THE CHANGING DEMAND FOR SKILLS IN THE UK

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Introduction

- Two dominant canonical explanations for observed changes in employment and wages over the last 30 years:
  1. SBTC – technology has monotonic effects throughout the skills distribution, and explains eg observed increased returns to education
  2. Tasks vs skills (David Autor and co-authors) – job 'polarisation' as routine tasks in the middle of the skills distribution are increasingly automated as compared to jobs at either ends of the skills spectrum
- More recently, Beaudry, Green & Sand (*JLE* 2016) provide evidence of a 'great reversal' in the US
  - stagnating or decreasing returns to cognitive skills since 2000 for young workers 25-35
  - high-skilled workers have displaced lower-educated workers in less-skilled jobs

Introduction

- Finally, Deming (*QJE* fc) reports growing importance of 'social skills' in US labour market
  - increasing share of US jobs require high levels of social interaction
  - increasing returns to social skills post 2000
  - flip side of automation/routinisation?
  - similar findings reported for Swedish prime-aged (38-42) males (Edin et al, IZA 2017)
- Most of the tasks vs skills literature is for the US
  - using DOT and/or O*NET measures of tasks and skills
    - eg Autor, Levy & Murnane (*QJE* 2003); Abraham & Spletzer (*AER* 2009)
  - or bespoke surveys (eg Autor and Handel, *JLE* 2013)

Introduction

- For the UK, ‘skills’ are a major policy priority
  - but we only have very imperfect measures of the skills available and in use in employment today
- We develop detailed, multi-dimensional occupational skills profiles for the UK which describe the skills used in the workplace
- Many potential uses, including:
  - providing a much richer and deeper understanding of the changing patterns of the demand for skills
  - assessing the changing value of skills in employment
  - informing individuals and those who advise them on the skills that are useful in employment today, and in the future

Measuring skills

- 'Skills' are currently measured in a variety of different ways
  - eg qualifications, occupational classification
- Simple to measure, but poor proxies for skills
  - **qualifications**: usually obtained while still in (full-time) education i.e. before labour market entry, and are not skills
  - **SOC**: hierarchical, uni-dimensional, and static - captures neither the range nor the changing nature of skills used in different jobs over time
- Employers increasingly focus on aspects other than qualifications or occupations – incl. generic, key or core skills
  - more difficult to measure, although some progress has been made in surveys that focus on the tasks that individuals perform in their jobs

Measuring skills

- In contrast, the US-based Occupational Information Network (O*NET) system provides ...
  - ... almost 250 measures of skills, abilities, work activities, training, work context and job characteristics
  - ... for each of around 1,000 different US occupations (excl. military)
- O*NET is the main source of occupational competency information in the US
  - almost 20 years in development as a replacement to the DOT system
  - constantly revised, with 100+ occupations updated per annum
- Information is gathered from
  - self-reported assessments by job incumbents based on standardised questionnaire surveys
  - professional assessments by job evaluation analysts

What is O*NET?

- Postal and online questionnaires administered by BLS
  - respondents only asked to complete a random selection of the questionnaires in order to avoid survey fatigue
  - also provide some background demographics (not released)
  - also indicate from a wide range of occupation-specific tasks those that apply to their particular job
- Occupation averages, rather than the individual micro-data, are publicly released – but have large samples
  - average of 31,000 responses for each of the 250 descriptors gathered from around 125,000 returned questionnaires
- Information published at the 'O*NET-SOC' occupation level
  - there are 1,110 O*NET-SOC2010 occupations (cf 840 in US-SOC2010), although data are only collected on 974 of these

Methodology

- Ideally we want O*NET for the UK
- In the absence of such a system, we adopt the US O*NET system to provide the same level of detail in terms of:
  - the occupations that can be separately identified and described, and
  - the range of skills descriptors that are available, and
  - changes within occupations over time
- Presuming that 'sensible' matches can be obtained between occupations, these can then be used to provide a set of descriptors of the skills used in occupations the UK
  - essentially we assume eg the skills of a plumber in the UK are similar to the skills of a plumber in the US

Methodology

- O*NET classified according to an extended version of US-SOC2010
  - no direct correspondence with UK-SOC2010 or ISCO
- However, both US and UK SOCs are skill-based, hierarchical and with distinct levels of aggregation:
  - UK-SOC2010 has nine major groups, 25 sub-major groups, 90 minor groups and 369 unit groups (4 digit)
  - US-SOC2010 has 23 major groups, 97 minor groups, 461 broad occupations and 840 detailed occupations (6 digit); O*NET SOC similar but with more detail (1,110 detailed occupations)
  - All 3 have undergone revisions in their classifications over time
- We construct a systematic and detailed match between O*NET SOC and 4-digit UK-SOC

Methodology

- Use CASCOT (Computer Assisted Structured COding Tool) …
  - used eg for classification of UK Census of Population occupations
- … plus human expert CASCOT coder
  - subjective, but removes ambiguities and obvious errors
- Produces one-to-many match between each UK-SOC2010 4-digit occupation (369 categories) and a number of O*NET-SOC2010 occupations (1,110 categories)
  - matching is based on the job titles underpinning each classification (c. 60,000 job titles in O*NET SOC and c. 30,000 in UK-SOC)
  - essentially we are assuming that eg the skills of a plumber in the UK are similar to the skills of a plumber in the US

