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# Economic growth, human capital and structural change: A dynamic panel data analysis

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ABSTRACT

Human capital is identified as one of the main determinants of economic growth and plays an important role in the technological progress of countries. Nevertheless, existing studies have to some extent neglected the importance of human capital in the growth process via the interaction it can have with a country's industrial specialization. Additionally, the emphasis is mainly placed on supply-side determinants, while demand-side factors are neglected, particularly the relevance of the processes of structural change. Thus, using a growth model which integrates variables from both the supply side and demand side, we assess the direct and indirect effects of human capital on economic growth, including in the latter the interaction of human capital with the industrial specialization of countries. Based on dynamic panel data estimations, we found that human capital and the countries' productive specialization dynamics are crucial factors for economic growth. Moreover, the interaction between human capital and structural change in high knowledge-intensive industries impacts significantly on economic growth. However, the sign of this effect depends on the type of country and the period of analysis. Specifically, over a longer time span (1960–2011) and for more highly developed (OECD) countries, the impact of the interaction between human capital and structural change is positive. When we also include transition and Mediterranean countries over a shorter time period (1990–2011), we find that human capital significantly and positively impacts on the countries' economic growth but the effect of human capital via specialization in high-tech and knowledge-intensive activities is negative. The latter result indicates that the lack of industrial structures able to properly integrate highly educated individuals into the productive system leads countries to experience disappointing economic returns.



## 1. Introduction

The analysis of the determinants of economic growth has been the subject of extensive literature, especially since the beginning of the 1990s. Some authors (e.g., Barro, 1991; Mankiw et al., 1992; Mauro, 1995) have estimated the impact of certain variables on economic growth through cross-section analysis and concluded that human capital plays an important role in economic growth.

Neoclassical and endogenous growth theory identified and analyzed some determinants of economic growth such as foreign trade, government consumption and geography, as well as institutions, namely the case of political instability (Barro, 1991; Levine and Renelt, 1992; Acemoglu et al., 2001; Moral-Benito, 2012). Nevertheless, human capital stock stands as one of the most frequent determinants included in such analyses (Barro, 1991; Hanushek and Wößmann, 2012; Aisen and Veiga, 2013).

The concept of human capital can be interpreted as the set of intangible resources embedded in the labor factor which have improved its productivity (Goldin, 2016). These are associated to knowledge and skills acquired through education, experience and health care (Schultz, 1961; Becker, 1962).

Human capital has a direct effect on economic growth because individuals with more education are more productive and innovative leading to the creation of new products and improving the productivity of factors (Romer, 1990; Benhabib and Spiegel, 1994; Teixeira and Fortuna, 2011; Bodman and Le, 2013). On the other hand, human capital enhances technology adoption from neighboring countries through the absorption of ideas and equipment imports (Nelson and Phelps, 1966; Benhabib and Spiegel, 1994; Teixeira and Fortuna, 2011). Human capital also has indirect effects namely via interaction with the productive structure of coun-

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tries. Concretely, the specialization of a country in technologically advanced activities improves the impact (positive) of human capital on economic growth (Silva and Teixeira, 2011).

Theoretical approaches related to evolutionary economics have revealed a need to add demand-side factors to economic growth analysis (Witt, 2001; Metcalfe et al., 2006; Dietrich, 2012; Teixeira, 2012). Certain changes in demand that favor more diverse and complex products lead to structural changes (Hidalgo and Hausmann, 2009), i.e., changes in sectoral composition and in economic specialization, by boosting technological innovation and creating new products (Silva and Teixeira, 2011; Saviotti and Pyka, 2012). In this line of thought, '*high-tech*' industries have higher growth rates of productivity and therefore contribute more than proportionally to economic growth (Silva and Teixeira, 2011). This contribution tends to increase the more intense the absorption capacity and innovation becomes, related to higher levels of human capital (Nelson and Phelps, 1966; Teixeira and Fortuna, 2011).

This paper intends to integrate into a single model supply-side variables linked to the endogenous growth theory, and demand-side variables linked to structural and evolutionary approaches, namely the specialization pattern of countries. More specifically, the aim of this paper is to estimate the direct effects of human capital on economic growth as well as indirect effects embodied in the interaction between human capital and the countries' productive structure, while controlling for other determinants reported in the literature. Our hypothesis is that a country with a higher level of human capital will grow faster the higher the level of specialization in high-tech and knowledge-intensive industries, in which skilled labor plays an important role.

