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MONTHLY REVIEW OF ACADEMIC LITERATURE ON RESEARCH AND INNOVATION AS SOURCES OF GROWTH

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1. IMF Fiscal Monitor. April 2016. Acting Now. Acting together.

<https://www.imf.org/external/pubs/ft/fm/2016/01/fmindex.htm>

The IMF Fiscal Monitor 2016 argues that fiscal policies can contribute significantly to innovation. With appropriate design, fiscal policies can generate a meaningful impact on productivity growth. The analysis focuses on three channels of innovation: research and development (R&D), technology transfer, and entrepreneurship. The key policy messages arising from the report are:

- Governments in many countries should do more to promote R&D. Private firms do not invest enough in R&D for two reasons. First, firms often find it difficult to finance these risky investment projects, especially during recessions. Fiscal policies that help stabilise output can effectively contribute to overcoming this problem. Second, R&D investments have beneficial effects for the wider economy as a result of knowledge spillovers. Firms do not take these positive externalities into account in their decisions. If they did, R&D would be 40% higher than it currently is. Such an increase could lift GDP in individual economies by 5% in the long term—and globally by as much as 8% due to international spillovers.
- Fiscal policy can play an important role in promoting private R&D, for example, by providing subsidies and tax incentives. The design and implementation of these instruments are critical for their effectiveness. Best practices include payroll tax relief for researchers and refundable R&D tax credits.
- In emerging markets and developing economies, governments should invest in education, infrastructure, and institutions to facilitate imitation and absorption of technologies from advanced economies. Many countries sacrifice their tax base by granting costly tax incentives (e.g. IP box regimes) to attract foreign investment, but the evidence suggests that these incentives are not very effective.
- Fiscal policies to foster innovative entrepreneurship should be targeted to new firms rather than small firms. High income tax rates exert only modest distortions to the entrepreneurial process. Yet innovation can be promoted by certain features in the design of taxes - in particular, generous provisions to offset taxable losses. To encourage entrepreneurship, many governments offer special tax incentives for small companies, but these incentives are not cost-effective and can even discourage such firms from growing. It is more important to facilitate the entry of new firms, including by simplifying taxes.

2. Regulation, red tape and location choices of top R&D investors

Ciriaci D, Grassano N, Vezzani A (2016). Regulation, red tape and location choices of top R&D investors. IPTS Working Papers on Corporate R&D and Innovation No 01/2016.

- This paper investigates how product and labour market regulations and red tape affect the location choices of top corporate R&D investors
- Both product market regulation (PMR) and employment protection legislation (EPL) are found to affect the location decisions of top R&D investors, as well as red tape and profit tax.
- The marginal effect of PMR is by far the largest, followed by EPL; the cost of starting a business and profit tax show lower marginal effects.
- PMR and EPL are complementary (i.e. reducing one would also reduce the negative impact of the other).
- Of the three components of the PMR indicator —barriers to trade and investment, state control and barriers to entrepreneurship—the latter is the one with the lowest marginal effect.

This paper investigates the extent to which product and labour market regulations and red tape affect, among other socio-economic factors, the probability that top corporate research and development (R&D) investors locate in a particular country. The decision about where a company locates its international subsidiaries is modelled using location-specific framework conditions, socio-economic factors and other controls commonly used in the economic geography literature. The location decision drivers are estimated using a multilevel mixed-effects logistic regression, controlling for both fixed and random effects. The results show that product and labour market regulations, as well as the cost of starting a business, significantly affect the location decision of top R&D investors' subsidiaries. When taken separately, the level of PMR has the greatest negative effect on companies' location decisions, while EPL does not appear to play a significant role in such choices. When considering the interaction between PMR and EPL, both exert a significant and negative effect on location decision. This shows that these two regulations exert a combined effect. In other words, the higher the level of product market regulation, the higher the negative effect of employment protection and viceversa. The interplay between PMR and EPL calls for integrated/coordinated policies in the two realms. Among the different components of the PMR index, barriers to trade and investment have the greatest impact on location decisions, followed by state control and barriers to entrepreneurship. By lowering barriers to trade and investment, EU policy-makers may facilitate the market uptake of new products and have the greatest impact in attracting foreign investments. The cost of starting a business and the corporate income tax rate play a negative role on companies' location decisions. However, their effect is much lower than that of the other framework conditions discussed above. The decisions of the companies considered in the study seem to be driven more by a desire to improve efficiency than by cost reduction considerations.