Methodology

- Compute a vector of skills, $S_{jt}^{(x)}$, where the measure of each skill *x*, $S^{(x)}$, for each UK 4-digit SOC2010 occupation j at time t is defined as:

$$S_{jt}^{(x)} = \sum_{k=1}^{K_j} O_{kt}^{(x)} \frac{n_{kt}}{\sum_k n_{kt}}$$

$O_{kt}^{(x)}$ is the measure of skill *x* for O*NET occupation *k;*
n_{kt} is employment in occupation *k* as derived from OES
summation over all $k \in \{S_j\}$ of the K_j O*NET occupations that are matched to the particular UK SOC occupation *j*

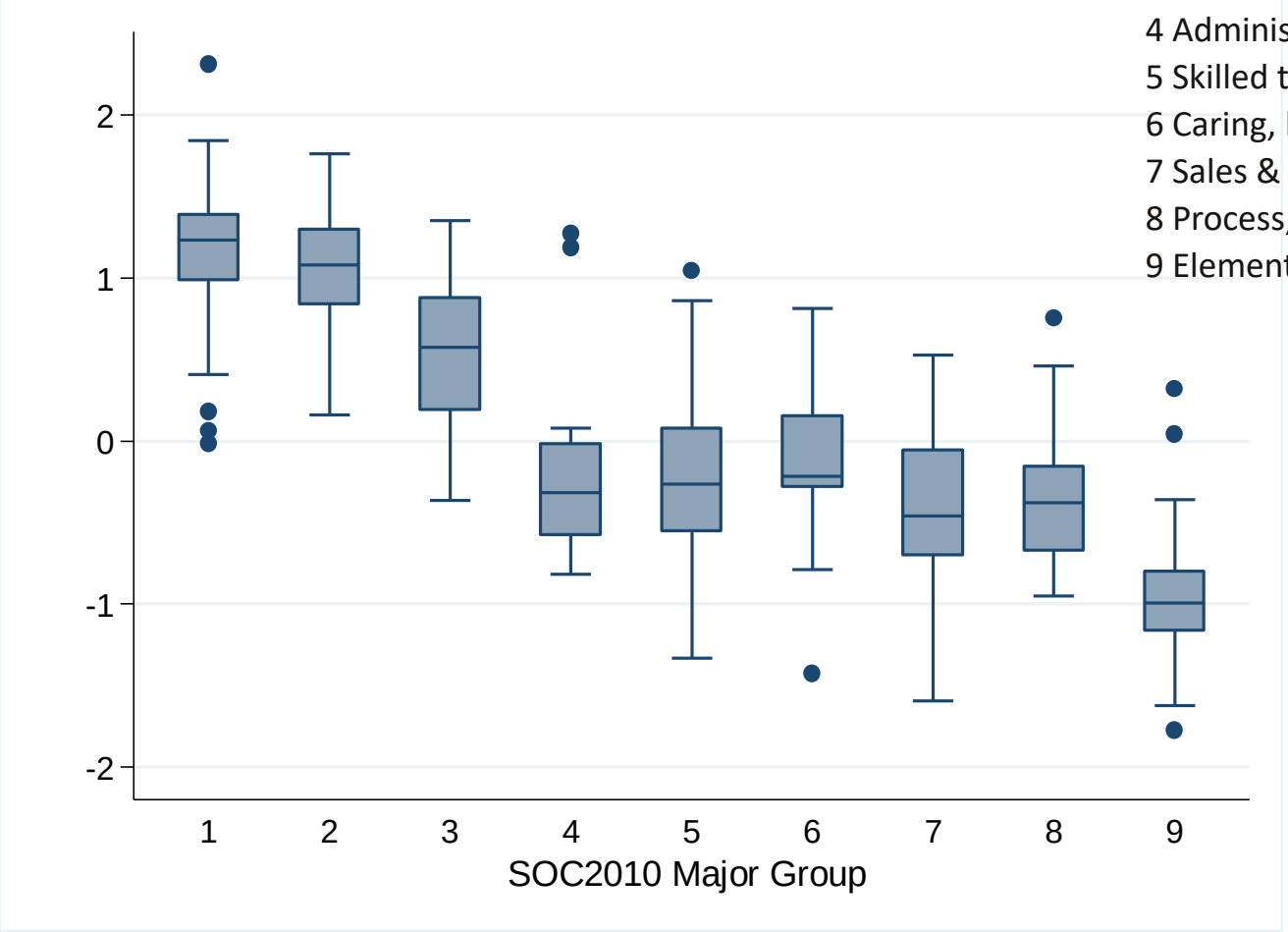
- This is the OES employment-weighted average of the O*NET skill measures for all O*NET occupations that match to UK SOC2010 occupation *j*

Methodology

Aggregate into 'Analytic', 'Interpersonal' and 'Physical' skills (similar to Abraham & Spletzer, 2009, *AER*)

- **Analytic skills (21 items)**:
  - Reading Comprehension, Writing, Mathematics, Science, Critical Thinking, Active Learning, Learning Strategies, Monitoring, Coordination, Negotiation, Complex Problem Solving, Operations Analysis, Technology, Design, Programming, Troubleshooting, Judgment and Decision Making, Systems Analysis, Systems Evaluation, Time Management, Management of Financial Resources, Management of Material Resources
- **Interpersonal skills (7 items)**:
  - Active Listening, Speaking, Social Perceptiveness, Persuasion, Instructing, Service Orientation, Management of Personnel Resources
- **Physical skills (7 items)**:
  - Equipment Selection, Installation, Operation Monitoring, Operation and Control, Equipment Maintenance, Repairing, Quality Control Analysis

