



# Heterogenous skills, growth and convergence



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## ABSTRACT

This paper analyzes the impact of different individual skills and their economy-wide distribution among heterogenous entrepreneurs on a country's catching up-process to the world technology frontier (WTF). Highly skilled entrepreneurs qualify as either technological specialists or as broadly skilled systemic entrepreneurs. Governmental policy may address individual skills or the aggregate composition of skills in society and may be interpreted as education policy. The effectiveness of alternative growth-promoting policies is shown to depend on the relationship between a country's state of development and the prevailing composition of entrepreneurs. Countries far from the WTF benefit from increasing the share of technological specialists, whereas countries close to the WTF benefit from increasing the share of broadly skilled systemic entrepreneurs.

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## 1. Introduction

The particular appeal of recent models of Schumpeterian growth lies in their combination of formal elegance and strong policy implications. A central reasoning of the latest model generation is that appropriate government interventions to foster economic growth depend critically on a country's distance to the world technology frontier (henceforth WTF). It is suggested that governments of relatively backward economies should intervene to increase investment and to induce faster copying and adoption of existing technologies. As an economy approaches the WTF, governmental policy should support the switch towards an

innovation-based strategy, younger firms and more selection (see [Acemoglu et al. \(2006\)](#) or [Acemoglu \(2009\)](#)).

While this literature has substantially improved our understanding of the mechanisms underlying long-term economic growth, it provides no convincing explanation for recent developments in the relative growth performance of the world's technologically most advanced economies, namely the US and Europe. In their Joseph Schumpeter Lecture presented to the 20th Annual Congress of the European Economic Association, Philippe Aghion and Peter Howitt characterized Europe as an economy that has long lagged behind the world's technological leader (the US), but which, after a long period of catching-up, has now closely approached the WTF ([Aghion and Howitt, 2006](#)). In fact, recent statistics on the number and growth rate of triadic patents per capita ([OECD, 2008](#)) and the number of scientific articles per million population ([National Science Board, 2012](#)) indicate that European countries have come very close to the WTF which is defined by the US as

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**Table 1**

Long-term labor productivity growth in Europe and the US (GDP per hour, annual average, percent).

	USA	Euro Area	France	GER	Italy	Spain	UK
1995–2005	2.4	1.4	1.8	1.6	0.5	0.5	2.2
2005–2009	1.5	0.5	0.8	0.2	−0.8	2.0	0.9

Source: The Conference Board Total Economy Database, January 2010 and January 2013.

the world's technologically leading country (see [Benhabib and Spiegel \(2005\)](#)), and in some cases even surpassed the US. However, this impressive technological catch-up has not translated into higher growth rates. By contrast, the average annual growth rate of real GDP in the period 1995–2009 was much higher for the US than for the EU ([The Conference Board, 2010, 13](#)). Moreover, annual labor productivity growth (in terms of GDP per hour worked) in the US accelerated from 1.2 percent in the 1973–1995 period to 2.3 percent from 1995 to 2006, whereas the EU-15 countries experienced a rapid productivity growth decline between these two time periods (see [Krueger and Kumar \(2004\)](#) and [van Ark et al. \(2008\)](#)).<sup>1</sup> Hence, it is quite obvious that growth (and convergence with the world's leading country) requires more than scientific and technological excellence, in particular for advanced industrialized countries that are already quite close to the WTF. This is, however, not adequately reflected in the theoretical literature as yet.

While current models of Schumpeterian growth theory suggest that growth in the most advanced industrialized countries is mainly technology-driven, the current paper offers a richer explanation of growth in countries close to the WTF by considering two different skills – denoted as systemic skills and technological skills – and by showing that when a country approaches the WTF systemic skills become relatively more important than technological skills. While surprising at first glance, the principal result is perfectly in line with recent empirical evidence on the growth performance of Europe relative to the US, and adds considerable value to the understanding of cross-country differences in innovation-driven growth performance.

The paper is organized as follows: Section 2 provides the empirical and theoretical motivation for a new growth model considering entrepreneurs with heterogenous skills, briefly reviews the related literature and lays out how the current paper fits in and adds value to the existing literature. Section 3 presents the basic model setup, whereas our innovative conception of heterogenous skills and their contribution to productivity at the individual (firm), national, and international level is developed in Section 4. Section 5 deals with the selection of entrepreneurs and the corresponding productivity implications in a static and a dynamic equilibrium context. Section 6 analyzes the impact of individual skills and their overall distribution on the speed of convergence and discusses the corresponding policy implications with a focus on education policy measures. Section 7 provides a summary of the main results and concludes.

<sup>1</sup> Note that also in the period 2005–2009 US labor productivity growth was clearly higher than labor productivity growth in Europe ([The Conference Board, 2010, 13](#)).

## 2. Motivation

### 2.1. Skills and growth: empirical background

Current models of Schumpeterian growth suggest that growth in the most advanced industrialized countries is mainly technology-driven. However, differences in scientific and technological excellence alone cannot explain differences in the relative growth performance of countries close to the WTF. While there can be little doubt that Europe has caught up with the US in terms of scientific and technological excellence ([Aghion and Howitt, 2006](#); [OECD, 2008](#); [National Science Board, 2012](#)), Europe as a whole as well as the major European economies have seen a rather poor growth performance relative to the US since the mid-1990s, as can be seen from [Table 1](#).

So, while the technology gap between the US and Europe has been narrowing, the growth/productivity gap has not – a phenomenon that can hardly be explained by referring to standard Schumpeterian growth theory. Recent empirical work by ([van Ark et al., 2008, 42](#)) suggests that the (actually even) widening of the productivity gap between the US and Europe is not carried by technological differences but largely attributable to slower multi-factor productivity growth in market services, which depend less on technological skills and frontier technologies than on the capability to closely interact with customers and consumers, i.e. on skills and competencies that are embedded in national and local cultures and institutions. We call this latter kind of skills *systemic skills* to reflect the systemic character and the embeddedness of modern production processes.

These empirical findings suggest that growth in modern, industrialized economies might depend less on technological skills linked to the WTF than on systemic skills linked to a national or local frontier. Such an argument does, however, not only hold for modern market services but also – and in particular – for knowledge-based and high tech industries such as IT, multimedia or commercial biotech. In these industries, a high level of technological skills is necessary to enter the market and, therefore, many start-ups in these sectors are founded by scientists or technological specialists. However, once the young firms have survived the start-up phase and are entering the growth phase other, non-technical skills (which we call systemic skills) become increasingly important.

The importance of general non-technical skills and the consequences of a lack of such skills in society are well documented for the case of commercial biotechnology in Europe. As commercial biotech is held to be a key technology of the 21st century, European governments have invested large amounts of money to push basic and applied research as well as firm-start-ups in biotech. European biotech clusters such as Cambridge (UK), Oxford,

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