



**Centre for  
Economic  
Performance**

**Discussion Paper**

ISSN 2042-2695

No.1767

May 2021

# **Education and management practices**

Anna Valero

## **Abstract**

The empirical management literature has found that the education of both managers and the workforce more generally appears to be an important driver of better management practices. This article sets out how such relationships might be conceptualised, and suggests that in a complementarities framework, modern management practices can be thought of as a type of skill-biased technology. It then summarises the literature that has explored the relationships between human capital and surveyed management practices in manufacturing firms and other sectors, highlighting the handful of papers that have found a positive correlation between management practices and measures of local skills supply. It concludes with a discussion of the policy implications that stem from what we know so far, together with avenues for future research that could shed more light on the causal mechanisms at play.

Key words: management practices, education, human capital

JEL codes: D22; I23; J24; L2; L60; M2

This paper was produced as part of the Centre's Growth Programme. The Centre for Economic Performance is financed by the Economic and Social Research Council.

The author is grateful to Simon Quinn, Daniela Scur, Chris Adam, John Van Reenen, an anonymous referee and the participants in the Oxford Review of Economic Policy editorial seminar in July 2020. Financial support from the Economic and Social Research Council through the Centre for Economic Performance, the Programme on Innovation and Diffusion (POID) and under grant ES/S001735/1 is gratefully acknowledged.

Anna Valero, Centre for Economic Performance, London School of Economics.

Published by  
Centre for Economic Performance  
London School of Economics and Political Science  
Houghton Street  
London WC2A 2AE

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means without the prior permission in writing of the publisher nor be issued to the public or circulated in any form other than that in which it is published.

Requests for permission to reproduce any article or part of the Working Paper should be sent to the editor at the above address.

# 1 Introduction

The past two decades have seen major advances in the measurement of management practices, with the deployment of the World Management Survey (WMS) across businesses and public sector organisations worldwide (Bloom and Van Reenen, 2007; Bloom *et al.*, 2014), and questions on management practices now being embedded in standard business surveys in a number of countries (Bloom *et al.*, 2016a). The empirical literature on management practices has established their importance in explaining differentials in productivity between and within countries and sectors, and a growing body of experimental evidence supports a causal interpretation; Bloom *et al.* (this issue) provide an overview of findings from 18 years of research as the WMS “comes of age”. Relatively less is known about the drivers of differences in management practices across firms, though a number of factors have been shown to be important, including informational or market frictions (Bloom *et al.*, 2019). This article summarises evidence from a series of papers that suggest that workforce education might help explain such differences.

A key finding in empirical analysis of the international WMS manufacturing data has been that the education of both managers and workers - typically measured in terms of the establishment-level share of each group with a university degree - is positively and significantly correlated with management practices (see for example Bloom and Van Reenen, 2007; Bloom *et al.*, 2014). In fact, in Bloom and Van Reenen (2007), human capital seemed perhaps the most important explanatory variable. Across countries, when managers were asked about the constraints to improving management practices, an inadequate supply of managerial human capital was the most cited constraint, followed by insufficient worker skills (Homkes, 2010). A correlation between management practices and human capital has been found in other contexts where WMS-style management surveys have been conducted. The human capital of business owners has been found to be positively associated with business practices in smaller (micro) firms in developing countries (McKenzie and Woodruff, 2017). Beyond the private sector, it has also been shown that the type of education received by clinical managers in hospitals matters - better managed hospitals tend to have a higher proportion of managers with MBA-type degrees (Bloom *et al.*, 2017b).

Given that management practices are a key driver of economic performance, these associations can be rationalised in the context of the broader literature that has linked human capital and the economic performance of firms, regions and countries.<sup>1</sup> Within standard growth frameworks, there

---

<sup>1</sup> See, for example, Abowd *et al.* (1999) and Moretti (2004b) on firms (the latter also finding evidence of human capital externalities in firm productivity), and Gennaioli *et al.* (2013) and Gennaioli *et al.* (2014) on regions. For recent discussion of the macro literature on human capital and growth, and estimates of relationships using measures of “knowledge capital” based on cognitive skills, see Hanushek and Woessmann (2015).

are a two key (non-mutually-exclusive) channels through which human capital could drive differences in management practices. First, the positive relationship between the education of managers and management practices could simply reflect the fact that more skilled managers are able to design and implement more effective (productivity-enhancing) management practices. This view is supported by the literature that has established an association between top-level managerial human capital and firm performance (see for example [Bertrand and Schoar, 2003](#); [Bandiera \*et al.\*, 2017](#); [Queiro, 2018](#)). Framed in terms of a “Lucas-Lucas” model which combines the allocation of talent between workers and managers ([Lucas, 1978](#)) and human capital externalities ([Lucas, 1988](#)), [Gennaioli \*et al.\* \(2013\)](#) find evidence to support the importance of educated entrepreneurs for the creation and productivity of firms.

Second, and considering the workforce more broadly to include workers as well as managers: if modern management practices can be thought of as a type of technology ([Bloom \*et al.\*, 2016b](#)), then given the features measured in the WMS, it is reasonable to predict that this technology is complementary with workforce skills, so that having a skilled workforce increases the marginal benefit or reduces the marginal cost associated with implementing better management practices (as argued is the case with technologies more broadly by [Nelson and Phelps, 1966](#)). In this sense, management practices can be thought of as a “skill-biased” organisational technology ([Caroli and Van Reenen, 2001](#); [Feng and Valero, 2020](#)).

There are, of course, a number of issues in interpreting organisation-level relationships between human capital and management practices. Such associations are subject to a number of sources of endogeneity: it could be that more highly educated managers and workers select into working in better managed organisations, or that these correlations are actually driven by unobserved (to the econometrician) factors that influence both workforce composition and management practices, for example, technology adoption or organisational culture. Such concerns have prompted some to investigate the extent to which external (to the firm) measures of skills supply might help explain differences in organisational human capital and management practices. Using an international sample of manufacturing plants surveyed in the WMS, [Feng and Valero \(2020\)](#) show that plants closer to universities and facing a lower price of skills tend to have a more skilled workforce and higher management scores, *ceteris paribus*. It is argued that this provides evidence in support for the complementarities hypothesis. [Bloom \*et al.\* \(2017a\)](#) link the presence of land-grant colleges in US counties to better management practices in manufacturing establishments, and [Bloom \*et al.\* \(2017b\)](#) show that hospitals closer to universities that have both medical and business schools have a higher share of clinical managers with MBA style courses and higher management scores. It must be noted

however that in the absence of an experiment that randomly allocates differentially skilled workers to firms it remains challenging to pinpoint the mechanisms driving these associations and address all sources of endogeneity.

Another issue regards the measures of human capital which tend to be available in the data. In general, the proxy for human capital is based on the organisation-level share of workers or managers with a university degree (or equivalent). There is clearly significant heterogeneity in the quality or focus of different degree courses and, with such data, it is difficult to determine whether effects are driven by general human capital or more specific knowledge picked up in business related courses (including MBAs), or simply via higher ability individuals selecting into higher levels of education. To try to get at measures of ability of employees within firms, [Bender \*et al.\* \(2018\)](#) link WMS data on manufacturing plants to longitudinal employee earnings records in Germany from which they derive estimates of skill at the individual level based on observed wages. The authors find that manager effects appear to be more important than worker effects for explaining management practices, and also that better managed firms are more likely to be able to recruit and retain higher ability workers. [Cornwell \*et al.\* \(2019\)](#) use a similar approach in Brazilian firms to examine the sorting of managers and workers into firms and how this relates to management practices.

These studies have policy relevance for a number of reasons. First, given the importance of management practices as a driver of organisational performance, and the general focus on education and skills policies for improving both growth and societal outcomes more broadly, shedding light on the relationships between human capital and management practices and how these might vary for different types of organisation or context can help inform growth policies at the national or local level that seek to improve productivity and living standards. While it remains challenging to establish causal relationships, the studies set out here attempt to address endogeneity concerns to the extent possible given data constraints. The evidence points to there being a complementarity between various measures of the supply of human capital and management practices, and suggests that there is merit in considering policies in these two areas in tandem.

