**Title: Policy support to commercialisation and Europe's 'commercialisation gap'**

**Author: Andrea Szalavetz**

**Affiliation:** Institute of World Economics, MTA KRTK

**Address:** 45, Budaörsi út, H-1112 Budapest, Hungary

**E-mail:** szalavetz.andrea@krtk.mta.hu

**Biographical note:** Andrea Szalavetz is senior research fellow at the Institute of World Economics, MTA KRTK, of the Hungarian Academy of Sciences. Her research interests include the economics of innovation, science & technology policies, FDI and technology transfer, and global value chain issues. Her recent papers include Regional Innovation Policy in Hungary – The Regionalism Façade, or the Limitations of Achieving Good Governance through Europeanization. Journal of Comparative Economic Studies, Vol. 10, March, 2015, pp. 159-182.; Post-crisis approaches to state intervention: new developmentalism or industrial policy as usual? Competition and Change, Vol. 19, No. 1, 2015, pp. 70-83.; R&D-based integration and upgrading in Hungary. Acta Oeconomica, Vol. 64., Special Issue: Post-Socialist Transition in a 25-Year Perspective, pp. 153-180. (with Magdolna Sass), 2014.

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## Abstract

*Despite substantial public funding dedicated to enhance the commercialisation and the market uptake of research results (CMU), Europe's perceived 'commercialisation gap' vis-à-vis its main competitors has remained substantial. This paper surveys the commonalities of successful commercialisation policy instruments, based on case studies of five European and four non-European CMU policy measures. Five common features are identified: 1) specific policy design; 2) combination of financial support and complementary services; 3) the spanning of several stages of the innovation cycle; 4) virtuous Matthew effect; 5) policy learning. These commonalities ensured that the policy instruments effectively addressed critical weaknesses in countries' innovation systems.*

## 1. Introduction and overview

Scholarly interest in the commercialisation[1] and market uptake of research results (CMU), a previously relatively underinvestigated component of countries' overall innovation performance recently increased considerably (*Grimaldi et al.,* 2011), partly in the context of the wide-held belief in the much-debated 'European Paradox' (*European Commission*, 1995). According to the hypothesis advanced by this popular term, Europe plays a leading role in science but underperforms in terms of converting its top-level scientific output into commercial success and generating innovation-driven growth.

As a consequence of heated debates on the European paradox (reviewed in *Dosi et al.*, 2006; 2009) the issue of CMU also got to the forefront of policy agenda. Over the past 15 years a proliferation of policy measures can be observed. New policy instruments support technology transfer and the commercialisation of the results of scientific research. Other measures stimulate industry-academia collaborations and firms' external knowledge exploitation. Others again, foster new technology-based entrepreneurship. Moreover, spectacular institutional development took place: a range of intermediary institutions were established to assist stakeholders in their commercialisation efforts.

Furthermore, legislative and regulatory changes have been adopted to improve universities' commercialisation performance. Emulating – with considerable delay – the U.S. 1980 Bayh-Dole Act that granted the ownership right of intellectual property (IPR) originating from publicly funded university-based research to universities,[2] European (and other OECD countries') governments changed their IPR-regulation on academic patenting (*Geuna and Rossi*, 2011; *Mowery and Sampat*, 2005). Other reform measures tried to integrate capital market-based

[1] *Commercialisation* refers to formal revenue generation from licensing or sale of intellectual property, and/or to the commercial exploitation of university inventions through academic entrepreneurship: start-ups and spin-offs. The involvement of private funding in university (or public research institution's) research projects that had previously been funded exclusively publicly, is also considered commercialisation.

[2] The Act has effectively changed university culture in the U.S. (referred to by *Etzkowitz et al.*, 2000 as the 'second academic revolution') and gave rise to the emergence of universities' third mission: entrepreneurship – in addition to education and research.

features in European bank-based systems. These latter measures addressed the oft-mentioned explanatory factor of Europe's observed innovation- and commercialisation gaps: its bank-based system, considered inadequate for seizing the opportunities of today's key enabling technologies (*Hirsch-Kreinsen,* 2011; *Martinsson*, 2010). Over the past two decades significant convergence took place in Europe with respect to the adoption of some Anglo-Saxon specifics in corporate financing (*Mullineux et al.*, 2011).

Despite legislative and regulatory reform and substantial public funding dedicated to enhance CMU in Europe, Europe's perceived 'commercialisation gap' vis-á-vis its main competitors has remained substantial (*IUC*, 2011), albeit hard to measure (see later).