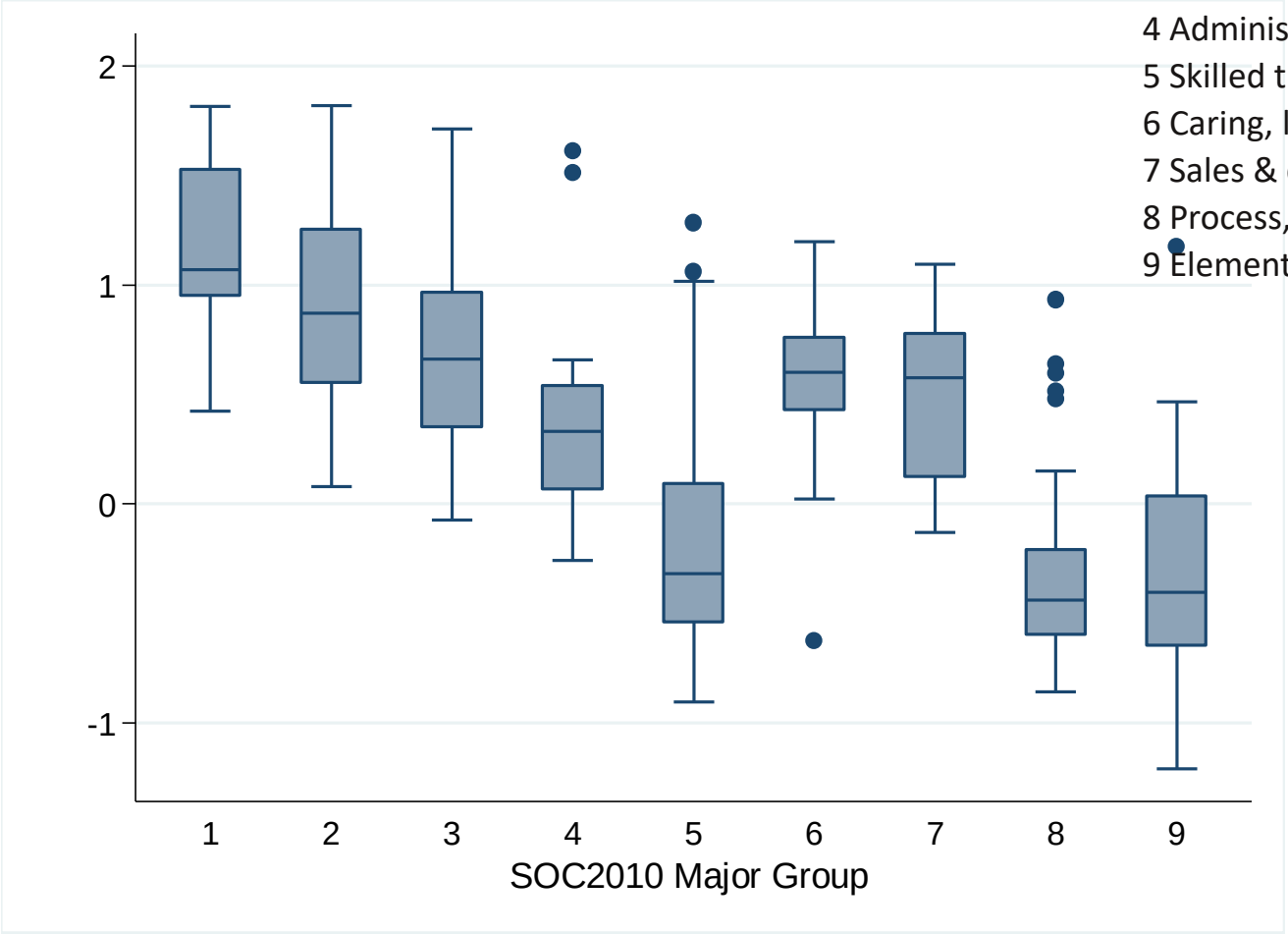
Analytic skills by 1-digit occ in 2016



SOC2010 Major Group

1 Managers, directors and senior officials
2 Professional occupations
3 Associate professional & technical occs
4 Administrative and secretarial occs
5 Skilled trades occupations
6 Caring, leisure & other service occs
7 Sales & customer service occs
8 Process, plant & machine operatives
9 Elementary occupations

