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**PRODUCTION FACTOR DYNAMICS AND RURAL
ENTREPRENEURIAL ACTIVITY IN CHINA**

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PhD

The Hong Kong Polytechnic University

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**Production Factor Dynamics and Rural Entrepreneurial Activity in
China**

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A thesis submitted in partial fulfilment of the requirements for the degree of

Doctor of Philosophy

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CERTIFICATE OF ORIGINALITY

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_____(Signed)

LIN Xin (Name of student)

Dedication

To my beloved family members.

Abstract

Rural entrepreneurial activity is widely recognized as a critical engine for economic growth, poverty alleviation, and narrowing the urban-rural divide in developing nations. However, the growth of these rural firms around the world is often disappointingly slow, particularly driven by limited access to fundamental production factors, such as continuous land, skilled labor, and advance capital. While the nature and influence of these production factors are rapidly evolving in the 21st century due to global institutional reforms and the digital revolution, it remains unclear how these transitional factors determine the emergence of rural entrepreneurial activities. Understanding these new dynamics is essential for crafting effective rural development policies.

This dissertation aims to bridge the knowledge gap by investigating the determinants of rural entrepreneurial activity from the perspective of production factor dynamics. Three types of production factors are examined: land property rights, human capital, and digital infrastructure. Firstly, the dissertation investigates whether strengthening communal rights can address coordination failure induced by fragmented security and promote rural entrepreneurial activity. Based on China's ambitious land reform that permits rural collectives to directly sell or rent their construction land to enterprises, this work discovers that collective land transfer rights boost rural entrepreneurial activity by 25%. This positive firm growth is entirely concentrated in regions where collective coordination is simpler to achieve (i.e., less rugged areas and regions with denser clan networks). Two specific pathways behind the entrepreneurial growth are identified: lower land use costs for firms and increased land wealth for local residents. The reform also facilitates expansion into non-farm wage employment, mainly due to more active participation in the labor market rather than via a decline in the agricultural sector. This section emphasizes the importance of communal rights and collective negotiation in reducing coordination costs and offers new insights into promoting rural development in developing countries.

Secondly, the dissertation investigates whether high-calibre external leaders can effectively drive development in underdeveloped regions with weak institutions. Specifically, this section leverages the staggered rollout of China's Village First

Secretary (VFS) program, which temporarily deploys high-calibre cadres from upper-level government agencies or state-owned enterprises to serve as local leaders in underdeveloped rural villages, to examine the impact of external leadership on rural entrepreneurial activity. Using a panel dataset covering 357 villages across 28 provinces, this work identifies sector-specific growth effects of VFSs on rural entrepreneurial activity with DID estimators. The arrival of VFSs significantly promotes the growth of rural firms in the agricultural and manufacturing sectors by 44% and 29%, respectively. This effect is more pronounced in villages with better access to entrepreneurial complements, weaker clan cultures, and highly educated local collaborators. The success of VFSs is driven by knowledge transfer and institutional capital support, which may help mitigate information and resource gaps within villages, rather than by trust-building, which may rely on long-term interventions. These findings shed light on the effectiveness of deploying high-skill leaders in short-term assignments to rural communities, providing valuable insights for other developing countries to tackle poverty.

Thirdly, the dissertation investigates the heterogeneous impact of digital infrastructure, such as broadband, on rural entrepreneurial activity. Building on the ongoing debate and mixed findings over the economic impact of rural broadband, this study aims to reconcile this literature by proposing and testing a novel theoretical framework centered on the remote substitutability of industries. This study hypothesizes that broadband unleashes two opposing forces: an enabling effect for local, non-substitutable enterprises and a crowding-out effect for substitutable businesses exposed to new, remote competition. Using the staggered, state-led rollout of broadband infrastructure across thousands of rural towns in China as a quasi-experimental setting, the empirical analysis provides robust support for this hypothesis. Broadband access significantly promotes rural firm entry in non-substitutable sectors like local services and agriculture, while simultaneously suppressing the formation of new enterprises in substitutable sectors like retail and manufacturing. Furthermore, these dual effects are not uniform; they are significantly more pronounced in China's most remote and economically less-developed regions, where broadband can serve as a powerful agent of market integration.

This dissertation makes a threefold contribution to the literature on rural development by providing a context-specific analysis of how key production factors—land, human capital, and digital infrastructure—shape entrepreneurship. First, it moves beyond the conventional focus on individual property rights, presenting causal evidence that strengthening communal land rights is critical for overcoming coordination failures and unlocking entrepreneurial potential in contexts of fragmented ownership. Second, in its analysis of human capital, the study reveals that high-calibre external leaders can effectively stimulate local enterprise not through long-term trust-building, but through the short-term injection of knowledge and institutional capital. Finally, the dissertation reconciles a contentious debate by proposing a novel “remote substitutability” framework. This theory explains the dual effect of broadband infrastructure, which simultaneously enables non-substitutable local enterprises while crowding out substitutable businesses exposed to new remote competition. Taken together, by leveraging quasi-experimental evidence from large-scale reforms in China, this research underscores the critical importance of physical capital, human capital, and digital capital in fostering rural economic transformation in developing countries.

Publications Arising from the Thesis

- **Papers arising from the thesis**

Lin, X., Hui, E. C. M., Cong, Z., & Shen, J. (2025). Solving coordination failures: Collective land transfer rights and rural entrepreneurship. *Journal of Development Economics*, 103609.

Lin, X., Hui, E. C., Ma, G., Tang, J., & Shen, J. (2025). The Arrival of Institutional Elites: Village First Secretaries and Rural Entrepreneurship in China. Resubmit at *American Journal of Agricultural Economics*.

- **Manuscripts under preparation**

Lin, X., Hui, E. C. M., & Shen, J. (Under preparation). Connection or Competition? The Effect of Broadband on Rural Entrepreneurship.

- **Other publications**

Lin, X., Hui, E. C. M., & Shen, J. (2025). Carbon emissions reduction target and green utilization of land resources: Evidence from the industrial land market in China. *Environmental Impact Assessment Review*, 110, 107677.

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Table of Contents

Dedication	I
Abstract	II
Publications Arising from the Thesis	V
Acknowledgements	VI
Table of Contents	VIII
List of Figures.....	XI
List of Tables	XII
Chapter 1. Introduction	1
1.1. Research background	1
1.1.1. Rural entrepreneurial activity as a solution for global poverty.....	1
1.1.2. Rural entrepreneurial activity in China.....	3
1.1.3. Production factor revolution and rural entrepreneurial activity.....	5
1.2. Research questions.....	10
1.4 Research significance	15
1.5 Chapter layout.....	16
Chapter 2. Literature Review	18
2.1. Definition of main concepts.....	18
2.1.1. Entrepreneurial activity.....	18
2.1.2. Rural and rural entrepreneurial activity	19
2.1.3. Production factors of our interests	20
2.2. Entrepreneurship and economic growth	21
2.3. The determinants of entrepreneurial activity	23
2.4. Production factors and rural entrepreneurial activity.....	25
2.4.1. Land property rights.....	25
2.4.2. Human capital	26
2.4.3. Digital infrastructure.....	27
2.5. Literature gaps	28
Chapter 3. Collective Land Transfer Rights and Rural Entrepreneurial Activity	31
3.1. Introduction.....	31
3.2. Institutional background	39

3.3. Data, sample, and methodology	43
3.3.1. Data	43
3.3.2. The Sample	47
3.3.3. Balance test	48
3.3.4. Model specification.....	50
3.4. Empirical results	51
3.4.1. Baseline findings and the role of collective coordination capability	51
3.4.2. Robustness checks	55
3.4.3. Heterogeneity	62
3.4.4. Mechanism.....	71
3.4.5. Further discussion	79
3.5. Conclusion	82
Chapter 4. Leadership and Rural Entrepreneurial Activity	85
4.1. Introduction.....	85
4.2. Background, theories, and hypotheses	91
4.2.1. Institutional background	91
4.2.2. Theories and hypotheses	94
4.3. Data and methodology	97
4.3.1. Data	97
4.3.2. The Sample	101
4.3.3. Balance test	102
4.3.4. Model specification.....	104
4.4. Empirical evidence.....	104
4.4.1. Baseline.....	104
4.4.2. Robust checks	106
4.4.3. Heterogeneous analysis.....	113
4.4.4. Mechanism.....	116
4.5. Conclusion	123
Chapter 5. Digital Infrastructure and Rural Entrepreneurial Activity.....	125
5.1. Introduction.....	125
5.2. Institutional background	128
5.3. Data and methodology	130
5.3.1. Data.....	130

5.3.2. The Sample	131
5.3.3. Balance test	132
5.3.4. Model specification.....	135
5.4. Empirical results	136
5.4.1. Baseline results	136
5.4.2. Robustness check	137
5.4.3. Heterogeneity analysis	140
5.5. Conclusions.....	141
Chapter 6. Conclusions	144
6.1. The achievement of research objectives and major findings	144
6.2. Policy implications.....	146
6.2.1. Empowering collectives to reduce coordination costs.....	146
6.2.2. Maximizing knowledge and capital advantages of external leaders.....	146
6.2.3. Provide complementary support for broadband deployments	147
6.3. Limitations and further research directions	148
Appendices: Supplementary Information	150
Appendix A: Other Details for Chapter 3	150
Appendix B: Other Tables	155
Appendix C: Other Figures.....	162
References	167

List of Figures

Figure 1. 1 Rural Population and Land Share in Major Economies in 2021	3
Figure 1. 2 Returning Rural Entrepreneurs in China	4
Figure 1. 3 Descriptive evidence on Rural Entrepreneurial Literature	9
Figure 1. 4 Research Framework	11
Figure 3. 1 The Process of Transferring Rural Land to Enterprises	40
Figure 3. 2 Sample Area.....	48
Figure 3. 3 Parallel Trends with Event Study Method.....	56
Figure 4. 1 Annual and Cumulative Distribution of VFSs in the Sample Villages	99
Figure 4. 2 Sample Distribution.....	102
Figure 4. 3 Parallel Trends with Event Study Method.....	108
Figure 4. 4 Heterogeneity by Village and VFS Characteristics	114
Figure 5. 1 Roll-out distribution of the Rural Broadband and the UTS program	132
Figure 5. 2 Parallel Trends with Event Study Method.....	138

List of Tables

Table 3. 1 Balance Tests for Predetermined Characteristics.....	49
Table 3. 2 Baseline Results	52
Table 3. 3 The Role of Collective Coordination	54
Table 3. 4 Confounding Policies	58
Table 3. 5 Excluding Spillovers	61
Table 3. 6 Heterogeneity by Industrial Type	64
Table 3. 7 Heterogeneity by Entrepreneurial Quality	66
Table 3. 8 Heterogeneity by Gender of Entrepreneurs.....	68
Table 3. 9 Regional Heterogeneity.....	70
Table 3. 10 Land Market Competition Mechanism	73
Table 3. 11 Direct Income Effect on Rural Entrepreneurial Activity	76
Table 3. 12 Wealth Effects on Consumption and Public Facilities.....	78
Table 3. 13 Potential Costs on Agricultural Sectors	80
Table 3. 14 Impact on Rural Employment Structure	82
Table 4. 1 Summary Statistics.....	100
Table 4. 2 Balance Test	103
Table 4. 3 Baseline Results	105
Table 4. 4 IV Estimation	109
Table 4. 5 Exclude Competitive Policies	111
Table 4. 6 Other Sensitive Checks	112
Table 4. 7 Heterogeneous Effects of VFS with Different Knowledge Intensity.....	116
Table 4. 8 Effect of VFS on Local Residents' Information Acquisition	118
Table 4. 9 Heterogeneous Effect of VFS with Different Institutional Capital.....	119
Table 4. 10 Effect of VFS on Local Facilities and Policy Support	121
Table 4. 11 Effect of VFS on Local Trust	122
Table 5. 1 Balance Test	134
Table 5. 2 Baseline Results	137
Table 5. 3 Other Robustness Checks.....	139
Table 5. 4 Heterogeneity	141

Chapter 1. Introduction

1.1. Research background

1.1.1. Rural entrepreneurial activity as a solution for global poverty

Poverty is one of the most intractable challenges around the world, which poses significant hurdles to the enhancement of human well-being (Burgess & Pande, 2004; Loayza & Raddatz, 2010; Shantz et al., 2018). This issue is particularly prominent in rural regions, as nearly half of the world's population and 85% of the extremely poor reside in those areas (Koo & Eesley, 2023; UN-Habitat, 2022). For a long time, the increased income of global farmers has been accompanied by the great rural-urban migration in the context of urbanization (Banerjee & Duflo, 2007; Bencivenga & Smith, 1997). While this kind of growth model enjoys the benefits of agglomeration, it generates huge social costs, such as left-behind children, rural aging, and overcrowded cities (Fellmeth et al., 2018; Rozelle et al., 1999; Sjaastad, 1962). As such, a growing number of researchers and practitioners are investigating whether there are alternative rural development paradigms that allow farmers to achieve self-sufficiency without having to leave their homes.

Rural entrepreneurial activity is considered such an optional channel to alleviate poverty and promote rural employment and revitalization (Alvarez & Barney, 2014; Banerjee & Newman, 1993; Sutter et al., 2019). According to Bosworth (2012), rural entrepreneurial activity refers to the act of catering to the rural population, selling a rural product, or being located in a rural area. Other scholars prefer to understand rural entrepreneurial activity through the place-based lens (Korsgaard et al., 2015; Muñoz & Kimmitt, 2019). In other words, they argue that business endeavors in rural regions can be categorized as rural entrepreneurial activity, regardless of the entrepreneur's identity, product sources, and selling market. One particular advantage of this definition is that it helps elucidate how entrepreneurs are influenced by the external environment (Anderson, 2000), as well as how their activities can shape their surroundings (Mair & Marti, 2009). We adopt the place-based approach to defining rural entrepreneurial activity by conceptualizing it as new business endeavors in rural areas. Local farmers

or urban-to-rural migrants can both initiate this activity, which may or may not be associated with agriculture.

As the engine for economic growth (Asturias et al., 2023; Hamilton, 2000), entrepreneurship may help rural development in the following three aspects. (1) New businesses can help reduce poverty by introducing innovative and affordable products and services tailored to the needs of rural consumers at the base of the pyramid (S. L. Hart, 2010; Si et al., 2015). In particular, they facilitate the rural utilization of items or services that were previously exclusive to wealthy individuals and organizations, significantly enhancing local production (Ahlstrom, 2010). (2) Emerging enterprises create new jobs, which optimizes the surplus labor and increases per capita income in rural areas (Decker et al., 2014; Deller et al., 2019). Previous work by Decker et al. (2014) and Haltiwanger et al. (2013) argues that small firms enjoy exceptional advantages in job creation, which may reduce migrant workers, attract returnees, and increase rural vitality (Gladwin et al., 1989). (3) Entrepreneurial activities provide rural residents with increased autonomy and flexibility in their employment, hence enhancing the synergistic relationship between entrepreneurial and agricultural activities (Dong et al., 2021; Venkatesh et al., 2017). Additionally, poor people living in rural areas are also recognized as a prodigious potential market for global new firms (Prahalad, 2005), which may facilitate a mutually beneficial outcome for both rural regions and entrepreneurs.

Despite all these benefits, rural enterprises grow very slowly, especially in many developing countries, resulting in an expanding gap within the emerging economy. For example, the US Bureau of Labor Statistics shows that the number of new firms in rural regions only accounts for 12% of the total number of manufacturing firms established in 1994 (Renski, 2008). In China, the percentage of newly established businesses in rural areas was only 5.8% in 2008 and increased to just 15.9% by 2014 (Bu & Liao, 2022). Previous research theoretically illustrates the lagging growth of rural firms from the perspective of limited local demand, away from the market, and a lack of effective production factors like continuous land, educated labor, advanced capital (Cadigan et al., 2011; Reynolds et al., 1995; Yu & Artz, 2019). Although countries around the world are devoting themselves to improving the relatively unfavorable location and factor

endowment environment in rural areas, little empirical evidence is known about whether these efforts pay off in motivating the growth of rural enterprises.

1.1.2. Rural entrepreneurial activity in China

China, as the world's greatest developing economy, possesses distinct benefits in studying rural entrepreneurial activity owing to its substantial rural population, growing rural business, and ambitious rural supportive programs. Firstly, China's current rural development is closely aligned with the global average. Figure 1.1 shows the share of the rural population and agricultural land within the main global economies. In 2021, rural regions represented about 55% of the land and almost 40% of the population in China, which are similar to the world average of 37% and 44%, respectively. Considering China's large population base and extensive geographical area, the rural population and area are substantial in absolute numbers.

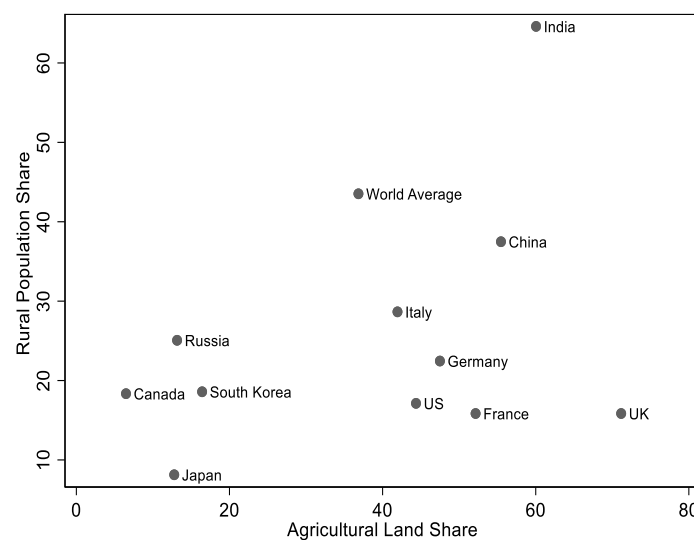


Figure 1. 1 Rural population and land share in major economies in 2021

Source: World Bank Open Data (2021)

Secondly, rural entrepreneurial activity in China is experiencing a rapid growth trend and has been recognized as one of the most dynamic forces in the Chinese economy (Yu et al., 2013). The ongoing economic expansion and reform in China have been propelled by private firms throughout the past three decades (Song et al., 2011). Most of such expansion and reform is located in rural regions such as small towns or villages, given the vast rural population in the country. As shown in Figure 1.2, there is a consistent upward trend in the number of rural entrepreneurs returning home. By 2022, a total of 12.2 million people returned to their rural hometowns to start businesses. The newly established rural industries cover agricultural product processing, rural e-commerce, rural tourism, and other aspects.

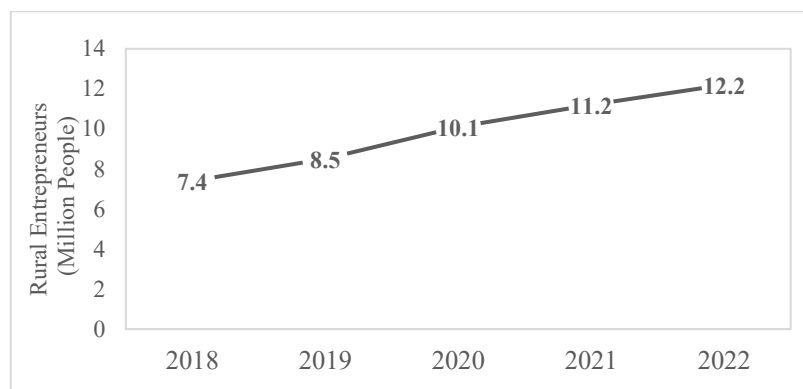


Figure 1. 2 Returning Rural Entrepreneurs in China

Source: Ministry of Agriculture and Rural Affairs of the People's Republic of China,
<https://zdscxx.moa.gov.cn:9443/misportal/public/publicationRedStyle.jsp>

Third and most importantly, China's government has initiated extensive rural entrepreneurial support programs that provide ideal empirical settings for investigating the determinants of rural entrepreneurial activity. Rural development has consistently garnered significant attention from the Chinese government. Since the 1980s, the first document issued by the Chinese government each year (No. 1 Central Document) has frequently targeted the issues of rural development. To motivate the rural economy and improve the rural production factor market, China's central government has launched a series of ambitious programs that aim to mitigate the gap in production factors of rural regions. For example, China initiated a pilot program in 2015, which empowered rural collectives with land transfer rights. A significant number of highly skilled and resourceful institutional elites have been selected to serve in rural areas, as part of

China's poverty alleviation policy effort. Additionally, like many other nations, China has initiated a substantial rural infrastructure investment initiative, encompassing the development of roads, power, and broadband services. Not only do these rich rural-oriented programs help improve the environment of the production factor market in rural China, but they also provide an ideal policy experimental setting to investigate the relationship between production factors and rural entrepreneurial activity.

1.1.3. Production factor revolution and rural entrepreneurial activity

Starting from Schumpeter's (1942) concepts of creative destruction, entrepreneurship scholars have locked their attention in the growth of high-wealth-creation start-ups in urban regions (Bruton et al., 2013). The legacy is continued in the work of Shane & Venkataraman (2000), as well as in the concept of "entrepreneuring" proposed by Rindova et al. (2009). This kind of knowledge gap primarily derives from the long-term lagging growth of rural enterprises. Regardless of distance, a rural region implies a peripheral setting characterized by both geographical seclusion and limited engagement in social, cultural, political, economic, and intellectual issues (Aguilar, 2021). Entrepreneurs are discouraged by a series of obstacles in rural regions, such as limited local demand, being away from the market, and a lack of effective production factors like educated labor, capital, and infrastructure (Reynolds et al., 1995; Yu & Artz, 2019). Compared with urban start-ups, rural enterprises were described in the past as necessity entrepreneurship with lower value-added and poorer income that may not contribute to substantial growth (Acs, 2006; Renski, 2008). As a result, the determinants and effects of rural firms have been neglected by researchers for a long time.

Recent structural changes in rural areas have turned more researchers' attention to the behavior of rural entrepreneurs in starting new businesses and economic activities (Asher & Novosad, 2020; Deller et al., 2022; Yu & Artz, 2019). Firstly, the local product demand structure is currently undergoing a giant transformation and upgradation. The relative significance of agricultural goods is declining (Bosworth & Turner, 2018), while more farmers are looking for recreation and amenities and quality products from the light manufacturing as well as service sectors (Bosworth, 2010). The upgraded local demand appeals to more diversified industries in rural regions. Secondly, the production factor market in rural regions is also experiencing drastic changes. More areas are

witnessing the growth of new inhabitants, including businessmen, retirees, college graduates, and visitors (Démurger & Xu, 2011; He & Wang, 2017; Stathopoulou et al., 2004). This influx leads to higher income and more investments because the returnees bring capital, entrepreneurial experience, market knowledge, and consumption demand to the relatively closed rural communities (Koo & Eesley, 2023; Y. Wang et al., 2022). Thirdly, an increasing number of countries are dedicating themselves to developing supportive policies to address the disadvantages of rural regions. Rural development has been incorporated into the prioritized agenda for a number of countries and institutions, such as China, the European Commission, the OECD, and the United Nations (Guo & Liu, 2021; Ward & Brown, 2009). Following the logic of addressing the main obstacles encountered by rural entrepreneurs, global governments have poured a lot of resources into underdeveloped rural areas, such as providing technical training, appointing governance elites, improving the land system, and building nationwide last-mile infrastructure (Bu & Liao, 2022; Burlig & Preonas, 2024; Venkatesh et al., 2017; Y. Zhang et al., 2021). These profound changes promoted by the states indicate a notable revolution of the entrepreneurial ecosystem, making rural regions more attractive for local and external entrepreneurs.

According to entrepreneurial ecosystem theory, institutional, economic, cultural, social, and other macro-factors that exist outside a new venture but inside a specific region possess significant explanatory power in understanding the growth of start-ups (Acs et al., 2017; Juma et al., 2023; Stam & Van De Ven, 2021). Different entrepreneurship scholars have developed heterogeneous frameworks that characterize the attributes of the entrepreneurial ecosystem. As one of the pioneer practices, Van de Ven (1993) identifies three types of elements for the ecosystem: (1) institutional arrangements such as entrepreneurship legitimization, regulation, and technology standard events; (2) resource endowments, like human capital and financing mechanism; and (3) proprietary functions for R&D, manufacturing, marketing, and distribution. The follow-up scholars have enriched and expanded this framework. For example, Isenberg (2010) delineated six components that comprise an ecosystem, namely markets, policy, finance, culture, support, and human capital. Recent researchers, such as Stam & Van De Ven (2021), elaborate the framework into ten elements: formal and informal institutions, social networks, physical and financial

resources, leadership, human capital, knowledge, means of consumption, and producer services.

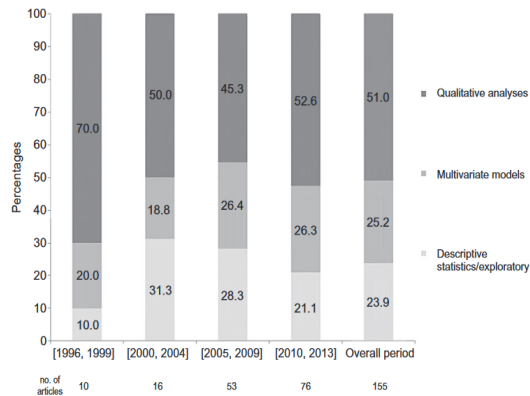
Though there is no consensus on the specific elements of the entrepreneurial ecosystem, scholars always recognize the significant role of production factors in shaping entrepreneurship. According to the tenets of producer theory, entrepreneurs are able to engage in entrepreneurial activities only when acquiring specific factors of production, such as land, labor, financial and human capital, and technology (Cobb & Douglas, 1928; Leibenstein, 1968). Within the framework of the entrepreneurial ecosystem, these production factors are considered the necessary resource endowment and precondition for entrepreneurship to take place (Leendertse et al., 2022; Stam & Van De Ven, 2021). For example, as the key factor in primary goods production, land provides the necessary space for most productive entrepreneurial activities, while stable labor may foster growth by safeguarding the employer's investment (Falkinger & Grossmann, 2013; Jeffers, 2024). Access to financial capital, particularly from investors who possess entrepreneurial expertise, plays a vital role in facilitating investments in uncertain entrepreneurial ventures that have a long-term time frame (Kerr & Nanda, 2009). Human capital is a factor that researchers have widely recognized as playing a role in identifying and generating entrepreneurial possibilities, acquiring financial resources, and acquiring new knowledge and entrepreneurial advantages (Alvarez & Barney, 2007; Marvel et al., 2016). Recently, in the digital world, the role of information and the internet has also gained more attention in the emergence of rural entrepreneurial activity.

