The Effects of E-Commerce on Regional Poverty Reduction: Evidence from China's Rural E-Commerce Demonstration County Program

Yong Qin, Yingfeng Fang*

Abstract

This paper uses the Rural E-Commerce Demonstration County (REDC) policy to estimate the effect of e-commerce on poverty reduction. We discover that the REDC policy enhanced the gross regional product per capita by 8.4 percent for the total sample of counties and 10.5 percent for a subsample of poor counties. Specifically, the REDC policy increased the aggregate final product in primary industry by 10.6 percent. The final product per capita in the secondary and service sectors was 13.1 percent and 3.3 percent higher in the REDCs than in other counties, respectively. The effects were even greater for the subsample of poor counties. The estimates demonstrate that e-commerce developed quickly in the REDCs since the implementation of the REDC policy. The income of those involved in e-commerce increased, yielding more aggregate savings deposits. The expansion of e-commerce induced more investment, suggesting that more aggregate loans are being made in REDCs. This evidence suggests new opportunities for poor people in the new digital economy.

Keywords: e-commerce, poverty reduction, rural e-commerce demonstration county
JEL codes: O10, P36

I. Introduction

China has achieved much success in rural poverty reduction. According to the National Bureau of Statistics of China (NBS, 2021), China's rural poor population decreased from 770.39 million in 1978 to 5.51 million in 2019 and was eliminated in 2020 (measured by China's official poverty standard – RMB2,300 per year per person at 2010 prices). According to data for the poverty standard of US$1.9 per day from PovcalNet (an online

*Yong Qin, Associate Professor, School of Economics, Nanjing Audit University, China. Email: raymondqin2005@126.com; Yingfeng Fang (corresponding author), Associate Professor, School of Economics and Management, Wuhan University, China. Email: eco_yingfeng@whu.edu.cn. This research was supported financially by the National Social Science Foundation of China (No. 17BJL085) and the National Natural Science Foundation of China (No. 72003143).

tool for poverty measurement developed by the World Bank), the incidence of poverty in China decreased from 66.6 percent in 1990 to 0.7 percent in 2015, and China contributed more than 70 percent to world poverty reduction. None of these achievements would have been possible without the strong support of China's government. In recent years, China's government has implemented a series of steps to support poverty reduction, even requiring officials to stay in poor villages until the mission has been completed. E-commerce has been an important component of poverty reduction since its rapid development in China over the past 10 years. It was listed as one of the "ten top-quality poverty alleviation projects" in 2015.

The e-commerce sector achieved remarkable growth in the last decade in China, making it a novel means to reduce poverty in rural areas. There are several advantages to the development of e-commerce in rural China. First, many surplus laborers in the agricultural sector in rural counties can obtain jobs in e-commerce. Those jobs do not require many skills. For example, anyone can pack parcels. It is not very difficult for an individual with a junior secondary school education to open and manage an online store (e-store). Second, particular items that are planted, produced, or mined in certain counties are popular and valuable in urban China. Third, the cost of land is meager in rural China, and land rent in urban areas is more expensive than that in rural areas. Much money can therefore be saved by building warehouses in rural areas instead of urban areas.

The booming digital economy may provide new opportunities for poor individuals and allow them to catch up with the new digital world. E-commerce is very suitable for poor individuals because it requires less investment, skill, and education. However, the consequences of promoting e-commerce for poverty alleviation are largely unexplored. In this paper, we fill this void with evidence from China's rural e-commerce demonstration county (REDC) program. The REDC policy promotes the development of e-commerce in rural China, especially in poverty-stricken areas. We estimate the effect of the REDC policy on the gross regional product at the county level and prove that the REDC policy increases the final product. The finding may shed light on the new method for poverty alleviation and new opportunities for poor individuals in the booming digital economy.

This article relates to the literature on the effect of e-commerce on poverty alleviation (Parker et al., 2016; Luo and Niu, 2019). In particular, some related studies examined why poor individuals benefited from e-commerce (Leong et al., 2016; Galperin and Viecens, 2017), such as new opportunities for entrepreneurship (He, 2019), job creation in rural areas (Leong et al., 2016), the reduction of intermediaries (Jensen, 2007; Goyal, 2010), and the extension of the market (Wei et al., 2019). Unrivaled access to information and communication technology can support rural residents in cultivating and

organizing local natural resources, capital, and labor. Information and communication technology enables entrepreneurs to interact with outside buyers with low information costs. Many job opportunities in occupations such as photography, graphic design, and delivery are created when micro e-business firms are built. E-commerce dramatically reduces transaction costs and asymmetric information between sellers and buyers, making some middlemen unnecessary (Mu et al., 2020). It also enables producers to expand their territory to enter the markets of their competitors.

Many empirical studies and case studies have attempted to identify a causal relationship between e-commerce and poverty alleviation (Jensen, 2007; Goyal, 2010; Luo and Niu, 2019). Luo and Niu (2019) found that e-commerce participation in rural areas in China was associated with higher household income. In particular, the poor experienced higher income growth than the rich. The availability of information also led to an increase in the price of agricultural products in developing countries (Jensen, 2007; Goyal, 2010), which increased the profits of poor individuals. In contrast, Moodley and Morris (2004) found that garment export producers seldom used the internet as a new method to trade with buyers abroad. Couture et al. (2021) found that participation in e-commerce had no significant effect on household income.

In contrast with the previous theoretical literature, we focus on the effect of e-commerce on the production side. We discover that the development of e-commerce gives rise to firms' scale enhancement. Unlike the existing empirical literature, we provide county-level evidence that e-commerce increases the gross regional product in rural China, especially in poverty-stricken areas. Our empirical results show that the gross regional product of REDCs is higher than those of their counterparts. The effects of the REDC policy are even more significant for the subsample of poor counties. We also provide a sufficiently detailed analysis of how REDC policy enhances the gross regional product in those REDCs, which has been lacking in existing research. The development of manufacturers resulting from e-commerce explains the higher gross regional product in REDCs.

The remainder of the article is organized as follows. Section II lays out some background on e-commerce and poverty reduction. Section III presents the empirical strategy and results. Section IV discusses the evidence regarding poverty alleviation mechanisms, and Section V concludes.

II. Background

1. E-commerce development in rural China

E-commerce has developed rapidly in rural China over the past decade. Retailing is the most important part of e-commerce in rural China, and it has grown tremendously

over this period. The volume of online retailing transactions in rural China increased from RMB180 billion in 2014 to RMB1.4 trillion in 2018 (Ministry of Commerce of the People's Republic of China, 2018). The average growth rate is approximately 66.5 percent per year, suggesting that the volume of online retail transactions in rural China has increased substantially. In rural China, the 8 million online stores and related services offered approximately 20 million jobs in 2016.

A clear indicator of the development of e-commerce in rural China is the number of Taobao villages. We usually categorize villages and towns as rural China. Taobao villages and Taobao towns are therefore reasonable indicators of the development of e-commerce in rural China.

A village is defined as a Taobao village by the Ali Research Institute if it satisfies one of two conditions: its annual e-commerce sales reach RMB10 million and the number of active online stores in the village exceeds 100 or 10 percent of the number of households. There were only three Taobao villages in 2009. The number soared to 4,310 in 2019, illustrating the rapid growth of e-commerce in rural China (Ali Research Institute, 2019).

The Ali Research Institute also defines a Taobao town as a town that includes at least three Taobao villages or a town in which the volume of online retailing transactions is at least RMB30 million, and the number of active online stores is at least 300. The number of Taobao towns grew from 19 in 2014 to 1,118 in 2019 (Ali Research Institute, 2019). The volume of online retail transactions in Taobao villages and Taobao towns from July 2018 to June 2019 was approximately RMB700 billion. Almost seven million people were employed by those online stores in Taobao villages and Taobao towns.

