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Skills and economic performance: The impact of intangible assets on UK productivity

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Intelligence Investment Impact

Introduction

Improving economic growth is a key policy objective for the Government. Therefore, understanding the drivers of productivity growth is a fundamental requirement for effective economic policy.

Current measurements of productivity, based on the 'tangible' inputs of capital and labour, do not fully account for variations in performance. As a result of this there is a growing interest in 'intangible' assets and their potential to help us to better understand the sources of growth.

Intangible assets are typically grouped into three main categories.

- **Economic Competences** - such as brand equity which would include advertising and marketing expenditures. This category includes firm specific resources, including human capital (investments in training) and organisational structure (management).
- **Innovative Property** - this includes both scientific R&D and non-scientific R&D. Non-scientific R&D includes research in social sciences and humanities, mineral exploration, new motion picture films and other forms of entertainment, new architectural and engineering design and new product development in financial industries.
- **Digitised information** - this is often measured as IT capital, composed of software as well as databases.

Existing studies at the macro level suggest intangible assets make a significant contribution to productivity growth and micro level studies suggest intangible assets help to explain difference in performance between firms.

Because intangible assets are embedded in knowledge workers, and as such are difficult to disentangle from firms' human capital, this research develops measures of intangible assets for UK firms based on the labour input of workers in high skilled organisation, R&D and IT related occupations. These measures are then used to assess how firms employ intangible assets to increase productivity and raise economic performance.

The aims of this research are to explore:

- the number and cost of intangible workers as a proportion of the overall workforce across a range of sectors;
- the relationship between intangible assets and performance; and
- the contribution of intangible assets to growth.

Approach

Intangibles assets have a number of attributes that make them difficult to measure in an investment framework: they are not always visible; not easily accounted for; and it may not always be easy to fully appropriate the returns. This research uses the number and wages of workers in occupations that are likely to contribute to the production of intangible assets as a basis for a measure of firms' intangible capital stock. These are adjusted to reflect the proportion of worker time invested in the production of intangible goods. Intangible workers are identified using UK Standard Occupation Classification (SOC) codes and are grouped into three categories representing the type of intangible assets they produce.

1 Organisational workers, composed of managers and marketers, reflecting economic competences

2 R&D workers (in broad sense), reflecting innovative property

3 IT workers, reflecting digitised information

The Annual Survey of Hours and Earnings and the Labour Force Survey are the sources of individual occupation and wage data. These are combined with firm level data from the Business Structure Database and Annual Business Inquiry to construct employee and employer data for the period 1998-2006.

This analysis adds to existing research on the role of intangibles in driving growth in a number of ways.

1 The data are constructed using a 'bottom-up' approach, based on firm level estimates of the contribution that wages of intangible rich occupations make to the intangible capital stock of the firm. In comparison to existing studies this gives a great deal of flexibility in analysing intangible assets across geographies and industrial sectors.

2 The analysis focuses on intangible assets that are produced within the firm (i.e. by the firm's own employees) and not purchased from the market (i.e. consultants or outsourcing a firm may use). Often the lines between own account and purchased intangibles is not clear, however own account intangible investments in the UK have often been recorded as accounting for up to half the total investment of intangibles (Awano et al, 2010, p19).

Our analysis of the role that intangible assets play is divided into two components.

- An estimation of sector-specific production functions (using firm-level data), testing for associations between intangible assets and productivity levels. Our findings confirm that there is a positive association between productivity levels and intangible assets as we measure it. These relationships vary across industry sectors and the relative importance of different types of intangible assets (be it R&D, IT or organisation capital) varies too.
- An estimation of the relative contribution to productivity growth made by intangible assets in different sectors and geographies. Productivity growth reflects the rate at which industries or regions are 'improving', i.e. getting more output for less input. Geographic analysis is conducted using 44 city regions (which does not provide total UK coverage but reflects the important functioning economic areas within Great Britain).

The distribution of intangible workers

Intangible workers make up around 17 per cent of UK workers. This proportion remained broadly stable between 1998 and 2006. The average wage for intangible workers is more than double the average wage for other workers, a gap maintained between 1998 and 2006.

