

# Computer Use, Productivity, and Implications to Economic Growth in China

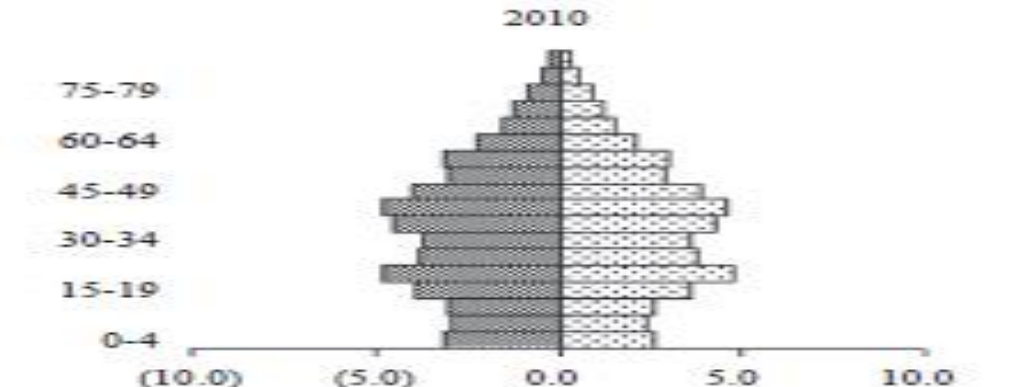
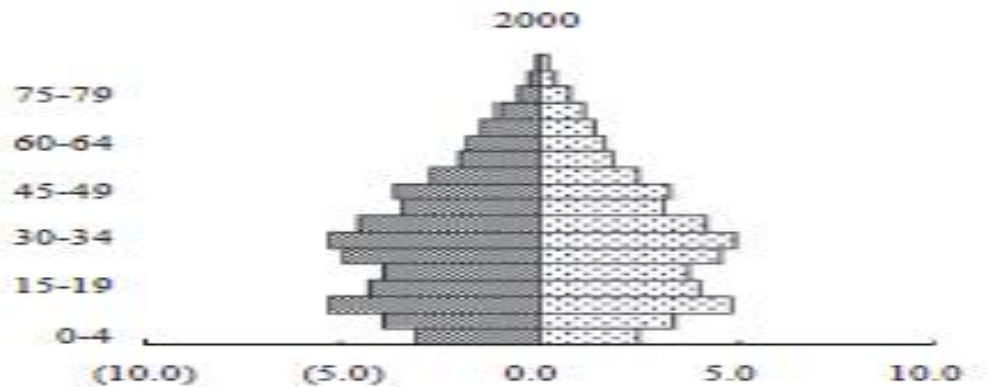
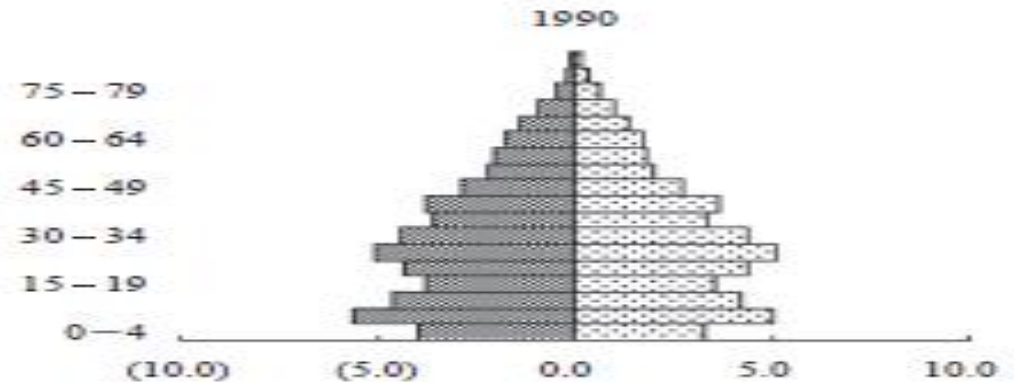