The papers that have linked proximity to universities to better management practices are also relevant for policies that seek to build or strengthen clusters around universities. The overall economic impact of universities on their surrounding regions is examined by [Valero and Van Reenen \(2019\)](#) using international data from the 1960s to today - a period of large-scale expansion in university enrolments worldwide. A robust positive association between the establishment of universities and growth in regional GDP per capita is found, and the authors suggest that this is likely to be driven by

an increased supply of human capital, innovation and associated spillovers.<sup>2</sup> The evidence set out in this article suggests that the positive relationship between human capital and productivity enhancing management practices could be one of the channels through which universities might contribute to regional economic growth.

From a policy perspective, it is also important to understand what type of education matters for improving management practices and whether this is more likely to be general, or business-related. Recent decades have seen a large growth in business focused education (Lock, 1996) which on average tends to generate relatively high returns in the labour market.<sup>3</sup> Today, UK enrolments in business and administrative studies subjects represent 14 per cent of undergraduates and 19 per cent of postgraduates; with over 19,000 students enrolled in MBA programmes.<sup>4</sup> Feng and Valero (2020) show the relationships between management practices and proximity to universities are no stronger for universities with business departments, while Bloom *et al.* (2017b) suggest that a combination of business and medical education is important in hospitals (perhaps hinting that specific knowledge is important in managing complex public sector organisations). Further research is needed to understand better which specific skills matter in different contexts.

The focus of this article is on the extent to which management practices - as measured in the WMS or similar surveys - might be driven by the general education of managers and/or workers (i.e. that obtained in the schooling system). Of course, knowledge and skills can also be gained on the job, or via training or consultancy programmes. A related literature has evaluated randomised business support programmes that seek to raise management practices and organisational performance (some examples include Bloom *et al.* (2013), Bloom *et al.* (2020), Bruhn *et al.* (2018), Iacovone and McKenzie (2019)). Such studies span a variety of sectors and countries, and evaluate consultancy or training provision of varying intensity, in general finding positive impacts. McKenzie (this issue) summarises the evidence on the impacts of small business training programmes in developing countries where to date the bulk of this type of research has been conducted, finding that training improves business performance but that impacts are often too small for experiments to detect. From a policy perspective, more research is needed to determine which types of intervention are most effective for different types of organisation, and deliver beneficial programmes that can be scaled-up in a cost-effective manner. For the purposes of this article, the relative effectiveness of training programmes for recipients with

---

<sup>2</sup> For a summary of the literature that links universities with local economic success see Glaeser and Hausman (2020), and Azmat *et al.* (2018) for application to the UK policy context.

<sup>3</sup> At the undergraduate level, Belfield *et al.* (2018) show that business courses generate wages that are 10 per cent above the average earnings for graduates in the UK; and Altonji and Zhong (2020) find positive returns to MBAs and other business related masters degrees using US data (controlling for selection on ability and occupational preferences).

<sup>4</sup> Data on 2018/19 student enrolments by subject area sourced from HESA, DT051 Table 22. MBA student numbers are obtained from OC051 Chart 8.

different levels of formal education is of particular interest, and so far findings on this have been mixed. For example, in the context of a bank in the Dominican Republic, [Drexler et al. \(2014\)](#) show that simplified levels of financial management training have larger impacts on real outcomes for micro entrepreneurs who have low educational attainment and poor business practices prior to the intervention, relative to more advanced businesses <sup>5</sup>; while [Fairlie et al. \(2015\)](#) find no evidence that an entrepreneurship training programme in the United States was more effective for those with less education (or other measures of human capital). [Fryer \(2017\)](#) evaluates a randomised control trial that provides training on management practices to principals of schools in Texas. The author finds that treatment effects (on student outcomes) are larger for higher ability teachers and principals.

This article is organised as follows. Section 2 summarises the key conceptual frameworks for thinking about how human capital might drive (or relate to) management practices. Focusing on manufacturing firms, Section 3 summarises the relationships between measures of human capital and management practices found in the literature, and Section 4 considers studies that have linked measures of skills supply external to the firm to management practices, in particular using proximity to universities as a shifter of local skill supply. Section 5 then summarises work that has linked managerial human capital to management practices in public services. Section 6 concludes with policy implications from what we know and avenues for future research.

## 2 Conceptualising the relationship between education and management practices

A starting point in this discussion is the view that higher management scores reflect better management quality. That is to say that while there might be elements of “contingency” in practice, whereby certain practices are more optimal in certain environments, higher scores across operations, monitoring, targeting and people management practices - as measured in the WMS - have been shown to be tightly linked to performance in the data and therefore it is fair to assume that management is an input in which output is monotonically increasing ([Bloom et al., 2016b](#)).

In thinking about the relationship between human capital and management practices it is helpful to reflect on the distinction between management and managers themselves. One interpretation of the WMS scores is that they reflect entrepreneurial ability as in [Lucas \(1978\)](#) (see discussion in [Bloom et al., 2014](#)). There is empirical evidence that top-level managers themselves matter for firm performance. In the case of senior leaders in U.S. firms, [Bertrand and Schoar \(2003\)](#) show that individual CEOs matter

---

<sup>5</sup> In this setting, while simplified training is found to be effective, more standard accounting training had little measurable effect.

for firm policies and performance, and that some characteristics of CEOs (including whether they have an MBA) are important drivers of these relationships. [Bandiera \*et al.\* \(2017\)](#) examine time use data on CEOs across manufacturing firms across six countries<sup>6</sup> and construct a CEO behaviour index where higher scores reflect “leader” CEOs, and are associated with better firm performance. They find that this index is significantly higher for individuals that hold an MBA. The fact that the education of top-level managers is related to firm performance does not necessarily imply that better operational management practices<sup>7</sup> can help explain this. But there is evidence to suggest this might be the case: on the subset of firms where both the CEO behaviour index and WMS scores are available, [Bandiera \*et al.\* \(2017\)](#) find the two measures to be correlated with each other, and also independently correlated with firm performance.

In another study focused on top-level managers, [Queiro \(2018\)](#) employs matched employer-employee data from Portugal and finds that firms with more highly educated managers have better growth performance (results are robust to accounting for the omitted ability of entrepreneurs and selection into being an entrepreneur). The author suggests that the mechanism for this involves more educated managers being more likely to introduce new technologies or management practices (consistent with a [Nelson and Phelps \(1966\)](#) view of human capital and technology diffusion), and finds that the relationships are stronger in more technology-intensive industries in support of this.

Managers are expected to have a strong influence on the processes and culture within their firms during their tenure, but these are likely to persist for some time after their departure. It seems more likely that management is a broader concept, more akin to a type of intangible capital ([Bloom \*et al.\*, 2016b](#)). In the “management as a technology” model ([Bloom \*et al.\*, 2016b](#)), there is a heterogeneous initial draw of managerial ability upon start-up, and an endogenous change in managerial capital in response to environmental shocks.

Thinking of management as a type of organisational technology allows us to conceptualise its relationship with firm human capital (that of both managers and workers) in terms of complementarities ([Brynjolfsson and Milgrom, 2013](#)). [Feng and Valero \(2020\)](#) hypothesise that modern management practices, as measured in the WMS, and firm human capital are complementary so that a skilled workforce increases the marginal benefit or reduces the marginal cost associated with good management practices, and firms facing a skill-abundant workforce employ more skilled labour and have better management practices in equilibrium. It would follow that, in equilibrium, the firm’s managerial technology is an increasing function of human capital. This type of relationship can be interpreted as

---

<sup>6</sup> There are: Brazil, France, Germany, India, UK and the US.

