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Digital Economy and Entrepreneurship: Heterogeneity of Labor Force Skills

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This study investigates the effect of digital economy on entrepreneurship. Our empirical results show that digital economic development significantly increases the probability of labor force participation in entrepreneurial activities. Digital economy also has a polarizing effect on entrepreneurial behavior. It significantly promotes the entrepreneurial probability of the low-skilled labor force but has a positive and an insignificant effect on the high-skilled labor force. Our findings contribute to enacting improved policies on entrepreneurial behavior and employment.

I. Introduction

This paper aims to investigate the impact of the development of digital economy on entrepreneurship in China. With the development and application of digital technologies, such as the Internet, big data, and artificial intelligence, digital economy has become a new driving force of global economic growth and social development (Yuan et al., 2021). However, the possibility that digital technology may lead to more unemployment has become a matter of public concern (Acemoglu & Restrepo, 2019). Nevertheless, some studies show that digital economy not only changes the demand for labor skills in production activities but also provides new opportunities for entrepreneurs (Wen et al., 2021; Youssef et al., 2020). Our hypothesis is that the employment creation effect of entrepreneurial activities may compensate for the replacement of workers with digital technologies.

This hypothesis test is important because this study provides a judgment for these concerns from the perspective of the entrepreneurial effects of the digital economy. Numerous studies have examined the aggregate and structural effects of digital technologies on employment. Digital technology has an important effect on employment structure, especially employment polarization (Autor et al., 2003, 2006; Goos et al., 2009). Employment polarization refers to an upward trend in employment rates for high- and low-skilled labor and a downward trend in employment rates for middle-skilled labor (Acemoglu & Autor, 2011; Frey & Osborne, 2013). In addition, digital economy creates opportunities for entrepreneurial activities (Szalavetz, 2020; Teece, 2010; Yin et al., 2019), and digital technology can support entrepreneurial activities (Elia et al., 2020). However, the literature on the entrepreneurial behavior of workers with different skills in digital economy is limited.

This study uses individual-level data on the labor market from the China Labor Force Dynamics Survey (CLDS) in 2016 and finds that digital economic development increases the probability of labor force participation in entrepreneurial activities. It also finds that the polarization of skill demand also appears in the field of entrepreneurship in the era of digital economy.

This study mainly makes two contributions to the literature. The first is that it deeply analyzes the micro-mechanism of the effect of digital economic development on entrepreneurial activities from the perspective of individual workers. The second is that it analyzes the heterogeneity of labor force skills in this relation, thus extending the existing theory of employment polarization.

The remainder of the study proceeds as follows. Section II describes the econometric model and the data. Section III provides the empirical results. Section IV concludes the study.

II. Data and Methodology

A. Model specification

To investigate the effect of digital economic development on the entrepreneurial activities of the labor force, this study uses the following regression model:

$$Prob\left(Startup_{ij}=1\right)=\Phi(\alpha+\beta\times Digital_{j}+X_{ij}\gamma+\mu_{p}+\varepsilon_{ij}) \quad (1)$$

where i and j refer to the subscripts of individual i in city j, *Startup* is a binary dependent variable and refers to whether the worker starts a business, *Digital* is the explanatory vari-

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able in our study and refers to the development level of the city's digital economy, **X** is a vector of control variables and includes a set of personal and family characteristics of workers, and Φ represents the normal distribution function. To control the unobserved regional characteristics, this study also controls the province fixed effect (μ_p) in the model. This study focuses on the coefficient β, which represents the effect of digital economic development on entrepreneurship.

B. Data and variables

This study uses individual-level data on the labor market from the CLDS in 2016. The CLDS collects various indicators of the labor force in a comprehensive and representative manner. The individuals with key missing information are excluded in our study, and a total of 7380 individual workers are obtained from the survey.