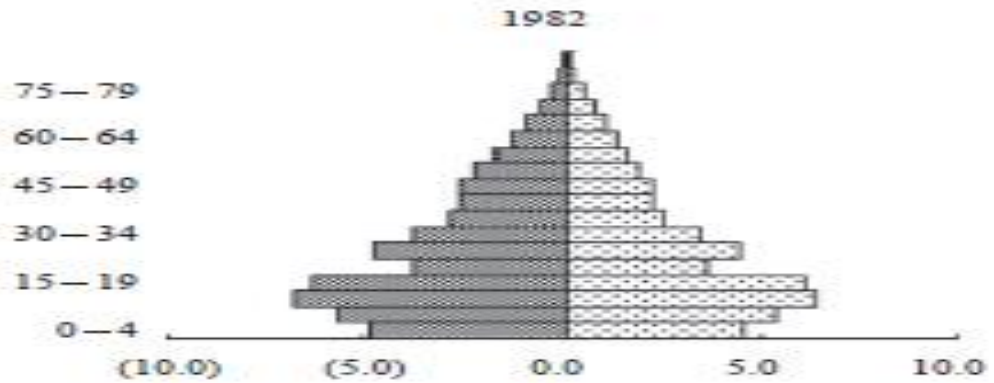
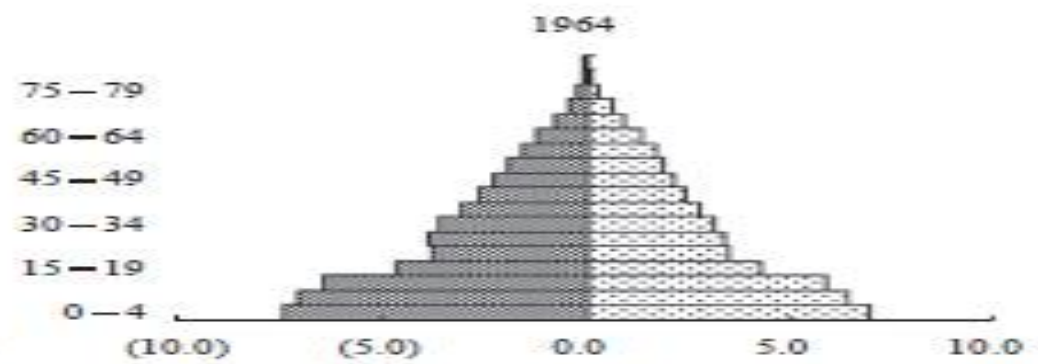
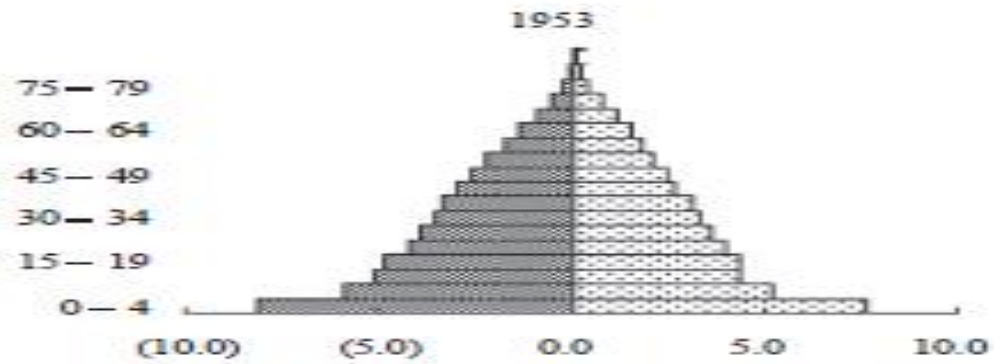
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# Background and Motivations

