

Digital Divide or Digital Welfare?

The Role of the Internet in Shaping the Sustainable Employability of Chinese Adults

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ABSTRACT

With the widespread use of the internet, exploring how it will influence the labor market is of great significance. Based on the 2010-2018 China Family Panel Studies dataset, this paper investigates the effect of the internet on sustainable employability among Chinese aged 16-60. The empirical results of the panel double-hurdle model show that the internet can significantly enhance an individual's competitiveness in the labor market. Moreover, the heterogeneity tests show that the middle aged and older adults, freelancers, and those living in disadvantaged regions can benefit more on employability brought about by the internet. The authors define this phenomenon as the information welfare of the internet, which has narrowed the digital gap caused by the uneven development of technology among different social groups. In addition, the positive coefficient associated with internet use is driven by higher skill requirements in specific workplaces. The authors further explored the role workplace computerization has had in this process.

KEYWORDS

Digital Economy, Internet, Skill Requirements, Sustainable Employability

1. INTRODUCTION

Digital technologies are rapidly transforming society, much of it driven by low-cost computing, the internet, and mobile connectivity. The large-scale and irreversible techno-economic transformation that has been occurring in China in recent decades is multifaceted. It thus provides an interesting case study for exploring the impact of Internet use in the context of a developing non-western environment. Up to June 30, 2018, the number of Chinese netizens reached 802 million, and the Internet penetration rate was 57.7 percent among its population (China Internet Network Information Center, 2018). Combined with the use of other Information and Communication Technologies (ICTs) such as personal computers and mobile devices, the rapid growth of Internet use in China may have a significant impact on the labor market.

Understanding the interplay between Internet technology and the labor market is important for evaluating whether additional scarce government resources should be allocated to expanding access

DOI: 10.4018/JGIM.20210901.aa2

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to digital infrastructure. It is noteworthy that Internet access in rural and isolated areas is still too slow and expensive to be effectively used. Until 2018, Chinese urban netizens accounted for 72.7 percent of the urban population, while rural netizens accounted for only 36.5 percent. The digital gap between those people who have internet access and those who do not will need to be further investigated.

This paper contributes to three strands in the literature: the one that studies the impact of Internet technology on employment rate, the one on job polarization and wage inequality, and the one on sustainable employability. We describe its relation to these pieces of literature in turn briefly.

Firstly, recent theoretical literature has studied the impact of Internet use on the labor market, motivated by the economic consequences of underemployment. Within this literature, Atasoy (2013) explores the impact of the expansion of broadband Internet access from 1999 to 2007 on employment rate throughout the United States and finds that Internet access is associated with a 1.8 percentage point increase in the employment rate. Some other cross-sectional studies have shown that there are some measurable effects on productivity and efficiency (Goldfarb & Tucker, 2017), but the more critical long-run effects are beyond measurement.

Secondly, a rich literature has emphasized positive or negative effects of the digitalization of information or other forms of skill-biased technical change on wage distribution (Autor et al., 2013; Acemoglu et al., 2016), but little has been examined at an individual level. Numerous studies have attempted to explain the impact of the digital economy on job polarization (Collard-Wexler et al., 2015). None of these papers embed the analysis of the impact of technology on the labor market in a model of sustainable employability. Thus none of them delivers implications for expanding access to digital infrastructure or for enabling and incentivizing lifelong learning, which is a focus of this paper.

Finally, up to now, previous studies on human capital usually apply education or other traditional measures to assess the skill level of employees. However, in the current trend of the digital economy, dynamic factors are essential in measuring an individual's capability, and additional effort should be devoted to analyzing those factors. The notion of employability and sustainable career provides relevant research frameworks to us, and these works have received increasing attention in scientific journals (e.g., Van der Heijde & Van der Heijden, 2006; Anseel, 2017). Our measurement of sustainable employability is consistent with theirs. However, among these works, no attempt has been made yet to examine the effect of external environment changes such as broadband network technology on employability, which is a major focus of our paper.

Digital technology can both provide opportunities and accentuate inequality. In order to understand the social and economic consequences brought about by broadband Internet, we need to understand the differences in professional skill accumulation between individuals, as well as their attitudes to changes in the workplace. In this contribution, we investigate the impact of Internet use on the labor market at the individual level, which are the most basic yet essential study units and targets of the current research.

Nevertheless, to investigate the relationship between internet use and sustainable employability, we do need to elaborate on what constructs sustainable employability. Our follow-up discussions are primarily about two aspects:

1. We construct a basic analysis framework based on a reliable and valid instrument with a five-dimensional conceptualization of sustainable employability. Furthermore, we perform a systematic evaluation of sustainable employability, which involves measuring change over time for individuals within the population.
2. We apply a panel double-hurdle method with 41,840 observations from China to predict the economic impact of Internet use on the labor market. The main findings are that Internet use generally gives rise to positive associations with sustainable employability. This association also exists within specific groups classified by age, workplace, and enterprise ownership. In addition, we take unobserved heterogeneity into account and use instrumental variable techniques to

question the causality between Internet use and sustainable employability, which constitutes an important step toward a fuller understanding of Internet use's impact on sustainable employability.

The remainder of this paper is structured as follows: after reviewing the relevant prior literature, we outline the framework of sustainable employability and methodologies, and then we conduct a panel double-hurdle model and report the estimation results beginning with descriptive statistics. Finally, we discuss the potential endogeneity associated with Internet use and then conclude the paper.