The dependent variable is the development level of digital economy (*Digital1*), which is measured by the natural logarithm of one plus "Internet +" Digital Economy Index published by Tencent Research Institute. In addition, this study uses a substitute indicator of digital economic development (*Digital2*), which is a comprehensive index of the development of information and communications technology (ICT) and digital financial inclusion. The development of ICT consists of four indicators: the number of Internet broadband access users among 100 people, the proportion of employees in computer services and software industries in urban units, the total number of telecommunication businesses per capita, and the number of mobile phone users among 100 people. The development of digital finance is obtained from the Digital Finance Research Center of Peking University. The constructed indicators, indicator attributes, and construction process of the evaluation index system for the development level of China's urban digital economy are shown in Table A1. Principal component analysis is used to construct the comprehensive index.

The core explanatory variable is the entrepreneurial behavior of the labor force. In the CLDS, interviewers judged whether the worker is involved in entrepreneurship by asking them their job type. Thus, this study constructs a binary variable, *Startup*, to measure the entrepreneurial behavior of workers. If the worker participates in a business, the value of the variable, *Startup*, is set to one; otherwise, the value of the variable is set to zero. This study uses a series of control variables for individual and family characteristics, which may influence entrepreneurial behaviors, and the dummy variables for entrepreneurial types. The descriptive statistics of variables are presented in Table 1.

III. Empirical Results

A. Effect of digital economic development on entrepreneurship

This study evaluates the influence of digital economic development on the probability of the labor force to start new businesses by using the probit model. The empirical results are shown in Table 2. Entrepreneurial activities are divided into two types: self-employed and employer-type entrepreneurship. Columns (5) and (6) show the different effects of these two kinds of entrepreneurship.

The empirical results show that the coefficient of digital economic development on entrepreneurship is significant and positive at the 5% level of statistical significance regardless of whether the core explanatory variable is measured by *Digital1* or *Digital2*. The results indicate that digital economic development increases the probability of entrepreneurship for workers. The results are consistent with those of Teece (2010) and Youssef et al. (2020), who find a positive correlation between digital technology and entrepreneurship. In Columns (5) and (6), the results indicate that digital economic development has a crucial role in improving the probabilities of both self-employed and employer-type entrepreneurship, which suggests that the development of the digital economy does not only promote the entrepreneurship of individual workers but also increases employment opportunities through entrepreneurial activities.

B. Entrepreneurial polarization in the era of digital economy

It is unclear whether the impact of digital economy on entrepreneurial activities is heterogeneous among workers with different skills. To clarify this, the study divides individual workers into low-, medium-, and high-skilled workers and investigates the heterogeneous effects of labor-force skill differences. The empirical results are shown in Table 3. In Columns (7) to (9), we use the policy shock of Broadband China Pilot at the city level as an instrumental variable for digital economic development.

In Table 3, the coefficients of *Digital* for low-skilled workers are significantly positive at the 1% level of statistical significance. This is consistent with Acemoglu & Restrepo's (2019) finding, supporting the view that digital economy lowers barriers to entrepreneurship and low-skilled workers are more likely to start their own businesses. For high-skilled workers, the coefficients of *Digital* are positive albeit statistically insignificant. In addition, the *t*-value in instrumental variable regression is 1.54, indicating that digital economic development likely promotes entrepreneurship for high-skilled workers. However, it has a negative but an insignificant effect on entrepreneurship for medium-skilled workers. The conclusion remains the same regardless of the robust regression analysis or the instrumental variable regression analysis. Our findings are consistent with the phenomenon of employment polarization (Autor et al., 2006); that is, digital economy provides opportunities for high- and low-skilled workers to start their own businesses. Therefore, digital economy has a polarizing effect on entrepreneurship.

IV. Conclusion and Policy Suggestion

Using the probit model and data from the CLDS in 2016, this study investigates the effect of digital economic development on entrepreneurship. Our empirical results show that digital economic development significantly improves