3. Why it pays off to pay us well: The impact of basic research on economic growth and welfare

Prettner K, Werner K (2016). Why it pays off to pay us well: The impact of basic research on economic growth and welfare. *Research Policy* 45(5):1075-1090.

- The paper analyses the growth and welfare effects of basic research in an R&D-based growth model.
- It finds a long-run welfare-maximising rate of basic research investments.
- This rate is shown to exceed the rates observed in the OECD by almost a factor of 8, which is within the range of plausible values on the social rate of return of R&D.
- In the short-run there are substantial costs of basic research, which potentially explain governments reluctance to invest in basic research.

The paper analyses the growth and welfare effects of governmental basic research investments in an R&D-based growth model with endogenous fertility and endogenous education. In line with the empirical evidence, the model accounts for (i) the negative effect of population growth on

economic growth, (ii) the positive effect of education on economic growth, (iii) the positive association between the level of per capita GDP and expenditures for basic research, and (iv) the gestation lag of basic research investments. The results indicate that there is a welfare-maximising level of basic research expenditures, that exceeds current outlays for basic research in the OECD by almost a factor of 8, which is well within the range of plausible values that can be derived from empirical estimates on the social rate of return of R&D. The model-based explanation that the authors provide for this discrepancy is that raising public investments in basic research toward the optimal level reduces the growth rate of GDP and welfare in the short run because taxes have to increase and resources have to be drawn away from other productive sectors of the economy. These adverse short-run welfare effects are one potential explanation for the reluctance of governments and their currently living voters to increase public R&D expenditures despite the long-run benefits of such a policy.

4. The fruits of R&D: Meta-analyses of the effects of Research and Development on productivity

Donselaar P, Koopmans C (2016). *The fruits of R&D: Meta-analyses of the effects of Research and Development on productivity*, Research Memorandum 2016-1, Free University of Amsterdam, Amsterdam.

- This study investigates the effect of R&D on productivity at the micro, meso and macro level.
- Meta-analyses were performed to analyse the variation in output elasticities of R&D.
- Study characteristics explain variations in output elasticities to a large extent.
- The output elasticity of domestic R&D at the macro level is (on average) much higher in G7 countries than in non-G7 countries
- The meta-analyses indicates an important influence of spillovers from foreign R&D capital on productivity.
- For non-G7 countries the output elasticity of foreign private R&D capital is estimated to be substantially higher than the output elasticity of domestic private R&D capital.

Research and Development (R&D) is a major factor in product and process innovation, and innovation in turn is one of the main drivers of productivity growth. This paper contributes to the literature by explaining the variation in results through meta-analyses of existing studies exploring the effects of firm and government investments in R&D on productivity. A database of study results and study characteristics has been constructed, containing 1214 output elasticities of R&D from 38 studies. The output elasticities generally refer to the effect of R&D capital on output, but sometimes R&D expenditure is the explanatory factor. R&D capital is the accumulation of R&D expenditures, adjusted for depreciation due to obsolescence of knowledge. Other main characteristics of studies that are taken into account in the meta-analyses are the econometric method used, the specification of the estimated equations, the output variable used as dependent variable (e.g. value added), the definition of the R&D input variable etc.. Furthermore, a distinction is made between low, medium and high tech sectors. The meta-regressions show that a substantial part of the differences in results between studies can be explained by study characteristics. Assuming 'optimal' study characteristics, the meta-regressions are used to compute 'best guess' estimates of the output elasticities of business R&D capital and public R&D capital in non-G7 countries. For domestic business R&D capital the best guess output elasticity is 0.06. For domestic public R&D capital a best guess output elasticity of roughly 0.03 was derived, but this result is subject to much uncertainty because of diverging results in a small number of studies. The meta-analyses also indicate an important influence of spillovers from foreign R&D capital on productivity. For non-G7 countries the output elasticity of foreign private R&D capital is estimated to be substantially higher than the output elasticity of domestic private R&D capital.

