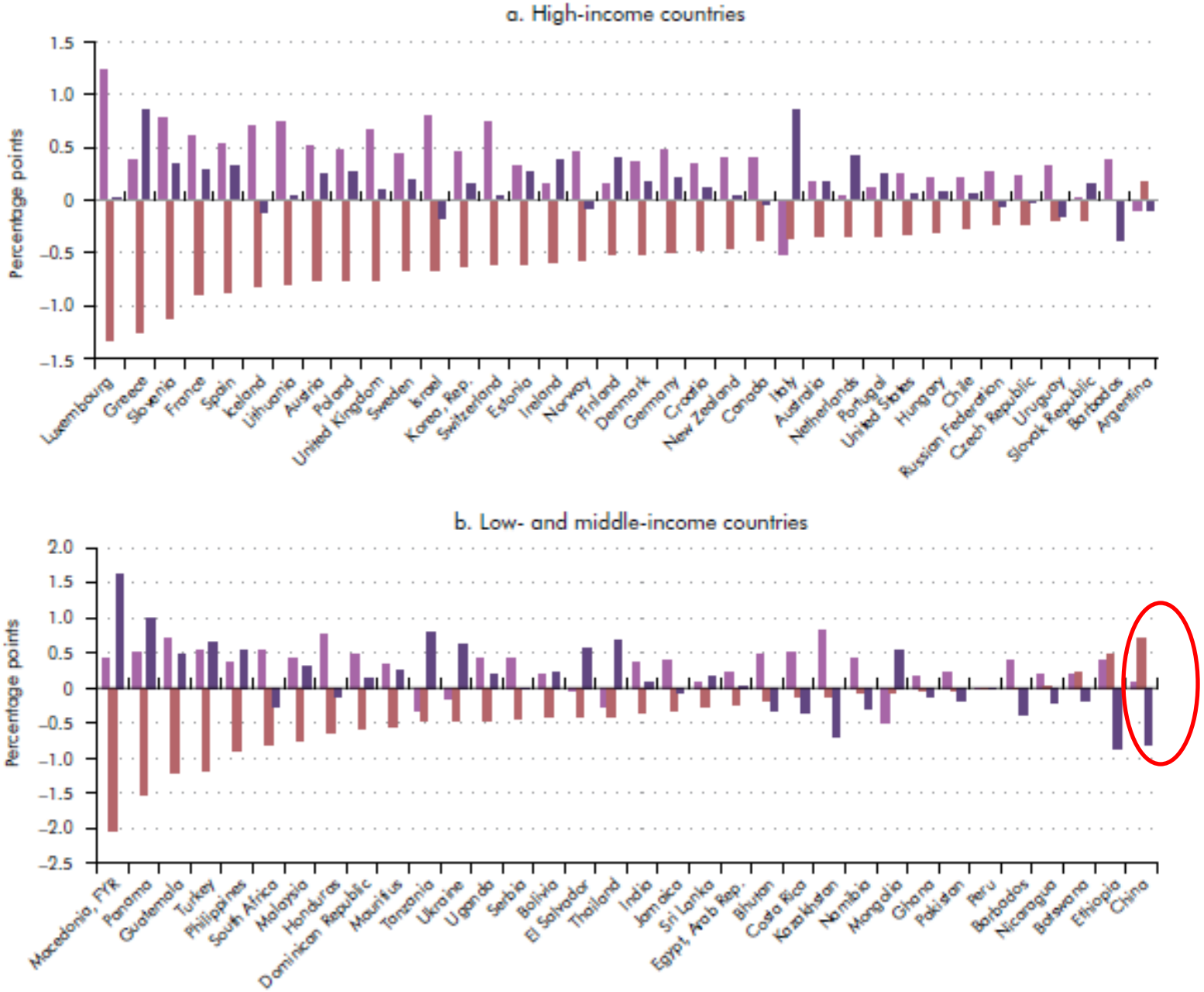
Changing Demand
For Tasks and Skills in China

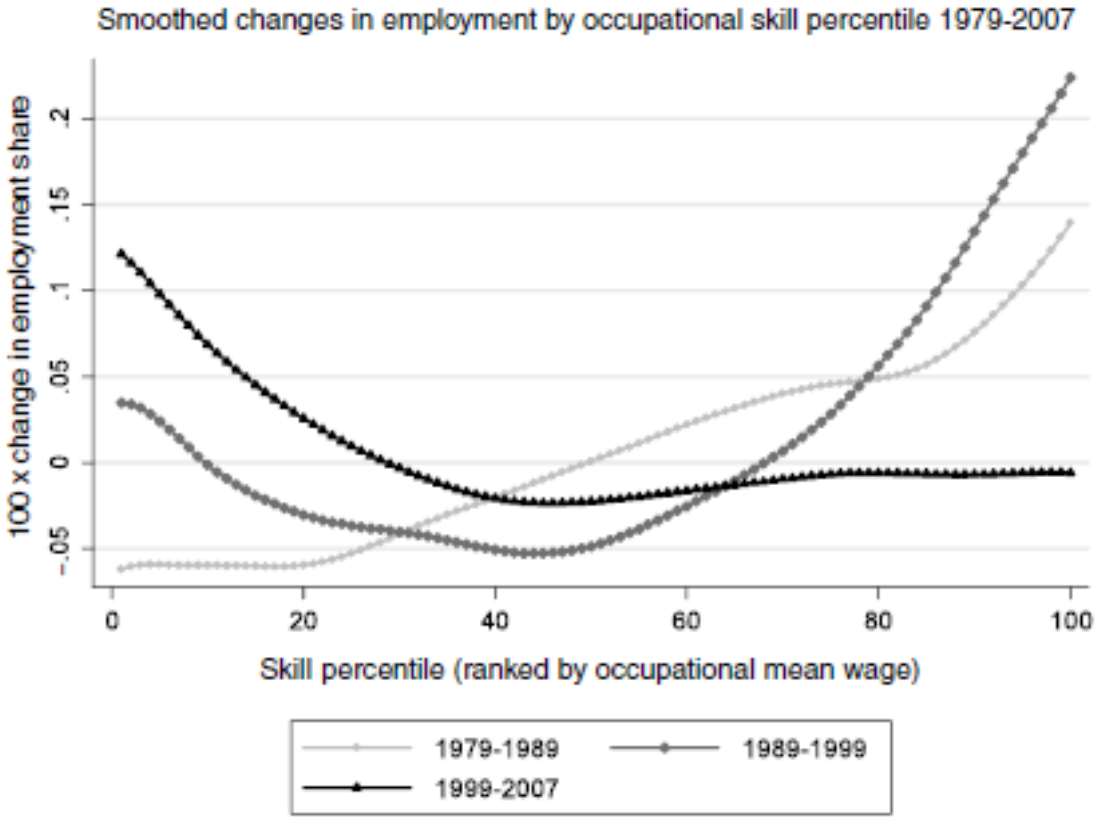
Albert Park, HKUST

Warsaw, July 11, 2017



Source: WDR 2016

US Job Polarization



Possible Explanations:

1. Computers
2. Outsourcing

Source: Acemoglu and Autor, 2011

Defining Tasks (Autor et al, 2003)

- Task categories
  - Nonroutine cognitive analytic
  - Nonroutine cognitive interactive
  - Routine cognitive*
  - Routine manual*
  - Nonroutine manual
- Tasks provide a useful framework for understanding nature of job creation and changes in returns to skill and inequality