2. FRAME AND MEASUREMENT OF SUSTAINABLE EMPLOYABILITY

Consistent with the concept of human capital, measured by the output an employee with a specific skill set can make (Schultz, 1968), the framework of sustainable employability is founded on the idea that continuous learning and skill development all lead to better performance or more output in a climate of constant change and uncertainty. It is worth noting that sustainable employability is not a set of skills but a series of dynamic self-improvements (Lee, 2005). Adapting to the digital economy would involve continuous self-improvement and movement towards initiative, creativity and competencies in the world of work (Spitz, 2004).

In other words, human capital is the body of human knowledge that contributes 'know-how' to productive activity, whereas sustainable employability is a management philosophy and tends to be more concerned with the capability of being continued with long-term employment. Forrier & Sels (2003) provides a valuable insight into sustainable employability and defines it as the ability to maintain employment and to meet new job requirements, such as make transitions between roles within the same organization. Berntson et al. (2008) point out the importance of embedding key competencies based on an understanding of the current changing job market. Van der Heijde & Van der Heijden (2006) present an extensive analysis of sustainable employability and emphasize the importance of continuously fulfilling, acquiring or creating of work through the optimal use of efforts.

2.1 Scale Construction

A multidimensional measure of sustainable employability has critical empirical implications. It also allows us to see the potentially different effects of being over- or underqualified along different dimensions, and we show that there are significant qualitative differences. Among relevant literature, approaches differ in terms of measurement and interpretation of employability. Berntson et al. (2008) differentiates employability into actual employability and perceived employability with objective and subjective indicators, respectively. Le et al. (2017) provide a more substantial and dynamic approach.

In our sustainable employability measurement, we identified five components thought to define sustainable employability that could be operationalized in the CFPS data. Multiple variables were used to construct these components:

- **Domain-specific occupational expertise:** Work performance (able to do things as well as most others); comprehension capability (ability to provide information comprehensible); quality of skills overall.
- **Anticipation and optimization:** Personal flexibility or attitude to changes; training or continuing education supposed to have; certificates related to personal working abilities; non-official education, e.g., tutoring class.
- **Self-efficacy:** Promotion opportunity (technique or management promotion); subjective career success (how satisfied with work); financial success; hierarchical success.
- **Corporate sense:** Share experience/knowledge; cultivate relationships with colleagues.
- **Balance:** Work-relaxation balance; work-related stress, e.g., feel that everything is difficult or feel agitated/upset; efforts are getting back in return; life satisfaction.

2.2 A Validity Survey

We conducted a small content validity survey to assess them in identifying potential variables to be used in our scale of sustainable employability. The evaluators included Professor Vander Heijden from Radboud University Nijmegen and other reviews with extensive experience in measuring employability. We collected comments and suggestions about the variables to be used and the scoring assignment for each variable.

2.3 Scale Scoring

With no reason to justify weighting specific components more heavily than others, we performed a global principal component analysis (GPCA) of the 18 components and used the factor weights as multipliers for each component. GPCA is sensitive to the relative scaling of the original variables. Hence, we recode the responses in the CFPS database into a 5-point scale from 1 to 5. Then, we assessed dimensionality by the number of variables with eigenvalues exceed 1 with a scree plot. Scoring algorithms within these components were developed based on an orthogonal transformation to convert our original variables into a set of values of linearly uncorrelated components. Evidenced by a high eigenvalue of one factor in the exploratory factor analysis, dimensionality of the transformed panel data is reduced. We also assessed the shared covariance (the internal consistency of the scale) among the scale components by Cronbach's alpha.

3. METHODOLOGY

3.1 The Panel Double-Hurdle Model

The panel double-hurdle model setting embodies the idea that an individual's sustainable employability is the result of two processes: the first hurdle, determining whether the individual is a zero type (a person who is unable to find a job, especially one that suits his/her skill set), and the second hurdle, determining the extent of sustainable employability given that the individual is not a zero type (has a job). Moreover, in the framework of the panel double-hurdle model, the zero censoring assumed in the second hurdle allows mixtures of zeros and positive observations for a given individual. In other words, if an individual passes or falls the first hurdle in time t , his or her outcomes are unnecessarily to be positive or zero in every period. Based on this framework, the two hurdles are defined as follows:

First hurdle: Individuals are observed at multiple points in time t . Their choices to have a job (being employed) or not to have a job (being unemployed) are determined by the latent variable job_i^* , which is assumed to be time invariant:

$$job_i^* = Z_i' \alpha + \varepsilon_{1,i} \quad (1)$$

$$\varepsilon_{1,i} \sim N(0,1) \quad (2)$$

An individual must cross the first hurdle to be a potential contributor. The first hurdle is represented by equation (3):

$$job_i = \begin{cases} job_i^* & \text{if } job_i^* > 0 \\ 0 & \text{if } job_i^* \leq 0 \end{cases} \quad (3)$$

Second hurdle: We denote $employability_{it}$ as the sustainable employability of individual i in time t . In the linear equation (4), the dependent variable $employability_{it}^{**}$ is another latent variable, representing the unobserved sustainable employability of individual i :

$$employability_{it}^{**} = X_{it}'\beta + \mu_i + \varepsilon_{2,it} \quad (4)$$

The desired sustainable employability is assumed to be a linear function of the observed individual and occupational characteristics contained in the vector X_{it} , plus a normally distributed random error $\varepsilon_{2,it}$:

$$employability_{it}^* = \max(employability_{it}^{**}, 0) \quad (5)$$

$$\begin{pmatrix} \varepsilon_{1,i} \\ \mu_i \\ \varepsilon_{2,it} \end{pmatrix} \sim N \left[\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho\sigma_\mu & 0 \\ \rho\sigma_\mu & \sigma_\mu^2 & 0 \\ 0 & 0 & \sigma^2 \end{pmatrix} \right] \quad (6)$$

$$corr(\varepsilon_1, \mu) = \rho \quad (7)$$

The second hurdle closely resembles a Tobit model. The censoring rule in equation (5) shows the relationship between actual employability and its contributions to observed values. The vital feature of $employability_{it}^{**}$ is that it can be continuous. If an individual does not have a job, the individual would be constrained to contribute zero; if an individual has a job, this amount will be his or her actual observed contribution.