5. Support for Private Research and Development in OECD Countries on the Rise but Increasingly Inefficient

Belitz H (2016). *Support for Private Research and Development in OECD Countries on the Rise but Increasingly Inefficient*. DIW Economic Bulletin 8.2016.

- The study examines the level of direct and indirect government support to business R&D in 18 OECD countries and the efficiency of the funding system.
- The share of business R&D expenditure funded by governments directly or indirectly is on the increase.
- However, one euro of public funding often fails to result in a corresponding increase in private R&D spending.
- In countries with high funding rates and substantial tax incentives, private R&D intensity has not increased any faster than in countries with considerably lower funding rates and no tax incentives at all.

The study examines the level of direct (e.g. project funding) and indirect (R&D tax incentives) government support for business research and innovation. It finds that the overall funding rate in some OECD countries has increased dramatically in recent years. At the same time, tax incentives have become increasingly important in many countries. However, there has been a decline in the efficiency of funding: in countries with high funding rates and a strong emphasis on tax incentives (such as France and the UK), private R&D intensity has not increased any faster than in countries with considerably lower funding rates and limited tax incentives— or no tax breaks at all (such as Germany). An increase in the funding rate, on the one hand, and changes in private R&D intensity and growth in business R&D expenditure in real terms, on the other hand, are not positively correlated in the OECD countries included in the study.

6. Financing patterns of R&D in small and medium-sized enterprises and the perception of innovation barriers in Germany

Belitz H, Lejpras A (2016). Financing patterns of R&D in small and medium-sized enterprises and the perception of innovation barriers in Germany. *Science and Public Policy* 43(2):245-261.

- The paper analyses the role public support plays in SMEs R&D financing as well as these firms' perception of obstacles to innovation.
- The analysis is based on a sample of German SMEs that participated in public R&D promotion programs.
- Firms are generally positive about public financing of R&D in Germany.
- SMEs perceive obstacles to innovation primarily in the non-financial sphere, namely, the supply of skilled personnel, market regulation, and competition conditions.

The paper analyses the role public support plays in small and medium-sized enterprises (SMEs) R&D financing as well as these firms' assessments of financing conditions in the context of other framework conditions for innovation. Using the sample of 2,708 German SMEs that participated in public R&D promotion programs during 2005–10, the authors identify four unique types of R&D financing. Firms are generally positive about public financing of R&D in Germany, although a group of R&D companies without a track record that wish to introduce an innovation to the market find it difficult to procure a loan. SMEs perceive obstacles to innovation primarily in the non-financial sphere, namely, the supply of skilled personnel, market regulation, and competition conditions. Therefore, the authors conclude that future work on innovation policies for SMEs should place greater emphasis on the non-financial external framework conditions for firm R&D and innovative activity.

7. Towards green growth: How does green innovation affect employment?

Kunapatarawong R, Martínez-Ros E (2016). Towards green growth: How does green innovation affect employment? *Research Policy* 45(6):1218-1232.

- The paper analyses the relationship between green innovation and employment using the Spanish PITEC data (2007–2011).
- It finds a positive relationship between green innovation and employment. The relationship is stronger for firms in dirty industries.

- There is a positive relationship for firms introducing green innovation voluntarily, as compared to firms complying with regulations.
- There is a positive relationship between employment and firms reporting an increase in the degree of importance paid to green innovation.

