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

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1. What is the relationship between public and private investment in science, research and innovation?

Economic Insight (2015). What is the relationship between public and private investment in science, research and innovation? A report commissioned by the Department for Business, Innovation and Skills (BIS).

- The report looks into the relationship between public and private investment in R&D and tries to categorise and measure the different types of leverage achieved in the UK.
- The analysis suggests that 1% increase in public expenditure on R&D will lead to between a 0.48% and 0.68% increase in private expenditure on R&D.
- This is equivalent to a £1 increase in public expenditure leading to a £1.13 to £1.60 increase in private expenditure.
- BIS uses an estimate of £0.85 and may be underestimating the effect of changes in public expenditure on R&D.
- The report estimates that an extra £1 of public spending on HEI research leads to £0.29 more of private funding of HEI research and £1.07 of research conducted elsewhere

Based on a literature review, econometric analysis, and qualitative interviews, the report looks into the relationship between public and private investment in R&D and tries to categorise and measure the different types of leverage achieved in the UK and to analyse the conditions under which leverage can be increased. The report distinguishes between two different measures of leverage: i) The private sector percentage is the proportion of total R&D expenditure that is funded by the private sector; ii) Additionality is the amount of private sector funding that arises as a result of public sector funding, and that otherwise would not have occurred. The report finds that the Department for Business, Innovation and Skills (BIS) may be understating the level of additionality that occurs from public funding of research. The analysis suggests that 1% increase in public expenditure on R&D will lead to between a 0.48% and 0.68% increase in private expenditure on R&D. This is equivalent to a £1 increase in public expenditure leading to a £1.13 to £1.60 increase in private expenditure – or a mid-point of £1.36. Whereas, BIS uses an estimate of £0.85 – and may therefore be materially underestimating the effect of changes in public expenditure on R&D. Holding the science budget for resource spending constant in cash terms has given rise to an estimated additional £1.2bn of private sector investment that would not have occurred if the budget had been cut. The results are consistent with the public investment in research conducted within HEIs giving rise to significant spillover effects outside of HEIs. The report estimates that an extra £1 of public expenditure on HEI research leads to £0.29 of private funding of HEI research and £1.07 of research conducted elsewhere. The key factor determining the leverage is the existence, longevity and quality of personal relationships supporting public-private collaborations.

2. Innovation and top income inequality

Aghion P, Akcigit U, Bergeaud A, Blundell R, Hemous D (2015): Innovation and top income inequality. Discussion Paper Series. Public Economics.

- In their paper the authors analyse the effect of innovation-led growth on top incomes and on social mobility.
- In recent decades, there has been an accelerated increase in top income inequality, particularly in developed countries.
- The authors argues that innovation partly accounts for the surge in top income inequality and fosters social mobility as they find positive and significant correlations between innovativeness and top income shares.
- The positive effect of innovation on social mobility is due to new innovators.

The study uses US cross-state panel data to show a positive and significant correlation between various measures of innovativeness and top income inequality over the past decades. Two distinct instrumentation strategies suggest that this correlation (partly) reflects a causality from innovativeness to top income inequality, and the effect is significant. For example, when measured by the number of patents per capita, innovativeness accounts on average across US states for around 17% of the total increase in the top 1% income share between 1975 and 2010. However, innovation does not appear to increase other measures of inequality which do not focus on top incomes. Next, the study shows that the positive effects of innovation on the top 1% income share are dampened in states with higher lobbying intensity. Finally, from cross-section regressions performed at the so-called commuting zone level, the study finds that: (i) innovativeness is positively correlated with upward social mobility; (ii) the positive correlation between innovativeness and social mobility, is driven by entrant innovators and less so by incumbent innovators, and it is dampened in states with higher lobbying intensity. Overall, the findings vindicate the Schumpeterian view that the rise in top income shares is partly related to innovation-led growth, where innovation itself fosters social mobility at the top through creative destruction.

