

PRELIMINARY RESULTS – NOT FOR CITATION

UK Economic Performance: How Far Do Intangibles Count?

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Overview

- Data sources
- Data construction: UK specific issues
- Occupational distributions
- Performance-based measures of intangibles
- Aggregated data
- Growth accounting



UK Data Sources

Level	Type	Source
<i>Intangible Items</i>		
Enterprise	Employee-based: Occupations	ASHE linked to BSD&ABI
NUTS4 groups	Innovation expenditure	CIS linked to BSD&ARD
	Reported innovation	CIS linked to BSD&ARD
	Employee qualifications/occupations	LFS, ASHE
	Employee-based: Occupations	ASHE linked to BSD&ABI
SIC2003 2-digit	Employee-based: Occupations	ASHE linked to BSD&ABI
<i>Growth Analysis Items</i>		
Enterprise	Input/Output items	ABI
SIC2003 2-digit	Employee-based: Occupations	ASHE linked to BSD&ABI

ASHE: Annual Survey of Hours and Earnings
 BSD: Business Structure Database
 ARD: Annual Respondents Database

ABI: Annual Business Inquiry
 CIS: Community Innovation Survey
 LFS: Labour Force Survey



UK data coverage

- Firms with sample average annual turnover of at least €2million and at least 30 employees
- Non-agriculture market sector with some exclusions
 - Excluded industries due to inadequate coverage: Mining and quarrying of energy producing materials; Manufacture of coke, refined petroleum products and nuclear fuel; Electricity, gas and water supply; Construction; Financial intermediation
 - Included sectors account for approximately 60% of UK employment
- Sample includes approximately 10,000 enterprises per year 1998-2006 accounting for approximately 20% of GVA in relevant industries
- Northern Ireland not represented (GB coverage)