One primary limitation regarding previous work lies in the fact that scholars often base their interpretations of entrepreneurship in the context of urban high-growth entrepreneurship (Aguilar, 2021). Given the large disparities in urban and rural geographical, social, economic, and developmental conditions, it remains debatable whether the components of the urban entrepreneurial ecosystem work for understanding rural entrepreneurial activity (Faggio & Silva, 2014; Muñoz & Kimmitt, 2019). On the one hand, urban ecosystems, as described by Dubini (1989), are generally more munificent for entrepreneurship, while rural ones tend to be sparser. On the other hand, Smallbone (2009) argues that urban-rural contrasts do not always indicate that rural

communities are inherently disadvantaged when compared to their metropolitan counterparts. Rural regions possess unique attributes that encourage entrepreneurship, such as informal cooperation networks, effective leadership, and abundant natural endowments such as continuous land (Bu & Liao, 2022; Galvao et al., 2020; Miles & Morrison, 2020). Additionally, the promotion of digital technologies results in the death of distance in a digital world, which is bridging the gap of location advantage between urban and rural areas (Cairncross, 1997). As a result, more research focusing on the rural entrepreneurial ecosystem is required to respond to the heated debates and the emergence of novel production factors. Questions closely related to policymakers, such as what kind of institution determines the rise of rural entrepreneurial activity, and whether the huge rural investments in human capital and physical infrastructure can effectively promote rural entrepreneurial activity, need to be answered in particular with a well-defined research design.

Another knowledge gap in previous research is associated with the research methodology. Firstly, most of the entrepreneurship research in the rural context follows a qualitative paradigm due to poor data accessibility (Besser & Miller, 2013; Muñoz & Kimmitt, 2019). Pato & Teixeira (2016) point out that nearly 75% of the 181 rural entrepreneurial studies from 1996 to 2013 employ qualitative methods such as case studies or simple descriptive strategies (Panel A of Figure 1.3). This kind of qualitative preference continues to be favored in recent rural entrepreneurial research (Yu & Artz, 2019). While qualitative methods have potential in generalized theorization within the context of a weak theoretical basis, more causality-based empirical work deserves attention to enrich the practical evidence. This is particularly important with the recent advancement in Geographic Information System (GIS) technology and disclosure of administrative data on business registration. Such advancement makes it feasible to reliably quantify rural entrepreneurial activity. Secondly, the bulk of empirical studies on rural entrepreneurial activity primarily concentrate on nations with high-income (74%) or upper middle-income (13%) levels, as shown in Panel B of Figure 1.3. This trend is consistent with their increased efforts in promoting entrepreneurship in rural areas in the developed world (United Nations Development Programme, 2013). However, given the huge rural share of developing countries, more rural entrepreneurial stories from developing countries are needed to stimulate global entrepreneurial vitality.

Panel A: Methodology distribution



Panel B: National distribution of empirical work

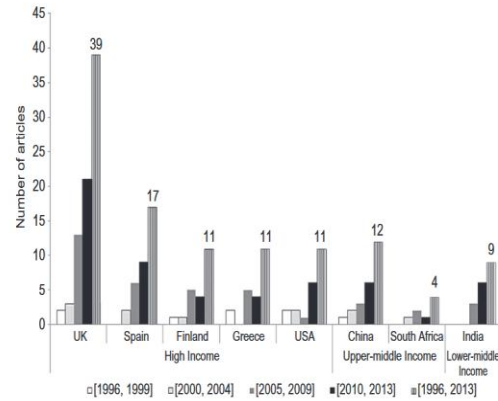


Figure 1. 3 Descriptive evidence on rural entrepreneurial literature

Source: Pato & Teixeira (2016)

Additionally, the disparity between the extensive reform practices in China's rural factor market and the scarcity of systematic policy evaluations calls for scholarly attention to the impact of production factor reforms on rural entrepreneurship. Since the late 1970s, China has witnessed profound institutional transitions in rural regions, from the initial de-collectivization and the implementation of the household responsibility system to more recent market-oriented changes in land tenure, state-owned enterprises, and digital infrastructure (Fang, Li, et al., 2023; Lin, 1992). This commitment to rural development is reaffirmed annually in China's "No. 1 Central Document," which consistently prioritizes rural revitalization as a core national strategy. In recent years, China's central government has launched a series of ambitious programs that aim to mitigate the gap in production factors of rural regions, including empowering rural collectives with land transfer rights, deploying skilled institutional elites to serve in underdeveloped areas, and investing heavily in infrastructure like roads, power, and broadband services. However, despite this rich policy landscape, there is a relative dearth of rigorous, micro-level empirical studies that causally evaluate the effectiveness of these specific reforms in fostering rural entrepreneurship. Therefore, understanding how these distinct institutional changes actually translate into new firm creation and sustainable local development remains a crucial, under-explored area.

1.2. Research questions

This dissertation follows the entrepreneurial ecosystem framework, which examines the external environmental determinants of rural entrepreneurial activity. Specifically, we focus on the impact of production factor dynamics. The study of entrepreneurship has evolved from focusing on individual traits to embracing a broader entrepreneurial ecosystem framework, which acknowledges the critical role of the external environment. While scholars like Van de Ven (1993), Isenberg (2010), and Stam & Van De Ven (2021) have identified essential components such as institutions, human capital, and resources, this dissertation argues that certain pivotal factors within this framework remain under-theorized or are treated too generally. Building on this foundation, our research sharpens the focus on three specific and crucial elements often overlooked in rural contexts: land, human capital, and digital infrastructure. We move beyond land as a mere physical asset to investigate the institutional power of land rights. In particular, we focus on communal rights rather than well-established individual tenure security (Ali et al., 2014; Bambio & Agha, 2018; Bu & Liao, 2022). We distill the broad concept of human capital to examine the catalytic impact of external leadership, and we specify the role of technology by analyzing the transformative potential of digital infrastructure, particularly broadband. By isolating these three factors, this study aims to provide a compelling understanding of the role of institutional capital, human capital, and digital capital in shaping modern rural entrepreneurial activity.

The main research question we aim to address is: What's the impact of production factor dynamics on rural entrepreneurial activity? In this context, we explicitly define dynamics not as static differences in initial endowments, such as natural resources or historical wealth, but as the institution-induced variations in factor accessibility over time. We further decompose this question into three sub-research questions: (1) Can communal land transfer rights encourage rural entrepreneurial activity (RQ1)? (2) Does the arrival of institutional elites effectively help rural areas and promote local entrepreneurship (RQ2)? (3) Are the extensive investments in last-mile digital infrastructure yielding positive results on rural entrepreneurial activity (RQ3)? The three research questions contribute to addressing two puzzles in development economics. The first puzzle is what kind(s) of institutional systems work best for

correcting the distortion in underdeveloped regions (RQ1). The second one is whether the large investments in physical and human capital for backward regions will be worthwhile. (RQ2 and RQ3). On this basis, we also investigate further consequences on rural development. Specifically, we consider both the micro perspective, such as the transformation of employment structure and consumption of rural households, and the macro perspective, e.g., whether rural entrepreneurial activity crowds out agricultural production. The research framework is shown in Figure 1.4.

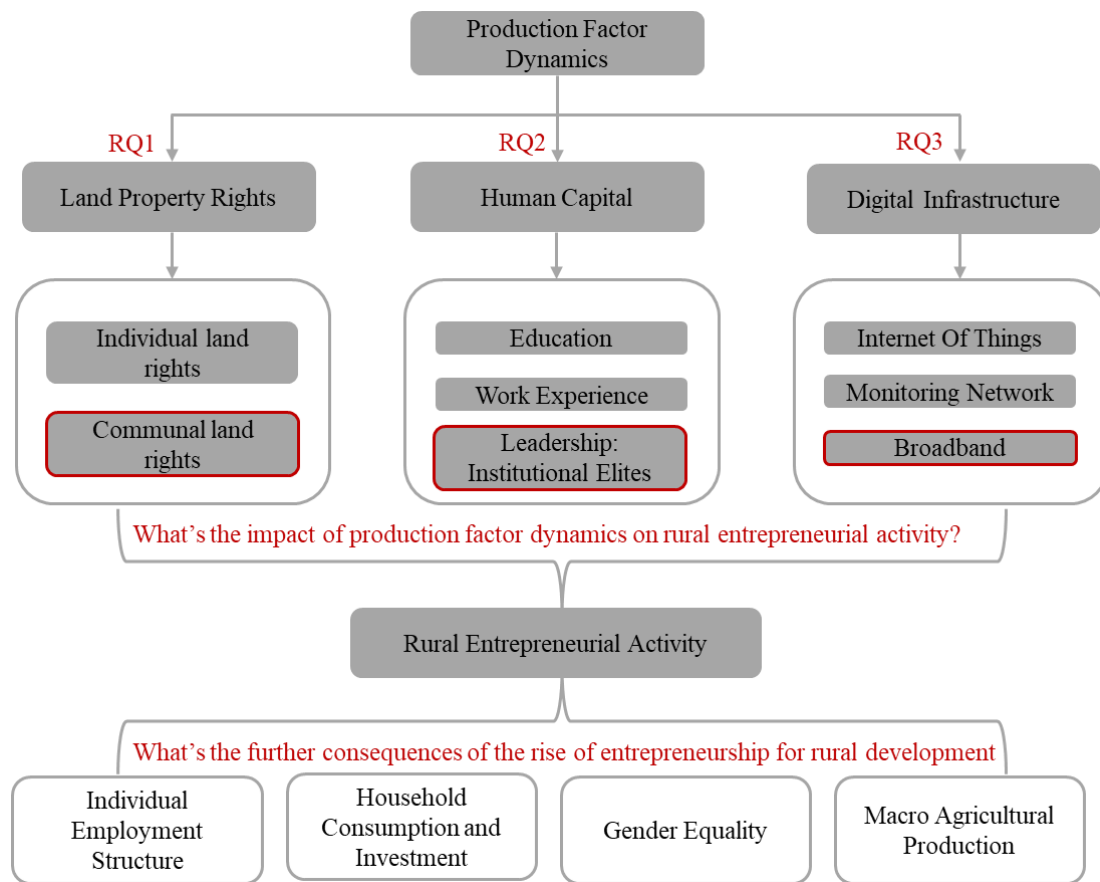


Figure 1. 4 Research Framework

Given that rural entrepreneurial activity is vital to poverty alleviation and regional development but has received limited attention in the developing world, this study aims to uncover the determinants of rural entrepreneurial activity with empirical evidence from China. The big question we would like to answer is what entrepreneurial ecosystem factors can promote the rise of rural entrepreneurial activity. Specifically, we focus on the causal relationship between the emerging productive factors and rural entrepreneurial activity, in which we attempt to analyze the mechanism and further

consequences. In China's context, we select three representative productive factors: land, human capital, and digital infrastructure. The specific research objectives are designed as follows.

Objective 1: To examine whether communal land transfer rights encourage rural entrepreneurial activity in China.

As the key factor in primary goods production, land provides the necessary space for most productive entrepreneurship (Falkinger & Grossmann, 2013). This kind of productive factor is particularly important in rural regions because the land is the primary asset for most farmers, and the lower land cost is recognized as a unique opportunity for the rise of rural firms (De Guzman et al., 2020; Wang et al., 2020). However, one foundational but less noticeable factor that impedes rural entrepreneurial activity enthusiasm lies in fragmented land tenure and corresponding high coordination costs (Haasbroek, 2025; Isaac et al., 2016). This coordination failure, often termed the holdout problem, arises when property rights are clearly defined to multiple owners, making it costly to assemble land, especially the large, contiguous parcels required by modern enterprises, which necessitates unanimous agreement from numerous smallholders (Foster & Rosenzweig, 2022; Kominers & Weyl, 2012; Strange, 1995). In this study, we explore whether strengthening communal rights can address this coordination failure. Since 2015, China has launched an ambitious pilot program to improve communal land transfer rights by allowing rural collectives to directly transfer land use rights to enterprises in several counties. This land reform provides an ideal setting to study whether collective land transfer rights and collective negotiation are useful in alleviating institutional friction and encouraging rural entrepreneurial activity.

Objective 2: To explore the impact of external human capital intervention on rural entrepreneurial activity in China.

Human capital is a factor that researchers have widely recognized its role in identifying and generating entrepreneurial possibilities, acquiring financial resources, and acquiring new knowledge and entrepreneurial advantages (Alvarez & Barney, 2007; Marvel et al., 2016). Given the large urban-rural wage gap, rural human capital has been

flowing to cities with higher returns for a long time, accelerating rural decay around the world (Fan & Stark, 2008; Young, 2013). To address the issue of inadequate rural governance and alleviate poverty, China has recently appointed a significant number of institutional elites, known as the village first secretaries, to rural regions. The institutional elites bridge the gap in community agents and human capital, as they bring new knowledge, leadership, and other resources from the dispatched units and superior organizations to support rural development. However, these first secretaries may sometimes be perceived as outsiders in village governance with limited impact on rural areas, attributable to their short tenure and unfamiliarity with local affairs. Given that one of the major reasons for rural decay is the loss of human capital, this chapter addresses the question of whether external human capital intervention (the arrival of institutional elites) can actually help the rural region and promote rural entrepreneurial activity.

Objective 3: To investigate the comprehensive role of digital infrastructure in shaping rural entrepreneurial activity in China.

The construction of last-mile digital infrastructure, represented by village broadband, is empowering rural entrepreneurial activity through increased market, credit opportunities and reduced input or training costs for small businesses (Deller et al., 2022a). However, the cost of laying or upgrading existing cables for that last mile may be prohibitive. Previous studies have documented mixed effects of broadband on rural entrepreneurial activity. On one hand, internet access can encourage rural start-ups through increased market and credit opportunities as well as reduced input or training costs (Cumming & Johan, 2010; Deller et al., 2022a). On the other hand, it may crowd out rural retailers, given the better access to urban products for local customers (Goldmanis et al., 2010). Other scholars report negligible or context-based effects of rural broadband and argue that the growth of firms is primarily driven by rural communities close to urban areas (Conley & Whitacre, 2016; Kandilov & Renkow, 2010). One reason for the inconsistent findings lies in disproportionate scholarly attention paid to specific sectors. Previous studies, while insightful, tend to focus on farmers' small businesses and specific industrial sectors, such as retail and knowledge-intensive sectors (Li X. & Hu, 2024; Mack et al., 2011; Tran, 2021). Even in studies

that incorporate a cross-section of industries (Deller et al., 2022a; Duvivier et al., 2021), the analysis often documents these differential impacts without systematically identifying the boundary conditions that explain why these effects vary. To reconcile these seemingly contradictory outcomes, this dissertation proposes a critical boundary condition: the remote substitutability of an industry's goods and services. Specifically, this section focuses on the effects of China's village broadband scheme on rural entrepreneurial activity, with a particular focus on the heterogeneous effects among different sectors.

1.4 Research significance

Based on the analysis of the determinants of rural entrepreneurial activity, this study has both theoretical and practical contributions to previous literature and policymakers.

Firstly, to the best of our knowledge, this work is the first comprehensive study to rigorously estimate the determinants of rural entrepreneurial activity in China. Due to data availability, previous research on rural entrepreneurial activity tends to follow a qualitative approach. (Aguilar, 2021; Besser & Miller, 2013; Bosworth, 2012; Si et al., 2015). Recent advancements in GIS technology and the release of administrative big data on business registration enable reliable measurement of rural entrepreneurial activity. We use extensive business registration data to illustrate the firm entry landscape in China's rural areas and connect it with changes in China's rural production factor market.

Secondly, in terms of literature, our work contributes to a body of theoretical and empirical research on the development of backward regions. As the engine of economic growth, entrepreneurship has gained more attention from development economists. While previous studies broadly discussed the factors limiting enterprise growth, such as access to capital, uncertainty, and the founder's human capital, most of them conducted their research within urban areas (Baron, 2007; Colombo & Grilli, 2005; Jeffers, 2024; Kim & Kung, 2017; Schmalz et al., 2017). In this study, we examine rural regions with some less obvious, yet important, issues: communal land rights, the arrival of institutional elites, and the development of digital infrastructure. Our work addresses two puzzles in development economics. The first puzzle is what types of institutional systems effectively correct distortions in underdeveloped regions. The second one is whether extensive investments in physical and human capital in these backward areas can yield positive results.

Thirdly, our work offers tangible policy implications by identifying the specific institutional configurations necessary for rural revitalization. While the literature widely acknowledges the role of institutions in economic development (Acemoglu et al., 2001, 2005; Hall & Jones, 1999), our study moves beyond theoretical recognition

to provide a practical roadmap for policymakers in developing regions. By analyzing the interplay between land rights, leadership, and broadband access, we offer evidence-based insights into how institutional, human, and digital capital can be synchronized. Specifically, our findings provide a framework for designing policies that simultaneously rectify land-market misallocations and bridge the digital divide, offering a scalable model for inclusive growth in rural China and similar emerging economies.

1.5 Chapter layout

This dissertation includes five chapters to accomplish the three research objectives. The methodologies and key findings of each chapter are summarized as follows.

Chapter 2 reviews the existing literature, identifies research gaps, and sets the stage for the focus of this dissertation. Specifically, the chapter discusses the definition of key concepts, the role of entrepreneurial activity in economic growth, the main determinants of entrepreneurial activity, and the current progress on production factors and rural entrepreneurial activity.

Chapter 3 explores whether collective land transfer rights can address land coordination failures and encourage rural entrepreneurial activity. Based on China's ambitious land reform, which allows rural collectives to directly sell or lease their construction land to enterprises, the chapter employs the Difference-in-Differences (DID) model to identify the causal effects and mechanisms of communal land rights. It also discusses broader impacts on rural employment, household consumption, and macro-level consequences for agricultural production. This approach helps achieve the research objective 1 by understanding the role of communal land rights in promoting rural entrepreneurial activity.

Chapter 4 examines whether external leadership intervention can assist rural areas and boost rural entrepreneurial activity. Using China's staggered allocation of village first secretaries across different villages, this chapter employs the DID model and Instrument Variables (IV) model to identify the causal effects of external leaders. It also explores the underlying mechanisms through knowledge transfer, institutional capital support, and trust building. Building on these analyses, this chapter effectively achieves

research objective 2 by clarifying the role of external leaders in rural entrepreneurial activity.

Chapter 5 examines the overall effect of rural broadband on rural entrepreneurial activity. Using China's Rural Broadband Program and the subsequent Universal Telecom Service Program, the chapter applies the DID model, conditioned on key factors, to determine the causal effect of broadband. It contributes to the ongoing debate about rural broadband and seeks to reconcile seemingly conflicting results by introducing a critical boundary condition: the remote substitutability of a region's goods and services. Based on these analyses, this chapter fulfils research objective 3 by examining the comprehensive impact of broadband on rural entrepreneurial activity.

Chapter 6 summarizes the findings from the previous three chapters. To enhance the practical contribution of this dissertation, this section also discusses the policy implications for the Chinese government and other developing countries. Additionally, research limitations related to concept and methodology, as well as research prospects, are identified here to guide future studies.

Chapter 2. Literature Review

This chapter reviews existing studies on the concept of rural entrepreneurial activity and the role of production factors in entrepreneurship research. Section 2.1 summarizes and identifies the key concepts in this study. Section 2.2 illustrates the relationship between entrepreneurship and economic growth to demonstrate the importance of this dissertation. Section 2.3 shifts the focus to the broad determinants of entrepreneurship, while the next section (2.4) examines the specific roles of production factors documented in existing research. The last section highlights the research gaps and sets the stage for the focus of this dissertation.

2.1. Definition of main concepts

2.1.1. Entrepreneurial activity

The term “entrepreneur” has its etymological roots in the thirteenth-century French verb “entreprendre,” which denotes the act of engaging in an activity or undertaking a task (Landstrom, 2007; Pato & Teixeira, 2016). A pioneer in the field of innovation and entrepreneurship, Schumpeter (1934) defines entrepreneurial activity as the process of creative destruction that reorganizes production factors. Based on his groundbreaking research, subsequent researchers have formulated both narrow and broad interpretations of entrepreneurial activity (Gartner, 1990). In a broad context, entrepreneurial activity can be comprehended as a sequence of procedures encompassing the creation of novel products, the development of innovative production methods, the identification of untapped markets, the establishment of fresh supply sources, and the implementation of novel organizational structures within the industry (Brockhaus, 1987). In a narrower sense, entrepreneurial activity refers to the process of establishing new organizations (Birley, 1986; Geroski et al., 2010). In this study, we will take a relatively narrow perspective that defines entrepreneurial activity as the process of creating new firms, including self-employed small businesses.

2.1.2. Rural and rural entrepreneurial activity

Researchers have developed different criteria to define rural. One of the demographic criteria that is frequently employed by researchers is population (Copus et al., 2008). While rural areas often have a smaller population compared to urban areas, the specific territorial unit, criteria, and threshold differ significantly across countries. Another popular definition is developed by the European Commission (1988), which argues that rural regions comprise natural countryside, farmland, villages, small towns, regional centers, and industrialized rural areas. Based on this definition, small towns and other non-agricultural regions are also defined as rural areas. In China's administrative system, there are two main kinds of township regions: towns and streets. While the criteria for establishing streets may differ based on local circumstances, nearly every province in China mandates a specific degree of urbanization, such as 80% or more in Beijing, as a prerequisite for establishing streets. Hence, in the context of China, streets are usually defined as the urban regions, while the towns can be considered as rural regions.

As for rural entrepreneurial activity, Wortman (1990) is one of the first scholars who defined this concept as the creation of a new business that introduces a new product, serves or creates a new market, or utilizes innovative technology within a rural environment. In another representative work, Bosworth (2012) illustrates rural entrepreneurial activity as the act of catering to rural populations, selling a rural product, or locating in a rural area. Other scholars prefer to understand rural entrepreneurial activity through the place-based lens (Korsgaard et al., 2015; Muñoz & Kimmitt, 2019). In other words, they argue that business creation in rural regions can be categorized as rural entrepreneurial activity, regardless of the entrepreneur's identity, product sources, and selling market. One particular advantage of this definition is that it helps elucidate how entrepreneurs are influenced by the external environment (Anderson, 2000), as well as the way in which their activities can shape their surroundings (Mair & Marti, 2009). We adopt the place-based approach to defining rural entrepreneurial activity by conceptualizing it as new business creation in rural areas. Local farmers or urban-to-rural migrants can both initiate this activity, which may or may not be associated with agriculture. Based on the above definition of a rural region, entrepreneurial activity in China's towns is considered rural entrepreneurship.

2.1.3. Production factors of our interests

According to the tenets of producer theory, entrepreneurs are able to engage in entrepreneurial activities only when acquiring specific factors of production, such as land, labor, financial and human capital, and technology (Cobb & Douglas, 1928; Leibenstein, 1968b). These production factors are considered the essential resource endowment and precondition for entrepreneurship to take place in the framework of the entrepreneurial ecosystem (Leendertse et al., 2022; Stam & Van De Ven, 2021).

In classical economic theory, the categorization of these production factors has evolved. Early economists, such as Adam Smith, established a three-factor theory, identifying the fundamental inputs to production as land, labor, and capital (Smith, 1776). Later, neoclassical economist Alfred Marshall expanded this model into a four-factor theory by introducing organization (Marshall, 1890), which is now widely recognized as entrepreneurship. In this context, entrepreneurship is understood as a specific skillset, including the managerial ability to effectively combine the other three factors—land, labor, and capital—and direct them towards productive ends. This conceptualization of entrepreneurship aligns more closely with a personnel-based entrepreneurship story, which emphasizes the innate abilities of the individual entrepreneur. However, the focus of this study shifts from the individual to the external environmental determinants that enable or constrain entrepreneurial activity for the entire rural population. Therefore, we return our focus to the three primary factors of production that shape this environment. More specifically, we focus on three representative factors of production: namely, rural land, human capital, and digital Infrastructure.

(1) Rural Land. Rural land refers to the land located in rural regions. From an economic perspective, land can be perceived as a scarce space for locating economic production activities, infrastructure, and residential structures (Hubacek & van den Bergh, 2006). It also serves as fertile soil that supplies both organic and inorganic materials for agricultural purposes. In China, there are three kinds of rural land: contracted land, collective operational construction land, and non-operational construction land (Zhou et al., 2020). The contracted land is usually used for agricultural purposes, while the other two kinds of land are used for business or public

facilities purposes. Since entrepreneurship is a kind of business activity, in this study, we mainly focus on the second type of land.

(2) Human Capital. Human capital is considered the knowledge, information, ideas, skills, and health of individuals that contribute to their productivity and economic value (Becker, 1964, 2002). Early work on human capital tends to develop this concept from the perspective of the individual level, while more scholars have recently begun to treat human capital as a resource for a unit, such as a firm or a region (Ployhart et al., 2014). In this study, we focus on a kind of special human capital in rural China, the institutional elites characterized as the first village secretaries. Compared with the local village residents, these institutional elites possess new knowledge, leadership, and other resources from the dispatched units and superior organizations to support rural construction.

