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The Impact of Investment in Intangible Assets on Productivity Spillovers: Summary

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Prepared by London Economics

The views expressed in this summary are the authors' and do not necessarily reflect those of the Department for Business, Innovation and Skills.

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Contents

Intangible Assets

London Economics were commissioned to conduct a review of the evidence regarding the impact of investment in intangible assets (IIA) on productivity spillovers and to make subsequent recommendations on how the evidence base could be improved. Although intangible assets (i.e. capital that is not physical in nature) have become an increasingly important driving force of economic growth, until recently there has not been an established approach to define and measure intangible assets, and traditional growth models have failed to account for their role in explaining economic growth. Recent economic literature has moved towards a consistent approach to measuring investment in intangible assets by classifying intangible assets into **economic competencies** (i.e. investment in skills, advertising and branding and organisational structure), **scientific and creative property** (i.e. R&D and 'innovation' more generally) and **Information and Communication Technology**. The intangible assets of particular focus in this study are 'skills' and human capital more broadly, and 'innovation'.

IIA can have an indirect as well as a direct impact on a range of outcomes (including labour productivity, firm level profitability, and earnings etc). The **direct effect** associated with IIA refers to the impact of the investment on the agent undertaking the investment (for example, the enhanced wage a worker achieves from his or her own investment in training. An indirect effect, or **spillover effect**, occurs when the investment also has an effect (either positive or negative) on parties other than those making the investment: for example, the enhanced productivity or wage gain achieved by *other* co-workers resulting from the first person's investment in their own training that may arise from interactions between employees (i.e. imitation, learning-by-example, learning-by-doing etc). Clearly, there are joint interests when both the firm and the individual can invest in the individual's training, and both can receive benefits through wages and profits.

While wages are an indicator of productivity (and in a competitive market, the wage equals marginal productivity), the existence of externalities and other market failures mean that productivity will in general be greater than the wage received. An aim of this study has been to make an assessment of relative magnitude of spillover effects to the direct effect associated with the investment in intangible assets, if only in broad terms. The section on findings summarises what we have found. Such a multiplier may be useful as while as number of economic outcomes can be measured relatively easily (such as wages), it is much more difficult to assess some other economic measures (e.g. productivity).

Mechanisms

Depending on the specific intangible investment considered and the nature of the interaction between firms and other parties, spillovers may occur at different levels (intra or inter-firm, regional, cross-border etc.) and through different mechanisms. One of the most commonly cited channels through which spillovers of knowledge and productivity may occur refers to the **mobility of skilled and experienced labour**. Specifically, knowledge regarding production processes, organisational structures, new technologies etc. is embodied in individual workers through the training received by their employers and related work experience (as well through the education, training and work experience

received elsewhere). When a worker leaves their current employer for a new job at a different firm, their accumulated knowledge will be diffused throughout the new firm through interactions with new colleagues, increasing overall productivity levels for the new employer.

Focusing on knowledge externalities, externalities might occur through **international trade** in intermediate inputs, where domestic companies purchasing the input will benefit from the technology embodied in the latter. Secondly, knowledge spillovers might also occur through **foreign direct investment** (FDI), where domestic firms achieve productivity increases via purchases from foreign-owned multinational subsidiaries, or multinationals deliberately initiate operations abroad in order to benefit from local knowledge in their host countries. Finally, international knowledge spillovers might also result from **direct learning about foreign technologies** by domestic companies, through the exchange of blueprints at prices that are lower than the costs originally incurred by the innovator. A large number of studies also consider how **geographical proximity** influences the effectiveness of the identified knowledge spillover channels, and the size of the resulting spillovers. As with labour mobility, it is important to differentiate between the spillovers associated with the investment in intangible assets and the diffusion of knowledge that may occur for a number of reasons relating to both the investment in intangible assets, as well as the wider embodiment of knowledge.

Policy implications

As a result of spillovers, the level of private investment in intangible assets may be sub-optimal, given that the individual or organisation incurring the cost of the investment may be unaware of the existence of spillovers or be unable to fully benefit from the IIA undertaken (i.e. when workers move between firms and industries taking with them their enhanced knowledge and training). Under these circumstances there may be scope for government intervention. The type of intervention will depend on the specific reason why the indirect benefit may not be captured and will not necessarily imply a full monetary subsidy (for example, if the under-investment is motivated by a lack of information or uncertainty in relation to the extent of the spillovers or coordination problems). The type of intervention that a government might take when faced with positive externalities may also depend on the level at which the externalities arise. For instance, when externalities occur within one particular sector of the domestic economy, it might be possible to make use of policy levers such as regulation or training levies; however, for externalities occurring between sectors or at other levels in the economy (for instance, along a supply chain), these types of option become less directly available.

It is important to note that the existence of externalities only requires intervention if there is sub-optimal investment as a result. Given other imperfections in the marketplace, we ideally need to know whether investment is sub-optimal, as well as the possible explanations, and whether these are related to externalities or otherwise. This report focuses on the existence and magnitude of the external benefits, rather than whether training investment is sub-optimal *per se*.

