

Winners and Losers in the Knowledge Economy:

Evidence from Linked Employer-Employee Data

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Background & Motivation

- New patterns of growth and other lessons from business microdata
 - Frontier firms pulling away from the rest (Andrews, Criscuolo & Gal, 2016, OECD)
 - Declining labour share associated with increasing market concentration (Autor et al., 2017, NBER)
 - Variation in workers' wages strongly linked to variation in average labour costs across firms (Barth et al, 2016, JoLE)
- Intangibles seen as a key driver of economic growth
 - Numerous studies establish a link between intangibles and productivity
 - Information Technologies (Jorgenson et al 2008; Oliner et al, 2007; van Ark et al, 2008)
 - R&D (e.g. for the US, Griliches & Mairesse, 1983; for the UK, Griffith et al, 2006)
 - Management (e.g. Bloom & Van Reenen, 2007) and management in combination with IT (Black & Lynch, 2001; Bloom et al, 2014)
 - Advances in the measurement of intangibles at the macro level (Corrado, Hulten & Sichel, 2006; Corrado, Haskel, Jona-Lasinio & Iommi, 2015)
 - Specific features of intangibles may link the rising importance of intangibles to some of the new patterns of growth that have been documented (Haskel & Westlake, 2017)
 - Intangibles are characteristically sunk, scalable, work in synergy and create spillovers

Contributions of this study

Explore the role of knowledge assets in the context of these new patterns of growth

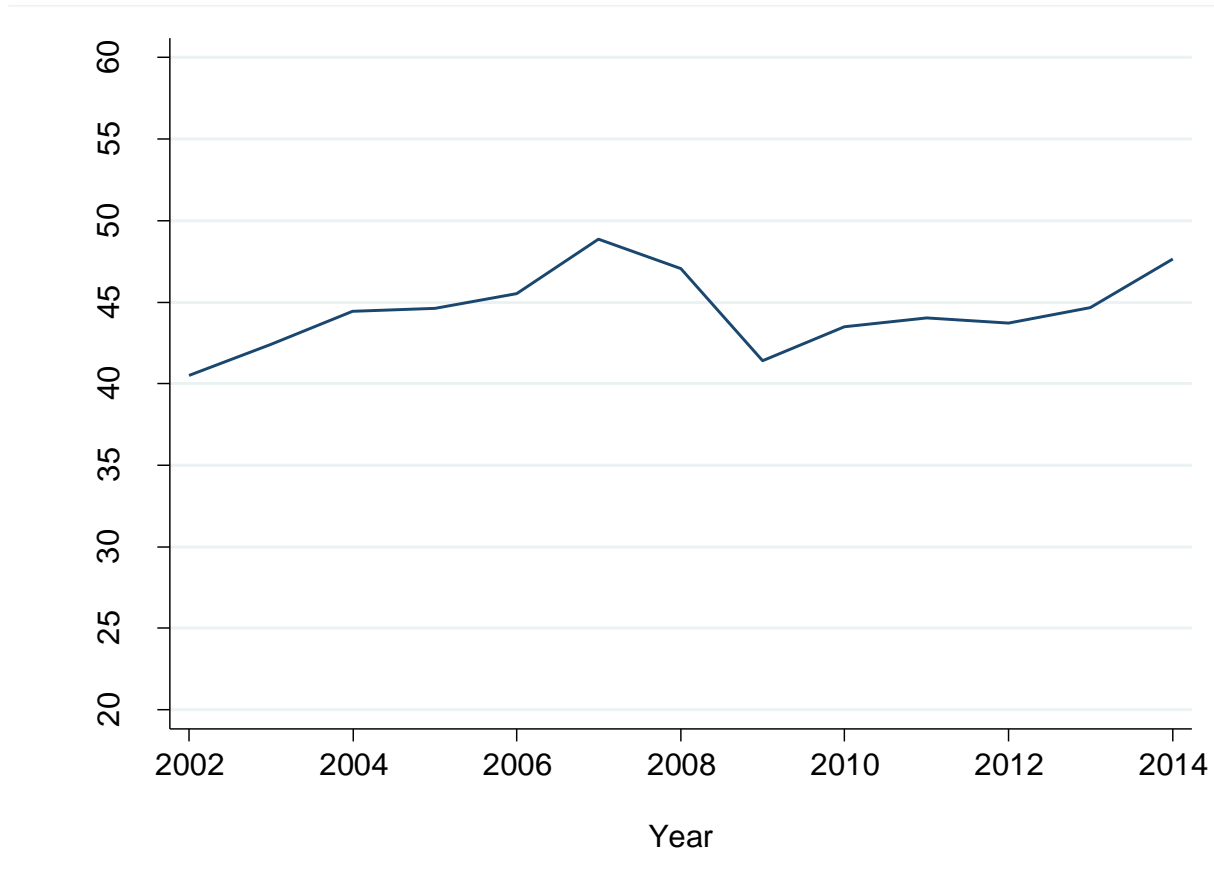
- Document features of the productivity distribution of UK firms
- Develop a representative dataset on intangible investment and capital using linked business data
 - Based in part on similar methods to those used in the recent macroeconomic literature on intangibles
- Document patterns of intangible investment and other characteristics across the productivity distribution
- Analyse the relationship between intangibles and productivity in a production function framework using a comprehensive set of intangible assets
- Consider the occupational structure (intangible producing occupations and other occupations) and employee returns amongst firms in different parts of the productivity distribution using linked business-employee data
- Consider the relationship between qualifications and intangible occupations

