

A firm-level analysis of the interaction between productivity antecedents

This study focuses on productivity at a firm level, examining the levers that management can potentially use to improve the productivity of their firm. Previous studies have characterised the factors that affect productivity at a firm level; however, the relative importance of these factors, and the way in which these factors interact, remains unclear. This study builds on the classification of productivity antecedents proposed by Syverson (2011), and it proposes two different archetypes of interaction between productivity antecedents: the hierarchical vs the flat model. Data collection is ongoing to refine and validate the theoretical model.

Track 17: Operations, Logistics and Supply Chain Management

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Purpose

Productivity growth, and the lack of it, has become a global concern (OECD, 2015; WEF, 2017). As Krugman (1994: PAGE) suggests: “productivity isn't everything, but, in the long run, it is almost everything”. The most recent data from the Office of National Statistics (ONS) suggests that many of the biggest EU nations are also facing negative labour productivity growth (Romei, 2019) and that the UK's productivity growth has been a particular worry since the global financial crisis of 2008, falling behind its European neighbours and G8 member nations. In the UK, the UK's problem with productivity, particularly compared to other economies, has become a favourite subject for politicians, economists and commentators, with the lack of improved productivity performance perceived as problematic (CBI, 2017; EEF, 2016; IoD, 2018; McCann, 2018).

The CBI (2017) explored influences on the UK's productivity success in their report “Unlocking Regional Growth” and the EEF (2016, 2018a, 2018b) has produced a number of reports highlighting key issues for UK manufacturing including the factors influencing productivity success. However, while such studies have addressed firm-related issues, the focus has been on the identification of the factors, with limited engagement within knowledge on the way in which the antecedents of productivity interact. This paper is part of a study funded by the UK's Economic and Social Science Research Council (ESRC - Productivity Insights Programme, Pioneer Award, Reference ES/R007810/1). The findings contribute empirical evidence from a firm-level, operational perspective about the interaction between the factors affecting productivity.

Literature review

The European Association for National Productivity Centres (EANPC 2005:12) defined productivity as “an expression of how efficiently and effectively goods and services are being produce”. The definitions highlight how productivity essentially measures the efficiency in production by relating the output obtained from some given inputs. Productivity measurements typically adopt physical or economic units and relate them as an output–input ratio. These measurements can focus on different levels: the overall economy, a sector of the economy, the enterprise, the plants, the machineries or the individuals.

This study focuses on productivity at the firm-level, examining the factors affecting productivity, namely the levers that management can potentially use to improve the productivity of their firm. Previous research has linked productivity levels to technological, organizational, demand, and market related factors. Examples include organisational structures (e.g. Hortaçsu and Syverson, 2011; Garicano and Heaton, 2007), human capital (Bandiera, Barankay and Rasul, 2009; Fox and Smeets, 2011), incentives and rewards (Lazear, 2000), human resources practices (Ichniowski and Shaw, 2003) and managerial talent and practices (Bloom and Van Reenen, 2007). Syverson (2011) classifies the antecedents of productivity at an enterprise level in six different groups, including Managerial Practice/Talent, Higher-Quality General Labor and Capital Inputs, Information Technology and R&D, Learning-by-Doing, Product Innovation, and Firm Structure Decisions.

The reviewed studies and others with a similar focus, have defined the factors that affect productivity at the level of the firm. However, the relative importance of these factors, and the way in which these factors interact, remains unclear. Improving the levels of understanding about such relativity and interactions is particularly relevant for managers that are trying to intervene and modify the productivity of their firm. Indeed, firms operate with limited resources and therefore a clear understanding of the interaction mechanisms between productivity antecedents can drive the design and the prioritisation of interventions.

This study builds on the constraint classification proposed by Syverson (2011). We develop a simple theoretical framework that proposes two different archetypes of interaction between productivity antecedents: the hierarchical vs the flat model. According to the hierarchical model (Figure 1) there is a hierarchy linking the productivity antecedents and therefore successful interventions should be based on the very “few” groups of factors that are more likely to cause the largest effect in improving the productivity performance.

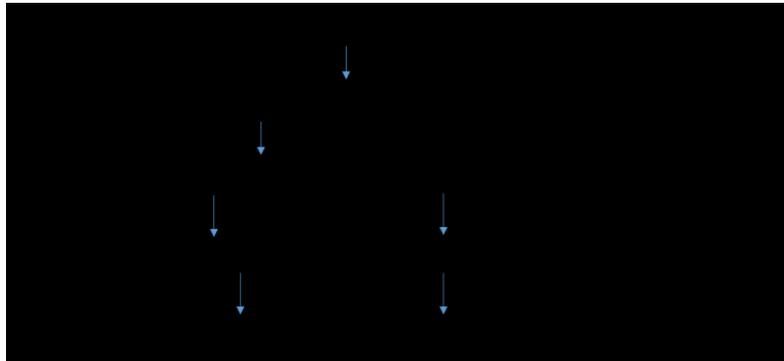


Figure 1: The hierarchical interaction model

According to the flat model (Figure 2) there is no real hierarchy linking the productivity antecedents and therefore successful interventions should simply be based on the factors that are more problematic for the specific firm.

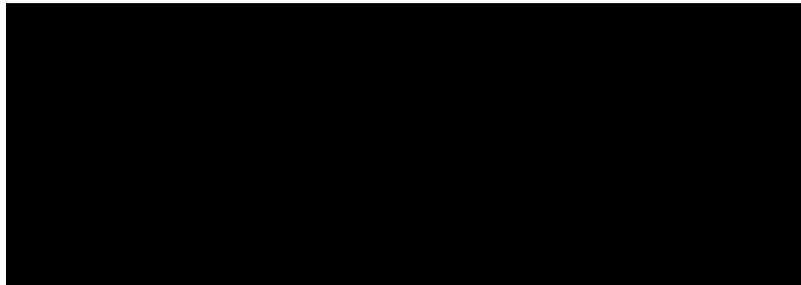


Figure 2: The flat interaction model

The models provide a framework are used within the study to examine, and illustrate, the nature and influence of factors constraining productivity across a range of manufacturing firms involve in different activities and operational contexts.