Table 1. Descriptive statistics

Variables	Definition	Mean	Std. Dev.	Min	Max
Startup	Dummy variable of entrepreneur	0.128	0.334	0	1
Startup1	Dummy for self-employed entrepreneur	0.019	0.135	0	1
Startup2	Dummy for employer-type entrepreneur	0.109	0.312	0	1
Digital1	Digital Economy Index	1.792	3.876	0.134	25.90
Digital2	Digital economy index	0.455	1.852	-2.646	8.445
Male	Gender, it equals 0 or 1	0.474	0.499	0	1
Politic	Dummy variable of political profile	0.088	0.283	0	1
Hukou	Dummy variable of the town account	0.211	0.408	0	1
Health	Dummy variable of health status	0.851	0.356	0	1
lnAge	Logarithm of respondent's age	3.868	0.256	2.833	4.454
Marriage	Dummy variable of marital status	0.945	0.228	0	1
Education	Average years of schooling in a family	2.186	1.532	1	11
Insurance	Dummy for endowment insurance	1.872	0.334	0	1
LSkill	Dummy variable of low-skilled labor	0.857	0.350	0	1
MSkill	Dummy variable of middle-skilled labor	0.086	0.281	0	1
HSkill	Dummy variable of high-skilled labor	0.057	0.232	0	1

Notes: This table reports descriptive statistics of relevant variables. Employer-type entrepreneur is the practice of employing one or more employees, while self-employed entrepreneur is the practice of working for oneself without employing others.

the probability of labor force participation in entrepreneurial activities. Moreover, digital economy has a polarizing effect on entrepreneurship; it promotes entrepreneurship for low- and high-skilled workers but has a negative effect on the entrepreneurship of medium-skilled workers. In the era of digital economy, the polarization of skill demand does not only exist in the field of employment, but also in the field of entrepreneurship. The government should formulate reasonable policies to deal with the polarizing effect of skill demand.

Declaration of Interest

The authors declare that they have no conflict of interest.

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Table 2. Effect of digital economic development on entrepreneurship

Variables	*Startup*				*Startup1*	*Startup2*
	(1)	(2)	(3)	(4)	(5)	(6)
Digital	0.203***	0.131***	0.068***	0.031**	0.082**	0.254***
	(7.51)	(3.48)	(6.55)	(1.99)	(2.07)	(3.98)
Male	0.335***	0.342***	0.333***	0.339***	0.291***	0.391***
	(8.56)	(8.58)	(8.34)	(8.32)	(7.04)	(5.11)
Politic	-0.356***	-0.353***	-0.322***	-0.319***	-0.296***	-0.372**
	(-4.37)	(-4.23)	(-3.94)	(-3.80)	(-3.39)	(-2.49)
Hukou	0.160***	0.207***	0.159***	0.201***	0.099	0.464***
	(2.81)	(3.59)	(2.75)	(3.40)	(1.60)	(4.97)
Health	0.358***	0.327***	0.355***	0.329***	0.274***	0.750***
	(5.48)	(4.90)	(5.35)	(4.87)	(4.03)	(3.14)
lnAge	-0.862***	-0.894***	-0.862***	-0.918***	-0.832***	-0.753***
	(-11.11)	(-11.11)	(-10.86)	(-11.21)	(-10.00)	(-5.33)
Marriage	0.104	0.091	0.091	0.077	0.026	0.342**
	(1.20)	(1.03)	(1.00)	(0.84)	(0.28)	(1.96)
Education	-0.017	-0.009	-0.011	-0.004	-0.012	-0.003
	(-1.16)	(-0.59)	(-0.70)	(-0.29)	(-0.75)	(-0.11)
Insurance	0.743***	0.800***	0.708***	0.756***	0.895***	0.282***
	(9.61)	(10.28)	(8.97)	(9.41)	(9.81)	(2.62)
Constant	0.074	-0.311	0.241	0.011	-0.710	-1.674**
	(0.22)	(-0.71)	(0.70)	(0.03)	(-1.45)	(-2.47)
Pseudo R^2	0.068	0.098	0.064	0.093	0.089	0.143
Province Fixed Effects	No	Yes	No	Yes	Yes	Yes
Observations	7,380	7,380	7,380	7,353	7,380	7,195

Notes: This table reports the empirical results of the impact of digital economic development on entrepreneurship. The (t)-values are shown in brackets. Asterisk***(1%), **(5%), and *(10%) indicate significance at the corresponding level. Columns (3) and (4) use *Digital2* as the core explanatory variable, while others use the *Digital1* as the core explanatory variable.