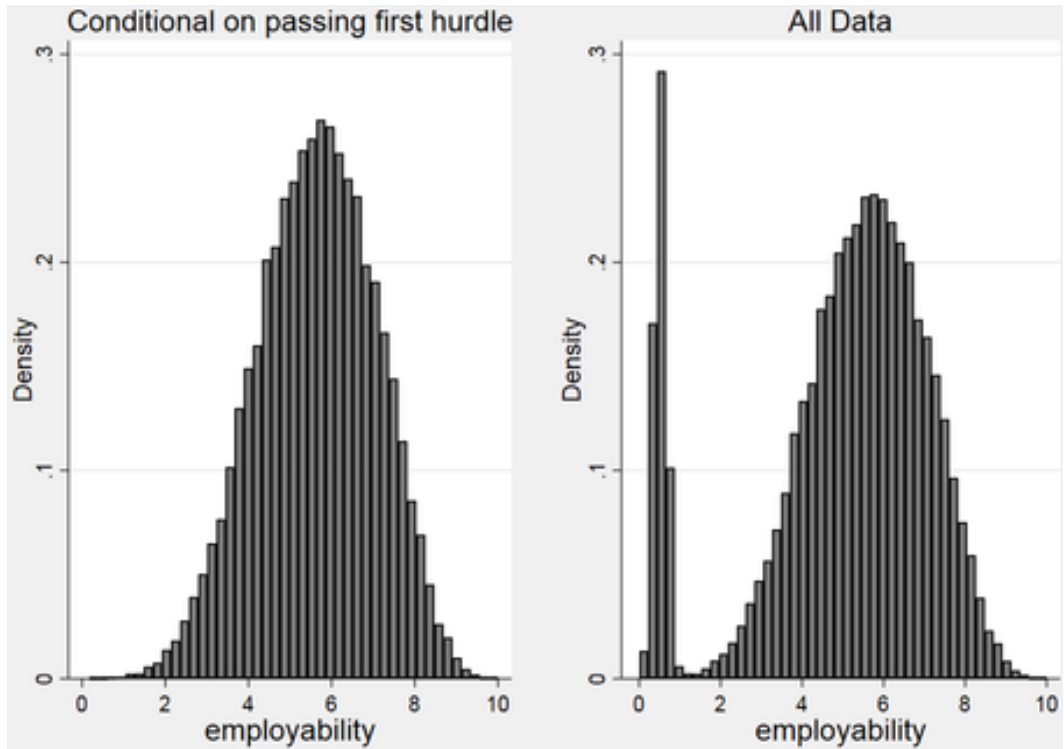
In the specification of the joint distribution of the three stochastic terms in formula (6), we have assumed that the correlation between $\varepsilon_{1,i}$ and μ_i is ρ . By introducing a correlation between the error terms in the two hurdles, we will allow ρ being nonzero. The correlation coefficient ρ can be estimated precisely with panel data and the estimation approach outlined by Engel & Moffatt (2014).

Finally, the observed variable, $employability_{it}$, is determined as:

$$employability_{it} = job_i \cdot employability_{it}^* \quad (8)$$

Estimation of the panel double-hurdle model is performed using the method of maximum simulated likelihood (Train 2009). Furthermore, the latent process defined by the first and second hurdle is shown in Figure 1.

Figure 1. Latent process defined by the first and second hurdle



3.2 Additional Variables

The explanatory variable Internet use is measured by the question asking respondents whether to use the Internet. Besides, use the Internet penetration rate at the county level to solve potential issues of selection bias and endogeneity. Additionally, individual employability development likely differs spatially, temporally, and by demographic characteristics. We also included a series of control variables to capture individual and occupational characteristics (for more details, see Table 1).

3.3 Data Sources

The variables described above were derived from the adult questionnaires in the China Family Panel Studies (CFPS). CFPS is a national longitudinal survey project, which implemented its baseline survey in 2010 and four waves of full sample follow-up surveys in 2012, 2014, 2016, and 2018. The target sample of CFPS consists of 16,000 households in 25 provinces, municipalities, or autonomous regions in China, representing 95% of the Chinese population. Thus, it provides us with comprehensive and longitudinal data to conduct in-depth research on the digitalization of information and its potential influence on individuals in the economic system.

4. EMPIRICAL RESULTS

4.1 Descriptive Statistics

Our sample consists of 8368 Chinese individuals aged 16 to 60 observed in 2010, 2012, 2014, 2016 and 2018. Therefore, the total number of observations in the final data set is 41,840 (8368×5). We screened the sample according to the definition of labor force and removed individuals who are

currently in school (formally receiving the education) or currently retired (including retirement due to disease, internal retirement, and informal retirement). Consistent with the results from the 42nd China Statistical Report on Internet Development (CINIC, 2018), most of the urban residents (61%) and relatively fewer rural residents (33%) are reported using a computer to surf the Internet. Our sample of Internet users is predominantly male (51%) and married (65%) at the time of the survey. Among these users, 32% were reported with high levels of education, and 65% of them are with good health. A number of individual characteristics are also incorporated as explanatory variables. Table 1 provides an overview of these dependent variables and explanatory variables.