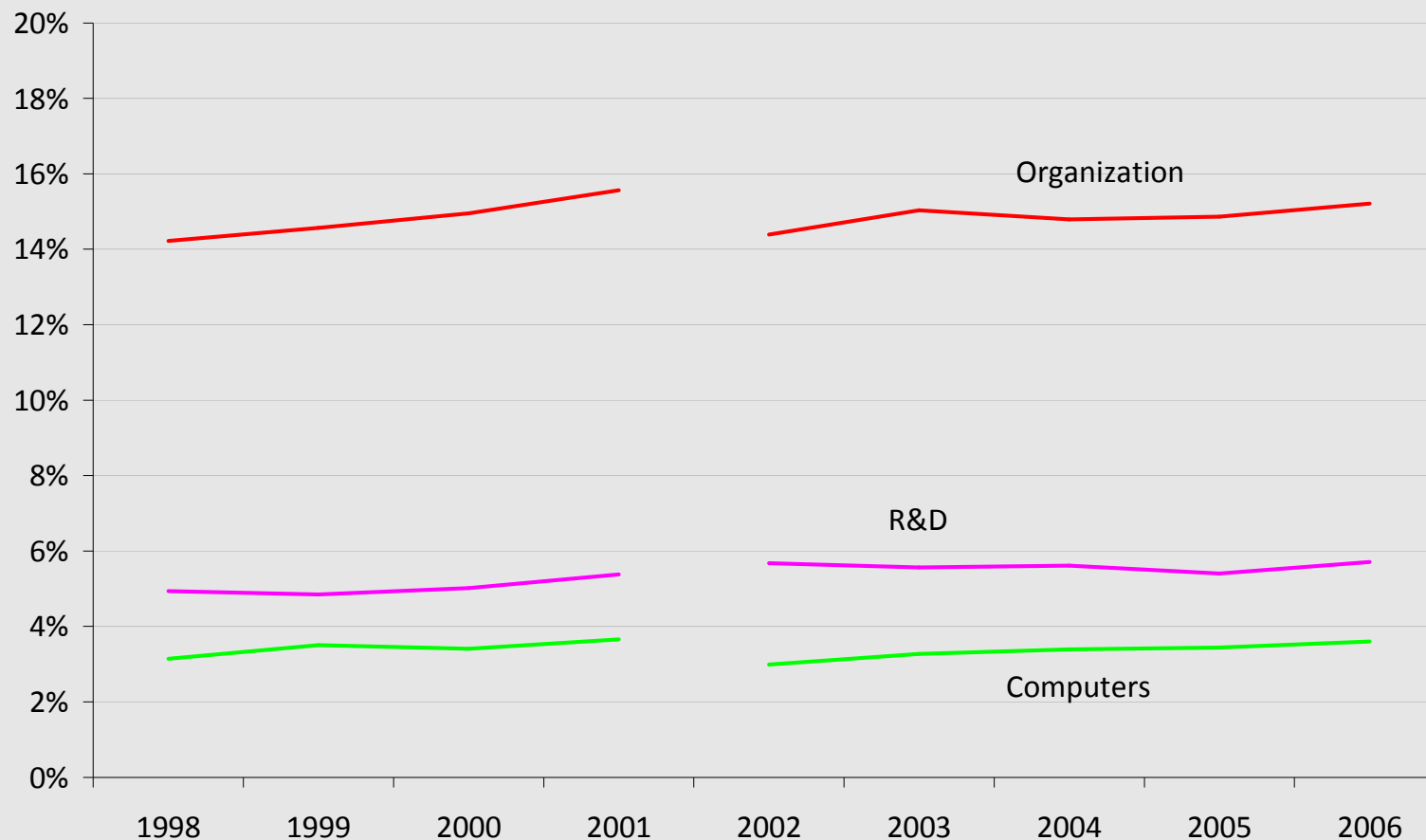
UK specific deviations from mainstream

- No information on workers' education in the enterprise data
 - Allocate occupations to key groups based on LFS information
- SOC90 and SOC2000 not comparable, particularly for managers
 - Data not strictly comparable between 2001 and 2002
- We are not using balance sheet data
 - Tangible capital stocks need to be constructed*
 - Our measure of capital stocks excl. property
- Longitudinal information on firms with lots of year gaps
 - Entry & exit does not measure genuine market entry & exit
 - Intangible investment has to be interpolated to construct intangible capital
- LEED includes on average a 1% sample of firms' employees
 - Construct firm-level occupational data using industry-size rather than enterprise code as the linking variable (robustness analysis)
- Weighting issues
 - Use GVA rather than turnover weights (ratio of GVA to turnover rises in the sample, but not in the aggregated data)
 - BSD turnover distribution used to construct correction for small firms (large firms are more productive than small firms; cannot base correction on employment in large turnover firms)

*We use capital stock data made available by Richard Harris



Mean (across firms) share of hours by occupation group

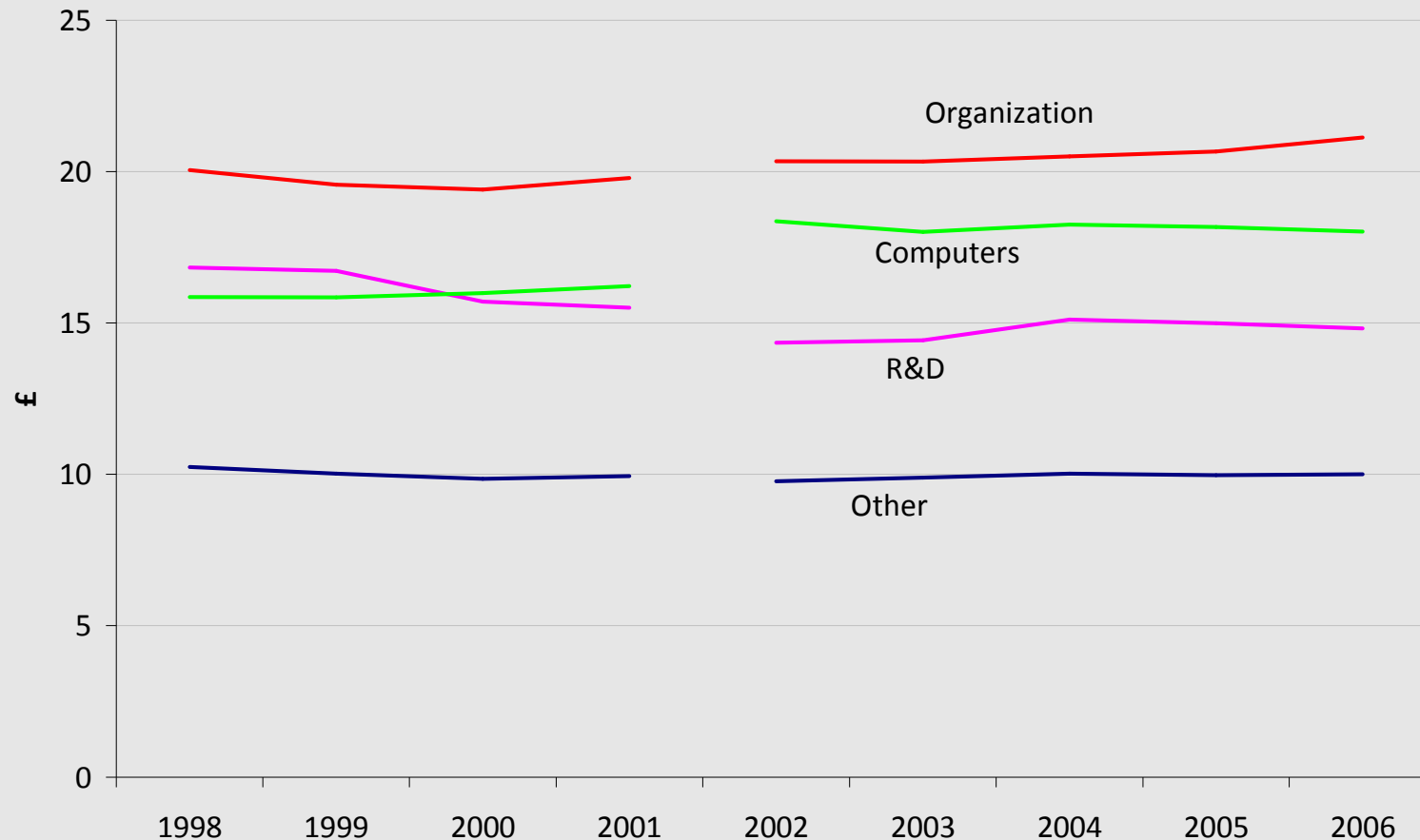


Notes: Non-Farm private business sector excl. A, B, CA, E, F, J

Source: Annual Survey of Hours and Earnings, Labour Force Survey, ARD



Mean (across firms) hourly labour costs by occupation group



Notes: Non-Farm private business sector excl. A, B, CA, E, F, J; Deflated by average earnings index 2000=100
Source: Annual Survey of Hours and Earnings, Labour Force Survey, ARD