In summary, the rapid growth of Taobao villages and Taobao towns demonstrates the remarkable progress of e-commerce in rural China.

2. E-commerce development and poverty alleviation

Most studies in China divided the country's poverty reduction into four phases. In the early period of reform and opening, China did not have any official poverty reduction policies, and most poverty reduction was due to institutional reform. Poverty reduction implemented with planning and organization by the government began in 1986 when the State Leading Group Office of Poverty Alleviation and Development was founded. After that, China implemented a series of poverty alleviation programs, including two national strategies: the *Seven-Year Priority Poverty Alleviation Program (1994–2000)* and the *Outline for the Development of China's Rural Areas (2001–2020)*. All of these programs aimed to reduce poverty by spurring regional development. China has designated 592 poor counties and provided policies and funding support. After 2012, China entered a

new phase in poverty alleviation. As the growth effect on poverty reduction weakened, the efficiency of traditional poverty reduction policies decreased. More concerning, China's economic growth went into an adjustment period, and the speed of growth decreased, which was not beneficial for poverty reduction. In 2013, Chinese President Xi Jinping put forward targeted poverty alleviation to achieve the goal of eliminating poverty (at the standard of RMB2,300 per year at constant 2010 prices) before 2020. After that, many poverty reduction policies were put forward, including point-to-point poverty alleviation, relocation of the poor, and poverty reduction by e-commerce.

Poverty reduction by e-commerce has grown with the development of e-commerce, and a few commerce giants have formed, such as Alibaba, Tencent, Jingdong, and Suning. They aim to sell all kinds of goods on the internet, and an important characteristic of these giants is that they help poor regions sell goods to push them out of poverty. In 2014, the Chinese government formally identified e-commerce as an important way to reduce poverty. In late 2014, China's State Council first listed the e-commerce poverty alleviation project as one of the top term projects for targeted poverty alleviation in 2015. It established the REDC policy, selecting 56 counties as REDCs. Most of the selected counties are nationally designated poor counties. After that, 192, 240, 260, and 260 counties were chosen to become REDCs in 2015, 2016, 2017, and 2018, respectively.[1] These counties would receive policy and funding support from the government in a similar way to the nationally designated poor counties.

The government also encourages e-commerce firms to invest in the poor villages in these counties. As of 2018, a total of 1,016 counties had received support as REDCs, and 737 of them were nationally designated poor counties, accounting for 88.6 percent of the total. This program has made significant achievements in poverty alleviation (Ministry of Commerce of the People's Republic of China, 2018). In 2018, the online sales in nationally designated poor counties reached RMB69.79 billion, an increase of 36.4 percent, which was 6 percent higher than China's rural online sales and 12.5 percent higher than China's online sales (Ministry of Commerce of the People's Republic of China, 2018).

Many researchers have studied the Chinese poverty problem (Chen and Ravallion, 2008; Park and Wang, 2010; Fang and Zou, 2014; Li, 2014; Ward, 2016; Alkire and Fang, 2019; Fang and Zhang, 2021) and they have evaluated the effect of the establishment of nationally designated poor counties (Meng, 2013). However, few studies have focused on evaluating the effect of poverty alleviation by e-commerce due

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[1]The data are from the Ministry of Commerce of China, available from: http://www.mofcom.gov.cn/article/zt_dzswjnc/lanmufive/201705/20170502572784.shtml; http://scjss.mofcom.gov.cn/article/cx/201708/20170802630135.shtml; http://www.mofcom.gov.cn/article/tongjiziliao/sjtj/jcktj/201809/20180902790215.shtml (online; cited April 2022).

to the challenge of data acquisition and the recent emergence of this project. Meng (2013) found that the establishment of nationally designated poor counties had significant effects on improving the development of these counties. It also showed that this program resulted in an increase of approximately 38 percent in the rural income for nationally designated poor counties from 1994 to 2000. The extensive support from the central and provincial governments has encouraged many counties to try to lobby their way onto the list, which led to a large targeting error in the program. A similar issue has affected the selection of REDCs for poverty alleviation.

III. Empirical framework and results

1. Empirical model and instrumental variable

To examine the relationship between the REDC policy and poverty reduction, we construct the following model:

$$\ln Y_{it} = \beta_0 + \beta_1 REDC_{it} + \beta X_{it} + u_t + v_i + \varepsilon_{it}, \tag{1}$$

where u_t and v_i are the year effect and county effect, respectively. In the estimation, we control for dummy variables in counties and years. Y_{it} is the dependent variable, and *REDC* is a dummy variable to indicate whether a county is identified as an REDC. The variable *REDC* is identical to the crucial variable difference-in-differences (DID) defined in Beck et al. (2010) when one treats the REDC policy as a quasi-natural experiment and applies the method of difference-in-differences. The REDC policy aims at reducing poverty in rural China. So, the policy and the corresponding DID variable are endogenous. The instrumental variable (IV) method may provide an unbiased *REDC* (DID) estimate. In this model, the dependent variables are the gross regional product per capita (*Grppc*), the final products of primary industry, the final products of secondary industry per capita, and the final products of the service sector per capita. *X* is composed of six basic controls and four characteristic controls. We also include dummy variables for each year and each county.

Endogeneity is a serious problem for our study because the identified *REDC* is related strongly to the development of counties. For example, the availability of the internet and roads is the most salient basis for e-commerce, but counties with a higher *Grppc* usually dominate poor counties in those infrastructures, making the wealthy counties more likely to be designated as REDCs. Following Duflo et al. (2011), we use the total number of REDCs in a province (*SUMREDC*) and the ratio of the number of REDCs to the total number of counties in a province (*RATEREDC*) as IVs because they are affected by the REDC policy and they are not influenced by the gross regional product

of the county. We also consider these two province-level IVs exogenous to decide whether one county is an REDC.

2. Data

Our sample comprises county-level data, mainly from the *China Statistical Yearbook* (*county-level*) between 2013 and 2017 (Organization of Rural Socio-Economic Survey, NBS, various years). There are approximately 2,080 rural counties in the *China Statistical Yearbook* (*county-level*). Although some variables and counties lack continuous data, we obtain an unbalanced panel of 2,081 counties between 2013 and 2017.

Our key variable is a binary variable that indicates whether a county is an REDC or not. The REDC program, launched jointly by the Ministry of Finance and Ministry of Commerce in 2014, aims to reduce poverty and promote e-commerce in rural areas. The list of REDCs in this paper was collected from the website of the Ministry of Commerce of the People's Republic of China.[2]

There were 56 REDCs in 2014 when the REDC policy was first established. Only eight provinces were chosen, and seven REDCs in each of those provinces were identified by the Ministry of Commerce. Later, 200, 240, and 260 new REDCs were appointed by the Ministry of Commerce in 2015, 2016, and 2017, respectively. Nearly every province, except Zhejiang province, had some counties designated REDCs by 2017, which brought nearly RMB20 million appropriation from the central government. With the appointment of new REDCs every year, the total number of affected counties was 756 in 2017. Most of them were national-level poverty-stricken counties in China.

The dependent variables are *Grppc*, the final product of primary industry, the final product of secondary industry per capita, and the final product of the service sector per capita at constant 2012 prices. All dependent variables are logged. We have six basic controls and four characteristic controls. The basic controls include population, investment in fixed assets, administrative area, number of students in secondary school and vocational school, number of workers in secondary industry, and the number of workers in the service sector. Investment is calculated at 2012 prices, and all the controls are logged. Characteristic controls are dummies and comprise being located in a poor region, being located in a hilly area, being a mountainous county, and being a minority county. Characteristic controls are from the *China Statistical Yearbook* (*county-level*) (Organization of Rural Socio-Economic Survey, NBS, 2010) and *Poverty Monitoring Report of Rural China* (Department of Household Surveys, NBS, 2016).