4.2 Sustainable Employability and Internet Use

In employment status equation (the first hurdle), we focus on the issue of how employability can be developed even for people who are not employed. The term may also refer to a person whose skill set has become obsolete. We are particularly interested in the estimation of the employability equation (the second hurdle), which gives an interpretation of the non-zero type and variable relationships. Then we also conduct various subsample estimations to capture the region-level, firm-level, and individual-level heterogeneity.

The estimated coefficients are presented in Table 2. Most of the coefficients are found to have statistically significant effects on getting a job in employment status equation. Then we perform a likelihood ratio test between the panel double-hurdle model and the Tobit model. The test rejects the hypothesis that the first hurdle does not exist.

The employability equation captures the factors that affect the degree of sustainable employability. In Table 2, we see that Internet use has positive and significant effects on sustainable employability. As expected, we find that socio-demographic variables such as gender, number of children, marital status are negatively related to an individual's sustainable employability, whereas health status and

Table 1. List of variables and statistical descriptions

| Variable | Definition | Mean | Standard deviation | Min | Max | Sample size |
|---------------|--|-------|--------------------|------|-----|-------------|
| Employability | Sustainable employability | 4.980 | 2.160 | 0.01 | 10 | 41790 |
| Job | Employment status: currently has a job = 1; otherwise = 0. | 0.874 | 0.332 | 0 | 1 | 41790 |
| Internet | Surf the Internet = 1; otherwise = 0. | 0.390 | 0.490 | 0 | 1 | 41838 |
| Gender | Male = 1; or female = 0. | 0.470 | 0.500 | 0 | 1 | 41840 |
| Child | The number of children. | 1.700 | 0.870 | 0 | 7 | 41840 |
| Marriage | Marital status: unmarried / divorced / widowed = 1; married/ cohabitation = 2. | 1.935 | 0.246 | 1 | 2 | 41838 |
| Health | Self-rated health status (1 = unhealthy to 5 = healthy) | 2.760 | 1.270 | 1 | 5 | 41835 |
| Edu | Years of education (detailed) | 7.180 | 4.420 | 0 | 19 | 41840 |
| Age | Current year minus birth year. | 42.87 | 8.660 | 16 | 60 | 41840 |
| Environment | Rate the performance of labor market (0 = inefficient to 10 = efficient) | 6.290 | 2.520 | 0 | 10 | 41835 |
| Register | Current household registration status: agricultural = 1; non-agricultural = 2. | 1.213 | 0.4094 | 1 | 2 | 41824 |
| Occup | Type of work unit: state-owned = 1; collectively-owned = 2; private = 3; foreign capital = 4; individually owned business = 5. | 2.850 | 1.480 | 1 | 5 | 41095 |

Sources: National adult questionnaire data from China Family Panel Studies (CFPS) database.

Table 2. Empirical results of double-hurdle model

| Variable | Employment status equation | | Employability equation | |
|----------------|----------------------------|--------|------------------------|--------|
| | Estimate | SE | Estimate | SE |
| Internet | 0.9708*** | 0.0477 | 1.1776*** | 0.0245 |
| Gender | 0.5280*** | 0.0652 | 0.1633*** | 0.0370 |
| Child | -0.1201*** | 0.0405 | -0.1154*** | 0.0236 |
| Marriage | -0.0731 | 0.0465 | -0.0725** | 0.0286 |
| Health | 0.3140*** | 0.0180 | 0.2123*** | 0.0101 |
| Edu | 0.0828*** | 0.0081 | 0.1274*** | 0.0045 |
| Age | 0.0900*** | 0.0049 | 0.0741*** | 0.0023 |
| Environment | 0.0040 | 0.0083 | 0.0129*** | 0.0048 |
| Register | -0.0240*** | 0.0083 | -0.0187*** | 0.0057 |
| Occup | -0.0895*** | 0.0184 | -0.0665*** | 0.0106 |
| Sector control | Yes | Yes | Yes | Yes |
| Sigma-cons | -0.3204 | | | |
| Log likelihood | -49720.24 | | | |
| Wald chi2(10) | 7723.70 | | | |
| Prob>chi2 | 0.0000 | | | |

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

education have positive impacts on sustainable employability. We also find that an individual's sustainable employability improves when the labor market performance better. It is worth noting that compared to all the control variables, the dependent variables in both equations appear more sensitive to Internet usage with estimated coefficients of 0.9708 and 1.1776, respectively.

There are two possible mechanisms by which Internet use may affect users' adaptability to the digital economy and consequently their sustainable employability. Firstly, Internet use may positively affect sustainable employability by entailing adults to prepare for future work changes in a personal and creative manner (Walker, 2020; Elnahla & Ruth, 2020). In a knowledge economy, knowledge is an essential input in production. Individuals with heterogeneous skills must choose how much knowledge to acquire and may produce on their own or in organizations (Garicano & Rossi-Hansberg, 2006). Recent improvements in information technology have affected how knowledge is acquired and communicated. E-learning has become an essential motivation for accessing the Internet during people's non-vacation periods. Thus with mobile internet and increasingly powerful and lower-cost computing, every person can theoretically connect to anyone else, obtain and generate knowledge, or engage in commercial or social activity. Secondly, online entertainment and social activities can provide emotional supports for workers. To be more specific, sharing thoughts or feelings or professional help from Internet friends help maintain an individual's ability to think, reason, and solve problems encountered at the workplace. The spread of digital technologies has revolutionized the ability to communicate effectively with others, to share and access knowledge. Therefore, the perceived importance of different purposes for Internet use may throw more light on user attitudes or motivations.