Expenditure versus Performance based measures of Intangibles

- Expenditure based measure of investment

- $INV_{exp} = (\text{share of labour w expected life} > 1 \text{ year}) * (\text{total factor multiplier}) * (\text{average wage of OC workers}) * (\text{OC workers})$

- What if wages don't reflect marginal products?

- The returns to successful management may be reflected in the value of the firm over and above the amount that managers are compensated in terms of salary
 - they may be paid in shares or other non-wage benefits
 - their output may be difficult to observe
 - complementarities with unobserved inputs

- Performance based measure of investment

- $INV_{perf} = (\text{share of labour w expected life} > 1 \text{ year}) * (\text{total factor multiplier}) * (\text{estimated average marginal product of OC workers}) * (\text{OC workers})$

INNODRIVE assumptions

	ICT	R&D	OC
Share of labour costs dedicated to own-account production of intangible capital	0.50	0.70	0.15
Associated intermediate and capital costs UK			
(EUKLEMS 2000; NACE 72-74)	1.31	1.10	1.47
ABI 2000 10th percentile	1.16	1.48	1.12
ABI 2000 median	1.77	2.09	1.64
ABI 2000 weighted mean	2.25	2.15	2.03
Expenditure multiplier UK			
(EUKLEMS 2000; NACE 72-74)	0.66	0.77	0.22
ABI 2000 10th percentile	0.58	1.04	0.17
ABI 2000 median	0.88	1.46	0.25
ABI 2000 weighted mean	1.12	1.51	0.31
Cross-country weighted average (rounded)	0.7	1.1	0.3
Depreciation rate	0.33	0.20	0.25

Notes: ABI figures based on authors' own calculations; Capital costs calculated using 6% depreciation rate and 10% external return.



Average coefficients and t-statistics of yearly estimates (1998-2006)

Panel	Mean Estimate	DPV=turnover
OC		1.362
	t-value	(2.75)
OC		0.923
Net Plant, Machinery & Equipment		0.037
	t-value	(4.2)
Net Plant, Machinery & Equipment weighted		0.028
Employment		0.347
	t-value	(13.27)
Employment weighted		0.320
R&D Asset		0.096
	t-value	(5.76)
R&D Asset weighted		0.067
Material		0.500
	t-value	(12.58)
Material weighted		0.535

Notes: OC spans over 6 industry groups; The table shows the average coefficient, Fama and MacBeth's "t-statistics" and weighted average coefficient over industries and years with inverse of variance as weight.



Relative marginal products and wages: OC workers versus non-OC workers (1998-2006)

- Relative marginal products appear to exceed relative wages
- Particularly in Business equipment etc
- But not in the majority of manufacturing (other)

Industry	Observations	OC workers versus non-OC workers	
		Estimated Ratio of Marginal Products (Coefficient OC Share / Coefficient Log Employment) +1	Ratio of Hourly Wages
Services; Consumer Non-Durables & Durables Production	19,639	3.82	1.98
Other Manufacturing (Metal, Trucks, Planes, Office Furniture, Paper, Chemicals, Energy)	23,093	2.36	1.86
Business Equipment (Computers, Software, and Electronic Equipment); Telecom, Telephone and Television Transmission; Medical Equipment, and Drugs	7,997	8.24	1.80
Wholesale, Retail, and Some Services, (Laundries, Repair Shops)	26,432	4.20	1.88
Business Services (Finance not included)	18,519	3.68	2.04
Other (Construction, Transportation, Building Materials, Mining)	9,309	5.10	1.85



Intangible capital in UK businesses

Variable	Mean	Standard Deviaton	Median Value
Organization Compensation / Sales	0.075	0.062	0.059
Organization Investment PERF / Sales	0.043	0.044	0.030
Organization Investment EXP / Sales	0.019	0.016	0.015
Organization Capital PERF / Sales	0.16	0.14	0.12
Organization Capital EXP / Sales	0.07	0.06	0.06
R&D Compensation / Sales	0.021	0.042	0.009
R&D Investment / Sales	0.023	0.047	0.010
R&D Capital / Sales	0.094	0.15	0.045
ICT Compensation / Sales	0.015	0.039	0.005
ICT Investment / Sales	0.010	0.028	0.004
ICT Capital / Sales	0.025	0.053	0.011
Intangible Investment PERF / Sales	0.077	0.086	0.050
Intangible Investment EXP / Sales	0.053	0.065	0.033
Intangible Capital PERF / Sales	0.28	0.27	0.20
Intangible Capital EXP / Sales	0.19	0.21	0.13
Tangible (plant, machinery & equipment) capital / Sales	0.29	0.57	0.17

Notes: 104989 observations; Minimum and maximum values not reported due to disclosure rules; Organization capital derived as $((\text{Coefficient OC Share} / \text{Coefficient Log Employment}) + 1) * \text{Average hourly wage all workers}$
 * OC share; Intangible capital includes Organization, R&D and IT capital; Absolute values are in £ thousands.