Interpersonal skills by 1-digit occ



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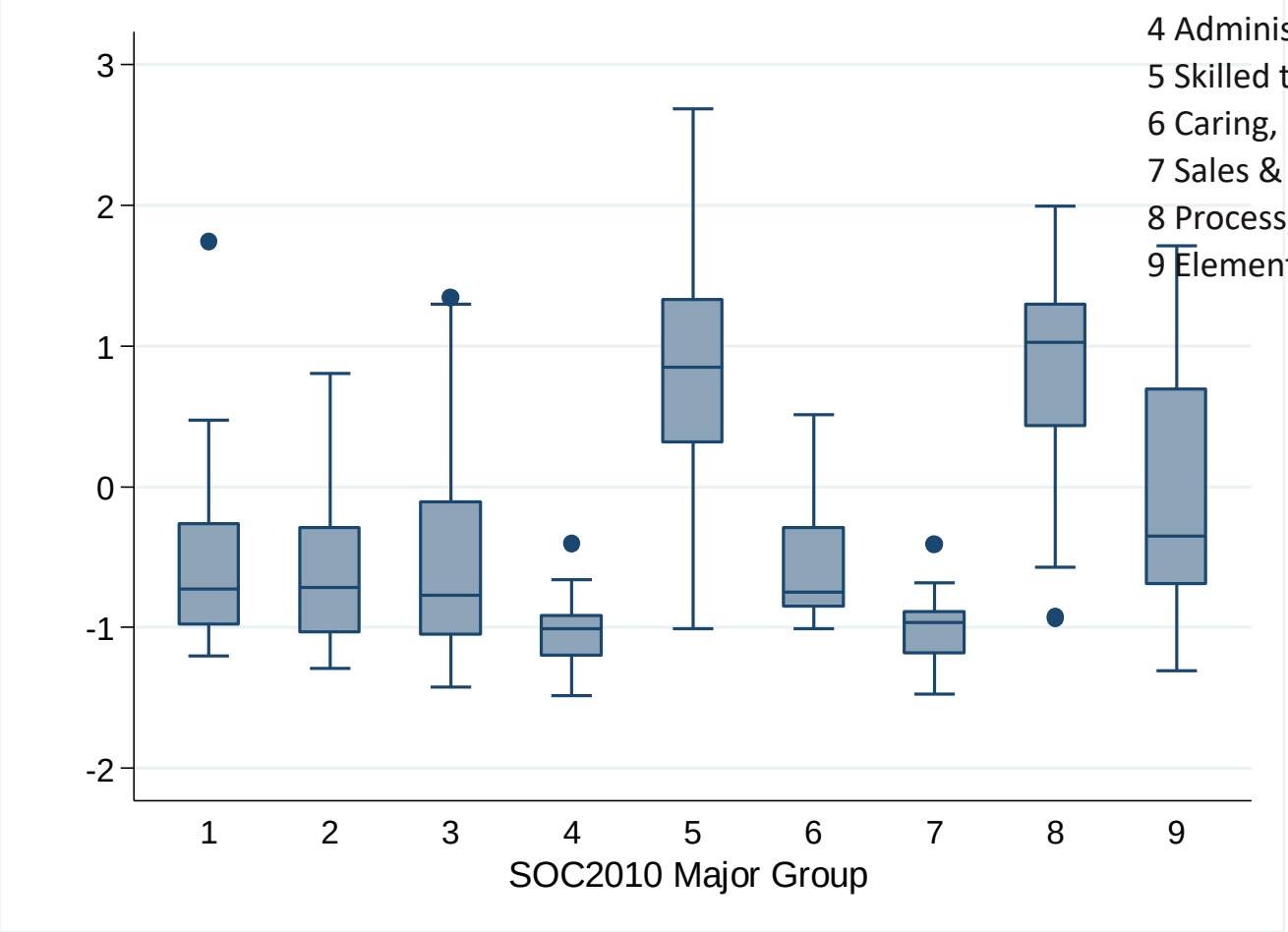
Physical skills by 1-digit occ in 2016



SOC2010 Major Group

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Demand for skills

- How can these occupational skills profiles help to inform us about the 'demand' for skills in the UK?
- Examine two indicators:
  - Skills utilisation in employment ('skills deployment')
    - takes into account both:
      (1) changing occupational distribution of employment
      (2) **PLUS** changing skills usage within occupations
  - Returns to skills ('the value of skills')
    - as an indication of the relative demand and supply of skills

Changing skills utilisation 2002-16

Decomposition of change into within and between occupations:

$$\Delta S = \sum_{j=1}^{J} \Delta e_j \bar{S}_j + \sum_{j=1}^{J} \Delta S_j \bar{e}_j$$

	Aggregate change	Between	Within
1-digit occupations (9 categories)		%	%
Analytic skills	+10%	24	76
Interpersonal skills	+23%	11	89
Physical skills	–14%	10	90
4-digit occupations (369 categories)		%	%
Analytic skills	+10%	18	82
Interpersonal skills	+23%	11	89
Physical skills	–14%	24	76

Returns to skills

- Construct 4-digit occupational panel 2002-2016
  - LFS for qualifications and demographics but ASHE for pay
    - increasing concerns about reliability of LFS, especially on pay …
    - … although ASHE is not a panacea!
  - other variables defined at the occupation mean level – age, gender proportion, region, firm size, public sector …
  - SOC2010-consistent, using ONS correspondence tables
- Merged with O*NET data on skills
  - O*NET matched to UK SOC using CASCOT/expert, plus BLS 'crosswalks' for changes in O*NET-SOC and US-SOC
  - use skills importance measures only
  - aggregate using means across Analytic, Interpersonal and Physical skills

Returns to skills

- Estimate occupation-level wage equation, including skills measures

$$log(w_{jt}) = \beta_1 Analytic_{jt} + \beta_2 Interpersonal_{jt} + \beta_3 Physical_{jt} + \\ + \gamma X_{jt} + \delta_t + \varepsilon_{jt}$$

- X_{jt} contains standard wage equation variables (occupation level means):
  - highest qualification level (5 categories, other/none omitted)
  - age, age squared, gender, region (12), firm size (3)
- Interpretation – conditional wage premia associated with skills used in jobs