Findings

Following a detailed review of the theoretical and empirical evidence and despite the inherent difficulties in identifying and measuring spillovers, the weight of the evidence suggests that spillovers from IIA exist at many levels, and that where these spillovers are estimated alongside the direct effect of IIA, the relative effect of these spillovers is large and often exceeds the direct effects.

In terms of **economic competencies**, in the stream of literature that considers the impact of human capital on firm or industry **productivity levels**, the research generally indicates that an increase in the level or structure of human capital **within industries** increases firm-level productivity (by **0.3%** following a 1 point increase in human capital (e.g. Gailndo-Rueda and Haskel (2005)), while Dearden et al. (2005) demonstrate that there is a **0.6%** increase in labour productivity and a **0.3%** increase in workers' wages following a 1 point increase in the volume of training, of which up to half may be attributable to spillovers.

The evidence comparing the direct and indirect effects of IIA suggests that there are significant spillovers associated with **regional human capital** on firm-level productivity (between 0.5 to 4.5 times the size of the direct effect). In addition, the evidence indicates that a worker's individual wage gains from an increase in **industry-level** or **city-level** human capital are *significant* (e.g. research from the US indicates that following a 1 percentage point increase in the share of graduates in the local labour market, the spillover effect on non- graduate wages are between 1.6-1.9%). At the **inter-industry** level, Moretti (2004c) also demonstrates that a 1 percentage point increase in the share of graduates increases firm level productivity in industries outside that which the graduate is employed by approximately **0.8%**.

Human capital spillovers **within-firms** are also relatively large compared to the direct effects, with evidence for the UK indicating that increasing the education of level of *all* co-workers by one year results in *larger* wage increases for a worker (9-12%) than if the worker raised his own education by one year (6-7%).

Given the inherence difficulties relating to estimating externalities, there is limited or no evidence relating to the existence or magnitude of spillovers at a more disaggregated level (e.g. firm size, supply chain, worker characteristics, level of skill, or mode of training provision(employer or college based).

Recent empirical evidence also indicates that the externalities derived from increases in **regional ICT capital** on firm-level productivity are larger than the direct effects on firm productivity of raising that firm's own investment in computerised information. Considering spillovers from investment in **R&D**, these are strongest at an international (cross-border) level, where the spillover effects are larger than the direct effect, with some additional evidence indicating relatively strong R&D externalities within regions. Several studies indicate that a country benefits *at least as much* from an increase in international R&D investment in terms of increased domestic total factor productivity, compared to an equivalent increase in its own national R&D expenditures. Although innovation is broader than investment in R&D, and includes investment in process and investment in

dissemination of the new approaches to the wider economy, there is less evidence available on these wider aspects of innovation spillovers.

Next Steps

More evidence is needed, especially for the UK, on the sources and recipients of spillovers from IIA at both an aggregate and disaggregated level. Traditionally, it has proven to be difficult to identify and measure different types of intangible assets, and it is only relatively recently that methodological advances have been achieved to improve their classification and estimation. In addition, the evidence on productivity spillovers is by definition indirect. The majority of studies in the literature have focused on the direct effect associated with the role of intangible assets; while the estimation of spillovers has relied on a 'residual' approach (i.e. what is not explained by other factors implies the remaining contribution is as a result of spillovers).

Despite this, we suggest further research is undertaken to establish a coherent and consistent definition of the sources of spillovers and approach to their measurement (e.g. Corrado et al (2005), Haskel (2006)), as well as to develop a better understanding of the distribution of economic benefits between learners, their employers and the externality effect (e.g. Dearden et al (2005)). This should also include the development of existing analyses to assess employers' incentives to invest in training, and the nature, extent and impact of labour mobility on the returns to employers from investment in training. Related to this point, it would also be worthwhile to develop the evidence base on the mechanisms by which spillovers occur and are transmitted, rather than just an assessment of the overall impact and their distribution. In addition to these general issues, we think it feasible and desirable to undertake analysis over the longer term and at a disaggregated level:

Analytical extensions of INNODRIVE dataset: The recently developed **INNODRIVE** dataset provides estimates of investment in the different types of intangible assets for UK firms and has already been used for analysis on productivity spillovers. Further refinements and extensions are possible and desirable, especially as a longer time series becomes available.

Analysis of matched employer-employee data: One approach to understanding spillovers would be to exploit the richness and comprehensiveness of a matched employer-employee dataset. Currently, the Workplace Employee Relations Survey (WERS) provides some detail based on a random sample of employees within the firm that could be exploited in the future (and it might be possible to link such a database with existing administrative sources).

Analysis of agglomeration or concentration effects: A number of authors have investigated the impact of city level or regional characteristics to understand the source and potential recipients of human capital spillovers. We are not aware of similar analyses for the UK. Clearly the possibility of using a similar approach may be hindered by the availability of a large longitudinal dataset with data on individual characteristics and wages; despite this, we would recommend further investigation of the spillover effect of education at a city or regional level and the impact of agglomeration.

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