The paper examines the relationship between green innovation and employment from data taken from the Spanish Technological Innovation Panel (PITEC) for the period 2007–2011. The increasing relevance of environmental issues for the Spanish economy, its unemployment problem and the uniqueness of its innovation structure make it a proper and interesting context to investigate green innovation dynamics. The authors find a positive relationship between green innovation and employment, and the relationship is stronger for firms in the so-called 'dirty' industries. In addition, the authors show that the relationship is positive for firms that introduce green innovation voluntarily, as compared to firms that introduce green innovation merely to comply with regulations. A positive and significant relationship is also found between employment and firms that report an increase in the degree of importance paid to green innovation.

8. The link between R&D, innovation and productivity: Are micro firms different?

Baumann J, Kritikos A S (2016). The link between R&D, innovation and productivity: Are micro firms different? *Research Policy* 45(6):1263-1274.

- The paper analyses the link between R&D, innovation, and productivity in micro firms.
- R&D intensity has a larger effect on product than process innovation for micro firms.
- Micro firms benefit from innovation processes, as these increase labor productivity.
- Only product innovation has a positive effect on MSMEs' labor productivity.

The paper analyses the link between R&D, innovation, and productivity in MSMEs with a special focus on micro firms with fewer than 10 employees; usually constituting the majority of firms in industrialised economies. Using the German KfW SME-panel, the authors examine to what extent micro firms are different from other firms in terms of innovativeness. They find that while firms engage in innovative activities with smaller probability, the smaller they are, for those firms that do make such investment, R&D intensity is larger the smaller the firms are. For all MSMEs, the predicted R&D intensity is positively correlated with the probability of reporting innovation, with a larger effect size for product than for process innovations. Moreover, micro firms benefit in a comparable way from innovation processes as larger firms, as they are similarly able to increase their labour productivity.

9. Where do spinouts come from? The role of technology relatedness and institutional context

Yeganegi S, Laplume A O, Dass P, Huynh C-L (2016). Where do spinouts come from? The role of technology relatedness and institutional context. *Research Policy* 45(5):1103-1112.

- Employees with experiences unrelated to core technology are more likely to start spinouts.
- Strong intellectual property rights impede spinouts.
- Venture capital availability stimulates spinouts.

This paper conceptualises and empirically examines organisational and institutional antecedents of spinouts (i.e., new businesses created by employees). The authors deploy multi-level logistic regression modeling methods on a sub-sample of the Global Entrepreneurship Monitor's 2011 survey covering 29 countries. The results reveal that employees who have experience with activities unrelated to the core technology of their organisations are more likely to spin out entrepreneurial ventures, whereas those with experiences related to the core technology are less likely to do so. In support of recent theory, the paper finds that the strength of intellectual property rights and the availability of venture capital have negative and positive effects, respectively, on the likelihood that employees become entrepreneurs. These institutional factors also moderate the effect of technology relatedness such that spinouts by employees with experiences related to core

technology are curbed more severely by stronger intellectual property rights protection regimes and lacking of venture capital.

10. Government-subsidized R&D and firm innovation: Evidence from China

Guo D, Guo Y, Jiang K (2016). Government-subsidized R&D and firm innovation: Evidence from China. *Research Policy* 45(6):1129-1144.

- The paper examines the effects of a government R&D program for SMEs (Innofund) on firms' innovation.
- Innofund-backed firms outperform their counterparts in innovation.
- The governance of Innofund influences the effects of Innofund.
- Innofund effects are stronger when Innofund governance is more decentralised.

This study investigates the effects of government R&D programs on firm innovation outputs, which are measured by the number of patents, sales from new products, and exports. Particularly, the authors examine the effects of Innovation Fund for Small and Medium Technology-based Firms (Innofund), which is one of the largest government R&D programs that support R&D activities of small and medium-sized enterprises in China. Using a panel dataset on Chinese manufacturing firms from 1998 to 2007, the authors find that Innofund-backed firms generate significantly higher technological and commercialised innovation outputs compared with their non-Innofund-backed counterparts and the same firms before winning the grant. Moreover, the changes in the governance of Innofund in 2005 from a centralised to a decentralised one due to policy amendments have significant effects on the effectiveness of the program. Specifically, the effects of Innofund on technological innovation outputs become significantly stronger after the governance of Innofund becomes more decentralised.