4-digit SOC Earnings Equations 2002-2016

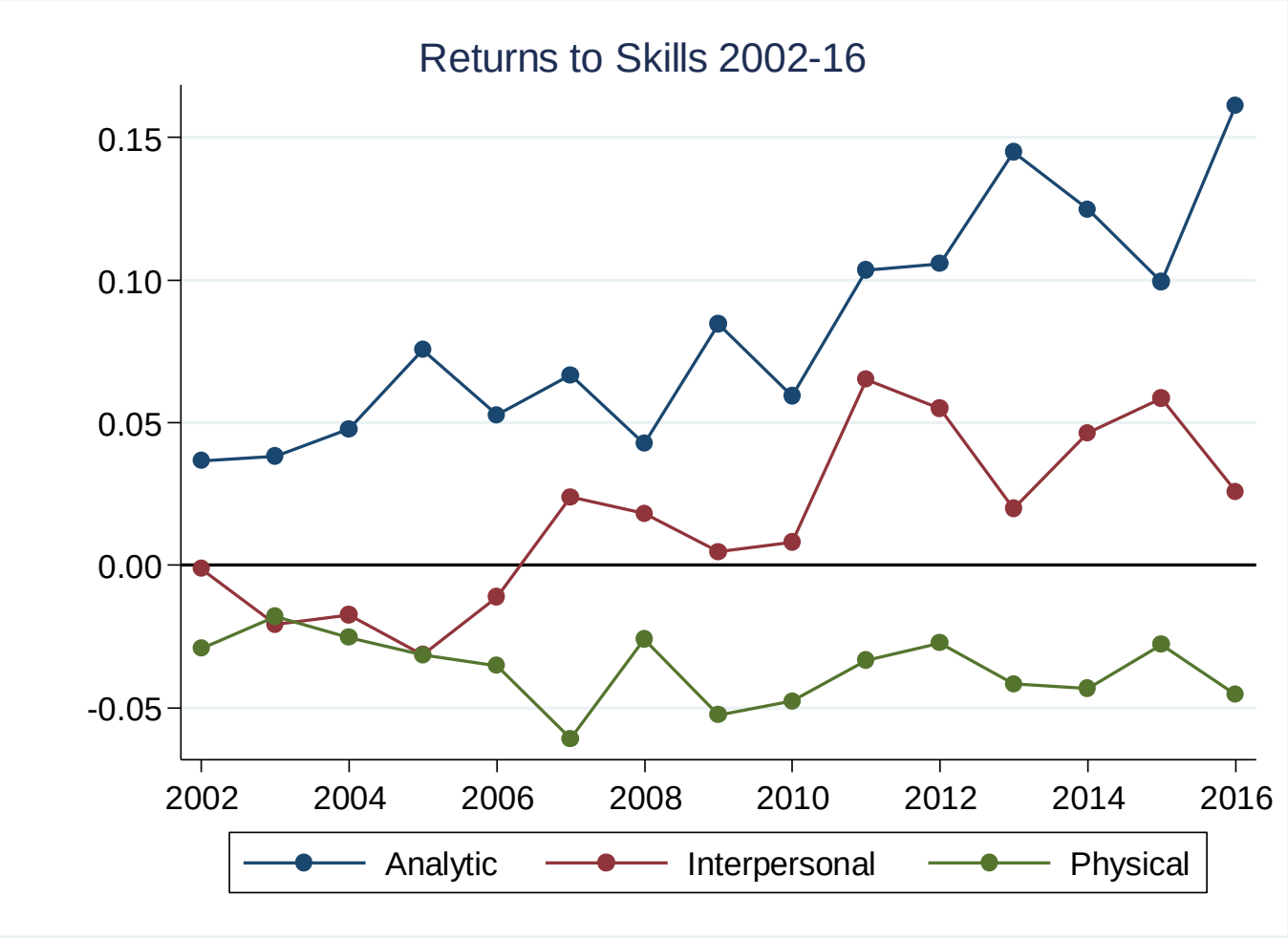
	(1)	(2)	(3)	(4)
Analytic skills	0.364***		0.083***	0.075***
(standardised)	(0.006)		(0.006)	(0.006)
Interpersonal skills	–0.135***		–0.019***	0.003
(standardised)	(0.007)		(0.005)	(0.006)
Physical skills	–0.099***		–0.037***	–0.038***
(standardised)	(0.005)		(0.004)	(0.004)
Highest Q NQF 4+		1.255***	0.869***	0.899***
		(0.028)	(0.029)	(0.029)
Highest Q NQF 3		0.514***	0.462***	0.489***
		(0.040)	(0.034)	(0.033)
Highest Q NQF 2		0.202***	0.422***	0.438***
		(0.051)	(0.044)	(0.044)
Highest Q below NQF 2		0.313***	0.195***	0.206***
		(0.063)	(0.050)	(0.049)
Highest Q Apprentice		1.092***	0.584***	0.599***
		(0.058)	(0.049)	(0.048)
Other controls X_{jt}			YES	YES
Year dummies				YES
Observations	5,156	5,383	4,944	4,944