Main data source

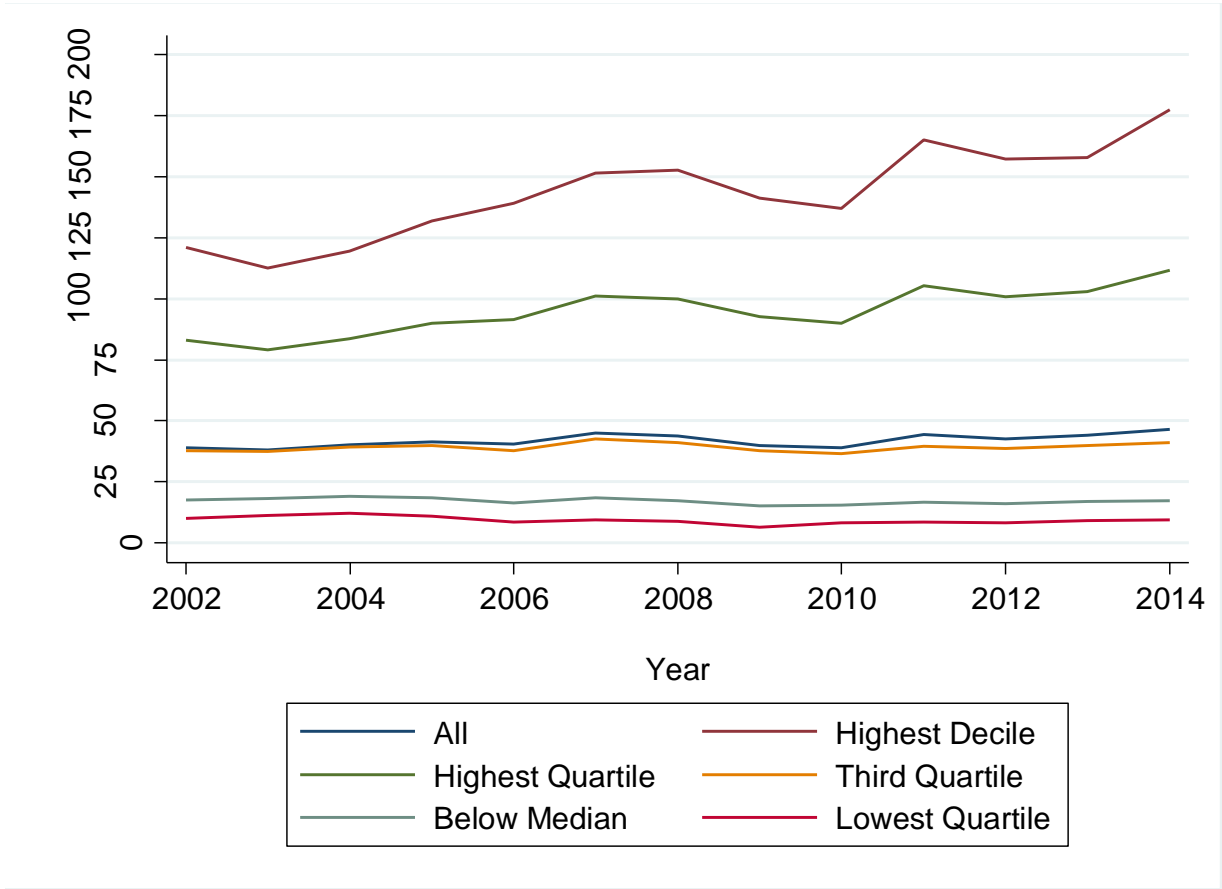
- Annual Respondents Database (ARDX)
 - establishment level business survey (or set of surveys) conducted by the UK Office for National Statistics (ONS) that is widely used in the study of firm behaviour and productivity analysis in the UK
 - including information on production inputs and outputs
 - a census of larger establishments and a stratified (by industry, region and employment size) random sample of establishments with less than 250 employees (SMEs)
 - grossing weights can be calculated using population data available in the Inter-Departmental Business Register
 - covers businesses in the non-financial non-agriculture sectors back to 1997, but some of the key questions we need to measure intangibles are not available before 2002, and are mainly available for larger firms
 - throughout we focus on the market sector and exclude
 - micro firms (with 0-9 employees)
 - the top and bottom 1% of the productivity distribution within 2-digit SIC groups
 - imputed responses

Aggregate labour productivity in our sub-sample

(2002-2014, £thousand 2010 prices)



Mean labour productivity by segment of the productivity distribution (2002-2014, £thousand 2010 prices)



The productivity distribution is calculated within 2-digit SIC group. This is similar to the methodology used by OECD in classifying global and national frontier firms.