In methodological terms, we apply the latest dynamic panel data techniques based on the generalized method of moments (GMM) developed by Arellano and Bover (1995) and Blundell and Bond (1998), to two distinct sets of data: one including only OECD countries over a long time span (52 years), 1960–2011; and another including (21) OECD plus (9) transition and Mediterranean countries over a shorter period of time (22 years), 1990–2011.

The paper is organized as follows. The following section presents a literature review on the relationship between economic growth and the three main variables of this study: human capital stock, structural change and the interaction between the two. Section 3 presents methodological considerations as well as a statistical description of the data for the relevant variables. In Section 4, we discuss the empirical results. The final section presents the main contributions of this study, policy implications, limitations and paths for future research.

## 2. Determinants of economic growth: a review

Over the last few decades, a large body of literature has been produced examining the role of human capital in determining the level and growth of GDP per capita (Goldin, 2016). The so-called 'growth accounting' literature emphasizes the importance of measuring changes in the quality of labor, as indicated by improved qualifications and higher skills, when trying to account for economic growth over the long term, whereas 'new growth theories' highlight the determinants of economic growth in the broadest sense, concentrating on human capital inputs (Wilson and Briscoe, 2004). In endogenous growth models, economic growth can continue indefinitely because the returns on investment in (both physical and) human capital goods do not necessarily diminish over time. Spillovers of knowledge across producers and external benefits from improvements in human capital are part of this process because they offset tendencies to diminishing returns.

Acquiring skills and knowledge is a means of capital formation by delaying consumption with the aim of increasing future income. Human capital improves the quality of labor, increasing its productivity (Mankiw et al., 1992; Wößmann, 2003; Bodman and Le, 2013). It is usually considered that an additional school year will increase the productivity and efficiency of workers, and consequently, their income (Hall and Jones, 1999). Likewise, differences in the average schooling of countries are related to different economic growth rates (Benos and Zotou, 2014). For example, Easterly and Levine (1997) found that the low economic growth observed in African countries is due, in part, to low rates of schooling.

Human capital is the driver of Research and Development (R&D), which enhances innovation and technological progress, thus leading to increased productivity and creation of new products (Romer, 1990; Benhabib and Spiegel, 1994; Teixeira and Fortuna, 2011; Bodman and Le, 2013). This means that the more educated the workforce of a country, the greater the benefits of the R&D activities in terms of economic growth. Human capital promotes the absorption of new ideas (absorption capacity) and products already created by other countries. This fosters a faster convergence of economies by importing equipment and technologies (Nelson and Phelps, 1966; Benhabib and Spiegel, 1994; Bodman and Le, 2013). Through the mechanisms described above, human capital will encourage greater investment in physical capital (Benhabib and Spiegel, 1994).

Finally, human capital also affects economic performance indirectly, most notably through its interconnections with institutions. Human capital accumulation contributes to shaping efficient policies, less violence and more political stability (Lipset, 1960; Glaeser et al., 2004) and, therefore, fosters economic growth. Consistent with this perspective, Sianesi and Reenen (2003) show that human capital, specifically in its educational dimension, besides stimulating the productivity of workers, tends to improve health levels, environmental conditions, criminal rates, social cohesion and civic participation. Therefore, investment in education (i.e., human capital accumulation) has an impact not only on individual returns, but also drives a spillover effect that produces social benefits (see Dias and Tebaldi, 2012).

Albeit some authors (e.g., Sunde and Vischer, 2015) acknowledge difficulties in clearly assessing the empirical effects of human capital on growth, most studies show a positive and significant relationship between human capital and economic growth (Barro, 1991; Mankiw et al., 1992; Easterly and Levine, 1997; Hall and Jones, 1999; Bodman and Le, 2013), regardless of the proxy used for human capital (e.g., the average schooling of the working population or initial enrollment rate) (see Benos and Zotou, 2014).

From the above, we assume that:

**H1.** Countries with a higher stock of human capital tend to grow faster than others.

Notwithstanding the enormous importance of human capital accumulation, the differentials in economic growth across countries should (also) be traced to structural change and the complexity underlying their productive structures. Indeed, several studies show that the productive structure of an economy and especially its dynamics, i.e., "structural change" (shifts in sectoral composition where certain industries gain relative shares in economy) emerge as an important determinant of economic growth (Montobbio, 2002; Saviotti and Frenken, 2008; Silva and Teixeira, 2011).

The influence of structural change on economic growth has been a highly disputed and controversial issue in the literature (Hartwig, 2012).

On the one hand, studies associated with supply-side approaches based on Baumol's (1967) cost disease generally advocate that structural change causes aggregate growth to decline (Nordhaus, 2008; Hartwig, 2012, 2015). Being relatively silent regarding the demand side of the economy, Baumol's argument posits that because the composition of output has shifted away