Interpretation

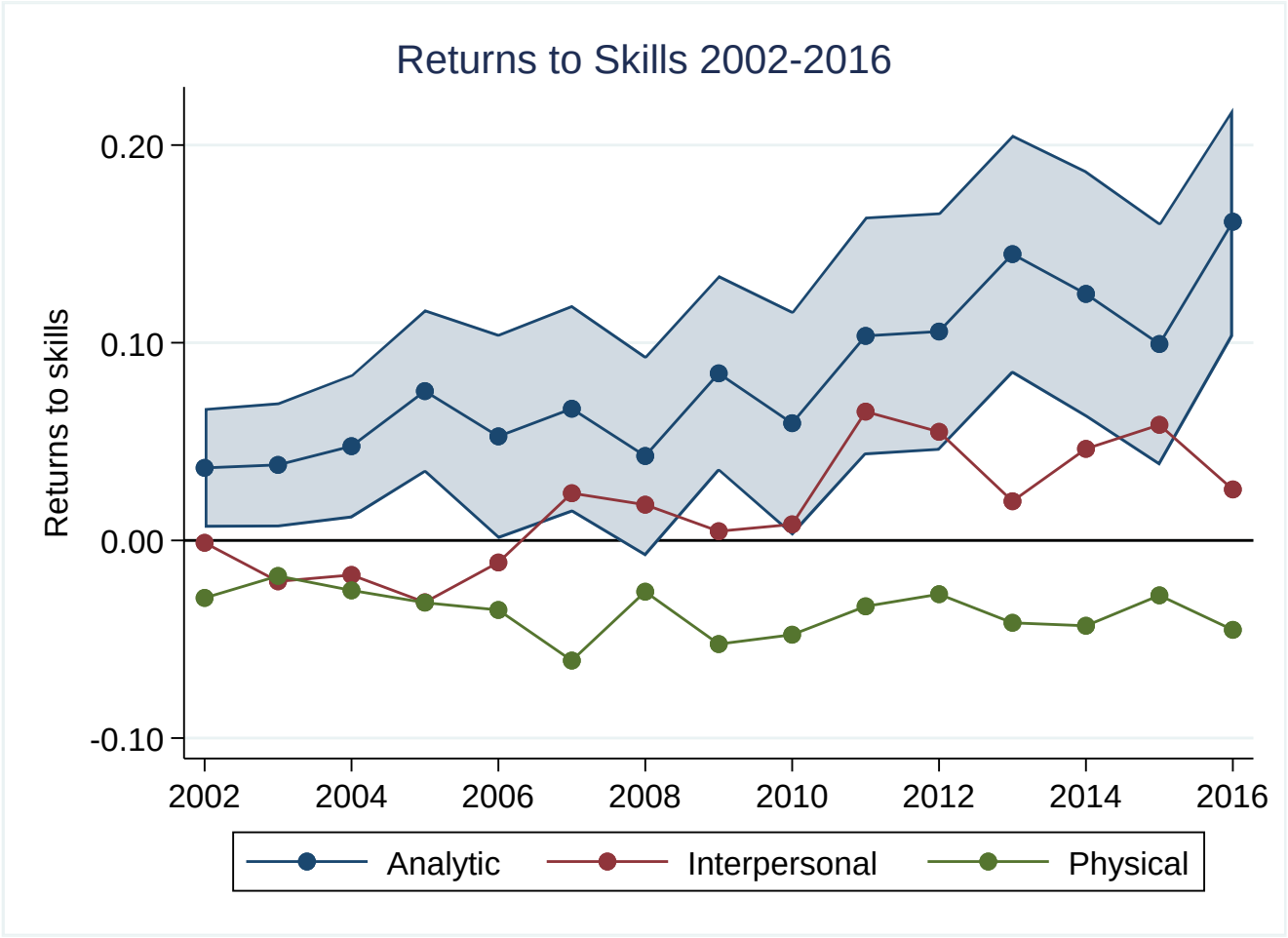
- Significant positive returns to analytic skills …
  - a job with analytic skills 1 sd above the mean has 8% higher wages
- … while significant negative returns to physical skills
  - a job with physical skills 1 sd above the mean has 4% lower wages