<sup>7</sup> As measured in the WMS via interviews with middle management in manufacturing plants.



a “demand equation” in a complementarity framework (see for example, [Bresnahan et al., 2002](#)).<sup>8</sup>

The complementarities framework can be justified on conceptual grounds because the management practices scored in the WMS are consistent with the complementary characteristics of “modern manufacturing” outlined in [Milgrom and Roberts \(1990\)](#) and [Roberts \(1995\)](#). Highly-skilled, cross-trained workers are listed alongside lean production techniques, performance tracking and communications as features of the modern firm ([Roberts, 1995](#)). Similarly, a well-managed firm in the WMS is defined as one that has successfully implemented modern manufacturing techniques; and one that is “continuously monitoring and trying to improve its processes, setting comprehensive and stretching targets, and promoting high-performing employees and fixing (by training or exit) underperforming employees” ([Bloom et al., 2012](#)).

To the extent that management practices are complementary with skills, there is a basis for considering them to be a type of “skill-biased” organisational technology.<sup>9</sup> [Caroli and Van Reenen \(2001\)](#) argue that this is the case for the decentralisation of authority in workplaces, and that such “skill-biased organisational change” is characterised by three features, which they provide empirical evidence in support of. First, given that the return to new practices are higher when the skill level of the workforce is higher, skill biased organisational changes will lead to an increased demand for skill in firms. Second, a lower price of skilled labour will accelerate the introduction of skill-biased organisational changes, all else equal. And third, more skill intensive firms will experience greater productivity growth when introducing skill-biased organisational changes (assuming that decision making is subject to some optimisation errors or lags).

A complementarity between skilled managers and management practices might seem intuitive. A more highly skilled manager is likely to find it easier to design and lead the implementation of better organisational processes. Similarly, a more educated workforce is more likely to show initiative and be able to effectively implement complex, flexible and more decentralised production practices set by managers. However, it could also be argued that management practices and workforce skills are more likely to be substitutes in certain cases. For example, there could be less need for continual performance tracking and communication when workers are more highly skilled. There might be heterogeneity in the relationships for different types of management practices or in different contexts.

Shedding light on the empirical relationship between human capital and management practices can therefore be valuable in helping managers and policy makers understand best how to improve productivity. In particular, given the positive correlations between human capital and management

---

<sup>8</sup> Other interpretations are possible, it could simply reflect better management practices being “produced” by higher skilled managers and workers as discussed above.

<sup>9</sup> For a condensed survey on the theoretical and empirical literature on skill biased technical change, see [Violante \(2008\)](#)

practices seen in the data, the key challenge is establishing the extent to which these reflect causal relationships. It is also important to understand whether managerial or worker skills (or both) appear to matter, which skills are important (and the relative importance of general education versus business specific education), and the extent to which relationships between human capital and management practices vary for organisations of different types. Progress in answering these questions is summarised in the following sections, and avenues for future research to fill remaining gaps are set out in the conclusion.

### 3 Human capital and management practices in firms

#### 3.1 Establishment-level human capital and management practices

In a series of papers based on international WMS data on manufacturing plants, Bloom, Sadun, Van Reenen and co-authors have shown that at the establishment level, the education of both managers and workers are strongly correlated with management scores (Bloom and Van Reenen, 2007, 2010; Bloom *et al.*, 2014). The measure of education available in the WMS is the reported share of the workforce with a university degree, split into managers and non-managers in most survey waves. In the management practices regressions of Bloom and Van Reenen (2007) based on data from the U.S., U.K., France and Germany, the natural log of the proportion of employees with a degree is the variable with the largest explanatory role for management. The authors also find that while firms with a higher degree share have higher management scores in general, they appear to be particularly good at the more human-capital focused management practices (relative to more fixed capital focused practices), suggesting that firms might tailor their specific mix of management practices to their environment.

The raw correlation between plant-level degree share and management practices on the sample of manufacturing plants across 19 countries analysed in Feng and Valero (2020) is shown in Figure 1. This plots the correlation between average management scores of firms within 20 equally sized bins in terms of degree share (absorbing country and survey wave fixed effects, though results are not sensitive to this), showing a positive and precise relationship. Table 1 reports the regression equivalent (panel A), and shows that the strong relationship holds for both managers and non-managers and is of similar order of magnitude. The relationships between firm skills and management practices remain highly significant, though coefficients are smaller in magnitude when a full set of firm and geographic controls are included (Panel B).

Focusing on manufacturing plants in Germany, Bender *et al.* (2018) link the WMS data to employee earnings records, enabling a richer analysis of worker features than is possible using the surveyed

measures of education. Using longitudinal data on earnings of workers, including their pay at previous or subsequent employers, the authors decompose wages into worker and establishment effects using the AKM approach (Abowd *et al.*, 1999). The worker effects allow for the measurement of the worker skill or ability, together with analysis of the relative quality of different employee subgroups - specifically, the authors assume that those in the top quartile of earnings are managers. Establishment effects provide a measure of the financial incentive system at each plant.

The authors find a strong relationship between average employee ability and management practices, conditioning on firm size and other standard firm covariates. The coefficient is over a third larger when only the ability of managers is considered. And when both of these are included in the specification, only the manager effect survives (the coefficient on average worker ability remains positive but is much smaller in magnitude and not significant). Moreover, the result with respect to managerial ability holds even when the plant-level share of workers with a college degree is controlled for (plus other measures of human capital including experience, age and tenure). The authors conclude that these results suggest that management practices and human capital (particularly managerial) are complementary in the sense that they covary together.

### **3.2 Management practices and the demand for skills**

While plant-level correlations might suggest a role of human capital as a driver of better management practices, they could also reflect an increased demand for highly skilled workers in better managed firms. Accordingly, some papers have examined the extent to which management practices explain variation in plant-level human capital. Bender *et al.* (2018) also use the longitudinal employee data in German establishments to examine job inflows and outflows, finding that plants with higher management scores are more likely to recruit higher ability workers, and are less likely to lay off such workers. Using a similar approach, Cornwell *et al.* (2019) link WMS data to matched employer-employee data from Brazil where information on individuals' occupation is also available so that managers and workers can be identified. This paper can therefore more accurately differentiate between worker and manager quality and consider the selection and sorting of these two groups separately. The authors find that better managed firms recruit higher ability workers, and this is particularly the case with managers. They find that such firms are better at retaining higher quality hires, and that they fire more selectively.

There is further evidence for both management practices-skill complementarities, and the role of management practices in increasing the relative demand for skilled workers in the context of South Korea. Lee (2018) analyses data on South Korean manufacturing firms in the years following

the Asian financial crisis and links the adoption of “modern” WMS-style management practices (which accelerated in that period as South Korea opened up to foreign firms) to increased demand for technical skills. More specifically, this study utilises a business survey that includes questions that can be mapped to the WMS, and also granular data of the number of employees by occupational skill groups (including managers and technical workers) which allow the construction of measures of relative demand for skilled occupations relative to unskilled groups using relative employment and wages respectively. The author finds that there is a positive correlation between the relative demand for more skilled workers and management practices. To address issues of endogeneity, the author instruments establishment-level management practices using an industry-level “frontier” management index.<sup>10</sup> Controlling also for establishment technology adoption, the results hold for technical workers only. The author provides evidence of a complementarity between modern management practices and technical skills via interactions between management practices and the quantity of technical workers in establishment-level performance regressions, and concludes that such complementarity is likely to be a reason for the technical skill demands of modern management practices.

### **3.3 The education of microenterprise owners and business practices**

The management practices literature outlined so far, based on the WMS, has been focused on medium-sized manufacturing firms across a mixture of advanced and developing countries. [McKenzie and Woodruff \(2017\)](#) explore the extent to which these types of practices matter in micro and small firms, across sectors, in the developing country context (where such firms account for the majority employment). The authors analyse surveys on business practices in marketing, stock-keeping, record-keeping, and financial planning across seven countries (a key difference from the WMS is that human resource practices are not included reflecting the fact that the median firm in the sample has no employees). They show that variation in business practices explains as much of the variation in performance in microenterprises as in larger enterprises. Moreover, as in the WMS, the effect of business practices is robust to including numerous measures of the owner’s human capital. This suggests that business practices are not simply capturing owner ability in this context.