5. DISCUSSION OF HETEROGENEITY

5.1 Urban-Rural Gap

Another question is the extent to which the Internet widens or narrows the digital gap between cities and rural areas. Previous literature suggests that the prime early beneficiaries of digital technologies have been in urban areas (Savage & Waldman, 2009; Eichengreen et al., 2016). People who lack affordable, portable and accessible access to digital technologies are overwhelmingly from groups who are already marginalized, especially those who live in poor, remote or rural areas. Many new inequalities – in opportunity and capability – are being widened further in the age of the digital economy. Under these circumstances, we provide some evidence that internet contributed to connecting isolated rural residents in low density areas, and thus enhanced their competitiveness in the labor market.

Table 3 reveals the coefficients of Internet use for rural and urban subsamples. Samples are classified according to people's current residence location instead of their household registration place. As for specific variables included in both models, Internet is found to be the most important variable related to sustainable employability. We note a significant positive effect of Internet use on promoting employment and improving employability in rural areas. Similarly, and consistent with rural areas, there is a positive association between Internet use and employability upgrading in cities, which implies that Internet use is associated with more employment opportunities and higher levels of employability. However, the magnitudes of these effects are slightly weakened than in rural areas. An implication of this is the possibility that the Internet may disproportionately benefit people in rural areas in terms of higher marginal returns on employability.

Due to space limitations, Figure 2 reports the regression coefficients of Internet use and their confidence intervals in each detailed group. The results show the employability upgrading has also occurred within detailed age groups. By further considering urban-rural differences, evidence emerges that the Internet plays a more influential role in benefiting rural residents than urban residents, especially in younger age groups (16 to 39). The results here are consistent with the interpretation of results in Table 3.

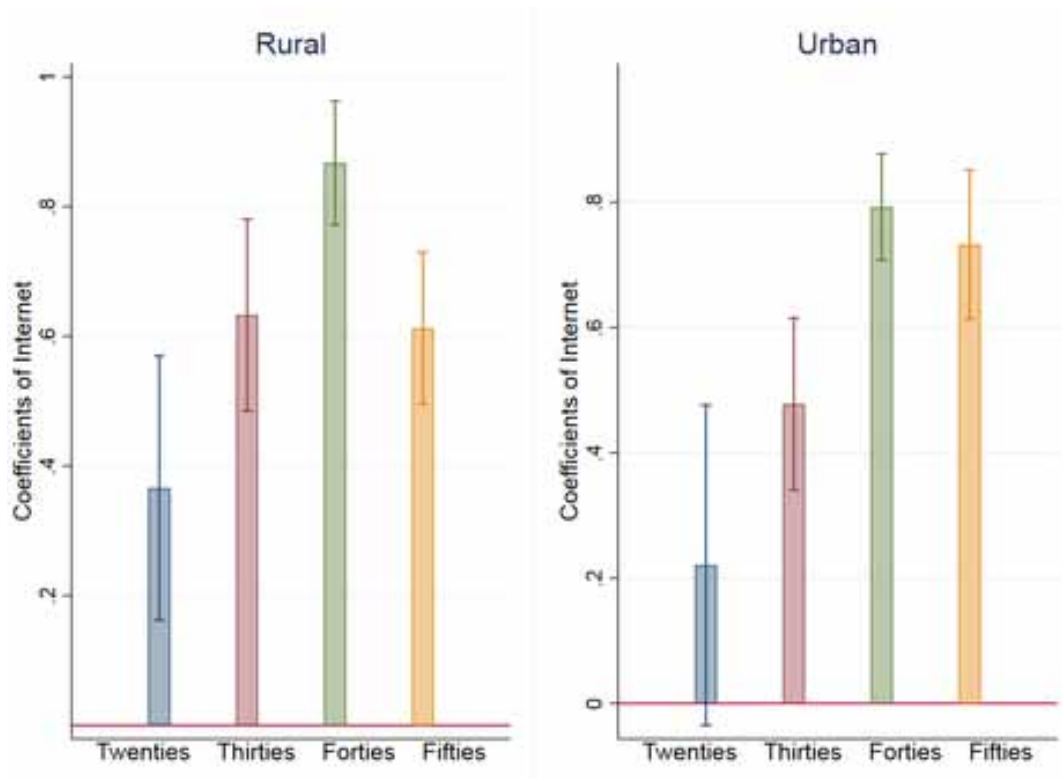
One interesting observation is that the positive effect is almost continuously enhanced with age, implying that the positive association between Internet use and sustainable employability is predominantly driven by the mid-aged reference group aged 40 to 49. The intense use of online learning by older Chinese adults might reflect an attempt to compensate for previous insufficient education. Among older citizens (>50), the coefficients of Internet use are still positively significant at 1% level, which contradicts previous reports which draw a pessimistic perspective for the labor