- China has witnessed quick population ageing: 10.8 percent of population are age 65 or above in 2016 (60+, 16.7%). In the meantime, the working age population started shrinking in 2012
- This demographic trend requires younger cohorts to be more productive to support the growing number of elderly
- In recent years, China has experienced significant economic slowdown and calls for a growth pattern driven by productivity rather than accumulation of production factors that China did before. To achieve this goal the Chinese government has encouraged comprehensive innovations.
- But at micro level, we need to know how the individual productivity is improved

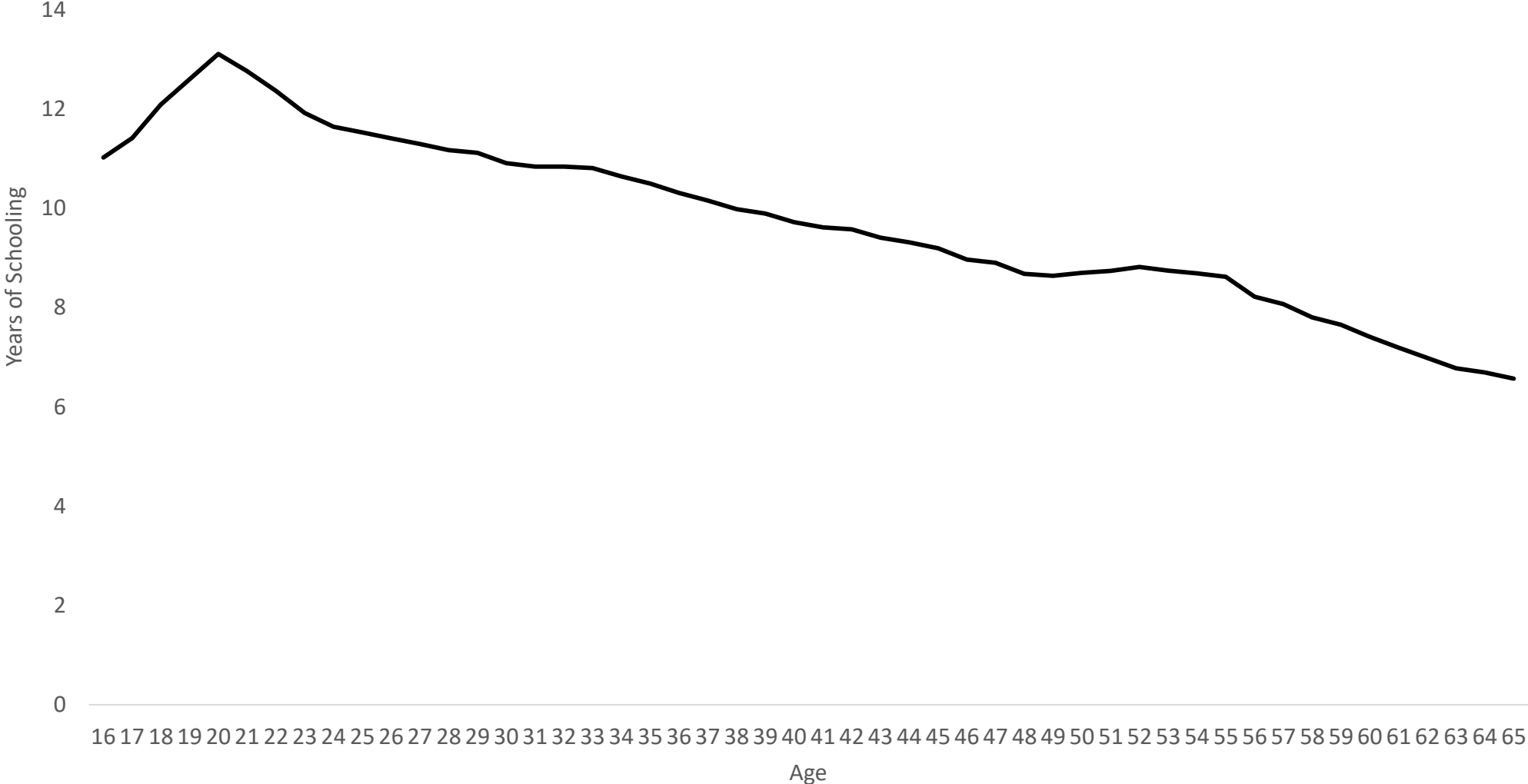
# Quick Demographic Transitions



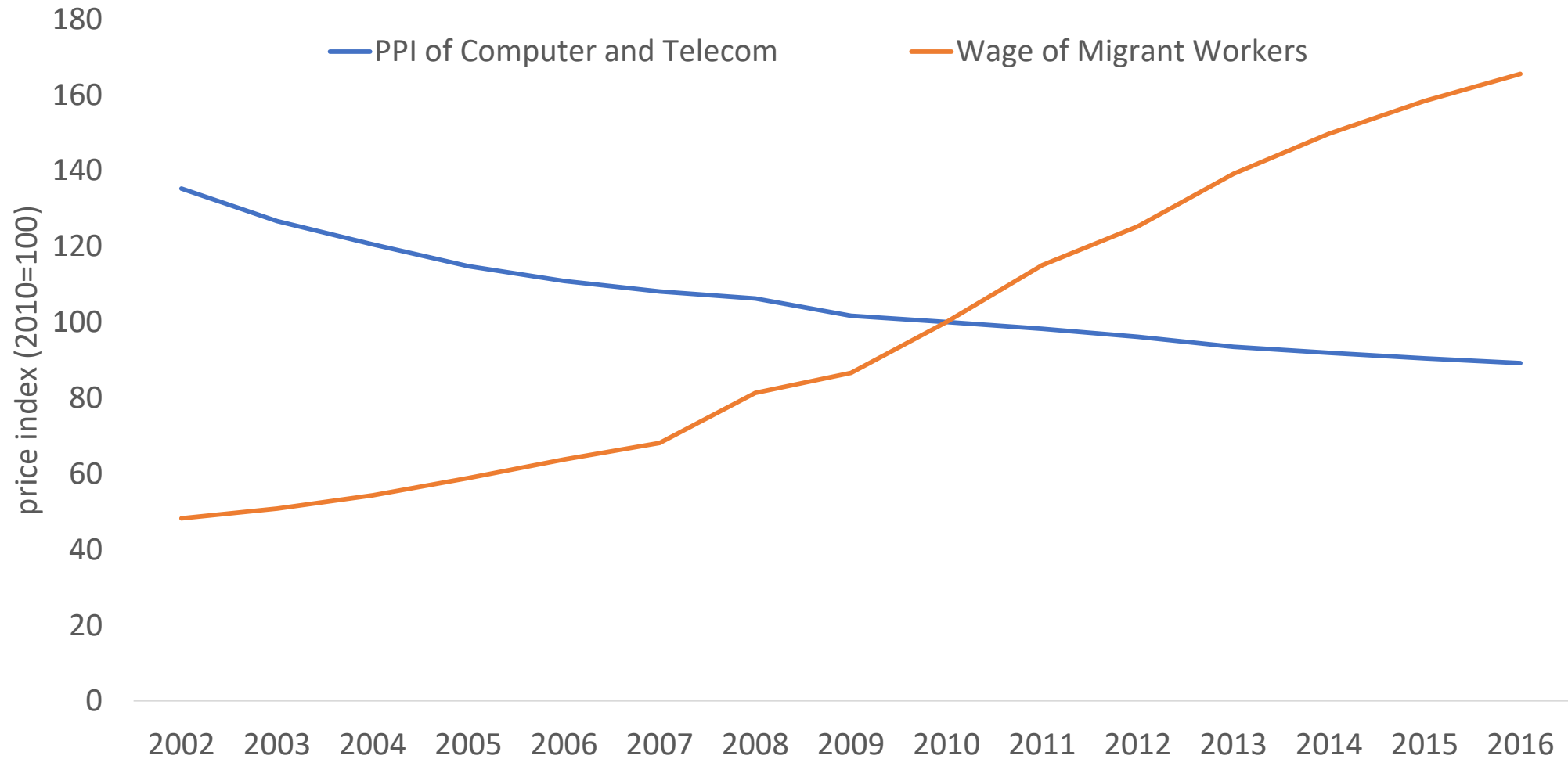
# Labor Shortage and Growing Wages

- In the past decade, the shortage of unskilled workers appeared frequently in China, which results in roaring up wages for migrant workers. From 2006 to 2016, average wages for migrant workers grow 15.7% per annum
- Due to fast growth of wages, the unit labor cost (labor cost per worker/average labor productivity) in China has grown rapidly from 0.149 in 2004 to 0.243 in 2014
- These new changes have comprehensive impacts on growth pattern and competitiveness, which require productivity growth

# Younger Workers have more schooling



# Declining prices of computer and growing wages



# Existing studies on computer use at work

- Krueger (1993) first studies this issue in the US, but his finding is questioned by DiNardo (1997) who argues that even pencil use at work could have return
- Using household survey data from West Germany Spitz-Oener (2008) also finds positive returns to computer use at work. She also points out that the return to pencils is insignificant after controlling for tasks
- Chen and Wu (2008) find similar results using urban household survey data in China, but they could not control for task variables

# China Urban Labor Survey

- The four rounds of China Urban Labor Survey is conducted by the Institute of Population and Labor Economics of CASS with joint inputs from Albert Park and John Giles (the first 3 rounds).
- In 2016, the fourth round of the survey was investigated in Shanghai, Shenyang, Wuhan, Fuzhou, Guangzhou, and Xi'an. The Survey sampled 260 neighborhoods, 2581 migrant households and 3897 local households, including 15448 individuals in total. Sampling weights are used in following analysis.
- In the survey, we asked the question “do you use computer at your current work” for each worker
- We also measure the job tasks for each worker using the STEP module designed by the World Bank