Source: Annual Survey of Hours and Earnings, Labour Force Survey, Annual Business Inquiry



Intangible capital in UK businesses

- Intangible investment is on average 7.7% of sales (5.3% on the expenditure based measure)
 - Note these are not weighted means
- Investment in ICT accounts for the smallest share of this (of the 3 components)
- Investment in ORG accounts for the largest share only when we use the performance based measure
- Intangible capital using the performance based measure for ORG is similar in size to Plant, machinery & equipment capital
- The performance based measure of intangible capital is around 1½ times the expenditure based measure



Correlations of capital items across firm-year observations

- Tangible and intangible capital positively correlated (particularly tangible capital and organization capital)
- The three components of intangible capital are positively correlated (particularly ICT and organization capital)

	Organization Capital PERF	Organization Capital EXP	R&D Capital	ICT Capital	Intangible Capital PERF	Intangible Capital EXP	Tangible (pe) capital
Organization Capital PERF	1						
Organization Capital EXP	0.7453*	1					
R&D Capital	0.2991*	0.3509*	1				
ICT Capital	0.5856*	0.4573*	0.2674*	1			
Intangible Capital PERF	0.8189*	0.6858*	0.7707*	0.6620*	1		
Intangible Capital EXP	0.5918*	0.6732*	0.8952*	0.5886*	0.9331*	1	
Tangible (pe) capital	0.1678*	0.1613*	0.1180*	0.1243*	0.1804*	0.1658*	1

Notes: 104989 observations; All variables measured relative to sales



Robustness: Measurement error

Potentially worst for organization occupations

Correlation of occupational distribution of the firm derived from 1% sample of employees and derived for the industry/size group

	Share of employees	Share of hours	Share of labour costs
Organisation	0.502	0.513	0.476
R&D	0.752	0.750	0.724
ICT	0.803	0.802	0.739

Notes: Correlations across 3619 firm-year observations; All correlations are statistically significant at the 5% level

Source: ARD, ASHE, LFS



Robustness: Intangible estimates on firm-linked sample

- EXP measure less sensitive than PERF measure of ORG CAP
- Performance based measure of organization capital
 - Significantly larger using industry link
 - Reflecting sensitivity to the linking variable of MP estimates on small sample (rather than of occupational structure)
- Industry link gives fewer zero R&D and zero ICT firms

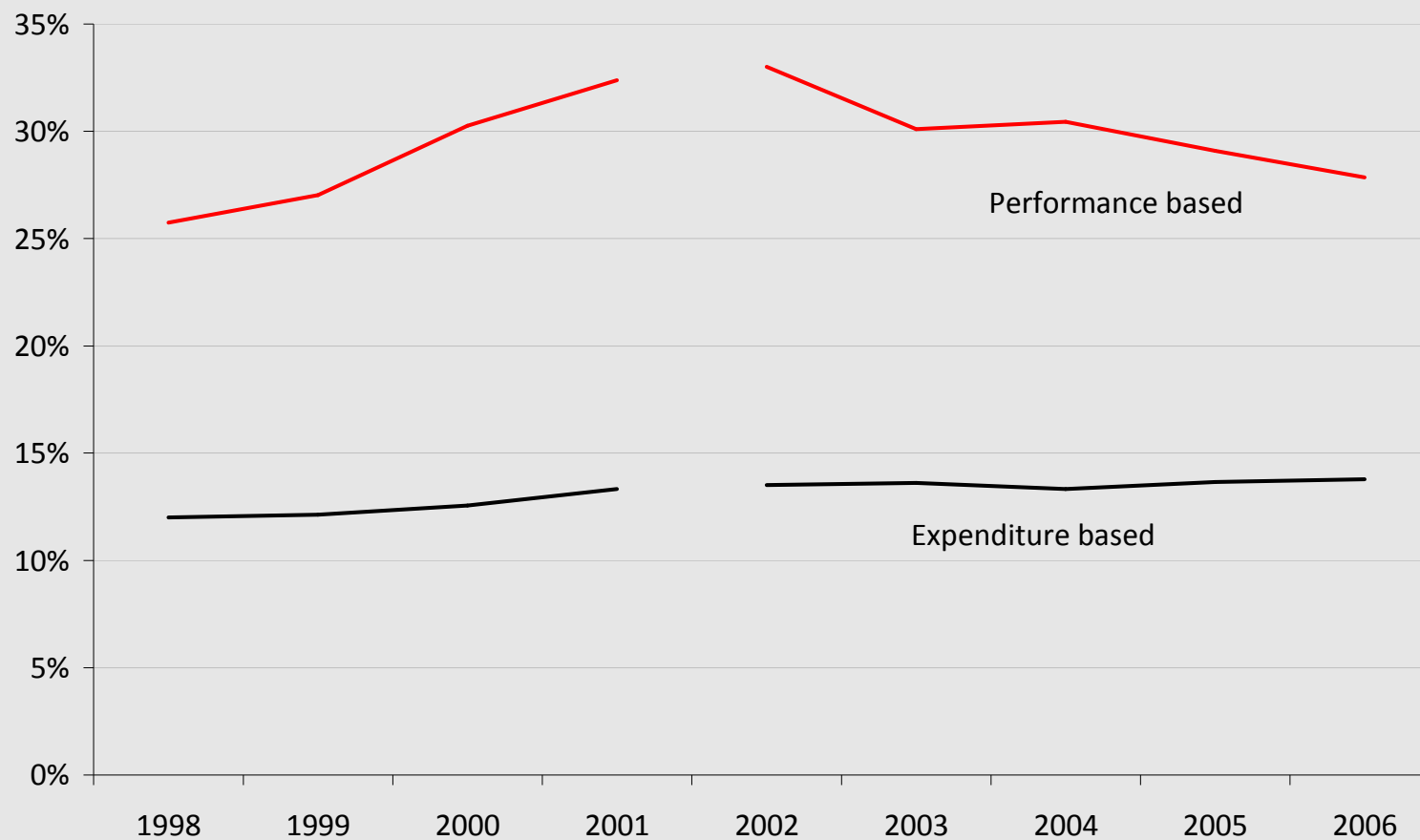
Variable	Industry linked occupations			Firm linked occupations			Industry linked occupations (full sample)		
	Mean	Standard Deviaton	Median Value	Mean	Standard Deviaton	Median Value	Mean	Standard Deviaton	Median Value
Organization Compensation / Sales	0.07	0.07	0.05	0.06	0.08	0.04	0.08	0.06	0.06
Organization Investment PERF / Sales	0.09	0.22	0.03	0.03	0.04	0.01	0.04	0.04	0.03
Organization Capital PERF / Sales	0.30	0.29	0.20	0.10	0.13	0.05	0.16	0.14	0.12
Intangible Capital PERF / Sales	0.42	0.37	0.30	0.20	0.28	0.10	0.28	0.27	0.20
R&D Capital / Sales	0.09	0.17	0.03	0.08	0.20	0.00	0.09	0.15	0.05
ICT Capital / Sales	0.03	0.05	0.01	0.02	0.07	0.00	0.03	0.05	0.01

