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Political economy of R&D to support the modern competitiveness of nations and determinants of economic optimization and inertia ☆

Mario Coccia [a,b,*]

[a] CNR – National Research Council of Italy
[b] Georgia Institute of Technology, USA

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ABSTRACT

The study here analyzes the association between R&D expenditure (as % of GDP) and labor productivity across leading geo-economic players. Empirical evidence seems to show, during the period of analysis, a strong positive association between public and private R&D expenditure. In addition, when R&D spending of business enterprise sector exceeds R&D spending of government sector, the labor productivity tends to growth (*economic optimization*), *ceteris paribus*. In general, effects of friction (*inertia*) on labor productivity growth are displayed by countries whose R&D intensity is driven mainly by R&D expenditure of government sector. Results provide fruitful implications that can support a rational political economy of R&D in order to foster the competitiveness of countries in fast-changing and turbulent markets.

1. Introduction

Economic recessions and high sovereign debts increase the turbulence of markets. In order to spur the recovery of the business cycle, countries should support science and innovation through higher R&D (Research & Development) investments conducive to industrial competitiveness (*cf.* Corrado et al., 2006; Coccia, 2007). R&D investment in economies requires considerable economic and human resources to contribute to the accumulation of intangible capital, which is one of the main determinants for patterns of economic growth. Several economic studies confirm the positive influence of R&D expenditure on the growth of total factor productivity (Mairesse and Sassenou, 1991; Hall and Mairesse, 1995; Guellec and van Pottelsberghe de la Potterie, 2001, 2004; Bravo-Ortega and García Marín, 2011). Brécard et al. (2006, p. 917, original emphasis) argue that: "In… the 'multiplier phase', growth is directly driven by R&D expenditures, while in the second phase, the 'innovation based growth', innovation is the engine of growth through productivity and competitiveness gains". Other studies show that the relationship between R&D expenditure and economic growth may be insignificant (*cf.* Lichtenberg and Siegel, 1991; Griliches, 1995; Hall, 1996; Samimi and Alerasoul, 2009 for developing countries).

In general, the production of scientific research and technological innovation depends on the structure of national system of innovation (NSI) and driving sectors, adequately supported by human and economic resources (Coccia, 2004, 2007, 2008, 2009, 2010a, 2011; Coccia and Rolfo, 2002; Breznitz, 2009). In particular, to cope with fast-changing markets, modern economies need an effective political economy of R&D that fosters competitiveness by emerging technologies and innovations (Coccia et al., 2012), to support the long-run economic growth and wellbeing of societies.

The **political economy of R&D** can be defined as a set of rules that support rational economic decisions by policy makers to efficiently allocate public and private economic resources in order to achieve the future objective of increasing scientific and technological performance in leading research fields and sectors, improving national competitiveness and welfare.

An effective Political Economy of R&D affects the "competitive advantage" (Porter, 1990) of countries and improves structural economic indicators, such as industrial production and employment growth, with fruitful effects on patterns of economic growth

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* Correspondence to: School of Public Policy at Georgia Institute of Technology-685 Cherry Street, N.W., Atlanta, Georgia 30332, USA. Tel. (CERIS-CNR): +39 011 68 24 925; fax: +39 011 68 24 966.
E-mail address: m.coccia@ceris.cnr.it

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(Coccia, 2009). As a matter of fact, the objectives of the political economy of R&D depend on the social welfare function of countries, which considers the preferences of the society (*e.g.* medicine, transport, environment, etc.) and the structure of driving industries of the economic system. The foundations of the political economy of R&D were laid by Bernal's and Bush's pioneering works over the 1940s–1950s, when public funding to R&D played a key role in achieving military objectives (see Martin and Nightingale, 2000, pp. 3–195). Nowadays, there is an intense debate across developed and developing countries on how to allocate the economic resources to support science and innovation in order to spur patterns of economic growth. Rational rules for an efficient and effective political economy of R&D require accurate answers to the following economic questions:

- How is public and private R&D expenditure correlated to the labor productivity growth of economies?
- How do R&D expenditures by governments and business enterprises differ in high-income and low-income per capita countries?

The purpose of this paper is to investigate these economic issues, mainly across European countries and other geo-economic players, by analyzing the relationship, at the country level, between R&D intensity, treated as an investment rather than as an expense, and labor productivity growth. Results may pinpoint some main rules of the political economy of R&D to support economic growth of countries in turbulent markets. Before tackling these issues, the theoretical framework and the research strategy are described.

