EUROPEAN COMMISSION / European Research Area / Social sciences & humanities

# EUROPEAN POLICY BRIEF

## Policy Incentives for the Creation of Knowledge: Methods and Evidence (PICK-ME)

**Policy Incentives for the Creation of Knowledge, an EU-funded research project exploring the key role of public demand in innovation policies aimed at fostering the multifaceted dynamics of technological knowledge**

December 2012

## INTRODUCTION

### Demand-oriented innovation policies

Knowledge creation and knowledge diffusion are the key factors of the economic growth. Recently, the EU in its Europe 2020 strategy (European Commission, 2010) underlines the importance of knowledge for achieving a smart, sustainable and inclusive economy.

One of the consequences of the global financial crisis is that the capacity to generate knowledge and innovate is under increasing pressure, because of the reduction of the private resources dedicated to innovation activities. Therefore the adoption of smart innovation policies is more relevant than ever. So far, these policies have mainly been designed by relying on a supply side perspective, but recently there is a growing focus of the policy makers on the implementation of demand-oriented innovation policies.

Traditionally, the demand pull innovation policies are targeted at the short term stimulus of the economy in order to cope with periods of recession while the consideration of long term effect on economic growth has been rather neglected. Among the factors that have hampered the adoption of a long term strategy are: lack of indicators able to identify the effects of demand driven policies; lack of empirical evidence on the effect at regional level of demand driven policies; lack of theoretical and empirical models that show the effects of demand driven policies in shaping technological change.

## KEY OBSERVATIONS

### Microeconomic foundation of demand pull policies

The hypothesis of Kaldor (1966 and 1972) refined, at a later stage, by Schmookler (1966) entails that demand driven policies can pull technological change and, then, can be used in a systematic way in order to sustain economic growth. However, the lack of an appropriate microeconomic foundations has led to persistent ambiguity and scepticisms about the positive relationship between demand pull policies and innovation activities.

In response to this gap in the literature, Antonelli and Gehringer (09/2012) provide a microeconomic foundation of demand driven policies building upon the Schumpeterian thinking. In particular, the derived demand of innovative firms of downstream sectors stir and support the innovative activities of firms in upstream sectors. This approach stresses the importance of vertical and pecuniary knowledge externalities where the transactions between users and producers are supported by knowledge interactions between them. In addition, the role of demand pull innovation activities channelled by user-producer interactions is empirically tested using input output data for 15 European countries. The results provide empirical evidence that transactions-*cum*-knowledge interactions affect positively the innovation activities in upstream sectors.

The above results underline that a generic policy in support to aggregate demand may speed the diffusion of knowledge, but do not have impacts on the generation of new technological knowledge and on the introduction of innovations. The latter requires the selection of the filiéres along which the users are able to catch the technological opportunities in the market and the vertical relations are based on active knowledge interactions.

### Path-dependence nature of local industrial development

The regions' ability to create new sectors is a key factor in explaining their long-term economic growth (Pasinetti, 1981, 1993). New industries and, thus, new knowledge allows a region both to avoid the loss of local advantages because the technology involved in pre-existing sectors may become more standardized and accessible to other regions (Maskell et al., 1998) and to avoid lock-in phenomenon (Bathelt et al., 2004). At the same time, a growing literature (Bathelt and Boggs, 2003; Glaeser, 2005; Hidalgo et al., 2007; Neffke et al., 2011) shows that the ability of regions to produce new goods depends on their ability to produce technologically related products. A crucial reason is that intangibles capabilities are not tradable and, thus, the possibility to develop a new industry is strongly linked to the pre-existing capabilities.

Using patent data for the EU 15 countries, Colombelli, Kraft and Quatraro (12/2012) have analysed the process of regional diversification during the period 1986-2006. This analysis is based on the representation of the regions' technology space and on the technological proximity between potential emerging sectors and the already existing sectors in regions. The results show that the

development of a new sector is more likely when it is closely related to the old sectors of the region.

