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Do business and public sector research and development expenditures contribute to economic growth in Central and Eastern European Countries? A dynamic panel estimation ☆

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ABSTRACT

This paper empirically estimates the role of private and public research and development in explaining growth of Central and Eastern European Countries (CEE) during 1998–2008. We employ a dynamic panel model using the Arellano–Bond's Generalized Methods of Moments (GMM). Our findings suggest that a 1% increase in business R&D intensity boosts economic growth by 0.050 (0.213) % in these countries in the short (long) run. Public R&D is found to be statistically insignificant. When introducing human capital in the regression, the contribution of business R&D to economic growth decreases, although it remains significant. We argue that part of its effect may be accounted for by human capital. While various robustness checks are performed (such as adding different control variables, sub-periods and dummies for the entrance years to the EU), most of the results imply significant business R&D coefficient. Some policy implications are addressed based on our results.

1. Introduction

The aim of the present paper is to assess the role of public and private R&D stock (expressed as percentages of GDP) for the economic growth of all 10 new member states of European Union (EU), the CEE countries[1] during 1998–2008.[2] In the EU enlargement context, our focus on the CEE countries is of real interest, given the specificity of this group of members. After the fall of communism, R&D intensities (i.e. R&D expenditures expressed as percentages of GDP) have been very low in these countries, as they experienced recession. In the last decade, the dynamics of R&D spending observed in many CEE countries are positive. Fig. 1 (see Appendix 1) presents the average R&D intensity for the period 1998–2008 for all CEE countries in comparison to EU27. However, most of the countries have R&D intensity below 1% of GDP, lower than one might expect given their income level (Kravtsova and Radosevic, 2012). Slovenia and the Czech Republic are the only countries accounting for higher shares of R&D expenditure (1.44% and respectively 1.3% of GDP on average).

Within the Lisbon strategy (The Lisbon Review, 2004), the EU set the ambitious goal of becoming "the most competitive and dynamic knowledge-based economy in the world" by allocating 3% of GDP to R&D link spending (with 2/3 realized by the private spending). Nevertheless, by 2010, these goals were far from being achieved. More recently, the Europe 2020 strategy "for smart, sustainable and inclusive growth" established the same target of investing 3% of GDP in R&D (European Commission, 2010). Among the initiatives, the Commission invites the Member States to prioritize "growth-enhancing items" such as education and skills, R&D, innovation, and infrastructure.

Given the Lisbon objectives, the R&D intensities in CEE countries are low. The weak R&D intensities can partially be explained by the fact that the research systems of these countries still largely depend on public funding, which is sometimes volatile and under restrictive conditions.

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[1] Bulgaria, Czech, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia, and Slovakia.

[2] The choice for the period is motivated by the fact that starting with the year 1998, positive dynamics for R&D could be found for most of the countries in the sample. To avoid the effects of the highly volatile data of the crisis period on our estimations, we also limit our analysis up to the year 2008.

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Therefore, the need for European Union is to focus not only on the amount of R&D but also on its composition and one strong recommendation of the EU Commission is to improve the conditions for private R&D sector in the union.

The above presented aspects enhance the motivation of our work. It is an ongoing debate on how to allocate between different types of R&D, such as public and private. Fig. 2 (Appendix 1) shows the changes of the two types of R&D between 1998 and 2008. The distribution of R&D expenditures by public and private funds has evolved quite differently. On average, the dynamics of private R&D has surpassed public R&D, in line with the Lisbon objectives. However, the increase in private R&D is very heterogeneous among the CEE countries: significant increase in Estonia and Slovenia, while Romania, Slovakia and Poland show a decrease. The high shares of public R&D in the latter group of countries partly compensate the weak business R&D intensity. Nevertheless, compared with the modest levels of R&D investment, all CEE countries are characterized by relatively high levels of human capital. Despite a certain mismatch between supply and demand of labor in CEE countries, an important level of human capital may favor social returns of R&D.

To the best of our knowledge there is no panel study to assess the role of R&D for the economic growth for the whole group of CEE countries.[3] Our original approach relies in splitting between private and public R&D, which brings an important contribution to the existing literature. Moreover, since possible complementarity between human capital and R&D is depicted in the growth theory (see Redding, 1996; Romer, 1990), we also include human capital in our empirical setting.