Table 3. Heterogeneity tests for rural and urban workers

| Variable | Rural | | | | Urban | | | |
|-------------------|----------------------------|--------|------------------------|--------|----------------------------|--------|------------------------|--------|
| | Employment status equation | | Employability equation | | Employment status equation | | Employability equation | |
| | Estimate | SE | Estimate | SE | Estimate | SE | Estimate | SE |
| Internet | 1.0697*** | 0.0802 | 1.2195*** | 0.0351 | 0.8997*** | 0.0604 | 1.2033*** | 0.0337 |
| Control variables | Yes 0.0269 | | Yes 0.0144 | | Yes 0.0234 | | Yes 0.0138 | |
| Sigma-cons | 0.5773 | | | | 0.6844 | | | |
| Log likelihood | -23081.00 | | | | -27855.15 | | | |
| Wald chi2(10) | 3734.46 | | | | 4079.67 | | | |
| Prob>chi2 | 0.0000 | | | | 0.0000 | | | |

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Figure 2. Coefficients of Internet use in detailed age groups



market prospects of employees in later life (e.g., Sabatini & Sarracino, 2017). Across most of the adult life span, people in different life stages may have different goals towards career success (such as get promoted in terms of a technical or administrative title), which may explain many contradictions. That is, due to diminishing marginal returns, Internet use can support inclusive development by breaking down barriers to information, broadening access, and covering competency gaps for the individuals in rural areas and among elderly cohorts.

5.2 Skill Requirements in the Workplace

In recent years, occupational distribution has been shifted to more skill demanding occupations such as professionals and managers. It has observed that skill requirements at the workplace have increased owing to a shift toward analytical activities and away from manual routine activities (Autor, 2013; Acemoglu, 2016).

Focuses on specific skill requirements, Table 4 reports the influence of Internet use on people's sustainable employability subsampled by their primary workplace. According to the results reported in column (1) to (4), Internet use generally gives rise to positive associations with employability, suggesting that the Internet is seen as a means for attaining a worthwhile goal at work. The internet might reduce the need for task-specific workspace, thereby increasing the prevalence of 'telecommuting' and the possibility of working as free lancers or ad hoc on projects at home.

As Table 4 shows, considering the Internet to be essential for analytical and interactive tasks, it increases people's sustainable employability when working from home or in the office, with estimated coefficients of 0.8239 and 0.7929, respectively (columns 2 and 3). Column (4) in Table 4 further indicates that the positive coefficient associated with Internet use is driven by higher skill

Table 4. Heterogeneity tests for different workplace

| Variable | (1) | (2) | (3) | (4) |
|-------------------------|-----------|-----------|-----------|-----------|
| | Outdoors | Home | Office | Workshop |
| Internet | 0.7381*** | 0.8239*** | 0.7929*** | 0.9659*** |
| | (0.0917) | (0.0267) | (0.0430) | (0.0311) |
| Control variables | Yes | Yes | Yes | Yes |
| Adjusted R ² | 0.1863 | 0.2577 | 0.2966 | 0.2706 |
| F-value | 7.4424 | 115.7239 | 58.0862 | 90.5663 |
| Obs. | 817 | 9914 | 4062 | 7244 |

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

requirements in workshops. On the other hand, those who see the Internet as necessary for seeking professional help are more likely to be motivated to improve themselves. This outcome may imply that when the Internet is perceived as a means for meeting occupational requirements, its use is more closely correlated with sustainable employability.

A number of studies emphasize the higher skills now required at the workplace owing to computerization (Benzell et al., 2015; UNCAD, 2016). We further explored the role workplace computerization has had in this process. Figure 3 reports the regression coefficients and confidence intervals of Internet use. The histogram on the left suggests that when computer operation is required at work, Internet use has similar influences on sustainable employability when subsamples are estimated separately by workplaces. This relationship is also found within the group in which computer operation is not required. However, their coefficients are quite lower than the opposite group. It is worth noting that the coefficient of Internet use significantly reduces from 0.85 to 0.62 when computer operation is not required for working from home.

The overall result has shown that people in the computerized workplace appear to have benefited from Internet use. It seems that higher computer adoption by businesses motivates their employees to develop their capabilities to the maximum. Occupations requiring computer operation emphasizes the importance of continuing education and training in order to enable employees to cope with the challenges brought about by the changing task.

5.3 Work Units and Job Security

Digital economy is reinventing organization structure of enterprise, by offering a continuous upgrade of competencies and exposure of certification for the people associated with various collaborative platforms (Cruickshank, 2020). A new way of organizing labor demand and supply reveals how employability can be developed even for people who are be unemployable due to personal reasons in the current labor market.

We further take the ownership structure of work units into account, which enables exploration of whether this relation varies among different corporate governance systems. Various work units are grouped into five categories: a) state-owned/state-controlled institution or enterprise (SOEs); b) collectively-owned enterprise; c) private enterprise; d) enterprise invested in by Hong Kong/Macao/Taiwan capital or invested in by foreign capital; e) individually owned business.

As shown in Table 5, Internet use contributes more to freelance, ad hoc work, foreign companies (ranging from small enterprises to large technology companies), and collectively-owned enterprises, whereas the positive impact of Internet use on employability slightly reduces within the state-owned enterprises group. One reason for this difference may due to their internal rules of operation and related organizational issues. SOEs are organized as semiautonomous corporate entities, thus they generally provide more stable jobs and lack motivation to promote re-organization.

