State of the Art Review

What Supports the Adoption of Innovations Within Established (non-frontier) Firms?

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The adoption of innovations can be strongly path-dependent and self-reinforcing in established firms. Policy can play a role in shifting the adoption of innovations away from existing technological trajectories towards new, more effective, innovations. This may have positive impacts on growth and productivity. This review addresses the following questions: What are the factors that affect technology change or inertia in established firms? What role can policy-makers play in over-coming such inertia?

Background

Technology adoption can play an important role in helping established firms to maintain and develop their competitiveness. Recent OECD research suggests the importance of technology diffusion both as a source of sustained competitiveness and as a contributor to national productivity improvement. Here we consider what determines the adoption of new technologies or innovations by established firms and how policy can support and promote adoption.

Technologies are often path-dependent. Once a critical mass of firms has adopted a specific technology, the likelihood that they will divert from this path progressively declines as time passes (Caiazza, 2016). The successive adoption of a specific technology by firms may therefore be responsible for one technology taking a lead over others. As more and more firms adopt a technology, the returns on its use will increase and social processes can continue to reinforce its diffusion despite the emergence of more efficient alternatives (Audretsch and Caiazza, 2016).

Innovation and its adoption is then the process that leads to technology change. When an innovation emerges which challenges established technologies it becomes successful only when a critical mass of firms establish new adopting rules replacing the previous technology with the new one (Caiazza, Richardson and Audretsch 2015). According to this model, innovation overcomes existing technology because of conscious choices by collective actors. These adoption

decisions reflect information flows, the returns to adoption and firms' own internal capabilities.

Evidence

Policy-makers can influence the process of innovation diffusion/adoption in firms that leads to technological change or inertia in several ways (Figure 1). They can play an important role in defining general policies to support adoption, by implementing measures to support the supply and demand of innovation and by becoming acquirers of new technologies (Caiazza and Volpe, 2017).

Policy-makers can support innovation diffusion through framework policies that update the regulatory system within which innovative activity takes place. Policy-makers can introduce tax or financial incentives for enterprises that invest to diffuse new technology. Policy-makers can also promote technology adoption through standards development which can accelerate common agreement between innovators and adopters about standards and technological compatibility. Finally, policy-makers can influence cultural norms through measures aimed to facilitate inter-firm collaboration, reduce risk aversion, share information and learning, achieve scale economies and strengthen ongoing business and technology development relationships.

Figure 1: Policies supporting technology diffusion

General	Supply	Demand
Tax incentive, financial support, standards development and IPR.	Reduction of innovators' costs for technology diffusion and support to their internationalization strategies.	Reduction of users' costs for selecting and adopting a new technology and public procurement.
Integration of regulatory authorities and creation of centers aimed to support diffusion and adoption.	Centers to promote technology improvement, extend capabilities of research facilities, facilitate industry-driven initiatives and support adaptation of technology to market needs.	Centers to make users more knowledgeable about available technologies and to provide technical assistance in innovation adoption.
Programs for collaboration and communication between innovators users and institutions.	Public-private projects aimed to commercialize new technology and identify potential users.	Projects aimed to reduce adopters information search costs, improve adopters absorptive capability, to train users and to provide technical assistance in switching previous technology with new ones.

Supply-side policies are also important instruments which can support innovation diffusion (Caiazza, 2017). These policies provide innovators with funds, human resources, political support and technical assistance to help overcome resistance

to innovation adoption. Policy-makers can establish intermediaries to support innovators in promoting technology transfer and provide information (Caiazza, 2016). Applied technology centres and other facilities can promote technology improvement. These centres often extend the capabilities of existing research facilities or they may be industry-driven initiatives (Caiazza and Stanton, 2016). Centres support innovators in the process of improvement aimed to adapt technology to market needs. Policy-makers may also absorb part of innovators' financial costs of innovation and support innovators in their internationalisation strategy.

Policy-makers can also adopt demand-side policies to improve conditions for the uptake of innovations or improve the articulation of demand in order to spur innovations and allow their diffusion. Policy-makers can support tendering processes to reduce innovators' risks, or become the main acquirer of an innovation through public procurement (Markuerkiaga et al., 2016).

Policy-makers can also support adopters' experimentation of new technology providing information, technical assistance for adoption and training programs to aid better utilisation. Public centres could be established to make potential users more knowledgeable about available technologies, their possible applications, and their benefits. Applied technology centres with trained staff can also offer technical assistance, technological advice, conducts assessments and recommendations to firms in local industries. At the same time policy-makers can realize some information or training programs aimed to reduce adopters' information search costs associated with new technology, exchange programs to improve adopters' absorptive capability (Caiazza and Ferrara, 2016). Finally, policy-makers can decide to adopt new technology facilitating its diffusion through the market.

A comprehensive assessment of the innovation system of individual OECD member and partner countries, is offered by OECD Reviews of Innovation Policy. The Countries' list of good practices can be downloaded from: http://www.oecd.org/innovation/inno/oecd-reviews-of-innovation-policy.htm.

Summary and evidence gaps

Barriers to diffusion can range from the structure of the whole economic system to specific resistances of markets and actors. They are commonly classified as 'general', 'supply-side' or 'demand-side'. To overcome these barriers, policy-makers pursue a wide variety of policies to promote technology diffusion. Such policies have to support new technology in becoming dominant. After the introduction of such policies the subsequent process of diffusion can become self-reinforcing ending the need for policy intervention.

UK evidence on the diffusion of technological innovations and aspects of management best practice is limited. UK policy insights evidence on effective measures to support technology diffusion is also minimal. International insights and policy lessons are available, however, and may suggest transferrable initiatives for the UK.

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