(3) Digital infrastructure. Digital infrastructure is regarded as a limitless, accessible, and dynamic socio-technical framework comprising technological and human elements, networks, and systems (Hanseth & Lyytinen, 2010; Schade & Schuhmacher, 2022). Therefore, digital infrastructure encompasses the utilization of information and communication technologies, as well as the accompanying physical infrastructure (Autio et al., 2018). In rural regions, the expanding network of digital infrastructure is known as the last-mile infrastructure. Common digital infrastructure includes broadband internet, fiber-optic cables, and wireless communication networks. Given the hot broadband village construction in China, this study will focus on broadband.

2.2. Entrepreneurship and economic growth

Ever since the groundbreaking work of Schumpeter (1934), entrepreneurship has been widely acknowledged as the prime driver of economic growth (Bjørnskov & Foss, 2016; Leibenstein, 1968b; Malchow-Møller et al., 2011). Scholars have established different theoretical models to explain the relationship between entrepreneurship and economic growth. As one of the earliest attempts, Leibenstein (1968) conceptualizes the entrepreneur as a gap-filler and input-completer, thereby playing a pivotal role in the capacity creation part of these elements of economic growth. Building on Romer's

(1986) growth model, Schmitz (1989) presents a framework in which economic growth is endogenously determined by individuals who make a rational decision between working as an employee or becoming an entrepreneur. He posits, based on certain assumptions, that the amount of output contributed to the economy by an entrepreneur is greater than what the same individual would contribute as an employee. Other researchers focus on the act of new firm entry and develop a theoretical model that illustrates the aggregate productivity growth from the new firm itself and its spillover effects (Asturias et al., 2023). Despite variations in design concepts, all these models recognize the significant impact of entrepreneurship on economic growth, leading to an increasing popularity of entrepreneurship research.

The empirical studies on the relationship between entrepreneurship and economic growth, however, seem to yield rather perplexing results. Some researchers, such as Fritsch (1997), indicate a negative contribution of start-up activities with evidence on regional employment. In another widely cited research, Stel et al. (2005) find heterogeneous effects on different countries, with positive effects on developed countries but negative effects on developing countries. Wennekers & Thurik (1999) show that there exists an inverted U-shaped relationship between entrepreneurship and economic growth. When economic development reaches a certain stage, entrepreneurship contributes to economic development; otherwise, there is a negative correlation between entrepreneurship and economic development. While various empirical findings exist, more researchers provide support for the positive impact of entrepreneurship on economic growth (Audretsch et al., 2006; Bosma et al., 2018; Brandt et al., 2012). The primary causal mechanisms are the generation and spread of innovations, as well as the competition fostered by entrepreneurs (Leendertse et al., 2022). Moreover, entrepreneurship is more productive in environments characterized by inclusive and growth-promoting institutions (Bosma et al., 2018; Sobel, 2008), which highlights the role of institutions in entrepreneurship.

Similarly, as the engine for economic growth (Asturias et al., 2023; Hamilton, 2000), entrepreneurship may help rural growth in the following three aspects. (1) New businesses can help reduce poverty by introducing innovative and affordable products and services tailored to the needs of rural consumers at the base of the pyramid (S. L.

Hart, 2010; Si et al., 2015). In particular, they facilitate the rural utilization of items or services that were previously exclusive to wealthy individuals and organizations, significantly enhancing local production (Ahlstrom, 2010). (2) Emerging enterprises create new jobs, which optimizes the surplus labor and increases per capita income in rural areas (Decker et al., 2014; Deller et al., 2019). Previous work by Decker et al. (2014) and Haltiwanger et al. (2013) argues that small firms enjoy exceptional advantages in job creation, which may reduce migrant workers, attract returnees, and increase rural vitality (Gladwin et al., 1989). (3) Entrepreneurial endeavors provide rural residents with increased autonomy and flexibility in their employment, hence enhancing the synergistic relationship between entrepreneurial and agricultural activities (Dong et al., 2021; Venkatesh et al., 2017). Additionally, poor people living in rural areas are also recognized as a prodigious potential market for global new firms (Prahalad, 2005), which may facilitate a mutually beneficial outcome for both rural regions and entrepreneurs.

2.3. The determinants of entrepreneurial activity

There are two main strands of literature that explain the growth of entrepreneurship: personality-based theories and environment-based theories (Cuervo, 2005). The first type of literature connects the rise of entrepreneurs with the traits of individuals. In the most representative contexts, researchers usually examine the psychological attributes of accomplished entrepreneurs to identify the unique traits within their personalities (Patel & Thatcher, 2014; Ray, 1993; Wille et al., 2010). Some of the attributes, such as creativity, risk-taking, leadership, the need for achievement, or the desire for independence and autonomy, are considered the key determinants for entrepreneurs (Cuervo, 2005; Miron & McClelland, 1979; Pfeffer, 2017). The occupational decision is determined, additionally, by an individual's non-psychological attributes, such as expectation for profits, education, previous experiences, and social network (Douglas & Shepherd, 2000; Greve & Salaff, 2003; Huang & Pearce, 2015; Rauch & Hulsink, 2015).

Another strand of literature focuses on the environmental determinants of entrepreneurship, which is represented by the framework of an entrepreneurial ecosystem. The concept of the entrepreneurial ecosystem arose from the growing

debates on entrepreneurship during the 1980s and 1990s. Now, more scholars are questioning the personality-based theories of entrepreneurship, so they have turned their attention to examining the effect of the external social and economic environment (Drakopoulou Dodd & Anderson, 2007; Spigel & Harrison, 2018). As one of the pioneer practices, Van de Ven (1993) identifies three types of elements for the ecosystem: (1) institutional arrangements such as entrepreneurship legitimization, regulation, and technology standard events; (2) resource endowments, like human capital and financing mechanisms; and (3) proprietary functions for R&D, manufacturing, marketing, and distribution. The follow-up scholars have enriched and expanded this framework. For example, Isenberg (2010) delineated six components that comprise an ecosystem, namely markets, policy, finance, culture, support, and human capital. Recent researchers, such as Stam & Van De Ven (2021), elaborate the framework into ten elements: formal and informal institutions, social networks, physical and financial resources, leadership, human capital, knowledge, means of consumption, and producer services.

While there is little or no consensus on the specific elements of the entrepreneurial ecosystem, scholars always recognize the significant role of production factors in shaping entrepreneurship. According to the tenets of producer theory, entrepreneurs are able to engage in entrepreneurial activities only when acquiring specific factors of production, such as land, labor, financial and human capital, and technology (Cobb & Douglas, 1928; Leibenstein, 1968a). In the framework of the entrepreneurial ecosystem, these factors of production are considered the necessary resource endowment and precondition for entrepreneurship to take place (Leendertse et al., 2022; Stam & Van De Ven, 2021). For example, as the key factor in primary goods production, land provides the necessary space for most productive entrepreneurship, while stable labor may foster growth by safeguarding the employer's investment (Falkinger & Grossmann, 2013; Jeffers, 2024). Access to financial capital, particularly from investors who possess entrepreneurial expertise, plays a vital role in facilitating investments in uncertain entrepreneurial ventures that have a long-term time frame (Kerr & Nanda, 2009). Human capital is a factor that researchers have widely recognized its role in identifying and generating entrepreneurial possibilities, acquiring financial resources, and acquiring new knowledge and entrepreneurial advantages (Alvarez & Barney, 2007;

Marvel et al., 2016). Recently, in the digital world, the role of information and the internet has also gained more attention in the emergence of entrepreneurship.

2.4. Production factors and rural entrepreneurial activity

2.4.1. Land property rights

We move beyond land as a mere physical asset to investigate the institutional power of land rights. Land property rights play a crucial role in the advancement of economic development. Undoubtedly, land serves as a primary productive resource for agricultural endeavors. Furthermore, due to its immobility and relative indestructibility (Galiani & Schargrodsky, 2011), it is well-suited for being used as collateral and has become one of the most important wealth considerations for farmers. Acquiring complete land property rights matters because it grants the privileges of utilizing the asset, preventing others from using it, transferring the asset to others, and maintaining these privileges. As highlighted in classical literature, individuals tend to underinvest if others are capable of seizing the fruits of their investments (Barzel, 1997; Demsetz, 1967a).

The debate surrounding property rights has primarily centered around the consequences of secure tenure for agricultural investments and productivity (Abdulai et al., 2011; Bambio & Agha, 2018; Fenske, 2011; Soule et al., 2000). Recent studies expand the literature on the consequences of land property rights in two ways: (1) by examining more comprehensive forms of property rights, and (2) by considering the wider economic effects beyond just the agricultural sector. For example, Chari et al. (2021) offer a distinct contribution to previous literature by focusing on the allocative implications of exchange rights on productivity. Other scholars have extensively explored the broader economic impacts, including the effects of land tenure on migration, labor misallocation, and human capital investments. (Adamopoulos et al., 2024; Galiani & Schargrodsky, 2010a; S. Liu et al., 2023).

In terms of the relationship between land property rights and entrepreneurship, to the best of our knowledge, only Bu & Liao (2022) analyze the effects of secure individual land tenure on the growth of rural firms. They argue that the growth of rural firms may be attributed to the increased availability and productivity of land and labor,

as well as the improvement in social trust. As one of the most valuable assets for farmers, the income from land may also serve as a decisive financial determinant that influences farmers' occupational choices (Falkinger & Grossmann, 2013). In China's context, this kind of land income growth is primarily driven by the advancement of rural land transfer rights. However, there is currently no existing research that has investigated the impact of enhancing rural land transfer rights on entrepreneurial activity in rural areas. In addition, previous studies tend to favor individual rights for their clear incentives and allocative efficiency; communal or collective rights, in some cases, can be superior, such as welfare allocation and sustainable long-term use (Besley & Ghatak, 2010; Chankrajang, 2019; Ostrom & Hess, 2010; Zhao, 2020).

2.4.2. Human capital

Human capital theory was initially developed to examine the value of education (Becker, 1964). Nowadays, it usually refers to the knowledge, information, ideas, skills, and health of individuals that contribute to their productivity and economic value (Becker, 2002; Dimov, 2010). A large body of urban entrepreneurship research has linked human capital with the rise of firms (Marvel et al., 2016). They focus on the effects of individuals' education, age, and work experiences and illustrate the role of human capital from three aspects: (1) identifying and generating entrepreneurial opportunities (Alvarez & Barney, 2007; Marvel, 2013); (2) obtaining financial resources and initiating entrepreneurial endeavors (Dimov, 2010); and (3) acquiring new knowledge and establishing competitive advantages for emerging companies (Unger et al., 2011).

Recently, more scholars have begun to treat human capital as a resource endowment for a unit, such as a firm or a region (Gennaioli et al., 2013; Ployhart et al., 2014; Zheng & Du, 2020). This kind of resource is particularly important for rural entrepreneurial activity because rural ecosystems are often characterized by fewer resources, such as infrastructure and human capital (Bosma & Sternberg, 2017; Dubini, 1989). Hence, any alteration in the distribution of human capital resources is expected to have a significant impact on the entrepreneurial activities within rural regions. Like urban entrepreneurship research, most of the previous studies focus on the effects of educational background on a farmer's occupational choice. Xiao & Wu (2021) note that educated individuals are more likely to engage in entrepreneurial activities. In another

work, Koo & Eesley (2023) argue that the arrival of returnees increases the performance of rural businesses through knowledge spillover. Other researchers focus on a special kind of human capital in rural regions: leadership. Miles & Morrison (2020) highlight the role of community leadership in rural entrepreneurial activity. However, they only provide a qualitative case study in the US. More empirical evidence is required to illustrate whether the arrival of elites with leadership and new knowledge can effectively promote rural new businesses.

2.4.3. Digital infrastructure

As one of the necessary resource endowments in the digital world, the effect of digital infrastructure, such as broadband, has attracted numerous researchers' attention (Canzian et al., 2019; Cumming & Johan, 2010; Deller et al., 2022a). Previous studies illustrate two theoretical channels through which digital infrastructure may promote entrepreneurship. The first channel that promotes entrepreneurship is the establishment of social networks, facilitated by broadband and internet service, which allow individuals to expand their social connections and capital (Barnett et al., 2019). A large number of scholars have confirmed the contribution of social networks in obtaining financing (Javakhadze et al., 2016; Karlan et al., 2009; Uzzi, 1999). This kind of impact is especially prominent in rural regions because obtaining external financing is critical for entrepreneurship in such an imperfect credit market with limited collateral (Djankov et al., 2006; Paulson & Townsend, 2004). The second channel is facilitated by the acquisition of information and knowledge. The expanding village broadband, known as the last-mile infrastructure, is empowering rural entrepreneurial activity through increased market and credit opportunities and reduced input or training costs for small businesses (Deller et al., 2022a).

However, empirical evidence indicates that digital infrastructure may not be as beneficial (Fox & Porca, 2001; Malecki, 2003). Broadband may hit rural retail businesses as online sales partly replace offline services (Kim & Orazem, 2017). Also, broadband may only benefit densely populated areas because of the high cost of last-mile infrastructure and the complementarities between infrastructure and agglomeration economies (Beaudry et al., 2010; Burlig & Preonas, 2024). Additionally, the positive effects of broadband are also challenged by the endogeneity of the location selection of broadband. Given the returns of broadband, governments tend to prioritize

broadband deployment in densely populated areas where there are usually more active entrepreneurial activities. As a result, more well-designed empirical research is needed to identify and generalize the actual effects of digital infrastructure on rural entrepreneurial activity.

2.5. Literature gaps

There are three main research gaps in previous literature. The first one lies in the fact that scholars often base their interpretations of entrepreneurship in the context of urban high-growth entrepreneurship (Aguilar, 2021). Given the large disparities in urban and rural geographical, social, economic, and developmental conditions, it remains debatable whether the components of the urban entrepreneurial ecosystem work for understanding (Muñoz & Kimmitt, 2019). On one hand, urban ecosystems, as described by Dubini (1989), are generally munificent for entrepreneurship, while rural ones tend to be sparser. On the other hand, Smallbone (2009) argues that urban-rural contrasts do not always indicate that rural communities are inherently disadvantaged when compared to their metropolitan counterparts. Rural regions possess unique attributes that encourage entrepreneurship, such as informal cooperation networks, effective leadership, and abundant natural endowments such as land (Bu & Liao, 2022; Galvao et al., 2020; Miles & Morrison, 2020). Additionally, the promotion of digital technologies results in the death of distance in a digital world, which is bridging the gap of location advantage between urban and rural areas, resulting in the death of distance (Cairncross, 1997). As a result, more research oriented to the rural entrepreneurial ecosystem is required to respond to the heated debates and emergence of novel productive factors. Questions closely related to policymakers, such as what kind of institutions determine the rise of rural entrepreneurial activity, and whether the huge rural investments in human capital and physical infrastructure can effectively promote rural entrepreneurial activity, need to be answered by way of a well-defined research design.

Another knowledge gap in previous research is associated with research methodology. Firstly, most of the rural entrepreneurial research follows a qualitative paradigm due to poor data accessibility (Besser & Miller, 2013; Muñoz & Kimmitt, 2019). Pato & Teixeira (2016) point out that nearly 75% of the 181 rural entrepreneurial studies from 1996 to 2013 employ qualitative methods such as case studies or simple

descriptive strategies. Such qualitative preference continues to be favored in rural entrepreneurial research (Yu & Artz, 2019). While qualitative methods have potential in generalized theorization within the context of a weak theoretical basis, causality-based empirical work deserves more attention to enrich practical evidence. This is particularly important in the context of recent advancements in Geographic Information System (GIS) technology and disclosure of administrative data on business registration. The GIS technology makes it feasible to reliably quantify rural entrepreneurial activity. Secondly, the bulk of empirical studies on rural entrepreneurial activity primarily concentrate on nations with high-income (74%) or upper-middle-income (13%) levels. This trend is consistent with their increased efforts in promoting entrepreneurship in rural areas in the developed world (United Nations Development Programme, 2013). However, given the huge rural share of developing countries, more rural entrepreneurial stories from developing countries are needed to stimulate global entrepreneurial vitality.

The third major gap in the literature pertains to the conceptualization and empirical treatment of three production factors critical to rural entrepreneurial activity. First, concerning land rights, existing research has disproportionately focused on the security of individual property rights (Abdulai et al., 2011; Adamopoulos et al., 2024; Bu & Liao, 2022), leaving a significant gap in our understanding of the transferability of these rights and, more critically, the role and function of communal rights in overcoming coordination failures. Second, within the human capital literature, the focus has predominantly centered on demographic characteristics such as education and age (Marvel et al., 2016; Xiao & Wu, 2021). Consequently, the impact of targeted external interventions—particularly the role of high-calibre leadership in catalyzing development in institutionally weak environments—remains notably under-explored. Finally, even within the widely discussed topic of digital infrastructure, a crucial analytical gap persists. Previous studies on broadband, while insightful, tend to focus on farmers' small businesses and specific industrial sectors, such as retail and knowledge-intensive sectors (Li X. & Hu, 2024; Mack et al., 2011; Tran, 2021). Even in studies that incorporate a cross-section of industries (Deller et al., 2022a; Duvivier et al., 2021), the analysis often documents these differential impacts without systematically identifying the boundary conditions that explain why these effects vary. A comprehensive framework to explain this heterogeneity is therefore missing.

Chapter 3. Collective Land Transfer Rights and Rural Entrepreneurial Activity

3.1. Introduction

This chapter investigates the relationship between effective institutional capital, namely collective land transfer rights, and rural entrepreneurial activity. Apart from well-documented constraints, such as lack of agglomeration economies, limited market, and imperfect credit (Asher & Novosad, 2020b; Cagetti & De Nardi, 2006; Gladwin et al., 1989), one foundational but less noticeable factor that impedes rural entrepreneurial enthusiasm lies in fragmented land tenure and corresponding high coordination costs (Haasbroek, 2025; Isaac et al., 2016). This coordination failure, often termed the holdout problem, arises when property rights are clearly defined to multiple owners, making it costly to assemble land, especially the large, contiguous parcels required by modern enterprises, which necessitates unanimous agreement from numerous smallholders (Foster & Rosenzweig, 2022; Kominers & Weyl, 2012; Strange, 1995). While state expropriation¹ is a common solution to this holdout problem (Miceli & Segerson, 2007; Nosal, 2001), the unconstrained executive power may undermine investment incentives (Besley, 1995; Jacoby et al., 2002), and even trigger a new political holdout that erodes political trust and stalls implementation (Kominers & Weyl, 2012; Sha, 2023). This dilemma, therefore, raises a critical question: Is there an alternative property rights arrangement that can overcome the coordination failure impeding entrepreneurship without incurring high political costs?

China's recent land transferability reform offers a potential communal rights solution by allocating land transfer rights to rural collectives. In China, there exists a dual land system, where urban land is state-owned, while rural land is owned by rural collectives. Unlike urban landowners, rural landowners previously lacked the discretion to directly transfer (i.e., sell or rent) their land use rights to enterprises unless the land was transformed into state-owned land through the local government's expropriation. Given the unequal bargaining power in negotiations between farmers and governments

¹ State expropriation is also termed as eminent domain, compulsory purchase or taking (Miceli & Segerson, 2007; Nosal, 2001; Sha, 2023).

(Cai & Sun, 2018; Sha, 2023), local governments typically provided meagre compensation to farmers whose agricultural land had been expropriated, while selling the land to real estate developers or industrial sectors at much higher market prices. This institutional arrangement infringed on farmers' and village collectives' rights to benefit from land ownership and triggered land disputes and an informal (grey) land transaction market, which increases land use costs and uncertainty for enterprises considering investment in rural areas (Jiao & Xu, 2022; Kominers & Weyl, 2012). To mitigate these problems, the State Council of China launched a landmark land transferability reform in 2015 that allowed rural collectives in 15 counties to directly transfer long-term rural construction land use rights² to enterprises. This pilot program was expanded to 33 counties one year later and eventually was rolled out nationwide through a modification to the legislation at the end of 2019. This study utilizes the staggered roll-out of this reform to examine whether the collective land transfer rights can solve coordination failure and promote rural entrepreneurial activity.

Theoretically, collective land transfer rights may solve the coordination incentives in land assembly by allowing rural collectives to directly capture rents from land transactions. In contrast to the high transaction costs in state-led expropriation and fragmented individual rights (Haasbroek, 2025; Isaac et al., 2016; Miceli & Segerson, 2007; Nosal, 2001), rural collectives can internalize the coordination costs through vote-based collective negotiation and lower external bargain costs by serving as a bargaining representative with firms (Kominers & Weyl, 2012; Ostrom, 1990). If this assumption holds, the reform is expected to spur rural entrepreneurial activity through at least two specific channels. First and more importantly, it may reduce land use costs for entrepreneurs who intend to invest in rural regions, especially those in land-intensive sectors, where land acquisition constitutes a large and unavoidable fixed cost (Haasbroek, 2025). From an industrial organization perspective, rural collectives, as an additional land supplier, can break governments' monopoly on the rural land market by

² Only rural collective operating construction land is allowed to be traded directly with firms. That is the idle rural construction land for industrial, mining, storage, commercial services, and other operational purposes specified in the predetermined general plan for land utilization and urban-rural planning in China (Yan et al., 2021). In contrast, agricultural land that has already been allocated for farmers is in principle not permitted for direct transaction with enterprises. In some cases that must occupy such land to assemble a contiguous land parcel, rural collectives are mandated to follow China's requisition-compensation balance policy (issued in 1999) by reclaiming an equivalent area of cropland elsewhere designated for construction.

supplying homogenous or even better assembled land parcels, which may lower the equilibrium land price given the effective competition (Bloom & Van Reenen, 2007; Shapiro & Varian, 1999; Stahl, 1988). Second, successful dealings with land users allow farmers and village collectives to earn additional land income (Dippel et al., 2020). This positive wealth shock can draw in new entrants either by providing start-up capital for local residents (Cagetti & De Nardi, 2006; Evans & Jovanovic, 1989; Wang et al., 2012), raising demand for non-tradables, or enabling collective infrastructure investments (Gan, 2010; Lettau & Ludvigson, 2004). Despite these potential benefits, it remains unclear whether they are substantial enough to overcome the preceding entrepreneurship barriers in rural regions—such as lack of agglomeration, market access, and imperfect credit (Asher & Novosad, 2020b; Cagetti & De Nardi, 2006; Gladwin et al., 1989). The impact of this ambitious reform on rural entrepreneurial activity, hence, remains an open empirical question, which this study aims to address.

The estimation strategy of this work uses the staggered DID framework, comparing the number of new rural firm registrations over time between the treatment and control groups. A unique feature of the reform is that all the 33 pilot regions were selected from two representative reform lists in China: (1) National Comprehensive Pilot Program for New-Type Urbanization, and (2) Rural Reform Pilot Zones, which provide an ideal counterfactual group for causal inference. The whole sample encompasses all towns within 666 counties in China, where the treatment group consists of the towns located in 33 counties that were designated as the land transferability reform counties, while the control group comprises towns situated in the remaining 633 counties nominated in the two reform lists. Since the land reform was rolled out nationwide at the end of 2019, our sample period spans from 2009 to 2019, with policy shock occurring in 2015 or 2016. The advantage of our empirical setting is two-fold. First, The treatment and control groups are likely to share similar unobserved attributes as they were simultaneously nominated by governments for the same reforms (Wang & Yang, 2023). Their comparability is confirmed based on careful balance tests in which no significant difference in predetermined socioeconomic factors can be observed between the treatment and control groups. Second, compared with using neighbors as the control group, this setting is less vulnerable to the challenges of the stable unit treatment value assumption (SUTVA).

The baseline findings show that towns in land reform counties observe a significant increase in the number of new firm registrations by approximately 25%, compared with the control group. More importantly, the growth of new firms is concentrated in regions with better collective coordination capacity (i.e., low-rugged areas and areas with denser clan networks) and is almost fully offset in regions where coordination is more difficult to achieve. This growth pattern supports the core argument that the reform's effectiveness hinges on solving the land coordination problem. By granting land transfer rights to a single bargaining representative, the rural collective, the transferability reform leverages the collective's inherent advantages in internalizing transaction costs and overcoming coordination failures that often plague state-led or individual-based land transactions.

The baseline results are robust throughout a range of validation and sensitivity tests, including an event study design to test comparable pre-trends and sensitivity checks with alternative control groups and estimation specifications. One primary concern for our findings derives from other confounding policies enacted in rural China. To rule out these alternative explanations, we consider three main policies: (1) the nationwide Land Titling Reform aiming to enhance individuals' agricultural land security (Bu and Liao, 2022); (2) the Rural Returnees' Entrepreneurship Supportive Program to support returnee entrepreneurs to engage in rural business, such as E-commerce; and (3) the Rural Housing Mortgage Program that improves credit access by allowing rural houses to be used as collateral for bank loans. This study first tests robustness by including time-varying indicators for each of these policies as control variables in our baseline model. Across all specifications, the coefficients of land reform remain statistically significant, while those of the other policies are nonsignificant and small in magnitude. Apart from the static robustness, this study goes a step further by testing potential interactions to explore whether these policies act as complements or substitutes to the land reform. While the reform shows no synergy with the land titling or entrepreneurship support programs due to a mismatch in their policy targets (i.e., different land assets and different types of entrepreneurships), this study documents a powerful complementary relationship with the housing mortgage program. This finding highlights the potential synergic effects of relaxing frictions in both land and financial markets.