Notes: 3487 observations; Minimum and maximum values not reported due to disclosure rules.

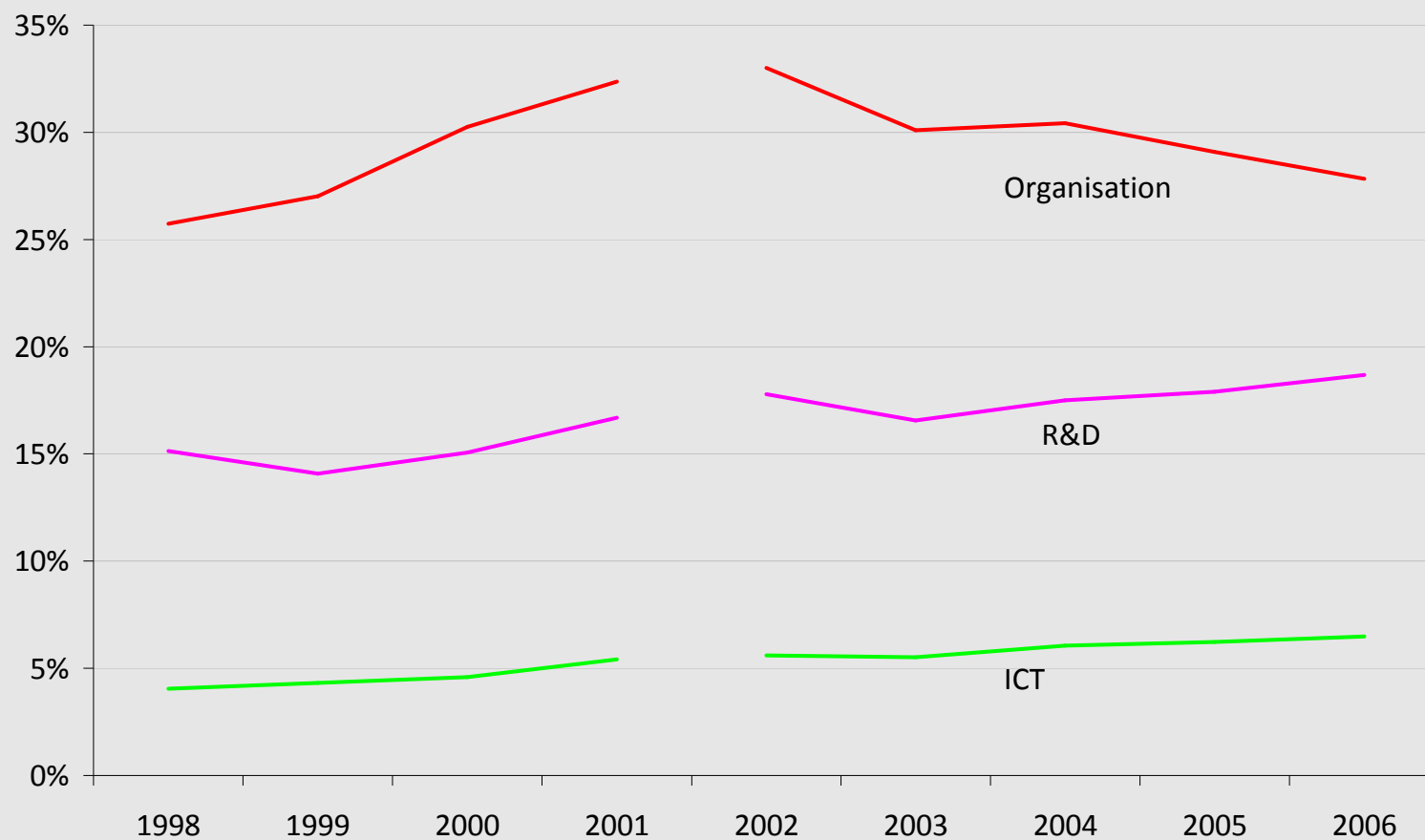
Source: Annual Survey of Hours and Earnings, Labour Force Survey, Annual Business Inquiry