3. Policies for Seed and Early State Finance

Wilson K, Silva F, (2013). Policies for Seed and Early State Finance: Findings from the 2012 OECD Financing Questionnaire, OECD Science, Technology and Industry Policy Papers. No. 9, OECD Publishing.

- Policy interventions in seed and early stage finance seem to focus heavily on supply side measures. Supply side policy interventions (grants, loans, guarantees, tax incentives, equity instruments) have increased in the past five years, as a direct result of the recent financial crisis.
- Increases can be observed in tax incentive programmes, including young innovative company schemes as well as "front-end" (incentives for investments in start-ups) and "back-end" (capital gains tax provisions, rollover and carry-forward of gains or losses) tax incentives.
- In terms of equity instruments, an increase, particularly in co-investments funds and fund-of-funds which seek to leverage private investment can be observed.
- Despite the growth of equity programmes, there is little evidence of the impact of these instruments and whether or not they crowd out private investors.
- The demand side is often overlooked in favour of supply side actions, however developing human capabilities is critical to success in early stage financing.

Young innovative firms face increasing difficulties accessing seed and early stage finance. Banks are less willing to provide loans to start-ups as a result of the financial crisis. Venture capital firms have become more risk adverse due to pressures on the industry and have focused on later stage investments. Angel investors have become more visible and active through groups, syndicates and networks but also face difficulties. Governments have sought to address the financing gap and market failures by supporting the seed and early stage market. Policy interventions in seed and early stage finance seem to focus heavily on supply side measures as they are perceived as being more visible and direct. Supply side interventions (grants, loans, guarantees, tax incentives, equity instruments) have increased in the past five years in many OECD countries, as a direct result of the recent financial crisis. Increases can be observed in tax incentive programmes in some OECD countries, including young innovative company schemes (YIC) as well as "front-end" (incentives for investments in start-ups) and "back-end" (capital gains tax provisions, rollover and carry-forward of gains or losses) tax incentives. There have only been a few evaluations of these programmes.

In terms of equity instruments, an increase, particularly in co-investments funds and fund-of-funds which seek to leverage private investment can be observed. Earlier experience from direct government funds indicated that those models were not effective. Despite the growth of equity programmes, there is little evidence of the impact of these instruments and whether or not they crowd out private investors. Only a small portion of the equity programmes in OECD countries have been formally evaluated and empirical analysis of the outcomes of these programmes has also been scarce, in part due to challenges with seed and early stage data.

The demand side is often overlooked in favour of supply side actions, however developing human capabilities is critical to success in early stage financing. There is also increasing evidence of the importance of social capital, both local and global, as high growth firms need to grow beyond national borders and networks are often critical in facilitating that growth. Growth in demand side programmes such as incubators, accelerators, business angel networks and matchmaking services can be observed in many OECD countries. The results also highlighted programmes to help entrepreneurs present to investors. However, a gap was noted in the training and development of investors themselves. Initiatives to create a more entrepreneurial culture are vital as in many countries the fear of failure is higher than perceived opportunities. Exit markets play a critical role as well as bankruptcy regulations, labour market restrictions and other framework conditions. Securities legislations and increasing restrictions on institutional investors can be barriers to investment in seed and early stage companies. Reforms such as Basel III make banking safer and more stable, but these more stringent capital requirements can reduce the supply of investment in venture capital from banks, pension funds and insurance companies (large institutional investors).

4. Inside the black box of outcome additionality: Effects of early-stage government subsidies on resource accumulation and new venture performance

Söderblom A, Samuelsson M, Wiklund J, Sandberg R (2015). Inside the black box of outcome additionality: Effects of early-stage government subsidies on resource accumulation and new venture performance. Research Policy. 44(8):1501-1512.

- The paper examines outcome additionality of prestigious early-stage government subsidies.
- It uses a matching approach when comparing approved and rejected applications.
- Subsidized new ventures attract more human and financial resources than others.
- These resources in turn have long-term and substantial influence on performance.