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[2]The website is available at http://www.mofcom.gov.cn/article/zt_dzswjnc/lanmufive/201705/20170502572784.shtml; http://scjss.mofcom.gov.cn/article/cx/201708/20170802630135.shtml (online; cited April 2022).

There are also some new variables, which are used in Section IV. The dependent variables comprise the number of industrial enterprises above designated size (*NIEDS*), the proportion of workers employed in secondary industry to the population, aggregate savings deposits, aggregate loans, the index of development of e-commerce (*AEDI*), and the index of development of online shops (*OBI*). The independent variables include the number of fixed telephones and the industrial structure. We define the industrial structure (*IS*) as the proportion of the final product of secondary industry in gross regional product. Except for the *AEDI* and the *OBI*, all the dependent and independent variables in Section IV come from the *China Statistical Yearbook* (*county-level*).

We used two indexes to indicate the development of e-commerce.[3] One was the *AEDI*, representing the development of e-commerce, and the other was the *OBI*, demonstrating the development of online shops. The two indexes, covering the years 2015 and 2016, were constructed by the Ali Research Institute. The *AEDI* measures the development of e-commerce in a county in a range from 0 to 100, where a higher index number represents greater development. The *OBI* reflects the proportion of online shopkeepers in the total population and the proportion of large online shops in the total number of online shops in a county. It is reasonable to consider the *AEDI* and *OBI* as excellent measures of the development of e-commerce because both indexes are based on the data of the Alibaba group, which represents nearly 45 percent of the volume of e-commerce transactions.[4] Table 1 presents the descriptive statistics of the major variables.

Table 1. Descriptive statistics

Variables	Definitions	Observations	Mean	Standard deviation
REDC	Whether it is an REDC	10,397	0.147	0.355
Grppc	Gross regional product per capita	10,380	36,251.58	36,077.7
Prodpri	Final product of primary industry	10,381	232,000	188,000
Prosecpc	Final product of secondary industry per capita	10,138	240,000	850,000
Proserpc	Final product of service sector per capita	10,177	107,000	120,000
Population	Population	10,383	49.218	36.826
Investment	Investment in fixed assets	8,306	1,360,000	1,370,000
Area	Administrative area	10,385	4,330.28	10,212.81

(Continued on the next page)

[3]The data can be applied for directly from the Ali Research Institute.

[4]The data are calculated based on data from the website of the Ministry of Commerce of the People's Republic of China, available from: http://dzsws.mofcom.gov.cn/article/ztxx/ndbg/201508/20150801082449.shtml, http://dzsws.mofcom.gov.cn/article/ztxx/ndbg/201807/20180702762458.shtm, and http://dzsws.mofcom.gov.cn/article/dzsw/tjjc/201706/20170602591881.shtml (online; cited April 2022).

(Table 1 continued)

Variables	Definitions	Observations	Mean	Standard deviation
Midvoc	Number of students in secondary school and vocational school	9,132	27,862.38	21,730.4
Worksec	Number of workers in secondary industry	10,140	72,580.66	92,629.04
Workser	Number of workers in the service sector	10,182	75,596.49	76,098.97
AEDI	Index of development of e-commerce	7,678	5.383	3.468
OBI	Index of development of online shops	7,677	8.023	4.967
NIEDS	Number of industrial enterprises above designated size	9,986	124.093	196.18
Proworksec	Proportion of workers employed in secondary industry to the population	10,138	0.127	0.105
Savings	Aggregate savings deposits	10,249	1,120,000	1,400,000
Loans	Aggregate loans	10,296	1,140,000	2,230,000
Numtele	Number of fixed telephones	10,292	54,319.74	86,907.35
IS	Proportion of the final product of secondary industry in gross regional product	10,383	0.434	0.149

Sources: Authors' calculations are based on data from the website of the Ministry of Commerce of the People's Republic of China, Organization of Rural Socio-Economic Survey, NBS (various years), and the Ali Research Institute (2019).

3. Effects on the gross regional product per capita

The effect of the REDC policy on the gross regional product per capita is presented in Table 2 along with the estimates of the IV regression.[5] Table 2 uses *RATEREDC* as the IV.

Column (1) shows that the estimate of *REDC* is positive and statistically significant when population, investment in fixed assets, administrative area, the number of students in secondary school and vocational school, and county fixed effects are included. The estimator of *REDC* demonstrates that REDCs have 25.2 percent higher *Grppc* than other counties. The identification and aid spur the development of e-commerce in those counties. The assistance to REDCs comes from the government and giant firms. The government helps rural areas build more roads, reducing transportation costs. Being identified as an REDC also requires the county government to provide invaluable resources, usually land for warehouses and offices for the development of e-commerce. The crucial aspect is the land quotas, which are very difficult to obtain in China. The high-speed optical fiber is the basic infrastructure for e-commerce. Not all villages have access to high-speed optical fiber internet but some telecom companies donate the necessary materials to the

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[5]Due to space limitations, the OLS outcome and first-stage estimation outcome of the IV are not shown in this paper but are available from the authors upon request.

poor farmers in the villages as an investment to spur the development of e-commerce. Platform companies, such as Alibaba, send their employees to teach farmers how to open online shops and manage them. Platform companies also construct many delivery centers to connect the villages to the world market. Some enterprises even donate computers and other equipment to the online storekeepers in the villages.

Table 2. The effect of the REDC policy on the gross regional product per capita (*Grppc*)

	Total sample					Subsample of poor counties				
	IV: *RATEREDC*					IV: *RATEREDC*				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
REDC	0.252***	0.240***	0.085***	0.084***	0.038*	0.289***	0.289***	0.105***	0.105***	−0.159***
	(0.015)	(0.015)	(0.013)	(0.013)	(0.022)	(0.019)	(0.019)	(0.020)	(0.020)	(0.040)
Population	−0.721***	−0.744***	−0.749***	−0.771***	−0.832***	−0.518***	−0.518***	−0.635***	−0.635***	−0.955***
	(0.118)	(0.118)	(0.107)	(0.107)	(0.086)	(0.117)	(0.117)	(0.085)	(0.085)	(0.086)
Investment	0.197***	0.199***	0.173***	0.175***	0.135***	0.125***	0.125***	0.055***	0.055***	0.065***
	(0.013)	(0.013)	(0.014)	(0.014)	(0.013)	(0.017)	(0.017)	(0.015)	(0.015)	(0.016)
Area	0.145***	0.187***	0.155***	0.191***	0.186***	−0.245**	−0.245**	−0.056	−0.056	0.113
	(0.042)	(0.053)	(0.038)	(0.049)	(0.049)	(0.107)	(0.107)	(0.050)	(0.050)	(0.078)
Midvoc	0.047***	0.057***	0.066***	0.075***	0.035***	0.081***	0.081***	0.086***	0.086***	0.011
	(0.012)	(0.014)	(0.011)	(0.012)	(0.012)	(0.023)	(0.023)	(0.018)	(0.018)	(0.015)
Characteristic controls	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Province time trends	No	No	No	No	Yes	No	No	No	No	Yes
Kleibergen–Paap rk LM statistic	659.2	642	350.2	331.5	168.6	262.2	262.2	96.25	96.25	35.04
Kleibergen–Paap rk Wald *F* statistic	924.7	932	481.3	470.6	138.9	455.2	455.2	119.3	119.3	26.79
Observations	7,289	6,713	7,289	6,713	6,714	1,997	1,997	1,997	1,997	1,997
R^2	0.982	0.981	0.988	0.987	0.990	0.967	0.967	0.982	0.982	0.987

Sources: Authors' estimations are based on data from the website of the Ministry of Commerce of the People's Republic of China, Organization of Rural Socio-Economic Survey, NBS (various years), and Department of Household Surveys, NBS (2016).