Next, this study examine the growth patterns of rural firms concerning industrial types, entrepreneurial quality, gender differences among entrepreneurs, and the spatial distribution of new firms. First, the industrial heterogeneity indicates that the growth of rural firms is concentrated both in land-intensive heavy sectors such as manufacturing and mining, as well as a wide range of service industries, including retail, leasing, real estate service, research, education, and environmental management. This dual-track expansion aligns with the previously established two specific channels: lower land use costs for firms and higher wealth for residents. We simultaneously observe a decline in agricultural enterprises, indicating that the reform regions are probably experiencing a structural entrepreneurial transformation away from agriculture (Dippel et al., 2020; Fried & Lagakos, 2021). Second, the newly established rural firms appeal to have higher quality, evidenced by a shift towards more formal organizational structures, a significant entry of large-scale and long-term survival firms. Third, in terms of entrepreneur gender differences, the reform's impact is not strongly biased at the aggregate level, but women disproportionately enter the service sector, while men enter both manufacturing and services. Finally, this study observe a distance-decay effect: the entrepreneurial growth—driven primarily by the service sector—is larger in towns near the urban centers, suggesting the reform may simultaneously widen spatial disparities within a county.

Having established the causal impact on entrepreneurship and suggestive evidence on growth patterns, this study now formally test the underlying mechanisms. The first and most important channel lies in the lower land use costs for enterprises given the emergence of competing rural land suppliers (Bloom & Van Reenen, 2007; Shapiro & Varian, 1999; Stahl, 1988). Since the transaction prices of collectively owned rural land are unavailable, this study investigates whether collective land transfer rights affect the transactions of state-owned land in rural regions. Specifically, this study find a 19.4% decrease in state-owned land prices in towns within land reform counties. The price reduction is almost entirely driven by land-intensive industries that are more sensitive to coordination frictions, such as manufacturing, mining, electricity, and construction, because land acquisition constitutes a large and unavoidable fixed cost for them (Haasbroek, 2025). No statistically significant effect can be observed on either the number of transacted state-owned land parcels or their total area. This null effect

suggests a possible decline in fiscal revenue for local governments from state-owned land transactions.

Second, the successful land transfer to firms helps to convert illiquid land assets into realizable wealth for rural collectives and their members. As illustrated before, this positive wealth shock can either directly encourage local farmers to start businesses or indirectly attract investors to rural regions, given the increased local demand and better business environments driven by wealthier collectives' infrastructure investments. The empirical evidence supports both direct wealth-driven and consumption-driven entrepreneurship instead of facility-driven entrepreneurship. Specifically, this study observes a significant land income growth by 909 RMB per household—about 121% compared with the sample average. The growing wealth is significantly higher (about six times) for rural households living near urban centers than for their counterparts living in remote villages. More importantly, a consistent spatial pattern emerges for entrepreneurial decisions of rural residents who are allowed to share land revenues, while the impacts are negligible for residents with urban hukou, who are exposed to the same local conditions but are legally ineligible to share land revenues, given the institutional arrangements for collective assets allocation³.

The study also observe significant growth in rural residents' expenditure on clothes and educational investments, which supports the consumption-driven entrepreneurship in the retail, leasing, and education sectors. However, no evidence supports the idea that rural collectives systemically increase investments in infrastructure and public facilities following the reform. This lack of impact can be understood from several perspectives. First, and most likely, rural households facing severe liquidity constraints often prefer direct cash transfers to in-kind or public provisions (Cunha, 2014). Moreover, the scale of the land revenue growth, while significant, may simply be insufficient to fund costly, large-scale infrastructure projects.

Finally, this study discusses potential reform costs and broader impacts on rural employment. Previous finding that the reform led to a decline in the number of newly

³ In China, the collective land revenues are exclusively distributed among members who hold a rural hukou, while residents without a rural hukou, even if they live in the same villages, are not eligible to share the land-related revenue.

registered agricultural enterprises raises a concern: the apparent entrepreneurial boom may have come at the expense of an agricultural recession. This study formally tests it through three distinct datasets: town-level satellite-observed cropland area, individual-level agricultural employment status, and county-level self-report agricultural outputs. Across all these indicators, the coefficients of land reform are statistically insignificant. This null effect is not beyond expectation, because the reform primarily targets collective operating construction land, which is legally and spatially distinct from the cropland allocated to households in pre-determined land use planning. Additionally, even in cases where land assembly requires the occupation of cropland, the village collective is mandated to follow China's requisition-compensation balance policy by reclaiming an equivalent area of cropland elsewhere designated for construction. Recalling the decrease in state-owned land price and null effects on land quantities, the primary costs of land reform may lie in the decline of government direct fiscal revenue from land transactions. Moving beyond entrepreneurship, this study shows that the reform precipitates a broader transformation in the rural labor market by pulling workers into wage employment. This labor market expansion proves particularly beneficial for women, who are drawn from unemployment into local non-farm jobs, while their male counterparts are primarily shifted from agriculture.

This study contributes to the literature on the institutional factors that influence entrepreneurship. Unlike personality-based theory, which connects the decision to become an entrepreneur with individuals' traits. (Kihlstrom & Laffont, 1979; Levine & Rubinstein, 2017), this strand of literature documents a series of institutional frictions affecting entrepreneurship, such as access to capital, investment uncertainty, entry regulation, and legitimacy barriers (Barwick et al., 2025; Hurst & Lusardi, 2004; Kim & Kung, 2017; Schmalz et al., 2017). This work adds to this literature by identifying a foundational yet often overlooked constraint: the fragmented land tenure and corresponding coordination costs. In particular, the analysis provides the first rigorous empirical evidence linking collective land transfer rights with rural entrepreneurial activity and specify the underlying channels from the perspective of land market imperfection and restricted land wealth.

This study also deepens the understanding of property rights and development. Grounded in the extensive theory of property rights (Coase, 1960; Demsetz, 1967; Hart

& Moore, 1990), a large body of literature establishes the broad economic impacts of tenure security, such as the effects on agricultural investments (Besley, 1995; Goldstein & Udry, 2008), agricultural productivity (Chen, 2017; Liu et al., 2023), labor supply (Field, 2007), long-term well-being (Xu, 2021), and housing investments (Galiani & Schargrodsky, 2010b). The study most relevant to our work is Bu and Liao (2022), who investigate the effect of individual land titling on the growth of rural firms. This work differs from their work in two aspects. First, this work shifts the focus from tenure security to the transferability margin of property rights. The findings elaborate the argument that security alone does not guarantee efficient use: when rights are non-tradable, the secure and clearly-defined rights can yield factor misallocation by locking land into original inefficient landowners (Jin & Deininger, 2009; Besley & Ghatak, 2010; Adamopoulos & Restuccia, 2020). Second, and more importantly, this study prioritize communal rights rather than individual rights. Unlike titling reforms securing individual land plots, the land transferability reform empowers collectives to negotiate contiguous land transfers. The findings suggest that who holds the transfer rights—and at what level of aggregation—can be as pivotal as the right security itself.

Finally, this work ties to the literature on how institutional arrangements can overcome coordination failures and holdout problems in the land market. A key barrier to rural development lies in the difficulty of assembling fragmented landholdings for more productive, non-agricultural use (Haasbroek, 2025; Isaac et al., 2016). Previous studies provide solutions from a variety of perspectives, such as contingent contracts (Collins & Isaac, 2012), state expropriation (Miceli & Segerson, 2007; Nosal, 2001), and site-development competition (Isaac et al., 2016). This study offers a novel institutional solution by allocating transfer rights to the village collectives rather than the individual. This solution is closely related to Kominers & Weyl (2012), who theoretically suggest that collective decision-making may help alleviate the holdout problems. This work builds on their insights and provide empirical evidence that collective negotiation can lower land coordination costs and therefore promote rural entrepreneurial activity.

The rest of this chapter is organized as follows. In Section 3.2, this study briefly introduces China's dual land system and the land transferability reform. Section 3.3

summarizes the data, sample area, and model specifications. Detailed empirical evidence is provided in Section 3.4 and the whole work is concluded in Section 3.5.

3.2. Institutional background

China first created an urban–rural dual land market system in the late 1980s through constitutional amendments, where urban land is owned by the state and rural land is owned by rural collectives. Only state-owned land is allowed to be transferred to individuals or enterprises within a specific period through a paid utilization system. Rural land, whether agricultural or idle construction land, is forbidden to enter the land market for non-agricultural use unless it is transformed into state-owned land through expropriation. This state-led expropriation approach is, in theory, a solution to the coordination costs of assembling rural land from numerous individual holders (Miceli & Segerson, 2007; Nosal, 2001). However, in practice, it triggers a series of problems that erode political trust and stall implementation (Kominers & Weyl, 2012; Sha, 2023).

During the land expropriation process, there is an inequality in bargaining power in negotiations between local governments and farmers or rural collectives, given the government’s capacities in an authoritarian regime and the ambiguous nature of collective property rights (Cai & Sun, 2018; Sha, 2023). Local governments typically provide meagre compensation to the farmers or rural collectives whose agricultural land has been expropriated, while selling the land to real estate or other industrial sectors at much higher market prices. Based on the Blue Book of Analysis and Forecast of China’s Social Development⁴ published in 2005, the original landholders, i.e., farmers and rural collectives, only benefit from 5%–10% of the increment in land value, the majority of which is instead captured by local governments and land developers. As a result, local governments have long been the sole monopolistic suppliers of industrial land, who are keen to promote rural–urban land conversion through land expropriation to earn huge profit margins (Henderson et al., 2022).

The extremely uneven redistribution of land revenue between the government and farmers who lose land not only causes frequent conflicts and disputes in rural regions, but also triggers the emergence of informal markets or grey trading (Hui & Bao, 2013).

⁴ See <https://search.library.wisc.edu/catalog/999934165102121>.

In the most extreme case, the entire village, including rural collectives and their members, could resist expropriation, leading to protracted negotiations, delays, and sometimes violent disputes (Sha, 2023), which significantly increased the transaction costs for any potential investor. The dotted line in Figure 3.1 shows how collectively owned land was traded in the past with enterprises. For an entrepreneur intending to start a business in rural areas, there were primarily two channels: (1) the formal channel—waiting for government-led expropriation—entailed purchasing land at high prices set by a state monopoly and enduring substantial bureaucratic delays; and (2) the informal channel, where transactions occurred outside the legal framework. While potentially cheaper, this path is subject to higher uncertainty because land can be taken back by local governments at any time. This institutional environment, characterized by high coordination costs (either through the monopolistic state or the uncertain grey market) and insecure property rights, suppressed rural entrepreneurial activity due to the expensive and risky land to acquire.

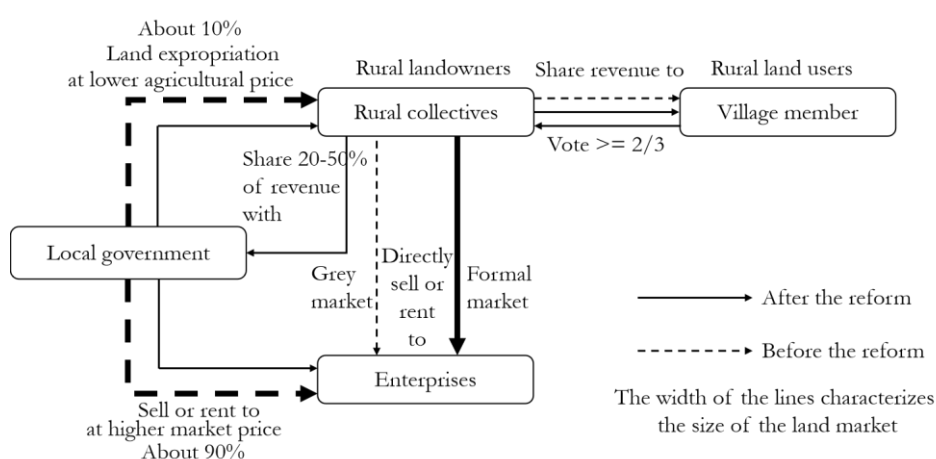


Figure 3. 1 The process of transferring rural land to enterprises

To eliminate the institutional friction of the dual land ownership system and promote rural development, the State Council of China launched a landmark land property rights reform in 2015 that allowed rural collectives to directly transfer rural construction land use rights to enterprises in 15 counties. This pilot program was expanded to 33 counties one year later and eventually rolled out nationwide through a modification to the legislation at the end of 2019. According to an interview with the

minister of China's Ministry of Land and Resources at that time⁵, the pilot counties were selected from the pilot region lists of two reforms: (1) National Comprehensive Pilot Program for New-Type Urbanization, and (2) Rural Reform Pilot Zones. Specifically, the selection of land reform counties is required to be representative across regions with different development levels (i.e., balance eastern, middle, and western regions), which hence provides a reliable counterfactual control group for effective causal inference. In following Section 3.1.1 and Section 3.3, this study provides a detailed discussion of the coverage and implementation of these two pilot programs and conducts a balance test to empirically demonstrate why these counties serve as a valid comparison group.

However, it is important to clarify that reform implementation was not uniform across all jurisdictions, even within the designated pilot counties. Due to variations in local administrative capacity, differences in existing land-use planning, and the voluntary nature of certain collective actions, the intensity and timing of the reform's rollout varied at the township and village levels. Consequently, the estimated results in this study should be interpreted as the average county-level treatment effect rather than a full coverage impact. This approach captures the overall policy efficacy under real-world administrative constraints while acknowledging that the reform did not instantly or homogeneously transform every acre of rural land within the pilot boundaries.

One unique feature of this reform is assigning land transfer rights to rural collectives, which introduces a vote-based collective decision-making process that can reduce internal coordination costs and a bargaining representative to coordinate with firms. The solid line in Figure 3.1 illustrates this new process. Crucially, the decision to sell or lease land requires a formal resolution passed by a two-thirds majority of the members of the whole village (or their representatives). This collective decision-making process effectively internalizes the negotiation among villagers, solving the potential for internal holdout problems. Instead of an external firm or government needing to negotiate with dozens of households, they now negotiate with a single, legally empowered entity, the rural collective committee, who possess an inherent advantage in consolidating land resources, given their authority from *de jure* land

⁵ See <http://politics.people.com.cn/n/2015/0112/c1001-26365839.html>

ownership and legitimacy conferred by democratic elections (Martinez-Bravo et al., 2022; Zhao, 2020).

The revenue from the successful land transfer is first shared with the local government, which typically receives 20-50% as a land value-added adjustment fee⁶. The remaining revenue is allocated according to the collective's charter: a portion is often reinvested into the collective's capital fund for public services or saving for future development, while the rest is distributed to village members who hold a local rural hukou (household registration) as dividends. For example, in some counties, such as Wenchang in Hainan Province and Meitan in Guizhou Province, the remaining land income can be distributed among village collectives and members in a ratio of 3:7 (Yan et al., 2021). Since the land revenue is exclusively distributed among members with rural hukou, we can expect that residents holding an urban hukou, even if they live in the same village and are exposed to the same local economic changes, are explicitly excluded from land revenue. This hukou-based distribution rule provides an ideal placebo group to isolate the effects of the reform-induced wealth from other confounding local factors. This placebo will be formally tested in Section 4.4.2.

Since this reform supplemented, rather than replaced, the existing state land supply system, it actually changed the supply structure of the rural land market from a complete state monopoly to a duopoly of local governments and rural collectives (Wen et al., 2022). It is worth noting that what rural collectives are allowed to trade directly is the long-term use rights (typically for 40-50 years) of a specific land category known as rural collective operating construction land (COCL). This kind of land refers to idle rural construction land for industrial, mining, storage, commercial services, and other operational purposes specified in the predetermined general plan for land utilization and urban–rural planning in China (Yan et al., 2021). In China's land use planning, rural land is mainly divided into two categories: (1) agricultural land, which includes cropland, forests, and grasslands; and (2) construction land, which encompasses homesteads for housing, land for public facilities, and the preceding COCL. Other idled construction land controlled by collectives is allowed to be traded with enterprises after being formally converted into COCL through the procedures of land use change. In

⁶ See <https://faolex.fao.org/docs/pdf/chn179547.pdf>

contrast, agricultural land that has already been allocated to village members is, in principle, not permitted to directly trade with enterprises. In some cases, where it must occupy such land to assemble a contiguous land parcel, rural collectives are mandated to follow China's requisition-compensation balance policy issued in 1999 by reclaiming an equivalent area of cropland elsewhere designated for construction. This institutional restriction, in a way, helps to alleviate the concerns about the large-scale transfer of farmland to enterprises.

Some anecdotal evidence suggests that this reform brought evident benefits to village collectives and members. Firstly, they could acquire additional property income through direct transactions with land users. According to reports from the State Council of China⁷, the village collectives and farmer members in the 33 pilot counties had earned a revenue of 17.81 billion yuan by 2018, which is equivalent to 35% of the total GDP of the agricultural sector in the Chinese capital, Beijing, during the pilot period. It is possible that the income growth induced by the land reform may encourage local farmers to become entrepreneurs, as suggested by the theory of initial wealth or start-up capital (Cagetti & De Nardi, 2006; Evans & Jovanovic, 1989; Wang et al., 2012). Additionally, the formalized collective-led land market may have changed the rural land supply structure from a monopoly of local governments to competition between local governments and rural collectives (Wen et al., 2022). The emergence of competitors can lead to strategic behaviors among different market players and reduce the equilibrium land price if the new supplier can provide homogenous or even better assembled land parcels. Despite these benefits, whether these potential benefits are substantial enough to overcome other barriers impeding rural entrepreneurial activity—such as lack of agglomeration, market access, and imperfect credit—remains a key empirical question this study seeks to answer.

3.3. Data, sample, and methodology

3.3.1. Data

This work is primarily built on a combination of the following five datasets: the county-level land reform roll-out agenda, enterprise registration records, residents'

⁷ See https://www.sohu.com/a/284677808_819998

employment, income, and expenditure information from a nationwide survey, state-owned land transaction records, and other socioeconomic attributes.

Reform roll-out agenda

To construct our sample, this study collects the county-level implementation agenda of the land transferability reform and the two other reforms mentioned in the background section from the official documents of the websites of the Chinese government. The first reform is the National Comprehensive Pilot Program for New-Type Urbanization, which was implemented across three batches from 2014 to 2018⁸. This study utilizes pilot counties only from the first two batches announced in 2014 and 2015 to align with the timeline of our treatment assignment. The second reform is the Rural Reform Pilot Zones, which selected a first wave of 24 pilot counties in 2012, followed by a second wave of 34 counties in 2014⁹. There is a total of 750 counties selected as the pilot regions for the two reforms, which are standardized to 2021 boundaries to ensure consistency with the aggregation unit of our firm-level data. The empirical work excludes 23 counties that exclusively permit individual towns within their jurisdiction to undertake the two reforms and 61 counties that, being fully urbanized, lack the town administrative units and therefore have no registered rural firms throughout the entire sample period. The final sample covers 666 counties, with 33 designated as the treatment group and the remaining 633 as the control group.

Enterprise registration records

The primary outcome variable, rural entrepreneurial activity, is measured by the number of newly registered businesses in each town per year. The raw data come from the National Enterprise Credit Information Publicity System, which records detailed

⁸ The first batch was announced in December 2014, comprising 62 pilots at various administrative levels, including two provinces and a variety of cities, counties, and towns (See <https://www.gov.cn/xinwen/site1/20150204/40201423027629790.pdf>). The second batch followed in 2015, consisting of 59 cities, counties or towns (See https://www.ndrc.gov.cn/xxgk/zcfb/tz/201511/t20151127_963507.html). The third batch was announced in November 2016, incorporating another 111 cities, counties or towns as reform regions (See https://www.gov.cn/xinwen/2016-12/07/content_5144553.htm#1).

⁹ The county list for the first wave can be found in https://zqb.cyol.com/html/2012-01/13/nw.D110000zgqnb_20120113_2-03.htm, while that of the second wave is manually collected from individual pilot announcement issued by each respective provincial governments (See example <http://m.sjmsw.org/Home/News/detail/id/17860.html>)

information on almost all legally established business entities in China, such as the entrepreneur's name, enterprise name, address, registration date, industrial type, registered capital, scope of business, and operating status¹⁰. The unregistered E-commerce and informal household businesses, whether agricultural or non-farm ones, are not captured by our dataset. This study obtains the geographic coordinates (latitude and longitude) of each enterprise based on its address and merge them with a map of China's 2021 township administrative divisions, which allows to aggregate the number of new firms in town-year cells.

Given that about 45% of observations lack industry information, this work develops a machine learning method that uses the term frequency–inverse document frequency (TF-IDF) vectorization and the multinomial Naive Bayes algorithm to predict a company's industry based on its name. For each year, this study trains and validates the model on a subset of data with non-missing industry information and then apply the trained classifier to predict the industries for the unlabelled companies. To test for potential gender differences in entrepreneurship, this study further predicts entrepreneurs' gender from their Chinese full names using the open-source gender predictor based on a Naïve Bayes classifier (<https://github.com/jaaack-wang/gender-predictor>). This tool is trained on over 3.65 million names and achieves 96.2 % accuracy on its test set. The final dataset covers 11263218 unique firms established in our sample counties between 2009 and 2019. To mitigate the influence of outliers, we have trimmed the top 1% of the number of new enterprises established per town per year.

China Household Finance Survey

The study introduces a nationally representative survey, the China Household Finance Survey (CHFS, see <https://chfser.swufe.edu.cn/datas/Home/HomeIndex>), to obtain additional employment and income information on rural residents. This survey, which started in 2011 and has been carried out every two years, is one of the largest longitudinal surveys on micro-level family information in China. Detailed information about residents' demographic attributes, such as gender, age, education, residential area,

¹⁰ Our dataset does not include the precise dates on which business cancellations occurred. Hence, operating status pertains to the operational status of enterprises in 2022, encompassing three categories: surviving, deregistered, and relocated status.

as well as their employment and consumption, is recorded in this dataset. The study introduces an unbalanced panel sample by pooling all five waves of the CHFS from 2011 to 2019 and then matching it with land reform roll-out information.

Land transaction records

To investigate the effect of collective land transfer rights on enterprises' land use costs, this study obtains state-owned land transaction records for rural regions from the official website of the land market (<https://www.landchina.com/>). The raw data documents the parcel-level transaction information, including land location, area, grade, total transaction price, land use type, land acquisition enterprise, industry, and transaction mode. This study aggregates the average of parcel-level land unit price, total land area, and total number of land parcels at the town-year level. Given the particular sensitivity of land price to parcel location, this study follows the random forest method of Grange et al. (2018) to isolate land quality and locational characteristics from land prices, which contributes to more accurate inter-region land price comparison.

Other socio-economic attributes

Finally, this work introduces a series of socioeconomic attributes to test predetermined differences between the treatment and control groups, or to examine potential aggregate effects. First, to test whether coordination capability matters for the effects of the land reform, the study introduces two time-invariant indicators: (1) terrain ruggedness, which is sourced from the National Earth System Science Data Center; and (2) density of lineage genealogies from the Comprehensive Catalog of Chinese Genealogies. The second type includes various pre-reform socioeconomic attributes obtained from satellite-based datasets, such as nightlight intensity from the Harvard Dataverse, PM2.5 concentrations estimated by the Atmospheric Composition Analysis Group, population density from the LandScan dataset, cropland area provided by Yang & Huang (2024), and road density observed from the OpenStreetMap. Except for road density, which is only available since 2013, these variables are measured over the pre-reform period from 2009 to 2014. Third, to investigate the pre-reform balance on employment structure, this study sources the share of non-agricultural to total employment at the county level from the 2010 National Population Census. Fourth, data on the output and planting area of major grain crops is collected from County Statistical

Yearbooks. The yearbook data, however, suffers from a high proportion of missing values (approximately 40%); this study tests whether this attrition is systematically correlated with treatment assignment in Appendix Table B-6. The study also introduces a panel dataset of points of interest (POIs) from Baidu Map, which is aggregated at the town-year level to test for changes in rural public facilities. Owing to the data access restrictions, the POI dataset spans from 2012 to 2017.

3.3.2. The Sample

Figure 3.2 shows the sample area, which covers all provinces in China. The treatment group consists of all towns located in 33 counties that are designated as the land transferability reform counties, while the control group comprises the towns situated in the remaining 633 counties that are selected as the pilot counties for the two reforms mentioned in the background section. All the streets in the sample counties are excluded because they are usually considered urban regions in China.

An advantage of the empirical setting is that it compares land reform counties with other runner-up counties that potentially would be treated, making the treatment and control groups highly comparable. Additionally, compared with using neighbors as the control group, this study is less vulnerable to the challenges of the SUTVA. Given that the land property rights reform was rolled out nationwide via legislation at the end of 2019, the sample period spans from 2009 to 2019, with the policy shock occurring in 2015 or 2016.

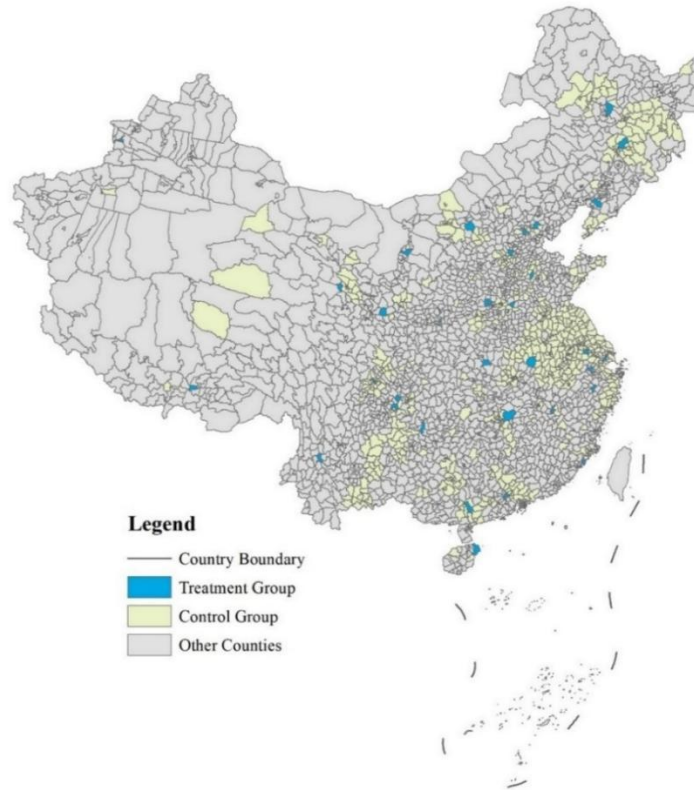


Figure 3. 2 Sample area

Note: This study acquires the base map from the official website of the Ministry of Natural Resources of the People's Republic of China (<http://bzdt.ch.mnr.gov.cn/browse.html?picId=%224o28b0625501ad13015501ad2bfc0480%22> accessed on 1 May 2024), Drawing review NO GS(2020)4619.