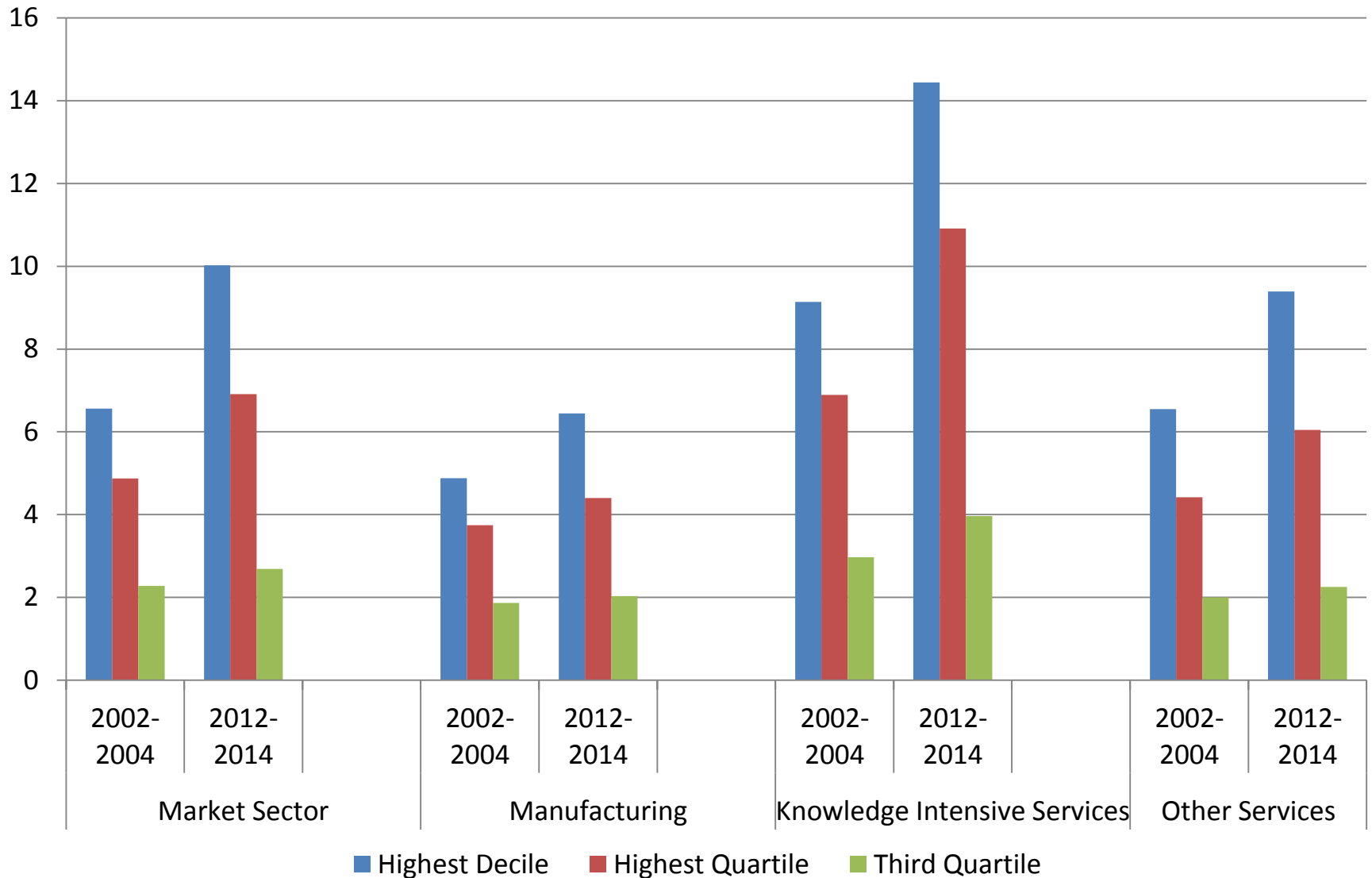
The productivity distribution is fanning out at the top

Mean labour productivity by segment of the labour productivity distribution relative to firms with below median productivity

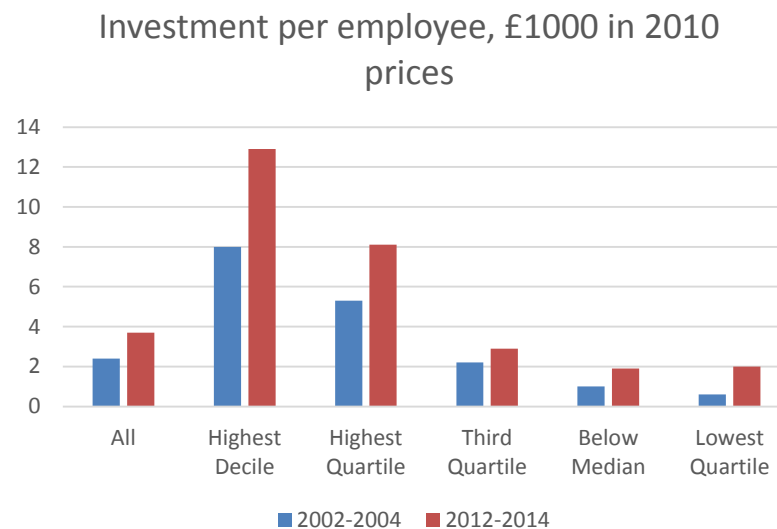
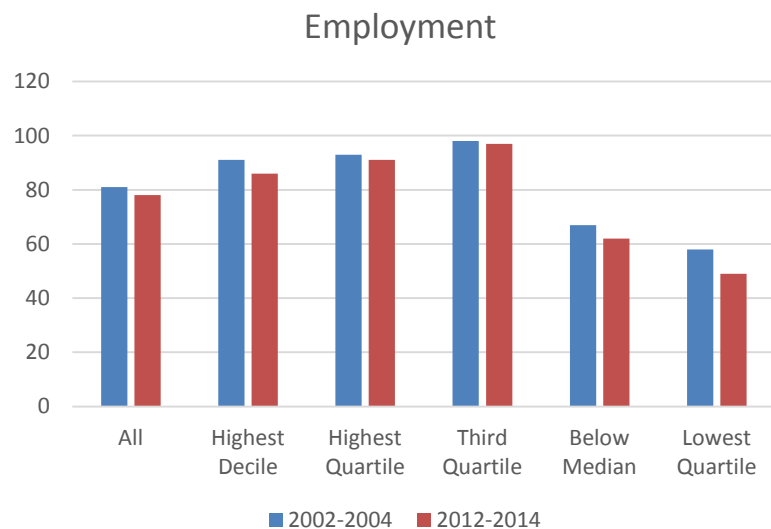