To accomplish our goals, we employ a dynamic panel estimation using the Arellano–Bond Generalized Method of Moments (GMM), based on a production function approach. The advantage of the first-differenced GMM estimator is that it is robust in the presence of endogenous covariates, allowing for individual fixed effects, heteroskedasticity and autocorrelation within the cross-section units.[4]

Our findings depict a significant coefficient for business R&D and confirm the hypothesis that human capital could play a role for the absorptive capacity of new technologies. The strong implication of our research is that governments should stimulate business (private) R&D. Based on our results, reflective points may be raised for the policy makers regarding the differences of the quality of the two types of R&D that should be analyzed and also the channels of cooperation between all the participants in the innovative systems that need to be improved.

The remainder of this paper is as follows: Section 2 presents a brief review of the relevant theoretical and empirical literature, Section 3 presents the methodology and the data, Section 4 presents the results, while Section 5 concludes and discusses the policy implications of the current work.

2. Theoretical and empirical literature background

It is acknowledged even starting with Solow (1956) that the new capital, based on known technology, which improves in time, has a more valuable role than the old (vintage) capital. Romer (1986) and Lucas (1988) pioneered an endogenous growth by introducing knowledge spillover, usually associated with R&D, respectively with human capital. Later on, models of horizontal product innovations (Romer, 1990) or vertical product innovations (Aghion and Howitt, 1992) are developed. The latter model implies a negative externality known in the literature as a "business-stealing" effect of R&D investment[5] which may promote over-investment in R&D activities.

In Jones (1995) "semi-endogenous" R&D based growth models consistent with time series evidence for the advanced countries, growth is endogenous in the sense that it is driven from the acquirement of new technologies by agents that are rational and seek to maximize profits. However, the growth rate is determined by exogenous parameters that are not affected by policy manipulation.

Some recent theoretical works give to R&D and human capital accumulation essential roles in driving economic growth. Sequeira (2008) develops an endogenous growth model with physical capital, human capital and R&D. He concludes that the R&D subsidies have an overall positive effect on growth, wealth and welfare while human capital policy is simultaneously the most income-generating and welfare-improving. In Gomez (2011), innovation is subject to externalities associated to the duplication of research effort, as well as to R&D spillovers which significantly increases the model's fit on the observed data. Mattalia (2012) employs human capital as a production factor in the final and intermediate goods sector, together with the embodied nature of the technological progress and the important role of R&D and concludes that the productivity of schooling affects the long run growth of the economy.

Empirically, the impact of R&D intensity on economic growth has been explored mostly for advanced countries. The empirical studies that enable a strong relationship between R&D and economic growth suggest that a 1% increase of the R&D stock will generate an output increase of 0.05–1% (Coe and Helpman, 1995; Grilliches, 1992). Some papers place human capital next to R&D as explanatory variables for productivity (see Coe et al., 1997; Engelbrecht, 1997; Frantzen, 2000, among others). Their findings suggest an overestimated coefficient for R&D in the absence of human capital.

Also, on aggregate data a large body of literature seeks to estimate the social and private returns of R&D[6], despite the measurement and specification errors encountered. The main conclusion is that the estimated social returns are greater than the private returns and this could explain the under-investment in R&D. Regarding the source of R&D funding, a lower rate of return is found for public R&D than private R&D, both at the private and social level (Grilliches, 1980; Park, 1995).

Therefore, an important research question that should be posed is whether the public policy should take into account the types of R&D when promoting them. David et al. (2000) make a review of the econometric evidence on the relationship between public and private R&D expenditures, at various levels of aggregation. They find complementarity more prevalent than substitution relationship in many industry or national-level studies for the US economy. They suggest further work in this area based on international panel data since a lot of variations may affect the expected private rates of return of R&D. Bassanini et al. (2001) estimate the impact of public and private R&D among other determinants of economic growth for OECD countries during 1980–1990 and find significant R&D business coefficient. For public R&D coefficient, the authors depict a negative impact of public R&D on growth. Their results suggest that the research expenditures in the public sector crowd out resources that could have been used by the private sector. Coccia (2012) finds that when R&D spending of the business enterprise sector exceeds R&D spending of the government sector, the labor productivity tends to grow in advanced countries. Moreover, they show a strong positive association between public and private R&D expenditure.

[3] Scarce literature on individual CEE countries exists (Dragomir et al. (2008), for Romania; Verbic et al. (2011), for Slovenia).

[4] The work of Caselli et al. (1996) is significant in recommending the first-differenced GMM estimator for empirical growth models.

[5] While not shown here in detail, readers may refer to Jones (2005) for a detailed presentation of the externalities. These externalities (positive or negative) may promote either under-investment in R&D activities or over-investment in R&D activities.

[6] Hall and Mairesse (2009) offer a comprehensive survey of the literature that sought to estimate the rate of return to R&D at country and international panel data set levels.