Table 3. Heterogeneous effect of digital economy on entrepreneurship

Variables	Baseline Regression			Robust Regression			Instrumental Variable Regression		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	LSkill	*MSkill*	*HSkill*	*LSkill*	*MSkill*	*HSkill*	*LSkill*	*MSkill*	*HSkill*
Digital	0.047***	-0.009	0.024	0.049***	-0.014	0.101	0.057***	-0.015	0.062
	(4.01)	(-0.43)	(1.33)	(2.88)	(-0.29)	(0.73)	(2.76)	(-0.43)	(1.54)
Male	0.067***	0.084***	0.046*	0.334***	0.454***	0.397*	0.067***	0.084***	0.049*
	(7.87)	(2.81)	(1.73)	(7.49)	(3.03)	(1.76)	(7.88)	(2.87)	(1.90)
Politic	-0.031*	-0.041	-0.064***	-0.139	-0.195	-0.665***	-0.030*	-0.040	-0.063***
	(-1.81)	(-1.20)	(-2.64)	(-1.33)	(-1.00)	(-2.65)	(-1.82)	(-1.22)	(-2.70)
Hukou	0.093***	-0.050	-0.105**	0.381***	-0.268*	-0.840***	0.092***	-0.050	-0.113**
	(5.26)	(-1.46)	(-1.99)	(5.41)	(-1.69)	(-2.61)	(5.15)	(-1.50)	(-2.17)
Health	0.045***	0.043	-0.062	0.317***	0.249	-0.555	0.044***	0.043	-0.065
	(5.08)	(0.88)	(-0.67)	(4.52)	(0.73)	(-1.04)	(5.05)	(0.91)	(-0.71)
lnAge	-0.228***	-0.079	-0.038	-1.123***	-0.288	-0.402	-0.226***	-0.079	-0.031
	(-11.44)	(-1.18)	(-0.55)	(-12.43)	(-0.95)	(-0.73)	(-11.11)	(-1.23)	(-0.47)
Marriage	-0.011	-0.010	0.044	-0.035	0.069	0.545	-0.011	-0.011	0.048
	(-0.56)	(-0.19)	(1.09)	(-0.33)	(0.28)	(1.44)	(-0.55)	(-0.21)	(1.23)
Education	0.002	-0.004	0.004	0.018	-0.023	0.042	0.002	-0.004	0.003
	(0.44)	(-0.58)	(0.69)	(0.97)	(-0.64)	(0.97)	(0.40)	(-0.60)	(0.60)
Insurance	0.188***	0.146***	0.025	0.814***	0.792***	0.162	0.189***	0.145***	0.028
	(10.96)	(5.33)	(0.91)	(7.43)	(4.95)	(0.73)	(11.00)	(5.45)	(1.05)
Constant	0.419***	0.080	0.241	0.614	-1.316	-0.232	0.377***	0.102	0.093
	(3.55)	(0.31)	(0.86)	(1.12)	(-1.04)	(-0.09)	(2.73)	(0.37)	(0.33)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,324	636	420	6,324	636	420	6,324	636	420
Pseudo R^2	0.095	0.111	0.141	0.089	0.112	0.125	0.095	0.111	0.136

Notes: This table reports the empirical results of the heterogeneous effect of digital economy on entrepreneurship. The T-values are shown in brackets. Asterisk***(1%), **(5%), and *(10%) indicate significance at the corresponding level. Columns (4)–(6) use *Digital2* as the core explanatory variable, whereas others use *Digital1*.

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Appendix

Table A1. Digital economy development level index evaluation system

First level indicator	Secondary indicators	Three level indicators	Indicator attributes
Comprehensive Development Index of Digital Economy	Internet penetration rate	Internet users per 100 people	+
	Number of Internet-related employees	Number of employees in computer services and software	+
	Internet related output	Total telecommunications business per capita	+
	Number of mobile internet users	Number of mobile phone users per 100 people	+
	Inclusive development of digital finance	China Digital Financial Inclusion Index	+