Intangibles are important in most sectors but are dominant in a handful. The findings support the expectation that sectors driven by high technology are likely to have higher levels of intangible assets. However, it is clear that intangible assets are not limited to these sectors. By the nature of the sectors, and the methods used in the analysis, research and development and computers and computing related activities are the two sectors with the highest proportions of workers engaged in the production of intangible assets. Manufacturing also has a high proportion of workers producing intangible assets, particularly the manufacture of medical and optical instruments, communications equipment, office machinery and computers, and the manufacture of chemicals. Sectors linked to energy production, both the mining and quarrying of energy producing materials and electricity, gas and water supply, have a high proportion of workers producing intangible assets.

Intangible Assets and Performance

Using firm level data, the econometric results indicate that intangible assets have a significant, positive, association with productivity, and that firms with a higher proportion of intangible assets are more likely to be highly productive. The various elements of intangible assets contribute in different ways. Particularly of note is that organisation capital, contributing to economic competences, has a greater impact than either R&D or IT capital. This suggests that a key factor in explaining differences in productivity are due to the way organisations are managed and run.

The total market economy (excluding some sectors) in 1998-2001 and 2003-2006 experienced average annual productivity growth of 2.63 per cent and 3.49 per cent, respectively. The average annual contribution of intangible assets to this growth was 0.46 per cent 1998-2001 and 0.33 per cent 2003-2006. All three intangible categories accounted for a significant share of this, with IT accounting for slightly less than R&D and organisation capital. Organisation capital dominates in market services whilst R&D dominates in manufacturing, despite the use of our broader definition.

Looking across sectors the association between R&D intangible assets and productivity is positive in many sectors, but appears particularly strong in mining and quarrying, and high technology manufacturing. IT capital provides a significant and positive contribution across all sectors. Organisation capital has a significant and positive contribution in nearly all sectors. In more mature, low technology manufacturing sectors (such as wood products or textiles), where R&D is not as significant, organisational capital is particularly important. This illustrates these sectors' reliance on achieving performance increases through process innovation rather than technological innovation.

Intangible Assets and Growth: sectoral analysis

More often than not, sectors where productivity is rising fastest are sectors where intangible assets make a relatively large contribution to productivity growth.

The growth accounting methodology reveals that the contributions of intangible assets to productivity growth are generally positive. Between 1998 and 2006, intangible assets have been a source of growth for UK firms in most sectors, although the magnitude and composition (across intangible asset types) of these contributions varies across sectors. The sectoral pattern of intangible asset contributions to productivity growth remains broadly stable over time. Organisation capital is more consistent in its importance across sectors compared to R&D and IT.

In production and manufacturing sectors, organisational capital and R&D capital account for a greater impact on growth than IT in general. In high technology sectors such as the manufacture of electrical machinery, medical and precision equipment, and chemicals R&D made the greatest contribution to growth. Whereas, in more mature manufacturing sectors, such as textiles or rubber and plastic products, organisational capital made the greatest contribution to growth.

In service sectors, organisational capital made a greater contribution to growth in more sectors than R&D or IT.

Intangible Assets and Growth: spatial analysis

The analysis shows that intangible assets contribute positively to productivity growth in the majority of the 44 city regions in both periods: 1998-2001 and 2002-2006. The contribution of intangible assets to growth in each city region varied substantially between the periods. This was true for the contribution of intangible assets overall, and the individual elements.

Still, we note that, particularly in the early period, regions that had the greatest contributions to productivity growth from intangible assets were not the major conurbations and industrial heartlands, but relatively affluent, cities and towns known perhaps for their strong knowledge base (Oxford, Cambridge, Brighton, Norwich) and having relatively good transport links to major conurbations.

Considerations and Implications

The analysis presented in this report provides an initial exploration of the relationships between intangible assets and economic performance in the UK. Research on intangible assets is a relatively new contribution to the productivity and growth literature and this paper contributes to the discussions that are ongoing. Further work linking skills to occupations will assist in identifying priority skills for future growth. Further research is also needed to move from associations between intangibles and performance to establishing more robust, causal relationships between the two. There is also the need to further disentangle human capital from intangible capital measures. Another area for further research is the potential for spillovers from intangibles within regions.

Executive Summaries present the key findings of the research produced by the UK Commission for Employment and Skills. More detailed analytical results are presented in Evidence Reports and all outputs are accessible on the UK Commission's website www.ukces.org.uk

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