Hollowing Out of Middle-Skill Jobs in the US

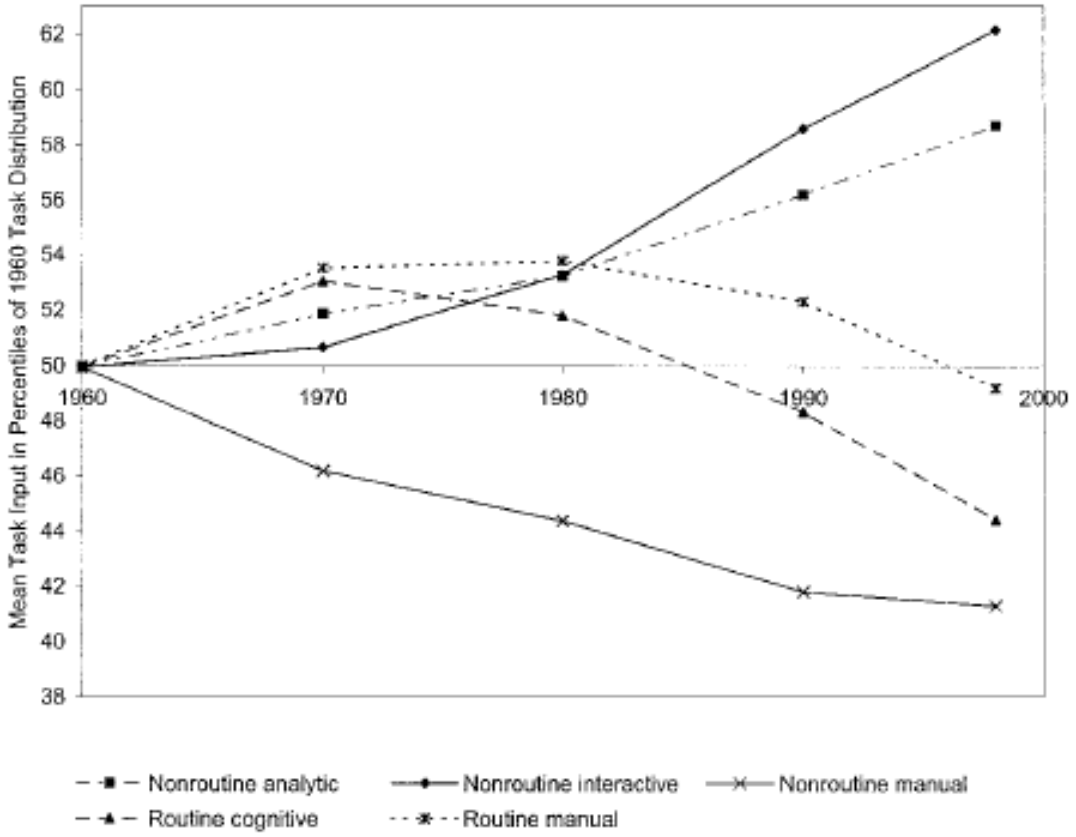


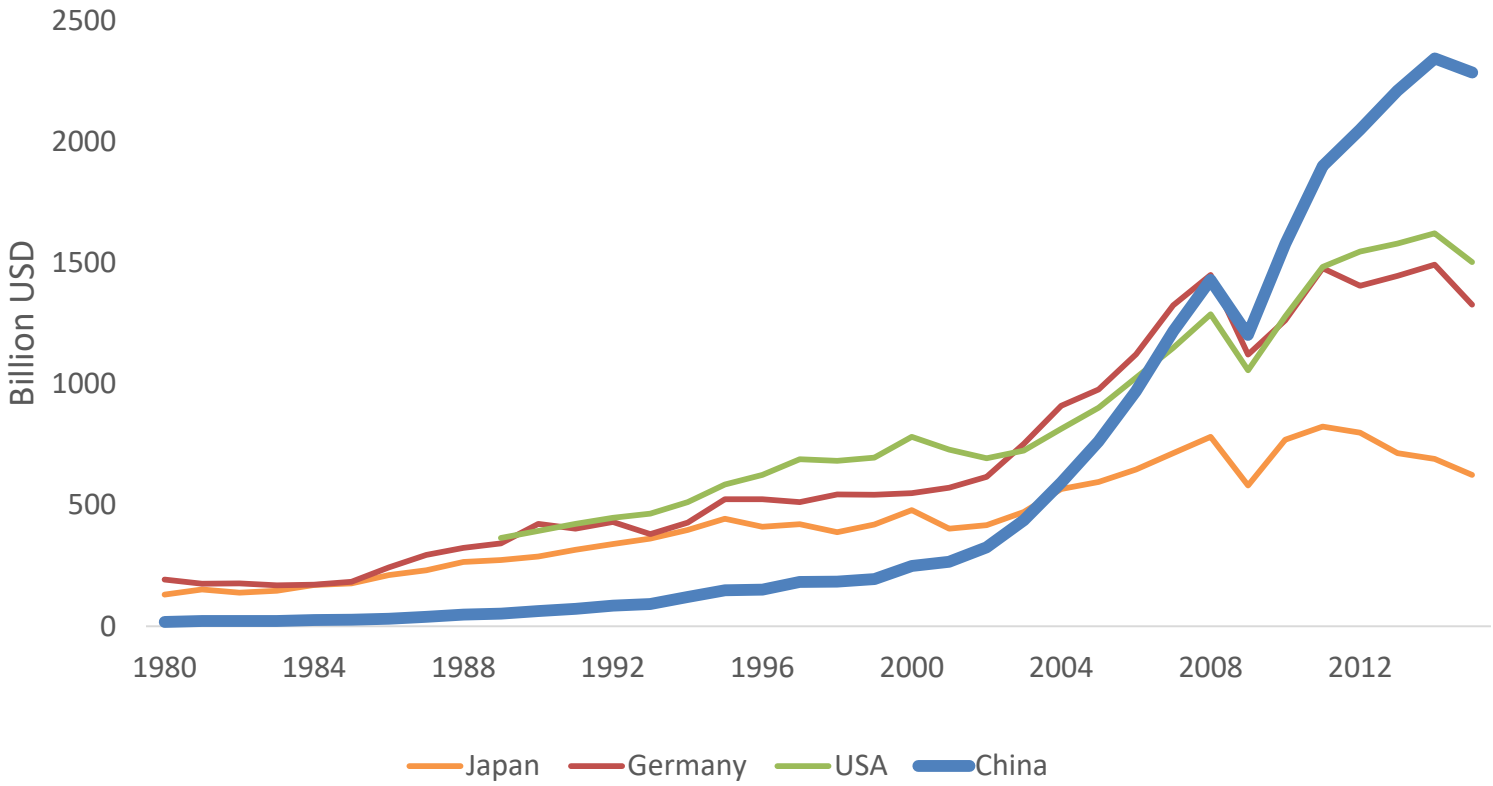
FIGURE I
Trends in Routine and Nonroutine Task Input, 1960 to 1998

Source: Autor, Levy, and Murnane, QJE 2003

Questions

- Why have middle-skill jobs increased relatively faster in China, in contrast to most countries?
- How have following key factors contributed to changing demand for tasks and skills?:
  - Structural change (employment share of tertiary sector increased from 27.5% in 2000 to 40.6% in 2014)
  - Globalization (rapid growth in exports since 2000, 7.5% of urban workers in FDI firms)
  - Technology (58% of urban workers use computers, 40% of manufacturing workers in firms with automation equipment)
  - Education expansion (college share of nonag workers increased from 12.8% in 2000 to 22.1% in 2015)
- What are the implications for sustaining growth and creating high quality jobs in the future?

