

Article

# Management practices and productivity among manufacturing businesses in Great Britain: Experimental estimates for 2015

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## 2 . Acknowledgements

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## 3 . Introduction

The UK's relatively poor labour productivity performance, both in terms of growth in recent years compared to previous trends and in level terms relative to other similar economies, is well documented<sup>1</sup>, but the reasons for this poor performance are less well established<sup>2</sup>. The relationship between management practices and productivity has received growing attention both in the theoretical literature on productivity and in empirical studies. The empirical literature in particular has found that the use of structured practices is tightly linked to better performance in terms of productivity, profitability, innovation and growth (Bloom et al (2013)). It follows that understanding differences in management practices may help to explain differences in productivity performance both within and between countries.

Drawing on existing international work in this area, we launched a pilot Management Practices Survey (MPS) of manufacturing businesses in Great Britain in early 2016<sup>3</sup>, to enable statistical analysis of the relationships between selected aspects of management practices and productivity. In an initial article on the [Management Practices Survey](#)<sup>4</sup>, we found that the use of structured management practices was higher among larger businesses and multinationals. On the other hand, smaller businesses and those owned and managed by family members, who account for the largest share of our sample population had relatively lower levels of structured management practices. We also found a positive correlation between average management practice scores and levels of labour productivity at the industry level.

In this article, we set out to explore the dependencies between levels of structured management practices and productivity at the enterprise level. Our results confirm that management practice scores are most closely associated with the size of a business in terms of employment. Management practice scores tend to increase as employment increases and this association is stronger among smaller enterprises. We also find a positive correlation between management practice scores and productivity when we analyse this relationship across industry groups. Consequently, multinationals, large businesses (employment of 250 and over) and non-family-owned businesses have higher management scores and outperform domestic, smaller and family-owned businesses in terms of productivity. Our analysis shows that on a scale of 0 to 1, a 0.10 increase in management practice score is associated with a 6.7% rise in productivity<sup>5</sup>. This controls for business size, industry grouping, family ownership status, multinational status and business age. The distribution of management scores shows a 0.13 difference between the median and the 75th percentile, which translates into a difference in productivity of 8.7%.

Among the individual management questions, we find that practices related to continuous improvement and promotions were most associated with productivity.

While this article moves us further in analysing the link between management practices and productivity, the wider literature has explored the causal "drivers" of structured management practices (Bloom et al, 2016) and the impact of management practices in explaining within-country and cross-country Total Factor Productivity (TFP) gaps<sup>6</sup>. We intend to explore these areas in future work.

The rest of this paper proceeds as follows: Section 4 describes the data sources used in our analysis; Sections 5 and 6 present relationships between management practice scores and business characteristics; Section 7 examines the correlation between management practice and productivity at the industry level and Sections 8 to 12 includes analysis of various business characteristics with productivity. Section 13 explores the risks and limitations of our analysis. Finally, Section 14 sets out some conclusions and next steps.

## Notes for: Introduction

1. Poor performance relative to other countries is discussed in our [International Comparisons of Productivity statistical bulletin](#) and the poor performance in terms of growth rates is discussed in our [Labour Productivity statistical bulletin](#).
2. Barnett et al (2014) and Goodridge et al (2015), among others, look at several potential contributing factors to the UK's low productivity growth of recent years. The range of factors considered and found by the authors to contribute indicates a complex picture of underlying causes.
3. We carried out the data collection in 2016, requesting information on management practices in the 2015 calendar year.
4. Awano and Robinson (2016): Experimental data on the management practices of manufacturing businesses in Great Britain.
5. This controls for business size, industry grouping, family ownership status, multinational status and business age.
6. Using the US Management and Organizational Practice Survey (MOPS), Bloom et al (2016) examine what drives differences in management, making use of geographic variation within the sample. The authors found evidence of 4 causal "drivers" of structured management: product market competition, state business environment, learning spill-overs and education. Collectively, these account for around one-third of the total variation in productivity, which suggests a need for wider theories to explain the remaining variation.

For an international perspective, Bloom et al (2014) used data from the World Management Survey (WMS) which has collected business level management practices data across multiple sectors and countries over the last decade. Their preliminary results show that around a quarter of cross-country and within-country TFP gaps can be accounted for by management practices. However, it must be considered that the WMS questions could be culturally biased – using "Anglo Saxon" practices rather than something that is more closely related to performance.

## 4 . Data sources

We use three main data sources for the analysis presented in this article: the pilot Management Practices Survey (MPS) of manufacturing businesses, the Annual Business Survey (ABS) and the Interdepartmental Business Register (IDBR).

The pilot Management Practices Survey (MPS) is a survey of 1,026 manufacturing businesses in Great Britain which collected new information on the use of selected aspects of structured management practices in 2015. The MPS sample covered businesses with employment of 10 or more, within manufacturing industries in section C (divisions 10 to 33) of the 2007 Standard Industry Classification (SIC2007). The sample was drawn through stratified random sampling and used the 2015 ABS as its sample frame in order to maximise the link between management practices and financial data from the ABS. The MPS achieved a 68% response rate and a 59% usable match between the MPS overall sample and the ABS, on which our productivity analyses were carried out.

The Annual Business Survey is the main structural business survey conducted by ONS which collects business and financial information of companies in the production, construction, distribution and services industries, which represent approximately two-thirds of the UK economy<sup>1</sup>. The ABS provided the financial data on turnover and Gross Value Added (aGVA) for calculating labour productivity for our analysis.

Data on several business characteristics, including employment, industry and birth date were taken from the IDBR at the time of sample selection. We derive a business' age in 2015 using its birth date on the IDBR.

Our estimates are weighted to represent the population of manufacturing businesses in Great Britain with employment<sup>2</sup> of at least 10 people. All data are for the enterprise level of the business, which includes both single-site and multi-site businesses.

We create a score for management practices using responses to MPS questions, which indicates the prevalence of structured practices within the business. The score ranges from 0 to 1, with a higher score indicating more structured practices. Further details on the construction of this score are available in [Section 6 of Awano and Robinson \(2016\)](#) and the scoring schedule can be found in [Annex 3](#) of this paper.

Our measure of labour productivity (output per worker) was calculated as Gross Value Added (GVA) at basic prices over employment. This measure differs from the ONS headline labour productivity measure which is on an output per hour worked basis. Aggregate GVA from the ABS is referred to as approximate GVA (aGVA) to differentiate from the National Accounts measure, of which aGVA is a component. The difference between aGVA and the National Accounts measure of GVA is discussed in Ayoubkhani (2014).

## Notes for: Data sources

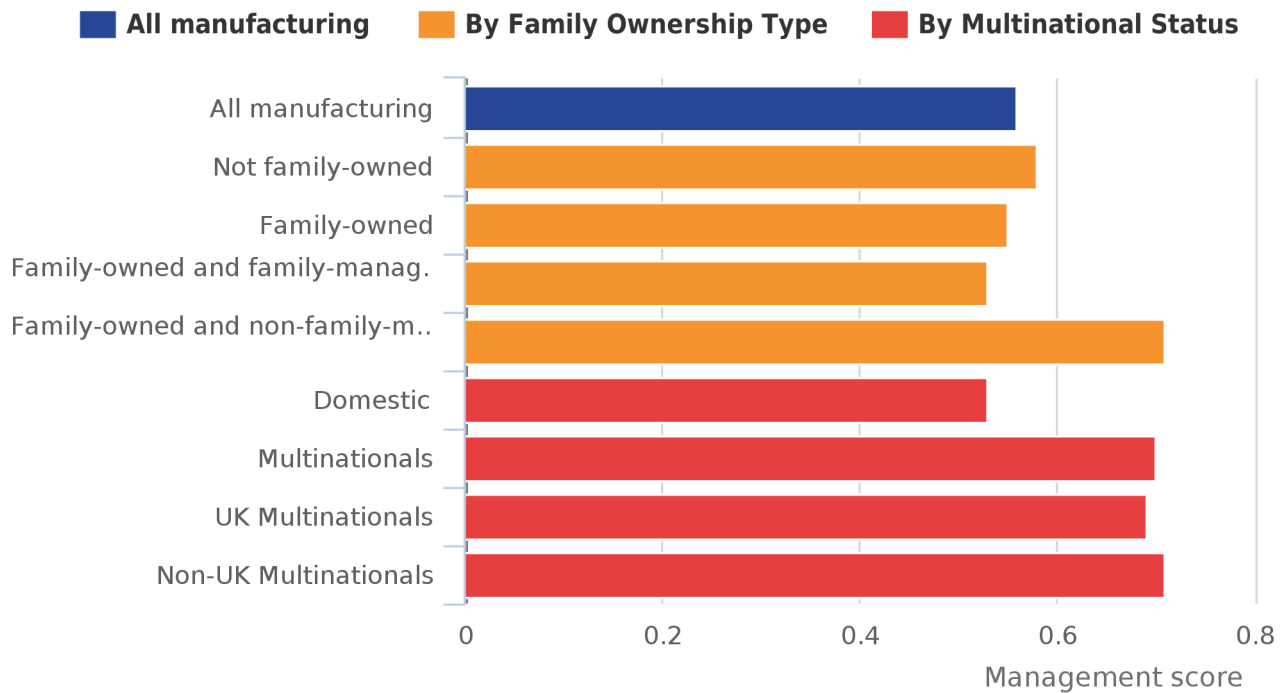
1. The ABS covers the non-financial business economy, which excludes financial services.
2. Employment includes employees and working proprietors.

## 5 . Management practice scores by business characteristics

In our previous article (Awano and Robinson, 2016), we found notable differences in average management practices scores across a range of business characteristics, including employment size, multinational and family ownership statuses<sup>1</sup>. On a scale of 0 to 1, where 0 represents least and 1 most structured management practices, our results showed the average management score of all manufacturing businesses with 10 or more workers to be 0.56. However, there were variations across business types, with higher scores among the largest establishments (employment of 250 and over), at 0.79, multinationals at 0.71 and family-owned and non-family-managed establishments at 0.70. These groups however account for a small share of the British manufacturing sector, with only 5 in every 100 businesses in the large (250 and over) employment size group and just 16 in every 100 businesses being a multinational. By contrast most manufacturing businesses in our population are small, with around three quarters (74%) within the 10 to 49 employment size class, and having an average management score of 0.51. Furthermore, just under two-thirds (64%) of manufacturing businesses are family-owned and among these almost 9 out of 10 (87%) are family-owned and family-managed. That is around 8 in every 100 manufacturing firms are family-owned and non-family-managed.

