Extended Abstract

Public R&D funding and private R&D investment in regions: UK regions in international comparison

- Public R&D investment (Research and Development investment) stimulates private R&D investment. In UK regions, a 1% increase in public R&D funding leads to a contemporaneous increase in private R&D investment by 0.3%. The impetus from public investment extends beyond the initial periods as firms tend to continue spending on R&D projects. The aggregate benefit accounting for the persistence of private R&D investment can accumulate up to 0.9%, most of which crowds-in by the fifth year after the public investment, with smaller benefits accruing for as long as the next 20 years. Given current public and private R&D investment in the United Kingdom, the percent increase translates into a total longer-term stimulus in private R&D investment of USD 2.40 for a USD 1.00 increase in public R&D investment.
- Returns on private R&D investment appear to be high in OECD regions that already invest heavily in R&D. Agglomeration benefits may allow a greater stimulus in regions where R&D is concentrated. In regions whose R&D investment is more than 2% of their GDP (i.e. high R&D intensity), the leverage rate (i.e. the impact of a 1% increase in public R&D investment on private R&D investment) is slightly larger than in the rest of the regions. The differences are, however, statistically insignificant. Similarly, regions with fertile ground for R&D (e.g. manufacturing and high-tech industries) show larger leverage rates, but without statistically significant differences.
- Returns on private R&D investment are finite. In UK regions, the returns on private R&D investment are not always higher in regions that heavily invest in R&D. East of England and South East England invested on average more than 2% of their GDP in R&D during 1998-2018, but the leverage rates of the two high R&D intensity regions are lower than the rest of UK regions. When UK regions are classified further into high, middle (i.e. between 1.1% and 2.0%), and low R&D intensity (i.e. below 1.1%), the regions with middle R&D intensity (North West England, East Midlands, West Midlands, South West England, Scotland, Northern Ireland) show the largest leverage rate, followed by the low R&D intensity regions. Cross-country evidence also shows that countries investing in R&D more than the United Kingdom (i.e. Korea, Austria, and the United States) do not exhibit higher returns. Furthermore, giving greater weights to regions by R&D intensity in the estimation rather lowers the returns.
- Business R&D expenditure data published by the UK Office for National Statistics (ONS) seems to have increasingly underestimated actual business R&D expenditure for several years, likely starting with the reform of the R&D tax credit system in the United Kingdom in 2013. In 2018, estimates by the ONS find that previously reported business R&D expenditure was 40% lower than the best estimate for the actual value. The UK government has set a target of 2.4% of GDP investment in R&D by 2027 given the past R&D trajectory calculated with the underestimated data, but the United Kingdom already reached 2.7% of GDP investment in R&D in 2018. This uncertainty in R&D data makes estimating the returns on private R&D investment challenging. In this paper, an uplifting methodology was developed by adapting the ONS methodology, and the results reflect actual private R&D investment. When using the underestimated private R&D investment from 2000 to 2018, the returns on private R&D investment fall to USD 1.7. Underestimated private R&D investment could result in underestimation of returns.
- Governments typically combine direct funding and indirect tax relief as a policy mix to encourage R&D. The United Kingdom has the highest share of tax relief support among OECD countries: 75% of the UK government support to business R&D expenditure occurs through tax relief while only 25% through direct government funding. One challenge is that R&D statistics include tax relief as part of business R&D investment instead of government R&D investment. To reflect the importance of tax relief, additional leverage rate is estimated as a robustness check by shifting the tax relief from private to public R&D investment for the period 2000-2018. This results in a 1% long-run leverage rate for UK regions (slightly higher than the main estimate of 0.9%), but the long-run monetary impact decreases to USD 2.2 due to increased public R&D funding and decreased private R&D funding as a result of tax relief shifting. On the other hand, the long-run impacts of direct government funding alone become 0.8% and USD 2.1, slightly lower than the estimates including the effects of direct funding and tax relief

both. This result suggests that tax relief and direct government funding as a R&D policy mix could complement each other in stimulating returns on private R&D investment.

- Going forward to one important area of consideration is higher education's internal funds. Higher education's R&D funding is part of public R&D investment, but a large portion of R&D funded by higher education comes from its internal funds which include tuition fees. In 2018, nearly 40% of the R&D carried out by UK higher education funded from its internal funds. This poses another challenge to estimating leverage rates because tuition fees cannot constitute public R&D investment. Official data published by the UK ONS, however, have excluded the higher education's internal funds in the R&D statistics until 2017. As a result, the UK leverage rates estimated in this paper exclude the effect of tuition fees, which is more precise than what would have been obtained otherwise. Yet, given the substantial share of the higher education's internal funds, the missing values are included as a robustness check in the UK public R&D funding following the ONS approach for the period 2010-2018. The long-run monetary impact drops to USD 1.7 mainly due to increased public R&D funding. This result may imply that Brexit - that potentially reduces UK higher education's income from tuition fees - would have little negative impact on the returns on private R&D investment in the United Kingdom.