Fanning out at the top in all sectors

Mean labour productivity by segment of the labour productivity distribution relative to firms with below median productivity



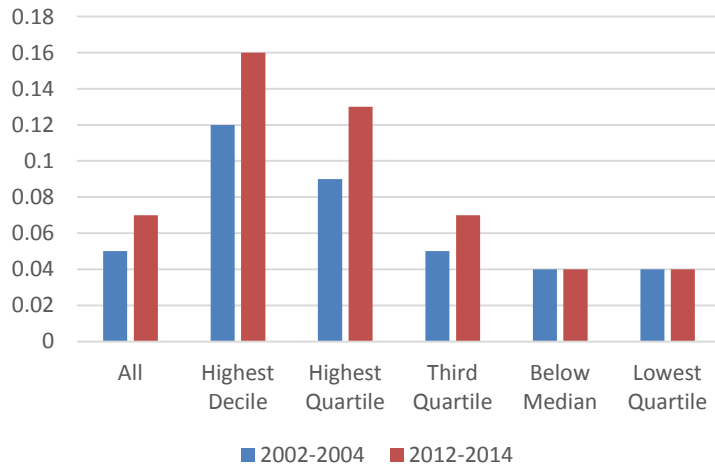
Top firms are not necessarily larger, but are much more (tangible) capital intensive than other firms



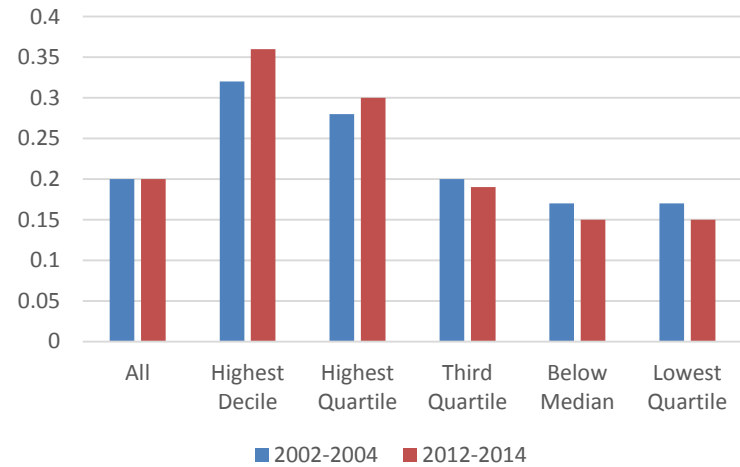
Investment includes tangible investment including land and buildings, as well as software and databases.