Figure 3. Coefficients of Internet use classified by computerization at workplace

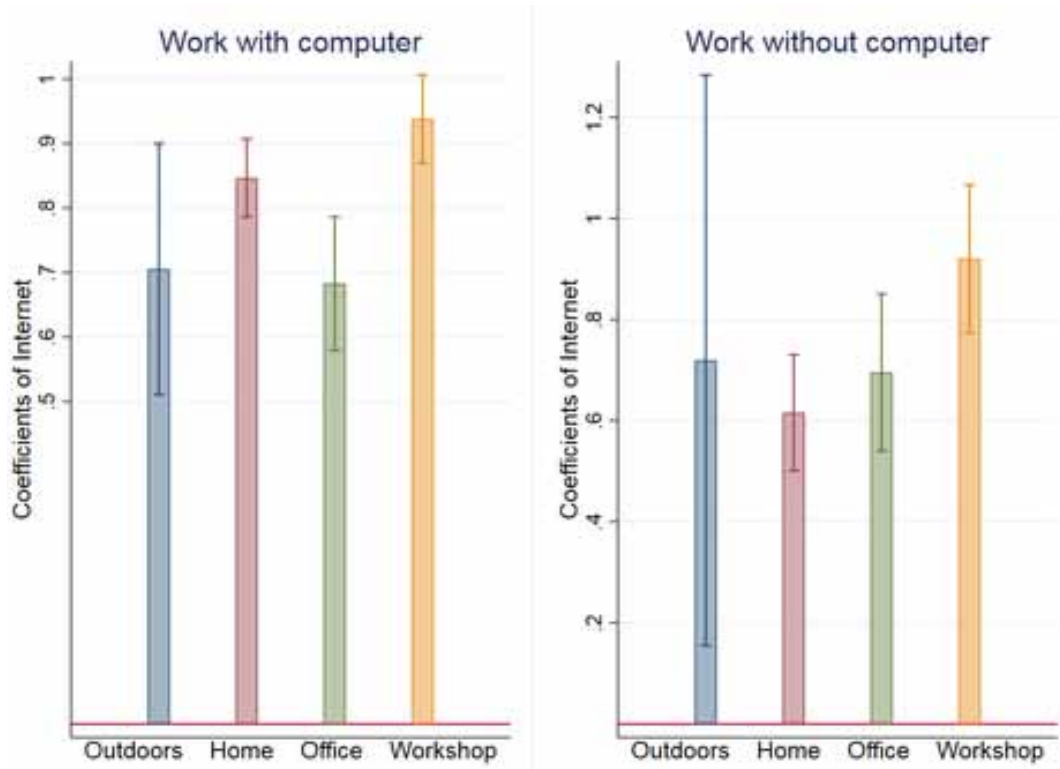


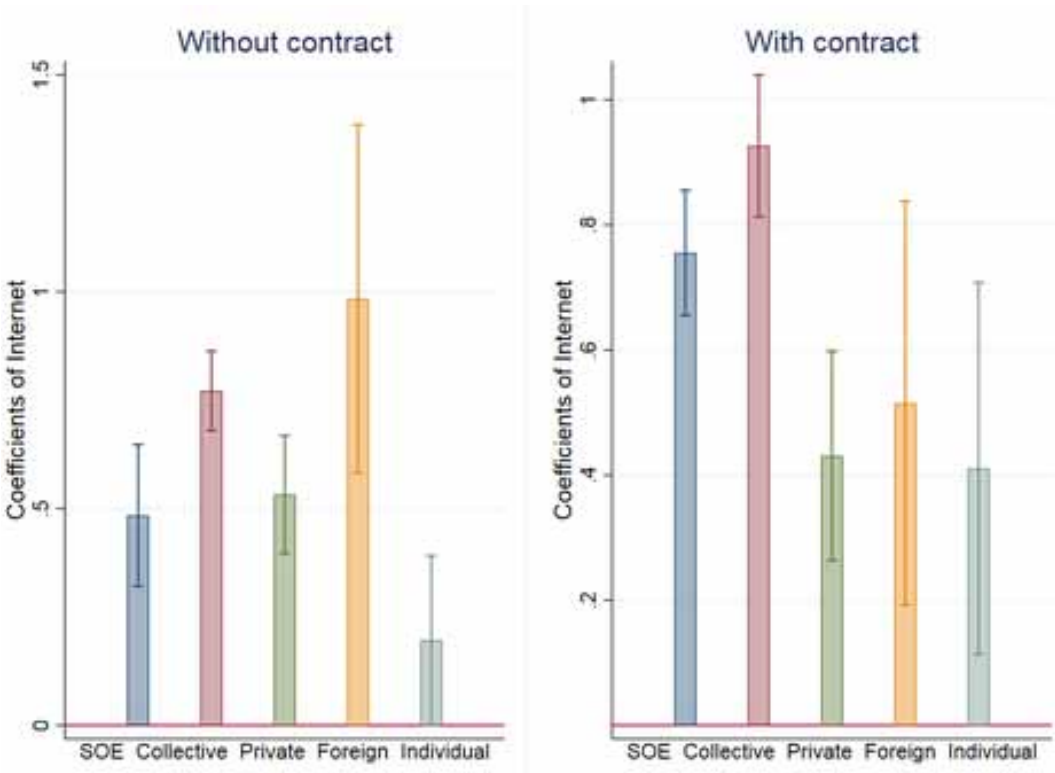
Table 5. Heterogeneity tests for organization structure of enterprise

| Variable | (1) | (2) | (3) | (4) | (5) |
|-------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | SOE | Collective | Private | Foreign | Individual |
| Internet | 0.7760*** (0.0392) | 0.9613*** (0.0310) | 0.7410*** (0.0416) | 0.8160*** (0.1043) | 0.8546*** (0.0344) |
| Control variables | Yes | Yes | Yes | Yes | Yes |
| Adjusted R ² | 0.2383 | 0.2719 | 0.2372 | 0.3244 | 0.2357 |
| F-value | 54.0586 | 94.6652 | 46.3539 | 12.7205 | 62.8582 |
| Obs. | 4918 | 7276 | 4231 | 709 | 5819 |