Notes: ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively. The robust standard errors are in parentheses. All the controls except for the characteristic controls are logged and *Grppc* is in log form. The Kleibergen–Paap rk LM statistic is used for the under-identification test, Kleibergen–Paap rk Wald *F* statistic is used for the weak identification test. IV, instrumental variables; *RATEREDC*, the ratio of the number of REDCs to the total number of counties in a province; *REDC*, rural e-commerce demonstration county. For the definitions of other variables, see Table 1.

The development of e-commerce expands the markets of the affected counties. This enables producers and farmers to sell their commodities across China, and even to South Korea, Japan, and the US. Profits made by the expansion of the market transfer into investment finally increase the *Grppc*.

E-commerce also makes many niche products producers profitable by markedly reducing the costs of marketing. The definition of niche products can be found in the well-known book *The Long Tail* written by Chris Anderson (Anderson, 2006). In this book, Anderson emphasizes the kinds of products that are not popular in the market but are truly wanted by a few aficionados. The demand for those products is usually too small to enable a producer to survive. However, the expanding market currently enables increasing numbers of producers to survive. As the variety of those products is almost infinite, the aggregate demand for them would be enormous. The development of e-commerce stimulates the establishment of factories that produce those products. If every factory needs only RMB1 million, the tremendous number of factories yields a high gross regional product in the given counties. As Goldfarb and Tucker (2019) mentioned, Brynjolfsson et al. (2011) documented that the variety of products available and purchased was higher online than offline. This is indirect evidence to support our view.

In summary, with high-speed optical fiber, land, capital, and human capital, REDCs experience rapid development of e-commerce. Induced by the higher income, many farmers or workers become employees or shopkeepers, thus raising the *Grppc* in REDCs.

Column (2) includes characteristic controls. We obtain a similar positive coefficient, implying that characteristic controls may not be important omitted variables. Column (3) includes county fixed effects and year fixed effects to control for factors that covary with the county and year. The coefficient declines dramatically, indicating that the year fixed effect plays a salient role in this regression. Nevertheless, the estimate remains positive and significant at the 5 percent level.

Column (4) displays our benchmark specification, including characteristic controls, year fixed effects, and county fixed effects. The estimate is positive and statistically significant, implying that REDCs have 8.4 percent higher *Grppc* than the other counties. Comparing columns (1) and (4), we can realize that the influence of the REDC policy without year fixed effects is more than twice that with year fixed effects, which means that the year fixed effects are noteworthy and the coefficient of *REDC* is estimated with omitted variable bias.

We also add a linear province-time trend in column (5). The estimate of *REDC* is still statistically significant, but the quantity is smaller than that in column (4). The estimates in column (5) may prove the robustness of our estimates in column (4).

Columns (6)–(10) display the results for a subset of the sample – the poor counties[6] – and present similar estimates to those of columns (1)–(4). The coefficient of

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[6]The list of national poor counties is available from: http://www.gov.cn/gzdt/2012-03/19/content_2094524.htm (online; cited April 2022).

column (9) is 25 percent greater than that of column (4), which may illustrate that the REDC policy dramatically alleviates the poverty of the selected counties. Poor counties usually lack infrastructures such as roads, delivery systems, and the Internet, and most of the population is involved in primary industry. Column (10) also includes linear province-time trends. The estimate of *REDC* becomes negative and statistically significant, which is not consistent with our whole analysis. The estimates in column (10) may suggest some other explanations of *REDC* when we add province–time trends. Because we have added county fixed effect and year fixed effect for all analyses, and we have adjusted the dependent variable with province-level price, adding province–time trends would introduce a collinearity problem, reducing the precision of our estimation. We think that the REDC policy should not influence regional development adversely. According to our interviews, e-commerce usually improves the income of participants. It is unreasonable that the donations of government and companies impede the aggregate product per capita in REDCs compared to their poor counterparts.

It is usually not a challenge for a farmer to become an online shopkeeper. Well-known platform enterprises are interested in establishing delivery stations and warehouses to expand their delivery systems to rural China. As mentioned above, being identified as an REDC leads to aid from the government and giant firms. This aid enables many farmers to leave the primary industry and become online shopkeepers, which increases their productivity and alleviates poverty. Most poor counties lie in mountainous areas, which often contain unique products. For example, some herbal medicines can be cultivated only in those mountains. Farmers can sell these items across China and even to the world and make more money than they could before.

4. Effects on different sectors

We now turn to the effects on primary industry, secondary industry, and the service sector. Table 3 presents all the results. Columns (1), (2), (7), and (8) show the effects of the REDC policy on the final product of primary industry. We cannot obtain the final product of primary industry per capita. Hence, we have to estimate the effects of the REDC policy on the aggregate final product of primary industry. When estimating the effects on all samples (columns (1) and (2)), the coefficients are positively and highly significant. Column (2) indicates that REDCs yield 10.6 percent higher final products from primary industry.

Most people living in REDCs are farmers. The disposable income of these farmers is nearly RMB1,200 per month. If an individual opens a Taobao store on the internet,

Table 3. The effects on different sectors

	Total sample						Subsample of poor counties					
	Final product of primary industry		Final product of secondary industry per capita		Final product of service sector per capita		Final product of primary industry		Final product of secondary industry per capita		Final product of service sector per capita	
			IV: *RATEREDC*						IV: *RATEREDC*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
REDC	0.124*** (0.013)	0.106*** (0.013)	0.124*** (0.023)	0.131*** (0.023)	0.042*** (0.013)	0.033** (0.013)	0.154*** (0.025)	0.154*** (0.025)	0.236*** (0.043)	0.236*** (0.043)	−0.071*** (0.020)	−0.071*** (0.020)
Population	0.197** (0.086)	0.186** (0.088)					0.546*** (0.116)	0.546*** (0.116)				
Worksec			−0.976*** (0.004)	−0.977*** (0.004)					−0.976*** (0.006)	−0.976*** (0.006)		
Workserv					−0.983*** (0.005)	−0.982*** (0.005)					−0.987*** (0.007)	−0.987*** (0.007)
Investment	0.057*** (0.008)	0.052*** (0.007)	0.295*** (0.023)	0.303*** (0.025)	0.114*** (0.011)	0.113*** (0.011)	−0.004 (0.012)	−0.004 (0.012)	0.110*** (0.025)	0.110*** (0.025)	−0.007 (0.012)	−0.007 (0.012)
Area	0.165*** (0.040)	0.151*** (0.038)	0.229*** (0.060)	0.293*** (0.079)	0.118*** (0.042)	0.115*** (0.043)	−0.087 (0.090)	−0.087 (0.090)	−0.123 (0.120)	−0.123 (0.120)	0.063 (0.066)	0.063 (0.066)
Midvoc	0.071*** (0.010)	0.073*** (0.010)	0.093*** (0.018)	0.113*** (0.019)	0.064*** (0.012)	0.062*** (0.013)	0.109*** (0.022)	0.109*** (0.022)	0.148*** (0.031)	0.148*** (0.031)	0.023 (0.017)	0.023 (0.017)
Characteristic controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,289	6,713	7,182	6,611	7,186	6,615	1,997	1,997	1,971	1,971	1,972	1,972
R^2	0.993	0.993	0.981	0.982	0.987	0.987	0.988	0.988	0.985	0.985	0.986	0.986

Sources: Authors' estimations are based on data from the website of the Ministry of Commerce of the People's Republic of China, Organization of Rural Socio-Economic Survey, NBS (various years), and Department of Household Surveys, NBS (2016).