3.3.3. Balance test

To validate the ex-ante comparability of our treatment and control groups, this study conducts a series of tests examining both the selection into treatment and pre-existing trends of key variables. First, it tests whether observable predetermined county characteristics can predict the assignment to the land reform and its timing. The results are shown in Table 3.1, where the outcome variable in Columns (1) to (3) is a dummy equal to one if a county was designated as a land reform county and zero otherwise, while that of Columns (4) to (6) is the year of the land reform. Following Feigenbaum & Gross (2024), this study regresses the two outcomes by Probit and OLS models on a wide range of predetermined county characteristics, including nightlight intensity, PM2.5 concentration, population density, road density, cropland share, geographic location, and the pre-reform attributes of our primary outcome variables, the number of

new rural firms and the share of non-agriculture employees. The selection of these characteristics is guided by insights from our communication with an official at the Beijing Municipal Natural Resources Bureau, who indicates that the pilot selection is likely based on local economic foundations, land resource endowments, and agricultural development levels.

Columns (1) and (4) introduce a panel dataset from 2009 to 2014, controlling for year fixed effects, while the remaining columns use a cross-sectional sample to include additional time-invariant variables. Across the six columns, the study finds that the pretreatment balance holds as almost no evidence shows that the land reform assignments are correlated with any of these attributes. One exception lies in the pre-reform cropland share, which is marginally significantly higher for the earlier wave of reform counties (Column (5)). To account for potential selection bias, this study incorporates heterogeneous trends of predetermined cropland share as control variables in robustness checks.

Beyond testing for cross-sectional balance, the study also examines the pre-treatment trends of time-varying covariates and the outcome variables. Appendix Figure C-1 plots the annual evolution of these variables for both treatment and control groups before the reform. The results show that the potential parallel trends hold for most of these variables, except for cropland share, which again shows a slightly converging trend between the treatment and control groups. The visually parallel trends provide complementary evidence that the control group serves as a valid counterfactual, reinforcing the underlying parallel trend assumption of the DID design.

Table 3. 1 Balance Tests for Predetermined Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
Model	Probit			OLS		
Outcome	Dummy of land reform counties			Timing of the reform		
(Log) Nightlight from 2009 to 2014	0.117 (0.168)	0.093 (0.188)	0.221 (0.286)	-0.022 (0.186)	0.027 (0.271)	0.003 (0.281)
(Log) PM2.5 from 2009 to 2014	0.044 (0.337)	0.069 (0.364)	0.006 (0.365)	0.266 (0.264)	0.210 (0.328)	0.231 (0.354)
(Log) Population from 2009 to 2014	-0.098 (0.160)	-0.131 (0.175)	-0.117 (0.175)	0.018 (0.202)	0.030 (0.242)	0.015 (0.262)

Cropland share from 2009 to 2014	-0.237 (0.360)	-0.195 (0.383)	-0.355 (0.443)	-0.743* (0.420)	-0.811 (0.518)	-0.766 (0.583)
(Log) Firm registration from 2009 to 2014	0.121 (0.084)	0.130 (0.090)	0.128 (0.092)	-0.134 (0.081)	-0.121 (0.105)	-0.136 (0.102)
Road Density from 2013 to 2014		0.064 (0.136)	0.073 (0.133)		-0.080 (0.233)	-0.099 (0.241)
(Log) Distance to city center		-0.064 (0.115)	-0.047 (0.112)		0.091 (0.094)	0.071 (0.113)
Non-agriculture employee ratio in 2010			-0.616 (0.726)			0.245 (0.887)
Observations	3,996	666	663	198	33	33
Year FE	Y	N	N	Y	N	N
Cluster	County	County	County	County	County	County
DV Mean	0.050	0.050	0.050	2016	2016	2016

Note: This table presents the balance test results. The outcome variable of Columns (1) to (3) is the dummy indicating 1 if the county is designated as a land reform county and 0 otherwise, while that of Columns (4) to (6) is the timing of land reform. This study takes a logarithmic transformation for numerical independent variables to mitigate inconsistent scales and heteroskedasticity. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

3.3.4. Model specification

This study exploits the staggered implementation of the land transferability reform across counties to identify the causal impacts on rural entrepreneurial activity. The empirical design follows the classical setting of a staggered DID (e.g., Liu et al., 2023), which specifies the baseline regression model as follows:

$$\text{Enterprises}_{i,c,t} = \beta_0 + \beta_1 \text{Reform}_{c,t} + \gamma_{p,t} + \mu_i + \varepsilon_{i,c,t} \quad (1)$$

where $\text{Enterprises}_{i,c,t}$ refers to the number of enterprises in town i of county c in year t . The independent variable $\text{Reform}_{c,t}$ equals to one for the years in and after which county c implemented the reform and zero otherwise. $\gamma_{p,t}$ and μ_i represent the province-by-year and town fixed effects, which capture the common shocks that happened in each year specific to each province, and the time-invariant characteristics

of each town, respectively. $\varepsilon_{i,c,t}$ is the error term, with the standard error clustered at the county level to allow correlation within the same county. The coefficient of interest is β_1 , which indicates the causal effect of the collective land transfer rights on rural entrepreneurial activity.

To test whether the underlying parallel trend assumption holds for the DID estimator, this study introduces an event study model and apply robust estimators developed in recent literature to deal with the heterogeneity of the treatment effect across counties and over time in the staggered DID model (Borusyak et al., 2024; Callaway & Sant’Anna, 2021; De Chaisemartin & D’Haultfœuille, 2020; Sun & Abraham, 2021). The event study model is specified as follows:

$$\text{Enterprises}_{i,c,t} = \beta_0 + \sum_{k=-7}^4 \beta_k \text{Reform}_{c,t,k} + \gamma_{p,t} + \mu_i + \varepsilon_{i,c,t} \quad (2)$$

where $\text{Reform}_{c,t,k}$ is a set of indicators that take the value of one if year t is k years relative to the land reform in county c . In the preferred setting, the year before the actual reform (namely $k = -1$) is designated as the reference group and is omitted from the regression. Other variables are defined as in equation (1). The baseline analysis unit is at the town level. In further mechanism analysis, this study employs similar models to those in equations (1) but change the analysis unit to the individual, household, or county level to illustrate potential channels for the growth of entrepreneurship.

3.4. Empirical results

3.4.1. Baseline findings and the role of collective coordination capability

Table 3.2 reports the baseline results, where the outcome variable of each column is the number of newly registered firms aggregated at the town-year level. All columns include town fixed effects and province-by-year fixed effects. Column (1) reports the preferred specification without any additional controls, while Columns (2) to (4) sequentially introduce interactions between predetermined cropland share—which shows pretreatment differences in balance test—and linear, quadratic, and cubic time trends to account for potential differential trends across counties and avoid bias from bad control.

As shown in Table 3.2, the coefficients of land reform are consistently positive and statistically significant at the 5% level across all these specifications. The magnitude also remains stable, with the coefficient in Column (1) suggesting an average increase of 33 newly registered enterprises in treatment towns, relative to the control group where the reform has not yet started. This growth is economically substantial (approximately 25%), given that the average number of rural enterprises per town is 132 in the sample. Overall, the baseline results suggest that the reform aimed at allocating land transfer rights to rural collectives promotes the growth of rural entrepreneurial activity.

Table 3. 2 Baseline Results

	(1)	(2)	(3)	(4)
Outcome	Newly Registered Enterprises			
Reform	33.442** (13.934)	32.838** (13.710)	32.837** (13.709)	32.783** (13.697)
Observations	85,603	85,603	85,603	85,603
R-squared	0.850	0.850	0.850	0.850
Town FE	Yes	Yes	Yes	Yes
Province by Year FE	Yes	Yes	Yes	Yes
Cropland Share Trend	No	Linear	Quadratic	Cubic
Cluster	County	County	County	County
DV Mean	131.575	131.575	131.575	131.575

Note: This table presents the impact of land reform on rural entrepreneurial activity. The outcome variable of this table is the number of newly registered enterprises aggregated at the town-year level. Column (1) only includes the town and province by year fixed effects without any covariates. This study controls the interaction of predetermined cropland share and different specifications of time trend in Columns (2) to (4). Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

As this study has emphasized in the background section, the collective land transfer rights differ fundamentally from the individual rights in their capacity to solve the land

coordination failure. The effectiveness of this reform thus may hinge on the collective's pre-existing coordination capacity. A collective with strong coordination abilities can more easily aggregate fragmented plots and negotiate with investors, thus amplifying the reform's effects. In contrast, where coordination is difficult due to geographic or social barriers, the reform's impact should be muted.

To test this core precondition, this study exploits regional variation in two proxies for a collective's coordination capability: terrain ruggedness and clan networks. The results, presented in Table 3.3, provide strong, complementary evidence supporting the hypothesis. First, the study uses the standardized minimum terrain ruggedness¹¹ of each county as an inverse proxy for coordination capacity, as consolidation is inherently more costly in topographically complex areas (Nunn & Puga, 2012). Column (1) introduces a dummy variable which equals 1 when a county's standardized ruggedness is above the sample mean and 0 otherwise. The coefficients show that the reform's positive effect is concentrated in low-rugged areas and is fully offset in highly rugged terrain where coordination is difficult to achieve. The continuous interaction in Column (2) further implies: a one-standard-deviation increase in ruggedness reduces the reform's impact by a substantial 23 firms. These results show direct evidence that geographic barriers, which raise coordination costs, act as a critical impediment to the reform's success.

Second, this study uses the density of lineage genealogies of each county as a proxy for clan culture, where a denser clan network is thought to facilitate collective cooperation and coordination (Chen et al., 2024; Greif & Tabellini, 2010). The results are reported in the next two columns in Table 3.3, where Column (3) introduces a dummy variable indicating 1 when the number of genealogies per 10000 residents in a county is above the sample average and 0 otherwise, while Column (4) utilizes the continuous specification. Column (3) shows that the reform's effect centers in communities with a denser clan culture. Specifically, the continuous interaction term in

¹¹ We use minimum instead of average terrain ruggedness because the topography within Chinese counties is often highly heterogeneous. The average ruggedness can be skewed by large, uninhabitable mountainous areas, making it an unrepresentative measure of the land available for development. Minimum ruggedness, in contrast, better captures the topographical constraints on a county's most developable land, where the land assembly we study is most likely to occur.

Column (4) indicates that a one standard deviation increase in clan density amplifies the reform's effect by an additional 34 firms.

These findings suggest that the success of the land reform is critically dependent on the collective's coordination capacity. Previous literature has compellingly documented the land assembly problem in both developing and developed countries, where fragmented ownership and corresponding holdouts and transaction costs crowded out enterprises' enthusiasm for investments (Haasbroek, 2025; Isaac et al., 2016). This work shows that allocating land transfer rights to rural collectives offers a solution to this coordination failure. On one hand, rural collectives can internalize coordination costs among village members through vote-based collective negotiation; on the other hand can work as a bargaining representative with firms given the authority from de jure land ownership and legitimacy conferred by democratic elections (Martinez-Bravo et al., 2022; Zhao, 2020). This coordination capacity, in turn, unlocks two specific channels for the rise of rural entrepreneurial activity, which will be formally tested in Section 4.4.

Table 3. 3 The Role of Collective Coordination

Outcome	(1)	(2)	(3)	(4)
	Newly Registered Enterprises			
Reform	47.520*** (18.321)	35.011** (13.980)	8.296 (9.638)	27.048** (10.997)
Reform * High Terrain	-50.581** (21.063)			
Reform * Terrain		-23.205*** (8.499)		
Reform * Intensive Clan Culture			93.318** (39.553)	
Reform * Clan Culture				33.619* (19.287)

Observations	85,603	85,603	85,603	85,603
R-squared	0.850	0.850	0.851	0.851
Town FE	Yes	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes	Yes
Cluster	County	County	County	County
DV Mean	131.575	131.575	131.575	131.575

Note: This table presents the heterogeneity effects on rural entrepreneurial activity by collective coordination capability. The outcome variable of this table is the number of newly registered enterprises aggregated at the town-year level. Terrain is the standardized minimum terrain ruggedness of a county. High Terrain is a dummy variable equal to 1 if a county's ruggedness is above the sample mean, and 0 otherwise. Similarly, Clan Culture is the standardized number of genealogies per 10000 residents in 2010, and Intensive Clan Culture is an indicator for counties with clan culture density above the sample mean. Robust standard errors clustered at county or province levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

3.4.2. Robustness checks

Parallel trends

Like all DID models, the validity of the strategy of this work relies on the assumption of parallel trends, which posits that the treatment and control groups would have experienced similar enterprise growth trends in the absence of land reform. This assumption is tested with an event study model as specified in equation (2). Figure 3.3 provides the pre-trend and dynamic effects based on equation (2). Apart from the ordinary least squares estimator, this work provides dynamic estimators robust to heterogeneous treatment effects based on Chaisemartin and D'Haultfœuille (2020) and Sun and Abraham (2021)¹². Across the estimators, consistently significant growth in the number of enterprises can be observed during the post-reform period, while prior to

¹² We also provide additional robust estimators from Borusyak et al. (2024) and Callaway & Sant'Anna (2021) in Appendix C-2. We feature the CD and SA estimators in the main text as they provide more conservative magnitudes and are better suited for our sample structure of small treatment cohort.

the land reform, the coefficients are small in magnitude and nonsignificant, which supports the underlying parallel trend assumption.

This study also tests whether the OLS estimators are sensitive to violations of parallel trends, following Rambachan & Roth (2023). Specifically, this study compares the original confidence intervals of each post-reform coefficient against a set of robust confidence intervals. These robust intervals account for the uncertainty of the pre-trends and allow for period-specific departures from the linear trends up to the chosen smoothness parameter M . As shown in Appendix Figure C-3, all post-reform coefficients are highly robust to a linear trend violation ($M=0$). Notably, the results allow for M values up to 6.5, which is equivalent to 50% of the corresponding standard error for the coefficient of the first post-reform year (L_1).

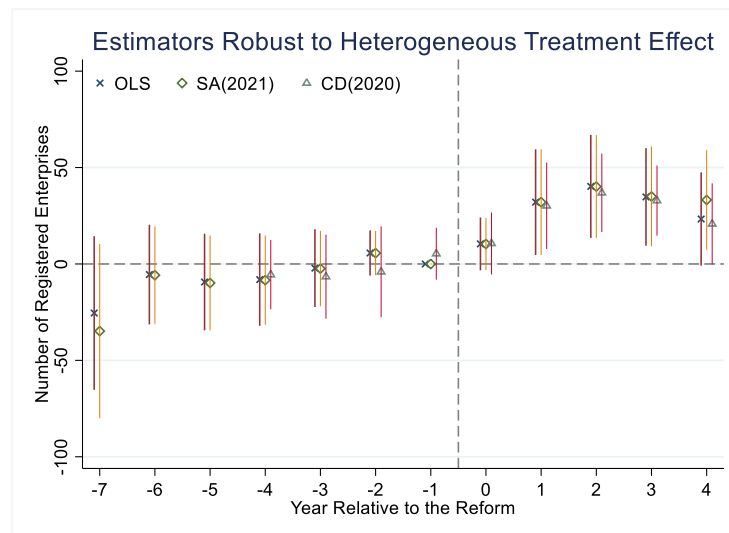


Figure 3. 3 Parallel Trends with Event Study Method

Note: This figure plots the event study coefficients, where the dependent variable consists of the annual number of registered enterprises for a given town. The regression model controls for province-by-year and town fixed effects. The vertical lines represent 95% confidence intervals for the respective point estimates.

Confounding policies

One central concern with the baseline findings derives from the concurrent policies enacted in rural China. During our sample period, rural China has witnessed several major policy initiatives aimed at promoting local economic growth. This study identifies three concurrent policies that could confound our results: (1) the nationwide

Land Titling Reform (Land Titling), which starts from 2009 and aims to enhance individual's agricultural land security (Bu and Liao, 2022); (2) the Rural Returnees' Entrepreneurship Supportive Program (RRESP), launched in 341 counties over three waves from 2016 to 2017, aiming to lower the institutional barriers for returnee entrepreneurs to engage in rural businesses, especially the rural E-Commerce; and (3) the Rural Housing Mortgage Program (Mortgage) introduced in 2016 that allows rural houses to be used as collateral for bank loans in 59 counties to improve rural access to credit. Detailed information on each confounding policy can be found in Appendix A-1, which specifies their background, implementation schedule, overlap with this sample, and the construction of the corresponding time-varying indicators used in the empirical analysis.

A twofold empirical strategy is employed to disentangle the effect of the land transferability reform from these confounding policies. First, this study tests the robustness of the main finding by including time-varying indicators¹³ for each of these policies as control variables in the baseline model. The results are presented in Panel A of Table 3.4, where controls for each policy are incrementally introduced in Columns (1) to (3) and simultaneously included in Columns (4). Across the specifications, the coefficients of interest remain statistically significant, while the coefficients of the confounding policies are small in magnitude and nonsignificant, suggesting that the observed entrepreneurial growth is primarily driven by land transferability reform itself, rather than the concurrent implementation of other policies.

Second, this study goes a step further by testing potential interactions to explore whether these policies act as complements or substitutes to the land reform. The results are presented in Panel B of Table 3.4. Column (1) shows no significant interaction effect between the land transferability reform and the nationwide Land Titling program. This null effect does not imply that individual titling and collective transfer rights are theoretically independent. Rather, this result stems from China's special land use system, under which the two sets of rights govern mutually exclusive categories of land.

¹³ The indicators are coded as time-varying dummies equal to 1 when a county is listed as participating in a given program in that year and 0 otherwise.

As detailed in Appendix Table A-1¹⁴, the collective land transfer reform grants transferability to non-agricultural construction land controlled by rural collectives, while the titling reform enhances security for farmland allocated to rural households. Somewhat unexpectedly, this study also finds no significant interaction between the land reform and the RRESP, as shown in Column (2) of Panel B. This null effect may be driven by RRESP's focus on rural E-Commerce, much of which is exempt from mandatory business registration¹⁵ and therefore is likely underrepresented in the dataset of this work. Column (3) observes a positive and statistically significant interaction between our reform and the mortgage program. Specifically, in counties without the mortgage policy, the transferability reform's effect is a modest 18.8. However, in counties where both reforms are active, the total effect surges to 77.3. The findings suggest a synergic effect of relaxing frictions in both land and financial markets.

Table 3. 4 Confounding Policies

	(1)	(2)	(3)	(4)
Outcome	Newly Registered Enterprises			
<i>Panel A: Control Confounding Policies</i>				
Reform	33.426** (13.936)	33.792** (13.816)	34.854*** (12.904)	34.421*** (12.811)
Land Titling	1.519 (5.947)			1.667 (5.978)
RRESP		-7.855 (7.156)		-7.795 (7.100)
Mortgage			-3.038 (17.633)	-1.396 (17.360)
Observations	85,603	85,603	85,603	85,603
R-squared	0.850	0.850	0.850	0.850

¹⁴ We identify the key differences between land titling and transferability reform of our interests in Appendix A-1, including the nature of property rights, targeted land assets and theoretical mechanisms that may affect rural entrepreneurship

¹⁵ <http://www.lawinfochina.com/display.aspx?lib=law&id=28792>

Town FE	Yes	Yes	Yes	Yes
Province by Year FE	Yes	Yes	Yes	Yes
Cluster	County	County	County	County
DV Mean	131.575	131.575	131.575	131.575
	(1)	(2)	(3)	
Confounding Policies	Land Titling	RRESP	Mortgage	
Outcome	Newly Registered Enterprises			
<i>Panel B: Interaction Between Confounding Policies</i>				
Reform	25.345	39.337**	18.826*	
	(15.979)	(15.456)	(10.112)	
Confounding Policy	1.148	-6.069	-28.152	
	(6.011)	(7.344)	(20.822)	
Reform * Confounding	9.245	-29.947	58.445*	
Policy	(14.064)	(25.904)	(33.884)	
Observations	85,603	85,603	85,603	
R-squared	0.850	0.850	0.850	
Town FE	Yes	Yes	Yes	
Province by Year FE	Yes	Yes	Yes	
Cluster	County	County	County	
DV Mean	131.575	131.575	131.575	

Note: This table presents the robustness check after accounting for confounding policies. The outcome variable of this table is the number of newly registered enterprises aggregated at the town-year level. Panel A gradually controls each confounding policy, and Panel B provides an analysis of policy interactions. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Spillovers

Another caveat for this design lies in the spillover effect, whereby entrepreneurship activities in the control group might be affected by the more desirable status of the treatment group nearby. Specifically, those who had intended to establish firms in control regions might have been attracted to land reform counties due to the advantages

of doing business there. If there are indeed such spillovers, the baseline findings might overestimate the advantages of land reform. Alternatively, the baseline results may underestimate the treatment effects if land reform counties can create new opportunities for suppliers or related service businesses in their neighbors. To test these potential spillovers, this study incorporates two additional tests in Table 3.5.

First, following the concentric ring design utilized by Lu et al. (2019), this study eliminates a small number of neighboring counties directly adjacent to the treated group. This strategy is plausible because the spillover is particularly salient in geographically adjacent control regions, as they share similar entrepreneurial environments with the treatment groups, and the relocation costs for firms are cheaper. The results are shown in Column (1) of Table 3.5, where the estimated coefficients remain significant and positive, with the magnitude closely aligned with the baseline estimates. Secondly, in Column (2), this study follows Li et al. (2025) and include a time-varying dummy “Neighbor Reform”, which equals one for control county i in year t if any of its adjacent counties has implemented land reform and zero otherwise. The coefficient of Neighbor Reform is small and statistically insignificant, suggesting that the land reform does not meaningfully affect the rural business creation in neighboring counties. In Columns (3) and (4), this study accounts for neighboring counties that are located within the same prefectural cities, which are likely to share more institutional and economic characteristics with the original treatment groups. The results are almost identical regardless of excluding these intra-city neighbors in Column (3) or applying a similar dummy variable in Column (4).

The absence of significant spillover effects during the pilot period warrants further discussion regarding the future competitive landscape. The current lack of impact on neighbors suggests that the reform dividend is presently concentrated within the pilot boundaries, likely because these counties hold a unique institutional advantage that neighboring areas cannot yet replicate. However, as the reform program expands nationwide, the scarcity of this institutional capital will diminish. We anticipate that competition for new enterprises will become more intense when neighboring counties are subsequently included in the reform program. In such a level playing field, counties may shift from competing on institutional access to competing on service quality, land price subsidies, or specialized infrastructure to attract firms. Therefore, while our

results show no immediate negative spillovers, the long-term equilibrium may involve a "race to the top" in rural governance quality as more regions gain the legal authority to trade collective land. In other words, the enterprise growth observed in land reform counties is unlikely to be biased by spillovers in the short term, though the dynamics of inter-county competition are expected to evolve as the policy scales.

Table 3. 5 Excluding Spillovers

Outcome	(1)	(2)	(3)	(4)
	Newly Registered Enterprises			
Reform	33.791** (14.923)	35.821** (14.179)	33.882** (14.803)	35.691** (14.151)
Neighbor Reform		14.427 (10.244)		
Intra-city Neighbor Reform				18.066 (11.367)
Observations	76,721	85,603	80,488	85,603
R-squared	0.853	0.850	0.853	0.850
Town FE	Yes	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes	Yes
Cluster	County	County	County	County
DV Mean	129.319	131.575	130.589	131.575

Note: This table investigates potential spillovers for neighboring counties. The outcome variable of this table is the number of newly registered enterprises aggregated at the town-year level. Neighbor Reform is a time-varying dummy that equals one for county i in year t if any adjacent county has implemented land reform and zero otherwise. Intra-city Neighbor Reform restricts the definition of neighboring counties to only include adjacent counties located within the same prefecture-level city. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Other robustness checks

This study further performs a series of other tests to illustrate the reliability of the main findings. First, a placebo test as implemented by Li et al. (2016) and Cantoni et al. (2017) is introduced to exclude unobserved time-varying factors specific to each county (See Appendix Figure C-4). Second, this study tests the sensitivity of the findings using alternative specifications in clustering methods, outcome definitions, empirical strategies, and alternative controls and sample structures. The results are shown in Appendix Table B-1 to Table B-3. Specifically, in Table B-1, this study introduces different specifications of clustering methods. The results are almost identical when standard errors are clustered at the city, province, or at the multi-levels, such as county and province-by-year or county and city-by-year levels. This study further tests the sensitivity in the outcome specifications and empirical strategies. In Column (1) of Appendix Table B-2, this study utilizes the logarithmic transformation of the original outcome variable, while in Column (2), this study introduces a Poisson regression model to account for the count nature of the dependent variable—the number of newly registered firms. Across these specifications, the core findings remain stable and robust. Finally, in Appendix Table B-3, this study introduces additional county-specific time trends and aggregate the sample into a county-panel. The first two columns of Table B-3 show the baseline results and robustness after accounting for county-specific time trends¹⁶. In Columns (3) and (4), this study aggregates the sample into a county panel and find a similar margin to our baseline results (28%). Taken together, the results are not sensitive to the specifications in outcome definitions, empirical strategies, alternative controls, and sample structure.