Boschma, Minondo and Navarro (2012) argue in their study that regions diversify into industries that make use of capabilities in which regions are specialized. As the spread of capabilities occurs through mechanisms that have a strong regional bias, they expect that capabilities available at the regional level play a larger role than capabilities available at the country level for the development of new industries. To test this, they analyze the emergence of new industries in 50 Spanish regions at the NUTS 3 level in the period 1988-2008. They calculate the capability-distance between new export products and existing export products in Spanish regions, and provide econometric evidence that regions tend to diversify into new industries that use similar capabilities as existing industries in these regions. As expected, proximity to the regional industrial structure plays a much larger role in the emergence of new industries in regions than proximity to the national industrial structure. This suggests that capabilities at the regional level enable the development of new industries.

The results of these analyses demonstrate that history matters in the regions' development of new sectors and, thus, for an effective implementation of regional innovation policies, it is necessary to take into account the pre-existing local competence. Some capabilities should be developed locally to raise the probability of developing new industries at the regional level. In that context, it would be wise to target policy intervention at the regional level, because it is at this level where the main assets to diversify successfully are present. That is, the implementation of policies directed to the development of sectors that are technologically unrelated with the local competence accumulated over time could be inefficient and unsuccessful. However, the study on Spain showed that capabilities at the national level also mattered for the process of regional diversification. Therefore, policy at the national level (like focusing on research and education system and institution building) seems also to be important, in addition to policy exclusively focused at the regional level. Recognizing that would bring us a big step forward in the design of policy programs that are focused on regional diversification, despite all the unpredictability that is part and parcel of the development of new growth paths in regions.

## Path-dependent character of innovation activities

The understanding of the characteristics and determinants of the persistence along time of firms' innovation activities has clearly important policy implication. The empirical literature on innovation persistence is mixed and show that the results obtained depends on the choosing of the innovation indicator (Duguet and Monjon, 2004).

Using survey data for Italian firms, Antonelli, Crespi and Scellato (2012) have analysed the persistence in innovation activities, as measured by the use of different innovation indicators. The results show that the R&D investments are the innovation activities with highest level of persistence. Additionally, it is found a more robust

evidence of persistence for product innovations than process innovations when are considered the complementarity effects between these two types of innovation activities.

These results imply that the provision of funding and assistance to promote R&D activities and to promote product innovations is likely to have long term effects, while the provision of fiscal subsidies for the adoption of process innovations is likely to have only short term effects.

## Properties of knowledge base and firm survival

Innovation activities enhance the survival likelihood of firms. However, in the literature on firms' survival, knowledge is mainly treated as an homogeneous stock generated through the accumulation over time of knowledge stemming from R&D activities. This view neglect all the qualitative aspects of the firm' s procedures of creation of knowledge which can be represented by search processes of alternative bits of knowledge that can be combined one another (Weitzmann, 1998; Kauffman, 1993). Whit this respect, a plausible hypothesis is that firms that rely in their accumulated knowledge are more likely to survive and to be successful respect to firms that rely on knowledge that is distant from their accumulated competence.

Using French firm data, Colombelli, Krafft and Quataro (11/2012) have analysed the relationship between firms' properties of knowledge base and their likely to survive. The results show that the degree of technological differentiation (i.e. a competence portfolio with multiple technological domains) affects positively the firms' likely to survive. However, the likely to survive is more high for firms pursuing search strategies in technologies related to their pre-existing competence than for firms pursuing search strategies in unrelated technologies.

These results imply that innovation policies should be designed in order to take into account of the different search strategies followed by firms. Firms that try to explore new technological trajectories may be supported providing access to external technology competences and enhancing their exploration activities. On the other hand, policy in supports of firms that exploit their accumulated knowledge are more likely to conduce to technology based economic growth.

## Education-job (mis)matching and interregional migration

One of the key function of the Universities is to shape the human capital and, thus, to create the knowledge necessary to sustain economic growth. However, the relationship between human capital and economic growth cannot be taken for granted. Public investments on human capital should match the technological competence embedded in the country or region in order to conduce to economic growth and to reduce the economical and technological disparities between countries and regions.

Job (mis)matching has important consequences both at the macro level as skill underutilisation, and at the micro level as employment

unsatisfying, lower productivity and high turnover.

Using data on recent Italian university graduates, Iammarino and Marinelli (10/2012) have analysed the impact of interregional migration on education-job (mis)matching. In particular, distinguishing between three different macro area (i.e. North, Centre and South Italy), they show that interregional labour mobility contributes to reduce education-job gaps, but these results are mainly driven by the mobility of graduates migrating from the South of Italy to the North of Italy and, to lesser extent by interregional mobility within the North.