Nevertheless, consistent with studies based on WMS data, owner education is found to be positively related to business practices. The authors argue that it is likely that more educated and able owners will find it easier to learn and adopt good business practices, and that owner education is likely to matter more in the context of smaller firms where there are no intermediate levels of managers or workers. It is shown that owner years of education have a positive and significant association

---

<sup>10</sup> This is based on the average WMS scores from five advanced economies: US, Britain, France, Germany and Italy, by sector.

with business practices, which survives the inclusion of key owner and firm covariates and also two measures of analytical and cognitive ability - both of which also matter, but have smaller coefficients.

### 3.4 Does human capital drive differences in management practices?

A series of studies have shown that variation in human capital appears to help explain variation in management practices at the establishment level. But clearly, a number of issues arise when attempting to interpret such a relationship. First, human capital could be a driver of better management practices, and at the same time, better management practices could be a driver of higher human capital in firms (Bender *et al.*, 2018; Cornwell *et al.*, 2019; Lee, 2018) - both are consistent with a complementarity hypothesis. Plant-level associations are also likely to be subject to omitted variables bias due to the presence of a number of typically unobserved characteristics of firms including technology adoption or firm culture, which are correlated with both management practices and human capital. Finally, given the need to find proxy variables for worker and manager skill in many contexts - based on quantities or relative prices of workers with different levels of education - there are also likely to be issues of measurement error, together with a lack of specificity in terms of which skills might drive the relationships.

The next section outlines two studies that have sought spatial measures of skills supply that are external to the firm in an attempt to move closer identifying the extent to which differences in human capital could drive differences in management practices, though in the absence of a natural experiment that generates random variation in human capital across places these studies cannot rule out all potential sources of endogeneity.

## 4 “External” measures of skills and management practices

### 4.1 Universities, regional skill premia and firm management practices

Feng and Valero (2020) combine international data on management practices in manufacturing plants from the WMS with spatial measures of skill availability based on university location and regional labour markets.<sup>11</sup> Data on universities are sourced from the World Higher Education Database (WHED), which provides university location and other characteristics,<sup>12</sup> and the key distance measure at the plant level is the estimated drive time to the nearest university.<sup>13</sup> On the subsample of 13

---

<sup>11</sup> A key assumption is that labour markets are local in nature (Moretti, 2011), so that local skill supply is relevant to firm hiring decisions.

<sup>12</sup> See Valero and Van Reenen (2019) for a full description of the WHED data.

<sup>13</sup> This type of measure has been used widely in the labour economics and innovation literatures. In labour, Card (1995) relates distance to university to individual level enrollment at university. Examples of papers that relate proximity to universities to firm innovation include Anselin *et al.* (1997), Henderson *et al.* (1998) and Belenzon and Schankerman (2013)

countries where international labour force survey (or equivalent) data was accessed, relative skills prices (the premium in wages for having a university degree), and quantities (degree share) were estimated at the region level. Such measures of skill supply have been linked to organisational practices and technology in previous papers, including decentralisation (Caroli and Van Reenen, 2001) and computer adoption (Beaudry *et al.*, 2010).

The empirical strategy is described schematically as follows (Feng and Valero, 2020):

$$Universities_k \rightarrow Skill Supply_k \rightarrow Skill Price_k \rightarrow H_{ik} \rightarrow M_{ik}$$

where the first arrow represents the relationship between the spatial presence of universities and supply of human capital (measured as the share of the workforce with a degree in a region  $k$ ), which is hypothesised to be positive. The share of skilled labour in the region can be expected to affect the relative skill price (skill premium), which then will influence the hiring decisions of firms. All else equal, we expect that a higher skill premium would result in a lower degree share in firm  $i$ , ( $H_{ik}$ ) since skilled labour is more expensive relative to unskilled labour. Finally, a complementarity between human capital and management practices implies a positive relationship between firm-level human capital and the adoption of management practices ( $M_{ik}$ ).

The approach to estimating these relationships is largely dictated by data availability and issues of aggregation. The authors begin by showing that regions with higher university density (universities normalised by population) have a higher degree share and lower skill premium.

Next, reduced form relationships between distance to closest university and firm skills and management practices are estimated. While firm-level measures of human capital are available for managers and workers separately, this analysis focuses on the entire workforce as it was not possible to meaningfully create external skills supply measures for these two categories separately.<sup>14</sup> The results of the core specifications are depicted in Figure 2. Firms located further from universities have both lower human capital and lower management scores, controlling for firm and geographic factors.

To get more information on the mechanism at work, similar specifications are estimated replacing distance to university with the regional skill premium. This analysis finds that firms facing higher skill premia in the regions in which they are located employ significantly less skilled workers and are significantly worse managed.<sup>15</sup> Interestingly, results are stronger when capital regions are excluded. This is to be expected since demand shocks or other unobservables that raise both the skill premium

<sup>14</sup> Moreover, the firm-level relationships between these two measures of human capital and management practices were not so different, as shown in Table 1.

<sup>15</sup> Applying the coefficient on the skill premium to the variation in this variable across US states, the results imply that one standard deviation rise in the skill premium reduces management scores by -0.048 standard deviations, representing 18 per cent of the cross-state variation in management practices.

and management practices to be more prevalent in capital regions, and in addition, firms in capital cities are more likely to be able to recruit from wider areas (due to commuting patterns or inward migration).

This analysis helps to address some of the endogeneity concerns in firm-level associations. In particular, using the university distance measure it is easier to rule out reverse causality: it seems unlikely that universities choose locations close to mid-sized manufacturing firms with higher management scores. Region fixed effects and a rich set of geographical and firm controls help to address concerns about unobservables that drive both university proximity and management practices, including the possibility that such relationships simply reflect agglomeration effects. However, in the absence of an instrument for university location using this international dataset, it is not possible to rule out a scenario whereby the results are driven by better managed firms choosing locations close to universities. [Feng and Valero \(2020\)](#) attempt to address this concern by showing that there is no differential effect for firms which are founded after their nearest university, and by considering within firm variation as an extension to the skill premium analysis. The authors note, however, that if these results are driven by better managed firms making such locational decisions, they are still suggestive of a complementarity between better management and skills.

The authors analyse heterogeneity by observable characteristics of firms and universities and provide insights that support the education-management practices complementarity hypothesis. The relationships between management practices and the external skills measures are stronger for single-plant firms compared to plants that are part of multinationals or multi-plant domestic firms. Smaller, single-plant firms are likely to be more reliant on local skills supply when recruiting staff and setting management practices. In contrast, plants that are part of larger multinational enterprises may be able to attract workers from other regions or countries due to their stronger brand, and might also move staff between locations ([Choudhury, 2017](#)). Moreover, management practices in such firms might be set centrally at the company headquarters, which may be located elsewhere.

The university distance effect does not appear to vary for universities offering different disciplines, including business related courses. This supports an interpretation that the university effect is operating (at least in part) via the production of general human capital - whereby the general education and skills picked up at university are complementary with modern management practices. If instead the main mechanism was the diffusion of information from universities to surrounding firms via consultancy services, managerial training or access to more specialised inputs including business-specific knowledge of graduates, we would expect stronger effects for universities with business

departments. Nevertheless, it is important to caveat this discussion given data limitations,<sup>16</sup> and further research is needed to understand which specific skills or knowledge might matter for managers and workers across different types of firms, and how these are acquired.

