006–11.
- Improved ability of enterprises to develop, use, adapt, and commercialize technology, as measured by increases in the number of R&D projects commercialized.

Overall, from 2006 to 2008, the share of Croatian SMEs that introduced new or significantly improved products to the market increased from 7.2 percent to 10.8 percent (Community Innovation Survey 2008), while the volume of private funding for R&D activities mobilized by firms reached €13.7 million (30 percent higher than initially envisaged).

More specific results on the implementation of the program are summarized as follows:

- 135 outline applications were received.
- 40 full applications were received.
- 31 projects were approved for funding.
- 22 financing contracts with innovative SMEs were concluded.
- The total value of the R&D projects amounted to €22 million, of which BICRO's contribution (stemming from the loan) was €14.4 million; the rest was private investment.
- The total of workers employed in firms was 602, of which 213 were directly involved in the R&D activities.
- 129 new jobs were created.
- The total income realized by the end of 2010 amounted to €33.8 million.
- Net profits generated by the end of 2010 amounted to €3.42 million.
- The stock of knowledge capital was increased by the development of 16 new products, 10 functional prototypes of new products, 10 new patents, 6 industrial designs, 5 new processes, 3 improved processes, and 3 publications.

In general, companies that received financing from RAZUM invested more than 30 percent of their own resources in the project, hence improving the Total and Firms' Own R&D intensity

indicators after the initiation of the RAZUM program (the Firms' Own R&D intensity increased, on average, from 0.41 in the year before the RAZUM grant to 0.44 in the year following the beginning of the RAZUM grant).

In 2011, ZIE undertook a qualitative and quantitative assessment of the development impact of the project, particularly related to innovation programs financed by it. The assessment investigated the project's overall performance, as perceived by actual and potential beneficiaries, along two dimensions. The first was the program's effectiveness and efficiency—that is, its effectiveness and efficiency in achieving its objectives, as perceived by the use of project funds for successful projects. The second was the program's administrative or institutional efficiency—that is, the efficiency of management practices in the organizations that implemented the program. The study concluded the following:

- A large share of RAZUM-mobilized business R&D spending would not have occurred in the absence of the program.
- Smaller budgets would have resulted in longer duration and smaller scope of the activities, lower R&D capacity, and lower levels of innovation.
- R&D intensity increased after the start of the RAZUM program in 9 out of 15 companies.
- Without RAZUM funds, firms would have been unable to establish new collaborations and the influx of knowledge coming through collaborative networks would have decreased.
- New employment, amounting to 54 new jobs, was generated, most of it (48 jobs) in R&D. The companies expressed their intentions to keep the new staff after the project was over; more than half would have been unable to hire the new staff without the public support.

Such results indicate the program not only achieved its targets; it exceeded expectations and brought about long-term behavioral changes in the firms. Secondary improvements attributed to the success of the program involved the following:

- The following capabilities were developed among the firms that might influence subsequent R&D productivity:
  - Improved international competitiveness
  - Increased technical capacity to conduct R&D
  - Increased skills and improved innovative orientation among the staff
- Expected benefits were derived from commercial application of the R&D results:
  - Strengthened presence on the targeted markets (65 percent of firms)
  - Improved knowledge of the markets (with 75 percent of firms with good or excellent levels of knowledge)

  - Improved skills for commercialization (with 15 percent of firms with excellent skills and 75 percent with good or medium skills)

- Changes in firm behavior resulted from having received support from RAZUM:
  - Generation of innovative ideas (with 55 percent of firms generating new ideas while working on the project, but with insufficient capacity to work on other innovations or engage in additional R&D activities, and 35 percent managing to work on additional R&D activities alongside the project itself)
  - Apparently sustainable increase in R&D human capacity (with 80 percent of firms intending to keep the newly hired staff after the project ended)

The factors that contributed to the program's success can be summarized as follows:

- The program was active for a long time (covering a whole decade, 2001–11).
- The sound monitoring and evaluation process accompanying implementation resulted in the timely revision and restructuring of objectives, expected results, and fund allocation.
- The government was committed to the success of the program.
- The implementing agency (BICRO) was restructured to improve its capacity and achieve better implementation.
- The World Bank provided support.

Lessons learned

When asked about the efficiency of management practices of the implementing agency (BICRO), companies that applied to participate in the program offered the following recommendations for future programs of similar nature:

- The application process should be simplified.
- The evaluation process should be sped up.
- Stronger promotion was needed to increase awareness of the program.

The last finding was confirmed in a survey of potential users (high-tech SMEs), in which companies not familiar with RAZUM rated the benefits of the program lower than RAZUM applicants did, suggesting that RAZUM could increase the number of applicants if companies were better informed about how they might benefit from the program. Hence, the promotion of government initiatives and the relevant publicity are important for ensuring wider participation.

A valuable lesson learned from this initiative is the importance of institutional scoping at the planning stage. Policy makers need to ensure that supporting institutions and organizations are properly evaluated and suitable for the implementation phase of such an undertaking. As mentioned earlier, the readiness of local institutions to launch and implement such types of initiatives is critical to their success. In Croatia, the willingness and aspirations of policy makers

to reform the science and technology system were overshadowed by a lack of institutions (in the sense both of executing organizations and of norms, rules, and procedures), limited manpower, and (initially) unrealistic expectations. The continuous evaluation and review of the STP's general objectives resulted in the reorientation of the initiative's targets, its recalibration to the needs of the private sector, and its overall satisfactory implementation.

Since 2011, Croatia's political developments and the uncertain availability of innovation financing mechanisms have been risk factors for the sustainability of R&D activities. Although the MSES 2012 R&D budget was larger than that of 2011, the availability of budgetary resources to existing BICRO early-stage financing programs has remained uncertain in the context of severe fiscal constraints. Furthermore, BICRO's transition from a private liability company to a government agency, initiated by the previous administration, has had at least two negative consequences: salary cuts of up to 40 percent, which have created a severe risk of the program's losing its cadre of highly trained professionals, and a more restrained capacity to manage multiyear budgets, which has increased BICRO's dependence on the budget cycle and contributed to the volatility of public financing for business R&D. ZIE (2011) reported that the RAZUM grant was not sufficient for 45 percent of the firms to complete their projects, and as markets are unlikely to provide angel or venture financing to the pipeline of innovation projects and technology-based startups that were generated by the STP, future governmental support will be needed.

Taking all of this into consideration, the government is planning to continue its collaboration with the World Bank to structure a second Science and Technology Project (STP II). Its primary objective is to ensure a high absorption rate of EU funds (estimated at about €150 million annually for 2014–20) by strengthening the policy and institutional frameworks of the project and further consolidating the institutional project management capacity. At the same time, to address the funding gap, the project would support firm-level R&D for the period ahead of EU admission and prepare a pipeline of project proposals for the use of EU funds. Finally, the extension of the project would allow more time for the full consolidation of newly created policies and institutions.

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