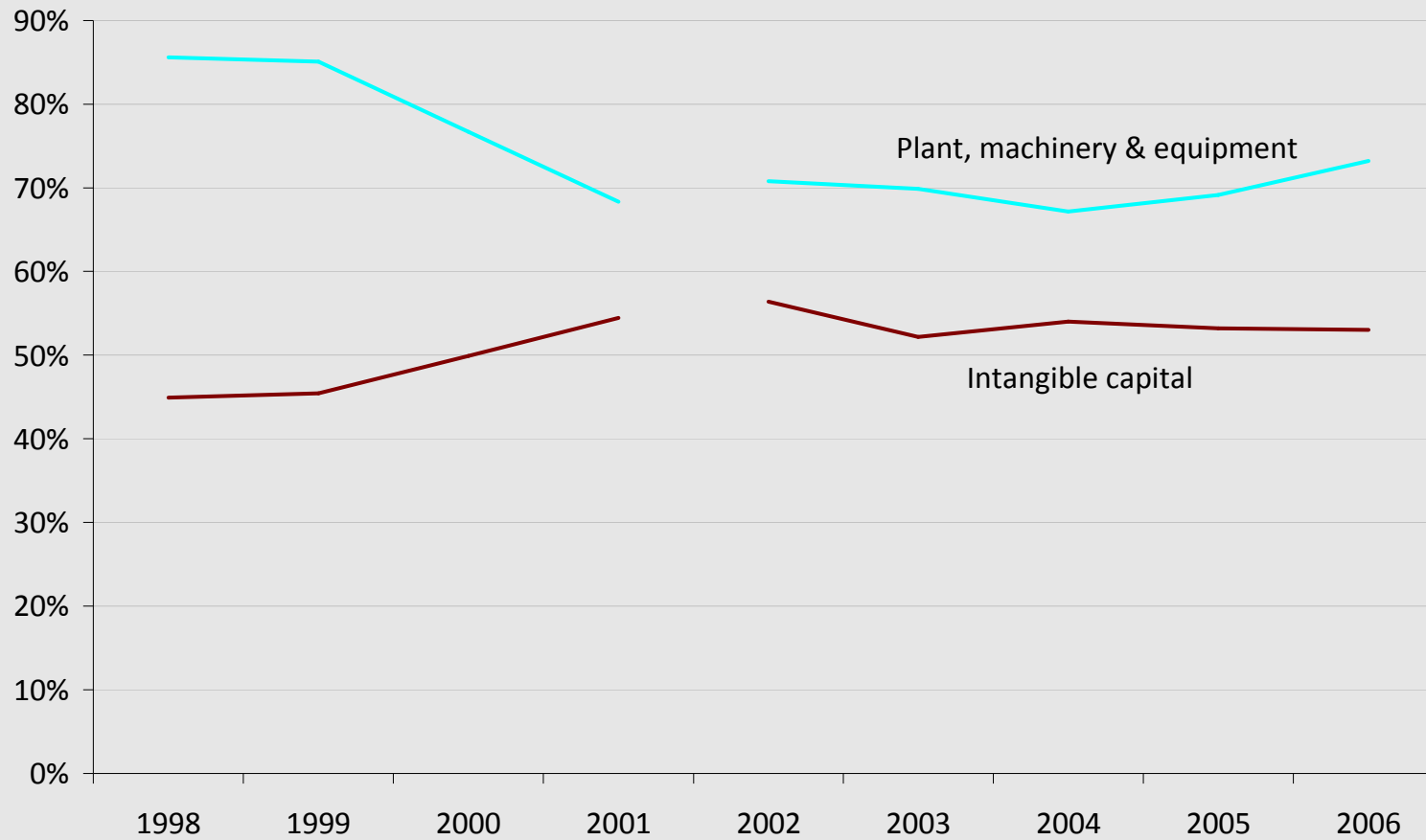
Ratio of organisation capital to adjusted GVA



