

## Growth, R&D expenditure and spillover effects: An input-output approach.

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R&D expenditure seems to be key explaining economic growth in developed countries. Some papers have attempted to analyse the effect of R&D expenditure realized in a particular sector over others. We can mention papers such as Tsai, K-H et al. (2004), Bernstein, J. I (1999) or Berndt, E.R. (1995) focused on specific sectors such as manufacturing sectors or high-tech industry. In this paper, on the basis of Ten Raa, T et al. (2000), that suggest an alternative way to calculate spillover effects of R&D expenditure and its effect over total factor productivity and Antonelli (2015) that captures the role of knowledge externalities over productivity making use of input-output tables of 15 countries, we deal with two interesting topics. First, we calculate within a multiregional framework relationship between growth and R&D spillovers from two perspectives: final consumption (R&D embodied in final demand) and production (R&D invested). The second approximation is related with the distribution of the embodied R&D effect over economic growth.

Empirically, we use MRIO-WIOD (1995 to 2011) to as well as R&D expenditure information provided by the OECD databases.

Preliminary results seem to reflect that the countries that achieve the most important role from both perspectives are USA, Japan and Germany, although scenery changes when we introduce China. In general, it is observed an increase in the number of "characters"™ along the period studied. If we pay attention on R&D embodied and invested coming from non-domestic countries we can observe that other countries gain relevance; Mexico and Canada in the case of R&D embodied perspective (surely due to their relationships with USA), France, UK or Italy in the case R&D invested perspective (probably as an indicator of European agreements). It is also remarkable the Chinese case, which, at the end of the period, get high values as an indicator of the current externalization of this country. Respect to sectors behavior, it is possible to observe a common pattern between countries, being the sectors where we find the highest level of, both, R&D embodied and R&D invested Rest of services, Transport equipment and Electrical and optical equipment. These results seem to be coherent with data used, as great part of R&D expenditure is done in high-tech industry sectors or in Rest of services.

Once a first picture of R&D flows in the world economy is obtained, the other question we try to analyze in this paper is the effect of this R&D over economic growth. In that way, we can expect that direct and indirect R&D expenditure has a positive effect over productivity and, so, over economic growth. However, in our opinion this effect is not immediate. It has to pass some time until these effects are visible in the economy; in other words, there is a gap between R&D investment and its effect on productivity and growth. We approximate to this idea using econometric techniques. Translated this into econometric terms, it means that the relationship between economic growth and R&D has not linear features. In order to study what kind of regression adjusts better, we use minimum least squares and non-parametric estimators, particularly local linear least squares following the methodology explained by Racine. S (2008).