Notes: *** and ** represent significance at the 1 and 5 percent levels, respectively. The robust standard errors are in parentheses. All the controls except for characteristic controls are logged. Under-identification tests and weak identification tests prove that *RATEREDC* is a reasonable IV for *REDC*. The final product of the primary industry, the final product of secondary industry per capita, and the final product of the service sector per capita are all in log form. IV: instrumental variable; *RATEREDC*, the ratio of the number of *REDC*s to the total number of counties in a province; *REDC*, rural e-commerce demonstration county. For the definitions of other variables, see Table 1.

he generally makes RMB5,000 per month.[7] Many farmers, therefore, open stores on the internet. Many Taobao storekeepers used to migrate to other provinces for employment with manufacturers but have returned to their villages because they could obtain higher income by opening online shops. Previously, agricultural goods were sold only in the local market, but e-commerce expanded the market. The availability of information also makes a middleman unnecessary. The growth of demand and the disappearance of the middleman result in a higher price for goods. Moreover, Taobao shopkeepers generally help farmers sell their most profitable agricultural goods, which leads to the expansion of the area cultivated. The final product of agricultural yield increases along with the expansion of the cultivated area under the most profitable agricultural goods and the rise of the price of agricultural goods.

When estimating the coefficient only with the sample of poor counties, the estimates are again positive and significant. We find that the coefficient of column (8) is 45.3 percent greater than that of column (2), implying the dramatic effects of the REDC policy on poor counties. The influence of the REDC policy is greater in poor counties because its effect may be constant, and the poor counties have a low agricultural final product. The poor people in poor counties benefit most from the policy, which is key for poverty alleviation.

Columns (3), (4), (9), and (10) show the estimates for the secondary industry. Most of the estimators are positive and statistically significant, showing the positive effects of the REDC policy on the final product per capita of secondary industry. Column (4) indicates that REDCs have a 13.1 percent higher final product of secondary industry per capita. Manufacturers also benefit from the expansion of the market induced by the development of e-commerce. As the demand for industrial goods increases, the price rises, and more investment in secondary industry is induced. As a result of the increase in the selling price and the new investment, the final product per capita of secondary industry increases. Column (10) shows that REDCs have a 23.6 percent higher final product of secondary industry per capita than other counties, indicating greater effects of the policy on poor counties. Columns (5), (6), (11), and (12) display the estimates for the service sector. Column (6) shows that the REDC policy increases the final product per capita of the service sector by 3.3 percent in all samples, but columns (11) and (12) illustrate that the REDC policy impeded the increase in the final product per capita of the service sector by 7.1 percent in poor counties.

When farmers or workers turn to work in e-commerce services, for example, as Taobao shopkeepers and couriers, their earnings rise. This means that more people

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[7]Data source: the authors' investigation and the National Bureau of Statistics of China. Available from: https://data.stats.gov.cn/easyquery.htm?cn=C01&zb=A0A01&sj=2018 (online; cited April 2022).

work in the service sector, implying that the final product per capita may decline. If the final product per capita of e-commerce services is greater than the current final product per capita of the service sector, the final product per capita of the service sector will increase, and vice versa.

For rich counties, the low costs of delivery and transport lead to higher output from online storekeepers than from conventional storekeepers in the service sector. The final product of the service sector per capita in the rich counties is, therefore, greater than that of current employees in the service sector, promoting a positive effect of the REDC policy on the final product of the service sector per capita. In contrast, due to their inferior infrastructure, the cost of delivery is higher in poor counties than in rich counties. In poor counties, a high proportion of employees in the service sector is employed by the government and have a good salary. The income of those involved in e-commerce may therefore be less than the income of current employees in the service sector. Finally, the effects of the REDC policy are negative for the subsample of poor counties.

The survival of the online shops in poor counties depends substantially on the special items sold on the Internet or the special advantages of the rural area, such as cheap land and a large supply of labor. For example, Xiaying village in Yunxi county in Hubei province is well known for selling turquoise jewelry, a special item mined from the mountain near the village, to all of China on the internet. Many skilled laborers can design and process turquoise jewelry. They can therefore produce or sell jewelry on the internet in the absence of strong competition. However, the delivery costs are still high for most poor counties, which may result in less output of online shopkeepers than conventional shopkeepers in the service sector. Another good example is Shaji town in Suining county in Jiangsu province, which is well known for producing assembled furniture. The cheap land and large supply of labor are the critical factors that boost the development of online storekeepers in those areas because they reduce the costs of input, and mass production further diminishes the costs. The wage of an employee in rural areas is lower than that in urban areas. In summary, online storekeepers can defeat their competitors because of the low costs.

5. Robustness test

Table 4 presents the robustness test of the effects of the REDC policy on gross regional product per capita by using *SUMREDC* as an instrumental variable. The magnitude of the estimates is similar to that in Table 2, except in columns (7) and (8), the estimates are still highly significant at the 5 percent level. All of these regressions show the robustness of the estimates in Table 2.

Table 4. The effect of the REDC policy on the gross regional product per capita (*Grppc*)

	Total sample				Subsample of poor counties			
	IV: *SUMREDC*				IV: *SUMREDC*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
REDC	0.277***	0.265***	0.093***	0.096***	0.312***	0.312***	−0.057	−0.057
	(0.017)	(0.017)	(0.020)	(0.021)	(0.023)	(0.023)	(0.063)	(0.063)
Population	−0.724***	−0.748***	−0.749***	−0.771***	−0.530***	−0.530***	−0.639***	−0.639***
	(0.117)	(0.116)	(0.108)	(0.107)	(0.119)	(0.119)	(0.077)	(0.077)
Investment	0.194***	0.195***	0.173***	0.176***	0.118***	0.118***	0.040***	0.040***
	(0.013)	(0.014)	(0.014)	(0.014)	(0.017)	(0.017)	(0.014)	(0.014)
Area	0.145***	0.188***	0.155***	0.191***	−0.264**	−0.264**	0.070	0.070
	(0.043)	(0.055)	(0.038)	(0.049)	(0.116)	(0.116)	(0.065)	(0.065)
Midvoc	0.053***	0.063***	0.067***	0.075***	0.086***	0.086***	0.065***	0.065***
	(0.013)	(0.014)	(0.011)	(0.012)	(0.024)	(0.024)	(0.018)	(0.018)
Characteristic controls	No	Yes	No	Yes	No	Yes	No	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
Kleibergen–Paap rk LM statistic	701.6	683.6	286.1	257.4	249.7	249.7	17.09	17.09
Kleibergen–Paap rk Wald *F* statistic	749.3	741.2	249.5	224.6	329.3	329.3	12.83	12.83
Observations	7,289	6,713	7,289	6,713	1,997	1,997	1,997	1,997
R^2	0.981	0.980	0.988	0.986	0.964	0.964	0.985	0.985

Sources: Authors' estimations are based on data from the website of the Ministry of Commerce of the People's Republic of China, Organization of Rural Socio-Economic Survey, NBS (various years), and Department of Household Surveys, NBS (2016).

Notes: *** and ** represent significance at the 1 and 5 percent levels, respectively. The robust standard errors are in parentheses. All the controls except for characteristic controls are logged and *Grppc* is in log form. The Kleibergen–Paap rk LM statistic is used for the under-identification test, Kleibergen–Paap rk Wald *F* statistic is used for the weak identification test. IV, instrumental variables; *REDC*, rural e-commerce demonstration county; *SUMREDC*, the total number of REDCs in a province. For the definitions of other variables, see Table 1.

Table 5 provides proof of the effects of the REDC policy on different sectors, as shown in Table 3. The estimates in columns (1) and (2) are similar to those in Table 3, but the estimates in columns (7) and (8) are dramatically greater than those in Table 3. We also present the effects of the REDC policy on the final product per capita of the secondary industry in columns (3) and (4). The magnitude of the estimates is approximately the same as that in Table 3. The coefficients of columns (9) and (10) are no longer significant. Columns (5) and (6) show that the effects of the REDC policy on the final product per capita of the service sector still hold, although the estimates of columns (11) and (12) are not significant.