Increased foreign ownership and consolidation at the top during the last decade

Foreign Ownership

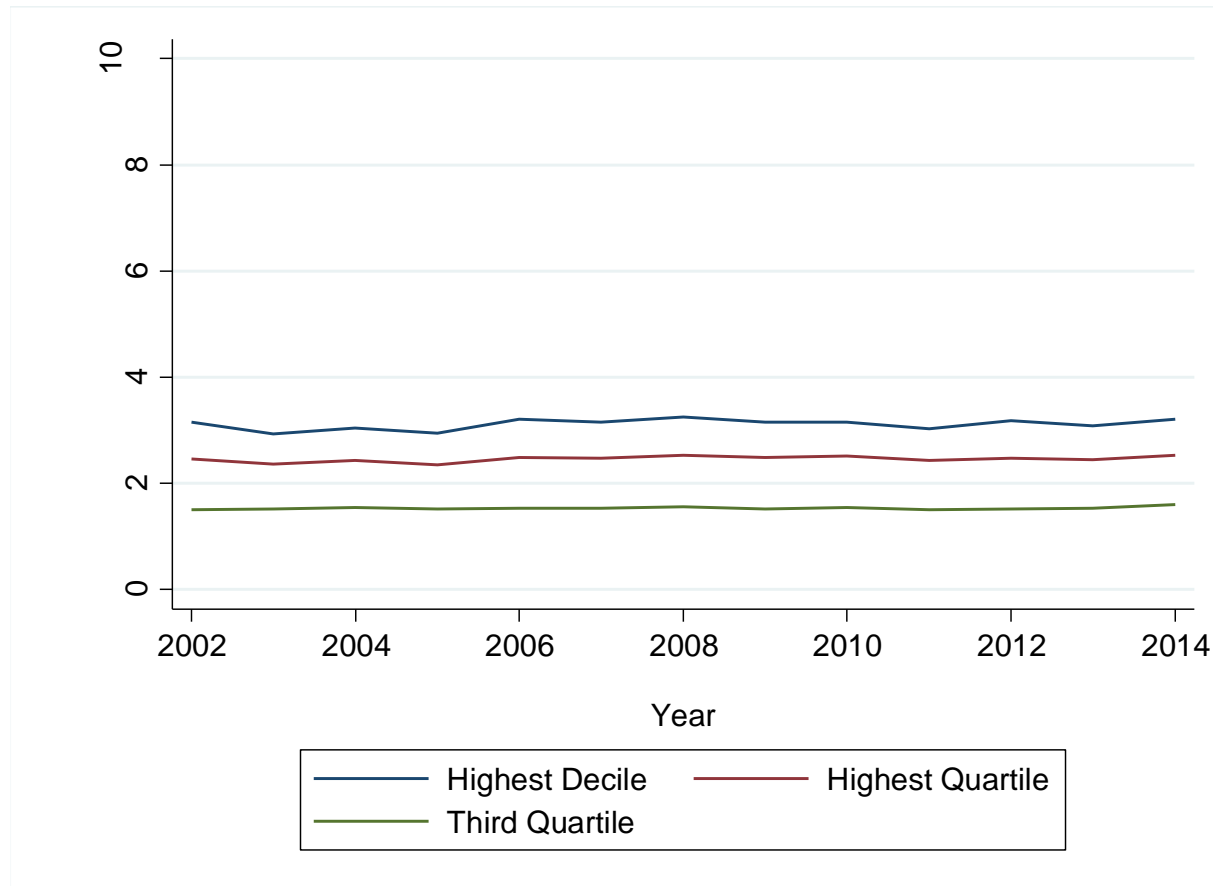


Part of multi-establishment group



Disparities in labour productivity are not fully reflected in wages

Mean labour costs per employee by segment of the labour productivity distribution relative to firms with below median productivity



Measuring firms' investments in intangibles

- Evaluate firms' expenditures on intangibles:
 - Using information on firms' purchases of intangibles (classified either as investment or expenditure)
 - And costs of workers undertaking “intangible” tasks
 - Evaluate investment share
 - Using common assumptions in the literature
 - Capitalise investment flow (PIM)
 - Using depreciation rates in the literature
 - Starting stocks proportional to sample average investment
- Number (or cost) of workers undertaking “intangible” tasks
- Data sources:
 - Annual Respondents Database (X)
 - Business Enterprise Research and Development Survey
 - Annual Survey of Hours and Earnings

Data Issues

- Focus intangibles analysis on large firms (250+) because of:
 - Time gaps
 - Imputed data
 - Assumptions made in linking ARDX to BERD
- Similar patterns across the productivity distribution:
 - For firms 250+ and firms 10+
 - Note that the productivity distribution is calculated on the sample of firms 10+

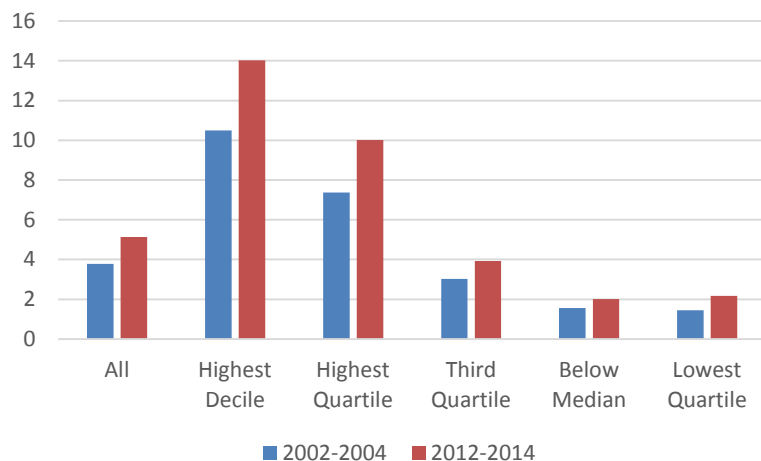
Occupations involved in the production of knowledge assets

- Digitised Information
 - ICT professionals & managers
- Intellectual Property
 - Natural & Social Science professionals & managers
 - Architects, Engineering professionals, Business research professionals
 - Highly skilled artistic workers, designers
- Organisational Capital (Economic Competencies)
 - **HRM:** human resources managers and directors, vocational and industrial trainers
 - **BRAND:** sales, marketing, advertising & public relations managers
 - **MANAGEMENT:** chief executive and senior officials, production & operations department managers

