Maria Urbaniec*

Innovation under Uncertainty: Toward a Strategic Micro—Meso—Macro Approach in Poland

This contribution shares the diagnosis formulated by M. Gorynia, Ł. Hardt, and M. Kośny [Gorynia, Hardt, Kośny, 2026] that Poland's catch-up model is approaching its limits and that the transition toward a new model will occur largely endogenously. However, the direction of this transition does not guarantee a sufficient pace of change, given the limited number of firms with both the capabilities and the propensity to innovate. Poland's innovation challenge therefore extends beyond funding and research capacity to firms' willingness to bear the risks of irreversible investment and their ability to assess long-term commitments under institutional and regulatory uncertainty.

Innovation should therefore be regarded not simply as a component of a new development model, but as the mechanism through which its other components are implemented and as a capability that needs to be strengthened at three levels. At the micro level, it depends on firms' decisions under uncertainty and the capabilities supporting them. At the meso level, it is predicated on firms' positions within value chains and on ecosystems of financing, linkages, and diffusion. At the macro level, it is contingent on institutions, policy predictability, demand structure, and the indicators used to assess economic performance.

> Over the past two decades, Polish policy has largely focused on transferring macro-level funding to micro-level projects, while leaving the meso level insufficiently addressed. This may help explain why increased inputs have not translated into corresponding growth in innovation outputs.

The Innovation Propensity Gap

Poland's gross domestic expenditure on R&D increased from approximately 0.6 percent of GDP at the time of EU accession to 1.56 percent in 2023, representing an almost threefold increase in relative terms [Eurostat, 2025]. In 2024, however, R&D intensity fell to 1.41 percent, while expenditure declined by 3.1 percent in nominal terms to PLN 51.5 billion, marking the first decline in the available time series [GUS, 2025]. Consequently, the gap relative to the EU average of 2.24 percent widened rather than narrowed. Public-sector R&D expenditure accounted for approximately 0.51 percent of GDP, compared with 0.72 percent across the EU [European Commission, 2026b; 2026c].

Innovation outputs have improved less than the growth in inputs would suggest. According to the European Innovation Scoreboard 2026, Poland remains an Emerging Innovator, with a score equal to 65.2 percent of the EU average, ranking 23rd among the 27 Member States. Its score increased by 16.3 percentage points between 2019 and 2026, compared with 11.6 percentage points for the EU as a whole, but declined by 1.5 percentage points in 2026, marking the first annual decrease since 2019. The improvement has been concentrated in inputs, particularly investment in information technologies, which increased by 83.6 percentage points since 2019 [European Commission, 2026a]. In terms of Innovators, Poland ranks 25th among the 27 Member States, while its position in sales and employment impacts has declined to 24th [European Commission, 2026b].

One indicator is particularly important in interpreting these patterns. Among Polish enterprises covered by the innovation survey, 50.7 percent report neither innovation activity nor a propensity to innovate, compared with 31 percent in the EU [European Commission, 2026b]. This does not indicate an absence of innovation capabilities: 18.5 percent developed business process innovations in-house, compared with

* Prof. Maria Urbaniec—Krakow University of Economics, Polish Economic Society.

7.6 percent in the EU, while 4.9 percent introduced in-house product innovations new to the market, compared with 5.1 percent in the EU. The difference therefore has less to do with the capacity to innovate than with the propensity to undertake innovation under market uncertainty. Internal process adaptation entails less exposure to uncertain market outcomes than the introduction of products that are genuinely new to the market.

No grant directly addresses this constraint. Grants co-finance projects that firms have already decided to carry out, while firms that report no propensity to innovate do not initiate such projects; there is no basis for assuming that this reflects an erroneous assessment. The premise that non-innovation results from information deficiencies or limited access to capital remains largely unexamined within the Polish support system.

> The ratio of R&D expenditure to GDP captures the behavior of firms that already undertake R&D but says nothing about the proportion of firms willing to make such a decision. Understanding why so many firms refrain from innovation requires considering the issue at each of the three levels in turn.

The Micro Level: Innovation Decisions under Uncertainty

Why would a rational firm choose not to innovate? The explanation underlying a decade of grant programs—that firms lack financial resources—is not fully consistent with the evidence. Investment in innovation is often irreversible, involves a long payback period, and generates returns that depend on conditions that cannot be anticipated at the time of commitment. Under such circumstances, investment constitutes a real option, and its exercise entails foregoing the value of waiting. The investment threshold therefore exceeds the conventional hurdle rate and increases with uncertainty [Dixit, Pindyck, 1994].

For a manufacturer considering a five-year investment commitment, the relevant uncertainty is not primarily technological but institutional, including the tax treatment of R&D, energy prices, regulatory stability, and the durability of support instruments. Greater uncertainty raises the threshold at which investment becomes preferable to postponement, particularly for long-horizon projects on which a new development model depends. No specific adverse outcome needs to be anticipated; uncertainty about the future institutional and regulatory framework may be sufficient in itself. The same logic applies to eco-innovation, where market uncertainty has been identified as a more important barrier than technological capability [Urbaniec, 2015]. Where demand depends on public support, investment decisions may follow program cycles, with postponement becoming preferable once a program ends. This provides one possible interpretation of the decline in R&D intensity in 2024.