This paper examines the outcome additionality of prestigious early-stage government subsidies. Drawing on arguments from liabilities of newness and certification literature this paper develops a mediated model that unpacks the outcome additionality of the subsidy. The paper hypothesizes that subsidized new ventures attract more human and financial capital than non-subsidized ones because the association with a prestigious government organization signals legitimacy. Such legitimacy is crucial for attracting qualified employees and financiers. The effect of the access to human and financial capital, in turn, has long-term and substantial influence on performance, whereas the effect of the subsidy itself is marginal and short-lived. Applying a novel matching approach, the paper compares 130 approved applicants to a government subsidy with a control group. The findings have implications for government support of new ventures and scholars.

5. Co-owner relationships conducive to high quality joint patents

Briggs K (2015): Co-owner relationships conducive to high quality joint patents. Research Policy. 44(8):1566-1573

- Multi-country ownership increases the likelihood that a joint patent is high quality.
- Co-ownership with a university enhances the long run benefit to quality.
- Co-ownership by countries with similar incomes enhances the short run benefit.
- Income similarity approximates positive benefits of similar national patent regimes.

Multi-country joint ownership of a patent positively impacts patent quality, which is evidenced by their receiving statistically more forward patent citations than patents co-owned within a single country. This paper considers the possibility that university partnerships and income differences between international co-owners further influence joint patent quality. Multi-country co-ownership in countries with similar per capita incomes enhances the likelihood a joint patent is of high quality in the short run, when quality is assessed as forward citations received within three years. However, this short run benefit disappears when differences in national patent regimes are controlled for in the analyses. Finally, although co-ownership with a university is not found to have immediate impact, it enhances the likelihood that a joint patent is classified as high over its life.

6. Companies learning to innovate in recessions

Amore M D (2015). Companies learning to innovate in recessions. Research Policy 44(8):1574-1583.

- The paper analyzes US firms' R&D activities over the business cycle.
- Results indicate that R&D activities conducted during past recessions improve a firm's ability to innovate during new downturns.
- R&D activities conducted during non-recession years do not have the same effect.
- Past experience with innovation during recessions is also beneficial to patent outcomes after a new recession.

Innovating in downturns can affect corporate success by improving a firm's position relative to competitors during the recovery period. However, increased uncertainty and more binding financial constraints complicate such innovation activity. The paper finds that past experience with innovation during recessions improves a firm's ability to invest in R&D when a new downturn hits. This result holds controlling for traditional drivers of innovation as cumulated innovations and financial constraints, as well as mitigating endogeneity and selection concerns. Moreover, the study finds that past experience with innovation during recessions is beneficial to patent outcomes after a new recession. Overall, it provides new evidence on business cycles shaping innovative capabilities.

7. Assessing an experimental approach to industrial policy evaluation: Applying RCT+ to the case of Creative Credits

Bakhshi H, Edwards J S, Roper S, Scully J, Shaw D, Morley L, Rathbone N (2015). Assessing an experimental approach to industrial policy evaluation: Applying RCT+ to the case of Creative Credits. Research Policy 44(8): 1462-1472.

- The paper explores the value of experimental methods in industrial & innovation policy evaluation.

- It proposes a new experimental policy evaluation approach combining randomised assignment, longitudinal and mixed-methods data collection.

- This methodology is applied to Creative Credits a B2B voucher scheme to stimulate creative partnerships.

- Results suggest the value of an experimental (and longitudinal) approach to innovation policy evaluation.