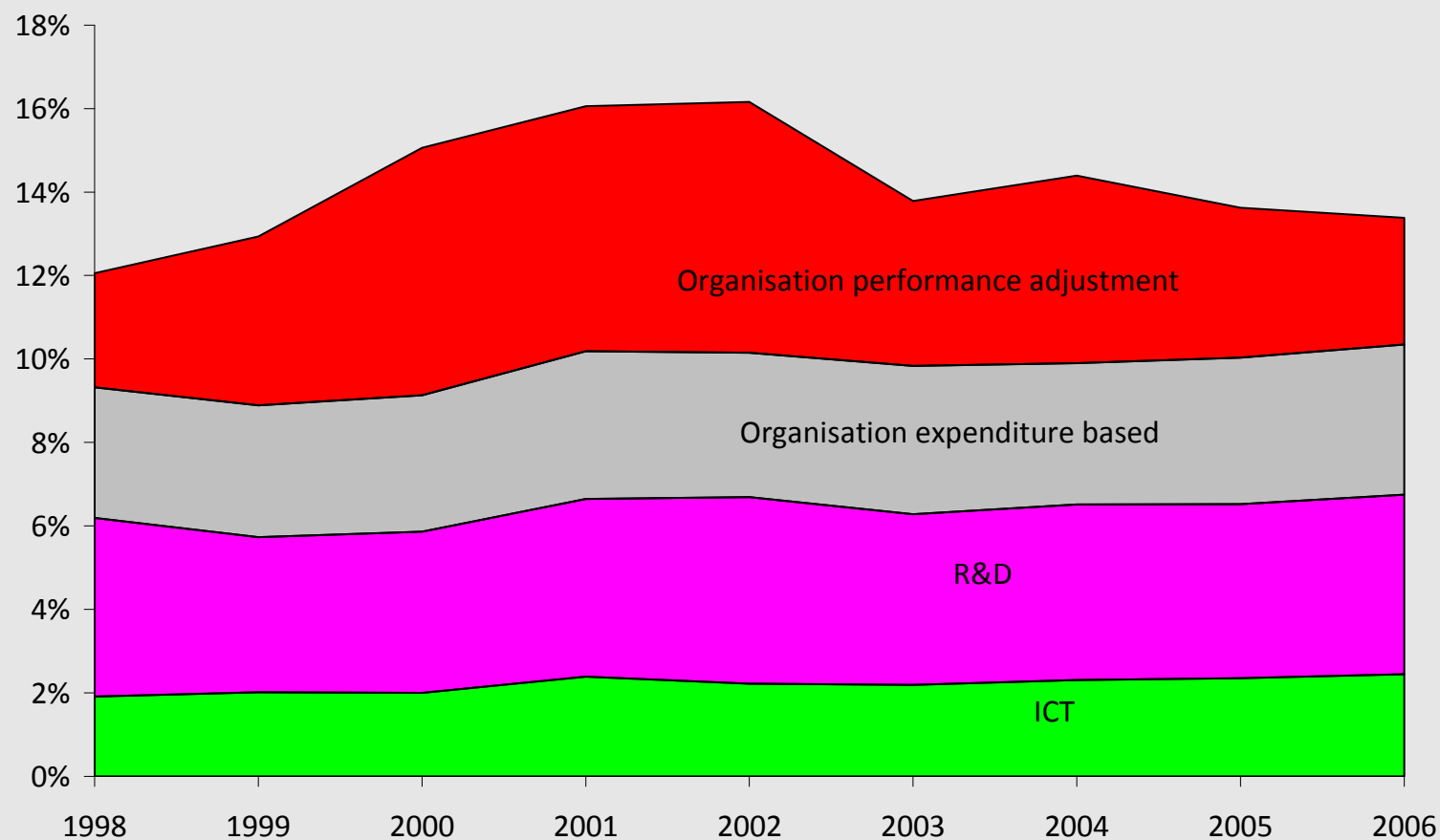
Intangible capital to adjusted GVA



Capital to adjusted GVA



Intangible investment to adjusted GVA



Intangibles in the UK market sector

- Intangible capital
 - Approx 50% of value added (half the size of the tangible capital stock if we include property)
 - Organisation capital the largest component (on the performance adjusted measure)
 - Rate of increase has declined between 1999-2001 and 2003-2006
- Intangible investment
 - Raises GDP by 10-14% (depending on organisation measure)
 - Similar to Marrano, Haskel & Wallis (2009) estimates (using aggregate data, slightly different industry coverage)
 - Flattening off of this increase 2003-2006 compared to 1999-2001
 - Consistent with MHW



What if the UK was Europe?

