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Why don't poor countries do R&D? Varying rates of factor returns across the development process☆

Edwin Goñi[a], William F. Maloney[b,*]

[a] Inter-American Development Bank, United States
[b] EFI and Development Economics Research Group, The World Bank, United States

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ABSTRACT

Using a global panel on research and development (R&D) expenditures, this paper documents that on average poor countries do far less R&D than rich as a share of GDP. This is arguably counter intuitive since the gains from doing the R&D required for technological catch up are thought to be very high and Griffith et al. (2004) have documented that in the OECD returns increase dramatically with distance from the frontier. Exploiting recent advances in instrumental variables in a varying coefficient context we find that the rates of return follow an inverted U: they rise with distance to the frontier and then fall thereafter, potentially turning negative for the poorest countries. The findings provide a new mechanism underlying the twin income peaks – poor countries cannot exploit technological transfer for convergence while middle income countries can converge rapidly to the frontier. The low returns found for poor countries does not diminish the centrality of technological transfer for development, but rather suggests the importance of factors complementary to R&D, such as education, the quality of scientific infrastructure, the overall functioning of the national innovation system, and the quality of the private sector, which become increasingly weak with distance from the frontier and offset the catch up effect.

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1. Introduction

The existing literature suggests that developing countries should invest very heavily in Research and Development (R&D). The estimates of the return to R&D for advanced countries have been argued to be so high as to justify levels of investment multiples of those actually found (Bloom et al., 2013; Jones and Williams, 1998).[1] The case is arguably even stronger for poor

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* Corresponding author.
E-mail address: wmaloney@worldbank.org (W.F. Maloney).

[1] See Hall et al. (2010) for a recent and very complete tabulation of studies of the returns to R&D (see also Sveikauskas, 2007). In this paper, we will focus mostly on those of the last 20 years. Bloom et al. (2013), using a panel of US firms, argue that social rates of return to R&D are 55% and private 21% suggesting that socially optimal level of R&D spending should be double the actual. Earlier Jones and Williams (1998) estimated the social return to be 28%, a modest estimate along Hall et al.'s (2010) spectrum of estimated returns, and, given the long run real US interest rate of 7%, they argue that the US should be investing perhaps 4 times the present R&D level observed which averaged approximately 2.6% of GDP during 1995–2000. Relatively few studies to date use cross country data, thereby presumably capturing intra-country spillovers. Coe and Helpman (1995) estimate rates of return to R&D of 123% for the G7 and 85% for the remaining 15 OECD countries; Potterie and Lichtenberg (2001) find returns of 68% in the G7 and 15% for a subset of the remaining

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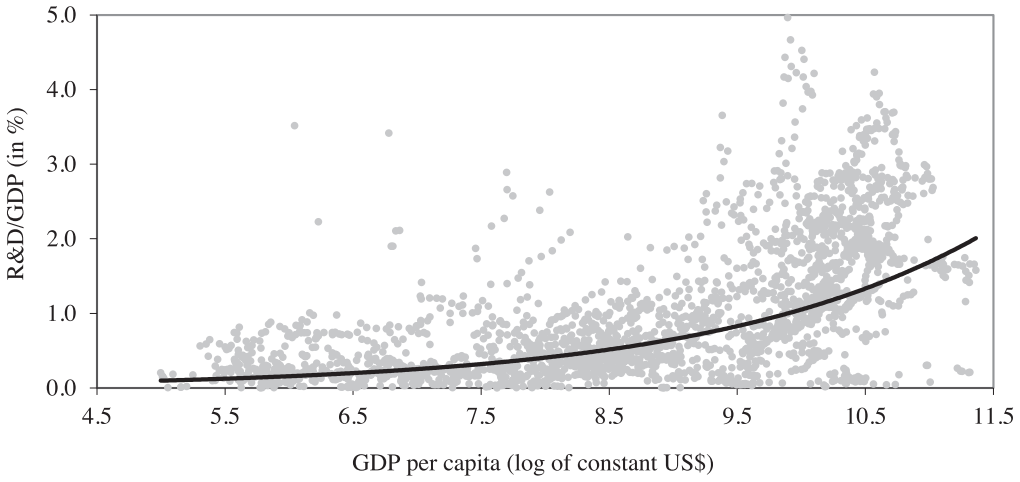