Finally, as an extension to the main analysis in [Feng and Valero \(2020\)](#), performance equations are also estimated on a subsample of firms where financial data were available. These take the form of simple production functions including, in turn, firm degree share, and then the external skills measures and their interaction with management practices. For single-plant firms only, the signs of the interaction terms are as would be expected under the hypothesis that skills and management practices are complements: positive for firm-level human capital; and negative for distance and the skill premium for which higher values imply that the skill price is higher. However, only the distance interaction is significant at conventional levels. This analysis therefore provides additional suggestive evidence to support the main results.

In summary, this paper finds robust associations between measures of local skill supply and firm management practices, and evidence that lends support to there being a complementarity between general workforce education and management practices.

## 4.2 County level universities and management practices

While the management scores in the WMS are determined based on the answers to open-ended questions asked in telephone interviews ([Bloom and Van Reenen, 2007](#)), more recently “closed-ended” questions on management practices have been integrated into business surveys carried out by national statistics offices (see [Bloom \*et al.\* \(2016a\)](#) for comparisons of these different approaches). The US Census Bureau’s Management and Organizational Practices Survey (MOPS), on US manufacturing plants, was the first-ever mandatory government management survey. [Bloom \*et al.\* \(2019\)](#) analyse these data for 35,000 plants across two waves of the survey in 2010 and 2015. The large sample size, panel structure and coverage of different plants within a firm enables a rich analysis of the relationships between management practices and productivity, and the drivers of management practices.

The published paper focuses on two key drivers: the business environment and learning spillovers, but a previous working paper version ([Bloom \*et al.\*, 2017a](#)) also explored human capital as a driver. Specifically, the authors combine information on the location of plants within counties across the U.S. with the quasi-random location of Land Grant Colleges across counties to construct an instrument for the local supply of educated employees. This approach builds on the work of ([Moretti, 2004a](#)), who

---

<sup>16</sup> Subjects offered by each university are ascertained by extracting relevant key words from the information provided in WHED. For some universities the descriptions offered can be quite broad (e.g. it may specify ‘social sciences’ instead of listing out individual subjects). The subject categories in the paper are broad to account for this, but there are likely to be cases where the accurate subject mix at a university is not picked up.



examines the impact of education on local productivity and wages.

The authors find that there is a positive and significant reduced form relationship between an indicator dummy for whether or not a county has a Land Grant College and plant-level management practices, controlling for local economic development features (population density and the unemployment rate) plus industry and state fixed-effects and plant-level covariates. Importantly, this relationship survives at the ten per cent level of significance even when controlling for firm-level fixed effects, so that variation is across plants in the same firm.

The authors also find positive and significant relationship between the share of working age adults with a degree in the county, and plant-level management practices. Instrumenting this with the Land Grant College variable they find that the effect is even higher, though as noted this relies on the strong assumption that Land Grant Colleges only affect management practices via their impact on the supply of skilled workers rather than any other routes, for example business education.

Finally, in a quantification exercise, the authors estimate that variation in human capital appears to account for the largest share of variation in management practices (around 15 per cent). Overall, the results of this piece of analysis - which uses a different dataset on management practices in the United States only and employs different university based measures of skills supply - finds results consistent with [Feng and Valero \(2020\)](#): plants in areas with a more plentiful supply of skilled workers tend to have better management practices.

## **5 Managerial human capital and management practices in public services**

A positive relationship between managerial education and management practices has also been found in hospitals. Employing WMS data from hospitals across 9 countries, [Bloom \*et al.\* \(2017b\)](#) investigate the extent to which differences in managerial education are a driver of variation in management scores.

The hospital level measure of managerial education is the share of managers that have an MBA (or management-related courses that are at least 6 months long). Overall in the sample, 26 per cent of managers are reported to have such a qualification, and this is positively and significantly associated with management practices, controlling for geographic and hospital characteristics. The authors employ the WHED data ([Valero and Van Reenen, 2019](#); [Feng and Valero, 2020](#)) to generate more exogenous measures of the supply of managerial skills in the hospital in the form of distance to nearest university.

While the authors calculate the distance to all types of university, the focus is on those that offer both medical and business courses. They find that the distance to such universities is positively and

significantly related to mortality rates from heart attacks, and negatively related to management practices. On management practices, their results imply that a 10 per cent increase in drive time to the nearest university offering both medical and business courses is associated with 0.014 standard deviations in the management score.<sup>17</sup> There is no such relationship for universities in general or those that offer just one of medical or business courses. This suggests that specialist knowledge or training of managers (medical and MBA) is more important in the management of hospitals and it contrasts with the findings in manufacturing firms where there is no evidence of heterogeneity by broad university subject areas (Feng and Valero, 2020).

In the robustness, the authors address a number of endogeneity concerns. First, it might be that universities offering both medical and business degrees are of higher quality. They find that the main results survive the inclusion of variables that proxy quality. Second, they show that the inclusion of region fixed effects and (on the US sample) county level controls based on census data for differences in labour markets does not wipe out the result. In addition, on the US sub-sample they show that results are robust to adding fixed effects for the networks that hospitals belong to.

Supporting the interpretation that universities with medical and business schools increase the supply of managerial human capital, the authors find that hospitals which are closer to the combined clinical and business schools also have a higher fraction of managers with MBAs. But they do note that the cross sectional nature of the data do not allow them to exclude the possibility that universities are creating bespoke managerial programmes in response to having a high quality hospital in the area.

The fact that specific types of education might matter more in hospitals is not surprising, since hospitals are large, complex organisations with multiple goals and stakeholders, and are therefore quite different from mid-sized manufacturing plants which have been the focus in the WMS manufacturing surveys. Indeed, the literature that has studied the effects of CEOs on organisational performance in the public sector (following the methods of Bertrand and Schoar (2003) in firms) has found mixed results. In UK hospitals Janke *et al.* (2019) find that the movement of CEOs does not affect performance which the authors attribute to being at least in part due to the size and complexity of hospitals. Perhaps consistent with Bloom *et al.* (2017b) however, this study finds that CEOs with a clinical background are associated with better clinical performance in teaching hospitals.

---

<sup>17</sup> In fact this is very similar to the magnitude of the effect found in Feng and Valero (2020) on the relationship between manufacturing plant management practices and distance to nearest (general) university, where a 10 per cent rise in distance is associated with 0.01 standard deviation lower management scores. The log specification for comparison is given in Table A.10 in the Online Appendix.

## 6 Conclusion

The evidence summarised in this article appears to suggest that human capital is an important driver of management practices. While some analyses have focused on management education (Bloom *et al.*, 2017b), others have considered the general education of both managers and workers. Feng and Valero (2020) provide evidence that supports there being a complementarity between workforce education and management practices using measures of local skills supply; while in focused analysis of human capital in German firms, Bender *et al.* (2018) find that manager ability appears to matter more.

A number of policy implications flow from the apparent complementarity between productivity enhancing management practices and general workforce human capital. First, complementarity implies that policies to raise human capital can raise productivity via a direct impact on worker skills, but also via an indirect effect as firms with a skilled workforce are more likely to successfully implement productivity enhancing management practices. The analysis in Feng and Valero (2020) suggests that this might be particularly the case for smaller, single-unit firms that are likely to be more reliant on their local skills environments. Second, complementarity implies that the payoffs from implementing education and skills policies to raise general human capital and policies specifically aimed at improving management practices (such as managerial training or consultancy) are likely to be higher when such policies are implemented in a coordinated fashion.

Secondly, and more broadly, the finding that proximity to universities appears to be related to the education of the workforce and management practices in firms (and hospitals) is relevant for place-based policies that seek to maximise the positive impacts that universities have on local economies via the diffusion of innovative technologies or organisational practices. There is a general need to know more about the mechanisms driving the positive impacts that universities can have on regional economic performance (Valero and Van Reenen, 2019; Valero, 2019), and to understand better how to encourage university-business collaboration, in particular for smaller firms (OECD, 2019).

With respect to future work, further efforts at finding causal relationships between organisational human capital and management practices are needed, together with gaining an improved understanding how these interact in driving organisational performance, and establishing which particular skills or knowledge matter in different contexts. Work in the following three areas will enable this.