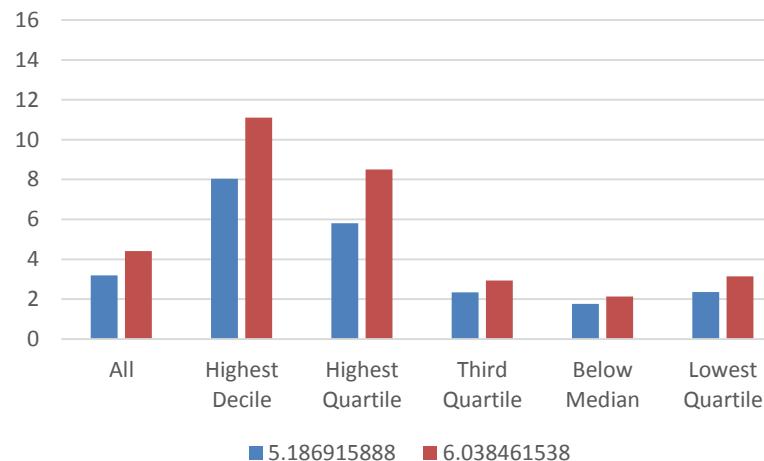
For related, but broader, occupational classifications of occupations involved in the production of intangibles see FP7 INNODRIVE and Riley and Robinson (2011) *Skills and Economic Performance: The Impact of Intangible Assets on UK Productivity Growth*, UK Commission for Employment and Skills.

Top firms are more *tangible* and *intangible* capital intensive than other firms

Investment in Tangibles per employee



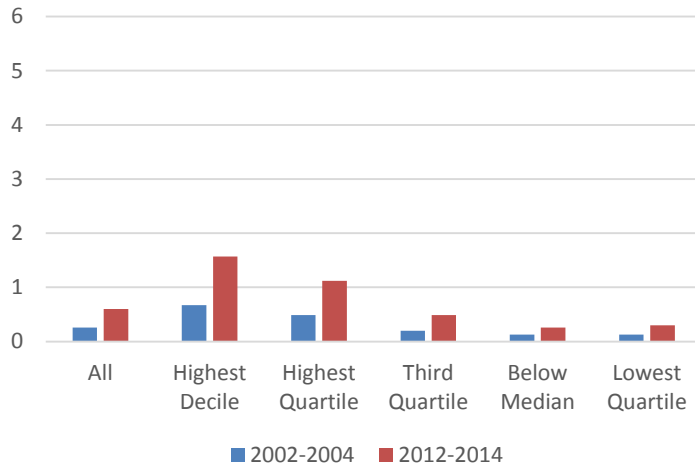
Investment in Intangibles per employee



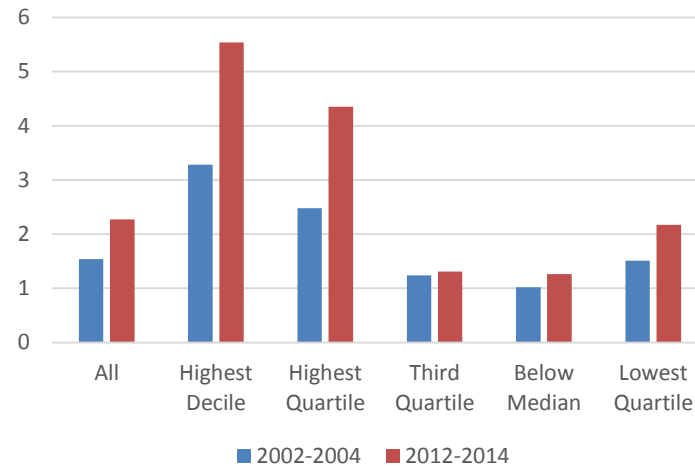
Firms with 250 or more employees. The productivity distribution is calculated on firms with 10 or more employees. Investment per employee in £1000 in 2010 prices. Tangible investment includes machinery and equipment. Intangible investment as shown above.

Top firms invest more in all intangibles ...