**Figure 1: Management score by business type**

Great Britain, 2015



Source: Office for National Statistics

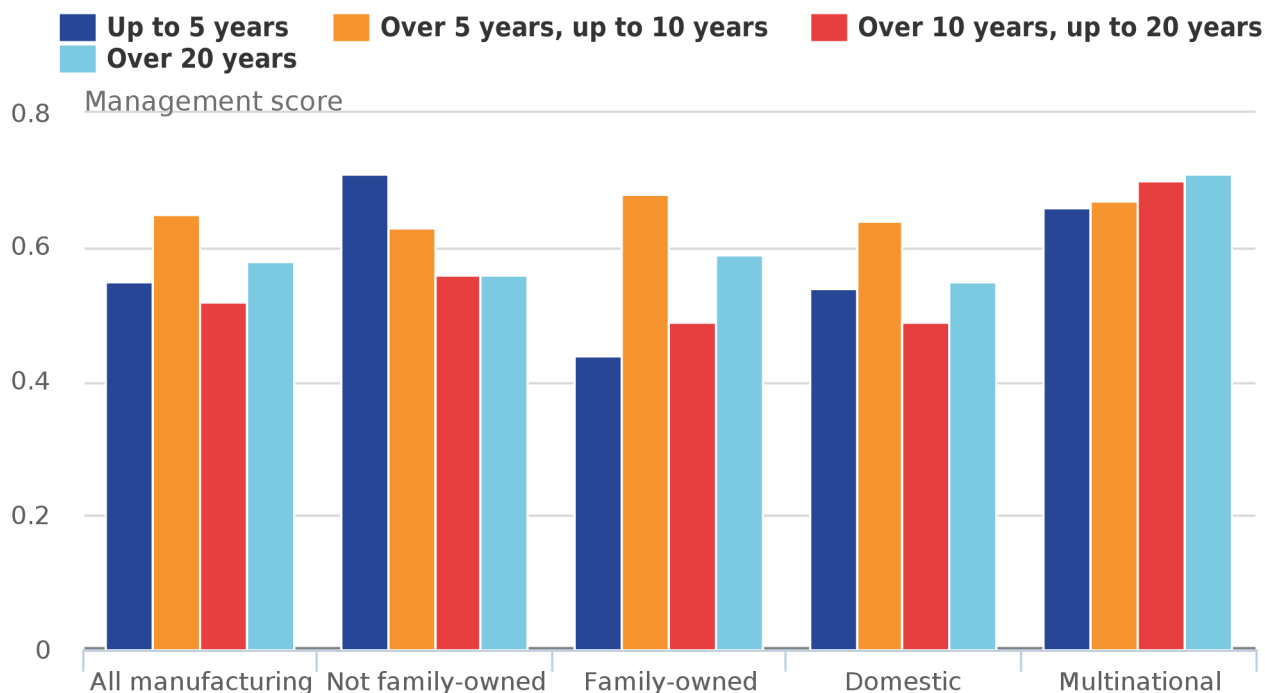
Notes:

1. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

We find less distinct patterns when we examine the distribution of management practice scores by the age of businesses (Figure 2). Although multinationals show slightly higher management scores as age increases, non-family-owned businesses show a converse trend, where management practice scores are higher among younger than older businesses. This could indicate an emergence of more structured start-ups among non-family-owned businesses, comparable to and even slightly higher than multinational start-ups.

**Figure 2: Management score by business type and age**

Great Britain, 2015



Source: Office for National Statistics

Notes:

1. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

## Notes for: Management practice scores of business characteristics

1. Further details on these characteristics are available in [Annex 1](#).

## 6 . Estimating relationships between management scores and business characteristics

In the following analysis, we use regression methods<sup>1</sup> to examine the relationships between management practice scores and each business characteristic, as well as for a combination of characteristics. This is particularly important since some of the characteristics of interest are related, for example the rate of family ownership is higher among small businesses, accounting for 69% of those in the 10 to 49 size class, compared with 29% of those in the 250 and over category. We also include age in our model, allowing for a quadratic relationship. Given the mixed picture in Figure 2, we are interested in observing whether there is a significant association, conditional on other characteristics. We test the hypothesis that it takes time to implement structured practices, so older businesses may have higher scores. It is worth noting that almost half (48%) of the manufacturing population in our sample was over 20 years old in 2015.

We begin with a simple regression model and add more variables in order to observe the association of these added dimensions with average management scores. In our first interaction between average score and business size (Table 1), we find that a 10% increase in employment is associated with an increase in management score of around 0.01. This outcome was consistent regardless of other characteristics included in the model, including age, family ownership and multinational statuses. Although this does not indicate causality, it confirms that an increase in the size of a business is strongly associated with higher levels of structured management practices<sup>2</sup>.





**Table 1: Multivariate analysis of management scores by business type and age**

	(1)	(2)	(3)	(4)
	Management score	Management score	Management score	Management score
Log(employment)	0.110 <sup>***</sup>	0.107 <sup>***</sup>	0.105 <sup>***</sup>	0.108 <sup>***</sup>
	(0.012)	(0.014)	(0.014)	(0.014)
Family-owned business		0.001		
		(0.051)		
Family-owned and family-managed business			-0.010	-0.006
			(0.056)	(0.058)
Family-owned and non-family-managed business			0.047	0.047
			(0.030)	(0.033)
Multinational		0.013	0.003	0.004
		(0.032)	(0.042)	(0.043)
UK Multinational			0.002	0.002
			(0.026)	(0.028)
Age (years)				-0.000
				(0.012)
Age squared				-0.000
				(0.000)
Industry group dummies	Yes	Yes	Yes	Yes
$R^2$	0.327	0.328	0.332	0.336
Adjusted $R^2$	0.319	0.318	0.320	0.322
Equal family p-value			0.096	0.115
Joint multinationals p-value			0.973	0.966
Joint industry p-value	0.000	0.000	0.000	0.000
Observations	694	694	694	694

Source: Office for National Statistics

Notes:

1. Standard errors in parentheses are clustered by industry and employment size band, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

2. Where we have indicated the inclusion of industry group dummies, we have included dummy variables for the industry groupings used in Figure 3 and elsewhere. A constant is also included in all regressions.

3. "Equal family p-value" is the probability that coefficients for "Family-owned and family-managed business" and "Family-owned and non-family-managed business" are equal. "Joint multinationals p-value" is the probability that both coefficients for "Multinationals" and "UK Multinationals" are both zero, and "Joint industry p-value" is the probability that the coefficients for all the industry grouping dummies are zero. These probabilities are all estimated using F-tests.

4. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

In Table 2 we include all business characteristics in the model, and examine their relationship with management scores for each employment size band. We find that for the smallest size band (employment of 10 to 49), a 10% increase in employment is associated with an increase in management score of 0.02, twice as much as for the manufacturing industry as a whole. The strength of the relationship between employment and management score weakens for the larger size bands, although coefficients remain positive.



**Table 2: Multivariate analysis of management scores by employment size**

	(1)	(2)	(3)	(4)
	Management score	Management score	Management score	Management score
	Small businesses	Medium businesses	Medium businesses	Large businesses
	(10-49 employment)	(50-99 employment)	(100-249 employment)	(250+ employment)
Log(employment)	0.195*** (0.038)	0.167* (0.082)	0.087* (0.042)	0.039 (0.024)
Family-owned and family-managed business	-0.007 (0.077)	-0.031 (0.043)	-0.085 (0.067)	0.005 (0.038)
Family-owned and non-family-managed business	0.028 (0.044)	0.025 (0.038)	0.021 (0.028)	0.035 (0.029)
Multinational	0.056 (0.081)	-0.057 (0.062)	0.017 (0.033)	0.008 (0.025)
UK Multinational	-0.001 (0.081)	0.054 (0.058)	0.018 (0.053)	-0.027 (0.020)
Age (years)	0 (0.017)	0.015 (0.010)	0.006 (0.019)	-0.008 (0.006)
Age squared	-0.000 (0.001)	-0.001 (0.000)	-0.000 (0.001)	0.000 (0.000)
Industry group dummies	Yes	Yes	Yes	Yes
$R^2$	0.283	0.131	0.234	0.165
Adjusted $R^2$	0.226	0.056	0.166	0.081
Family equal p-value	0.468	0.089	0.166	0.362
Joint multinationals p-value	0.009	0.645	0.485	0.436
Joint industry p-value	0.000	0.000	0.000	0.000
Observations	190	178	172	154

Source: Office for National Statistics

Notes:

1. Standard errors in parentheses are clustered by industry and employment size band, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

2. Where we have indicated the inclusion of industry group dummies, we have included dummy variables for the industry groupings used in Figure 3 and elsewhere. A constant is also included in all regressions.

3. "Equal family p-value" is the probability that coefficients for "Family-owned and family-managed business" and "Family-owned and non-family-managed business" are equal. "Joint multinationals p-value" is the probability that both coefficients for "Multinationals" and "UK Multinationals" are both zero, and "Joint industry p-value" is the probability that the coefficients for all the industry grouping dummies are zero. These probabilities are all estimated using F-tests.

4. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

In Table 3, we separate our management scores into two broad groups: those pertaining to monitoring (such as targets and key performance indicators) and those related to employment practices<sup>3</sup>. As with the outcomes observed above, we find that management practice scores are positively correlated with employment size.

We also find that family-owned and non-family-managed businesses have higher employment management scores by 0.12 on average, controlling for age, multinational status, size and industry grouping<sup>4</sup>, while there is no significant difference in monitoring scores for this group. We hypothesise that the involvement of individuals who do not own the company in senior management necessitates more structured employment practices, rather than relying on informal practices enabled by family relationships. When we disaggregate the employment management score into the individual question scores<sup>5</sup>, we find that for family-owned and non-family-managed businesses the largest coefficient, and the only coefficient significant at any conventional level, is associated with the question on managing employee underperformance (see column 4)<sup>6</sup>. We also note that UK Multinationals on average have a higher hiring score by 0.13<sup>7</sup>, conditional on the other business characteristics (see column 5).