China's Rapid Growth in Exports…



Source: CEIC (2016). Indicator IDs: 374718297, 374731267, 374365287, 6328701. Retrieved from bit.ly/2eBtRxu

*Although FDI share of investment is not substantial, 7.5% of urban workers work in FDI firms in 2014

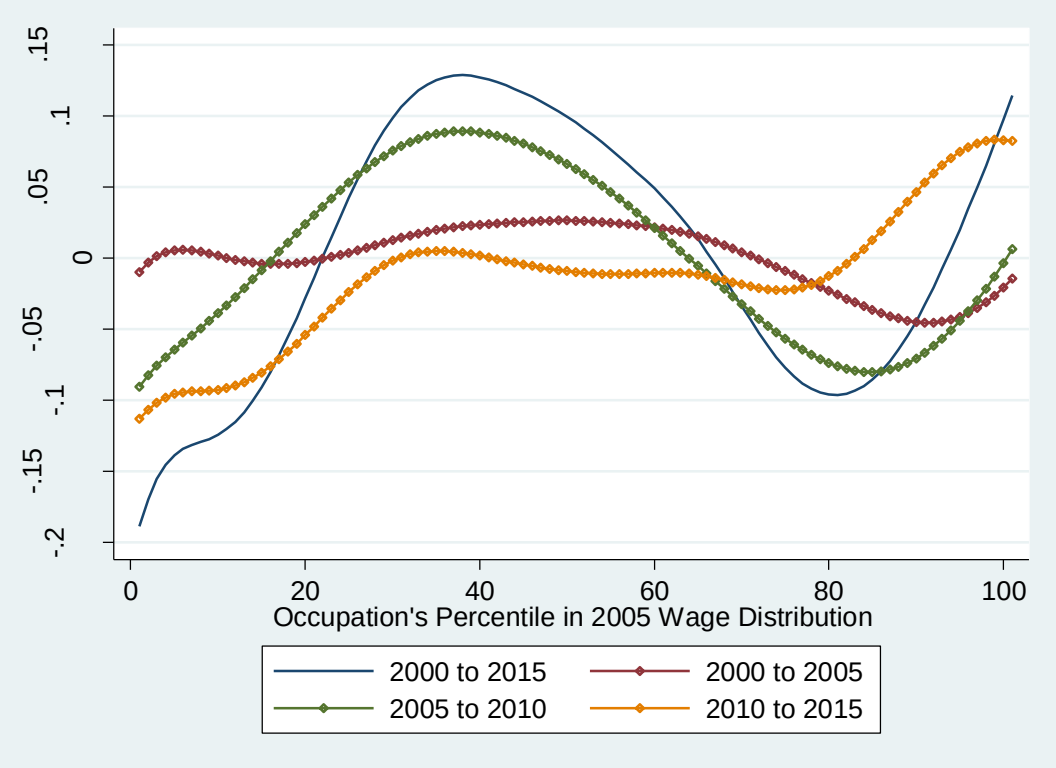
Task Measurement

- Challenge: lack of direct measurements of tasks for China
- Our solutions:
  - Combine census data (2000-2015) and US Department of Labor ONET data on occupational tasks (2003)
    - Assume task demand for occupations in China is same as for US occupations (in 2003) and that task demand for each occupation is fixed over time
    - Enables study of change in task demand due to changing occupational structure, but excludes within-occupation changes in task demand
    - Focus on 50 occupational categories in 2000, 2005, 2010, and 2015
  - New urban labor survey
    - WB Skills Toward Employment and Productivity (STEP) surveys in 12 middle-income and developing countries
    - Added STEP module to China Urban Labor Survey in 6 large cities in 2016 (Shanghai, Fuzhou, Wuhan, Xian, Shenyang, Guangzhou)
    - Enables estimation of China-specific task demands by occupation (and within occupations) and facilitates cross-country comparisons
  - Firm-worker surveys (2015-2016)
    - Linked surveys of manufacturing firms and employees in Guangdong and Hubei
    - Include Princeton Princeton Data Improvement Initiative (PDII) task measures (Autor and Handel)

Findings: Preview

- Census data (constant task content of occupations)
  - Confirm relative increase in routine-task intensive occupations
  - Key driver is structural change: growth in services
  - Skill-intensive occupations and sectors have not grown faster than less skill-intensive sectors
- China Urban Labor Survey (CULS)
  - Significant variation in tasks *within* occupations, especially by education, suggests task demand has changed over time within occupations
  - Positive (and independent) wage returns to education and tasks
- China Employer-Employee Survey (CEES), 2015
  - Consistent with rise of global product chains, FDI firms and export firms specialize in less abstract, more routine tasks
  - Demand for more abstract (less routine) tasks is associated with firm capital intensity, size, and productivity.

Change in Occupational Employment Shares by 2005 Wage Percentile

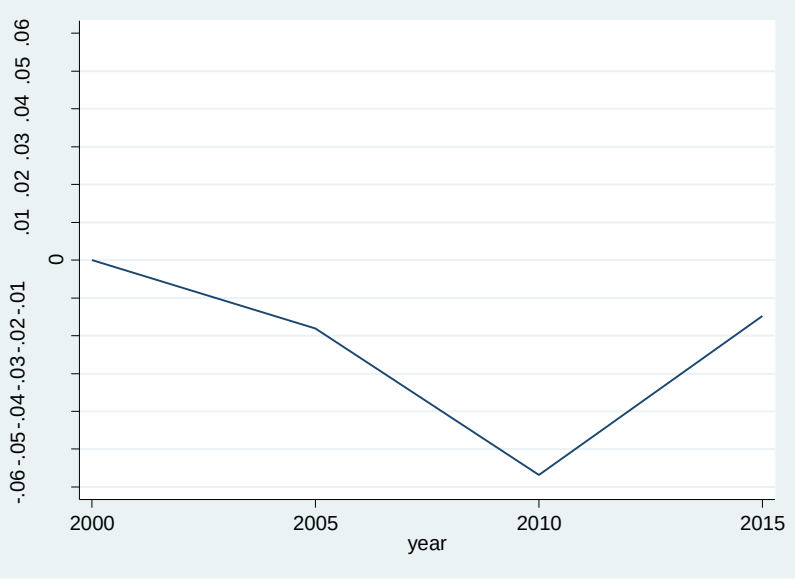


Source:
China census data

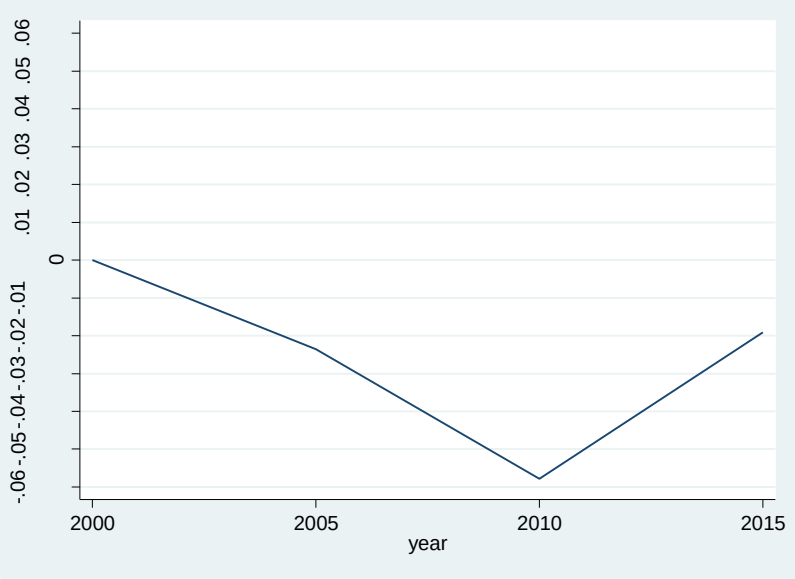
- Confirms faster growth in middle-wage jobs in China
- Changing pattern since 2010