Consequently, it is of utmost importance for Europe to improve the effectiveness of the design and use of commercialisation policy instruments. Since academic papers contain rather general recommendations, such as bottom-up policy design, systemic and problem-oriented configuration of policy measures, cost-effectiveness, competitive allocation of support, the necessity to monitor and evaluate the measures and refine policy (*Bemelmans-Videc et al.,* 2011; see also *Borrás and Edquist*, 2013), policy effectiveness can rather be improved by a systematic monitoring of peers' best practices. Despite the limitations of policy emulation in different (e.g. economic, social, institutional and cultural) contexts, a comparative analysis of countries' commercialisation policy instruments may contribute to policy learning.

The objective of this paper is to survey and analyse a sample of CMU policy measures considered successful, and identify their commonalities. A case study based investigation method is applied, covering five European and four non-European CMU policy measures.

The rest of the paper is structured in four sections. Section 3 presents the research method and the deriving limitations. The analysis of the commonalities of the surveyed cases is presented in section 4. Section 5 concludes and summarises the general lessons of the cases.

Before embarking on the analysis, the next section reviews the difficulties of quantifying the extent of Europe's commercialisation gap.

## 2. Measuring commercialisation performance

Despite a long record of dedicated policy measures countries' commercialisation performance, i.e. the aggregate impact of the CMU policy mix is still hard to measure. Few readily available data sources exist (*Gulbrandsen and Rasmussen*, 2012) and the currently applied indicators (e.g. *IUC* 2011; *OECD*, 2011) are of limited use, since they

- focus on *invention-type* outputs, such as PCT patent applications and public-private co-publications,[3] or
- are concerned with broad, competitiveness-type factors (e.g. knowledge-intensive services exports; share of innovative SMEs, share of fast growing innovative firms), or
- quantify the 'explanatory factors of underperformance': availability of venture capital; availability of public support.

[3] Co-publication data proxy stakeholders' commitment to engage in innovation collaboration, but their use to quantify Europe's CMU gap is not straightforward.

Some indicators quantify the intensity of science-industry links, such as ‘percentage of firms collaborating with universities’; ‘share of business funded R&D in higher education’. These indicators do not reveal much about CMU performance, at least not directly: they are rather concerned with collaboration that may, or may not result in inventions, that, in turn, may or may not be commercialised.

Other indicators seem more useful from CMU point of view such as ‘license and patent revenues from abroad as percent of GDP’; ‘share of young innovative companies within the total corporate population’; ‘number of spin-offs and new technology-oriented start-ups’,[4] nevertheless they are far from sufficient for a precise measurement of comparative CMU-performance.

Hence, at risk of some exaggeration it can be determined that the consensus view of Europe’s CMU-gap (European Commission, 2007) is a *perception* rather than a precisely quantified fact. This perception is based on selected innovation- and CMU-indicators, on anecdotal evidence and, more importantly, on the results of competitiveness benchmarking exercises.

## 3. Research methodology and limitations

The case study investigation that constitutes the empirical basis of this paper was started in the framework of a research project carried out for the European Commission: analysis of CMU policy instruments. The case studies investigated the objectives, policy rationales, sectoral orientation, funding modalities and impact of the selected measures as well as the evolution of these factors. The author of this paper prepared the case studies over the period between March and May 2013. This initial stock of evidence was complemented with desk research on five additional policy measures (table 1).

For the selection of the sample the following procedure has been applied. Drawing on Erawatch’s inventory[5] of innovation support measures, the ones that are relevant from the point of view of CMU were first identified. CMU policy measures are designed to meet one or several of the following policy objectives: they support 1) knowledge transfer and the commercialisation of public research results; 2) public-private research collaboration; 3) sectoral innovation in manufacturing and the commercial applications of the results of applied research; 4) technology transfer and innovation collaboration between firms; 5) establishment of innovative start-ups; 6) innovative stakeholders’ access to funding and particularly to risk capital; 7) scale-up of initial commercialisation results and move from the prototype phase towards market uptake (demonstration projects, pilot plants and living labs); 8) diffusion of innovative technologies.[6]

This method resulted in a sample of altogether 313 measures (in 31 countries: EU27, USA, Japan, Korea, and China). The measures selected for case study investigation were selected on the basis that they encompass a diversified mixture of the above-identified categories and be located in a variety of European and non-

[4] These latter data are available only in a couple of countries.