The threshold is only one part of the micro-level problem; the other concerns firms' capabilities. The conditions required for public funding to generate substantive effects are well established: absorptive capacity, based on knowledge accumulated within the firm [Cohen, Levinthal, 1990], and complementary intangible investment in organizational redesign, skills, and decision rights [Brynjolfsson, Hitt, Yang, 2002]. A subsidy granted to a firm lacking these foundations may result in the formal implementation of a project without generating substantive innovation or lasting productivity gains. The relevant national asset is therefore not the R&D budget alone but the extent to which firms possess the capabilities and entrepreneurial orientation required to identify, undertake, and commercialize innovation [Lumpkin, Dess, 1996]. These characteristics are unevenly distributed across the firm population and cannot be substantially altered by individual firms acting in isolation.

The Meso Level: Value Chains and a Missing Ecosystem

Where does this distribution come from? In the three-dimensional framework of firm competitiveness—position, potential, and strategy [Gorynia, 2004]—position is an outcome, whereas potential and strategy require transformation. Polish firms have strengthened their position in international markets [Dzikowska, Gorynia, Jankowska, 2017], while technological, organizational, and managerial capabilities have developed considerably more slowly. This divergence reflects not only firm-level factors but also the structural conditions within which firms operate.

The argument is not that Polish competitiveness rests solely on low labor costs, but that it has been shaped by a particular position in the international division of labor. Firms supplying components to externally determined specifications have limited access to market information and limited capacity to appropriate returns from innovation. The compression of markups among Polish exporters between 2002 and 2016 illustrates this mechanism in price terms [Gradzewicz, Mućk, 2024]: when margins are reduced to retain contracts, incentives for process improvement weaken. The decoupling of wages from productivity, discussed by M. Gorynia, Ł. Hardt, and M. Kośny [Gorynia, Hardt, Kośny, 2026], can therefore be interpreted at the firm level as a rational equilibrium—not as a cultural

deficiency, but as the cumulative response of firms to the incentives prevailing over the past two decades.

The framework associated with two of the 2025 Nobel laureates is relevant here, with one qualification. In the Aghion—Howitt model, growth is driven by innovators who capture rents generated by the displacement of incumbents [Aghion, Howitt, 1992; Aghion, Antonin, Bunel, 2021]. In a subcontracting economy, however, a substantial share of these rents accrues to value-chain coordinators abroad, limiting domestic value capture from creative destruction. Employment in high- and medium-high-technology activities accounts for 29.5 percent of total employment in Poland (2023–2025 average), compared with 38.6 percent in the EU, while foreign investment remains concentrated in medium-technology assembly rather than R&D-intensive activities [European Commission, 2026b].

Nor is the transition away from this position adequately supported by the surrounding innovation ecosystem. Enterprise birth rates exceed the EU average (1.6 compared with 0.9), while venture capital expenditure remains at only 27.1 percent of the EU level [European Commission, 2026b]. The composition of venture capital financing is equally important: of the 183 venture capital transactions recorded in Poland in 2025, 134 were seed rounds, while only seven involved growth-stage enterprises [PFR Ventures, Inovo VC, 2026].

> Support for business creation is therefore not matched by financing for subsequent scaling, limiting the number of firms able to accumulate capabilities, strengthen their market position, and generate productivity gains at scale. A similar asymmetry characterizes knowledge-transfer channels: links between academia and business, as well as between leading firms and their suppliers, remain weak relative to the scale of public funding directed toward the innovation system. The resulting ecosystem provides stronger support for firm entry than for the subsequent development of capabilities, scaling, and upgrading within value chains.

The Macro Level: Demand, Predictability, and Demographic Pressure

If the binding constraint is the willingness to bear irreversible uncertainty, the relevant instruments are those that reduce such uncertainty or increase the returns to accepting it, most of which are not grants. The first is demand. Poland has developed extensive supply-side support but substantially less capacity for market creation: innovation procurement accounts for 6.8 percent of public procurement, compared with an EU average of 10.5 percent in 2023 [European Commission, 2026b]. Where private demand for quality is weak, public procurement remains an underused instrument for stimulating innovation. When decarbonization is treated primarily as a cost, it is addressed through compliance rather than R&D; Poland's weak position on the Eco-Innovation Index (69.7 compared with 127.5 for the EU in 2024) reflects limitations in innovation capacity as well as environmental performance [European Commission, 2026b]. A credible carbon price can strengthen incentives for innovation, whereas volatility increases the value of postponing investment.