Mean Task Demand by Year

Nonroutine cognitive analytical



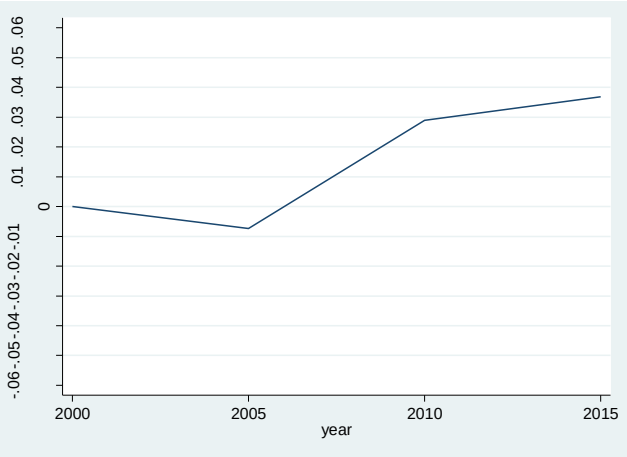
Nonroutine cognitive interactive



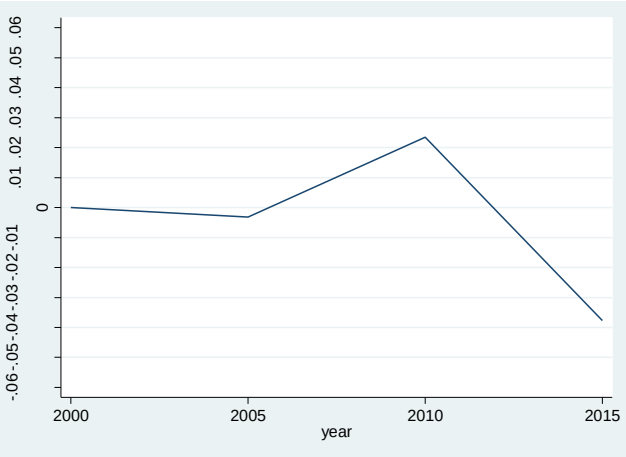
- Abstract task demand has fallen in China
- Changing trend since 2010