2. Literature review and related works: a theoretical background

R&D plays a key role for supporting economic growth of modern economies and includes expenditures by the industry, government, higher education and private non-profit sectors (cf. Jones and Williams, 1998, p. 1133ff; Brécard et al., 2006, pp. 917–921). More specifically, the relationship between public and private R&D expenditure has been analyzed at the firm level (Higgins and Link, 1981; Link, 1982; Link and Scott, 1998; Toivanen and Niininen, 1998; Duguet, 2003; Lööf and Heshmati, 2005; Clausen, 2009; Griffiths and Webster, 2010; Hervas-Oliver et al., 2011), at the sector level – by Levin and Reiss (1984), Lichtenberg (1984, 1987) and other scholars – and at the aggregate level (*e.g.* Kealey, 1996). As patterns of economic growth can be affected by private under-investment in R&D (Peneder, 2008), several studies analyze whether public R&D expenditure is a complement or substitute for private R&D. David et al. (2000) shows the higher frequency of complementary effects between public and private R&D expenditures, in particular at the national level. However, Table 1 shows ambiguous results about this relationship since R&D spending includes heterogeneous elements that generate different effects on indicators and economic systems.

Table 1
Main results and studies about the relationship between public and private R&D expenditure, productivity and economic growth.

Main results about the relationship between public and private R&D expenditure	**+ = Complementarity effect; − = Crowding out effect; 0 = Neutral effect • Between R&D (public and private) • Between R&D and Productivity**
Kealey (1996) states that public funding and private funding displace each other.	−(R&D)
Levy and Terleckyi (as quoted by David et al., 2000) argue that government contract R&D is positively and significantly associated with private R&D investment and productivity.	+ (R&D & Productivity)
Lichtenberg (1984, 1987) reports that there is no additional impact from public R&D expenditure on private R&D investment.	0 (R&D)
Levin and Reiss (1984) find that government R&D intensity has a positive and significant effect on private R&D intensity. In particular, they find a complementary relationship showing that each additional dollar of public funds stimulates from seven to seventy-four cents of private R&D investment.	+ (R&D)
Lichtenberg (1984) finds that public R&D reduces private R&D investment at the industry level and an additional dollar crowds out eight cents of private R&D investment.	−(R&D)
Support for a complementarity effect between public and private R&D investments has emerged from studies by Hertzfeld and Mowery [as quoted by David et al., 2000, p. 521].	+ + (R&D)
Levy (1990) finds that five countries exhibit significant overall public-private complementarity effects, whereas two countries show significant substitution effects.	+ (R&D) −(R&D)
Hall and Mairesse (1995) find that the interaction between R&D and productivity in the manufacturing sector in France is positive (p. 263, *passim*).	+ (R&D & Productivity)
Mamuneas and Nadiri (1996) show that publicly financed R&D induces cost savings but crowds out privately financed R&D investment, while the incremental R&D tax credit and immediate deductibility provision of R&D expenditures have a significant impact on privately financed R&D investment.	−, + (R&D)
Wallsten (as quoted by David et al., 2000) shows that there is a one-for-one crowding-out of private investment, whereas Robson (as quoted by David et al., 2000) concludes that there is a one-for-one stimulus of private R&D investment. These studies are not based on the same dataset.	− (R&D) + (R&D)
González and Pazó (2008) confirm the lack of crowding-out between public R&D support and private R&D investment and that small firms operating in low technology sectors may not engage in R&D activities in the absence of public subsidies (p. 371).	0 (R&D)
Clausen (2009) argue that: " 'research' subsidies stimulate R&D spending within firms while 'development' subsidies substitute such spending" (original emphasis, p. 239).	+, − (R&D)
Coccia (2010a, 2011)	+ (R&D)
Lee (2011, p. 256) shows: "public support tends to have a complementarity effect on private R&D for firms with low technological competence, for firms in industries with high technological opportunities and for firms facing intense market competition. In contrast, firms with high technological competence and firms that have enjoyed fast demand growth in recent years show a crowding-out effect, and firm size and age do not show any discernible differential effect".	+, − (R&D)
Main studies about the relationship between R&D expenditure and productivity/economic growth	
Lichtenberg and Siegel (1991); Mairesse and Sassenou (1991); Griliches (1995); Hall (1996); Mamuneas and Nadiri (1996); Hall and Mairesse (1995); Guellec and van Pottelsberghe de la Potterie (2001, 2003 and 2004); Griffith et al. (2004); Zachariadis (2004); Goel et al. (2008); Brécard et al. (2006); Samimi and Alerasoul, 2009; Coccia (2010a; 2011), Bravo-Ortega and García Marín (2011).	

Note: Economic literature is vast and not fully quoted here.