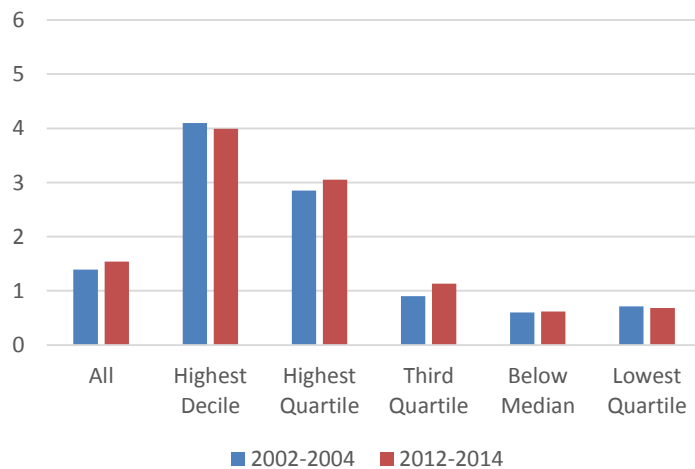
Software & Databases



R&D



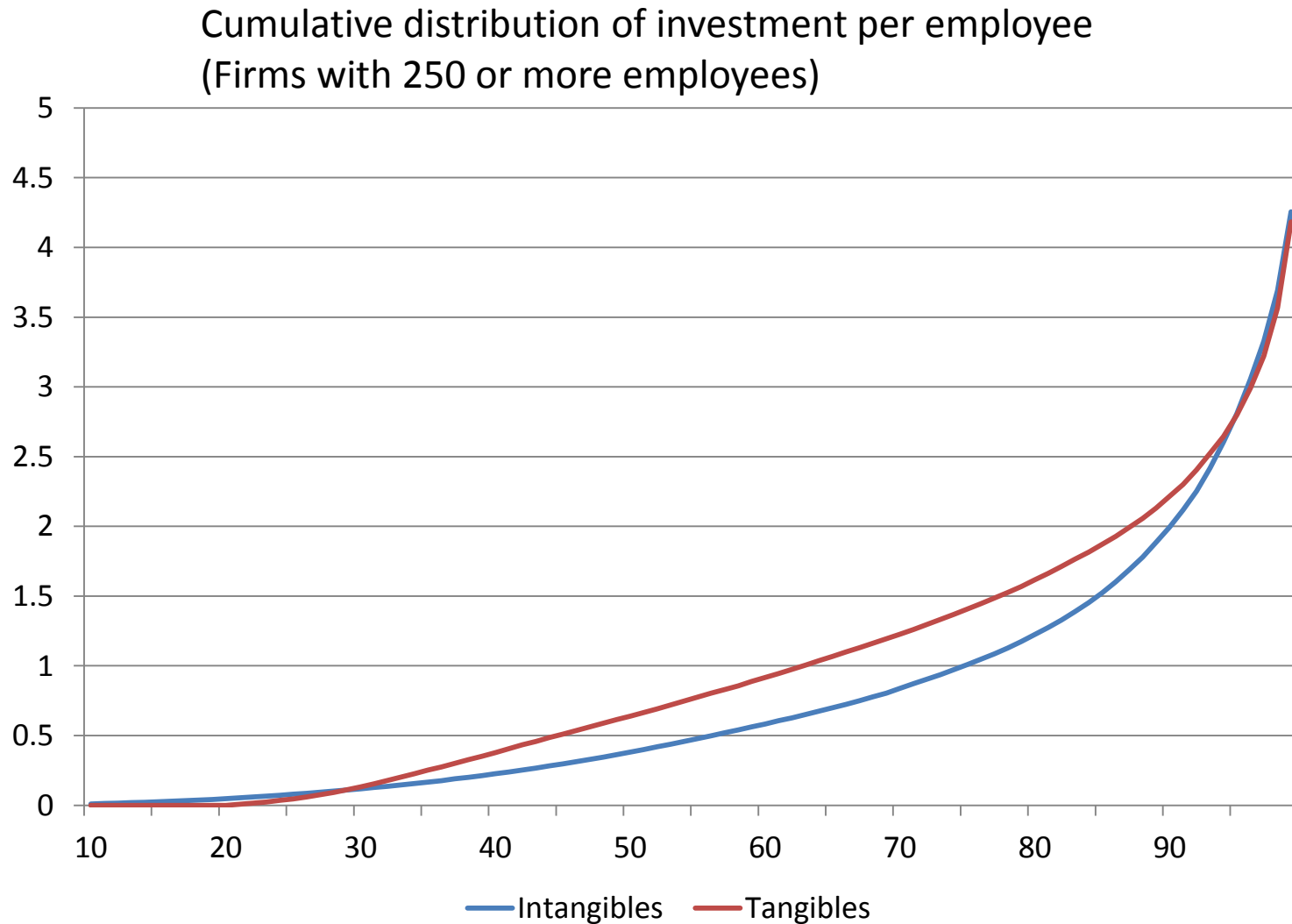
Advertising & Marketing



... and their lead in Software & Databases and R&D investment has increased over the last decade

Firms with 250 or more employees. The productivity distribution is calculated on firms with 10 or more employees. Investment per employee in £1000 in 2010 prices.

Intangible investment appears even more concentrated amongst a few firms than tangible investment does



Note: investment per employee in logs $[\ln(1+inv/emp)]$.

Top firms employ a higher share of workers in “intangibles producing” occupations

Share of employees in “intangibles producing” occupations amongst firms in different parts of the firm productivity distribution						
	All	Highest Decile	Highest Quartile	Third Quartile	Below Median	Lowest Quartile
<i>Average 2002-2004</i>						
Digitised Information	0.029	0.051	0.050	0.022	0.017	0.017
Intellectual Property	0.049	0.071	0.069	0.041	0.040	0.047
Brand	0.025	0.040	0.037	0.021	0.019	0.022
Management	0.074	0.094	0.091	0.073	0.063	0.058
Management (auxiliary)	0.014	0.045	0.028	0.008	0.007	0.008
Total Intangibles	0.191	0.301	0.275	0.165	0.146	0.152
<i>Average 2012-2014</i>						
Digitised Information	0.034	0.056	0.052	0.031	0.019	0.022
Intellectual Property	0.046	0.078	0.070	0.037	0.036	0.048
Brand	0.033	0.053	0.045	0.027	0.029	0.034
Management	0.081	0.116	0.101	0.074	0.071	0.074
Management (auxiliary)	0.016	0.057	0.034	0.009	0.007	0.007
Total Intangibles	0.210	0.360	0.302	0.178	0.162	0.185
Observations (persons, average per year)	55775	6690	17003	19476	19295	7590
Observations (firms, average per year)	10523	1627	3689	4042	5629	2731

Source: ARDX, ASHE, Own calculations.

Notes: Share of employees in particular occupations in firms with 10 or more employees in the non-farm non-financial business sector, by segment of the firm productivity distribution.