Mean Task Demand by Year

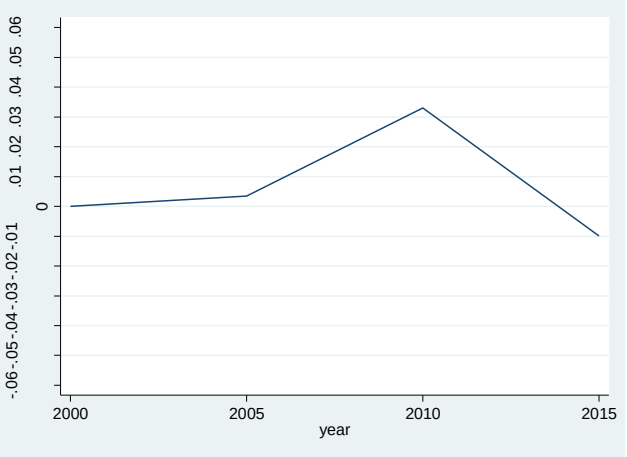
Routine cognitive



Routine manual

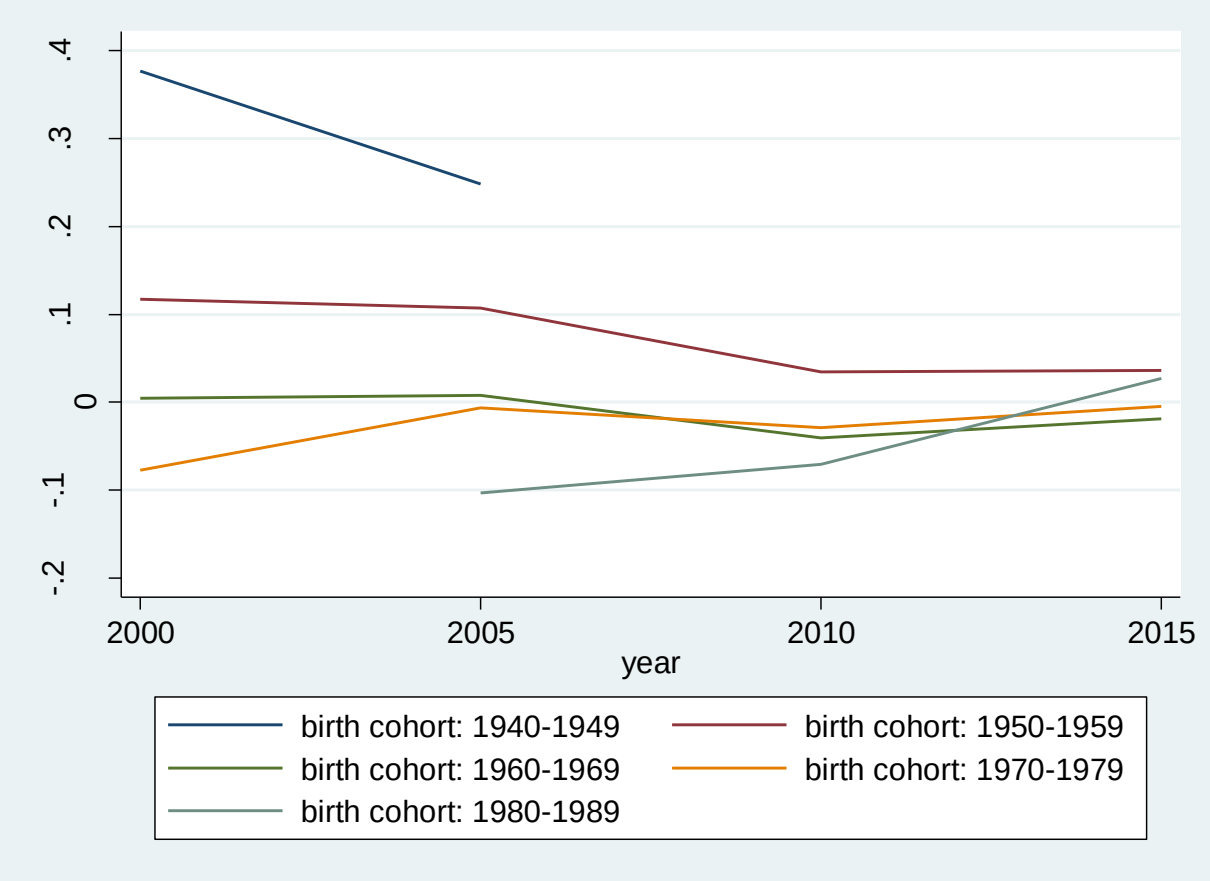


Nonroutine manual



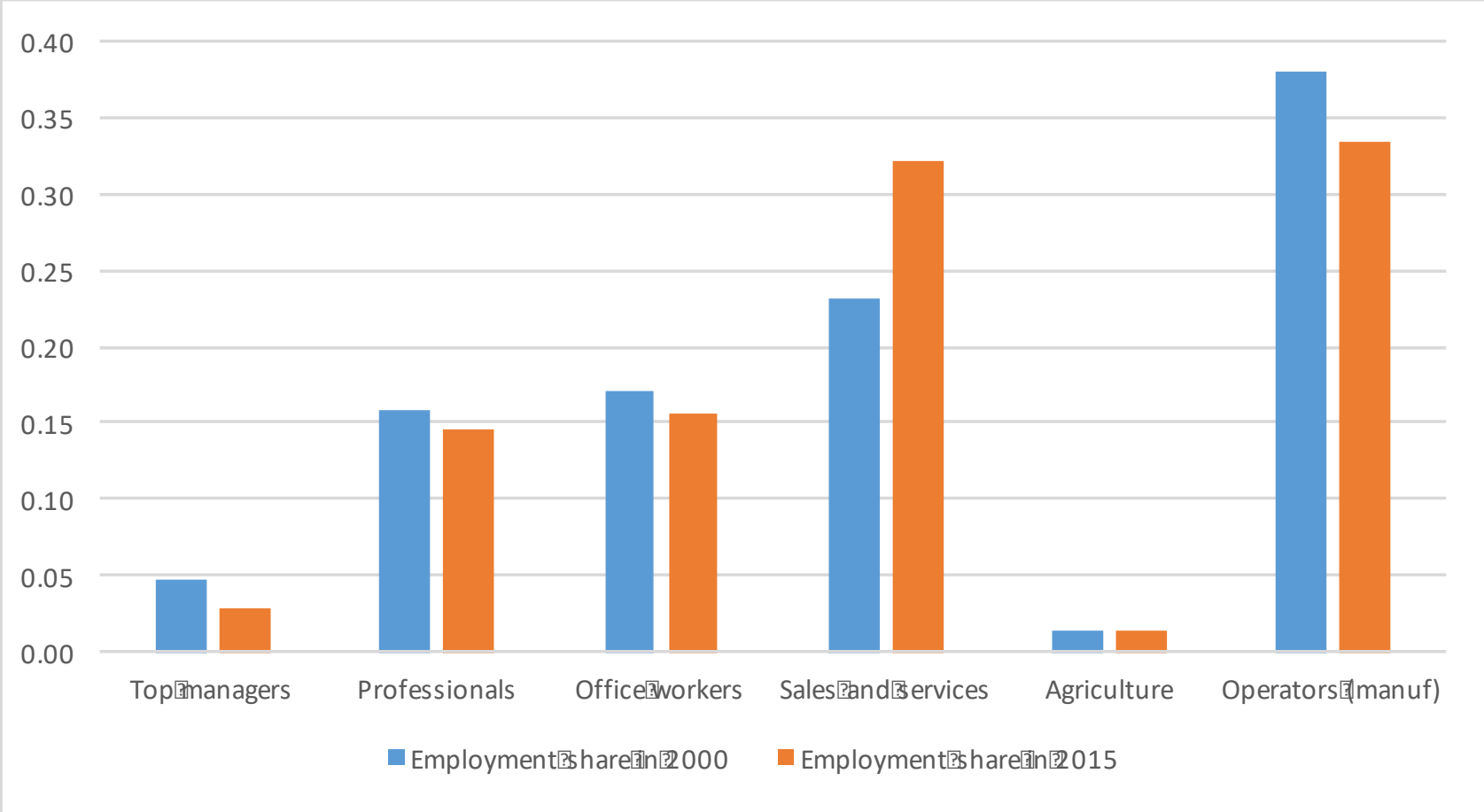
- Increasing demand for routine cognitive tasks
- Falling demand for manual tasks

Nonroutine Cognitive Analytical Tasks by Year by Cohort



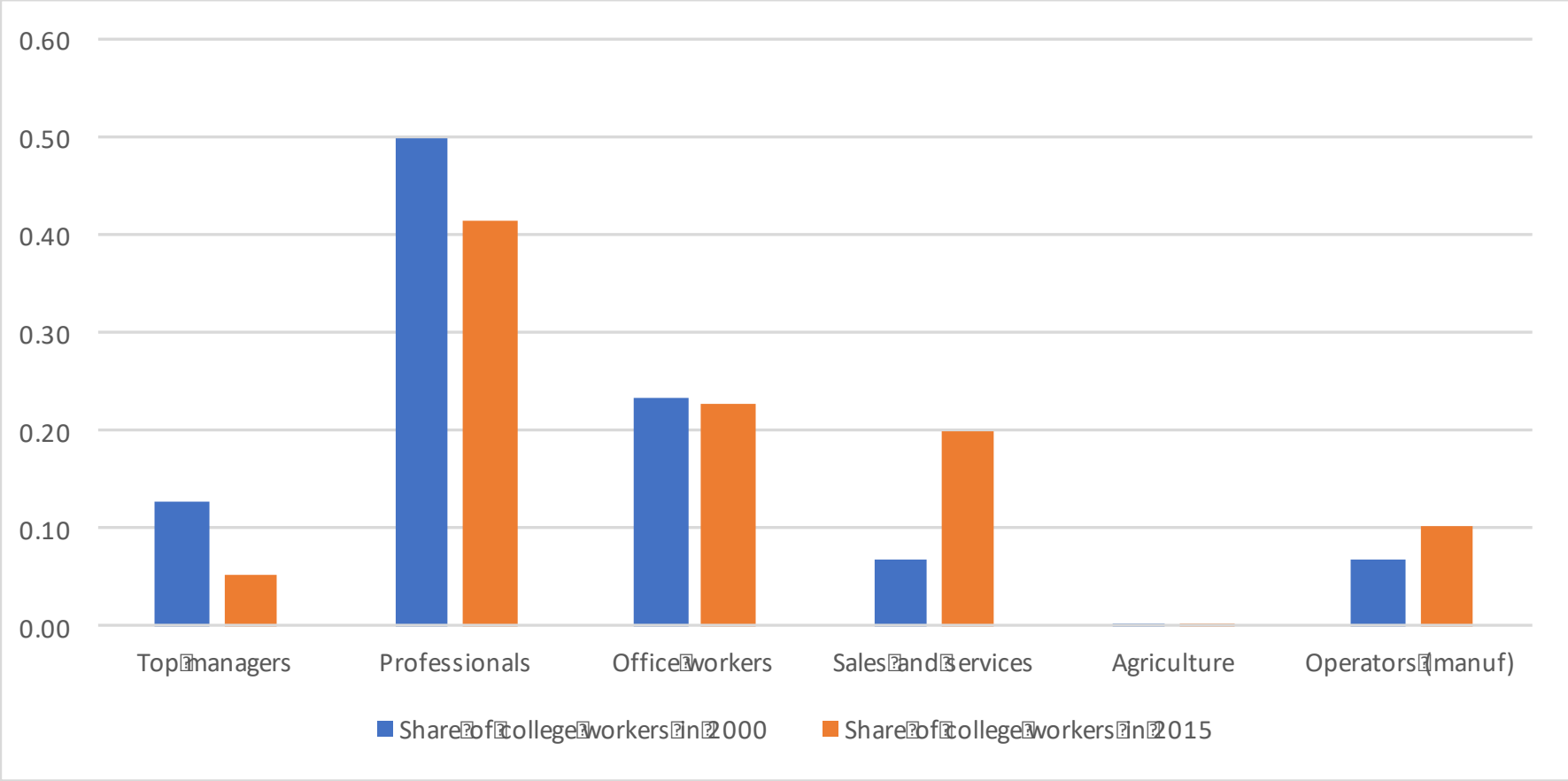
- Demand for abstract tasks declining more for older cohorts, increasing for younger cohorts