First, expanded datasets will allow for more controls or fixed effects in regressions. As further survey waves become available in WMS and standard business survey versions like the MOPS, more panel evidence can be built. Datasets where more than one surveyed manager within larger organisations has been interviewed allow an assessment of differences in management practices holding aggregate organisational factors constant. Larger samples with more coverage of performance

data can also allow more detailed analysis of complementarities in performance equations.

Second, causal evidence on the drivers of management practices can continue to be built exploiting experimental or quasi-experimental variation. To the extent that human capital can be built via more targeted educational programmes, there could be an important role for well-designed managerial education and workforce training programmes in raising management practices and productivity in lagging firms. Training and consultancy programmes that seek to do this have been evaluated in a series of randomised controlled trials, and the need for more experimentation in this area is acknowledged by policymakers.<sup>18</sup> There might be scope for programme design that can introduce some level of randomness in access to more general business training delivered in the education system. An example would be subsidised higher or further education courses being offered to managers (for example, through vouchers or other incentives) which could be randomised or implemented in a way that would allow robust evaluation.<sup>19</sup>

In order to understand how best to target interventions in different contexts, interactions between the effectiveness of targeted management training or consulting programmes and the formal education of managers (or workers) could also be explored further. Another interesting avenue would be to consider the relative effectiveness of programmes that include training both managers and workers, versus those focused only on one group.

Third, the measure of firm-level human capital used in much of the analysis described in this paper (degree share, or MBA equivalent qualification share) is rather broad. It would be valuable to understand at a more granular level the specific types of skills or cognitive/non cognitive abilities that are relevant with respect to improving modern management practices, and how these can best be acquired.

---

<sup>18</sup> A good example is the UK's Business Basics Programme, which has been designed to fund the implementation and evaluation of innovative ways of encouraging small and medium sized enterprises to adopt existing technologies and management practices to improve their productivity.

<sup>19</sup> For example, a gradual roll-out across locations, or eligibility criteria for accessing support that could create discontinuities to be exploited in evaluation.

## References

- Abowd, J., Kramarz, F. and Margolis, D. (1999). 'High wage workers and high wage firms', *Econometrica*, vol. 67(2), pp. 251–333.
- Altonji, J.G. and Zhong, L. (2020). 'The labor market returns to advanced degrees', National Bureau of Economic Research.
- Anselin, L., Varga, A. and Acs, Z. (1997). 'Local geographic spillovers between university research and high technology innovations', *Journal of urban economics*, vol. 42(3), pp. 422–448.
- Azmat, G., Murphy, R., Wyness, G. and Valero, A. (2018). 'Universities and industrial strategy in the uk: Review of evidence and implications for policy', *CEP Industrial Strategy Paper, CEPIS06*.
- Bandiera, O., Hansen, S., Prat, A. and Sadun, R. (2017). 'Ceo behavior and firm performance', *NBER Working Paper No. 23248*.
- Beaudry, P., Doms, M.E. and Lewis, E.G. (2010). 'Should the personal computer be considered a technological revolution? evidence from u.s. metropolitan areas', *Journal of Political Economy*, vol. 118(5), pp. 988–1036.
- Belenzon, S. and Schankerman, M. (2013). 'Spreading the word: Geography, policy, and knowledge spillovers', *Review of Economics and Statistics*, vol. 95(3), pp. 884–903.
- Belfield, C., Britton, J., Buscha, F., Dearden, L., Dickson, M., Van Der Erve, L., Sibieta, L., Vignoles, A., Walker, I. and Zhu, Y. (2018). 'The relative labour market returns to different degrees: Research report: June 2018', .
- Bender, S., Bloom, N., Card, D., Van Reenen, J. and Wolter, S. (2018). 'Management practices, workforce selection, and productivity', *Journal of Labor Economics*, vol. 36(S1), pp. S371–S409.
- Bertrand, M. and Schoar, A. (2003). 'Managing with style: The effect of managers on firm policies', *The Quarterly Journal of Economics*, vol. 118(4), p. 1169–1208.
- Bloom, N., Brynjolfsson, E., Foster, L., Jarmin, R.S., Patnaik, M., Saporta-Eksten, I. and Van Reenen, J. (2017a). 'What drives differences in management', *NBER Working Paper No. 23300*.
- Bloom, N., Brynjolfsson, E., Foster, L., Jarmin, R.S., Patnaik, M., Saporta-Eksten, I. and Van Reenen, J. (2019). 'What drives differences in management', *American Economic Review*, vol. 109(5), pp. 1648–1683.

- Bloom, N., Eifert, B., Mahajan, A., McKenzie, D. and Roberts, J. (2013). 'Does management matter? evidence from india', *The Quarterly Journal of Economics*, vol. 128(1), pp. 1–51.
- Bloom, N., Genakos, C., Sadun, R. and Van Reenen, J. (2012). 'Management practices across firms and countries', *The Academy of Management Perspectives*, vol. 26(1), pp. 12–33.
- Bloom, N., Lemos, R., Sadun, R., Scur, D. and Van Reenen, J. (2014). 'The new empirical economics of management', *Journal of the European Economic Association*, vol. 12(4), p. 835–876.
- Bloom, N., Lemos, R., Sadun, R., Scur, D. and Van Reenen, J. (2016a). 'International data on measuring management practices', *American Economic Review*, vol. 106(5), pp. 152–56.
- Bloom, N., Lemos, R., Sadun, R., Scur, D. and Van Reenen, J. (this issue). 'The world management survey comes of age', *Oxford Review of Economic Policy*.
- Bloom, N., Lemos, R., Sadun, R. and Van Reenen, J. (2017b). 'Healthy business? managerial education and management in health care', *Review of Economics and Statistics*, pp. 1–12.
- Bloom, N., Mahajan, A., McKenzie, D. and Roberts, J. (2020). 'Do management interventions last? evidence from india', *American Economic Journal: Applied Economics*, vol. 12(2), pp. 198–219.
- Bloom, N., Sadun, R. and Van Reenen, J. (2016b). 'Management as a technology', *NBER Working Paper No. 22327*.
- Bloom, N. and Van Reenen, J. (2007). 'Measuring and explaining management practices across firms and countries', *The Quarterly Journal of Economics*, vol. 122(4), pp. 1351–1408.
- Bloom, N. and Van Reenen, J. (2010). 'Why do management practices differ across firms and countries?', *The Journal of Economic Perspectives*, vol. 24(1), pp. 203–224.
- Bresnahan, T.F., Brynjolfsson, E. and Hitt, L.M. (2002). 'Information technology, workplace organization, and the demand for skilled labor: Firm-level evidence', *Quarterly Journal of Economics*, vol. 117(1), pp. 339–376.
- Bruhn, M., Karlan, D. and Schoar, A. (2018). 'The impact of consulting services on small and medium enterprises: Evidence from a randomized trial in mexico', *Journal of Political Economy*, vol. 126(2), pp. 635–687.
- Brynjolfsson, E. and Milgrom, P. (2013). 'Complementarity in organisations', in (R. Gibbons and J. Roberts, eds.), *The Handbook of Organizational Economics*, pp. 11–55, chap. 1, Princeton.