The results of this analysis demonstrate that labour mobility do not promote regional convergence because regions of North Italy, i.e. the economically most advanced part of the country, take advantage of the skills shaped in the regions of South Italy, i.e. the economically less advanced part of the country. A natural consequence of these results is that it is necessary to design and implement regionally-based policy in order to align the competence produced by the universities with the competence demanded by the local actors in order to retain and maximize the private and public investment in human capital.

## Intra- and inter-regional labour mobility and plant performance

Labour mobility is often regarded as a key mechanism through which knowledge diffuses across firms within regions (Angel, 1991; Almeida and Kogut, 1999; Pinch and Henry, 1999; Malmberg and Power, 2005; Iammarino and McCann, 2006; Rodriguez-Pose and Vilalta-Bufi, 2005). However, scholars have also pointed out that labour mobility may obstruct human capital formation at the regional level, because of labour poaching. Quantitative studies have indeed shown that intra-regional labour mobility is not *per se* a good thing (e.g. McCann and Simonen, 2005; Eriksson, 2011). In that context, Boschma *et al.* (2009) claimed that the effect of labour mobility on firm performance can only be assessed when one accounts for the types of skills that are transferred when people change jobs, and the degree to which these match the existing skills in the firm.

Timmermans and Boschma (2012) have investigated the impact of labour mobility on plant performance in Denmark. They analysed close to 52,000 high-skilled job moves into almost 17,000 Danish plants in the period 1999-2003. These data were drawn from the so-called IDA-database that provides detailed information on individuals and plants for the whole Danish economy, Their study confirms that the effect of labour mobility can only be assessed when one accounts for the type of skills that flow into the plant. As expected, they found that the inflow of skills that are related to skills in the plant impacts positively on plant productivity growth, while inflows of skills that are similar to the plant skills have a negative effect. They used a sophisticated indicator of revealed relatedness that measures the degree of skill relatedness between sectors on the basis of the intensity of labour flows between sectors. Intra-regional mobility of skilled labour had a positive effect on plant performance, but the impacts of intra- and inter-regional mobility depended on the type of skills that flow into the plant.

Regional innovation policy could focus on encouraging labor mobility. Since most labor mobility takes place at the regional level, policies promoting labor mobility may enhance knowledge transfer and innovation at the regional level. Since labor mobility may take away the incentive of firms to invest in their personnel, public policy should invest heavily in education and life-long learning at the same time. Labor markets need to be more flexible in order to smooth the process of creative destruction and lower the costs of such adjustments. This needs to be complemented by a policy of life-long-learning that increases the capability of individuals to confront changes and to move from one job to the other. Another policy measure is to encourage the immigration of skilled labor because it may bring new ideas and knowledge into the region. One way to achieve this is through international exchange programmes for students. Incoming students bring in new talents and skills from abroad, and combine these with new skills that are acquired in high education institutes in the host country. If the host country is capable of maintaining this group of high-skilled students after graduation (policy can most certainly play a role here), they will contribute to the economy as skilled employees or as founders of new firms. Outgoing students will acquire new skills in research and education institutes abroad, and may return to their home region after a while, where they will exploit their newly acquired skills in an environment they are familiar with. Policy could target those outgoing groups and provide incentives to return to their home region.

## University-industry relations and knowledge governance

Knowledge governance consists in the set of structures and mechanisms that influence the creation and the diffusion of knowledge in an economic system. In the last century, advanced countries have relied on a corporate model of knowledge governance, characterized by large firms which conduct research and development activities internally, and universities play a marginal role. Recent developments in the information and communication technologies and in biotechnologies have revealed the limitations of the corporate model, which is illustrated by the non-invented-here syndrome and the low ability to respond to technological discontinuity. As consequence, there is a growing interest in the academic model where universities take a central role in the generation and diffusion of knowledge.

In the literature on university-industry relationships the knowledge generated by universities is mainly treated as homogeneous (Aghion, Dewatripont, Hoxby, Mas-Colell, Sapir, 2009) and, thus, little attention is given to the potentially different impacts of different types of academic knowledge on economic growth. In brief, the heterogeneity of academic knowledge with respect to economic growth may have important implications in terms of policy.