[5] ERAWATCH is the European Commission's information platform on European, national and regional research and innovation systems and policies (http://erawatch.jrc.ec.europa.eu). It provides information among others on research and innovation policy support measures implemented by national governments in 61 countries.

[6] This methodology and the above categories were elaborated by IDEA Consult, the coordinator of the research project carried out for the European Commission (coordinator: Vincent Duchene). The categories applied originally included two more items: support to IPR-issues, and support to the innovative use of standards.

European countries. This paper draws exclusively on the case studies prepared by the author.

An important selection criterion was the given measures' success. Success was assessed analysing the evaluation reports of the individual policy measures as well as a range of other documents. The policy schemes were considered successful, if they

- contributed to enhancing the technological readiness of a given R&D effort, i.e. to moving a given R&D undertaking ahead, along the innovation cycle; or
- contributed to the implementation of specific commercialisation acts (see footnote 1); or
- enhanced the market uptake or the diffusion of new technology and
- managed to mobilise their target groups.[7]

In order to gain sufficient information for a well-substantiated analysis of the individual policy measures, only measures with respect to which abundant information was available (such as impact analysis, evaluation reports, success stories, academic papers) have been selected in the sample. This can be considered a limitation, because non-negligible selection bias applies.

Other selection criteria were a minimum threshold budget of € 5 million annually, and the lack of predetermined end dates of the policy schemes. In addition to established schemes going on for more than half a decade, some recently introduced policy measures have also been included in the sample.

**Table 1 around here**

Table 1 makes it clear that the policy objectives related to the individual schemes are quite heterogeneous. Most of the programmes try to incorporate several, albeit related policy objectives at the same time. Moreover, the measures target multiple industries and technologies, and annual budgets are also divergent: while all of them exceed the minimum threshold established as selection criterion (€ 5 million), the budget of some measures (e.g. KOTEC; A-STEP, SBIR) is by orders of magnitude higher than that of other measures. Additionally, the socio-economic and institutional contexts which shape the framework conditions of stakeholders' activities are also dissimilar.

This heterogeneity raises doubts about the generalisation of the results of this comparative survey. These limitations notwithstanding, the common features of the surveyed cases presented in the next section are thought-provoking and elicit substantial policy learning.

## 4. Common features of the selected cases

### 4.1 Specific or broad-based policy design?

The first conspicuous commonality of several of the surveyed instruments was that policy-makers stipulated well-defined, specific objectives, to be achieved with the help of the given measure. The well-formulated, detailed policy objectives suggested that policy-makers have a clear concept of 1) what they want to achieve; 2) the ways to achieve the objectives and 3) the potential users of the results.

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[7] Note that the number of support recipients is influenced by industry-, technology- and policy objective-specific features.

Information for policy design was in most of the surveyed cases compiled in a bottom-up manner, involving both the representatives of the potential target groups and policy designers at various levels of public policy.

The history of the Japanese 'Industrial Technology Development Programme' launched by the New Energy and Industrial Technology Development Organization (NEDO) exemplifies the bottom-up approach specific policy instruments are conceived with.

Following extensive information collection activities: foresight studies; interviews with industry experts on technological trends and industry's needs; consultation with the academia about research endeavours that may fulfil industry needs; and about the feasibility and the perspectives of some proposed research projects, NEDO's experts together with ministry (Ministry of Economy Trade and Industry) officials and cabinet office representatives identified critical medium-, and longer-term research and development issues. They set R&D targets and developed programmes that contribute to the achievement of these targets. Planning also considered the issue of commercialisation: intellectual property (IP) strategies were designed in the planning period. The 'Industrial Technology Development Programme' was the result of this long planning and programming exercise. The calls of this programme contained highly specific objectives, for example technology development of next-generation high-efficiency and high-quality lighting; development of extremely low-power circuits and systems; shifting from petrol to biomass in the chemical industry to reduce petrol consumption; rare metal substitute materials development.