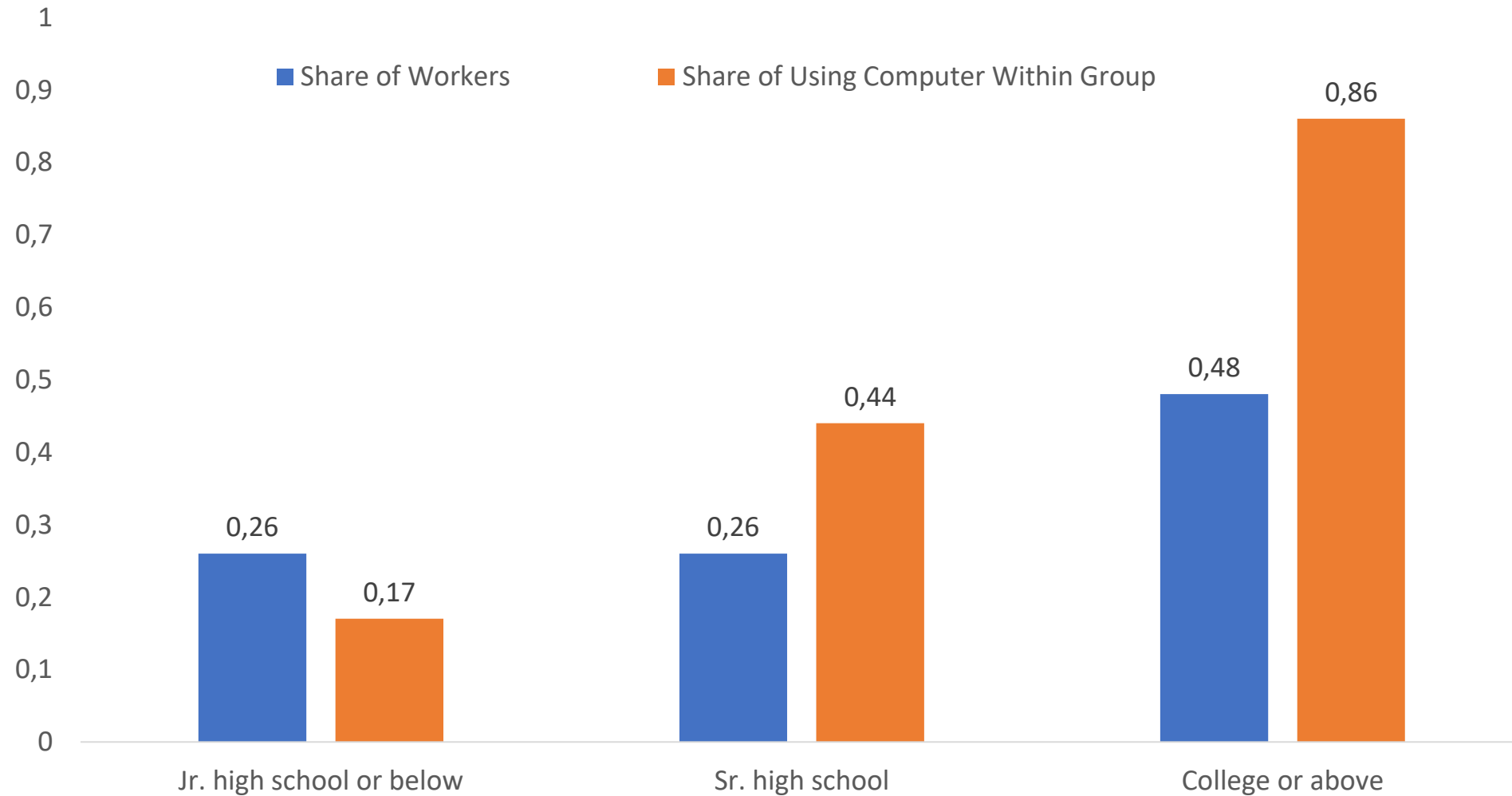
# 57% of workers in our survey use computer at work

|               | Share of Workers | Share of Using Computer<br>Within Group | Monthly Wages<br>(RMB, Yuan) |
|---------------|------------------|---|------------------------------|
| <b>Gender</b> |                  |   |                              |
| Male          | 0.58             | 0.53 (0.50)                             | 6033 (6230)                  |
| Female        | 0.42             | 0.63 (0.48)                             | 4830 (4090)                  |
| <b>Age</b>    |                  |   |                              |
| 16-29         | 0.21             | 0.71 (0.45)                             | 5080 (4050)                  |
| 30-39         | 0.34             | 0.68 (0.47)                             | 6810(6580)                   |
| 40-49         | 0.29             | 0.47 (0.50)                             | 5460(5280)                   |
| 50-59         | 0.16             | 0.36 (0.48)                             | 4820(4650)                   |
| 60+           | 0.01             | 0.43 (0.50)                             | 3220(2710)                   |