**Table 3: Multivariate analysis of management scores by management categories**

Great Britain, 2015

	(1)	(2)	(3)	(4)	(5)
	Management score - Monitoring	Management score - Employment	Promotions Score (Question 6)	Underperformance Score (Question 7)	Hiring Score (Question 8)
Log(employment)	0.090*** (0.015)	0.137*** (0.024)	0.142*** (0.042)	0.106*** (0.033)	0.162*** (0.021)
Family-owned and family-managed business	-0.009 (0.084)	0.000 (0.031)	0.049 (0.052)	-0.001 (0.115)	-0.052 (0.042)
Family-owned and non-family-managed business	0.007 (0.045)	0.115*** (0.030)	0.06 (0.051)	0.235** (0.096)	0.052 (0.065)
Multinational	0.049 (0.048)	-0.071 (0.049)	-0.013 (0.074)	-0.149 (0.107)	-0.051 (0.054)
UK Multinational	-0.005 (0.035)	0.017 (0.043)	-0.100 (0.080)	0.024 (0.078)	0.127** (0.059)
Age (years)	0.002 (0.015)	-0.003 (0.014)	0.031 (0.020)	-0.032 (0.025)	-0.010 (0.014)
Age squared	0.000 (0.001)	-0.000 (0.000)	-0.001* (0.001)	0.001 (0.001)	0.000 (0.001)
Industry group dummies	Yes	Yes	Yes	Yes	Yes
$R^2$	0.289	0.257	0.181	0.158	0.296
Adjusted $R^2$	0.274	0.242	0.165	0.140	0.281
Equal family p-value	0.741	0.000	0.808	0.033	0.175
Joint multinationals p-value	0.409	0.325	0.464	0.227	0.117
Joint industry p-value	0.000	0.000	0.000	0.000	0.008
Observations	694	694	691	687	693

Source: Office for National Statistics

Notes:

1. Standard errors in parentheses are clustered by industry and employment size band, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

2. Where we have indicated the inclusion of industry group dummies, we have included dummy variables for the industry groupings used in Figure 3 and elsewhere. A constant is also included in all regressions.

3. "Equal family p-value" is the probability that coefficients for "Family-owned and family-managed business" and "Family-owned and non-family-managed business" are equal. "Joint multinationals p-value" is the probability that both coefficients for "Multinationals" and "UK Multinationals" are both zero, and "Joint industry p-value" is the probability that the coefficients for all the industry grouping dummies are zero. These probabilities are all estimated using F-tests.

4. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.



## Notes for: Estimating relationships between management scores and business characteristics

1. All analyses use Ordinary Least Squares regressions, with standard errors clustered by industry and size (using the employment size bands used in the rest of the paper). Sampling weights are used to produce estimates for the population of interest. The resulting coefficients estimate the relationship between characteristics and management score. The exact nature of the relationship cannot be determined; in particular we cannot say that the relationship is directly causal. We also have a relatively small sample, leading to larger standard errors and confidence intervals for our coefficient estimates than if we had a larger sample for the same data collection. Therefore we treat coefficients with relatively low significance levels as being of interest.

The results in Table 1 include several regressions, adding explanatory variables to each column. All regressions include the natural log of employment and indicator dummies for the industry groups, with the grouping of "Chemicals, pharmaceuticals, rubber, plastics and non-metallic minerals" used as the base level for comparisons. In all regressions the industry grouping variables are jointly statistically significant, indicating that industry grouping provides significant explanatory power for management score.

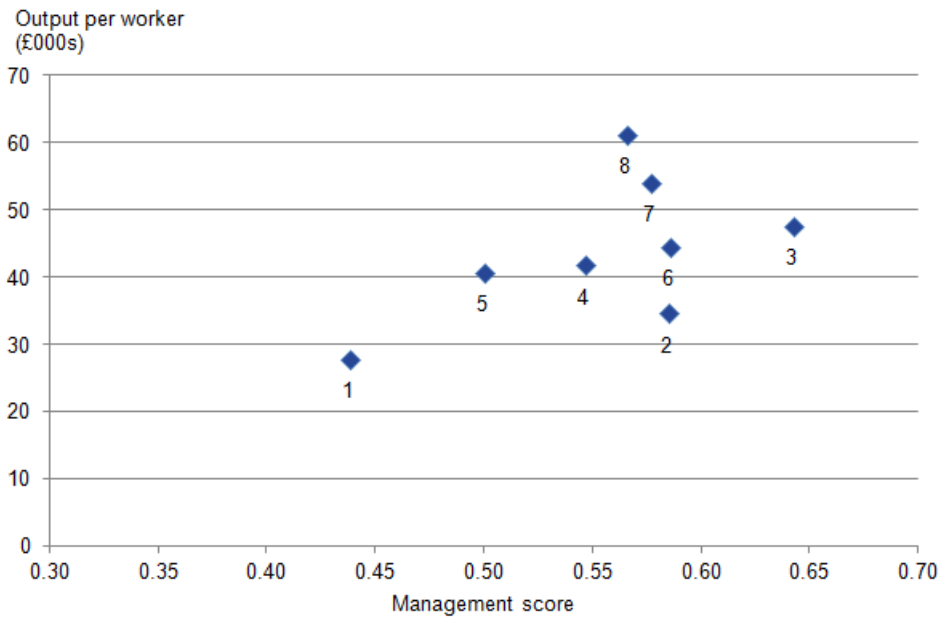
2. No other characteristic is statistically significant, and coefficients for multinationals, age and family-owned and family-managed are negligible, indicating that the variation in scores observed in the descriptive statistics in our previous article, can be attributed to the difference in size across different types of businesses.
3. Monitoring includes the use of continuous improvement processes, key performance indicators and targets. Employment practices include basis for promotions, timescales for handling underperformance, and who makes hiring decisions.
4. The coefficient on this indicator in column 2 is significant at the 1% level.
5. Further information on the questions is available in [Awano and Robinson \(2016\)](#).
6. The coefficient is significant at the 5% level.
7. The coefficient is significant at the 5% level.

## 7 . Management practice scores and productivity at the industry level

[In our previous article \(Awano and Robinson, 2016\)](#) we found a positive correlation between average management practice scores and levels of labour productivity (output per worker) at the industry level. We re-examine this relationship using aggregated business-level productivity estimates<sup>1</sup> from the Management Practices Survey sample and find a comparable level of correlation, supporting our earlier finding.

**Figure 3: Correlation between management score and productivity at industry grouping level**

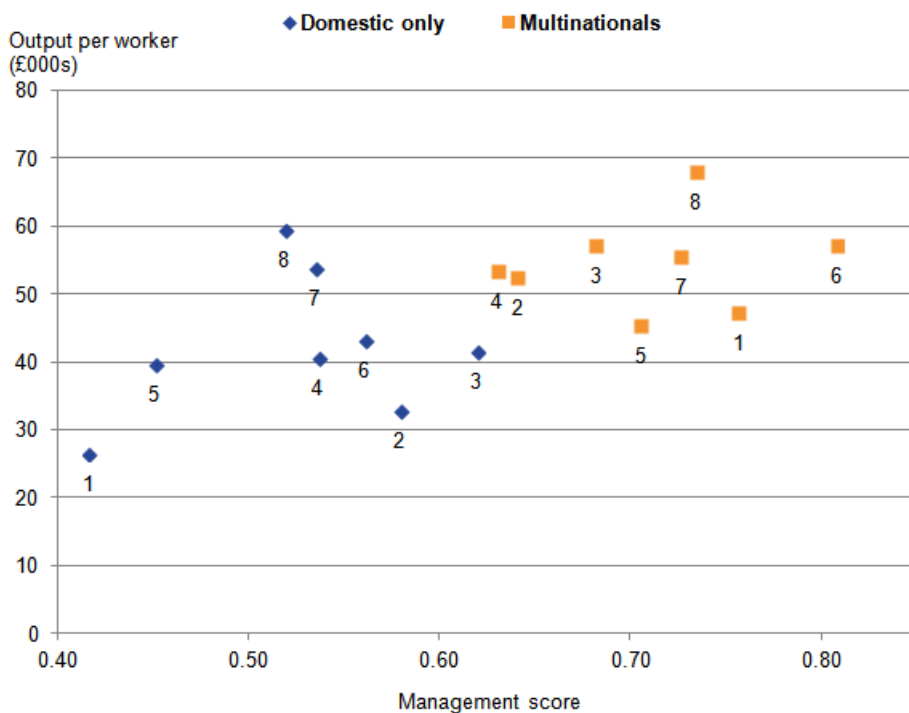
Great Britain, 2015



We examine this relationship further by comparing multinationals which have relatively higher management practice scores, against UK domestic businesses which have lower management scores (Figure 4). We find the correlation between management practice scores and productivity levels stronger among domestic businesses, at 0.27, compared to multinationals at 0.17. This could reflect the more clustered management scores and productivity levels for multinationals compared with domestic businesses.

**Figure 4: Correlation between management score and productivity by multinational status**

Great Britain, 2015



Notes for: Management practice scores and productivity at the industry level

1. We use output per worker at the business level as our measure of labour productivity, where output is Gross Value Added (GVA), obtained from the Annual Business Survey (ABS).

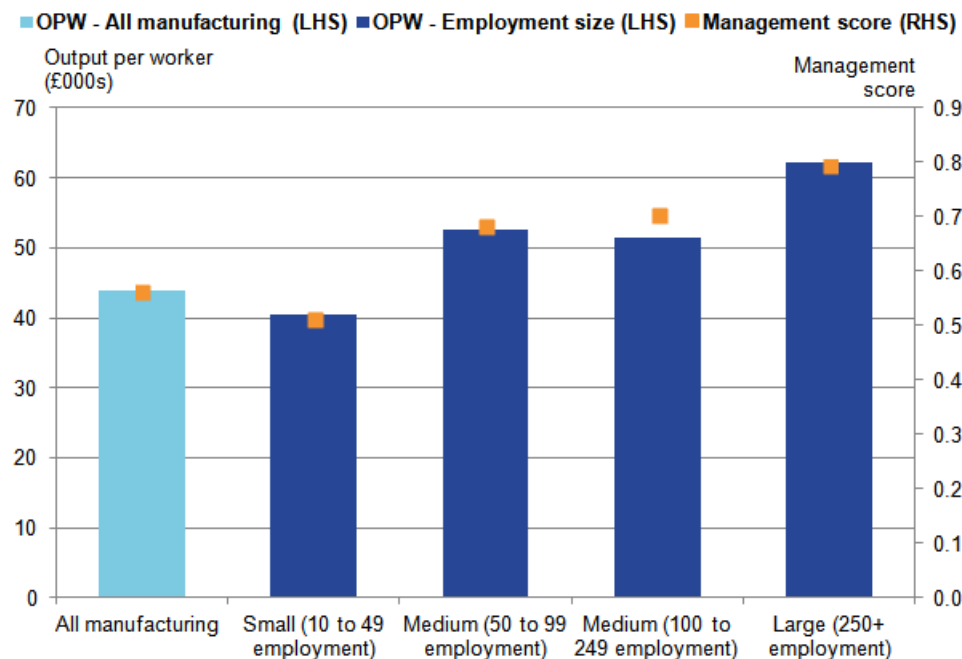
## 8 . Management practice and productivity by employment size

The use of structured management practices is found to increase as the employment size of the business increases. Looking at relationships between mean management scores against mean productivity for each size group (Figure 5), we find that an increase in the size of a business is associated with an increase in productivity, as average annual output per worker increases from around £40,000 for small businesses (10 to 49 employment) to £53,000 for medium-sized businesses (50 to 99 employment) and £62,000 for large businesses (employment of 250 and over). We also observe that on average, the increase in use of structured management practices is greater when businesses move from small to medium size (50 to 99 employment), with a 33% rise in average management score, compared with a 4% increase in score between the 50 to 99 and 100 to 249 size groups. This is broadly consistent with the regression results presented in Table 2.