Similarly, before launching the Catapult Centres programme, the UK Technology Strategy Board (TSB) invited stakeholders' views – not only on relevant technology areas, but also on management and governance arrangements they considered as optimal. Stakeholders were defined in the broadest possible sense, involving business and research communities, the public administration, and representatives of various innovation supporting organisations. Drawing on stakeholders' inputs gained in a series of consultations and workshops, TSB prepared the mid-term strategy of the new centres: how they ought to complement existing innovation infrastructure, how their outreach is ensured, how they fill the space between 'concept' and 'commercialisation'. TSB identified the key priority technological areas in which the new centres should be established. In turn, each centre prepared its own strategy and communicated the ways they work with business.[8]

As a result of these bottom-up policy design exercises, several of the surveyed programmes featured highly specific objectives. In addition to the above-detailed cases, the Austrian 'Technologies for Sustainable Development' programme also features very specific objectives such as low-energy and environmentally sustainable buildings. Calls for proposals of the U.S. SBIR programme are also structured around specific problems that need to be solved. The Finnish Electric Vehicle Systems Programme's objective was the diffusion of electric vehicles through demonstration projects and testing platforms. The sub-projects, such as the 'development of electric snowmobile'; 'electric vehicle charging infrastructure for urban environment'; 'eBus: Testbed for Development'; 'eStorage – battery systems', were communicated in a systematic manner: they identified the *need* that requires R&D (what policy intends to

[8] Catapult Centres undertake among others, contract research for business enterprises and participate in collaborative applied research projects through ensuring access to capital equipment and high-cost research and development infrastructure.

achieve); the *solution* (the funded research projects and the supported demonstration programmes), and the expected benefits together with the potential users of the results.

Nevertheless broadly formulated programmes cannot be automatically labelled as ones without any strategic vision. As stated in a Swedish Innovation Agency publication (*Elg and Håkansson*, 2012), open calls breed creativity and lead to the emergence of ideas with the help of which new priorities can be formulated. It is important that policy-makers and supporting organisations do not get stuck in existing paradigms, or do not serve only the *existing* needs of industry; and do not fund only the continuation and enhancement of *existing* research directions. Programmes need to be formulated in a way to serve as *agents of change,* and foster renewal through addressing new areas of knowledge. Hence, part of the STI budget needs to be earmarked for broadly formulated 'support of new research directions'.

In this vein, the Irish portfolio of commercialisation policy measures exemplifies the other extreme compared to the Finnish or Japanese ones: it contains practically only broadly formulated, general policy measures, such as the 'Commercialisation Fund', the 'Applied Research Enhancement Programme'; the 'Technology Gateway Programme', the 'Industry-Led Research Networks Programme'; and the 'Innovation Partnership Programme'. The satisfactory results of these programmes[9] demonstrate that success can be achieved even without meticulously and precisely specified policy objectives. Nevertheless, the fact that Irish STI policy advisors recently made recommendations about the necessity of prioritisation of public investment in STI and identified priority research areas (*RPSG*, 2011), predicts that the Irish policy design will also gradually embrace increasingly specific policy measures.

### 4.2 Complementary services

A common feature of the surveyed policy measures was that the financial support provided in the framework of most of the surveyed programmes was allocated together with complementary services. In this way, the surveyed CMU policy instruments have not only fostered narrowly defined CMU-specific activities, but have also contributed to the accumulation of complementary assets, indispensable for capturing value.[10] Complementary services have, in a way, accompanied the recipients of the given programmes' core support to further stages in the business development cycle.

The Korean loan guarantee programme, for example, is accompanied by technology appraisal, venture certification, consultancy services and mediation of technology agreements and technology transfers. Among these complementary services, technology appraisal and certification proved highly valuable for an increasing number of stakeholders in the Korean innovation system. The Korean Finance and Technology Corporation's (KOTEC) technology appraisal is carried out with the help of a non-financial appraisal model that combines technology valuation and business feasibility / business potential valuation. KOTEC's methodology of assessing the value of individual indicators, and calculating the summary technology

[9] See e.g. annual reports of Enterprise Ireland; Forfás, Science Foundation Ireland.

[10] Recall *Teece's* (1986) classical argument, that the ownership of complementary assets will determine who captures value from innovations.

rating grade (the weighting of these indicators) is protected by patent. The indicators considered include

- the technological ability of the applicant, i.e. his/its technology management ability and R&D ability;
- the value of the technology, (technological superiority, or 'degree of technological extension');
- marketability and the potential size of the market;
- business prospects;
- profit prospects;
- the related risks.

