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New CEPR Press eBook: Moving to the Innovation Frontier

Christian Keuschnigg 22 March 2016

Innovation drives macroeconomic growth, determines the competitive position of firms, and leads to factor reallocation. This column introduces a new CEPR Press eBook which argues that firms must implement more risky innovations as the economy approaches the technological frontier. The five contributions, from leading economists in the field, suggest that priority should be given to research, selection of firms, and reducing frictions.

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Innovation determines the competitive position of firms, drives macroeconomic growth, and leads to factor reallocation and structural change. This column introduces a new CEPR Press eBook, *Moving to the Innovation Frontier* [3], that shows that firms must shift from continuous improvements to more radical and risky innovations as the economy approaches the technological frontier (Keuschnigg 2016). The policy design should give higher priority to basic research, selection of firms, and reducing frictions to factor reallocation.

Systemic approach

Moving to the technological frontier requires a systemic policy approach which spans the entire innovation value chain, starting with idea generation and ending with investment and employment after successful market introduction. Innovation builds on education and training and is followed by factor reallocation and structural change. The policies needed to improve the parts of this value chain are complementary. The returns to private innovation are higher if it can draw on a highly-skilled, inventive, and flexible workforce, and if capital and labour easily flow from declining to expanding

industries. A more innovative economy needs a more skilled workforce and is likely to reduce demand for low-skilled labour.

To prevent rising inequality and to render innovation-based growth more inclusive, the system must succeed in attracting a larger part of talented individuals to proceed with higher qualifications and advanced education, and limit the share of low-skilled labour. Secondary technical education is relatively more important when a country is catching up by adopting new technologies and refining them in small steps. As new technologies get implemented, the skill requirements of jobs may change rapidly during a person's employment history. Life-long training is thus essential to facilitate the implementation of new technologies.

Basic research

Near the knowledge frontier, the capacity to innovate must shift from imitation and differentiation towards more radical and more risky innovations that aim at entirely new products and services. In this process, tertiary education, basic research, and technological infrastructure become more critical factors in activating private innovation and boosting the returns to R&D. When an economy has completed the catch-up phase and has come close to the knowledge frontier, it needs to generate genuinely new knowledge and shift out the frontier itself, rather than imitating and improving existing technologies in small steps.

Highly competitive universities complemented by other institutions of basic research become key. They produce new results of basic research and supply students endowed with knowledge at the research frontier. University patenting and incentives of university researchers to develop applications support the commercialisation of new research. Highly productive and R&D intensive multinationals often locate near competitive universities to better benefit from these sources of knowledge. Universities are also a source of high tech start-up entrepreneurs. By their activities in research and education, universities provide critical inputs to industrial innovation and raise the returns to private sector R&D.

Private R&D drives firm growth and internationalisation

Success in private R&D improves existing products and often creates entirely new markets. Clearly, developing new products and processes is more ambitious and inherently more risky than refining existing ones. The more radical the innovations and the larger the steps of quality improvements, the larger the subsequent growth opportunities of firms. Successful innovation is thus a key determinant of a firm's competitive advantage in product markets and is a necessary condition for employment and investment to be profitable. Patent protection allows firms to cash in on successful innovations for a while, but tense competition from potential and actual new competitors forces them to continuously invest in new R&D to keep ahead of rivals and protect their growth potential.

Firms mostly start small and local and, if innovation is successful, become large and international. Especially in small countries, local markets are much too small to exploit the growth potential of successful innovators. In a firm's lifecycle, innovation-driven growth ultimately creates the need to enter world markets where competition is

worldwide and therefore most intense. In the cross-section, exporting firms and multinational companies are thus substantially more productive and larger than other firms mostly active in domestic markets only. Helpman et al. (2004) calculated that productivity in exporting firms is 139% and in multinational firms it is 154% relative to local firms. Competition policy and international market integration facilitate entry of new firms, allow larger firms to expand to new markets, and are thus important drivers of growth.

Structural change and factor reallocation

Innovation-based growth is a process of creative destruction. Innovation is associated with market entry and exit and therefore selection among younger firms. The creation of new product lines and closing down of old ones rejuvenates the product cycle in large firms. In all cases, innovation leads to a reallocation of labour and capital. Investment and employment must flow into more profitable activities with higher value-added growth, away from activities with low returns and declining market prospects. Entry and exit, as well as the expansion and contraction of active firms, results in hiring and firing, in raising of new capital, or in issuing dividends and paying back funds by mature firms. Apart from trading on external markets, large firms also operate internal capital and labour markets to reallocate their resources to new uses (Giroud and Mueller 2015). The better a country's ability to reallocate labour and capital from declining to expanding industries and from low-return to high-return activities, the larger are the productivity gains at the aggregate level. Empirical research indeed suggests that about half of a country's productivity growth is due to a targeted allocation and ongoing reallocation of investment and employment to more valuable uses, helping innovative firms to grow and forcing less productive firms to shrink (Lentz and Mortensen 2008). In facilitating reallocation, capital and labour markets influence trade patterns and allow a country to better exploit its advantages to specialise in innovative industries (Egger and Keuschnigg 2015).