The slightly lower level of productivity in the larger of the medium size bands (100 to 249) could indicate the need for greater use of structured practices as employment numbers move towards the higher end of the scale (250 and over). On average, businesses in the largest size band (250 and over) score 11% higher on management practices than those in the medium-sized group of 100 to 249 employment and are 21% more productive than the latter.

**Figure 5: Labour productivity and management score by employment size**

Great Britain, 2015

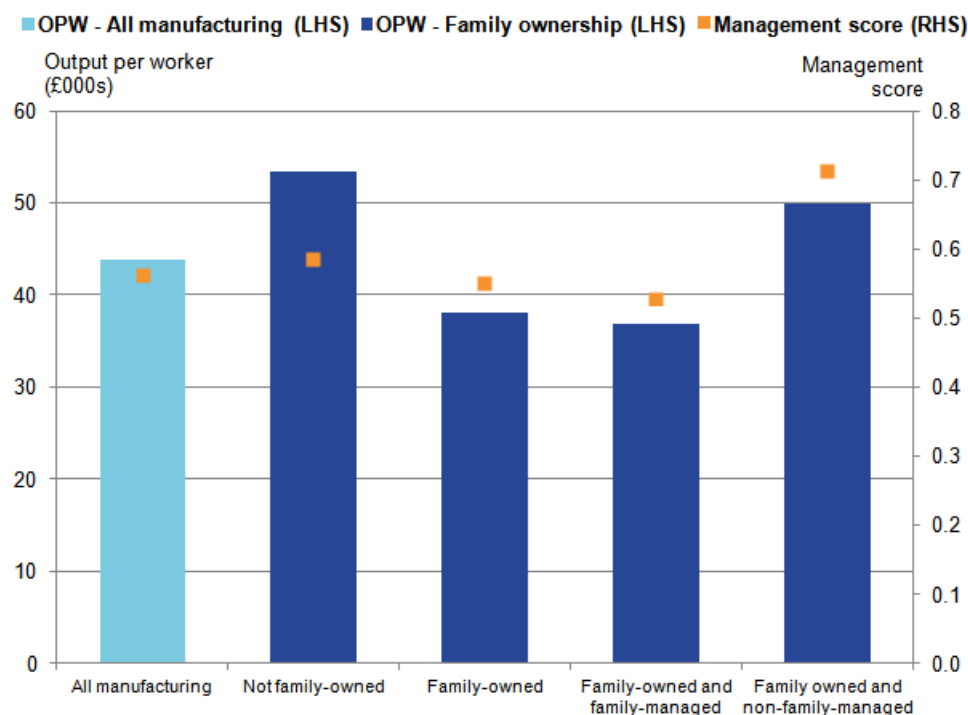


## 9 . Management practice and productivity by family ownership and multinational status

We find similar trends in productivity levels and management scores across family ownership and multinational statuses, with productivity levels relatively higher among businesses with higher management scores. In particular family-owned and managed establishments, with an average management score of 0.53 perform 24% lower in terms of output per worker, compared to family-owned but not family-managed enterprises with a mean management score of 0.71, at around £38,000 and £50,000 respectively. We estimate that family-owned and managed businesses account for over half (55%) of our population of interest, that is manufacturing businesses in Great Britain with employment of at least 10. Figure 10 in [Annex 5](#) of this paper shows the relationship between ownership and productivity by industry grouping.

**Figure 6: Labour productivity and management score by family ownership status**

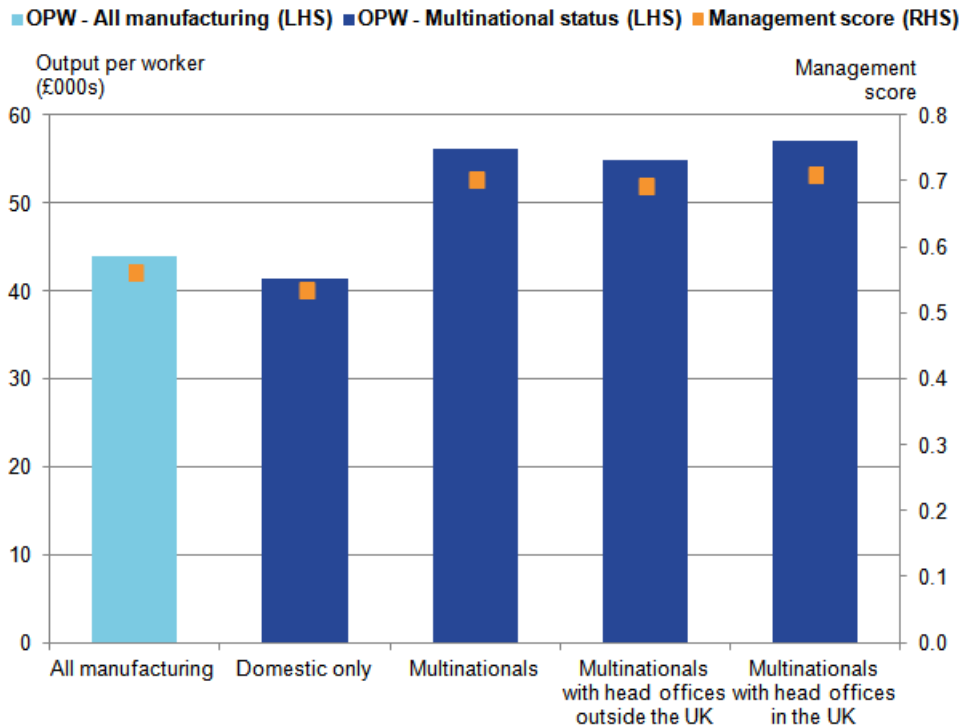
Great Britain, 2015



Similarly, as presented in Figure 7, we find that businesses which only operate domestically have lower management scores than average (0.53) and lower output per worker than average (around £41,000), while multinational businesses have higher management scores and higher productivity. Productivity levels between multinationals with UK head offices and those with head offices abroad are comparable at around £55,000 and £57,000 respectively.

**Figure 7: Labour productivity and management score by multinational status**

Great Britain, 2015



## 10 . Estimating relationships between management practices and productivity

Following on from the descriptive analysis of average management scores and productivity above, we use regression methods to estimate the strength of the relationships between productivity and business characteristics and management scores<sup>1</sup>. We start with a simple model, gradually adding characteristics as explanatory variables. Our first model looks at the relationship between management score and productivity, and shows that on a scale of 0 to 1, a 0.10 increase in management score is associated with an 8.6%<sup>2</sup> increase in labour productivity. In terms of the distribution of management scores, there is a 0.13 difference between the median and the 75th percentile, which translates into a difference in productivity of 11.1%<sup>3</sup>. When we include controls for employment size, family ownership and management, multinational status, age and industry grouping, we find that a 0.10 increase in management score is associated with a 6.7% rise in productivity, and a difference in productivity of 8.7% between the median management score and the 75th percentile.

From the initial model (column 1), adding industry grouping indicators and employment size (in log form) reduces the associated increase in productivity of a change of management score by around a third<sup>4</sup> to 6.1%. Adding indicators for family-owned businesses and multinationals only marginally alter the coefficient on management score, but they do provide additional explanatory power, indicated by the increase in the adjusted R<sup>2</sup><sup>5</sup>.



**Table 4: Multivariate analysis of labour productivity at the business level**

	(1)	(2)	(3)	(4)	(5)
	Log(Output per worker)	Log(Output per worker)	Log(Output per worker)	Log(Output per worker)	Log(Output per worker)
Management score	0.855** (0.312)	0.608** (0.290)	0.609** (0.223)	0.629** (0.239)	0.669*** (0.226)
Log(employment)		0.049* (0.027)	0.060 (0.038)	0.060 (0.037)	0.047 (0.042)
Family-owned business			-0.188*** (0.051)		
Family-owned and family- managed business				-0.162*** (0.055)	-0.184*** (0.067)
Family-owned and non-family- managed business				-0.271*** (0.094)	-0.265*** (0.095)
Multinational (MPS data)			-0.136 (0.124)	-0.086 (0.112)	-0.090 (0.105)
UK Multinational (MPS data)				-0.072 (0.114)	-0.080 (0.115)
Age (years)					0.017 (0.068)
Age squared					-0.000 (0.002)
Industry dummies	No	Yes	Yes	Yes	Yes
$R^2$	0.079	0.184	0.203	0.205	0.216
Adjusted $R^2$	0.077	0.171	0.188	0.187	0.195
Equal family p-value				0.302	0.507
Joint multinationals p-value				0.519	0.444
Joint industry p-value		0.000	0.000	0.000	0.000
Joint age p-value					0.622
Observations	591	591	591	591	591

Source: Office for National Statistics

Notes:

1. Standard errors in parentheses are clustered by industry and employment size band, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

2. Where we have indicated the inclusion of industry group dummies, we have included dummy variables for the industry groupings used in Figure 3 and elsewhere. A constant is also included in all regressions.



3. “Equal family p-value” is the probability that coefficients for “Family-owned and family-managed business” and “Family-owned and non-family-managed business” are equal. “Joint multinationals p-value” is the probability that both coefficients for “Multinationals” and “UK Multinationals” are both zero, and “Joint industry p-value” is the probability that the coefficients for all the industry grouping dummies are zero. These probabilities are all estimated using F-tests.

4. Labour productivity is measured as output per worker (GVA/employment) in 2015 current prices.

5. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

Another notable result from this regression is the relationship between productivity and family ownership, where family ownership is associated with 18.8% lower productivity, when we account for size, industry, management score and multinational status.