- More workers would be employed in manufacturing, less in services
- Production would involve significantly more tangible capital (plant, machinery & equipment)
- But intangible capital would not be very different (a little less organisation and ICT capital, more R&D capital)

	1999	2000	2001	2002	2003	2004
<i>UK with EU industry structure</i>						
Organisation capital	26%	30%	32%	32%	29%	29%
R&D capital	15%	17%	19%	19%	17%	19%
ICT capital	4%	4%	5%	5%	5%	5%
Plant, machinery & equipment	190%	180%	194%	196%	190%	189%
<i>UK as is</i>						
Organisation capital	27%	30%	32%	33%	30%	30%
R&D capital	14%	15%	17%	18%	17%	18%
ICT capital	4%	5%	5%	6%	6%	6%
Plant, machinery & equipment	85%	77%	68%	71%	70%	67%



Traditional growth accounting

- Increase in rate of productivity growth per hour between 1999-2001 and 2003-2006
- Associated with capital deepening
- On average over the years shown all productivity growth is MFP
 - Note that we do not quality adjust labour
 - Property capital is not included

Traditional (No Intangibles)

Year	Labour productivity	MFP	Tangible capital	Organization capital	R&D capital	ICT capital	Total Intangibles
1999	1.4 %	1.2 %	0.2 %	0.0 %	0.0 %	0.0 %	0.0 %
2000	4.9 %	6.4 %	-1.5 %	0.0 %	0.0 %	0.0 %	0.0 %
2001	1.2 %	4.8 %	-3.6 %	0.0 %	0.0 %	0.0 %	0.0 %
2003	3.8 %	3.7 %	0.1 %	0.0 %	0.0 %	0.0 %	0.0 %
2004	5.8 %	5.5 %	0.2 %	0.0 %	0.0 %	0.0 %	0.0 %
2005	-0.5 %	-1.0 %	0.5 %	0.0 %	0.0 %	0.0 %	0.0 %
2006	6.6 %	2.2 %	4.4 %	0.0 %	0.0 %	0.0 %	0.0 %
Average 1999-2001	2.5 %	4.1 %	-1.6 %	0.0 %	0.0 %	0.0 %	0.0 %
Average 2003-2006	3.9 %	2.6 %	1.3 %	0.0 %	0.0 %	0.0 %	0.0 %
Average all years	3.3 %	3.3 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %



Growth accounting with new intangibles (Performance based)

- Decrease in rate of productivity growth per hour 1999-2001 to 2003-2006
- Associated with smaller contributions from the knowledge economy
 - MFP* and Intangible capital each contribute less in 2003-2006
- On average over the years shown intangibles add 0.4 %points to productivity growth

Intangibles PERF

Year	Labour productivity	MFP	Tangible capital	Organization capital	R&D capital	ICT capital	Total Intangibles
1999	1.9 %	1.7 %	0.2 %	0.2 %	-0.3 %	0.1 %	0.0 %
2000	6.9 %	6.4 %	-1.3 %	1.3 %	0.4 %	0.2 %	1.8 %
2001	1.9 %	3.8 %	-3.2 %	0.6 %	0.4 %	0.3 %	1.3 %
2003	1.0 %	2.0 %	0.1 %	-0.8 %	-0.3 %	0.0 %	-1.1 %
2004	6.0 %	4.9 %	0.2 %	0.3 %	0.3 %	0.2 %	0.9 %
2005	-1.6 %	-1.3 %	0.4 %	-0.7 %	-0.1 %	0.0 %	-0.7 %
2006	6.0 %	1.9 %	3.7 %	0.0 %	0.3 %	0.2 %	0.4 %
Average 1999-2001	3.6 %	4.0 %	-1.4 %	0.7 %	0.1 %	0.2 %	1.0 %
Average 2003-2006	2.8 %	1.9 %	1.1 %	-0.3 %	0.1 %	0.1 %	-0.1 %
Average all years	3.2 %	2.8 %	0.0 %	0.1 %	0.1 %	0.1 %	0.4 %



Growth accounting with new intangibles (Expenditure based)

- Increase in rate of productivity growth per hour 1999-2001 to 2003-2006
 - as in traditional, but different to performance based analysis
- Contributions from the knowledge economy decrease over this period
 - Contribution from plant, machinery & equipment increases
- On average over the years shown intangibles add 0.3 %points to productivity growth

Intangibles EXP

Year	Labour productivity	MFP	Tangible capital	Organization capital	R&D capital	ICT capital	Total Intangibles
1999	0.6 %	0.8 %	0.2 %	-0.1 %	-0.3 %	0.1 %	-0.3 %
2000	5.0 %	5.6 %	-1.4 %	0.2 %	0.4 %	0.2 %	0.7 %
2001	2.1 %	4.5 %	-3.3 %	0.2 %	0.4 %	0.3 %	0.9 %
2003	3.1 %	3.2 %	0.1 %	0.1 %	-0.3 %	0.0 %	-0.2 %
2004	5.6 %	4.8 %	0.2 %	0.0 %	0.3 %	0.3 %	0.6 %
2005	-0.7 %	-1.0 %	0.4 %	0.0 %	-0.1 %	0.0 %	-0.1 %
2006	6.6 %	2.0 %	3.9 %	0.2 %	0.3 %	0.2 %	0.7 %
Average 1999-2001	2.6 %	3.6 %	-1.5 %	0.1 %	0.1 %	0.2 %	0.4 %
Average 2003-2006	3.6 %	2.2 %	1.2 %	0.1 %	0.1 %	0.1 %	0.2 %
Average all years	3.2 %	2.8 %	0.0 %	0.1 %	0.1 %	0.1 %	0.3 %