Top firms pay workers a premium (even when we account for the occupational mix)

Annual pay and employer position in the firm productivity distribution				
Dependent variable is log annual gross pay	(1)	(2)	(3)	(4)
Employer in Highest Decile	0.160*** (0.004)	0.109*** (0.003)	0.092*** (0.003)	0.071*** (0.003)
Employer in the Highest Quartile	0.335*** (0.004)	0.213*** (0.003)	0.187*** (0.003)	0.146*** (0.003)
Employer in the Third Quartile	0.199*** (0.003)	0.123*** (0.002)	0.117*** (0.002)	0.100*** (0.002)
Employer in the Lowest Quartile	-0.051*** (0.004)	-0.017*** (0.003)	-0.018*** (0.003)	-0.016*** (0.003)
Observations	721,863	721,800	721,800	721,800
Adjusted R-squared	0.296	0.603	0.633	0.671

Source: ASHE, ARDX, own calculations.

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Model 1 includes industry and year dummies; Model 2 also controls for firm size and region of work, age, age squared, female, part-time working, and being employed in the same job last year; Model 3 also includes additional controls for five intangible asset producing groups; Model 4 also includes 4-digit occupational controls.

“Intangibles producing” occupations typically taken by highly qualified individuals

<i>Intangible Occupations</i>		share with Highest Educational Qualification			
		Degree	Higher Education	GCE, A-level	Other
Digitised information	2004	0.530	0.124	0.180	0.167
	2012	0.630	0.098	0.148	0.124
Intellectual property	2004	0.558	0.157	0.165	0.120
	2012	0.631	0.133	0.143	0.093
Organisational Brand	2004	0.412	0.115	0.208	0.265
	2012	0.521	0.099	0.187	0.192
Management	2004	0.198	0.110	0.289	0.403
	2012	0.352	0.120	0.226	0.302
<i>Other Occupations</i>	<i>2004</i>	<i>0.177</i>	<i>0.097</i>	<i>0.235</i>	<i>0.491</i>
	<i>2012</i>	<i>0.266</i>	<i>0.096</i>	<i>0.238</i>	<i>0.400</i>

Source: Labour Force Survey; Authors' calculations

All age groups are becoming more highly qualified

		<i>Age</i>		
		<i>25-34</i>	<i>35-44</i>	<i>45-54</i>
<i>Highest Qualification</i>				
Degree	2004	0.301	0.209	0.191
	2012	0.419	0.357	0.260
Higher Education	2004	0.095	0.111	0.120
	2012	0.077	0.107	0.121
GCE, A-level	2004	0.222	0.227	0.241
	2012	0.220	0.195	0.214
GCSE grades A*-C	2004	0.212	0.250	0.186
	2012	0.169	0.210	0.237
Other	2004	0.170	0.202	0.261
	2012	0.115	0.130	0.167

Source: Labour Force Survey; Authors' calculations

The young are the most qualified, but are not more likely to be employed in “intangibles producing” occupations

		<i>Age</i>		
		<i>25-34</i>	<i>35-44</i>	<i>45-54</i>
<i>Intangible Occupations</i>				
Digitised information	2004	0.042	0.030	0.021
	2012	0.039	0.040	0.027
Intellectual property	2004	0.047	0.040	0.033
	2012	0.043	0.041	0.032
Organisational Brand	2004	0.038	0.032	0.022
	2012	0.033	0.038	0.030
Management	2004	0.070	0.094	0.094
	2012	0.066	0.098	0.104
<i>Total</i>	<i>2004</i>	<i>0.197</i>	<i>0.196</i>	<i>0.170</i>
	<i>2012</i>	<i>0.182</i>	<i>0.218</i>	<i>0.194</i>

Source: Labour Force Survey; Authors' calculations

The returns to working in “intangibles producing” occupations are not declining

Dependent variable is log hourly wage.

	Coeff.	Std. Err.		Coeff.	Std. Err.
Digitised information	0.300 ***	(0.020)	Degree	0.607 ***	(0.009)
Intellectual property	0.132 ***	(0.017)	Higher Education	0.348 ***	(0.011)
Brand	0.413 ***	(0.019)	GCE, A-level	0.157 ***	(0.009)
Management	0.298 ***	(0.012)			

Change 2004 to 2012:

Digitised information	-0.040	(0.031)
Intellectual property	-0.005	(0.026)
Brand	-0.039	(0.028)
Management	-0.021	(0.019)

Change 2004 to 2012:

Degree	-0.086 ***	(0.014)
Higher Education	-0.088 ***	(0.018)
GCE, A-level	-0.051 ***	(0.014)

Base: Other

Base: Other or none

Notes: Regressions include controls for potential experience and potential experience squared, female, hours worked, and 2-digit industry dummies for each year. 29,085 observations. Adjusted R-squared=.473. *** 1%, ** 5%, * 10% statistical significance. LFS 2004 and 2012.

Conclusions

- The firm-productivity distribution is fanning out within sectors in the UK.
- Top firms are much more likely than lower tail firms to be foreign owned and part of a group, and invest much more in both tangibles and intangibles.
- Top firms are also much more likely to employ workers who are highly qualified and in “intangibles producing” occupations.
- These patterns have become more pronounced over the last decade and do not reflect firm-size differentials.
- Workers in top firms earn a premium compared to similar workers in lower tail firms. But, productivity differentials are not fully reflected in pay differentials.
- Younger workers are more highly qualified than older workers, but are no more likely to be in “intangibles producing” occupations.
- Wage premia in “intangibles producing” occupations are not declining, although the return to qualifications is.

Data References

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