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The EU 2020 innovation indicator: A step forward in measuring innovation outputs and outcomes?

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ABSTRACT

In October 2013, the European Commission presented a new indicator intended to capture innovation outputs and outcomes and thereby "support policy-makers in establishing new or reinforced actions to remove bottlenecks that prevent innovators from translating ideas into products and services that can be successful on the market". This article aims to evaluate the usefulness of the new indicator against the background of the difficulties in measuring innovation outputs and outcomes. We develop a unique conceptual framework for measuring innovation outcomes that distinguishes structural change and structural upgrading as two key dimensions in both manufacturing and services. We conclude that the new indicator is biased towards a somewhat narrowly defined "high-tech" understanding of innovation outcomes. We illustrate our framework proposing a broader set of outcome indicators capturing also structural upgrading. We find that the results for the modified indicator differ substantially for a number of countries, with potentially wide-ranging consequences for innovation and industrial policies.

1. Introduction

In October 2013, the European Commission (EC) launched a new indicator (henceforth the EU 2020 Innovation Indicator) for measuring the EU's progress in meeting the goals of the Europe 2020 Strategy and its Innovation Union flagship initiative (European Commission, 2013). The EU 2020 Innovation Indicator is intended to measure innovation outputs and outcomes, complementing the headline R&D intensity indicator (R&D expenditures as a share of GDP) used so far for policy coordination. During the 2000s, this R&D intensity indicator strongly influenced research and innovation policy in Europe as the heads of state and government of EU member states agreed on a 3% target for this indicator at their Barcelona summit in 2002 (European Commission, 2002). Over time, both policy makers and researchers recognised that the R&D intensity indicator had certain limitations in order to serve as the main indicator to monitor improvements of the EU in becoming the most competitive knowledge-intensive society. On the one hand, industry structure strongly determines R&D intensity (Mathieu and van Pottelsberghe de la Potterie, 2010; Reinstaller and Unterlass, 2012), favouring countries with R&D-intensive industries. On the other hand, relying only on input indicators might result in overrating unproductive R&D investment (Edquist and Zabala-Iturriagagoitia, 2015).

The European Council tried to solve these problems and asked the EC to develop "*a new indicator measuring the share of fast-*

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growing innovative companies in the economy"[1]; to add an output and outcome dimension to the input dimension already provided by the R&D intensity indicator. In the following two years, the Commission services experimented with different approaches to develop and measure such an indicator, consulting also with a High Level Panel on the Measurement of Innovation (2013) and finally presented the EU 2020 Innovation Indicator. It combines four individual indicators intended to measure innovation outputs and outcomes into a single composite indicator: (1) patent applications, (2) economic significance of knowledge-intensive sectors, (3) trade performance of knowledge-intensive goods and services and (4) significance of fast-growing firms in innovative sectors. The four individual indicators are also part of the Innovation Union Scoreboard (IUS, from 2016 on: European Innovation Scoreboard).

Since tools such as the EU 2020 Innovation Indicator are not only used as a purely informational basis but also feed into evidence-based policy advice, e.g. country specific recommendations within the Europe 2020 strategy or smart specialisation initiatives, the adequacy of the information provided becomes crucial. It is therefore critical to know whether the EU 2020 Innovation Indicator measures innovation outputs and outcomes without bias. This paper attempts to evaluate the EU 2020 Innovation Indicator against this policy background. We develop a conceptual framework of innovation outcomes at the sectoral level that distinguishes two types of innovation outcomes: (1) structural change towards knowledge-intensive sectors, and (2) structural upgrading, i.e. moving closer to the frontier[2] within existing sectors.

An illustrative empirical analysis using novel indicators for structural upgrading reveals that the EU 2020 Innovation Indicator is reasonably well reflecting processes of structural change while it does not appropriately address structural upgrading. The indicator therefore overrates countries specialised in knowledge-intensive sectors far from the frontier. With the same reasoning it underrates countries specialised in less-knowledge intensive sectors close to the frontier. In this respect, the EU 2020 Innovation Indicator solves only one of the two problems associated with the R&D intensity indicator. While it complements the input perspective with an outcome perspective, it also strongly focuses on the share of sectors classified as knowledge-intensive in the economy and tends to ignore actual innovation outcomes.