- Card, D. (1995). *Using Geographic Variation in College Proximity to Estimate the Return to Schooling*, Toronto: University of Toronto Press.
- Caroli, E. and Van Reenen, J. (2001). 'Skill-biased organizational change? evidence from a panel of british and french establishments', *Quarterly Journal of Economics*, vol. 116(4), pp. 1449–1492.
- Choudhury, P. (2017). 'Innovation outcomes in a distributed organization: Intrafirm mobility and access to resources.', *Organization Science*, vol. 28(2), pp. 339–354.
- Cornwell, C., Schmutte, I.M. and Scur, D. (2019). 'Building a productive workforce: The role of structured management practices', *Centre for Economic Performance Discussion Paper 1644*.
- Drexler, A., Fischer, G. and Schoar, A. (2014). 'Keeping it simple: Financial literacy and rules of thumb', *American Economic Journal: Applied Economics*, vol. 6(2), pp. 1–31.
- Fairlie, R.W., Karlan, D. and Zinman, J. (2015). 'Behind the gate experiment: Evidence on effects of and rationales for subsidized entrepreneurship training', *American Economic Journal: Economic Policy*, vol. 7(2), pp. 125–61.
- Feng, A. and Valero, A. (2020). 'Skill biased management: Evidence from manufacturing firms', *The Economic Journal*, vol. 130(628), pp. 1057–1080.
- Fryer, R.G. (2017). 'Management and student achievement: Evidence from a randomized field experiment', .
- Gennaioli, N., La Porta, R., De Silanes, F.L. and Shleifer, A. (2013). 'Human capital and regional development', *Quarterly Journal of Economics*, vol. 128(1), pp. 105–164.
- Gennaioli, N., La Porta, R., De Silanes, F.L. and Shleifer, A. (2014). 'Growth in regions', *Journal of Economic growth*, vol. 19(3), pp. 259–309.
- Glaeser, E.L. and Hausman, N. (2020). 'The spatial mismatch between innovation and joblessness', *Innovation Policy and the Economy*, vol. 20(1), pp. 233–299.
- Hanushek, E.A. and Woessmann, L. (2015). *The Knowledge Capital of Nations: Education and the Economics of Growth*, The MIT Press, ISBN 9780262029179.
- Henderson, R., Jaffe, A.B. and Trajtenberg, M. (1998). 'Universities as a source of commercial technology: a detailed analysis of university patenting, 1965–1988', *Review of Economics and statistics*, vol. 80(1), pp. 119–127.

- Homkes, R. (2010). 'Enhancing management quality: the potential for productivity growth after the recession', *CentrePiece*, vol. 15(3), pp. 2–6.
- Iacovone, Leonardo; Maloney, W.F. and McKenzie, D. (2019). 'Improving management with individual and group-based consulting : Results from a randomized experiment in colombia', *WPS 8854*.
- Janke, K., Propper, C. and Sadun, R. (2019). 'The impact of ceos in the public sector: Evidence from the english nhs', National Bureau of Economic Research.
- Lee, Y.S. (2018). 'Modern management and the demand for technical skill', *Labour Economics*, vol. 55, pp. 328–343.
- Lock, A.R. (1996). 'The future of the mba in the uk', *Higher Education*, vol. 31(2), pp. 165–185.
- Lucas, R.E. (1978). 'On the size distribution of business firms', *The Bell Journal of Economics*, pp. 508–523.
- Lucas, R.E. (1988). 'On the mechanics of economic development', *Journal of Monetary Economics*, vol. 22, pp. 3–42.
- McKenzie, D. (this issue). 'Small business training to improve management practices in developing countries: Re-assessing the evidence for "training doesn't work"', *Oxford Review of Economic Policy*.
- McKenzie, D. and Woodruff, C. (2017). 'Business practices in small firms in developing countries', *Management Science*, vol. 63(9), pp. 2967–2981.
- Milgrom, P. and Roberts, J. (1990). 'The economics of modern manufacturing - technology, strategy, and organization', *American Economic Review*, vol. 80(3), pp. 511–528.
- Moretti, E. (2004a). 'Estimating the social return to higher education: evidence from longitudinal and repeated cross-sectional data', *Journal of econometrics*, vol. 121(1), pp. 175–212.
- Moretti, E. (2004b). 'Worker's education, spillovers, and productivity: Evidence from plant-level production functions', *American Economic Review*, vol. 94(3), pp. 656–690.
- Moretti, E. (2011). 'Local labor markets', *Handbook of labor economics*, vol. 4, pp. 1237–1313.
- Nelson, R.R. and Phelps, E.S. (1966). 'Investment in humans, technological diffusion, and economic growth', *The American Economic Review*, vol. 56(1/2), pp. 69–75.
- OECD (2019). *University-Industry Collaboration*.
- Queiro, F. (2018). 'Entrepreneurial human capital and firm dynamics', *Available at SSRN: <https://ssrn.com/abstract=3280925>*.



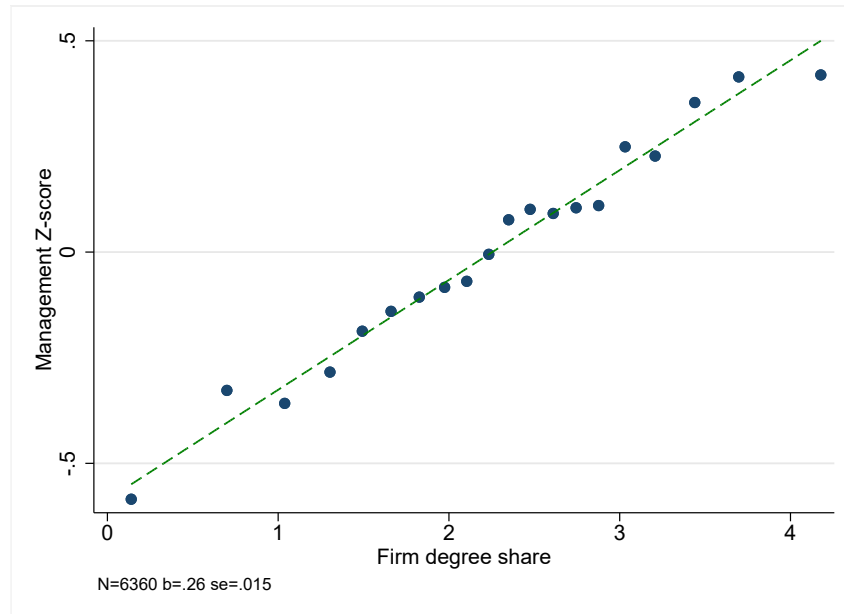
Roberts, J. (1995). *The Modern Firm. Organizational Design for Performance and Growth*, Oxford, ISBN 0198293755.

Valero, A. (2019). 'Economic impact of universities in the uk: A firm level analysis', *Mimeo*.

Valero, A. and Van Reenen, J. (2019). 'The economic impact of universities: Evidence from around the globe', *Economics of Education Review*, vol. 68, pp. 53–67.