Experimental methods of policy evaluation are well-established in social policy and development economics but are rare in industrial and innovation policy. The authors of the paper consider the arguments for applying experimental methods to industrial policy measures, and propose an experimental policy evaluation approach (which they call RCT+). This approach combines the randomised assignment of firms to treatment and control groups with a longitudinal data collection strategy incorporating quantitative and qualitative data (so-called mixed methods). The RCT+ approach is designed to provide a causative rather than purely summative evaluation, i.e. to assess both 'whether' and 'how' programme outcomes are achieved. This paper assesses the RCT+ approach through an evaluation of Creative Credits – a UK business-to-business innovation voucher initiative intended to promote new innovation partnerships between SMEs and creative service providers. The results suggest the potential value of the RCT+ approach to industrial policy evaluation, and the benefits of mixed methods and longitudinal data collection.

8. Identifying the sources of technological novelty in the process of invention

Strumsky D, Lobo J (2015). Identifying the sources of technological novelty in the process of invention. Research Policy 44(8): 1445-1461

- Patent technology codes, used by the U.S. Patent Office to classify inventions, are used to identify and quantify the sources of technological novelty in patented inventions.

- A taxonomy of technological novelty is built on the basis of the patent technology codes.

- Origination, combination, and refinement are the three principal sources of technological novelty instantiated by patented inventions.

- Combination and refinements are the most common sources of novelty in patents; truly original technologies are very rare.

- The main driver of the invention process is the new combination of existing technologies.

- There is no straightforward relationship between the novelty of a patented invention and the number of citations it accrues.

Much work on technological change agrees that the combination of new and existing technological capabilities is one of the principal sources of inventive novelty, and that there have been instances in history when new inventions appear with few antecedents. The many discussions across research communities regarding the relative roles of combination and origination as sources of technological novelty have not provided much in the way of formal identification and quantification. By taking advantage of the technology codes used by the U.S. Patent Office to classify patents, the paper discretizes technologies and identifies four distinct sources of technological novelty. The resulting technological novelty taxonomy is then used to assess the relative importance of refining existing technologies, combining existing and new technologies, and de novo creation of technological capabilities as sources of new inventions. The results clearly show that the process of invention has been primarily a combinatorial process accompanied by rare occurrences of technological origination. The importance of reusing existing technological capabilities to generate inventions has been steadily rising and recently overtook recombination as the source of novelty for most new inventions.

9. Another cluster premium: Innovation subsidies and R&D collaboration networks

Broekel T, Fornahl D, Morrison A (2015). Another cluster premium: Innovation subsidies and R&D collaboration networks. Research Policy44(8): 1431-1444

- The study empirically confirms firms in clusters to be subject to another cluster premium.
- The paper shows that firms in technology clusters are more likely to receive support from the 6th EU-Framework Programmes but not from national subsidization schemes.
- It finds firms in clusters to be less intensively embedded into nationally subsidized networks of R&D collaboration whereby they nevertheless hold more central positions.
- The paper finds firms in clusters to frequently utilize national subsidization programs for collaboration with public research organizations (not universities).

This paper investigates the allocation of R&D subsidies with a focus on the granting success of firms located in clusters. On this basis it is evaluated whether firms in these clusters are differently embedded into networks of subsidized R&D collaboration than firms located elsewhere. The theoretical arguments are empirically tested using the example of the German biotechnology firms' participation in the 6th EU-Framework Programmes and national R&D subsidization schemes in the early 2000s. The paper shows that clusters grant firms another premium to their location, as they are more likely to receive funds from the EU-Framework Programmes and hold more favorable positions in national knowledge networks based on subsidies for joint R&D.

10. How novelty in knowledge earns recognition: The role of consistent identities.

Trapido D (2015). How novelty in knowledge earns recognition: The role of consistent identities. Research Policy 44(8): 1488-1500

- Highly novel ideas are subject to a higher risk of rejection by their evaluating audiences than incremental contributions. Yet the same audiences may deem a contribution to knowledge valuable because it is highly novel.
- This study develops and tests an explanation of this dual effect.
- Peers prize novelty of authors who have earned recognition for novelty.
- They also prize novelty of authors whose mentors earned recognition for novelty.
- Past recognition earned for low-novelty work lowers peer appraisals of novelty.