Changing Occupational Structure



- Sales and service workers increase, all other occupations decrease

Occupations of college workers



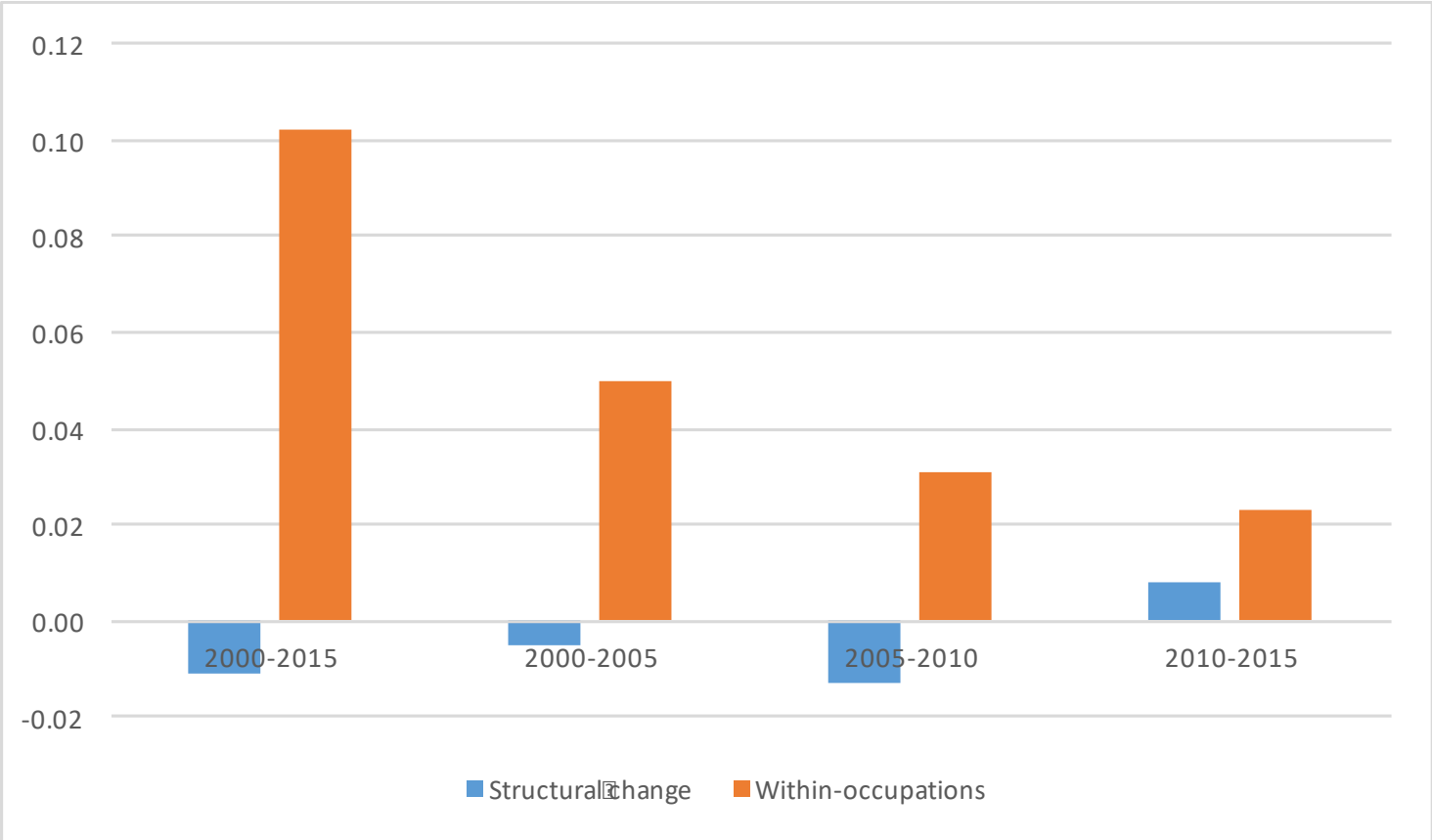
Decomposition of Increase in Relative Demand for Skilled Workers

$$(1) \quad \Delta D_t = \Delta E_t^{services}(D_t^{services} - D_t^{mfg}) + \Delta D_t^{mfg} \cdot E_t^{mfg} + \Delta D_t^{services} \cdot E_t^{services}$$

Where D_t is demand (employment) share of skilled workers within manufacturing or services, and E_t is employment share of services or manufacturing

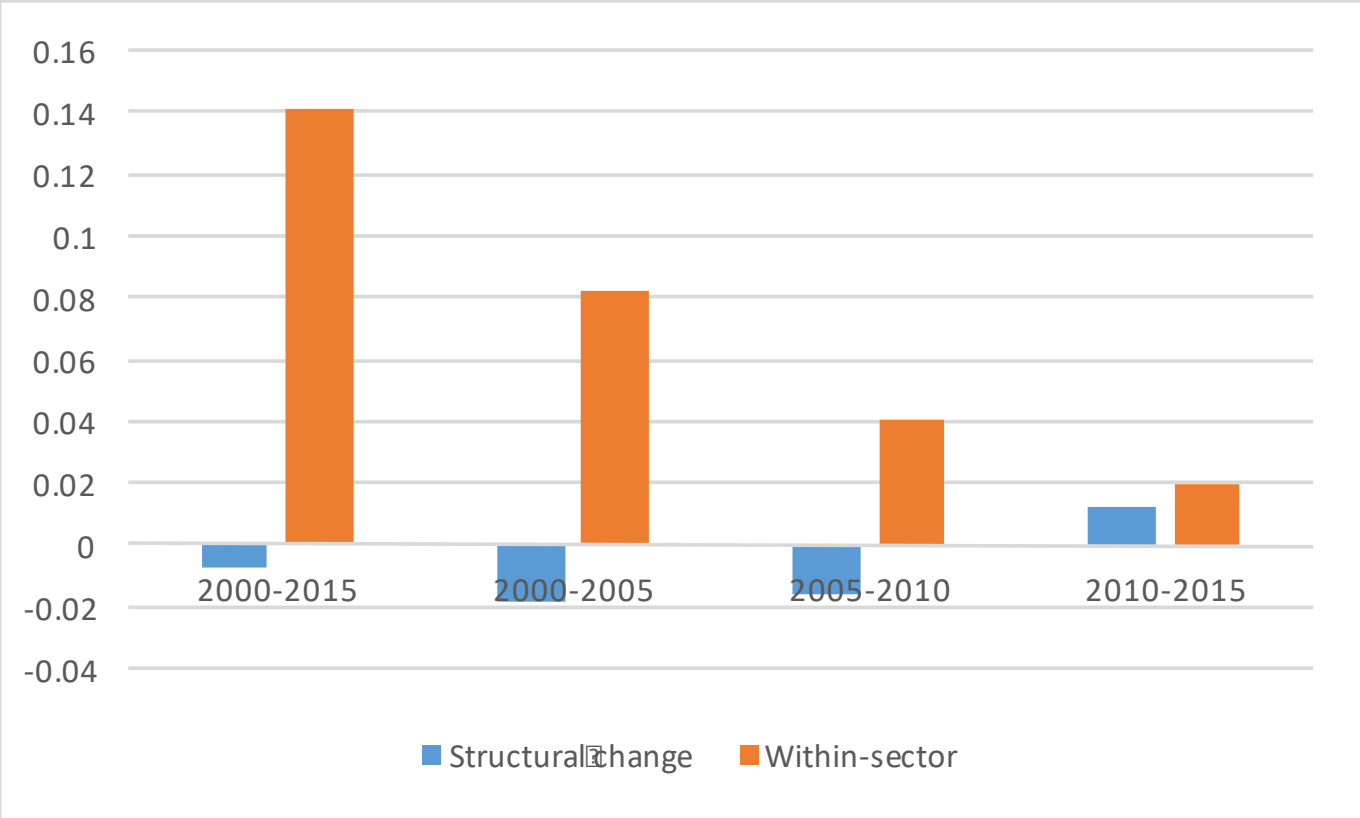
- First term captures reallocation effect of workers across sectors
- Second and third term capture within-sector changes in relative skill demand