We find that that a 0.10 increase in management score increases productivity by 6.3%, when we divide family-owned businesses into those with and without family members in management, as well as between UK and non-UK based multinationals (column 4). We also find from this model that both types of family-ownership are associated with lower productivity. We find no statistically significant difference between the coefficients for the two family ownership indicators, despite the relative large difference in the coefficients<sup>6</sup>. This is in contrast to the pattern found in our descriptive statistics (Figure 6), where family-owned and non-family-managed businesses have higher management scores and productivity. These results indicate that management score and the other characteristics included in our regressions do not fully account for the relatively poor performance of family-owned businesses relative to non-family-owned businesses. This may be due to other aspects of management which have not been captured by our measure, and suggests an avenue for further work.

Finally, in column 5, we add a quadratic term for the age of the business in years, because age may be related positively to both management score and productivity. We hypothesise that more mature businesses may have more structured practices because they have had longer to implement them, and they are also likely to be more productive, either because they have had time to build up their stock of capital, which we have not included directly, or through competitive selection only more productive businesses survive in the medium or long term. However we do not find a significant relationship between age and productivity, conditional on our other explanatory variables. A larger sample with more explanatory power may provide further insight into this question. The differences between coefficients in columns 4 and 5 are relatively small.

## Notes for: Estimating relationships between management practices and productivity

1. We take logs of labour productivity, so the coefficients in our regressions represent a percentage change in productivity.
2. The coefficient is significant at the 5% level.
3. The median management score is 0.59 and the score for the 75th percentile is 0.72. Further information on percentiles of interest for both management score and labour productivity are included in [Annex 4](#).
4. Neither management score nor log employment are statistically significant, but the industry grouping variables are jointly significant at all conventional levels.
5. This improves the precision of the management score coefficient, although the standard error for log employment rises, indicating a relationship between log employment and the indicators for business type.
6. The f-test that both coefficients for family-ownership indicators are equal has a probability value of 0.302. Employment remains statistically insignificant and the indicators for multinationals are neither individually nor jointly significant.

## 11 . Estimating the relationships between management scores and productivity by employment size

The relationship between management practices and productivity may vary across different kinds of businesses. In particular we are interested in whether the relationship between productivity and management practices is different for family-owned businesses and whether this relationship varies with the employment size of the business. We estimate these relationships by adding interaction terms to the specification in column 5 of Table 4 and present the results in Table 5. The small sample may mean that we cannot pick up existing correlations but these regressions do suggest some interesting patterns for further investigation with a larger sample.

The first column examines interactions between management practices and family ownership. The coefficient on management score indicates the relationship for non-family-owned businesses, while the relationship for family-owned businesses is the sum of the management score coefficient and the interaction term (in the second row). Neither coefficient is statistically significant, but they are jointly significant at the 1% level. Notably, the coefficient on management score is very small, while the coefficient on the interaction term is larger than the coefficient for management score in column 5 of Table 4. Despite the lack of statistical significance, this suggests an interesting hypothesis, for future data collection and analysis, that the relationship between management practices and productivity may be stronger for family-owned businesses.



**Table 5: Multivariate analysis of labour productivity including interactions with management score Great Britain, 2015**

	(1)	(2)	(3)
	Log(Output per worker)	Log(Output per worker)	Log(Output per worker)
Management score	0.152 (0.464)	0.665*** (0.234)	1.443* (0.802)
Management score x Family-owned business	0.834 (0.671)		
Management score x Employment of 50-99		-0.055 (0.202)	
Management score x Employment of 100-249		-0.192 (0.236)	
Management score x Employment of 250+		-0.178 (0.316)	
Management score x Log(employment)			-0.249 (0.205)
Log(employment)	0.061 (0.042)	0.083 (0.071)	0.216 (0.153)
Family-owned and family-managed business	-0.631* -0.354	-0.188*** -0.064	-0.194*** -0.065
Family-owned and non-family-managed business	-0.792* (0.412)	-0.267*** (0.095)	-0.270** (0.099)
Multinational	-0.041 (0.102)	-0.078 (0.108)	-0.077 (0.097)
UK Multinational	-0.11 (0.112)	-0.082 (0.116)	-0.083 (0.114)
Age (years)	0.017 (0.060)	0.018 (0.067)	0.018 (0.067)
Age squared	0 (0.002)	0 (0.002)	0 (0.002)
Industry dummies	Yes	Yes	Yes
$R^2$	0.231	0.217	0.221
Adjusted $R^2$	0.209	0.193	0.199
Equal family p-value	0.198	0.51	0.538
Joint multinationals p-value	0.557	0.503	0.462
Joint industry p-value	0	0	0
Joint age p-value	0.732	0.609	0.613
Observations	591	591	591

Notes:

1. Standard errors in parentheses are clustered by industry and employment size band, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$
2. Where we have indicated the inclusion of industry group dummies, we have included dummy variables for the industry groupings used in Figure 3 and elsewhere. A constant is also included in all regressions.
3. “Equal family p-value” is the probability that coefficients for “Family-owned and family-managed business” and “Family-owned and non-family-managed business” are equal. “Joint multinationals p-value” is the probability that both coefficients for “Multinationals” and “UK Multinationals” are both zero, “Joint industry p-value” is the probability that the coefficients for all the industry grouping dummies are zero, and “Joint score p-value” is the probability that all coefficients for management score and its interaction terms are zero. These probabilities are all estimated using F-tests.
4. Labour productivity is measured as output per worker (GVA /employment) in 2015 current prices.
5. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

We investigate further in Table 5 whether the relationships we observe on productivity vary with the employment size of the business using two different specifications<sup>1</sup>. The results of the first specification indicate that, an increase in the management score of 0.1 is associated with a 6.7% increase in labour productivity<sup>2</sup>, and there are no significant differences to this for medium-sized or large businesses. In column 3, we interact management score and the log of employment. We find a weakly significant relationship between score and productivity, with no significance for the interaction term, but the coefficients on these two variables are jointly significant. Thus neither specification indicates that the relationship between management practices and productivity varies with size.

## Notes for: Estimating the relationships between management scores and productivity by employment size

1. The first, in column 2, uses indicators for the different size bands, using small businesses as the reference category. The second specification includes an interaction between score and the log of employment.
2. Statistically significant at the 1% level

## 12 . Estimating relationships between detailed management scores and productivity

The final area we examined is whether different components of management practices have different relationships with productivity – shown in Table 6. As presented in Table 3, we group our management questions into two groups – production monitoring and employment practices. Production monitoring includes the use of continuous improvement processes, key performance indicators and targets, while employment practices include basis for promotions, timescales for handling underperformance, and who makes hiring decisions<sup>1</sup>. We find that the monitoring score does not have a relationship with productivity (column 1), as the coefficient is very small and not significant, and that the coefficient for the employment score is broadly in line with estimates in previous specifications.

We next investigate the relationship with size, using interactions in the same way as column 3 in Table 5. Here we find that there is still a weakly significant relationship between employment practices and productivity, and a suggestion, albeit only weakly statistical significant, that the relationship is stronger for smaller businesses, as the coefficient on the employment management score is higher, and the coefficient on the interaction with employment is negative.



**Table 6: Multivariate analysis of labour productivity and management practice categories**



	(1)	(2)	(3)
	Log(Output per worker)	Log(Output per worker)	Log(Output per worker)
Monitoring Management score	0.068 (0.143)	0.064 (0.620)	
Monitoring score x Log(employment)		-0.008 (0.174)	
Employment Management score	0.575** (0.219)	1.396** (0.590)	
Employment score x Log(employment)		-0.251* (0.134)	
(1) Continuous improvement			0.527** (0.194)
(2) Number of KPIs			0.221 (0.174)
(3) Frequency of KPI monitoring			-0.250 (0.238)
(4) Target timelines			0.090 (0.103)
(5) Stretching targets			-0.102 (0.108)
(6) Promotions Score			0.415*** (0.099)
(7) Underperformance Score			0.038 (0.084)
(8) Hiring Score			0.000 (0.180)
Log(employment)	0.039 (0.037)	0.204 (0.141)	0.048 (0.044)
Family-owned and family-managed business	-0.173*** (0.054)	-0.178*** (0.053)	-0.238*** (0.055)
Family-owned and non-family-managed business	-0.305*** (0.105)	-0.307** (0.115)	-0.282** (0.106)
Multinational	-0.049 (0.107)	-0.044 (0.095)	-0.138 (0.102)
UK Multinational	-0.093 (0.112)	-0.093 (0.110)	-0.059 (0.107)
Age (years)	0.017	0.021	0.015

	(0.068)	(0.067)	(0.059)
Age squared	-0.000	-0.000	-0.000
	(0.002)	(0.002)	(0.002)
Industry dummies	Yes	Yes	Yes
$R^2$	0.233	0.242	0.302
Adjusted $R^2$	0.211	0.219	0.274
Equal family p-value	0.316	0.35	0.727
Joint multinationals p-value	0.532	0.504	0.301
Joint industry p-value	0.000	0.000	0.000
Joint age p-value	0.422	0.389	0.527
Observations	591	591	568

Source: Office for National Statistics

Notes:

1. Standard errors in parentheses are clustered by industry and employment size band, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .
2. Where we have indicated the inclusion of industry group dummies, we have included dummy variables for the industry groupings used in Figure 3 and elsewhere. A constant is also included in all regressions.
3. “Equal family p-value” is the probability that coefficients for “Family-owned and family-managed business” and “Family-owned and non-family-managed business” are equal. “Joint multinationals p-value” is the probability that both coefficients for “Multinationals” and “UK Multinationals” are both zero, and “Joint industry p-value” is the probability that the coefficients for all the industry grouping dummies are zero. These probabilities are all estimated using F-tests.
4. Labour productivity is measured as output per worker (GVA/employment) in 2015 current prices.
5. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

Finally we include the scores for each question individually. A few coefficients are notable: there are significant relationships between continuous improvement processes and promotions practices and productivity, with coefficients only slightly smaller than the overall employment score coefficient in column 1. At this point it is important to note that we cannot interpret causality from these estimates – the relationship may be that following these practices affects productivity in these directions and with these magnitudes, but an alternative explanation is that there is some other unobserved characteristic of these businesses which results in both following these practices and higher productivity. These results indicate an interesting direction for future analysis, to explore these potential relationships in more detail.

While not significant, it is interesting to note the large negative coefficient of 0.250 on the frequency of Key Performance Indicator (KPI) monitoring. Our data cannot distinguish between different kinds of KPIs, which may vary in their suitability for frequent monitoring, but this result suggests an interesting question of whether there is an optimum frequency of monitoring, which may be lower than expected.