Table 5. The effects on different sectors

	Total sample						Subsample of poor counties					
	Final product of primary industry		Final product of secondary industry per capita		Final product of service sector per capita		Final product of primary industry		Final product of secondary industry per capita		Final product of service sector per capita	
			IV: SUMREDC						IV: SUMREDC			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
REDC	0.104*** (0.018)	0.091*** (0.018)	0.094*** (0.032)	0.109*** (0.034)	0.218*** (0.023)	0.211*** (0.024)	0.256*** (0.087)	0.256*** (0.087)	0.065 (0.116)	0.065 (0.116)	−0.109 (0.072)	−0.109 (0.072)
Population	0.197** (0.086)	0.186** (0.088)					0.549*** (0.127)	0.549*** (0.127)				
Worksec			−0.976*** (0.004)	−0.977*** (0.004)					−0.976*** (0.005)	−0.976*** (0.005)		
Workserv					−0.983*** (0.005)	−0.982*** (0.005)					−0.987*** (0.007)	−0.987*** (0.007)
Investment	0.0057*** (0.007)	0.052*** (0.007)	0.295*** (0.023)	0.303*** (0.025)	0.116*** (0.011)	0.116*** (0.012)	0.005 (0.015)	0.005 (0.015)	0.095*** (0.024)	0.095*** (0.024)	−0.010 (0.014)	−0.010 (0.014)
Area	0.165*** (0.039)	0.151*** (0.038)	0.230*** (0.060)	0.293*** (0.078)	0.115** (0.046)	0.114** (0.047)	−0.166 (0.132)	−0.166 (0.132)	0.020 (0.133)	0.020 (0.133)	0.094 (0.088)	0.094 (0.088)
Midvoc	0.070*** (0.010)	0.072*** (0.010)	0.092*** (0.018)	0.112*** (0.019)	0.070*** (0.013)	0.071*** (0.014)	0.122*** (0.027)	0.122*** (0.027)	0.126*** (0.032)	0.126*** (0.032)	0.018 (0.021)	0.018 (0.021)
Characteristic controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,289	6,713	7,182	6,611	7,186	6,615	1,997	1,997	1,971	1,971	1,972	1,972
R^2	0.993	0.994	0.982	0.982	0.984	0.983	0.984	0.984	0.987	0.987	0.985	0.985

Sources: Authors' estimations are based on data from the website of the Ministry of Commerce of the People's Republic of China, Organization of Rural Socio-Economic Survey, NBS (various years), and Department of Household Surveys, NBS (2016).

Notes: ***, *** and ** represent significance at the 1 and 5 percent levels, respectively. Robust standard errors are in parentheses. All the controls except for characteristic controls are logged. Final product of primary industry, the final product of secondary industry per capita, and the final product of the service sector per capita are all in log form. The Kleibergen–Paap rk LM statistic is used for the under-identification test, Kleibergen–Paap Wald *F* statistic is used for the weak identification test. IV, instrumental variables; *REDC*, rural e-commerce demonstration county; *SUMREDC*, the total number of REDCs in a province. For the definitions of other variables, see Table 1.

IV. Mechanism

The REDC policy has a statistically significant and quantitatively important positive effect on gross regional product per capita. It increases the aggregate final productivity of primary industry, final productivity per capita of secondary industry, and final productivity per capita of the service sector. What is the underlying mechanism driving these results? We use *RATEREDC* and the *SUMREDC* as the IVs in the following regressions.

1. Development of e-commerce

We think that the development of e-commerce is the key explanation for the positive economic influence of the REDC policy. Specifically, the REDC policy stimulates online deals in two ways. First, it encourages an increasing number of individuals to open online shops, which enables them to make more money than they did as farmers or workers. Moreover, online stores expand the markets for farmers and local manufacturers. Clearly, the development of e-commerce increases gross regional product per capita.

Table 6 shows that the REDC policy has a statistically significant and large positive effect on the development of e-commerce. Columns (2) and (4) show that the level of e-commerce is approximately twice as high as that in unaffected counties. Regarding the poor counties, columns (6) and (8) display that the coefficient is small or nonsignificant. The lack of infrastructure in REDCs reduces the effects of the REDC policy in poor counties. Columns (5) and (7) show that the estimates are similar when we control for the characteristics of counties.

Table 7 shows that the REDC policy has a positive effect on the index of online stores, with and without controlling the county characteristics. This demonstrates that aid and donations attract an increasing number of people to open online stores, and the revenue of online stores increases remarkably, which usually increases the aggregate value of online transactions. Columns (2) and (4) show that the *OBI* of REDCs is approximately twice as high as that of other counties. When estimating the poor counties, columns (6) and (8) prove that REDCs also have a higher *OBI*. The estimates nearly do not change when we control for the characteristics of counties.

Some giant companies, such as Alibaba, donate computers, provide loans, and train online store managers (Lai et al., 2020). The local government not only provides infrastructure, licenses, and public services, but also assists managers in laying high-speed fiber, constructing an express system, and even building factories to produce the goods to be sold. All of these incentives inspire an increasing number of people to devote themselves to e-commerce. The income of an online store manager is usually higher than that of a farmer or factory worker. The development of e-commerce therefore leads to an increase in the income of participants.

Table 6. The effect of the REDC on the index of development of e-commerce (*AEDI*)

	Total sample				Subsample of poor counties			
	IV: *RATEREDC*		IV: *SUMREDC*		IV: *RATEREDC*		IV: *SUMREDC*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
REDC	0.919***	0.866***	1.282***	1.212***	0.034	0.034	1.083***	1.083***
	(0.113)	(0.111)	(0.138)	(0.136)	(0.221)	(0.221)	(0.407)	(0.407)
Grppc	−0.147*	−0.147*	−0.172**	−0.171**	0.087	0.087	−0.085	−0.085
	(0.079)	(0.080)	(0.087)	(0.087)	(0.284)	(0.284)	(0.358)	(0.358)
Numtele	0.094***	0.091***	0.098***	0.096***	0.042	0.042	0.012	0.012
	(0.028)	(0.028)	(0.032)	(0.032)	(0.043)	(0.043)	(0.063)	(0.063)
Investment	0.059	0.062	0.048	0.052	−0.000	−0.000	0.099	0.099
	(0.039)	(0.040)	(0.044)	(0.044)	(0.049)	(0.049)	(0.082)	(0.082)
Characteristic controls	No	Yes	No	Yes	No	Yes	No	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,783	3,656	3,783	3,656	1,107	1,107	1,107	1,107
R^2	0.807	0.811	0.754	0.763	0.797	0.797	0.605	0.605

Sources: Authors' estimations are based on data from the website of the Ministry of Commerce of the People's Republic of China, Organization of Rural Socio-Economic Survey, NBS (various years), and the Ali Research Institute (2019).

Notes: ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively. The robust standard errors are in parentheses. All the controls except for characteristic controls are logged. *AEDI* is in log form. Except for columns (7) and (8), under-identification tests and weak identification tests prove that *RATEREDC* is a reasonable IV for *REDC*. IV, instrument variable; *RATEREDC*, the ratio of the number of REDCs to the total number of counties in a province; *REDC*, the rural e-commerce demonstration county; *SUMREDC*, the total number of REDCs in a province.