3.4.3. Heterogeneity

This section analyzes the growth patterns of rural firms by asking four questions: (1) what industries are growing? (2) what is the quality of these new ventures? (3) who are the entrepreneurs leading them? and (4) where is this growth geographically concentrated? Answering these questions not only characterizes the firm types and

¹⁶ The coefficient in Column (2) decreases from 33.442 to 17.065 after adding county-specific time trends. This pattern likely reflects downward-bias induced by potential over-control, especially when the treatment effect itself is time-varying (Goodman-Bacon, 2021).

spatial distribution of the entrepreneurial boom but also offers suggestive evidence for the underlying mechanisms that are formally tested in Section 4.4.

Industrial type

This work starts with the industrial type of newly registered firms. The firms are aggregated by industrial type in each town-year cell. To account for the zero-inflated problem in industry-level firm entry, this study employs a dual strategy. First, the industries are aggregated into three broad sectors¹⁷—agriculture, manufacturing, and services (Table 3.6). Second, to explore more granular dynamics, this study leverages Poisson regression models on 18 finely disaggregated, one-digit industry classifications (Appendix Figure C-5).

Table 3.6 shows that the land transferability reform increases the number of manufacturing and service firms by 9% and 28%, respectively. According to Appendix Figure C-5, the growth of firms is concentrated in land-intensive heavy sectors such as manufacturing and mining, as well as a wide range of service industries, including retail, leasing, real estate service, research, education, and environmental management. This dual-track expansion provides suggestive evidence for two separate channels that are hypothesized in the institutional background. On the one hand, given the land and capital-intensive attributes of manufacturing firms, it's suspected that the firm growth in this sector may be driven by investors who are able to acquire cheaper and consolidated contiguous land in land reform counties. On the other hand, the surge of service establishments is consistent with the story of wealth effect (Corradin & Popov, 2015; Hurst & Lusardi, 2004), where windfall land revenues can relax entrepreneurial liquidity constraints for local farmers to start low-barrier retail ventures, and simultaneously boost local consumption demand and stimulate entry in these non-tradable activities such as repair, leasing, real estate and education (Hollenbeck & Giroldo, 2022; Sato et al., 2012). Additionally, the growth of new manufacturers may

¹⁷ Agricultural firms comprise those engaged in crop cultivation, forestry, raising livestock, and fisheries. Manufacturing firms cover firms in manufacturing, mining, electricity and construction. Service firms include firms in retail, transportation and postal service, catering and accommodation, finance, real estate service, information and communications technology (ICT), leasing, scientific research, environmental management, repair, education, health and social work, culture, sports and entertainment.

create demand for production-network complementarities, such as demand for R&D service and services for environmental compliance (Ellison et al., 2010).

This study further aggregates the firms by their ownership attributes in Appendix Table B-4. The results show that the growth of manufacturing and service firms is exclusively driven by private firms rather than state-owned firms, which have better access to state-owned rural land given their strong political connections (Chen & Kung, 2019; Wang & Yang, 2021). Consistent with the global pattern of rural structural transformation away from agriculture (Dippel et al., 2020; Fried & Lagakos, 2021), this study also observes a decline in agricultural firms by 12% compared to the mean value of the outcome. This decline raises the concern that the observed positive entrepreneurship effects may come at the cost of agricultural recession, which will be formally tested in Section 4.5.1

Table 3. 6 Heterogeneity by Industrial Type

Outcome	(1) Agricultural	(2) Manufacturing	(3) Service
Reform	-0.456** (0.218)	1.016* (0.594)	32.882** (13.589)
Observations	85,603	85,603	85,603
R-squared	0.596	0.886	0.841
Town FE	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes
Cluster	County	County	County
DV Mean	3.766	10.738	117.071

Note: This table presents the heterogeneity effects on rural entrepreneurial activity across different industries. The outcome variable of this table is the number of newly registered enterprises of each industry aggregated at the town-year level. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Entrepreneurial quality

While previous sections have documented a significant increase in the quantity of new firms, one may wonder whether the reform also improved their quality. This section thus tests the quality of new firms induced by land reform from multiple aspects: organizational types, initial capital investments, and post-entry survival.

The first evidence on quality is associated with the organizational structure of firms. There are three organizational types in China: farmers' professional cooperatives, self-employment, and formally registered firms¹⁸. Panel A of Table 3.7 shows an organizational structure shift away from traditional collective agricultural firms toward more market-oriented individual and corporate ventures. Specifically, the land reform increases the number of formal firms and self-employment businesses by 35% and 21% (Columns (1) and (2)), respectively. Consistent with the decline in agricultural firms, this study observes a similar decrease of 17% in farmers' professional cooperatives that focus on agricultural services (Column (3)). This leap towards formalization marks an upgrade in enterprise quality, as formal firms tend to exhibit higher productivity, stronger scalability, and legal protections (La Porta & Shleifer, 2014).

This study next examines the size of new firms, proxied by their registered capital, which reflects the founder's commitment to maximum liability and the venture's initial scale. Following Bai et al. (2025), firms with registered capital below RMB 2 million are defined as small, and those exceeding RMB 15 million are defined as large¹⁹. As shown in Panel B of Table 3.7, the reform significantly boosts the entry of both small firms (Column (1)) and large firms (Column (3)), with a null effect on medium-sized enterprises (Column (2)). The magnitudes are substantial: the number of small firms rises by 32 percent, whereas large-scale entrants expand by 24 percent relative to their

¹⁸ Farmers' professional cooperatives are collective mutual-aid organizations focusing on agricultural services. Self-employment represents individual proprietorships or small businesses with low entry barriers, typically started by local residents. Formal firms are other legally incorporated entities (e.g., LLCs) with a structure suitable for scaling, established by either local or outside investors.

¹⁹ One concern with our identification lies in the sizeable share of observations lacking registered-capital information (about 34%). To test whether the attrition is systematically related to our treatment, we regress the number of firms with missing information on registered capital on the land reform indicator in Appendix Table B-5. Column 1 shows that the coefficient on the reform variable is small and statistically insignificant, alleviating concerns of selective attrition. We run the same test for the tiny fraction of firms without survival status (0.1%) and predicted entrepreneur gender (0.5%) in Columns (2) and (3) and likewise obtain economically negligible and statistically insignificant estimates.

respective means. The growth of large firms mirrors the previously documented firm expansion in heavy industries, suggesting that the land reform can unlock capital-intensive investments by lowering land use costs of assembled contiguous plots. The findings of this work differ from earlier titling or collateral-based reforms, as they predominantly benefited micro-scale ventures or self-employment by relaxing liquidity constraints or labor mobility (Bu & Liao, 2022; Field, 2007). Put differently, collective land transfer rights may remove land-market frictions that previously impeded high-stakes industrial entry, as rural collectives can better integrate the scattered land through collective negotiation to meet the demands of large enterprises.

Another attribute of firm quality lies in the post-entry performance. Three kinds of post-entry operational status are recorded in China's enterprise registration system: surviving, deregistered, and relocated. Due to the lack of exact firm exit and relocation dates in our dataset, this study classifies firms registered in a given town-year based on their operational status as of 2022. The results are reported in Panel C of Table 3.7, which observes evidence against the story of registration boom for low-viability, short-lived ventures (Branstetter et al., 2014). Instead, the land reform encourages a large and statistically significant increase (about 31%) in the number of firms surviving until 2022 (Column (1)). At the same time, this study observes null effects on deregistered and relocated firms (Columns (1) and (2)). This results implies that the marginal entrant induced by land reform appears to be high-quality firms with long-term survival.

Table 3. 7 Heterogeneity by Entrepreneurial Quality

	(1)	(2)	(3)
Outcome	Formal Firms	Self-Employment	Farmer's Cooperatives
<i>Panel A:</i>			
<i>Organizational Type</i>			
Reform	19.347** (9.722)	14.839** (7.303)	-0.745* (0.410)
R-squared	0.770	0.836	0.612
DV Mean	55.726	71.560	4.289
	(1)	(2)	(3)

Outcome	Small Firms	Median Firms	Large Firms
<i>Panel B: Firm Size</i>			
Reform	22.953** (9.820)	1.513 (1.724)	0.609** (0.264)
R-squared	0.812	0.677	0.777
DV Mean	71.783	11.782	2.513
	(1)	(2)	(3)
Outcome	Surviving Firms	De-registered Firms	Relocated Firms
<i>Panel C: Post-entry Survival</i>			
Reform	31.931** (14.240)	1.457 (2.111)	-0.038 (0.033)
R-squared	0.788	0.823	0.262
DV Mean	103.387	28.027	0.036
Observations	85,603	85,603	85,603
Town FE	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes
Cluster	County	County	County

Note: This table presents the heterogeneity effects on rural entrepreneurial activity across different measures of firm quality. The outcome variable of this table is the number of newly registered enterprises of each type aggregated at the town-year level. Panel A shows the results on organizational status, while Panel B shows the results on firm size, proxied by registered capital. We provide results on post-entry performance in Panel C, which records the firm's operational status as of year 2022. There are 34% and 0.1% firms in our sample lacking registered capital and operational status. We test whether the attrition is correlated with treatment status in Columns (1) and (2) of Appendix Table B-5. Robust standard errors clustered at county levels are in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Gender difference of entrepreneurs

This study further tests whether the effects of land reform vary across male and female-led enterprises. Theoretically, the effect of the transferability reform on the gender gap in entrepreneurship is ambiguous. On the one hand, the reform could disproportionately benefit female entrepreneurs, who typically face more severe credit constraints (Asiedu et al., 2012; Ewens & Townsend, 2020), if the land revenues distributed by the collective relax binding household liquidity constraints. On the other hand, the reform could reinforce existing inequalities or even widen the gender gap. If male-dominated village collectives distribute proceeds inequitably, or if the primary benefits of lower land costs accrue to capital-intensive, male-dominated sectors like manufacturing, then men would be the main beneficiaries. Given these competing channels, this study holds no strong prior on the net direction of the effect and turn to the data.

Table 3.8 reports the results, where new firms of each town-year cell are aggregated by the predicted gender of entrepreneurs across different industrial sectors. Columns (1) and (2) suggest that the reform’s impact is not strongly biased at the aggregate level, as it simultaneously boosts the entry of male and female-led firms by 24% and 29%. This aggregate result, however, may mask gender-based sorting across different industrial sectors. The decline in agricultural enterprises, for instance, is driven almost entirely by a reduction in male-owned firms (Columns (3) and (4)), suggesting a reallocation of male entrepreneurs away from traditional low-return farming. Columns (5) to (8) further report the gender heterogeneity in manufacturing and service sectors. The results show that the reform spurs male-led entry in both manufacturing and service industries, whereas female-led firms only increase in the service sector with low start-up costs (Wang et al., 2024). This gender difference is plausible because manufacturing ventures demand substantial fixed capital and collateral, which therefore benefits male entrepreneurs who already possess, or can more easily mobilize, financial resources and production networks. These findings are consistent with broader literature on gendered financial constraints (Asiedu et al., 2012; Ewens & Townsend, 2020) as well as cross-country evidence on how land-related income can empower women to engage in non-farm businesses (Efobi et al., 2019).

Table 3. 8 Heterogeneity by Gender of Entrepreneurs

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
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Outcome	Total Firms		Agricultural Firms		Manufacturing Firms		Service Firms	
	Male	Female	Male	Female	Male	Female	Male	Female
Reform	22.700** (9.565)	10.610** (4.426)	-0.422** (0.164)	-0.034 (0.069)	0.953* (0.552)	0.063 (0.250)	22.169** (9.214)	10.582** (4.436)
Observations	85,603	85,603	85,603	85,603	85,603	85,603	85,603	85,603
R-squared	0.850	0.836	0.541	0.436	0.859	0.584	0.841	0.826
Town FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	County	County	County	County	County	County	County	County
DV Mean	93.999	36.897	3.017	0.748	8.929	1.809	82.053	34.340

Note: This table presents the heterogeneity effects on rural entrepreneurial activity across different genders of entrepreneurs. The outcome variable of this table is the number of newly registered enterprises of each type aggregated at the town-year level. The gender information of entrepreneurs is predicted from their Chinese full names using a Naïve Bayes classifier, which attains 96.2% accuracy on the test set when unknown-gender cases are excluded. There are 0.5% firms in our sample lacking the predicted gender of entrepreneurs. This study tests whether the attrition is correlated with treatment status in Column (3) of Appendix Table B-5. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Spatial distribution of the growing firms

Having profiled the firm types that underline the observed expansion, this study next investigates the spatial distribution of the firm growth based on a town's standardized distance to its county government, a proxy for access to entrepreneurial complements such as better infrastructure and market connectivity (Kim & Orazem, 2017). The results are presented in Table 3.9, where Columns (1) and (2) show the aggregate effect on all new firms, while Columns (3) to (5) unpack the sectoral decomposition. As shown in Column (1), the reform's positive effect is significantly weaker for remote towns whose distance to the county government is larger than the sample average. The continuous interaction in Column (2) further confirms the magnitude of the distance decay: a one standard deviation increase in the town-county distance reduces the reform's positive effect by 12.3 firms. The sectoral decomposition

in Columns (3) to (5) reveals that the overall distance decay is driven by the service sector, rather than manufacturing or agricultural firms.

Two reasons can explain this spatial heterogeneity. First, land transaction values are typically highest near urban centers (Albouy et al., 2018; Alonso, 1964). Consequently, land transfers in these areas would generate larger achievable land wealth, equipping households with more substantial seed capital and easier liquidity constraints. Secondly, central locations likely possess superior entrepreneurial complements, such as better infrastructure and market connectivity (Kim & Orazem, 2017), which can amplify the benefits of entrepreneurship by enhancing resource complementarities, especially for service sectors that are highly sensitive to consumer demand and market access (Hollenbeck & Giroldo, 2022; Sato et al., 2012). Additionally, this spatial distribution implies that while the reform successfully unlocks new ventures, it may simultaneously exacerbate spatial inequality between core and peripheral regions within a county. This regional inequality is possibly driven by the disproportionately concentrated urbanization-induced demand.

Table 3. 9 Regional Heterogeneity

Outcome	(1) All Firms	(2) All Firms	(3) Agricultural Firms	(4) Manufacturing Firms	(5) Service Firms
Reform	53.133*** (18.847)	38.715*** (14.696)	-0.272 (0.195)	1.793*** (0.654)	51.613*** (18.460)
Reform * Remote Towns	-44.592** (17.552)				
Reform * Distance to County		-12.327** (5.862)	0.075 (0.130)	-0.261 (0.314)	-12.142** (5.511)
Observations	85,603	85,603	85,603	85,603	85,603
R-squared	0.850	0.850	0.596	0.886	0.841
Town FE	Yes	Yes	Yes	Yes	Yes
Province by Year FE	Yes	Yes	Yes	Yes	Yes
Cluster	County	County	County	County	County

DV Mean	131.575	131.575	3.766	10.738	117.071
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Note: This table investigates the regional heterogeneity in rural firm growth. The outcome variable of this table is the number of newly registered enterprises of each type aggregated at the town-year level. Distance to County indicates the standard distance of each town to its county government. Remote Towns is a dummy variable equal to 1 if this distance is above the sample mean, and 0 otherwise. Robust standard errors clustered at county or province levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

3.4.4. Mechanism

This analysis has so far established that the land transferability reform spurred dual-track entrepreneurial growth in large, capital-intensive ventures and small self-employment businesses. In this section, this study formally tests the causal channels behind the firm growth. As illustrated in Section 4.1.2, the reform's success first hinges on the village collective's capacity to solve a fundamental land coordination problem. When this coordination is successful, it then unlocks two powerful downstream channels: a land use cost channel that benefits firms, and a land wealth channel that empowers local residents. This study tests each component of this causal chain in turn.

Land use costs

The first and most important downstream channel unlocked by effective collective coordination is associated with lower land use costs. From an industrial organization perspective, the land transferability reform introduces price competition into the previously monopolistic rural land market. Before the reform, local governments were the sole legal suppliers of land for business purposes. The coordination ability of rural collectives allows them to bring large-scale, comparable land parcels to the market, making the rural collective a competitive land supplier after the reform. Previous literature has elaborated on how price is adjusted in the context of competition (Bloom & Van Reenen, 2007; Shapiro & Varian, 1999; Stahl, 1988). For example, Bertrand's competition model argues that competition on price, providing that goods are perfect substitutes, ends with firms selling their goods at marginal costs, thus making zero profits. As a result, this new supplier entry is expected to exert downward pressure on

the equilibrium price of land, which in turn lowers the entry barrier (e.g., fixed land use costs), particularly for land-intensive ventures.

This study tests the hypotheses using extensive state-owned land transaction records located in rural regions, given the access restriction on transaction records of collectively owned rural land. The results are reported in Table 3.10. Columns (1) to (3) report the reform's impact on logarithmic average land transaction unit prices aggregated at the town-year level, where observations are treated as missing for town-years without any state-owned land transactions. To isolate the reform's net impact from potential composition bias attributed to land quality and locational heterogeneity, this study constructs quality-adjusted land prices using a random forest model developed by Grange et al. (2018) (See Appendix A-2). Column (1) provides direct evidence of lower land use costs for potential entrepreneurs: a significant 19.4% decrease is observed in state-owned land prices in towns within land reform counties. Columns (2) to (3) further reveal that the price reduction is almost entirely driven by land sold to land-intensive industries, such as manufacturing, mining, electricity, and construction, rather than other industries. This asymmetric distribution effect strengthens the story of coordination costs, as these sectors are more sensitive to coordination frictions due to huge and unavoidable fixed costs on contiguous land acquisition (Haasbroek, 2025).

This study further provides evidence on market volumes by aggregating the raw counts and total areas of transacted land parcels in each town-year cell. Theoretically, the prediction for the transaction volume effect on state-owned land is context dependent. On the one hand, a lower equilibrium price should stimulate overall demand from firms, potentially increasing total market transactions (market expansion effect). On the other hand, the entry of a new competitor—the village collective—should capture a portion of the market, reducing the state's market share (market-share-stealing effect). The net effect on the volume of state-owned land transactions may depend on the magnitudes of the two opposing effects. Columns (4) and (5) report the results, where no statistically significant effect is observed on either the number of transacted state-owned land parcels or their total area. This null effect suggests that the market expansion and the market-share-stealing effect may either be roughly equal in magnitude, or that reform's primary competitive impact, at least in the short term, is felt on the price margin rather than the quantity margin. Additionally, the unit price

reduction and stable transaction volumes indicate a potential cost of the reform: a possible decline in fiscal revenue for local governments from state-owned land transactions. But since local governments can earn an additional 40% from collectively owned land transactions, as illustrated in Section 2, the aggregate effects on fiscal pressure rely on more rigorous empirical evidence.

Table 3. 10 Land Market Competition Mechanism

	(1)	(2)	(3)	(4)	(5)
	(Log) State-owned Land Price			State-owned Land	
Outcome	All Industries	Land-intensive Industries	Other Industries	Numbers	Areas
Reform	-0.194** (0.096)	-0.191** (0.085)	-0.147 (0.121)	-0.007 (0.134)	-0.020 (0.270)
Observations	27,121	18,222	18,725	85,603	85,603
R-squared	0.525	0.593	0.526	0.540	0.567
Town FE	Yes	Yes	Yes	Yes	Yes
Province*Year FE	Yes	Yes	Yes	Yes	Yes
Cluster	County	County	County	County	County
DV Mean	5.706	5.585	5.794	1.442	3.224

Note: This table presents the impact of land reform on state-owned rural land prices. The outcome variables of this table are the logarithmic state-owned land price, raw count of land numbers, and land areas aggregated at the town-year level, respectively. The land price is defined as the average unit price of newly transacted construction land in that town and year, computed only for town-years with at least one transaction. To account for potential composition effects, this study uses a machine learning model in Appendix A-2 to isolate comparable land prices across different years and regions based on a rich set of land plot attributes, such as location, size, time trend, and intended use types. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Land wealth effects

The second hypothetical channel derives from the land-induced wealth effects. Since collective land transfer rights solve the coordination incentive problems for rural collectives, they facilitate the transfer of previously idle land to firms, thereby converting illiquid land assets into realizable wealth for communities and their members. Intuitively, this wealth shock can directly encourage local farmers to start businesses, especially in service sectors with lower entry barriers, as it provides seed capital that can relax the liquidity constraints in an imperfect credit market (Cagetti & De Nardi, 2006; Evans & Jovanovic, 1989; Wang et al., 2012). On the other hand, the increased property income may indirectly attract investors to rural regions, given the increased demand for non-tradable local goods and services (Gan, 2010; Lettau & Ludvigson, 2004), or the better business environments driven by wealthier collectives' public facility investments.

This study first tests the direct wealth channel using detailed information on rural households' income and residents' entrepreneurial decisions from the CHFS dataset. Rural residents are defined as working-age individuals (aged 18-64) who hold a rural hukou prior to the reform. This restriction is grounded in China's institutional background: the collective land revenues are exclusively distributed among members who hold a rural hukou, while residents without a rural hukou, even if they live in villages, are not eligible to share the land-related revenue. Table 3.11 reports empirical results, where the first two columns test the effect of reform on household land income, while Columns (3) to (6) shift the focus to individuals' entrepreneurial decisions. If a causal link between land income and entrepreneurship exists, it would be expected to observe a stronger entrepreneurial response among residents in areas poised to receive higher land income. Conversely, a similar entrepreneurial pattern should not be observed among residents who, for exogenous reasons, are excluded from these wealth benefits.

As expected, this study observes a significant land income growth by 909 RMB per household in Column (1)—about 121% compared with the sample average. Recalling the distance decay observed in Section 4.3.4, this study introduces in Column (2) an interaction term between the land reform and a dummy variable for remote villages to test the potential spatial heterogeneity. Consistent with the previous expectations, this study finds that the growing land wealth is significantly weaker for households living

in remote villages. Specifically, rural households living in non-remote villages (i.e., near urban centers) see their land income rise by approximately 2098 RMB, an amount over six times greater than the modest 304 RMB observed in remote villages. These findings align with the land price gradients documented in urban economics (Albouy et al., 2018; Alonso, 1964), in which the revenues of land closer to urban centers are typically higher due to higher demand induced by better access to markets and infrastructure.

Columns (3) and (4) further establish the impact of land reform on individuals' entrepreneurial decisions. The outcome variable is a dummy indicating 1 if a rural hukou holder reports entrepreneur as his or her primary occupation for a given year. Column (3) shows that the average effect of the reform on local individuals' entrepreneurship is small and statistically insignificant when pooling all villagers together. However, after accounting for spatial heterogeneity in Column (4), this study finds that the land reform significantly boosts the probability of individual entrepreneurship in non-remote villages by 6.5 percentage points (about a 59% increase compared to the sample average). Mirroring the income results, the entrepreneurship effect is wiped out in remote villages where the land-wealth shock is negligible and complementary market services are scarce. This consistent spatial pattern between land wealth and entrepreneurial activities provides compelling evidence for the direct wealth-driven channel, as the entrepreneurial activity responds only where households actually receive sizable land revenues.

To strengthen the causality between land income and entrepreneurship, this study introduces two strategies. First, a placebo test is conducted using the entrepreneurial decision of urban residents without rural hukou as outcome variables. These urban residents serve as a credible placebo because, while they are exposed to the same local economic conditions as rural residents, they are legally ineligible to receive any financial benefits from the land transfer. Therefore, if the wealth channel holds, the reform should have no significant effect on their entrepreneurial choices. Columns (5) and (6) report the results, where no significant average effect is observed on urban entrepreneurship, and critically, this null result holds even when accounting for spatial heterogeneity in Column (6), as both the main effect and the interaction term are statistically insignificant. These findings mitigate the concerns about unobserved

confounders and reinforce our interpretation that the effect on rural entrepreneurial activity, observed specifically in non-remote villages, is attributable to the specific wealth channel of the reform. Second, this study provides a composition test in Appendix Table B-7 to rule out the potential reverse causality that the land income growth is driven by existing entrepreneurs or landlords who rent their land or properties to grow land income. Since the dataset only provides household main entrepreneurship industries, this test is performed at the household level. The results show that the entrepreneurship pattern is entirely driven by other industries unrelated to property management, which helps to alleviate the concerns of reverse causality.

Table 3. 11 Direct Income Effect on Rural entrepreneurial activity

	(1)	(2)	(3)	(4)	(5)	(6)
Analysis Unit	Household Panel		Individual Panel			
Outcome	Household Land Income		Rural Entrepreneur		Urban Entrepreneur	
Reform	909.200*	2,098.439***	-0.001	0.065***	0.012	0.029
	(484.761)	(427.175)	(0.033)	(0.014)	(0.026)	(0.034)
Reform * Remote Village		-1,793.988**		-0.100**		-0.087
		(740.061)		(0.048)		(0.151)
Observations	7,926	7,926	26,938	26,938	16,446	16,446
R-squared	0.389	0.389	0.696	0.696	0.734	0.734
Household FE	Yes	Yes	No	No	No	No
Individual FE	No	No	Yes	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	County	County	County	County	County	County
DV Mean	751.367	751.367	0.111	0.111	0.116	0.116

Note: This table examines the effect of land transferability reform on household land income and individuals' entrepreneurial decisions. The outcome variable in Columns (1) and (2) is land-related property income for rural households. In Columns (3) and (4), the outcome is a dummy equal to 1 if working-age rural residents report entrepreneurs as their primary career, and 0 otherwise. Columns (5) and (6) serve as placebo tests that focus on the same outcome for urban residents (i.e., those without a

rural hukou). Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Secondly, this study explores two potential indirect wealth channels through which the reform could foster entrepreneurship: the consumption and facility-driven channels. In addition to being directly used to start a business, the increased land wealth may also stimulate households' consumption demand for local goods and services (Gan, 2010; Lettau & Ludvigson, 2004), thereby attracting potential entrepreneurs to serve the growing rural markets. This study tests this hypothesis using household consumption records in Panel A of Table 3.12. As expected, significant consumption growth is observed in clothes and education, which aligns with previous findings regarding the expansion of retail and education-related businesses outlined in Appendix Figure C-5.