## Notes for: Estimating relationships between detailed management scores and productivity

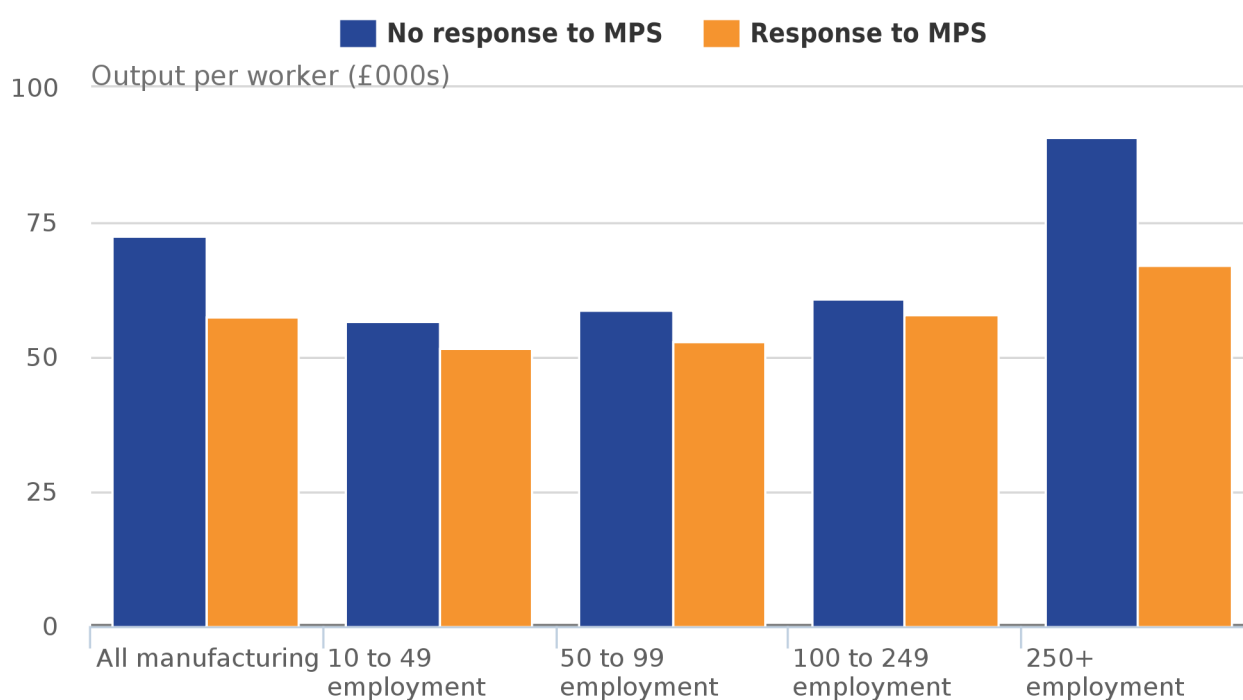
1. Further details of the questions can be found in [Awano and Robinson \(2016\)](#)

## 13 . Risks and limitations

In our previous article, we showed that the Management Practices Survey (MPS) pilot achieved a 68% response rate, with the lowest percentage of responses among larger businesses – with 250 people or more in employment. We compare the productivity<sup>1</sup> of our respondent MPS sample against our non-respondents who had provided financial data on the Annual Business Survey (ABS). This is to examine the possibility of a bias which could indicate that our non-respondents are less productive than our respondents, and act as a signal regarding their management practices. We find no such bias, as Figure 8 shows that across all employment size bands, the productivity of non-respondents was comparable to that of our respondent sample, except for the largest employment size group, where productivity of non-respondents was significantly higher.

**Figure 8: Labour productivity by employment size and MPS response status (unweighted)**

Great Britain, 2015



Source: Office for National Statistics

Notes:

1. Labour productivity is measured as output per worker (GVA/employment) in 2015 current prices.
2. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

The result discussed above is supported by the linear probability regression results in Table 7, which shows significant negative association of employment size and turnover on businesses' probability to respond to the MPS survey (that is, larger businesses which are also expected to have higher levels of turnover are less likely to respond to the MPS survey). In general, we consider our sample size to be small, so estimates may not be very precise, but the substantial difference for large businesses is notable, and may imply that our sample, even once weighted, is not as representative as we would like. We however consider the broad findings of our analysis consistent with the literature and general expectations.

**Table 7: Analysis of MPS response rates using Linear Probability Regression**

Great Britain, 2015

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	MPS Response	MPS Response	MPS Response	MPS Response	MPS Response	MPS Response	MPS Response
Log(employment)	-0.029*		-0.011	-0.013		-0.046***	-0.046
	(0.012)		(0.024)	(0.025)		(0.013)	(0.057)
Log(turnover)		-0.022*	-0.015	-0.013			
		(0.009)	(0.018)	(0.018)			
Log(Output per worker)					-0.065**	-0.048*	-0.049
					(0.022)	(0.023)	(0.071)
Log(Output per worker) x Log (employment)							0.000
							(0.014)
Industry grouping dummies	No	No	No	Yes	No	Yes	Yes
$R^2$	0.006	0.007	0.007	0.015	0.011	0.033	0.033
Adjusted $R^2$	0.005	0.006	0.005	0.006	0.010	0.023	0.022
Industry Joint Significance p- value				0.387		0.646	0.647
Observations	1026	1026	1026	1026	836	836	836

Source: Office for National Statistics

Notes:

1. Standard errors in parentheses are robust to heteroskedasticity, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$
2. Where we have indicated the inclusion of industry group dummies, we have included dummy variables for the industry groupings used in Figure 3 and elsewhere. A constant is also included in all regressions.
3. "Joint industry p-value" is the probability that the coefficients for all industry grouping dummies are zero, estimated using an F-test.
4. Labour productivity is measured as output per worker (GVA/employment) in 2015 current prices
5. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

When we check for the relationship between MPS response status and productivity using the linear probability model (column 5), we find a notably negative relationship between productivity and response rate<sup>2</sup>. A 100% increase in Output per worker is associated with a drop in response of 5.4%<sup>3</sup>. When we control for employment and industry, we find a significant negative relationship between size and response, but the relationship between productivity and response is not significant at conventional levels and the magnitude of the coefficient has reduced by over a quarter<sup>4</sup>.

Overall we conclude that there is some difference between businesses which respond to MPS and those who do not, with non-respondents likely to have higher productivity. Perhaps this may be because the businesses focus on activities which contribute to their measurable output. However once we control for size, the relationship is no longer significant. This suggests that our estimates of productivity may be underestimates, but using weights which adjust for non-response will account for much of this difference.

## Notes for: Risks and limitations

1. Productivity is calculated as Gross Value Added per worker.
2. We also ran the same covariate specifications using a probit model, which gave very similar predicted responses and the same patterns of statistical significance. Results for these regressions are available on request.
3. Significant at the 5% level.
4. We introduce an interaction term to confirm whether the relationship between productivity and response varies by size. The coefficient on this term is negligible, indicating no impact.

## 14 . Conclusion and next steps

We have established that the use of structured management practices differ across manufacturing businesses, at different levels of stratification. Although we cannot conclude on causality, we find a strong relationship between higher management practice scores and employment size, with the strongest association for smaller businesses (10 to 49).

We have also established a positive relationship between higher management practices scores and higher levels of labour productivity. We find the use of structured management practices higher across larger businesses, multinationals and non-family-owned businesses and consequently find these groups outperforming their peers in terms of productivity. Our estimate of this relationship shows that an increase in the management score of 0.1 is associated with an increase in labour productivity of 8.6%, and when conditioning on certain business characteristics, including size and industry, we find an increase in score of 0.1 is associated with an increase of 6.7%. However, these groups only account for a small share of the British manufacturing sector, with only 5 in every 100 businesses in the large (250 and over) employment size group, just 16 in every 100 businesses being a multinational, and only around 8 in every 100 manufacturing firms being family-owned and not family-managed.

These results support the importance of structured management practices among the determinants of higher productivity levels. However, a larger dataset could strengthen the findings in this analysis, and there are further aspects of management, such as employee engagement and development, which were not covered in the Management Practices Survey pilot, which might provide further insight into business performance. Further work could be carried out with interactions with other factors such as capital, indicators of innovation and the level of skills within businesses. With sufficient data, variations across regions could also be explored to inform regional policy.

## 15 . References

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## **16 . Annex 1 – Characteristics of businesses in the Management Practices Survey (MPS) pilot**

We present results on average management scores and labour productivity based on several characteristics.

### **Industry**

Results by industry are based on industry divisions, grouped to avoid disclosure, and in line with our labour productivity estimates where possible. We use the following groups:

- Food, beverages and tobacco (SIC 2007 divisions 10 to 12)
- Textiles, wearing apparel and leather (SIC 2007 divisions 13 to 15)
- Wood, paper products and printing (SIC 2007 divisions 16 to 18)
- Chemicals, Pharmaceuticals, rubber, plastics and non-metallic minerals (SIC 2007 divisions 20 to 23)
- Basic metals and metal products (SIC 2007 divisions 24 to 25)
- Computer etc products, Electrical equipment (SIC 2007 divisions 26 to 27)
- Machinery and equipment, Transport equipment (SIC 2007 divisions 28 to 30)
- Coke and petroleum, and Other (SIC 2007 divisions 19 and 31 to 33)

### **Size**

Results by business size are based on employment, for small, medium-sized and large businesses. Employment includes all employees and any working proprietors. Small businesses include those with employment between 10 and 49, medium-sized businesses are between 50 and 249, and large businesses have employment of at least 250. We further split medium-sized businesses between those with employment of 50 to 99 and those with employment of 100 to 249.

### **Family ownership**

We included questions on whether the business was family-owned and if so, whether the managing director is a member of the owning family, to identify family-owned businesses and differentiate between businesses which were both family-owned and family run, and those with external senior management.

## Multinationals

We asked respondents whether their businesses had units in other countries to identify multinational businesses. We further asked those who responded affirmatively whether they had their head office outside the UK, to distinguish between UK-based and non-UK based multinational businesses. We further compared our results for these questions with data held on the Interdepartmental Business Register (IDBR) with information on business ownership and found a close relationship, which validated our response. In this article we present analysis based on the data collected in the Management Practices Survey (MPS).

## 17 . Annex 2 – Composition of manufacturing industries by business types

This annex includes information on the distribution of various business characteristics. Table 8 presents information on industry composition by employment size, showing what percentage of businesses in each industry fall into each employment size band. Table 9 and Table 10 present information on how many businesses in each industry are family-owned and how many are multinationals respectively; Table 11 and Table 12 present similar information but by employment size bands rather than industry.