Table 7. The effect of the REDC on index of development of online shops (*OBI*)

Variables	Total sample				Subsample of poor counties			
	IV: *RATEREDC*		IV: *SUMREDC*		IV: *RATEREDC*		IV: *SUMREDC*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
REDC	0.876***	0.822***	1.269***	1.206***	0.088	0.088	1.239***	1.239***
	(0.102)	(0.099)	(0.133)	(0.131)	(0.186)	(0.186)	(0.428)	(0.427)
Grppc	−0.189**	−0.190**	−0.216**	−0.216**	0.058	0.058	−0.131	−0.131
	(0.080)	(0.080)	(0.088)	(0.088)	(0.228)	(0.228)	(0.330)	(0.330)
Numtele	0.072***	0.071***	0.077***	0.076**	0.030	0.030	−0.003	−0.003
	(0.026)	(0.026)	(0.030)	(0.030)	(0.037)	(0.037)	(0.064)	(0.064)
Investment	0.068**	0.070**	0.056	0.059	−0.040	−0.040	0.069	0.069
	(0.033)	(0.033)	(0.038)	(0.038)	(0.057)	(0.057)	(0.084)	(0.084)
Characteristic controls	No	Yes	No	Yes	No	Yes	No	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,782	3,655	3,782	3,655	1,107	1,107	1,107	1,107
R^2	0.822	0.826	0.761	0.769	0.855	0.855	0.605	0.605

Sources: Authors' estimations are based on data from the website of the Ministry of Commerce of the People's Republic of China, Organization of Rural Socio-Economic Survey, NBS (various years), and the Ali Research Institute (2019).

Notes: *** and ** represent significance at the 1 and 5 percent levels, respectively. The robust standard errors are in parentheses. All the controls except for characteristic controls are logged. *OBI* is in log form. Except for columns (7) and (8), the under-identification tests and weak identification tests prove that *RATEREDC* is a reasonable IV for *REDC*. IV, instrument variable; *RATEREDC*, the ratio of the number of REDCs to the total number of counties in a province; *REDC*, the rural e-commerce demonstration county; *SUMREDC*, the total number of REDCs in a province. For the definitions of other variables, see Table 1.

2. Scale of manufacturers

The development of e-commerce generally expands the market for local manufacturers. The increase in demand may lead manufacturers to expand. We, therefore, wondered whether the REDC policy enlarged the scale of manufacturers in the affected counties. We examined the *NIEDS* in the counties, as we could not find the microdata related to factories in those years. It is reasonable to expect that the REDC policy should lead to an increase in *NIEDS*.

We present the results in Table 8. Column (2) shows that REDCs had a higher *NIEDS*, as we expected. This estimate means that the *NIEDS* of REDCs was 22.8 percent higher than that of other counties. The coefficient of *REDC* was highly statistically significant and quantitatively large. The identification of REDCs motivates farmers or

Table 8. The effect of the REDC policy on the number of industrial
enterprises above the designated size (*NIEDS*)

Variables	Total sample				Subsample of poor counties			
	IV: *RATEREDC*		IV: *SUMREDC*		IV: *RATEREDC*		IV: *SUMREDC*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
REDC	0.266***	0.228***	0.414***	0.392***	0.107*	0.107*	0.621***	0.621***
	(0.031)	(0.029)	(0.044)	(0.044)	(0.056)	(0.056)	(0.222)	(0.222)
Grppc	0.543***	0.547***	0.539***	0.541***	0.336***	0.336***	0.431***	0.431***
	(0.045)	(0.046)	(0.046)	(0.048)	(0.090)	(0.090)	(0.114)	(0.114)
Population	0.579***	0.586***	0.579***	0.583***	0.879***	0.879***	0.937***	0.937***
	(0.069)	(0.071)	(0.072)	(0.075)	(0.188)	(0.188)	(0.230)	(0.230)
Investment	0.156***	0.153***	0.158***	0.157***	0.123***	0.123***	0.165***	0.165***
	(0.017)	(0.018)	(0.018)	(0.019)	(0.032)	(0.032)	(0.041)	(0.041)
Area	0.070	0.053	0.067	0.052	0.297**	0.298**	−0.104	−0.105
	(0.066)	(0.051)	(0.071)	(0.062)	(0.151)	(0.151)	(0.299)	(0.299)
Midvoc	0.049***	0.041**	0.055***	0.050**	−0.003	−0.003	0.055	0.055
	(0.019)	(0.020)	(0.020)	(0.022)	(0.037)	(0.037)	(0.051)	(0.051)
Savings	0.009	0.012	0.005	0.009	0.064**	0.064**	0.082**	0.082**
	(0.023)	(0.023)	(0.025)	(0.025)	(0.025)	(0.025)	(0.034)	(0.034)
Characteristic controls	No	Yes	No	Yes	No	Yes	No	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,184	6,656	7,184	6,656	1,972	1,972	1,972	1,972
R^2	0.986	0.986	0.984	0.983	0.973	0.973	0.954	0.954

Sources: Authors' estimations are based on data from the website of the Ministry of Commerce of the People's Republic of China, Organization of Rural Socio-Economic Survey, NBS (various years), and Department of Household Surveys, NBS (2016).

Notes: ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively. The robust standard errors are in parentheses. All the controls except for characteristic controls are logged. *NIEDS* is in log form. Under-identification tests and weak identification tests prove that *RATEREDC* is a reasonable IV for *REDC*. IV, instrument variable; *RATEREDC*, the ratio of the number of REDCs to the total number of counties in a province; *REDC*, the rural e-commerce demonstration county; *SUMREDC*, the total number of REDCs in a province. For the definitions of other variables, see Table 1.

workers to open online shops. The industrial enterprises located in an REDC can enter markets previously occupied by local industrial companies through online stores, such as Taobao stores and Tmall stores, and compete with local industrial companies. The winner of the competition encroaches on and eventually captures the market previously held by the local industrial enterprises. With the expansion of the market, the winner of the competition becomes increasingly larger.

When estimating the coefficient with the subsample of poor counties, the estimate is still significant, with decreasing effects of *REDC* on the *NIEDS*. The lack of manufacturers leads to a decline in the revenue of e-commerce in poor counties.

With the expansion of manufacturing, there is an increase in the number of workers employed in secondary industry as a proportion of the total population. Table 9 shows the effects of the REDC policy on the number of workers employed in secondary industry as a proportion of the population. When estimating with the total sample, we found that most of the estimates are significant. Column (2) shows that the proportion of workers employed in secondary industry was 1.3 percent higher in REDCs than in the

Table 9. The effect of the REDC policy on the proportion of workers employed in the secondary industry (*Proworksec*)

Variables	Total sample				Subsample of poor counties			
	IV: *RATEREDC*		IV: *SUMREDC*		IV: *RATEREDC*		IV: *SUMREDC*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
REDC	0.018***	0.013***	0.012*	0.003	0.013*	0.013*	0.023	0.023
	(0.005)	(0.004)	(0.007)	(0.006)	(0.007)	(0.007)	(0.062)	(0.062)
Grppc	0.013***	0.017***	0.013***	0.018***	0.008*	0.008*	0.009*	0.009*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Population	−0.076***	−0.066***	−0.076***	−0.067***	−0.031**	−0.031**	−0.028	−0.028
	(0.019)	(0.021)	(0.018)	(0.021)	(0.015)	(0.015)	(0.024)	(0.024)
IS	0.040***	0.023**	0.039***	0.022**	0.017	0.017	0.020	0.020
	(0.011)	(0.011)	(0.011)	(0.011)	(0.014)	(0.014)	(0.023)	(0.023)
Characteristic controls	No	Yes	No	Yes	No	Yes	No	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,125	9,335	10,125	9,335	2,765	2,765	2,765	2,765
R^2	0.889	0.906	0.890	0.907	0.894	0.894	0.888	0.888

Sources: Authors' estimations are based on data from the website of the Ministry of Commerce of the People's Republic of China, Organization of Rural Socio-Economic Survey, NBS (various years), and Department of Household Surveys, NBS (2016).