The novelty and the value added of KOTEC's appraisal system lie in the fact that the usual problem impeding commercialisation: that individual stakeholders have a good understanding of *either* the technology *or* of the business potential – is present also in support organisations and in financial institutions. A reliable certificate of the potential value of the technology and of its business feasibility / business potential is therefore extremely valuable: it reduces the common information asymmetries that are otherwise the main barriers of new technology-oriented business development. It is by no surprise that KOTEC's appraisal has been extensively used by public R&D support organisations for selecting the recipients of various innovation-, SME-, and commercialisation support schemes. Appraisal is provided also as a service that precedes companies' listing on KOSDAQ market.

Beneficiaries of CMU programmes in other countries could also benefit from various complementary services, such as business consultancy, coaching and capability building for efficient innovation management, or consultancy on IPR issues, support to the identification of suitable business partners. The experts of the public innovation intermediaries, e.g. Enterprise Ireland; Tekes, Finland; Design Council, UK; Austrian Research Promotion Agency, Japan Science and Technology Agency, evaluated the commercial potential of the scientific results and helped grantees to elaborate IPR and commercialisation strategies. Experts and grantees jointly decided about the adequate commercialisation channel (licensing, or start-up formation, contract research). Once this latter decision had been taken, innovation agencies offered channel-specific services: if start-up formation was the decided commercialisation mode, academic entrepreneurs were offered consultancy services with respect to the design of the business plan. The agencies assisted beneficiaries also by building and mediating linkages to third party funding providers.

If contract research or collaboration with industry was the chosen commercialisation channel, the experts of the public intermediary organizations provided linkage building services to detect potential industrial partners: they organised business meetings and university technology exhibitions.

In summary, complementary services aimed at *embedding* innovative stakeholders into the national/regional innovation system, or enhancing awardees' system embeddedness.

### 4.3 Spanning several stages of the innovation cycle

A noticeable commonality of the surveyed cases was that they span several stages in the innovation cycle. Although the surveyed policy measures were all targeting CMU, the case study investigations revealed that recipients' R&D activity, more specifically, translational research was also supported. Support was provided both to the initial stage of the commercialisation process: proof-of-concept; implementation of prototypes, or test devices; pre-clinical drug trials; and to later stages: commercial application (actual commercial product, actual device, clinical trial).

The recognition that *commercialisation* necessitates further research and development efforts underlines the well-known thesis of innovation economics that R&D is not a separate stage that precedes commercialisation: the two stages are deeply intertwined in the innovation process through multiple feedback loops (*Kline and Rosenberg*, 1986).

In this vein, it can be established that the valley of death between research and commercial application is not *one single* valley, *rather a series of valleys*. Outputs in one stage of the innovation cycle (e.g. IP, prototype, new product, new venture, spin-off company) immediately trigger demand for new types of support that facilitate activities in the subsequent stage of the cycle.

By designing policy measures that span several stages of the innovation cycle or by systematically combining multiple policy measures that address subsequent stages of the cycle, the bureaucratic procedure of support allocation can be shortened. Consequently, the time-to-market requirement of new product development – a critical factor for commercialisation success – is not jeopardised by long bidding procedures.

The primary example of stage-spanning measures is the U.S. SBIR programme, where participation is organised in 'phases' and only Phase I awardees are entitled to apply for Phase II funding. Accordingly, only if the technical merit, feasibility and commercial potential of the proposed R&D effort is validated (this is what funding can be applied for) can applicants submit proposals for Phase II funding. In this (later) stage of the commercialisation process, funding targets demonstration activities such as testing, prototype, scale-up studies, design, performance verification of test products ( Audretsch and Aldridge, 2014).

Emulating the successful U.S. practice of early-stage financing through government procurement several countries have introduced similar schemes, including Korea (KOSBIR), the UK (Small Business Research Initiative), and even Europe's Horizon 2020 includes a new SME instrument, building on the SBIR model (Audretsch and Aldridge, 2014).

The Japanese A-Step programme is another example of stage-spanning programmes. At the IPR stage of the university invention, for example, support is provided to the preparation of a feasibility study: the experts of the programme's funding and administering body (Japan Science and Technology Agency) evaluate the practical applicability of the given basic research output. They validate whether the research undertaking in question has a technology transfer potential and whether the research output meets potential collaborating companies' needs. Another audit investigates, whether a university spin-off company would be a good channel of commercialisation. At a later stage, the programme supports applied R&D carried out in science–industry collaboration. Once applied R&D bears fruit (prototype stage), R&D activities that aim to test the new product may obtain support. Finally, if the chosen commercialisation channel is university-based start-up venture formation, support can be obtained to cover the costs of the first commercial activities.