**Table 8: Distribution of manufacturing businesses by industry groups and employment size**

Great Britain, 2015

Manufacturing industry groupings	10 to 49 employment	50 to 99 employment	100 to 249 employment	250+ employment	Total
Food, beverages and tobacco (10 to 12)	67.7%	13.5%	9.4%	9.4%	100%
Textiles, wearing apparel and leather (13 to 15)	85.8%	7.5%	5.1%	1.5%	100%
Wood, paper products and printing (16 to 18)	76.8%	13.0%	6.1%	4.1%	100%
Chemicals, Pharmaceuticals, rubber, plastics and non-metallic minerals (20 to 23)	65.4%	17.0%	11.5%	6.2%	100%
Basic metals and metal products (24 to 25)	77.6%	15.2%	4.1%	3.1%	100%
Computer etc products, Electrical equipment (26 to 27)	69.2%	17.5%	8.3%	5.0%	100%
Machinery and equipment, Transport equipment (28 to 30)	72.0%	12.2%	8.4%	7.4%	100%
Coke and Petroleum, Other (19 and 31 to 33)	80.0%	10.0%	6.0%	4.0%	100%
<b>TOTAL</b>	<b>74.0%</b>	<b>13.6%</b>	<b>7.3%</b>	<b>5.1%</b>	<b>100%</b>

Source: Office for National Statistics

Notes:

1. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

**Table 9: Share of family-owned businesses by industry groups**

Great Britain, 2015

Manufacturing industry groupings	Share of businesses which are family-owned
Food, beverages and tobacco (10 to 12)	83.0%
Textiles, wearing apparel and leather (13 to 15)	78.0%
Wood, paper products and printing (16 to 18)	67.6%
Chemicals, Pharmaceuticals, rubber, plastics and non-metallic minerals (20 to 23)	62.7%
Basic metals and metal products (24 to 25)	63.4%
Computer etc products, Electrical equipment (26 to 27)	48.3%
Machinery and equipment, Transport equipment (28 to 30)	52.5%
Coke and Petroleum, Other (19 and 31 to 33)	58.9%
All Manufacturing	63.7%

Source: Office for National Statistics

Notes:

1. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

**Table 10: Share of multinational businesses by industry groups**

Great Britain, 2015

Manufacturing industry groupings	Share of businesses which are Multinationals
Food, beverages and tobacco (10 to 12)	9.9%
Textiles, wearing apparel and leather (13 to 15)	8.0%
Wood, paper products and printing (16 to 18)	10.2%
Chemicals, Pharmaceuticals, rubber, plastics and non-metallic minerals (20 to 23)	29.3%
Basic metals and metal products (24 to 25)	11.6%
Computer etc products, Electrical equipment (26 to 27)	21.1%
Machinery and equipment, Transport equipment (28 to 30)	20.5%
Coke and Petroleum, Other (19 and 31 to 33)	17.7%
All Manufacturing	16.4%

Source: Office for National Statistics

Notes:

1. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.



**Table 11: Share of family-owned businesses by employment size**

Great Britain, 2015

Employment size	Share of businesses which are family-owned
Small (10 to 49 employment)	68.5%
Medium (band 1) (50 to 99 employment)	56.3%
Medium (band 2) (100 to 249 employment)	52.6%
Large (250+ employment)	28.6%
All Manufacturing	63.7%

Source: Office for National Statistics

Notes:

1. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

**Table 12: Share of multinational businesses by employment size**

Great Britain, 2015

Employment size	Share of businesses which are Multinationals
Small (10 to 49 employment)	5.3%
Medium (band 1) (50 to 99 employment)	36.1%
Medium (band 2) (100 to 249 employment)	46.1%
Large (250+ employment)	81.5%
All Manufacturing	16.4%

Source: Office for National Statistics

Notes:

1. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

**Table 13: Distribution of manufacturing businesses by age**

Great Britain, 2015

Business age	All manufacturing	Non-family-owned businesses	Family-owned businesses
Up to 5 years	5.6%	6.2%	5.3%
Over 5 years, up to 10 years	11.4%	16.9%	8.1%
Over 10 years, up to 20 years	35.1%	31.0%	37.5%
Over 20 years	47.9%	46.0%	49.0%
<b>TOTAL</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

Source: Office for National Statistics

Notes:

1. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

## 18 . Annex 3 – Scoring schedule

This annex includes details of the survey questions on management practices and how responses were scored. For unanswered questions, individual question scores were left as missing. The average score for the business is the mean score for all questions with a non-missing score value.



**Table 14: Scoring system of the Management Practices Survey by question**

Question	Score
1 In 2015, what generally best describes what happened at this business when a production problem arose?	
a We fixed it but did not take further action	1/3
b We fixed it and took action to make sure that it did not happen again	2/3
c We fixed it and took action to make sure that it did not happen again, and had a continuous improvement process to anticipate problems like these in advance	1
d No action was taken	0
2 In 2015, how many key performance indicators were monitored at this business?	
a 1 to 2 key performance indicators	1/3
b 3 to 9 key performance indicators	2/3
c 10 or more key performance indicators	1
d No key performance indicators	0
3 In 2015, how frequently were the key performance indicators reviewed at this business?	
1	
a Annually	1/6
b Quarterly	1/3
c Monthly	1/2
d Weekly	2/3
e Daily	5/6
f Hourly or more frequently	1
g Never	0
4 In 2015, what best describes the time frame of production targets at this business?	
a Main focus was on short-term (less than one year) production targets	1/3
b Main focus was on long-term (more than one year) production targets	2/3
c Combination of short-term and long-term production targets	1
d No production targets	0
5 In 2015, how easy or difficult was it for this business to achieve its production targets?	
2	
a Possible to achieve without much effort	0
b Possible to achieve with some effort	1/2
c Possible to achieve with normal amount of effort	3/4
d Possible to achieve with more than normal effort	1
e Only possible to achieve with extraordinary effort	1/4
6 In 2015, how were employees usually promoted at this business?	
a Promotions were based solely on performance and ability	1
b Promotions were based partly on performance and ability, and partly on other factors, such as tenure	2/3
c Promotions were based mainly on factors other than performance and ability, such as tenure	1/3
d Employees are normally not promoted	0

7 In 2015, when was an under-performing employee moved from their current role?	
a Within 6 months of identifying employee under-performance	1
b After 6 months of identifying employee under-performance	1/2
c Rarely or never	0
8 In 2015, who made decisions over the hiring of permanent full-time employees?	
a Only the owner(s)	0
b Mostly the owner(s) with some input from other employees	1/3
c Jointly the owner(s) and other employees	2/3
d Other employees	1

Source: Office for National Statistics

Notes:

1. For Question 3 respondents were asked to mark all options which applied. The score was determined by the most frequent option selected. Where respondents marked for Question 2 that they had no key performance indicators, they were given a score of zero.

2. Where respondents indicated in question 4 that they did not use targets, they were given a score of zero for question 5.

## 19 . Annex 4 – Distribution of management score and labour productivity

**Table 15: Distribution of management score and productivity**

Great Britain, 2015

Percentile	Management score	Output per worker
10	0.22	£14,500
25	0.41	£27,000
50	0.59	£42,100
75	0.72	£55,540
90	0.81	£78,440

Source: Office for National Statistics

Notes:

1. Labour productivity is measured as output per worker (GVA/employment) in 2015 current prices.

2. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

**Table 16: Labour productivity and management score by industry group and multinational status**

Great Britain, 2015

Manufacturing industry groupings	Management score	Output per worker	Management score (Dom.)	Output per worker (Dom.)	Management score (MNC)	Output per worker (MNC)
Textiles, wearing apparel, leather (13 to 15)	0.44	£27,900	0.42	£26,590	0.76	£47,210
Basic metals, metal products (24 to 25)	0.58	£34,730	0.58	£32,990	0.64	£52,410
Chemicals, Pharmaceuticals, rubber, plastics, non-metallic minerals (20 to 23)	0.64	£47,720	0.62	£41,630	0.68	£57,140
Wood, paper products, printing (16 to 18)	0.55	£41,860	0.54	£40,610	0.63	£53,340
Coke, petroleum, other manufacturing (19 and 31 to 33)	0.50	£40,760	0.45	£39,700	0.71	£45,280
Food, beverages, tobacco (10 to 12)	0.59	£44,610	0.56	£43,230	0.81	£57,260
Computer etc. products, electrical equipment (26 to 27)	0.58	£54,260	0.53	£53,910	0.73	£55,490
Machinery, equipment, transport equipment (28 to 30)	0.57	£61,300	0.52	£59,430	0.73	£68,140

Source: Office for National Statistics

## Notes

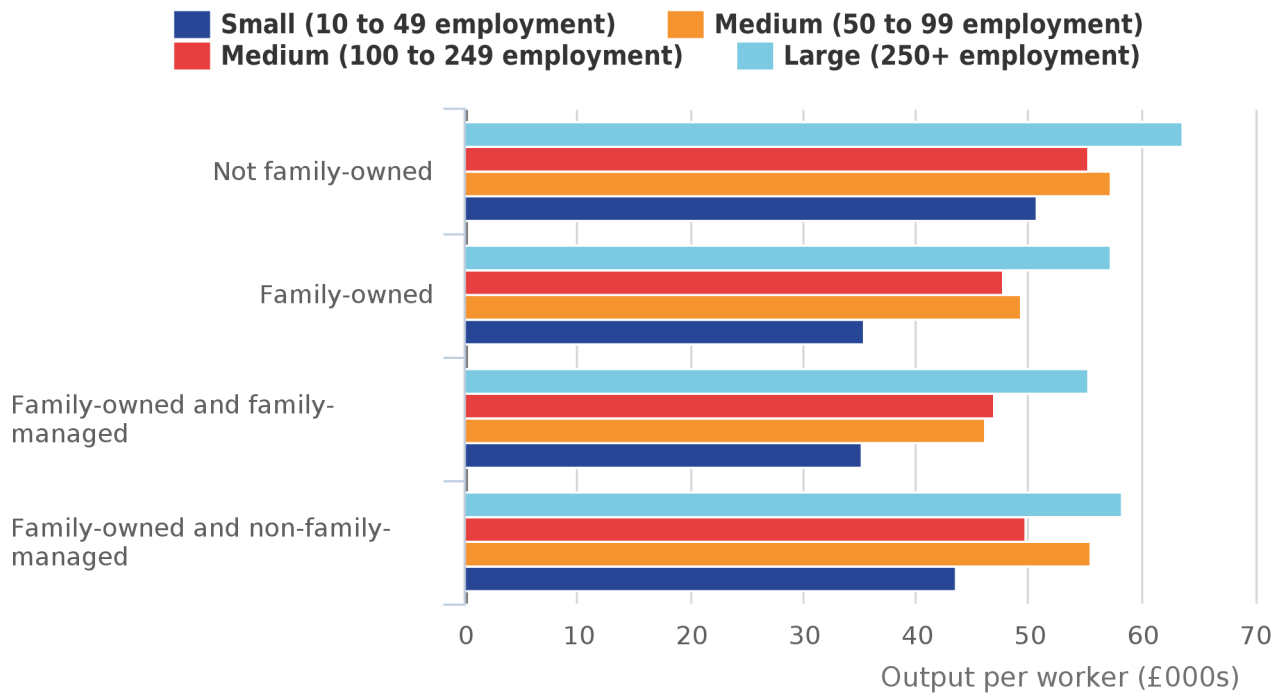
1. Dom. is short for Domestic businesses. MNC is short for Multinationals.
2. Labour productivity is measured as output per worker (GVA/employment) in 2015 current prices.
3. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

## 20 . Annex 5 – Detailed estimates of productivity by business characteristics

In Figure 9, we find that across all family ownership statuses, businesses in the small employment size group, which account for a larger share of businesses, are outperformed by those in the bigger size groups in terms of productivity. We find a similar trend of relatively lower levels of productivity in the 100 to 249 size group for non-family-owned and family-owned but non-family-managed businesses. Family-owned and family-managed businesses are found to have relatively lower levels of productivity across all size groups as well as comparatively lower management practice scores relative to other ownership types<sup>1</sup>.