Research Design

This is an empirical study incorporating an exploratory approach with a multiple case study design and two units of analysis namely the firm and job hierarchy. A firm-level perspective is adopted to address the objective of the research.

Qualitative data have been collected via semi-structured interviews with three levels of personnel, observations during site visits, and firm-related archival data.

The study incorporated 19 firms, purposefully selected using secondary data and the team’s knowledge and contacts, from four sectors (food & drink, automotive, aerospace and pharmaceutical) identified as important to the UK, and based on a combination of sector, size, geography and High Value Manufacturing activity.

Semi-structured Interviews have been undertaken with 40 respondents, both in-person and by telephone/Skype, each lasting between 30 and 90 minutes. Respondents have been

purposefully selected to reflect Director, Manager and Supervisor positions. An interview protocol has been used to guide semi-structured interviews, allowing the respondents' view of the world to emerge and for discussion points to change as new data are revealed.

Findings

The data analysis is still ongoing, but preliminary evidence allowed the characterisation of the behaviour of the following factors: firm structure decisions, managerial practice / talent, information technology and R&D, product innovation, higher quality capital inputs, and higher quality labour inputs.

Firm structure decisions impact productivity in both positive and negative ways. Specifically, the planning processes, the design for assembly, gated processes to get things right, productivity culture, and a value adding structure found to have a positive impact on productivity. On the other hand, slow legacy systems, large company size, many regulations about health and safety, slow changing organisations, waste within processes and bureaucracy were stated to be constraints of productivity. Underestimating the details of the tasks involved could lead to flawed planning issue. Health and safety regulations are essential in this sector, and this can slow down the business operations. The firm structure should also facilitate the recruitment of the right people.

The *managerial practice / talent* was found to be mainly an enabler of productivity under specific conditions: proactive senior management, leadership with access to the shop floor, leadership motivating staff, recognition of achievements, trust between management and staff, and alignment of managerial hierarchies. Innovative and well-trained management can impact staff happiness and make them more productive. However, managerial practice can have negative implications on productivity due to slow decision making, complex judgement due to varying requirements for customer satisfaction, management not exhibiting the behaviour they talk about, and senior staff not willing to accept new practices.

Information technology was found to have positive and negative effects on productivity. The positive effects were linked to the use of ERP systems, investments in automation, digital technology for data analysis and management, innovation, new layouts, materials, and machine tools. The negative effects of information technology were found to be related to the legacy systems with old software, uncertainty and difficult to monitor, union protests for job losses, culture change, cash release to invest in new technologies, and automation.

Product innovation was found to be an enabler of productivity. Some examples of how product innovations can be achieved as given by the interviewees include encouraging people to come forward with ideas, allowing free thinking, being flexible in product refining based on customer needs, and diversifying product portfolio in collaboration with suppliers.

Higher quality of capital inputs was found to have a significant effect on productivity. Investing in new equipment, partnering with suppliers to benefit from sharing resources and equipment, and effective utilisation of inputs were found to impact positively productivity. However, inflexible suppliers, supplier's capability to accept parts transfer, and supplier's consolidation could create complex business relationships. Regarding the input of personnel, the factors impacting productivity negatively were an aging workforce, difficulty of recruiting local staff, difficulty of bringing apprentices across all business activities, and lack of training of staff. Machinery and tooling can also lead to lower quality of inputs with the following factors emerging from the interview analysis: lack of appropriate machinery and tooling, non-availability of parts/ tools, aging machinery, trade-off when buying tooling i.e. cost effective versus output possible, maintenance of inputs quality, and low-quality inputs causing delays.

Higher quality labour inputs were also found to enable productivity. Based on the interviewees the main factors that lead to higher quality labour inputs are skilled machinists, having apprenticeship schemes for bringing in new talent, staff bonuses, workforce motivation

through recognition, good leadership, clear employee objectives, staff training, and keeping employees healthy. There are also factors that can hinder productivity and lead to lower quality inputs. According to the interviews these factors are: reliance on aging demographic, experience loss due to retirement and new employees, experienced staff not interested in training, resistance to change.

The cross-case analysis of antecedents is revealing that there is no fixed hierarchy among the different antecedents of productivity, but that the nature of their interaction depends on the nature of the specific firm. At the same time, however, the results suggest that there are “interaction patterns” between the antecedents of productivity in the different firms. Indeed, some factors regularly appear as antecedents or key moderating factors for productivity, and this results suggests that it is possible to identify clusters of factors that regularly interact in a hierarchical way.

Contribution

The paper contributes to the operations management literature on how productivity antecedents interact to influence productivity success or failure. This firm-level approach gives new empirical data from across the firm hierarchy and, as a result, moves the conversation forward at the micro level, identifying the realities of productivity success and failure. The findings highlight key constraints as well as opportunities to address these and to make improvements to how productivity is addressed. Finally, the paper identifies potential 'access points' or 'key levers' of how to motivate workers to focus on productivity. For practitioners the study identifies the factors constraining productivity success and suggests how such constraints might be addressed, while for policymakers, it improves the evidence-base by providing much-needed empirical data about the barriers encountered by UK manufacturers, the actions needed to overcome these and the support required.

Plans for further development of the paper

After the completion of the data analysis, this paper will be developed further by identifying “interaction patterns” between the antecedents of productivity in the different firms.

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