# Using Computer at Work: by Occupation

|                    | Share of Workers | Share of Using Computer<br>Within Group | Monthly Wages<br>(RMB, Yuan) |
|--------------------|------------------|---|------------------------------|
| Employers          | 0.04             | 0.90 (0.30)                             | 11.07 (10.38)                |
| Professionals      | 0.19             | 0.89 (0.31)                             | 7.13 (5.34)                  |
| Clerk              | 0.13             | 0.82 (0.39)                             | 4.84 (3.32)                  |
| Service            | 0.52             | 0.43 (0.50)                             | 5.21 (5.47)                  |
| Production Workers | 0.11             | 0.30 (0.46)                             | 4.55 (3.02)                  |

# Who uses computer at work?



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|  | Share of worker using computer | Monthly wages (Yuan) |
|--|--------------------------------|----------------------|
| <b>Non-Routine Cognitive Analytical</b>    |                                |                      |
| Low  | 0.15 (0.36)                    | 3760 (3450)          |
| Medium                                     | 0.59 (0.49)                    | 5160 (4300)          |
| High                                       | 0.93 (0.25)                    | 7920 (6970)          |
| <b>Non-Routine Cognitive Interpersonal</b> |                                |                      |
| Low  | 0.32 (0.47)                    | 4140 (3240)          |
| Medium                                     | 0.59 (0.49)                    | 5000 (4220)          |
| High                                       | 0.87 (0.34)                    | 8160 (7370)          |
| <b>Routine Cognitive</b>                   |                                |                      |
| Low  | 0.31 (0.46)                    | 4610 (4940)          |
| Medium                                     | 0.56 (0.50)                    | 5550 (5090)          |
| High                                       | 0.83 (0.38)                    | 6850 (6070)          |
| <b>Manual</b>                              |                                |                      |
| Low  | 0.63 (0.48)                    | 5590 (5460)          |
| Medium                                     | 0.40 (0.49)                    | 4900 (4270)          |
| High                                       | 0.62 (0.48)                    | 6470 (6190)          |

# The determinants of computer use

- Running a Probit of the determinants of computer use at work, we find the following characteristics of the users.
- Education is an obvious determinant of computer use
- Young workers, aged below 40, have more advantages in computer use
- Workers who implement non-routine cognitive tasks tend to have high share of using computer at work

# The contents of computer use

|  | Share  | SD     |
|--|--------|--------|
| Email  | 0.4659 | 0.4989 |
| Search info on Internet                      | 0.5127 | 0.4999 |
| Data entry                                   | 0.4736 | 0.4993 |
| Processing texts                             | 0.4709 | 0.4992 |
| Tabulation                                   | 0.4533 | 0.4979 |
| Data management                              | 0.1489 | 0.3560 |
| Software package, website design, programing | 0.0547 | 0.2274 |

# Returns to Computer Use at Work: CULS

|                                       | (1)                 | (2)                  | (3)                  |
|---------------------------------------|---------------------|----------------------|----------------------|
| Use computer (never use=0)            | 0.602***<br>(0.024) | 0.225***<br>(0.029)  | 0.138***<br>(0.032)  |
| Sr. high school (Jr. high school=0)   |                     | 0.124***<br>(0.035)  | 0.127***<br>(0.034)  |
| College and above (Jr. high school=0) |                     | 0.374***<br>(0.047)  | 0.328***<br>(0.047)  |
| Experience                            |                     | 0.032***<br>(0.003)  | 0.029***<br>(0.003)  |
| Squared term of experience            |                     | -0.001***<br>(0.000) | -0.001***<br>(0.000) |
| Gender (male=0)                       |                     | -0.181***<br>(0.024) | -0.155***<br>(0.024) |
| Shanghai (Shenyang=0)                 |                     | 0.583***<br>(0.042)  | 0.549***<br>(0.042)  |
| Fuzhou (Shenyang=0)                   |                     | 0.321***             | 0.287***             |