When a country moves closer to the knowledge frontier, innovation must become more risky and radical and factor reallocation must occur at a larger scale. One must conclude that the full potential of innovation can be exploited only if factor reallocation is supported by flexible capital and labour markets. For workers to more readily accept the employment risk in innovative industries, welfare policy should become more of the 'flexicurity' type and combine generous unemployment insurance with low job protection and active labour market policies for retraining and supporting job search. Regarding capital markets, credit financing is exposed to a firm's bankruptcy risk but is neither endowed with control rights to intervene in case of problems nor does it participate in a firm's upside potential. Credit financing is suitable for more established firms and relatively safe investments and is not particularly innovation friendly. When an economy shifts towards more risky but potentially more profitable innovations, financing should shift from credit to relatively more equity financing, giving a larger role to stock markets, venture capital, private equity, and securities markets (Demirgüc-Kunt et al. 2013).

New eBook

The new CEPR Press eBook [3] (Keuschnigg 2016) collects five essays based on the invited lectures of the workshop "Moving to the Innovation Frontier" in Vienna, 19-20 January 2015, which was organised jointly by CEPR, the University of St. Gallen, and

the Institute of Advanced Studies. Philippe Aghion investigates the process of creative destruction from a firm perspective, contrasts the nature of productivity growth in advanced countries and emerging economies, and discusses the design and governance of industrial policy for innovation based growth (Aghion 2016). Ufuk Akcigit argues that the design of optimal innovation policy should focus relatively more on the selection of firms which may be more or less R&D intensive and feature higher and lower growth potential (Akcigit 2016). It should also focus more on the complementary roles of basic and applied research. Basic research is an essential responsibility of government. It also occurs in the private sector and sometimes creates unexpected applications in other sectors different from original intentions. Large firms which are active in many different industries invest relatively more since they can better exploit the general nature of basic research.

William Kerr investigates innovation in large firms which face a trade-off between improvements of existing product lines and creating entirely new business opportunities (Kerr 2016). He develops a theoretical framework capturing these two alternative directions of private R&D. He then explores in a case study how IBM introduced a new innovation strategy to better identify and implement newly emerging business opportunities and was thereby able to manage a turnaround from a declining and loss making to a dynamic and most profitable company. Ramana Nanda and Matthew Rhodes-Kropf discuss the role of venture capital in funding high risk and high potential innovations in new start-up firms (Nanda and Rhodes-Kropf 2016). Venture capital backed investment is a rather small part which is, however, disproportionately effective in generating employment and growth. The experimental and high risk nature of start-up investment makes it unsuitable for more conservative bank financing and requires active venture capital support with a participation in the upside potential of the firm. The experimental nature of investment typically calls for staged financing. Venture capitalists save scarce capital resources by abandoning unsuccessful projects early on and continue financing in later stages as more reliable information becomes available.

Ensuring effective innovation incentives is a central element of innovation policy, and property rights in the form of patents is one of the main policy instruments to achieve this. Mark Schankerman, however, discusses empirical evidence that patent protection can also discourage follow-on innovation by downstream firms if bargaining between upstream patent holders and potential downstream licensees breaks down (Schankerman 2016). For the vast majority of patents, the evidence indicates that patents do not impede downstream innovation. However, blocking occurs in complex technology areas where later innovators need many different patents to conduct research (e.g. information technology and electronics), but not in other important sectors like pharmaceuticals and chemicals. Blocking appears to be concentrated in cases where large firms with patents interact with small downstream innovators. The finding that the impact of patent rights on cumulative innovation is localised rather than pervasive calls for more targeted policies rather than a general restriction in patent rights.

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List of chapters and authors

Editorial
Christian Keuschnigg

Competitiveness and Growth Policy Design
Philippe Aghion

R&D Policies and Economic Growth
Ufuk Akcigit

Innovation and Business Growth
William R. Kerr

Regional Variation in Venture Capital: Causes and Consequences
Ramana Nanda and Matthew Rhodes-Kropf

Patent Rights and Cumulative Innovation: Causal Evidence and Policy Implications
Mark Schankerman

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