Fig. 1. R&D vs. level of development.
Source: R&D series from UNESCO, OECD, Taiwan Statistical Yearbook, RICyT, WDI and Lederman and Saenz (2005). GDP/capita from Penn World Tables v8.1. Each entry corresponds to a specific year for a specific country. Continuous line represents the exponential fit of the scattered points.

countries where a long literature argues that R&D is essential to the "absorptive" or "national learning" capacity required to exploit technological advance in the advanced countries.[2] Empirically, Griffith et al. (2004) for the OECD demonstrate that the estimated returns to R&D, in fact, rise with distance from the technological frontier and increasingly reflect the greater gains from catch-up afforded to follower countries. Extrapolating their estimates out of sample to even middle income countries, the implied returns are truly large and suggest a much larger effort in R&D is justified in developing countries than found in the advanced.

Yet Fig. 1 establishes that the poor countries invest far less as a share of their GDP than rich countries in R&D: the Scandinavian countries, Japan and the US occupy the top and Africa and Asia the bottom. The literature offers various possible explanations. Griffith et al. (2004) postulate the wedge between private and social returns; Aghion et al. (2012), Bond et al. (2010), Hall and Lerner (2009), Mulkay et al. (2000) have explored the role of credit constraints; (Bloom, 2007), the depressing impact of uncertainty, all of which would arguably be more binding in LDCs.

However, this still raises the question of why, given these high rates of return, developing countries do not take measures to offset the implicit market failures in credit, appropriability, or insurance and facilitate private sector R&D investment, or even undertake it directly. In fact, to re-frame Lucas' famous observation about growth, confronted with the rates of return found in the literature, it would be hard for governments to think of anything else-not removing barriers to the reallocation of factors of production (Hsieh and Klenow, 2009), nor reforming institutions (Acemoglu et al., 2005) for example, or other factors recently focused on in the growth literature (see for a summary Syverson, 2011). Indeed, looking again at Fig. 2, the dramatic trajectories of two important exceptions, China and India (following Israel, Finland, Korea previously), would suggest that they, in fact, think about R&D a lot.

This paper argues that developing country governments may well be rational: there may be countervailing forces that prevent Griffith et al.'s (2004) tendency from continuing monotonically with distance from the technological frontier. In particular, another literature stresses the necessary complementarities to R&D expenditure which are likely to diminish with distance from the frontier and hence reduce the efficacy of a given unit of R&D.[3] Howitt (2000), Aghion et al. (2005), Howitt and Mayer-Foulkes (2005) for example, use an aggregate productivity parameter for the R&D production function that could capture any number of institutional, and educational factors which can offset the Schumpeter catch-up effect.[4] In particular, analogous to Lucas's (1988) classic argument for the complementarity of human and physical capital, a large

OECD countries. Kao et al. (1999) for 22 OECD countries plus Israel find returns of 120% for the G7 and 79% for the remainder. In a previous version of this paper that did not allow as much parameter flexibility, Lederman and Maloney (2003) used an earlier version of the data base here and generated results in the same vicinity.

[2] Cohen and Levinthal (1989), Griffith et al. (2004) among others stress learning -knowing where the frontier is and figuring out what adaptations are necessary- as the "second face" of R&D. See also Forbes and Wield (2000), Pavitt (2001), Baumol et al. (1994), Nelson and Phelps (1966), Foster and Rosenzweig (1996), Cohen and Levinthal (1989), Acemoglu and Zilibotti (2001), Howitt (2000), Aghion et al. (2005), Howitt and Mayer-Foulkes (2005). Pavitt (2001) argues that even investment in pure research is also important for developing countries. First, those most familiar with the frontiers of basic science will best train the applied problem solvers in the private sector. Second, even basic research does not flow easily or costlessly across borders so developing countries cannot simply rely on what is being generated in the advanced countries.

[3] More generally, recent literatures have stressed the very large impact that missing complementarities can have in stymieing development (see Kremer, 1993; Jones, 2011).

[4] Aw et al. (2008) argue from Taiwanese data that a larger export market increases the expected returns to R&D. To the degree that poorer countries have smaller markets and fewer export linkages, the returns may be lower.

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