# The returns to computer use (cont.)

|                                     | (1)   | (2)                 | (3)                  |
|-------------------------------------|-------|---------------------|----------------------|
| Wuhan (Shenyang=0)                  |       | 0.062<br>(0.043)    | 0.051<br>(0.043)     |
| Guangzhou (Shenyang=0)              |       | 0.376***<br>(0.043) | 0.349***<br>(0.043)  |
| Xian (Shenyang=0)                   |       | 0.054<br>(0.043)    | 0.031<br>(0.042)     |
| Non-Routine Cognitive Analytical    |       |                     | 0.625***<br>(0.089)  |
| Non-Routine Cognitive Interpersonal |       |                     | 0.153***<br>(0.059)  |
| Routine Cognitive                   |       |                     | -0.412***<br>(0.077) |
| Manual                              |       |                     | -0.014<br>(0.069)    |
| No. obs                             | 7,126 | 7,126               | 7,126                |



# Computer use at home

|                               | (1)                 | (2)                 | Share      |
|-------------------------------|---------------------|---------------------|------------|
| Computer use at work          | 0.387***<br>(0.064) | 0.117*<br>(0.064)   | 0.575<br>- |
| Computer use at home          | 0.305***<br>(0.038) | 0.122***<br>(0.036) | 0.853<br>- |
| Computer use at work and home | 0.158**<br>(0.070)  | 0.017<br>(0.068)    | 0.544<br>- |
| Other control var             | No                  | Yes                 | -          |
| No. of obs                    | 7126                | 7126                | -          |
| R <sup>2</sup>                | 0.146               | 0.337               | -          |

# Returns to Computer Use at Work: CEEES

|                            | (1)      | (2)      | (3)      | (4)      |
|----------------------------|----------|----------|----------|----------|
| Computer use at work       | 0.409*** | 0.206*** | 0.107*** | 0.053*** |
|                            | (0.010)  | (0.011)  | (0.012)  | (0.012)  |
| Individual characteristics | No       | Yes      | Yes      | Yes      |
| Firm characteristics       | No       | No       | Yes      | Yes      |
| Occupations                | No       | No       | No       | Yes      |
| Industries                 | No       | No       | No       | Yes      |
| Cities                     | No       | Yes      | Yes      | Yes      |
| No. of Obs                 | 11,470   | 11,470   | 11,470   | 11,470   |
| R <sup>2</sup>             | 0.117    | 0.261    | 0.296    | 0.305    |

# Returns to Computer Use at Work: CEEES

| Dept var: Log of hourly wages   | (1)                 | (2)                 | (3)                 | (4)                 |
|---|---------------------|---------------------|---------------------|---------------------|
| Internet, data entry, or word   | 0.214***<br>(0.019) | 0.098***<br>(0.018) | 0.039**<br>(0.018)  | 0.003<br>(0.018)    |
| Operation of assembly lines, electronic sheets,<br>intranet, or processing on-line orders | 0.400***<br>(0.011) | 0.211***<br>(0.012) | 0.107***<br>(0.013) | 0.055***<br>(0.013) |
| Data management, programing,<br>or using specialized software                             | 0.498***<br>(0.014) | 0.270***<br>(0.015) | 0.170***<br>(0.015) | 0.109***<br>(0.016) |
| Individual characteristics  | No                  | Yes                 | Yes                 | Yes                 |
| Firm characteristics  | No                  | No                  | Yes                 | Yes                 |
| Occupation  | No                  | No                  | Yes                 | Yes                 |
| Sub-sectors   | No                  | No                  | Yes                 | Yes                 |
| Cities  | No                  | Yes                 | Yes                 | Yes                 |
| Tasks   | No                  | No                  | No                  | Yes                 |
| Observations  | 11,470              | 11,470              | 11,470              | 11,470              |
| R-squared   | 0.138               | 0.292               | 0.345               | 0.355               |

# Conclusion

- Using different data sources recently collected in China, this paper finds that workers using computer at work can get 12-15% of premium in wages even controlling for typical wage determinants and tasks assigned to workers
- As a proxy for technology progress, the results imply that computer use and the other technology attached to computer could improve the individual labor productivity
- Our empirical evidence also shows that young and educated workers have advantages in computer use, which may facilitate China to deal with the challenges with ageing
- Although the household data show that most workers use simple functions of computer, the firm survey indicates that operation of more complicated function may get high returns, in particular combining computer with other technologies