The paper is organised as follows: Section 2 develops a conceptual framework of innovation outcome measurement. Based on this framework, Section 3 analyses the strengths and weaknesses of the new EU 2020 Innovation Indicator and compares the results of this indicator with a more comprehensive outcome indicator that includes structural upgrading. In Section 4 we discuss the policy relevance of our findings and suggest ways for improving the measurement of innovation outcomes at the country level.

2. Measuring innovation outputs and outcomes at the country level

2.1. Innovation outputs vs. outcomes

Traditionally, most attempts to measure innovation focused on innovation inputs, in particular R&D (see the Frascati Manual; OECD, 2015) and human resources for innovation (see the Canberra Manual; OECD and Eurostat, 1995). While these approaches have been by and large successful in terms of delivering comparable international data on the input side, comparable and reliable indicators on innovation outputs and outcomes at the country-level are still largely missing in spite of the efforts by the Oslo Manual (OECD and Eurostat, 2005) to harmonise measurement of innovation output and outcomes (see Godin, 2003, 2007; Freeman and Soete, 2009).

A starting point to derive country-level indicators of innovation outputs and outcomes is the literature on the innovation production function (e.g., Pakes and Griliches, 1984; Bernstein and Singh, 2006; Godin, 2007; Roper et al., 2008; Chen and Guan, 2011). In addition, stage process models from the evaluation literature (e.g., the logic chain model) try to identify critical areas of innovation performance measurement, including wider impacts of innovation on society and the economy (e.g. McLaughlin and Jordan, 1999).

Following this literature and the terminology of the Oslo Manual, firms can transform innovation inputs (e.g. R&D, human resources, research infrastructures and the stock of existing knowledge) in a first stage into intermediate outputs, such as patents, often referred to as throughputs (Grupp, 1997; Frietsch and Schmoch, 2006) and potentially,[3] in a second stage, into innovation *outputs*. They refer to the direct results of innovative efforts of economic actors. This is typically the introduction of an innovation on the market (product innovation, marketing innovation) or in the economic actor's operation (process innovation, organisational innovation). Typical measures of innovation output are counts of product and process innovations (see Geroski, 1994) or the share of firms that have introduced innovations.

Innovation *outcomes* are the consequences of the introduction of innovations, among them the economic effects of innovation outputs on the firms introducing them. Introducing an innovation and even less so applying for a patent does not automatically have economic effects. A product innovation, for example, needs to be sold to users, and a process innovation must lead to significant changes in cost or other production related inputs in order to generate economic effects. Linked to these potential firm-level outcomes are economy-wide outcomes, also called impacts, resulting from the diffusion of an innovation from the firm and sector where the innovation originated onto other industries and finally the economy as a whole (see the seminal work by Rogers, 2003, on the diffusion of innovations). These outcomes also include non-economic ones, e.g. health benefits of new medical equipment. In the present paper, we refer to the economic consequences of all four types of innovation output identified by the Oslo Manual (product, process, marketing, organisational), in line with the scope of the EU Innovation Indicator.

While the EU 2020 Innovation Indicator is a systematic attempt to provide internationally comparable data on the output and outcome dimension of innovation, it has important limitations. First, while the EU 2020 Innovation Indicator tries to address innovation outputs, it does so only based on patent data which reflect the output of R&D processes but should, for several reasons discussed below, not be equated with innovation output. Second, we will argue that the EU 2020 Innovation Indicator adopts a "high-tech" view on innovation because the three indicators relating to innovation outcomes (significance of knowledge-intensive sectors, the competitiveness of knowledge-intensive goods and services, and the significance of fast-growing firms in innovative sectors) mainly attempt to measure structural change of economic activity towards predefined sectors with high knowledge intensity. The sole focus on such sectors, however, neglects innovation outcomes of firms in less-knowledge-intensive sectors that may lead to an upgrading of such sectors and may improve economy-wide performance substantially. It also neglects actual innovation outcomes in

[1] Conclusion of 4/2/2011 (Council doc. EUCO 2/1/11 REV1).

[2] We use the term "frontier" broadly in this paper, indicating the highest level of the concept of interest, such as knowledge intensity, quality, etc., referring to the performance of both manufacturing and services.

[3] Not all patents are used for the introduction of innovations (Section 3.1).