Another interpretation of the land wealth effect is related to collective investments in public infrastructure and facilities. In rural China, village collectives are responsible for “last-mile” public goods investments and often raise funds from existing collective assets or among their members to fill the fiscal gap left by centralized government funding (Xu & Yao, 2015; Zhang et al., 2004). The wealthier rural collectives may allocate their increased land revenue toward improving village infrastructure and facilities, which may attract new entrepreneurs given the improved business environments. Panel B of Table 3.12 tests this hypothesis using a series of satellite-observed indicators reflecting local public goods, including road density and the raw number of various facility POIs aggregated at the town-year level. This study finds no evidence that the rural collectives systemically increased investments in infrastructure and public facilities following the reform, as the coefficients of land reform are small and statistically indistinguishable from zero across all four columns. The null effects can be explained from several perspectives. First, and most likely, rural households in the context of high liquidity constraints often prefer direct cash transfers than from in-kind or public provisions (Cunha, 2014). Second, the scale of the revenue increase, while significant, may simply be insufficient to fund costly, large-scale infrastructure projects. Combined with the findings in Panel A, the results of this work support the likelihood of consumption-driven rather than facility-driven entrepreneurship.

Table 3. 12 Wealth Effects on Consumption and Public Facilities

Outcome Variables	(1) Food	(2) Clothes	(3) Commodity and Service	(4) Education
<i>Panel A: Consumption</i>				
Reform	-933.600 (997.743)	457.280** (225.074)	103.598 (677.147)	1,123.935** (529.527)
Observations	13,470	12,727	13,988	13,894
R-squared	0.650	0.646	0.462	0.576
Household FE	Yes	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes	Yes
Cluster	County	County	County	County
DV Mean	15326	2235	1811	3668
Outcome Variables	(1) Road density	(2) Road Facility	(3) Transport Facility	(4) Public Facility
<i>Panel B: Infrastructure and Facility</i>				
Reform	0.076 (0.098)	0.023 (0.049)	3.714 (4.556)	0.263 (0.485)
Observations	54,209	46,811	46,811	46,811
R-squared	0.883	0.894	0.801	0.783
Town FE	Yes	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes	Yes
Cluster	County	County	County	County
DV Mean	1.091	0.760	8.731	2.715

Note: This table examines the effects of land transferability reform on household consumption and rural infrastructure and facilities. The outcome variables of Panel A are raw values of rural household consumption for different goods and services. In Panel B, this study introduces the road density from the Open Street Map and the raw number of a series of facility POI from Baidu MAP as outcome variables. Owing to the data access restrictions, the road density spans from 2013 to 2019, while the POI data

spans from 2012 to 2017. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

3.4.5. Further discussion

Potential costs on the agricultural sector

The previous finding that the reform led to a decline in the number of registered agricultural enterprises (Table 3.6) raises a potential concern: the observed entrepreneurial boom may have come at the cost of an agricultural recession. This concern, however, can be alleviated through two institutional features of the collective land transferability reform. First, as emphasized in the institutional background, the reform primarily targets collective operating construction land, which is legally and spatially distinct from the cropland allocated to households in pre-determined land use planning. Second, even in cases where land assembly for new ventures requires the occupation of cropland, the village collective is mandated to follow China's requisition-compensation balance policy issued in 1991 by reclaiming an equivalent area of cropland elsewhere designated for construction. Therefore, this study anticipates that the reform's direct impact on agricultural production should be limited.

To formally test the anticipation, this study introduces three distinct datasets: town-level satellite-observed cropland area, individual-level agricultural employment status, and county-level self-report agricultural outputs. The results, presented in Table 3.13, alleviate concerns about an absolute agricultural decline. Specifically, the study finds no statistically significant effect on either the total cropland area (Column (1)), the probability that rural residents are primarily engaged in agriculture (Column (2)), or agricultural outputs for primary food crops, including total yields, planting area, and yields per planting area (Columns (3) to (5)). These consistent findings indicate that the reform does not lead to a broad reallocation of land or a wholesale exit of labor away from the agricultural sector. The previously observed decline in the number of new agricultural firms is likely to reflect a reallocation of entrepreneur talent from lower-return commercial farming toward higher-return opportunities in the non-agricultural sector, driven by the reform-induced surge in local demand for non-tradable commodities and services.

Table 3. 13 Potential Costs on Agricultural Sectors

	(1)	(2)	(3)	(4)	(5)
Analysis Unit	Town-year	Individual- year	County-year level agricultural outputs		
Outcome	(Log) Cropland Area	Agricultural Employment	Yields (10 ⁴ t)	Planting Area (km ²)	Yields Per Planting Area
Reform	0.023 (0.020)	-0.011 (0.033)	0.744 (1.250)	5.195 (17.651)	0.002 (0.003)
Observations	85,603	26,938	4,663	3,662	3,542
R-squared	0.995	0.727	0.972	0.987	0.512
Town FE	Yes	No	No	No	No
Individual FE	No	Yes	No	No	No
County FE	No	No	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes	Yes	Yes
Cluster	County	County	County	County	County
DV Mean	3.820	0.406	38.039	629.892	0.061

Note: This table tests the impact of land reform on agricultural sectors using three distinct datasets. The outcome of Column (1) is the logarithmic satellite-observed cropland area aggregated at the town-year level. Column (2) introduces a dummy variable indicating rural residents' employment status, which denotes 1 if the residents primarily engage in farming for a given year. In Columns (3) to (5), this study introduces county-level self-report agricultural outputs as outcome variables, including logarithmic total yields, total planting area, and yields per planting area. There are more than 40% missing values in self-report agricultural outputs. This study has tested whether the attrition is correlated with treatment status in Appendix Table B-6. Robust standard errors clustered at county levels are in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Transformation of the rural employment structure

This section moves beyond entrepreneurship to investigate whether the land reform precipitated a more profound transformation in the rural employment structure. Table 3.14 provides empirical evidence on the employment status of the rural working-age population between 18 to 64. The odd-numbered columns report the average effects, while the even columns introduce an interaction term with a male indicator to test for potential gender differences. As indicated by Columns (1) and (3), rural residents in the land reform counties are less likely to report unemployment and more likely to be employed by an enterprise following the reform compared with their counterparts living in control counties.

The expansion in wage-employment can be explained at least from two perspectives. First, on the demand side, the entry of new firms induced by the land reform, especially in the manufacturing sector, can create new wage job opportunities for local residents (Jensen, 2012; Zhao & Qu, 2024). Second, the wealth generated from land transfers can relax liquidity constraints and searching costs that previously inhibited rural residents from non-farm wage jobs (Chernina et al., 2014; Chetty, 2008). Unlike the substitution effects observed in previous literature on positive wealth shocks and labor supply (Li et al., 2020), the results of this work indicate that transitory income can also be used to overcome financial barriers in searching for wage jobs, in particular in the context of imperfect rural credit and insurance markets. These findings echo the evidence from Chernina et al. (2014), who find that improvements in land liquidity can finance internal rural-urban migration in Russia.

This study further test the employment gender difference in the even-number columns. The insignificant interaction term in Column (2) shows no significant gender difference in the growth of wage-job participation: both men and women in land reform counties experience a comparable increase in paid employment after the land reform. However, the sectors from which these additional wage workers are reallocated differ by gender. The significantly positive interaction term in Column (4) indicates that female workers tend to shift from unemployment to wage jobs, while the negative interaction term in Column (6) shows that male workers are more likely to exit lower-return farming. This sectoral asymmetry mirrors their baseline occupational positions in rural China. In the sample of this work, 21% of women are out of work before the

land reform, which is double that of men (8%). Previous literature attributes this gap to heavier housework, caregiving duties, fertility, and the lack of female-friendly labor market opportunities (Chen & Ge, 2018; Goldin & Katz, 2002; Shi et al., 2024). The land reform, by generating flexible local non-farm job opportunities, may enable women to achieve a better work-family balance by entering the local labor market without migrating far from home.

Table 3. 14 Impact on Rural Employment Structure

Outcome	(1) Employee	(2)	(3) Unemployment	(4)	(5) Farming	(6)
Reform	0.046*** (0.014)	0.062* (0.032)	-0.034*** (0.011)	-0.085*** (0.028)	-0.011 (0.033)	0.011 (0.036)
Reform * Male		-0.032 (0.056)		0.102*** (0.036)		-0.044*** (0.016)
Observations	26,938	26,938	26,938	26,938	26,938	26,938
R-squared	0.710	0.710	0.578	0.578	0.727	0.727
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	County	County	County	County	County	County
DV Mean	0.362	0.362	0.121	0.121	0.406	0.406

Note: The outcome variables are a set of dummy variables that capture an individual's employment status in a given year, indicating whether their primary occupation is an employee (wage-earner), a farmer engaged in farming, or in a state of unemployment. Robust standard errors clustered at the county level are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

3.5. Conclusion

Understanding the determinants of rural entrepreneurial activity is crucial for tackling global rural poverty (Alvarez & Barney, 2014; Bruton et al., 2013). This study focuses on a less noticed but vital barrier for rural entrepreneurial activity: fragmented land tenure and corresponding transaction costs to assemble land for modern enterprises. In the context of an ambitious land reform in China, this study finds that collective land

transfer rights can lower land coordination costs and encourage rural entrepreneurial activity. Specifically, towns subjected to the land reform observe a significant 25% increase in the number of newly registered rural firms compared with the control group. As expected, the increase in rural firms is concentrated in regions with better collective coordination capacity (i.e., low-rugged areas and areas with denser clan networks) and is almost fully offset in regions where coordination is difficult to achieve.

Both land and capital-intensive firms in manufacturing and small firms in the service sectors experience growth following the land reform. This study posits two different channels to explain this dual-track firm growth driven by collective land transfer rights: (1) lower land use costs for firms, and (2) higher land wealth for local residents. This work first finds that land use prices decrease by 19%, given the emergence of competing rural land suppliers (Bloom & Van Reenen, 2007; Shapiro & Varian, 1999; Stahl, 1988). The price reduction is driven by land-intensive industries, which are more sensitive to coordination frictions as land acquisition constitutes a large and unavoidable fixed cost (Haasbroek, 2025). Additionally, successful land transfer to firms helps convert illiquid land assets into realizable wealth for rural collectives and their members. This positive wealth shock, on one hand, promotes rural residents living near town and urban regions to directly start business, on the other hand, attracts new investors given the significant increase of household expenditure in non-tradable goods and services. Beyond entrepreneurship, the reform also contributes to the expansion of non-farm wage jobs, primarily attributed to more active labor market participation rather than the absolute decline of the agricultural sector.

This work echoes a long-standing debate on the efficiency of private versus communal rights. While a large number of studies favor individual rights for their clear incentives and allocative efficiency, communal or collective rights, in some cases, can be superior, such as in welfare allocation and sustainable long-term use (Besley & Ghatak, 2010; Chankrajang, 2019; Ostrom & Hess, 2010; Zhao, 2020). Grounded in China's ambitious land reform that allocates land transfer rights to rural collectives, this work highlights the value of collective rights and collective negotiation in solving coordination costs and holdout problems. The implication of this study suggests that who holds the transfer rights—and at what level of aggregation—can be as pivotal as the right security itself.

Chapter 4. Leadership and Rural Entrepreneurial Activity

4.1. Introduction

This chapter explores the role of a special kind of human capital—the high-calibre leadership—on rural entrepreneurial activity. Policymakers and researchers are increasingly interested in whether high-calibre external leaders can effectively drive development in underdeveloped regions with weak institutions. Previous evidence from the private sector suggests that such external quality leaders, leveraging their unique networks and information advantage, can drive organizational transformation and enhance corporate performance (Karaevli, 2007; Tushman & Rosenkopf, 1996; Zhang & Rajagopalan, 2003). In the public sector, a growing body of literature has noticed the role of leadership origins in shaping local governance and economic outcomes (Besley & Coate, 2003; Dippel & Heblich, 2021; Hill, 2005; Villadsen, 2012). While externally appointed bureaucrats can facilitate knowledge transfer and inter-organizational learning (Yu et al., 2024), they may fail to generate intended outcomes due to a lack of familiarity with local contexts and challenges in integrating into existing structures (Jongjaroenkamol & Laux, 2017; Zhang & Rajagopalan, 2010). This tension is particularly pronounced in rural areas (He & Wang, 2017), where resource constraints and weak institutions simultaneously heighten the potential benefits and stakes of external leadership. Despite the growing global practice of deploying high-calibre bureaucrats to rural areas²⁰, empirical evidence of their actual impact on local development remains limited due to data restrictions.

To bridge the knowledge gap, this study focuses on one specific economic consequence of external leaders: rural entrepreneurial activity, which not only serves as a measure of rural economic vitality but also reflects the capacity of leaders to mobilize resources, reduce information asymmetry, and inspire structural transformation (Leibenstein, 1968a; Baumol & Strom, 2007; Tushman & Rosenkopf, 1996). China's Village First Secretary (VFS) program offers an ideal setting to examine how high-calibre external leaders influence entrepreneurial activities in resource-constrained

²⁰ Typical examples include the Saemaul instructors in the Saemaul Undong Movement in the Republic of Korea and the “pair-up” model in Khon Kaen province of Thailand.

rural regions. Building on local pilot practices in the early 21st century, the Chinese central government formally launched the VFS program in 2015, which temporarily deploys a large number of high-calibre cadres from upper-level government agencies or state-owned enterprises to serve as local leaders in underdeveloped rural villages. With unique advantages of human capital (i.e., professional experience and education) and social capital (i.e., resources from the original dispatching institutions and personal network), these institutional elites typically serve in rural regions for one to three years to alleviate poverty and promote rural economic development.

The following stylized facts make this question especially appealing to investigate in China's context. First, China's VFS program is representative of large-scale human capital redeployment in the public sector²¹, relative to similar programs in South Korea and Thailand. Second, China's unique dual-leadership structure at the village level differentiates this study from existing organizational and management literature on the impacts of external leadership. Unlike conventional organizational settings where leadership authority is typically centralized, VFSs jointly manage village affairs with locally elected village heads (i.e., village committee directors). This distinctive arrangement introduces a complex dynamic of power-sharing and collaboration (Chen & Liu, 2021), which can either amplify or constrain the effectiveness of external leaders.

The empirical analysis utilizes the rich variation in the staggered rollout of the VFS program across villages to identify the causal impact of external leadership on rural entrepreneurial activity. The dataset of this work integrates unique firsthand data on the characteristics of first secretaries with public records of China's enterprise registration from 2009 to 2020²². Specifically, in January 2024, a retrospective survey is conducted across 357 villages in 28 provinces in China, collecting detailed data on the arrival year of the first VFS, their demographic characteristics—including gender, education level, hometown, and age—and subjective performance evaluations provided by the village committee directors. This dataset offers several key advantages. Most notably, the variation in VFS arrival timing across villages allows for a generalized DID estimator,

²¹ According to official statistics, as of 2023, approximately 206,000 first secretaries were actively serving in rural villages, covering 42.2% of all administrative villages in China.

²² In our sample, the first VFS is deployed in 2010. As such, our analysis starts from 2009 to guarantee that each village can be observed at least one pre-treatment period.

which controls for province by year and village fixed effects to capture any province-specific shocks and time-invariant village characteristics, such as location and village size. In addition, the detailed demographic attributes of VFSs help to investigate how heterogeneous leadership attributes influence the success of external institutional elites in shaping rural economic consequences.

One challenge in the empirical design is that VFSs may not be randomly dispatched to villages. This study addresses the concern using two approaches. Firstly, this study examines the relationship between predetermined village attributes and both the likelihood and timing of VFS deployment. The results show that, aside from predetermined nighttime light intensity, which is negatively correlated with the timing of VFS deployment, other characteristics, such as population size, climate conditions, geographic location, and village culture, do not systematically predict deployment patterns. Therefore, following Feigenbaum & Gross (2024), this study includes an interaction term between nighttime light intensity and time trends in all regression models to account for potential selection bias. Secondly, given the potential hometown favoritism in China's political resource allocation (Do et al., 2017; Fisman et al., 2018), this study introduces an instrumental variable (IV) using the interaction between historical political capital—proxied by the number of high-power officials nurtured by the village—and the arrival year of the first VFS. This approach combines the exogeneity of historical political capital and temporal variation in the timing of VFS deployment, helping to alleviate endogeneity concerns arising from unobserved village-level factors.

Our baseline results show that the arrival of a VFS does not significantly increase the total number of newly registered firms in the treatment villages. However, this aggregate effect masks substantial sectoral heterogeneity: significant growth in agricultural and manufacturing firms is observed during the tenure of VFSs, with increases of approximately 43% and 29%, respectively. These findings remain robust across multiple validation tests, including parallel trend analysis, alternative IV estimations, controls for concurrent policies, Poisson regression models to address zero-inflated outcomes, and standard errors clustered at more conservative levels (e.g., city or county). The consistent sectoral divergence observed across these tests falls closely with theories of comparative advantage and specialization (Becker & Murphy,

1992; Matsuyama, 1992), suggesting that institutional elites are instrumental in helping villages exploit their comparative advantages, such as abundant, low-cost labor and agricultural resources, rather than facilitating the development of retail, catering, and other service industries, which may rely more heavily on consumer demand, market size, and urban proximity (Hollenbeck & Giroldo, 2022; Sato et al., 2012).

This study further investigates how VFS effects vary with village and leader characteristics. At the village level, VFSs boost the growth of agricultural and manufacturing firms only in central villages—defined as urban villages and peri-urban villages located near city centers with better infrastructure and market access (Y. Liu et al., 2010). This spatial divergence mirrors evidence from Asher & Novosad (2020) and Burlig & Preonas (2024), who show that remote areas may continue to lack economic opportunities even with aid from government intervention. Recalling the objectives of the VFS program to promote growth in less developed villages, this work suggests that government interventions aimed at reducing development disparities may inadvertently widen regional gaps. Additionally, the entrepreneurial gains can only be observed in villages with weaker clan cultures and highly educated village heads. This pattern fits the literature highlighting the interplay between leadership quality and local contexts (Jones & Olken, 2005; Besley et al., 2011; Fang, Ren, et al., 2023). Specifically, this study extends their argument by emphasizing that lower social frictions and better-educated collaborators can amplify the returns to high-quality leaders.

Regarding VFS characteristics, older VFSs and VFSs from non-local counties are more effective in promoting the growth of rural firms. These results are plausible, as both kinds of leaders benefit from their broader social capital and resource complementarity: older VFSs can leverage their experience and networks accumulated over long careers to coordinate resources more effectively (Lau & Redlawsk, 2008; Alesina et al., 2019), while non-local officials are less embedded in local power structures, allowing them to make more impartial decisions and introduce complementary resources that differ with local contexts (Hodler & Raschky, 2014; G. Xu et al., 2018). Somewhat surprisingly, prior rural work experience does not enhance the effectiveness of VFSs. This study finds that both experienced and inexperienced VFS officials can significantly promote the growth of agricultural and manufacturing firms in villages. This unexpected finding may be driven by China's dual rural

leadership structure, where the locally elected village heads can complement external VFSs by providing deep local knowledge and familiarity with village affairs.

To gain a deeper insight into the underlying mechanisms, this study theorizes and empirically examines three mechanisms through which external leaders may influence rural entrepreneurial activity: knowledge transfer, institutional capital support, and social trust building. Consistent with the theories of knowledge spillover and resource dependence (Pfeffer & Salancik, 2006; Andrews, 2023), the empirical evidence strongly supports the first two channels. Specifically, this study first observes that knowledge-intensive VFSs—those with higher education levels or recognized for contributing new ideas to rural development—significantly drive entrepreneurial growth in the agriculture and manufacturing sectors. Similar patterns can be observed when investigating the effects of VFSs with intensive institutional capital, such as those appointed from higher levels of government or acknowledged for their ability to attract new resources. More importantly, these external leaders are effective in bridging informational and institutional gaps within communities as we observe significant growth in career-related internet adoption and property-related policy support in villages with VFSs, which may encourage local entrepreneurial activities through better digital literacy and access to financial capital (Wang, 2012; Hjort & Poulsen, 2019). It's noted that this study also observes an increase in E-commerce consumption in villages with VFSs, although the effect is statistically insignificant when using IV estimates. Since the rise in e-commerce demand could have crowded out the offline retail businesses in villages (Forman et al., 2009; Hortaçsu & Syverson, 2015), this finding may help explain why an insignificant decline is observed in the number of retail firms in the baseline results.

While prior studies emphasize the role of external leaders in curbing corruption and preventing elite capture—mechanisms that could foster trust within rural communities (He & Wang, 2017; Xu et al., 2018)—the empirical evidence of this work reveals no significant effect of VFSs on trust-building. This null effect holds across both revealed preference measures (e.g., conflict frequency and villagers' conflict resolution preferences) and villagers' subjective evaluations (e.g., their perceived trust for the village committee directors). These findings suggest that the trust-building channel, which could theoretically encourage risk-taking activities (Welter & Smallbone, 2006;

Bu & Liao, 2022), may not function effectively in the context of short-term external leadership interventions.

This work relates to three strands of literature. First, the findings add to the literature on bureaucrat quality and development. Prior research has extensively examined how the bureaucrats' attributes, such as their education level, political ideology, origins, and work experience, affect regional development and governance quality (Jones & Olken, 2005; Besley et al., 2011; Shi, 2021; Fang, Ren, et al., 2023; Funke et al., 2023). However, most of this work focuses on high-level bureaucrats, such as national or city leaders, while much less is known about grassroots regions due to the lack of detailed information on local leadership attributes. This study complements this literature with information on the characteristics of rural bureaucrats. Unlike national or urban contexts, rural areas often face significant resource constraints and weak institutions (Bebbington, 1999), which may simultaneously heighten leadership interventions' potential benefits and stakes. This work is most related to He & Wang (2017), who investigate the effect of a similar human capital relocation program on the effectiveness of policy implementation. Unlike their work, this study extends the effects to the private sector, focusing on broader economic spillovers (i.e., rural entrepreneurial activity) and examining whether high-calibre bureaucrats support the growth of industries aligned with local comparative advantages. The perspective of this study highlights the importance of grassroots governance and the adaptability of bureaucrats in resource-scarce environments.

Second, this study engages with literature on the economic consequences of leadership origins. Previous literature from the private and public sectors has yielded mixed findings on the effects of external leadership. On the one hand, external leaders can promote organizational transformation and performance by leveraging their external networks and unique information advantages (Kaplan et al., 2012; Chung & Luo, 2013; Jiang & Mei, 2020; Nian & Wang, 2023). On the other hand, these outsiders may fail to achieve the intended outcomes due to a lack of familiarity with local contexts and challenges in integrating into existing structures (Bhavnani & Lee, 2018; Balán et al., 2022). This study adds to this debate by utilizing the unique fact of dual-leadership structure in China's VFS program. Unlike conventional organizational settings where leadership authority is typically centralized, externally appointed VFSs

jointly manage village affairs with locally elected village heads. The findings of this work reveal that external leaders can effectively overcome their lack of local familiarity when paired with collaborators well-acquainted with organizational affairs.

This work also speaks to the growing body of work on institutional determinants of entrepreneurship, particularly in rural settings where the resources and institutions are constrained. Numerous studies have emphasized how exogenous variation in human capital (Koo & Eesley, 2023; Lin et al., 2025), social capital (Bauernschuster et al., 2010; Dai et al., 2024), financial constraints (Wang, 2012; Wang et al., 2024), and infrastructure access (Kim & Orazem, 2017b; Hjort & Poulsen, 2019; Asher & Novosad, 2020a) shapes firm entry. We extend their arguments by isolating the effects of a neglected source of human capital—temporarily appointed high-calibre leaders. The evidence of this work shows that these “parachuted” leaders spur new agricultural and manufacturing firms through knowledge transfer and institutional capital support, whereas their influence on social-trust formation is negligible. The contrast implies that while informational and resource frictions can be relaxed through external leadership, durable trust may require deeper social embeddedness and a longer-term intervention (Welter & Smallbone, 2006). These insights enrich the understanding of how leadership interventions can shape entrepreneurial ecosystems in rural economies.

The rest of the chapter is organized as follows: Section 4.2 presents the institutional background of China’s VFS program and frames the theories and hypotheses. Section 4.3 introduces our data, sample, and empirical strategies. The empirical results, including baseline results, detailed robustness checks, and potential mechanisms, are discussed in Section 4.4. This study summarizes all the findings in Section 4.5.

4.2. Background, theories, and hypotheses

4.2.1. Institutional background

China’s VFS program can be traced back to a pilot initiative in Anhui province in the early 21st century. To alleviate persistent rural poverty, brain drain, and governance inefficiencies, local governments in Anhui launched a pioneering program in 2001, assigning 3000 provincial government officials to work in poor villages for three-year terms (Sina Finance, 2012). Subsequently, starting in 2010, several other provinces, including Jiangsu, Henan, Liaoning, Shandong, and Guangxi, selected similar cadres to

work in rural regions to tackle rural poverty. Building on these local efforts, the Chinese central government formally established the VFS program in 2015, deploying a large number of high-calibre officials from upper-level government agencies or state-owned enterprises to serve as village leaders. Since then, the scale of the cadre deployment has expanded rapidly. According to official statistics, China has dispatched a total of 518,000 VFSs to villages by 2021, with approximately 206,000 VFSs still actively serving in approximately 42.2% of Chinese administrative villages (People's Daily Online, 2021, 2024). To the best of our knowledge, China's VFS program is one of the world's most extensive human capital relocation programs, compared to similar programs in South Korea and Thailand.