How much of the increase in employment of college graduates is due to structural change (growth in high skill occupations) versus within-occupation increases in share of college workers?



- Results similar for major or detailed occupations and for major or detailed sectors

Decomposition of increase demand for college workers in 32 service subsectors



Question: what is expected shares of service subsectors if no restrictiveness?

China Employer Employee Survey

How do firm characteristics influence task demand?

Task Demand Prediction for Foreign Firms

- Foreign firms are more likely to offshore production (via FDI) if tasks are less abstract and more routine
  - Easier to train/supervise production from a distance (Grossman & Rossi-Hansberg, 2008; Oldenski, 2012)
  - Can keep more abstract tasks (strategy, design, marketing) in home country (global value chain
  - But if targeting Chinese consumers, may also be more likely to offshore if face-to-face (less routine) interactions are required (Oldenski, 2012)

Task Demand Prediction for Exporters

- Export-oriented firms may demand less abstract/more routine tasks
  - Require fewer face-to-face interactions with local customers
  - More likely to be part of global value chains in which firm specializes in production with other functions (design, marketing, done outside the country)
- However, exporting firms also tend to be more productive and produce higher quality products (Bernard et al., 2010), so may demand more abstract/less routine tasks
  - In China, however, export *processing* firms have been found to have lower productivity than domestic firms (Dai et al., 2016)

Task Demand: Prediction for Other Variables

- Capital-labor Ratio: capital can be complementary to abstract or routine jobs, depending on the type of capital (e.g., computers enhance productivity of abstract work, machines enhance productivity of routine and manual work)
- Ln(employees): larger firms tend to more complex, with more levels of management, so should demand more abstract/less routine tasks
- Productivity: more productive firms produce higher quality products, so may demand more abstract/less routine tasks

Task Demand: Firm Variables

	(1) Abstract	(2) Rountine	(3) Manual
FDI	-0.123	0.071	0.042
	(0.042)***	(0.044)	(0.044)
SOE	0.120	-0.218	-0.138
	(0.076)	(0.079)***	(0.079)*
Exporter	-0.082	0.065	-0.005
	(0.043)*	(0.044)	(0.044)
Ln(capital/labor)	0.033	-0.038	-0.000
	(0.013)***	(0.013)***	(0.013)
Ln(# of employees)	0.092	-0.020	-0.064
	(0.014)***	(0.014)	(0.014)***
Ln(output/# of employees)	0.046	-0.040	-0.037
	(0.016)***	(0.017)**	(0.017)**
2-digit industries	Yes	Yes	Yes
Observations	3074	3074	3074

Concluding Thoughts

- Structural change (rise of services) has led to an increase in middle skill, routine jobs
  - Structural change only recently contributing to increasing demand for educated workers
  - Priority to address barriers to expanding high-skill, non-routine cognitive occupations and sectors
- Demand for abstract (routine) tasks is lower (higher) for firms with FDI and which export
  - As Chinese manufacturing firms capture larger shares of global value chains, become less export-oriented, more capital-intensive, and more productive, the demand for abstract (routine and manual) tasks will increase (decrease).

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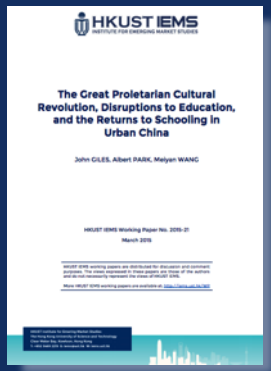

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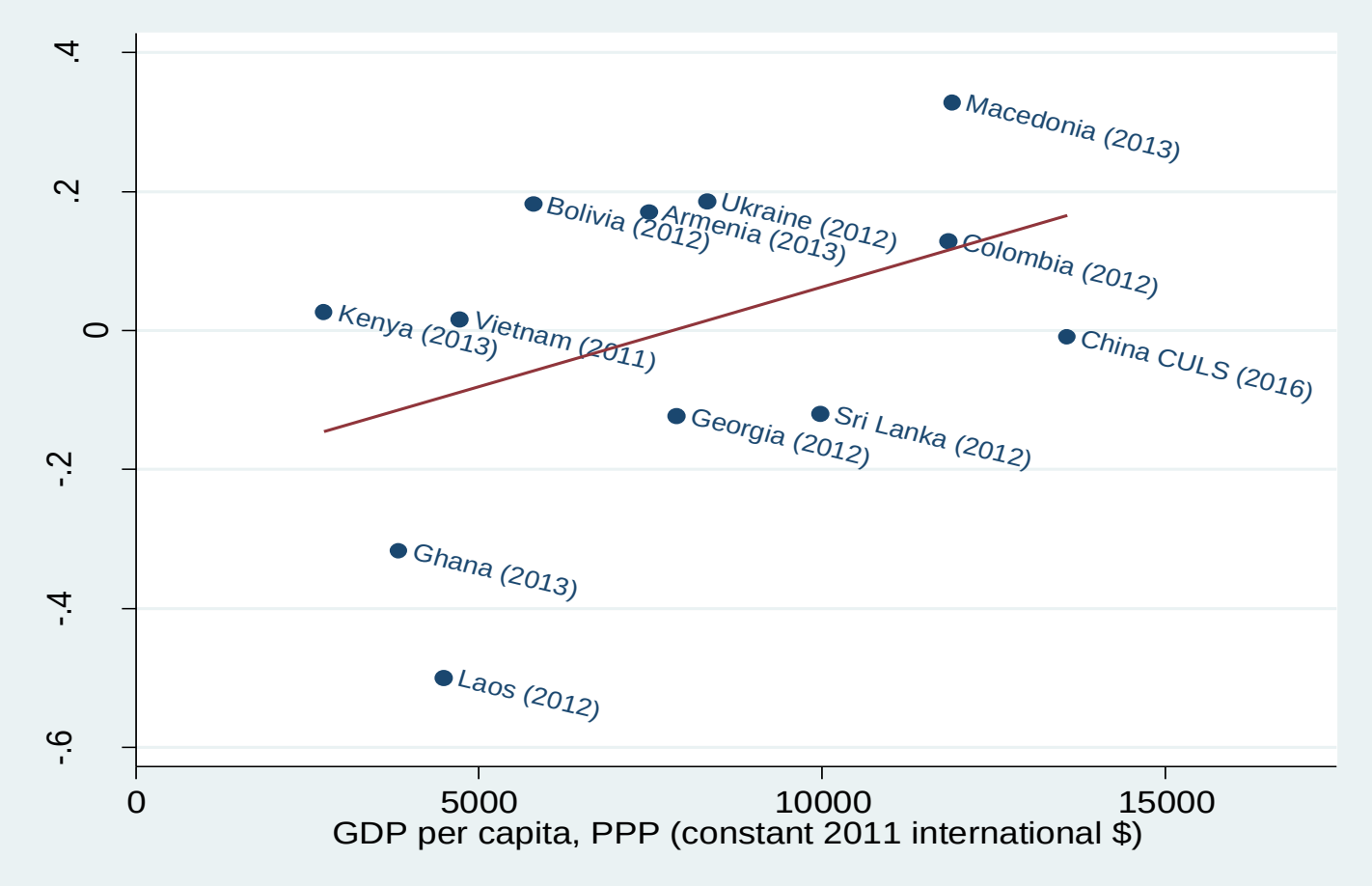
China Urban Labor Survey (STEP module)