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Labor contract is an objective measure of the certainty of continued employment with a particular organization. Figure 4 reports the regression coefficients and confidence intervals of Internet use. In contrast to the non-collective work unit, the coefficients of Internet use decreases when workers are informally employed (without a contract) in state-owned public institutions and collective enterprises, although at the relatively small magnitudes of 0.2634 and 0.1531, respectively. Interestingly, the association between Internet use and sustainable employability is absent among informal employees within the individually owned business group (the rightmost bar in the left histogram), which may imply that self-employed individuals are more conservative or even fail to see the value of Internet

Figure 4. Coefficients of Internet use in detailed work unit groups



use in dealing with problems at work. Thus, in a new cyber-coordinated labor market, employment is more atomizing and fluid due to the new world of work and complex tasks in the workplace. These rapid changes have made sustainable careers an increasingly salient concern for individuals.

6. DISCUSSION OF ENDOGENOUS PROBLEM

To rule out the endogeneity problem caused by omitted variable, we controlled a list of variables in our models to explore the influence of Internet use on sustainable employability. However, we can presume another endogeneity problem caused by a loop of causality between Internet use and sustainable employability (inverse causality). Employable people may be more likely to use the Internet since Internet users must have the necessary knowledge required to use web technology.

The instrumental variable method allows for consistent estimation when the correlation between the explanatory variable and the dependent variable does not plausibly reflect the causal relationship. We use the Internet penetration rate (Internet_pe) to control for the endogeneity of Internet use (Internet). Firstly, we have reasons to believe that our instrumental variable is correlated with Internet use, conditional on the other covariates. Sabatini & Sarraino (2014) and Pénard et al. (2013) provide evidence that an individual's propensity to go online will be directly influenced by Internet use among people who live in proximity. Secondly, our instrumental variable (Internet_pe) can meet the exogenous assumption. The Internet penetration rate of a given region must be considered as a "natural" cause of the variation in access to the Internet, which is exogenous to people's employability and cannot be driven by their preference for online networking.

We first perform a generalized method of moments (GMM) estimation for Internet use. The instrumental variable is the Internet penetration rate (the proportion of Internet users to total population) at the county level. The estimation equation includes all explanatory variables. In the second stage, we estimate the panel double-hurdle model of sustainable employability using the predicted value in the first stage model.

Table 6 displays the results. Column (1) suggest that Internet penetration rate has a strong first stage since the correlation is highly statistically significant, allowing us to uncover the causal effect of the Internet use on sustainable employability. According to results reported in column (2), Internet use has a significant impact on sustainable employability when we use the instrumental variable for Internet use.

7. CONCLUSION

The present study was designed to determine the effect of the Internet on sustainable employability. Our analysis shows that Internet use is significantly associated with higher levels of sustainable employability in general. Moreover, we can still observe close associations when our focus is on the heterogeneity among different groups. In heterogeneity tests, two key points are worth highlighting: a) Internet adoption is more beneficial to rural residents rather than urban residents, especially among younger cohorts (aged 16 to 39); b) occupations requiring computer operation emphasizes the importance of continuing education and training, thereby contributing to Internet users' performance in their relevant domains of work.

Returning to the question posed at the beginning of this study, it is now possible to state that the information welfare of the Internet has narrowed the digital gap caused by technology among different social groups. We provide evidence on sustainable employability in China, where previous findings are less clear than in developed countries. Besides, the data set used in the present paper has several advantages over survey data within limited numbers of enterprises. The findings support the argument that Internet use increases Chinese adults' sustainable employability through multiple mechanisms and thus contributes to an active and growing literature that studies the influence of information technology on the labor market.

Our findings provide a novel perspective to understand how modern information technology shapes adults' sustainable employability in China. More informal approaches to learning may be needed to prepare for future challenges. As the boundaries increasingly blur between work and learning, we need to enable and incentivize lifelong learning. Furthermore, broadening affordable and portable

Table 6. Empirical results for instrumental variable

| | First stage | IV |
|-----------------------|-------------|-------------------------|
| | (1) GMM | (2) Double-hurdle model |
| Internet | | 1.043*** |
| | | (0.0262) |
| Internet_pe | 3.074*** | |
| | (0.0910) | |
| Explanatory variables | Yes | Yes |
| Sector control | Yes | Yes |
| Obs | 25355 | 25355 |

Note: (1) Control Variables include gender, child, marriage, health, edu, age, environment, register, occup. (3) ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

access to the Internet can support economic inclusion by breaking down barriers to information and improving the level of skills needed to participate in future work. We also recommend interventions to help Internet users see the Internet as a means for attaining valuable goals and performing significant roles. We hope the current paper will contribute to improved understanding of the opportunities and challenges ahead so that we can help to shape a more inclusive and sustainable future for individuals.

The current paper also has some limitations that should be noted here and lead to future work. Our work focuses on the mechanism that the Internet can help workers learn about their skills and then maximize their comparative advantage, whereas combining the study of psychological factors may provide further insights on the mechanisms by which Internet use affects sustainable employability.

ACKNOWLEDGMENT

This research was funded by a grant from the Humanities and Social Science Foundation provided by the Chinese Ministry of Education (No. 19YJC790108). For comments and discussions, we thank Beatrice I.J.M. Vander Heijden and anonymous reviewers for their constructive suggestions.

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