The second is predictability, which constitutes the macro-level counterpart of the option value described above. Competition requires a stable institutional framework that enables long-term private investment, consistent with the constitutional principle of the social market economy [Mączyńska, Pysz, Urbaniec, 2023]. The empirical evidence is unambiguous: Poland ranks 109th among 139 economies in policy stability for doing business, its weakest institutional indicator by a wide margin, while gross capital formation stands at 19.2 percent of GDP, placing Poland 108th [WIPO, 2025]. Mokyr's account of economic growth as a process rooted in a culture that values the creation and application of useful knowledge [Mokyr, 2016] points in the same direction: the propensity to innovate is not fixed but is shaped by the institutional and economic environment in which firms operate and may strengthen or weaken in response to changes in that environment.

The third concerns demographic change. A shrinking labor force increases pressure on firms to substitute capital and technology for labor. As labor becomes scarcer, investment in automation and digital technologies can become more economically attractive, creating a persistent incentive to adopt labor-saving technologies. In Poland, access to digital technologies is already relatively widespread, but their use in business processes remains limited [European Commission, 2026b]. The key challenge is therefore not access to technology itself, but firms' capacity to adopt and use existing technologies in ways that increase productivity. Whether such diffusion generates broad-based productivity gains or rents captured by a limited number of firms depends on institutional arrangements [Acemoglu, Johnson, 2023].

What Needs to Be Done

Because the constraint operates at all three levels, action confined to any one of them is unlikely to change the outcome. Three courses of action therefore follow, one for each level.

At the macro level, what is required is a long-term and politically durable framework. For firms, the expected duration of a development strategy matters more than its specific content. A framework in which the key parameters—R&D tax relief, IP Box, the treatment of energy costs, and the rules governing support instruments—are established for a decade and insulated from the electoral cycle would reduce the option value of waiting more effectively than additional calls for proposals. Where full political agreement is unattainable, credible commitment mechanisms provide a second-best solution, including multi-year budget lines and statutory rather than program-based instruments. Within such a framework, the policy mix should shift from discretionary grants toward automatic and demand-side instruments, including R&D tax relief and support for related intangible investment, guarantees, equity co-investment, and innovation procurement in defense, energy, and health care.

At the meso level, the priority should be to strengthen the innovation ecosystem, with particular emphasis on technology diffusion, firm scaling and upgrading within value chains. The diffusion of existing technologies should constitute a distinct objective of innovation policy, as a substantial share of potential productivity gains depends on their wider adoption by firms, particularly medium-sized enterprises. Strengthening the ecosystem also requires continuity of financing from market entry through the growth stage. The concentration of financing in the early stages limits firms' capacity to scale and develop durable market positions. Addressing this constraint requires greater access to long-term capital and co-investment mechanisms capable of mobilizing private investment.

> Equally important are linkages between academia and business, as well as between leading firms and their suppliers, as these linkages facilitate access to technological knowledge and market information. A stronger innovation ecosystem should therefore support the diffusion of existing technologies, the scaling of firms, and their upgrading within value chains.

At the micro level, investment is required in the capabilities that determine whether these conditions translate into firm-level outcomes. Technology adoption generates returns only when accompanied by complementary intangible investment in process redesign, data infrastructure, managerial capabilities, and decision rights. Instruments that finance equipment without these complementary investments may therefore generate formal compliance rather than productivity growth. Managerial, digital, and entrepreneurial competencies translate macro-level conditions and meso-level linkages into firm-level decisions, making education a strategic public investment rather than merely current expenditure. Finally, portfolio-level evaluation with an explicit tolerance for failure is necessary for uncertain projects to be considered fundable.

One condition cuts across all three levels: measurement. What is measured shapes policy priorities, and evaluating innovation policy primarily through R&D intensity may reinforce the very input used as its performance measure [Stiglitz, Fitoussi, Durand, 2019]. Assessment should also consider the direction and purpose of innovation, rather than treating these dimensions as arguments against innovation [Gorynia, Śliwińska, 2024]. Relevant indicators should therefore capture not only R&D inputs, but also the share of firms undertaking innovation under market uncertainty, the scaling of new firms, and the diffusion of existing technologies. Such measures would provide a better indication of whether innovation policy addresses the underlying constraint rather than simply increasing innovation-related inputs.

> Poland's catch-up was achieved through the adoption and adaptation of foreign technology, capital, and institutions to domestic conditions. This model has not failed; rather, the conditions underpinning its effectiveness have run their course. The next stage of development cannot rely primarily on the import of capabilities, as it requires domestic capacity to create and commercialize new knowledge at the level of firms, value chains, and institutions.

Progress at this stage depends less on the size of public innovation expenditure than on whether the institutional environment provides sufficient predictability for firms to undertake risky, long-term investments and appropriate the resulting returns. The measures outlined above are largely inexpensive but require policy consistency over a horizon extending beyond a single electoral cycle. In this context, the debate initiated at the 11th Congress of Polish Economists, held in Poznań on December 4–5, 2025, and reflected in the Poznań Declaration, provides a basis for further reflection on the direction of Poland's development and for identifying solutions to the structural constraints on innovation.

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