How does task demand vary within occupation?

What are the wage returns to tasks and skills?

Cross-country Comparisons: Non-routine Cognitive Analytical Tasks



Wage Regressions

VARIABLES	(1) w1 lnw	(2) w2 lnw	(3) w3 lnw
1.female	-0.182***	-0.227***	-0.171***
	(0.046)	(0.042)	(0.046)
expr	0.021***	0.032***	0.028***
	(0.006)	(0.006)	(0.006)
expr2	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)
tc_nrca	0.227***		0.145***
	(0.035)		(0.039)
tc_nrcp	0.031		0.024
	(0.026)		(0.026)
tc_rc	-0.098***		-0.084***
	(0.024)		(0.024)
tc_man	0.038*		0.050**
	(0.021)		(0.021)
2.edu		0.169***	0.142**
		(0.065)	(0.066)
3.edu		0.558***	0.414***
		(0.068)	(0.078)

Simulating Task Changes (with Occupations)

Year	Non-routine cognitive analytic	Non-routine cognitive interactive	Routine cognitive	Manual
2005	-0.30	-0.12	-0.12	-0.02
2010	-0.03	0.03	-0.05	-0.01
2016	0.00	0.00	0.00	-0.02
2005-2016 decomposition				
Age groups	0.01	0.01	0.01	0.00
City	0.00	-0.02	-0.01	0.02
Education	0.18	0.13	0.08	0.01
Industry	0.00	0.01	0.00	0.00
Male	0.00	0.00	0.00	0.01
Occupation	0.10	0.00	0.05	-0.04

- Based on task demand regressions using CULS data in 2016, we predict task demand i 2010 and 2005 based on covariates of workers in the same cities, then explain how much of the change in task demand is due to changes in different covariates
- Education explains the most, followed by occupation

CULS Task Measurement

Task Measures	*China Analysis*	*Comparative STEP Analysis*
nonroutine cognitive analytic	frequency of learning new knowledge [0-5]	-
	longest materials typically read [0-5]	-
	complexity of mathematics use at work [0-4]	calculate prices or costs [0-1] calculate fractions, decimals or percentages [0-1]
	read bills [0-1]	same as left
	read newspaper [0-1]	same as left
	read reports [0-1]	same as left
	use advanced math [0-1]	same as left
	solve complex problems [1-5]	same as left
	use programming language [0-1]	same as left
nonroutine cognitive interpersonal	use phone [0-1]	-
	interaction with customers [0-10]	same as left
	supervise coworkers [0-1]	same as left
	make presentations [0-1]	same as left
	collaborating with coworkers [1-5]	-
routine cognitive	complexity of mathematics use at work [0-4]	calculate fractions, decimals or percentages [0-1]
	time spent on repetitive work [1-4]	-
	freedom in changing assignment order [1-10]	same as left
	fill form [0-1]	same as left
	read manual [0-1]	same as left
manual	drive vehicle [0-1]	-
	repair electronics [0-1]	-
	operate on heavy machines [0-1]	-
	physical demand [1-10]	same as left

Abstract Task Measurement

from Princeton Data Improvement Initiative survey

Abstract:

1. the length of longest document typically read as part of the job ranging from one page or less to more than 25 pages
2. frequency of mathematics tasks involving high school or higher mathematics (algebra, geometry, trigonometry, probability/statistics, or calculus
3. frequency of problem-solving tasks requiring at least 30 minutes to find a good solution
4. proportion of workday managing or supervising other workers

*All questions have 4-6 response categories. Abstract measure uses the first principal component of the four items, normalized as standard deviations from sample means

Routine and Manual Task Measurement

from Princeton Data Improvement Initiative survey

Routine:

1. proportion of the workday spent performing short, repetitive tasks
2. frequency of face-to-face interactions with customers or clients
3. frequency of face-to-face interactions with suppliers or contractors
4. frequency of face-to-face interactions with students or trainees

Manual:

1. proportion of the workday spent performing physical tasks such as standing, operating machinery or vehicles, or making or fixing things by hand

*All questions have 4-6 response categories. Routine measure uses first principal component of the four items, all measures normalized to be standard deviations from sample means

Task Demand: Worker Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Abstract	Routine	Manual	Abstract	Routine	Manual	Abstract	Routine	Manual
Middle school or less	-0.662	0.705	0.607	-0.397	0.368	0.244	-0.601	0.688	0.558
	(0.035)***	(0.036)***	(0.037)***	(0.036)***	(0.036)***	(0.037)***	(0.036)***	(0.037)***	(0.038)***
College or above	0.387	-0.475	-0.563	0.189	-0.211	-0.310	0.362	-0.506	-0.554
	(0.041)***	(0.042)***	(0.043)***	(0.039)***	(0.039)***	(0.041)***	(0.042)***	(0.043)***	(0.044)***
Female	-0.383	0.239	-0.233	-0.303	0.196	-0.152	-0.373	0.227	-0.214
	(0.031)***	(0.032)***	(0.033)***	(0.031)***	(0.031)***	(0.032)***	(0.031)***	(0.032)***	(0.033)***
Having local hukou	-0.048	-0.037	-0.009	-0.035	0.008	0.056	-0.008	-0.115	-0.166
	(0.033)	(0.033)	(0.034)	(0.030)	(0.030)	(0.032)*	(0.043)	(0.044)***	(0.045)***
Experience	0.048	-0.043	-0.022	0.019	-0.015	-0.008	0.042	-0.048	-0.020
	(0.005)***	(0.006)***	(0.006)***	(0.005)***	(0.005)***	(0.005)	(0.005)***	(0.006)***	(0.006)***
Experience squared/10	-0.013	0.011	0.007	-0.006	0.004	0.004	-0.011	0.011	0.005
	(0.001)***	(0.002)***	(0.002)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.002)***	(0.002)***
Having training	0.244	-0.163	-0.114	0.181	-0.091	-0.065	0.250	-0.179	-0.139
	(0.035)***	(0.036)***	(0.037)***	(0.032)***	(0.033)***	(0.034)*	(0.035)***	(0.036)***	(0.037)***
Occupation	No	No	No	Yes	Yes	Yes	No	No	No
Firm	No	No	No	No	No	No	Yes	Yes	Yes
Observations	3074	3074	3074	3074	3074	3074	3074	3074	3074