- Can also examine changes in returns over time …

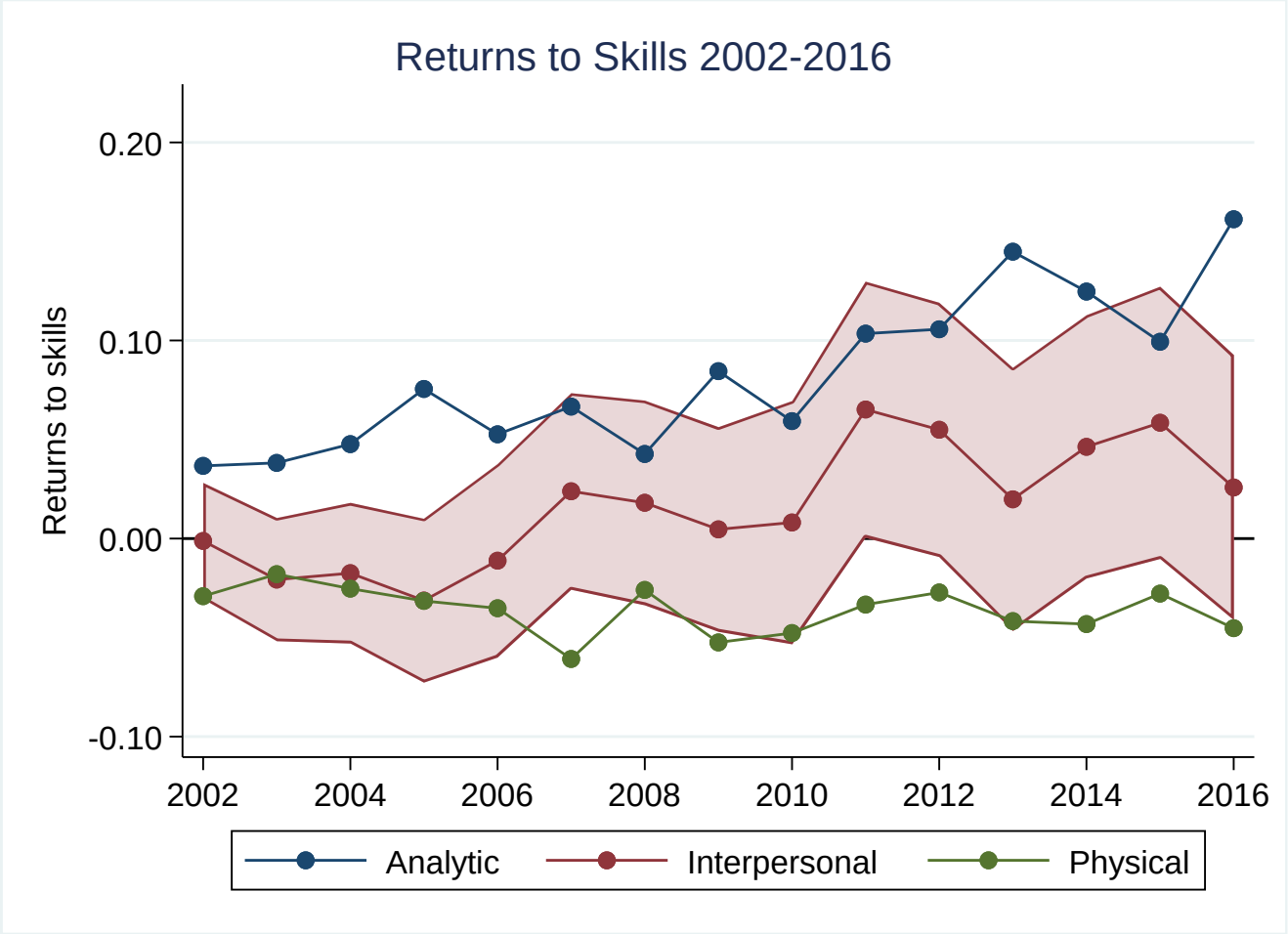
Returns to skills over time



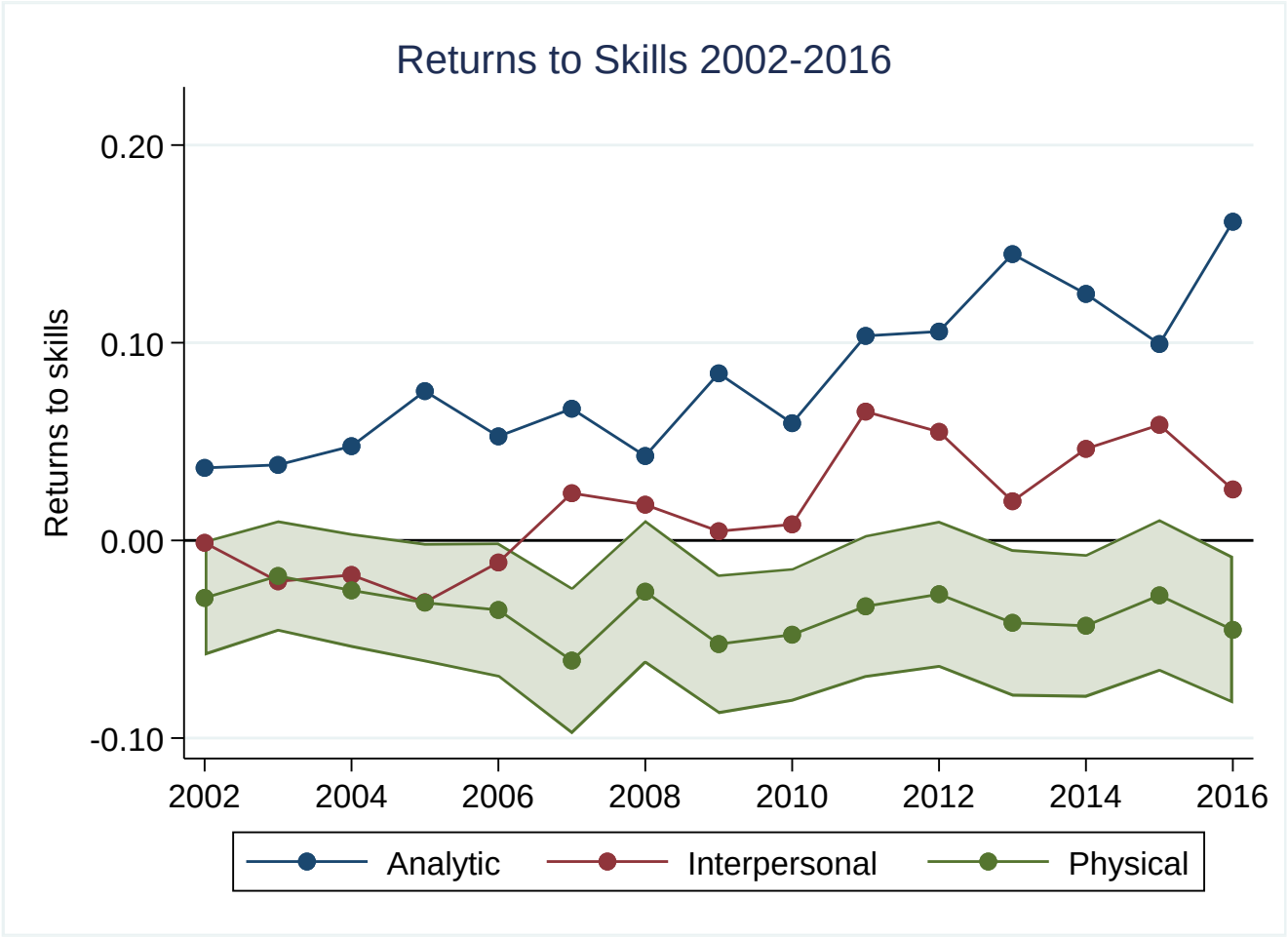
Returns to analytic skills



Returns to interpersonal skills



Returns to physical skills

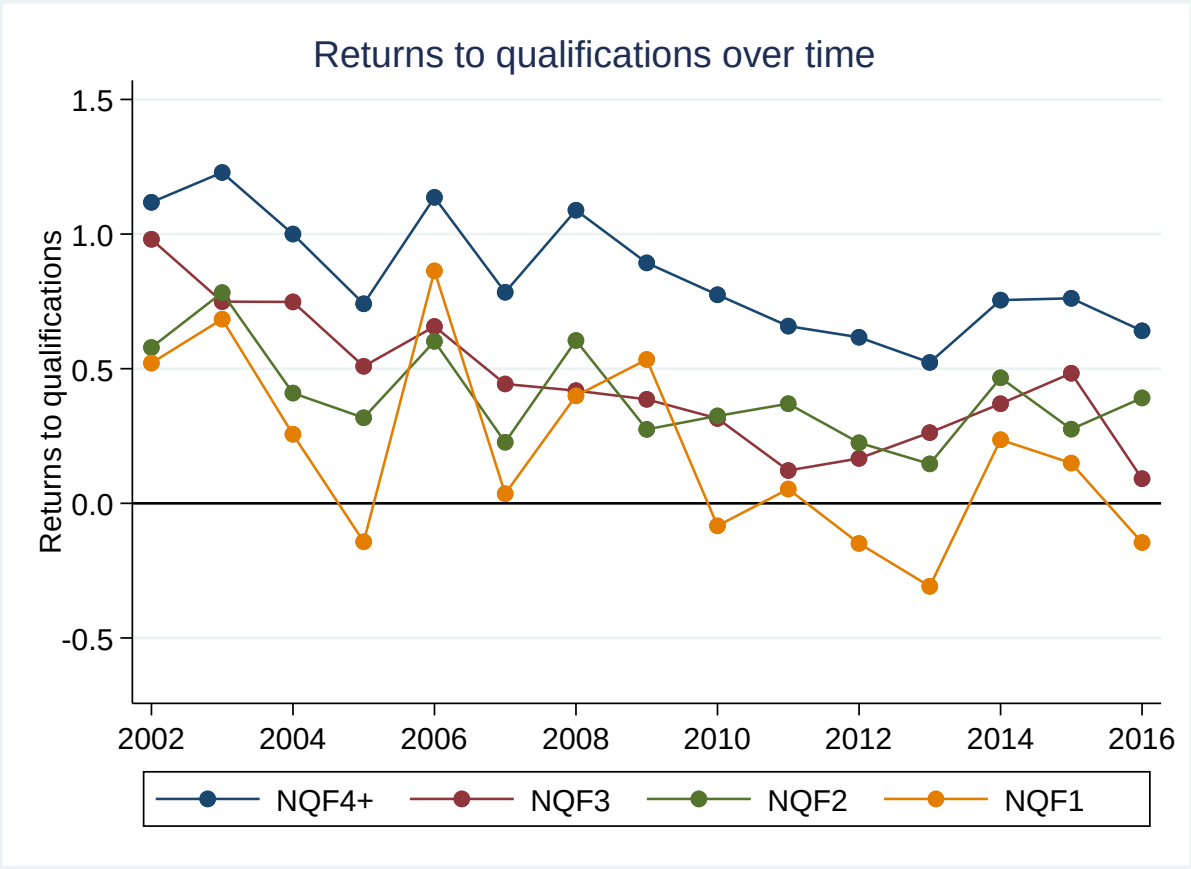


Discussion

- **Analytic skills:** significantly positive and increasing returns over time
  - suggests demand for such skills is still increasing even more strongly than the strong growth in their utilisation
- **Interpersonal skills:** returns are positively trended, but are low and statistically insignificant
  - possible interpretation is there has been a corresponding growth in the supply of these skills to match the very strong increase in their utilisation
- **Physical skills:** returns are negative, but statistically insignificant in some years
  - returns appear to be unaffected by the strong secular decline in the utilisation of these kinds of skills

Discussion

- Interesting to note that (occupational level) returns to qualifications are monotonically declining over the period



Robustness checks

- Our findings are robust to:
  - how SOC2000 data is converted to SOC2010
  - use of LFS wages or ASHE wages
  - restricting to full time workers
  - weighting by cell size (employment)
  - aggregation method for O*NET skills
    - skills importance measures only, or skills importance and level
    - Aggregation by mean, PCA, CD weighting
- Results stronger for 2011-16
  - incl. sig positive returns to Interpersonal skills ('social skills' - Deming, *QJE* fc)

Conclusions

- Main findings:
  - Increasing utilisation of analytic and interpersonal skills, but declining utilisation of physical, mostly routine, skills
  - These changes are pervasive – predominantly within jobs
- Returns to skills:
  - Positive and increasing returns to analytic skills over time, indicative of continued growing demand for such skilsl in the UK
  - Returns to skills are over and above the returns to educational qualifications
  - Occupational returns to qualifications are decreasing over time – evidence of a UK 'reversal'?
- Methodology can advance our understanding and knowledge of the nature of skills demand and utilisation in the UK