**Figure 9: Labour productivity by employment size and family ownership status**

Great Britain, 2015



Source: Office for National Statistics

**Notes:**

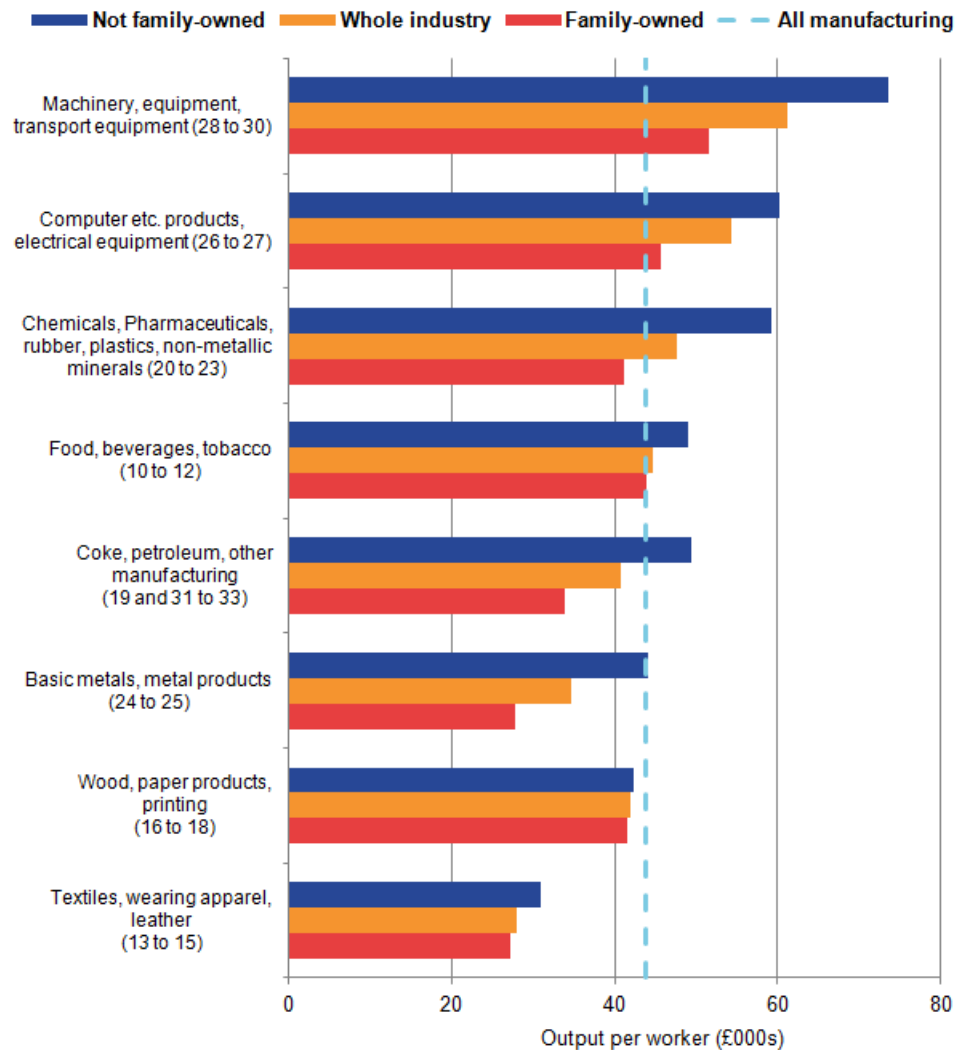
1. Labour productivity is measured as output per worker (GVA/employment) in 2015 current prices.
2. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

Figure 10 shows this relationship for detailed industry groups. Across all industries, businesses that were not family-owned performed best in productivity. Only in Machinery, equipment, transport equipment and Computer etc. products, electrical equipment do family-owned businesses achieve a higher productivity than the average for all manufacturing, whilst businesses that were not family run achieved this in 6 industries.



**Figure 10: Labour productivity by industry group and family ownership status**

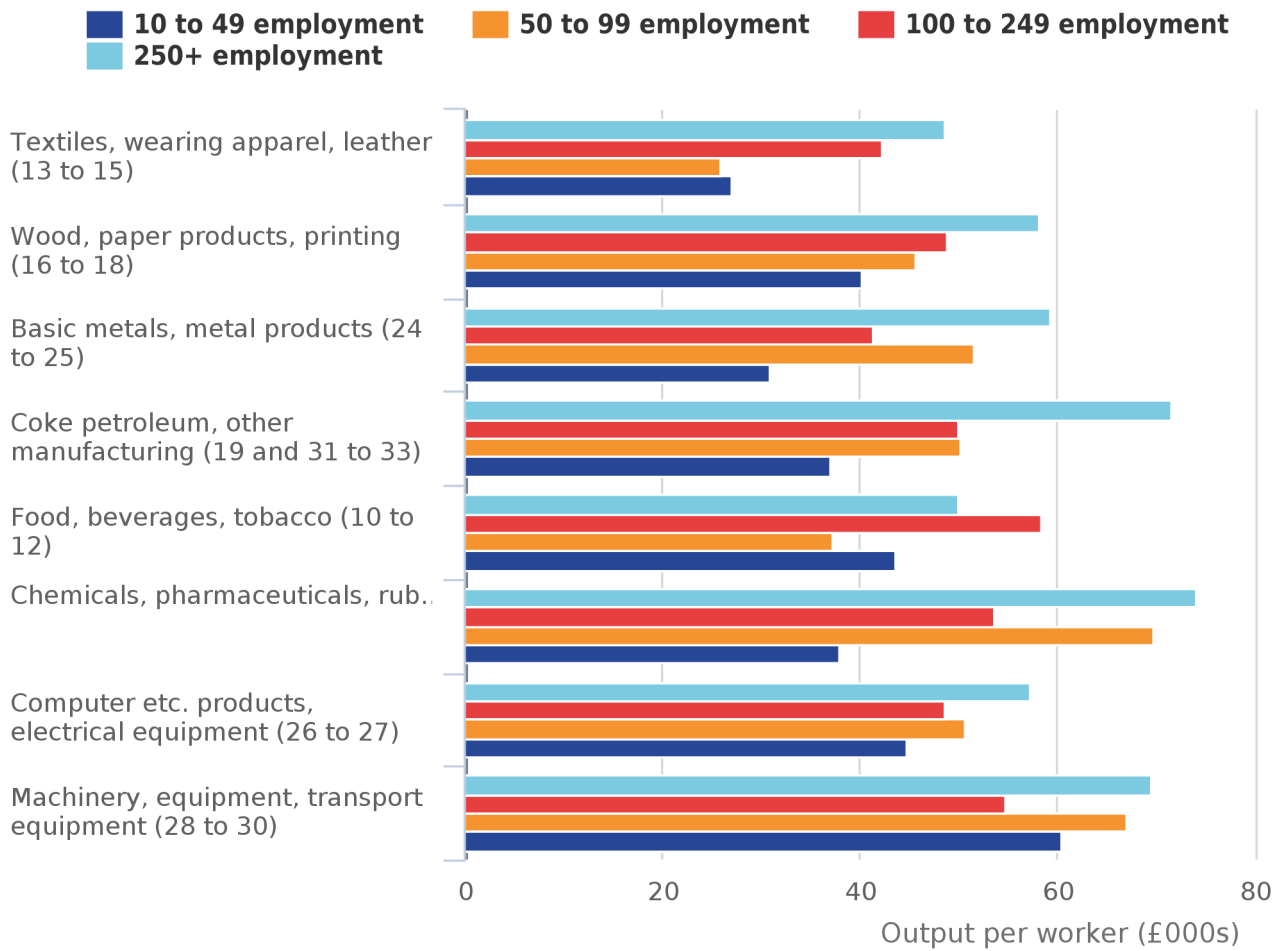
Great Britain, 2015



When examining productivity by industry and employment size in Figure 11, we find that in most industries the largest businesses were most productive. However, in “Chemicals, Pharmaceuticals, rubber, plastics, non-metallic minerals” (divisions 20 to 23) and “Food, beverages, tobacco” (divisions 10 to 12), the 50 to 99 employment and 100 to 249 employment size bands respectively were more productive. Another variation of note is the productiveness of small businesses (employment of 10 to 49) in industries such as “Machinery, equipment, transport equipment” (divisions 28 to 30), “Computer etc. products, electrical equipment” (divisions 26 to 27), “Food, beverages, tobacco” (divisions 10 to 12) and “Textiles, wearing apparel, leather” (divisions 13 to 15). In all these industries, small businesses perform better than either one or both of the businesses in the medium-sized categories.

**Figure 11: Labour productivity by industry group and employment size**

Great Britain, 2015



Source: Office for National Statistics

**Notes:**

1. Labour productivity is measured as output per worker (GVA/employment) in 2015 current prices.
2. Population of interest covers manufacturing businesses in Great Britain with employment of at least 10.

**Notes for Annex 5 – Detailed estimates of productivity by business characteristics:**

1. Awano and Robinson (2016).