In the UK, two policy measures are formally combined to span multiple stages in the innovation cycle. The Catapult Centres Programme focuses on the translation of research into products and services (technology transfer stage) through science-industry collaboration in technology and innovation centres. The Design Leadership Programme offers businesses and university scientists a package of support and coaching with the help of which companies can boost the sales of their new, innovative products and enter new markets. The latter policy measure focuses on one of the last stages in the innovation cycle, in which technological innovation and design for innovation are combined to maximise IP value and improve the marketability of new products.

Recognising that design is a cross-cutting theme within general innovation and CMU strategies, the concept has been formally integrated within the role and mission of the Catapults. In the framework of the Design Leadership Programme, the experts (associates) of the UK Design Council collaborate with individual Catapult Centres to address particular challenges (e.g. with respect to product branding, product and packaging design) in the commercialisation process of the products and technologies developed within the centres.

### 4.4 Virtuous Matthew effect

A recurring element in the impact evaluations of the surveyed policy measures was that support recipients became later eligible for other types of support. Support recipients actively participated in further rounds of the given scheme and/or in related regional, national or supra-national programmes.

The phenomenon of repeated funding of the same recipient is related to the debates on the so-called Matthew effect (*Merton*, 1968) of public subsidy allocation, namely that initial advantage (in our case: public subsidy allocation to support specific firms' R&D activities) begets further advantage: there is an observed persistence in the allocation of support to past recipients (*Antonelli and Crespi*, 2013).

The latter authors emphasise that this persistence is not always the result of information asymmetries that make funding agencies' grant provision become based on the reputation of applicants rather than on the merit of the given proposal. The authors make a case for a 'virtuous Matthew effect', in which repeated subsidy allocation is a condition of success. The virtuous Matthew effect denotes the knowledge and competence accumulation of past recipients, who in fact necessitate repeated support so that their initial developments attain an elevated stage of technology readiness or surpass the prototype phase and be scaled up.

The recognition of the virtuous Matthew effect has been incorporated into the design of some of the surveyed policy measures, by making the support gained in previous rounds/phases of the scheme a criterion of support allocation.

For example, the Austrian 'Technologies for Sustainable Development' programme's calls emphasised the cumulative nature of the programme. If a submitted proposal intends to build on the results of past projects carried out in the framework of previous rounds, and elaborate on them – this is considered an asset.
The Japanese A-STEP programme – that supports industry-academia collaboration – is characterised by stage-based contingent funding: support recipients of the 'feasibility study stage' may later qualify for additional, larger-scale support in the so-called 'full R&D stage'. A-STEP's programme design emulates thereby the highly successful U.S. SBIR programme, where Phase 1 awardees (who got support for proof of concept) could qualify for Phase 2 (full R&D) support. Later, in Phase 3 (commercialisation) the same recipients may get support from other agencies (Audretsch, 2003).

### 4.5 Policy learning

The surveyed policy instruments – even the relatively new, emerging ones – have all been evolving for longer or shorter periods.

Policy learning and the occasional rearrangement of the programmes were notable commonalities of the surveyed successful cases. They were characterised by the dialectics of continuity and change.

The evolution of the instruments was the result of repeated monitoring; policy and project evaluation exercises, and expert advice that considered 1) what worked and what did not; 2) changes in target groups' environment; 3) changes in policy priorities and 4) emerging new priorities. Following the feedbacks, decision-makers kept refining their selection and evaluation methods, got better acquainted with target group characteristics, as well as with the in-built bottlenecks of the given policy instruments. In an effort to unblock or mitigate the newly identified bottlenecks they kept diversifying their portfolio of complementary services, or adapted the measures themselves to overcome the barriers that had been discovered during the policy implementation process. Over time this resulted in significantly improved policy delivery.

Two analogies come to observers' mind. Firstly, that similarly to path breaking innovations, effective policy instruments are not 'born fully armed' either (like Pallas Athena): it takes time they develop (through feedbacks, learning and policy refinement) to become a success story. Secondly, *Hausmann and Rodrik*'s (2003) remarks, applied originally to economic development, can be paraphrased with respect to successful policy measures: STI and CMU policy development is *a process of self-discovery*.

**5. Conclusions and lessons**

This paper argued that in the context of idea-based growth (Jones, 2005), countries are exploring new ways to support the translation of new ideas into technological and economically viable innovations. The impact of newly introduced policy measures may however be inferior to expectations, which necessitates a continuous monitoring of peers' best practices.