The novelty of scientific or technological knowledge has a paradoxical dual implication. Highly novel ideas are subject to a higher risk of rejection by their evaluating audiences than incremental, "normal science" contributions. Yet the same audiences may deem a contribution to knowledge valuable because it is highly novel. This study develops and tests an explanation of this dual effect. It is argued that the recognition premium that highly acclaimed authors' work enjoys disproportionately accrues to work that is consistent with the authors' previously developed identity. Because high novelty is a salient identity marker, authors' past recognition for highly novel work helps same authors' new highly novel work earn positive audience valuation. It is argued that, because recognition for novelty is partly inherited from mentors, disciples of highly acclaimed producers of novel work are more likely to have their work prized for novelty. In contrast, authors' or mentors' recognition earned for relatively less novel work does not trigger similar spillover effects and leaves authors vulnerable to novelty discount. The findings of the study come from unique data on citations and careers of electrical engineers. Data on the productivity, career histories, and mentoring relations of academic electrical engineers support these arguments.

11. The direction of firm innovation: The contrasting roles of strategic alliances and individual scientific collaborations

Hohberger J, Almeida P, Parada P (2015). The direction of firm innovation: The contrasting roles of strategic alliances and individual scientific collaborations. Research Policy. 44(8): 1473-1487.

- The paper relates different types of collaborations to a firms position and movement in the technological space of an industry.
- It distinguishes alliances, external individual scientific collaborations and internal scientific collaborations.
- The paper finds that firms relying on external individual collaborations are more likely to grow closer to the industry center of innovation.
- Firms relying on alliances and internal collaborations are more likely to grow distant to the industry center of innovation.

In dynamic and uncertain technological environments, the focus of industry innovative activity changes over time and the position of each firm with respect to the industry's innovative focus changes as well. Drawing upon insights from evolutionary economics, the paper derives hypothesis on the role of R&D alliances and individual scientific collaborations in influencing a firm's innovative direction and its position relative to the industry's innovation focus. The analyses of patent and alliance data show that biotechnology firms that rely on external individual scientific collaborations are likely to grow closer to the future focus of innovation, while firms that emphasize R&D alliances grow more distant from the future industry focus. Thus, the use of collaborative mechanisms influences the position of firms in innovative space over time. Additionally, the effect of collaborative mechanisms on the direction of innovation is influenced by the technological specialization of the firm.

12. Innovation policy mix in a multi-level context: The case of the Baltic Sea Region countries

Vītola A (2015). Innovation policy mix in a multi-level context: The case of the Baltic Sea Region countries. Science and Public Policy 42(3):401-414.

- This paper aims to identify the character of the relations between different government levels which implement innovation policy in six Baltic Sea Region (BSR) countries.
- Expansion of innovation policy to different government levels may create risks of overlapping between initiatives, therefore a distribution of tasks and coordination is key.
- Innovation policy mixes in the BSR countries are not characterized by incoherence or overlapping.
- However, strong mutual reinforcement cannot be identified either.

Innovation policies are no longer the responsibility of national-level governments alone, because regions and supra-national organizations also implement these policies. This paper aims to identify the character of the relations between different government levels which implement innovation policy in six Baltic Sea Region (BSR) countries (Sweden, Denmark, Finland, Latvia, Estonia and Lithuania). Expansion of innovation policy to different government levels may create a risk of overlapping between various initiatives, therefore a distribution of tasks and policy coordination is important. The theoretical background of the paper focuses on the concept of policy mix which emphasizes the role of interactions between different policies in different dimensions. Innovation policy strategies and in-depth interviews with policy-makers were analysed to characterize the multi-level innovation policy mixes. The results demonstrate that innovation policy mixes in the BSR countries are not characterized by incoherence or overlapping, however, strong mutual reinforcement cannot be identified either.