Using data on the number of chairs in Italy for the period 1900-1960, Antonelli and Fassio (07/2012) have analysed the impact of knowledge spillovers stemming from universities on economic growth distinguishing between different types of academic disciplines. This analysis provides interesting historical evidence for

a country characterized by an academic model of knowledge governance, in a period characterized by the transition from an agricultural economic system to an industrialized economic system.

The results of the analysis show that only spillovers stemming from applied science academic fields (i.e. chemistry and engineering) significantly contributed to the growth of total factor productivity of Italy during the period analysed.

These results have important policy implications. They underline the importance of taking into account the heterogeneity of knowledge generated by universities in order to have efficient mechanism of knowledge governance. It is not sufficient to increase the resources transferred by government to universities to supporting economic growth, but it necessary to align the knowledge supplied by universities with the knowledge demanded by the business sector. A set of indicators such as the citations of academic outputs by patents and essays produced in the business sector can help to recognize the knowledge needs of the business sector and mitigate the effects of the lack of price signalling and of opportunistic behaviours (principal-agent problem) within the academic system.

## RECOMMENDATIONS FOR POLICY-MAKERS

**Demand driven innovation policies as a systematic way to sustain economic growth**

Demand driven innovation policies are traditionally view as public support in order to cope to cope with short run shocks leading for example to GDP and employment decrease in recession times. However, as showed above, contrary to a generic demand pull policy, a competent demand pull policy represents an effective strategy in order to obtain technology change and sustain long-run economic growth. User-producer transactions-cum-interactions represents a key mechanism in explaining the development of new technologies in the economic system. The implementation of an effective demand driven innovation policy requires the selection of filières along which innovative users are able to support the innovative efforts of their suppliers.

**Path-dependent nature of technological development**

Second, it should be taken into account that the emergence of new technology activities or new sectors are more likely when they are based on the accumulated competencies at the local level. This implies that innovation policies should not abstract away from the pre-existing technological specialisation of a country or region. Innovation policies promoting the emergence of new sectors that are technologically close to the existing sectors are more likely to be successful than those promoting the emergence of technologically distant sectors.

**Demand and the local availability of skilled labour force**

Finally, the introduction of new technologies in a economic system is influenced by the local availability of skilled labour force. The human capital and in general the knowledge produced by universities should match the knowledge needs of the business sector. The inability to align the supply and demand of specific skills may represent an obstacle to the effective implementation of demand driven innovation policies. With this respect, the geographical mobility of labour force does not represent a mechanism that promote technological and economical convergence. In order to connect better the supply of academic knowledge and the real needs of the business sector, there is a need to use indicators that signal the real use of knowledge generated by local universities by local economic agents. Some useful indicators are represented by the citations of academic outputs by patents developed by firms and the degree of inter-sectoral labour mobility between regions.

## PROJECT IDENTITY

**Coordinator**

**Cristiano Antonelli**
Department of Economics, University of Torino/Fondazione Collegio Carlo Alberto, Italy

**Consortium**

**Ron Boschma**
Urban and Regional Research Centre Utrecht, University of Utrecht, the Netherlands

**Jackie Krafft**
GREDEG, University of Nice Sophia Antipolis and CNRS, France

**Simona Iammarino**
London School of Economics and Political Science, United Kingdom

**Davide Consoli**
Agencia Estatal Consejo Superior de Investigaciones Cientificas, Spain

**Itzhak Goldberg**
CASE - Centrum Analiz Społeczno-Ekonomicznych - Fundacja Naukowa, Poland

**Andreas Pyka**
Universität Hohenheim, Lehrstuhl für Innovationsökonomik, Germany

**Amnon Frenkel**
Technion – Israel Institute of Technology, Israel

**EC contact**

**Heino Nau**
Directorate B European Research Area
Research and Innovation DG
Email: Heino.Nau@ec.europa.eu

**Funding Sheme**

EU 7th Framework Programme
THEME [SSH-2010-1.1-1]
[Demand-driven research and innovation policies for growth, welfare and wellbeing]

**Duration**

January 2011 – December 2014

**Budget**

EU Contribution: EUR 1.838.817

**Website**

http://www.gredeg.cnrs.fr/projets/pick-me/index.html

**Further information**

**Francesco Quatraro**
GREDEG, University of Nice Sophia Antipolis and CNRS, France
Email: francesco.quatraro@unice.fr