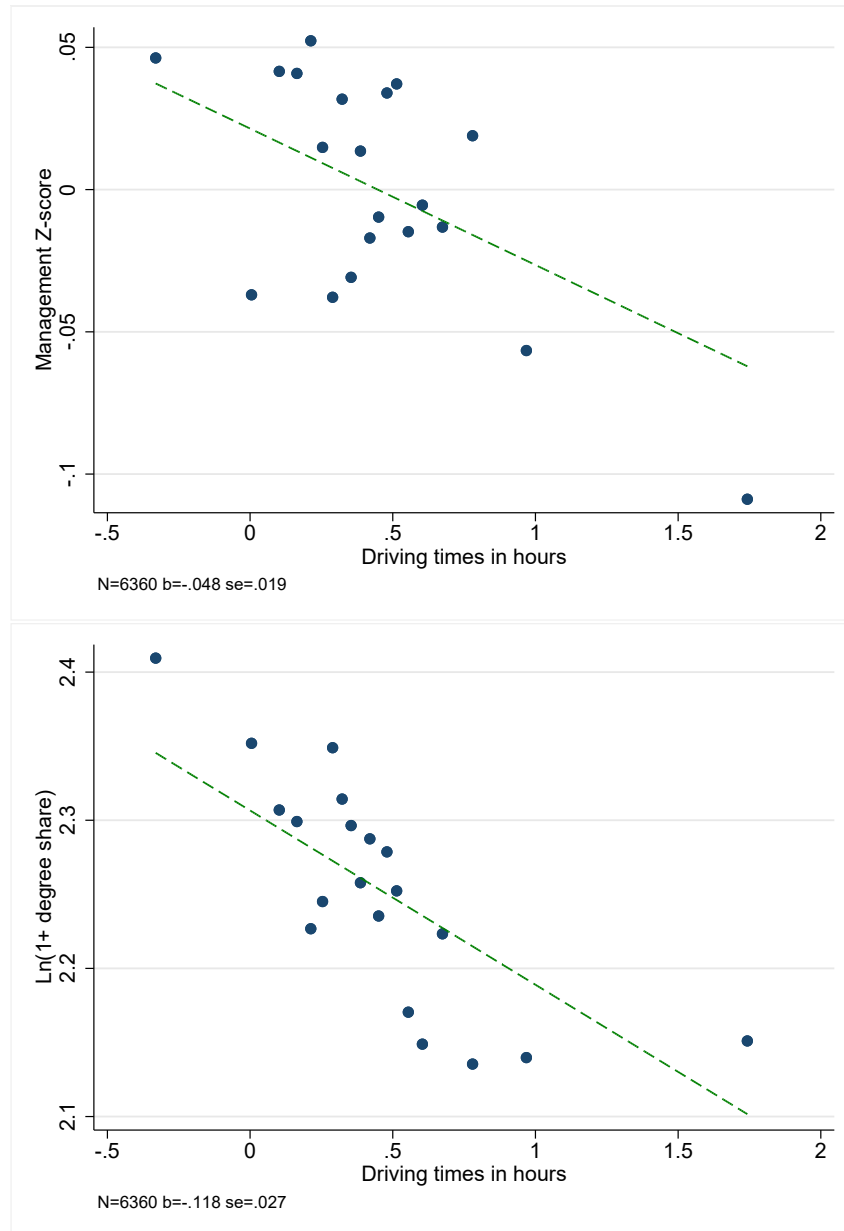
Violante, G.L. (2008). 'Skill-biased technical change', *The new Palgrave dictionary of economics*, vol. 2.

**Figure 1: Firm skills and management practices**



NOTES: Source: [Feng and Valero \(2020\)](#). Scatter plot of average firm management practices on average  $\ln(1+\text{degree share})$  within 20 evenly sized bins. Sample includes manufacturing plants surveyed in the WMS across 19 countries: Argentina, Australia, Brazil, Canada, Chile, China, France, Germany, Greece, India, Italy, Japan, Mexico, New Zealand, Poland, Portugal, Sweden, United Kingdom and United States. Variation is within country and wave dummies are also absorbed. For details on the sample see the online data appendix in [Feng and Valero \(2020\)](#). Reported standard errors are clustered at the region level for consistency with regional analysis in paper. The dashed line represents the line of best fit.

Figure 2: Distance to University, Management Scores and Degree Share



NOTES: Source: [Feng and Valero \(2020\)](#). Scatter plots of average management Z-score and degree share on average driving time within 20 evenly sized bins. Controls and fixed effects are absorbed. Reported standard errors are clustered at the region level. The dashed line represents the line of best fit.

**Table 1: Firm Skills and Management Practices, Basic Regressions**

| Dependent variable:<br>Management Z-score | (1)                 | (2)                 | (3)                 | (4)                 |
|---|---------------------|---------------------|---------------------|---------------------|
| A. No controls                            |                     |                     |                     |                     |
| Ln(1+degree share)                        | 0.260***<br>(0.015) |                     |                     |                     |
| Ln(1+degree share), managers              |                     | 0.206***<br>(0.013) |                     | 0.138***<br>(0.011) |
| Ln(1+degree share), non managers          |                     |                     | 0.196***<br>(0.010) | 0.154***<br>(0.010) |
| B. Full controls                          |                     |                     |                     |                     |
| Ln(1+degree share)                        | 0.156***<br>(0.014) |                     |                     |                     |
| Ln(1+degree share), managers              |                     | 0.101***<br>(0.012) |                     | 0.069***<br>(0.011) |
| Ln(1+degree share), non managers          |                     |                     | 0.109***<br>(0.009) | 0.091***<br>(0.009) |
| Observations                              | 6360                | 6360                | 6360                | 6360                |

NOTES: Source: [Feng and Valero \(2020\)](#). \*\*\* denotes significance at the 1% level, \*\* 5% level and \* 10% level. All columns estimated by OLS. Reported standard errors are clustered at the region level for consistency with regional analysis in paper. Panel A specifications include only country and year dummies. Panel B include a full set of firm, industry, geography and survey controls as per the main specifications in the paper.

**CENTRE FOR ECONOMIC PERFORMANCE**  
**Recent Discussion Papers**

|      |  |   |
|------|--|---|
| 1766 | Piero Monteburno<br>Olmo Silva<br>Nikodem Szumilo                | Court severity, repossession risk and demand in mortgage and housing markets                              |
| 1765 | Ghazala Azmat<br>Katja Kaufmann                                  | Formation of college plans: expected returns, preferences and adjustment process                          |
| 1764 | Anna Valero  | Education and economic growth   |
| 1763 | John Van Reenen  | Innovation and human capital policy   |
| 1762 | Sarah Flèche<br>Anthony Lepinteur<br>Nattavudh Powdthavee        | The importance of capital in closing the entrepreneurial gender gap: a longitudinal study of lottery wins |
| 1761 | Elodie Djemai<br>Andrew E. Clark<br>Conchita D'Ambrosio          | Take the highway? Paved roads and well-being in Africa  |
| 1760 | Sabrina T. Howell<br>Jason Rathje<br>John Van Reenen<br>Jun Wong | Opening up military innovation: causal effects of 'bottom-up' reforms to U.S. defense research            |
| 1759 | Marcus Biermann  | Remote talks: changes to economics seminars during Covid-19   |
| 1758 | Yatang Lin<br>Thomas K.J. McDermott<br>Guy Michaels              | Cities and the sea level  |
| 1757 | Maria Cotofan<br>Robert Dur<br>Stephen Meier                     | Does growing up in a recession increase compassion? The case of attitudes towards immigration             |

|      |  |   |
|------|--|---|
| 1756 | Jo Blanden<br>Andrew Eyles<br>Stephen Machin   | Trends in intergenerational home ownership and wealth transmission                        |
| 1755 | Martin Beraja<br>David Y. Yang<br>Noam Yuchtman  | Data-intensive innovation and the State: evidence from AI firms in China                  |
| 1754 | Rafael Dix-Carneiro<br>João Paulo Pessoa<br>Ricardo Reyes-Heroles<br>Sharon Traiberman           | Globalization, trade imbalances and labor market adjustment                               |
| 1753 | Niklas Gohl<br>Peter Haan<br>Elisabeth Kurz<br>Felix Weinhardt                                   | Working life and human capital investment   |
| 1752 | Holger Breinlich<br>Harald Fadinger<br>Volker Nocke<br>Nicolas Schutz                            | Gravity with granularity  |
| 1751 | Bernardo Guimaraes<br>João Paulo Pessoa<br>Vladimir Ponczek                                      | Non-compete agreements, wages and efficiency: theory and evidence from Brazilian football |
| 1750 | Jack Blundell  | Wage responses to gender pay gap reporting requirements                                   |
| 1749 | Andrew E. Clark<br>Conchita D'Ambrosio<br>Simone Ghislandi<br>Anthony Lepinteur<br>Giorgia Menta | Maternal depression and child human capital: a genetic instrumental-variable approach     |
| 1748 | Lee Elliot Major<br>Andrew Eyles<br>Stephen Machin   | Unequal learning and labour market losses in the crisis: consequences for social mobility |

**The Centre for Economic Performance Publications Unit**

Tel: +44 (0)20 7955 7673 Email [info@cep.lse.ac.uk](mailto:info@cep.lse.ac.uk)

Website: <http://cep.lse.ac.uk> Twitter: @CEP\_LSE