Notes: ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively. The robust standard errors are in parentheses. *Grppc* and *Population* are logged. Except for columns (7) and (8), under-identification tests and weak identification tests prove that *RATEREDC* is a reasonable IV for *REDC*. IV, instrumental variable; *RATEREDC*, the ratio of the number of REDCs to the total number of counties in a province; *REDC*, the rural e-commerce demonstration county; *SUMREDC*, the total number of REDCs in a province. For the definitions of other variables, see Table 1.

other counties. As the average population of all counties was approximately 492,000,[8] the estimate demonstrates that REDCs will obtain another 6,400 jobs in the secondary industry in the next few years. Wages from manufacturing are usually higher than the income of farmers, so many poor farmers can benefit from the REDC policy. When we use the subsample of poor counties, the estimates are still statistically significant and quantitatively similar.

3. Aggregate savings deposits and aggregate loans

E-commerce may provide new opportunities to the inhabitants of REDCs. Individuals who transfer from primary and secondary industries to e-commerce should earn more than they did before. More income results in more savings deposits. Hence, we may expect the aggregate savings deposits to be greater in REDCs than in other counties.

Table 10 displays the effects of the REDC policy on aggregate savings deposits. Most of the estimates are significant. Columns (1)–(4) show that the REDC policy has a

Table 10. The effect of the REDC policy on aggregate savings deposits (*Savings*)

	Total sample				Subsample of poor counties			
	IV: *RATEREDC*		IV: *SUMREDC*		IV: *RATEREDC*		IV: *SUMREDC*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
REDC	0.077***	0.047**	0.073**	0.032	0.214***	0.214***	0.480	0.480
	(0.024)	(0.024)	(0.030)	(0.031)	(0.076)	(0.076)	(0.552)	(0.552)
Grppc	0.100***	0.093***	0.100***	0.094***	−0.025	−0.025	−0.017	−0.017
	(0.026)	(0.028)	(0.027)	(0.028)	(0.048)	(0.048)	(0.059)	(0.059)
Population	0.170**	0.206***	0.169**	0.205***	0.221	0.221	0.313	0.313
	(0.066)	(0.074)	(0.066)	(0.074)	(0.171)	(0.171)	(0.255)	(0.255)
IS	0.153**	0.166**	0.153**	0.164**	0.384**	0.384**	0.466*	0.466*
	(0.074)	(0.078)	(0.074)	(0.078)	(0.191)	(0.191)	(0.267)	(0.267)
Characteristic controls	No	Yes	No	Yes	No	Yes	No	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,234	9,499	10,234	9,499	2,809	2,809	2,809	2,809
R^2	0.981	0.980	0.981	0.980	0.939	0.939	0.921	0.921

Sources: Authors' estimations are based on data from the website of the Ministry of Commerce of the People's Republic of China, Organization of Rural Socio-Economic Survey, NBS (various years), and Department of Household Surveys, NBS (2016).

Notes: ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively. The robust standard errors are in parentheses. *Grppc* and *Population* are logged. *Savings* are in log form. Except for columns (7) and (8), under-identification tests and weak identification tests show that *RATEREDC* is a reasonable IV for *REDC*. IV, instrumental variables; *RATEREDC*, the ratio of the number of REDCs to the total number of counties in a province; *REDC*, the rural e-commerce demonstration county; *SUMREDC*, the total number of REDCs in a province. For the definitions of other variables, see Table 1.

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[8]Data Source: National Bureau of Statistics of China, *China Statistical Yearbook* (*county level*).

positive effect on aggregate savings deposits when we use the total sample. The effects srise dramatically when we use only the subsample of poor counties. Column (6) shows that the REDC policy increases the savings deposit by 21.4 percent, which demonstrates the excellent effects of the policy for poverty alleviation.

The new participants in e-commerce must invest some money to open an online business. For instance, a storekeeper must buy a computer and build a new warehouse to store the inventory. We also maintain that the manufacturing sector benefits from the development of e-commerce by expanding its markets. The development of e-commerce, therefore, encourages the expansion of manufacturing, which leads to new investments. Investment in e-commerce and the investment in manufacturing induced by e-commerce lead to more aggregate loans in REDCs.

Table 11 presents the effects of the REDC policy on aggregate loans. Most of the estimates are significant. Column (2) shows that the REDC policy increases aggregate loans by 27.2 percent. The estimates in columns (1), (3), and (4) are similar to that in column (2). The effects are even larger in poor counties. Column (6) shows that the aggregate loans in REDCs are 38.4 percent higher than those in their counterparts.

Table 11. The effect of the REDC policy on aggregate loans (*Loans*)

	Total sample				Subsample of poor counties			
	IV: *RATEREDC*		IV: *SUMREDC*		IV: *RATEREDC*		IV: *SUMREDC*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
REDC	0.268***	0.272***	0.174***	0.165***	0.384***	0.384***	−0.910	−0.910
	(0.032)	(0.032)	(0.039)	(0.040)	(0.111)	(0.111)	(0.858)	(0.858)
Grppc	0.287***	0.297***	0.294***	0.303***	0.287***	0.287***	0.248***	0.248***
	(0.044)	(0.045)	(0.043)	(0.044)	(0.066)	(0.066)	(0.090)	(0.090)
Population	0.434***	0.479***	0.430***	0.473***	0.990***	0.990***	0.545	0.545
	(0.121)	(0.134)	(0.120)	(0.134)	(0.275)	(0.275)	(0.405)	(0.405)
IS	−0.018	−0.058	−0.033	−0.070	−0.093	−0.093	−0.496	−0.496
	(0.108)	(0.110)	(0.106)	(0.107)	(0.206)	(0.206)	(0.346)	(0.346)
Characteristic controls	No	Yes	No	Yes	No	Yes	No	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,280	9,536	10,280	9,536	2,814	2,814	2,814	2,814
R^2	0.973	0.972	0.974	0.974	0.952	0.952	0.900	0.900

Sources: Authors' estimations are based on data from the website of the Ministry of Commerce of the People's Republic of China, Organization of Rural Socio-Economic Survey, NBS (various years), and Department of Household Surveys, NBS (2016).

Notes: *** represent significance at the 1 percent levels, The robust standard errors are in parentheses. *Loans* are in log form. *Grppc* and *Population* are logged. Except for columns (7) and (8), under-identification tests and weak identification tests prove that *RATEREDC* is a reasonable IV for *REDC*. IV, instrumental variables; *RATEREDC*, the ratio of the number of REDCs to the total number of counties in a province; *REDC*, the rural e-commerce demonstration county; *SUMREDC*, the total number of REDCs in a province. For the definitions of other variables, see Table 1.

V. Conclusion

Using the data for counties in China, we demonstrated that the REDC program was an effective policy to reduce poverty. The REDC policy encouraged the development of e-commerce in the selected counties. The development of e-commerce increased the gross regional product per capita in rural areas in China. Individuals who were, directly and indirectly, involved in e-commerce achieved a higher income, i.e., poverty was reduced.

The REDC policy is a new sustainable means of poverty alleviation as it enables poor people to benefit continuously from the most advanced emerging firms and new technology. Poor individuals can benefit from e-commerce directly and indirectly. The people employed by online stores gain direct benefits, and people who are indirectly involved acquire new opportunities, such as in graphic design, and firms can enter new markets derived from e-commerce. Government and nongovernmental organizations investment in physical and digital infrastructure can enable poor people to gain new opportunities and earn a higher income. However, the increasing digital gap between urban and rural areas will aggravate inequality, which is not beneficial to poverty reduction.

It is, therefore, necessary for the government to build internet and communication infrastructure such as optical fiber in rural areas, improve the business environment, and provide subsidies and credit policies to support the participation of platform companies and logistic companies in poverty reduction. County governments should also cultivate local characteristic industries to build brand products, publicize products, provide skills training to improve farmers' human capital, and build a long-term poverty reduction mechanism.

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