Analysing and comparing selected support programmes within and outside Europe that aim to foster the commercialisation and the market uptake of research results this paper tried to deepen our understanding on factors that account for the success of CMU policy instruments.

A general lesson of the surveyed cases is that successful policy schemes are not restricted to simple subsidy provision. Policy instruments can better fulfil the related policy objectives if they combine core financial support and complementary services.

The selected policy measures proved successful according to the predetermined success criteria (contribution to recipients' progress along the innovation cycle; implementation of specific commercialisation acts; enhanced diffusion of new technology; mobilisation of target groups) because above and beyond improving innovative stakeholders' access to innovation financing, they addressed several critical weaknesses of the innovation systems – in combination with other components of the given countries' policy mixes. Specific policy design, as well as official validation (as in the case of KOTEC and A-STEP) reduced information asymmetries in the market for technology and improved the framework conditions of both innovation collaboration and stakeholders' investment in commercialisation.

The combination of financial support with the provision of soft resources contributed to enhancing innovative stakeholders' system embeddedness and network capital. Moreover, this common feature of the surveyed successful policy measures effectively ameliorated recipients' managerial competencies that often proved insufficient for leveraging the newly developed technologies.

The attribute of the surveyed measures that they span several stages of the innovation cycle mitigated some systemic deficiencies that inhibited private investment in research; public-private collaboration; the scaling-up of initial commercialisation results and the diffusion of new technology.

An important lesson of the fifth common feature is that policy development necessitates evolutionary thinking. Policy instruments become successful in an interactive learning process involving all stakeholders. Evolutionary policy design should allow for policy experimentation and subsequent changes in the programme configuration: in terms of the actors addressed; the activities supported; the type of support allocated; and the merit review criteria applied during the selection and the evaluation processes.

Finally, the survey of the individual measures and the evolution thereof recalls a classical reference work discussing the factors behind the East Asian Miracle (World Bank, 1993). According to the referred study, one explanatory factor of the East Asian success was the competence of these countries' high-quality bureaucracies that conceived, administered and managed the states' intervention programmes. This thesis perfectly applies to the surveyed cases.

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**Table 1: Short description of the surveyed measures**

| Name | Agency/Country | Purpose* & (Implementation date) | Success factor |
|---|---|---|---|
| Technologies for Sustainable Development | Austrian Research Promotion Agency, Austria | 3,7,8 (2000 – ) | SPD; F+S; I_Cycle; vM; PL |
| A-STEP: Adaptable and Seamless Technology Transfer Program through Target-Driven R&D | Japan Science and Technology Agency, Japan | 1,2,4,5 (2009 – ) | SPD; F+S; I_Cycle; vM; PL |
| Industrial Technology Development Programme | New Energy and Industrial Development Technology Organization, Japan | 2,3,4 (2008 – ) | SPD; F+S; I_Cycle; vM; PL |
| KOTEC Loan Guarantee Scheme | KOTEC: Korea Finance and Technology Corporation, Korea | 6 (1990 – ) | SPD, F+S[a]; I_Cycle[b]; vM; PL |
| Electric Vehicle Systems Programme | Tekes, Finland | 2,3,7,8 (2011 – ) | SPD, F+S; I_Cycle; vM, PL |
| Commercialisation Fund | Enterprise Ireland, Ireland | 1,2,5,7 (2003 – ) | F+S; I_Cycle; vM; PL |
| Catapult Centres | Technology Strategy Board, UK | 1,2,5,7 (2010 – ) | SPD; F+S[a]; I_Cycle; vM; PL |
| Design Leadership Programme | Design Council, UK | 3,8 (2007 – ) | SPD; F+S[a]; PL |
| Small Business Innovation Research Program (SBIR) | Small Business Administration (inter-departmental), U.S. | 2,3,5,7 (1982 – ) | SPD; F+S; I_Cycle; vM; PL |

* see the list of categories in the second paragraph of section 3.
SPD = specific policy design; F+S = provision of both financial support and complementary soft resources and services; I_Cycle = the scheme spans several stages of the innovation cycle; vM = the scheme allows for virtuous Matthew effect; PL = policy learning: the current scheme is the result of gradual policy development: it has undergone a series of incremental improvements.
[a] = requires recipients' co-funding
[b] = in partnership with other organisations