These VFSs are selected from outstanding young officials, reserve cadres, and high-performing personnel in state-owned enterprises, public institutions, and government agencies. Senior officials nearing retirement who remain capable and enthusiastic about rural development are also considered. It is important to acknowledge that this selection process introduces significant heterogeneity among the VFS cadres. Individual secretaries differ in their professional backgrounds, personal motivations, and the level of resource endowment they can leverage from their parent (sending) institutions. For instance, a VFS dispatched from a state-owned bank may prioritize financial access for the village, whereas one from a provincial agriculture department might focus on technical farming upgrades. Furthermore, their personal career trajectories, whether they view the deployment as a mandatory hurdle or a strategic opportunity for promotion, can influence their level of proactivity. Consequently, the empirical results presented in this study should be interpreted as the overall average treatment effect across this diverse group of individuals and institutional backgrounds.

The typical term for a VFS ranges from one to three years, during which they reside in villages and jointly manage village affairs with locally elected village heads, namely village committee directors. This unique dual-leadership arrangement introduces a complex dynamic of power-sharing and collaboration (Chen & Liu, 2021), which can either amplify or constrain the effectiveness of externally appointed VFSs. The main tasks of VFSs during their tenure include advancing poverty alleviation, strengthening government capacity, and stimulating local economic development. To maximize the impacts of VFSs on these goals, villages with weak or ineffective Party organizations

and those classified as registered poverty-stricken villages are more likely to be deployed to a VFS. This deployment preference inherently suggests potential selection bias. In Section 3.4, this study will carefully examine whether the baseline socio-economic conditions of villages are correlated with both the arrival of VFSs and the timing of their deployment.

The Chinese central government has established clear incentive and supervision measures to ensure VFSs can effectively fulfill their responsibilities. Firstly, financial and institutional support are prioritized as key incentives. Local government departments, such as fiscal and poverty alleviation agencies, are mandated to allocate dedicated support funds for VFSs. Moreover, dispatching institutions are encouraged to establish partnerships with their assigned villages, offering continuous institutional and resource support to ensure the successful implementation of development projects led by VFSs. Secondly, on the supervision side, dispatching institutions conduct annual performance evaluations of VFSs to monitor their progress in poverty alleviation, governance improvements, and other economic outcomes. Upon completion of their term, a joint assessment by the dispatching institutions and the local county party committees determines the overall performance of each VFS. Outstanding VFSs are given priority for promotion opportunities within their parent institutions, while those who fail to fulfill their duties or engage in misconduct face disciplinary actions, including dismissal, to minimize disruptions to village governance. Since VFSs' future career promotion is closely tied to their performance in villages, they are highly motivated to improve rural economic conditions during their tenure.

Some anecdotal evidence suggests that VFSs can bring new knowledge, social resources, and institutional capacity to rural areas, creating a fertile environment for entrepreneurial activities and local economic growth. For example, in Mupen Village, Guizhou Province, VFS Liang Jiajia leveraged his managerial experience from a central state-owned enterprise to help villagers develop the bamboo weaving industry (Youth. CN, 2022). With CNY 400,000 in financial support from his dispatching institution, Liang collaborated with local trainers to develop a specialized skill training program, which enabled villagers to acquire bamboo craftsmanship skills and facilitated the establishment of a rural collective enterprise focused on bamboo manufacturing and marketing. Similarly, in other regions, such as villages in Sichuan and Guangxi

Provinces, local VFSs combined their personal networks and village comparative advantages to introduce new crop varieties and establish stable customer groups, promoting the scale of local farming and breeding industries (Xinhua News, 2023). These cases highlight how VFSs act as catalysts for rural enterprise development by leveraging their technical expertise, social networks, and resource mobilization capacities.

However, there are also concerns about the impact of VFSs on local economic development (People's Daily Online, 2020). First, the temporary nature of their tenure often constrains their ability to implement long-term strategies or sustain initiatives beyond their service period (Besley & Case, 1995; He & Wang, 2017). Second, as suggested by Jones & Olken (2005) and Yu et al. (2024), the degree to which outside leaders matter may largely depend on local contexts. Village-specific characteristics, such as resource endowments, the attributes of locally elected village heads, and the influence of clan-based cultural forces, can affect the effectiveness of VFS interventions. These contextual factors may dilute or even counteract the positive effects expected from high-calibre external leadership. As a result, determining whether the anecdotally positive impacts mentioned above are isolated cases or reflect broader, systematic outcomes requires empirical validation using more extensive and representative datasets.

4.2.2. Theories and hypotheses

As a primary driver of economic growth (Hamilton, 2000; Asturias et al., 2023), entrepreneurship can help rural development by introducing innovative products and services, as well as creating new jobs that optimize the surplus labor and boost per capita income in rural areas (Decker et al., 2014; Bu & Liao, 2022). However, rural enterprises often experience slow growth due to a series of barriers, such as credit constraints, limited local demand, inadequate infrastructure, and a lack of market information (Gladwin et al., 1989; Asher & Novosad, 2020; Wang et al., 2024). Allocating quality human capital to rural areas, such as deploying skilled community leaders, may serve as an effective strategy to overcome these challenges. Leadership in rural contexts can alleviate such constraints by coordinating internal and external resources and introducing information that facilitates access to markets and credit support (Miles & Morrison, 2020).

Previous literature from private and public sectors has extensively examined the economic consequences of leaders' attributes, such as their education level, gender, origin, and work experience (Jones & Olken, 2005; Besley et al., 2011; Shi, 2021; Fang, Ren, et al., 2023; Funke et al., 2023). A key topic of debate in this field is how leadership origins shape organizational and, more broadly, local development (Chung & Luo, 2013; Yu et al., 2024). Externally appointed leaders and leaders internally selected within the organizations often differ in their knowledge, experience, and resource networks, which can lead to distinct economic outcomes (Cao et al., 2006). On the one hand, compared to internally selected leaders, external leaders can facilitate knowledge transfer and structural transformation by leveraging their unique information and network advantages (Tushman & Rosenkopf, 1996; Karaevli, 2007; Nian & Wang, 2023). The infusion of new knowledge and expanded social capital can reduce informational barriers, provide new business opportunities, and create an environment conducive to entrepreneurial activities (Mathews, 2021; Koo & Eesley, 2023). On the other hand, external leaders often lack familiarity with local contexts and may struggle to integrate into existing structures (Bhavnani & Lee, 2018; Balán et al., 2022). As such, these outsiders may have negligible or even disruptive effects on local development.

In the context of rural China, VFSs represent a unique form of externally appointed high-calibre leadership, sharing governance power with local elected village heads. These institutional elites are selected from higher levels of government or large state-owned enterprises and possess distinct advantages in human capital (i.e., professional experience and education) and social capital (i.e., resources from the original dispatching institutions and personal network), both of which are scarce in rural regions. Given the dual leadership structure, which may mitigate VFS's risks associated with their lack of familiarity with rural affairs, we expect that VFSs can effectively address key rural entrepreneurial barriers and promote the growth of rural firms.

Specifically, this study theorizes three channels that may explain the relationship between these external institutional elites and rural entrepreneurial activity: knowledge transfer, institutional capital support, and social trust building. (1) Knowledge transfer. Theories of knowledge spillovers suggest that leadership intervention can enhance entrepreneurial ecosystems by transferring market information and providing technical and business knowledge to local entrepreneurs (Audretsch & Keilbach, 2007). Similar

to the effects of high-skill returnees on firm performance (Koo & Eesley, 2023), VFSs may introduce modern management practices and facilitate internet adoption to bridge entrepreneurial information gaps within rural communities. (2) Institutional capital support. Drawing on the theories of resource dependence and governance capacity (Pfeffer & Salancik, 2006), this channel emphasizes the role of institutional support in economic growth. VFS, with their direct connections to higher levels of governments and superstar firms, can advocate for policy or resource incentives, such as regulatory benefits or targeted subsidies, that lower entry costs for rural entrepreneurs (Pflüger & Südekum, 2013). (3) Social trust building. Social capital theory suggests that trust and local networks are crucial for fostering entrepreneurship, particularly in environments with weak formal institutions, such as rural regions (Welter & Smallbone, 2006; Karlan et al., 2009). Since outsiders are relatively independent of local interests, prior literature emphasizes the role of external leaders in supervising corruption and preventing elite capture (He & Wang, 2017; G. Xu et al., 2018), which may strengthen community trust and encourage entrepreneurial risk-taking in rural communities.

Despite the benefits of VFSs mentioned above, their effectiveness on rural entrepreneurial activity is likely to be context-dependent, shaped by local resource endowments and comparative advantages. A substantial body of literature has highlighted the interplay between external institutional interventions and local characteristics (Acemoglu et al., 2001; Jones & Olken, 2005). Given the lower factor costs and higher productivity associated with specialization (Becker & Murphy, 1992; Matsuyama, 1992), sectors with comparative advantages may scale more rapidly when the arrival of VFSs reduces information asymmetries and barriers to social capital. Rural areas in China typically possess abundant natural resources and low-cost labor (Meng, 2012), making agriculture and manufacturing the sectors best positioned to expand under institutional interventions induced by VFSs. In contrast, service sectors such as retail and high-end service industries, which rely on vigorous demand for products and a higher concentration of human capital and advanced technological inputs, may not experience significant benefits from the deployment of VFSs (Sato et al., 2012; Hollenbeck & Giroldo, 2022).

Taken together, this study puts forward the primary hypothesis (H1): *The arrival of VFSs promotes the growth of rural firms, especially in sectors with comparative advantages, such as agricultural and manufacturing firms.*

4.3. Data and methodology

4.3.1. Data

This work combines the following datasets: (1) survey information on first secretaries, village characteristics, and representative villagers; (2) public enterprise registration records; and (3) other village-level socio-economic attributes observed from satellites. Table 4.1 shows the summary statistics of our primary variables. To mitigate the influence of outliers, this study follows Andrews (2023) and winsorizes the top 5% of villages by the number of newly registered firms.

Village survey

The primary dataset for identification originates from the well-designed “Qian Ren Bai Xiang” survey conducted by students and faculty of Renmin University of China in the Spring of 2024. The survey includes two sub-surveys: a village survey and a resident survey. The village survey provides detailed information on village attributes, such as location, culture, policy support from upper governments, and other governance characteristics (i.e., the education level of the locally elected village committee directors). The resident survey records represent villagers’ demographics, personal experiences, attitudes, and household behaviors. Collaborating with the survey team, this study designed a set of questions related to VFSs in the village survey, including the arrival year of the first VFS, their demographic characteristics, and subjective performance evaluations provided by the corresponding village committee directors.

Considering statistical representativeness and practical feasibility, the original survey encompassed 2031 residents in 416 villages across 218 counties, 142 cities, and

29 provinces in China²³. The sample counties were randomly chosen using a multi-stage stratified sampling method with the probability proportional to population size. The sampling frame was based on the home counties of students from Renmin University of China, ensuring broad geographic coverage across diverse regions. One to three local students formed a survey team within each selected county. They selected one to three villages per county using a combination of random sampling and practical methods, such as distance sampling and spot mapping, to ensure logistical feasibility. In each village, 4 to 6 residents were randomly selected based on household lists or, where unavailable, using convenience sampling techniques. After excluding samples absorbed by fixed effects, those without recorded VFS arrival dates, and samples with incorrectly reported VFS characteristics—such as cases where the VFS departure year precedes the appointment year or where respondents expressed uncertainty about the exact year of the VFS’s arrival during the survey—the final sample of this work covers 1463 residents in 357 villages across 201 counties, 132 cities, and 28 provinces in China.

The following two facts support the representativeness of our sample in terms of VFSs. First, in the sample, 116 villages (approximately 32.5% of the total sample) were assigned at least one VFS, while the remaining 241 villages did not receive such an assignment. This distribution is close to the official statistic of approximately 40%, suggesting that the sample accurately reflects the overall deployment pattern of VFSs across China. Second, Figure 4.1 illustrates the annual and cumulative deployment distribution of VFSs in our sample. Consistent with the gradual rollout timeline of the VFS program, the results show that VFS deployment began around 2010, coinciding with the initial phase of pilot experiments. Deployment accelerated significantly after 2015, aligning with the nationwide scaling-up of the VFS initiative. By 2020, when China officially declared the achievement of comprehensive poverty alleviation, the number of new VFS deployments began to decline.

²³ This sample size was determined based on the geographical distribution of students in Renmin University of China, available time, human resources, and logistical constraints. It ensures that high-quality data can be collected while maintaining broad regional representation. Renmin University of China, located in Beijing, is a leading national university in China and famous in social science. Its students came from all provinces in mainland China.

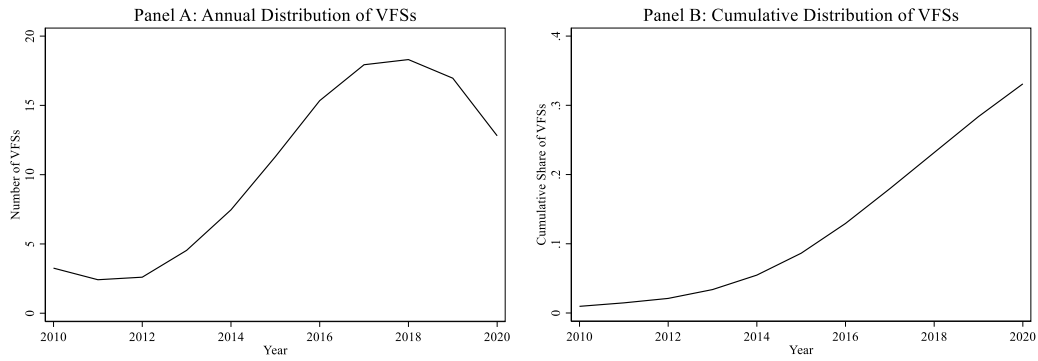


Figure 4. 1 Annual and Cumulative Distribution of VFSs in the Sample Villages

Enterprise registration records

This study measures the core outcome variable, rural entrepreneurial activity, by the number of enterprises registered in each village from 2009 to 2020. The raw data is sourced from the National Enterprise Credit Information Publicity System, which provides detailed firm-level information, including their name, address, registration date, industrial classification, registered capital, and operational status. To accurately map enterprises to their respective villages, this study extracts geographic coordinates (latitude and longitude) from enterprise addresses and integrate them with village-level administrative boundary maps, enabling aggregation at the village-year level. The enterprises are further categorized based on their industrial type to examine the effects of VFSs on rural entrepreneurial activity across different sectors. Specifically, this study defines five main types of rural firms: agricultural, manufacturing, retail, catering and service, and other firms. Given that approximately 45% of the industry classification information is missing, this work employs a machine learning approach that combines term frequency-inverse document frequency (TF-IDF) vectorization with the multinomial naive Bayes algorithm to predict firm industries based on their names. The model is trained annually on observations with non-missing industry classifications to establish correlations between company names and industry types. This study then validates the model using the annual subsets of the missing data to accurately classify the industries of unlabelled firms.

Other socio-economic attributes

This study also incorporates village-level socio-economic attributes to examine pre-existing differences between the treatment and control groups and test the impact of VFSs on broader economic outcomes. Specifically, the study compiles high-resolution datasets covering population, nighttime light intensity, temperature, and precipitation. The population data are sourced from the LandScan dataset provided by the U.S. Department of Energy’s Oak Ridge National Laboratory (ORNL), while data on nighttime light intensity, temperature, and precipitation are obtained from large-scale datasets compiled by Zhang et al. (2024) and Peng et al. (2019). All these variables correspond to the year 2009, one year prior to the initial implementation of the treatment in the sample, to capture pre-treatment conditions. Additionally, this study introduces two panel datasets aggregated at the village-year level to assess changes in rural public infrastructure and facilities: (1) Points of Interest (POI) data from Baidu Map and (2) road density data from OpenStreetMap. Due to data access limitations, these two datasets’ sample sizes are significantly smaller than the other datasets used in this study. Specifically, the POI dataset covers the period from 2012 to 2017, while the road density dataset spans from 2013 to 2020.

Table 4. 1 Summary Statistics

Variables	Observation	Mean	SD	Min	Max
<i>Panel A: Panel Village Variables</i>					
VFS	4,284	0.325	0.468	0.000	1.000
Number of All Firms	4284	6.544	14.856	0.000	87.000
Number of Agricultural Firms	4284	0.208	0.502	0.000	3.000
Number of Manufacturing Firms	4284	0.574	1.403	0.000	8.000
Number of Retail Firms	4284	4.845	12.701	0.000	69.000
Number of Catering & Service Firms	4284	0.325	0.784	0.000	3.000
Number of Other Firms	4284	0.592	1.315	0.000	5.000
Any Computer Center	4,236	0.037	0.190	0.000	1.000
Any Land Rights Supportive Policy	4,140	0.370	0.483	0.000	1.000
Any House Rights Supportive Policy	4,176	0.114	0.318	0.000	1.000
Road Facility (from 2012 to 2017)	2,142	0.056	0.354	0.000	4.000
Public Facility (from 2012 to 2017)	2,142	0.235	1.004	0.000	12.000
Road density (m/km ² , from 2013 to 2020)	2,499	5.573	10.534	0.000	140.797
<i>Panel B: Cross-sectional Village Characteristics</i>					
(log) Population in 2009	353	5.923	1.130	2.084	9.809
(log) Nightlight in 2009	357	5.263	2.550	0.000	8.719
(log) Precipitation in 2009	350	6.788	0.468	4.130	7.635
(log) Temperature in 2009	350	2.793	0.279	1.147	3.254
Central Village	354	0.548	0.498	0.000	1.000
Strong Clan Culture	356	0.447	0.498	0.000	1.000
Historical Leaders	357	0.286	0.721	0.000	3.000
Any VFS	357	0.325	0.469	0.000	1.000

Panel C: Cross-sectional Resident Characteristics

Male	1,463	0.646	0.478	0.000	1.000
College	1,463	0.166	0.372	0.000	1.000
Religion	1,463	0.100	0.301	0.000	1.000
Health	1,463	0.938	0.242	0.000	1.000
Age	1,463	41.002	12.260	12.000	89.000
Individual Income	1,463	10.402	1.021	8.517	11.918
Any Children	1,463	0.743	0.437	0.000	1.000
Any Internet Use for Work	1,463	0.777	0.416	0.000	1.000
Any Career Training	1,362	0.393	0.489	0.000	1.000
(Log) E-Commerce Consumption	1,326	5.296	3.496	0.000	9.393
Any conflicts	1,357	0.496	0.500	0.000	1.000
Conflicts Resolution Preference	1,455	0.825	0.380	0.000	1.000
Trust for Local Elected Village Head	1,449	0.817	0.387	0.000	1.000

Note: This table shows the summary statistics of our primary variables.

4.3.2. The Sample

The sample includes 357 villages across 201 counties, 132 cities, and 28 provinces in China, covering the period from 2009 to 2020. Since the first VFS was deployed in 2010, the analysis period was set to start in 2009 to ensure that each village had at least one pre-treatment observation. Of the total sample, 116 villages (32.5%) were eventually treated with the VFS program, while the remaining 241 villages (67.5%) serve as the control group. Figure 4.2 illustrates the spatial distribution of the treatment and control groups. Villages are categorized into two groups: those with VFSs (represented by blue dots) and those without VFSs (represented by yellow dots). The map displays provincial boundaries in gray and national boundaries with dashed purple lines. A distinct spatial pattern emerges, with a higher concentration of VFSs deployed in central and western regions of China, while the eastern coastal areas exhibit relatively fewer VFS deployments. This distribution suggests a strategic priority for underdeveloped and rural inland regions, where socio-economic conditions and public governance capacity may require more substantial external support. Another key observation is that villages with and without VFSs coexist within most provinces. This intra-provincial variation provides a valuable opportunity for empirical analysis, as within-province comparisons between treatment (villages with VFSs) and control (villages without VFSs) groups may work to mitigate potential selection bias arising from unobserved province-level heterogeneity. This study formally tests this expectation in the following section.

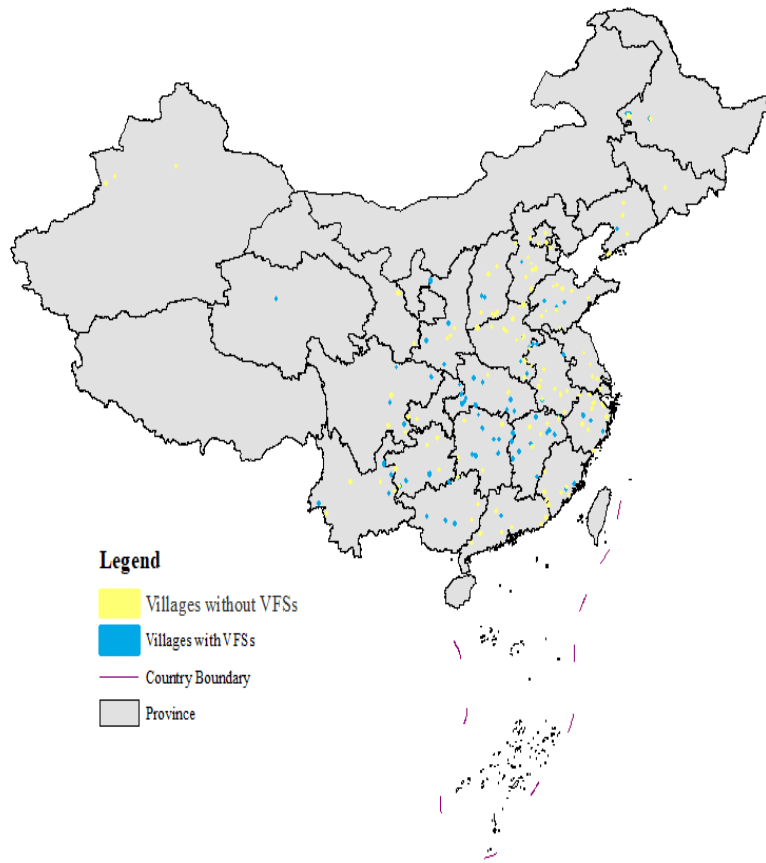


Figure 4. 2 Sample Distribution

4.3.3. Balance test

Table 4.2 presents the results of the balance test, which examines whether baseline village characteristics can predict both the assignment of VFSs and the timing of their deployment. In the first two columns, the outcome variable is whether a village was assigned a VFS, while in the latter two columns, the outcome variable is the timing of the first VFS's arrival. Grounded in the insights from our sample distribution, this study controls for province fixed effects in the even columns to compare the village differences within provinces. The results show that, after controlling for province fixed effects, predetermined village characteristics—including population size, climate conditions, geographic location, and village culture—do not systematically predict the assignment or timing of VFSs. However, one notable exception emerges: predetermined nighttime light intensity, a proxy for the level of predetermined economic development, is negatively correlated with the timing of VFS deployment. In

other words, villages with lower initial levels of economic development are more likely to receive VFSs earlier. This finding highlights the role of pre-existing economic conditions in determining the deployment strategy of VFSs. To rule out the selection bias from pre-existing economic differences across villages, this study includes an interaction term between predetermined nighttime light intensity and time trends in all subsequent regression models.

Table 4. 2 Balance Test

	(1)	(2)	(3)	(4)
Model	OLS			
Outcome	Any Elites by 2020	Timing of Earliest Elites		
(log) Population in 2009	-0.042 (0.032)	-0.026 (0.033)	0.273 (0.235)	0.260 (0.359)
(log) Nightlight in 2009	-0.046*** (0.014)	-0.017 (0.018)	-0.215** (0.100)	-0.305** (0.132)
(log) Precipitation in 2009	0.120 (0.091)	0.229 (0.176)	0.911* (0.510)	1.450 (1.862)
(log) Temperature in 2009	0.026 (0.153)	-0.325 (0.277)	0.029 (0.867)	-0.147 (2.810)
Central Village	0.089* (0.054)	0.063 (0.058)	-0.157 (0.439)	-0.002 (0.539)
Strong Clan Culture	-0.009 (0.054)	0.010 (0.062)	-0.964** (0.440)	-0.925 (0.604)
Observations	344	341	113	111
R-squared	0.114	0.216	0.146	0.227
Mean of Outcome	0.328	0.328	2017	2017
Province FE	No	Yes	No	Yes
Cluster	Village	Village	Village	Village

Note: The outcome variable of this table is shown in each column. Robust standard errors clustered at the village level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.3.4. Model specification

Following He & Wang (2017), this study estimates the impacts of external leaders on rural entrepreneurial activity using a generalized DID approach. Based on the insights from sample distribution and balance tests, the model is specified as equation (1).

$$\text{Enterprises}_{v,p,t} = \beta_0 + \beta_1 \text{VFS}_{v,p,t} + \text{Light}_{2009} * f(t) + \gamma_{p,t} + \mu_v + \varepsilon_{v,p,t} \quad (1)$$

where $\text{Enterprises}_{v,p,t}$ is the number of enterprises established in village v of province p in year t . The explanatory variable of our interests, $\text{VFS}_{v,p,t}$, is a binary indicator equal to 1 if village v has been assigned a VFS in year t or any subsequent year following the initial assignment, and 0 otherwise. Light_{2009} denotes the predetermined value of nighttime light intensity in 2009, which interacted with the time trend $f(t)$ to account for potential differences in baseline economic activities and growth trajectories across villages. $\gamma_{p,t}$ and μ_v represent the province-by-year and village fixed effects, which capture the province-specific shocks that vary over time and time-invariant characteristics at the village level, respectively. The error term is denoted by $\varepsilon_{v,p,t}$, and standard errors are clustered at our treatment level, namely the village level.

4.4. Empirical evidence

4.4.1. Baseline

Table 4.3 presents the baseline regression results, controlling for village fixed effects, province-by-year fixed effects, and an interaction term between predetermined night light intensity and the time trend to account for differential pre-treatment growth trajectories across villages. Column (1) reports the impact of VFSs on the total number of newly established firms across all sectors. Interestingly, we find no statistically significant effect of VFS deployment on the aggregate number of new rural firms. This null effect is consistent with He & Wang (2017), who report similar results regarding village income when examining the impact of another human capital relocation

program in China—the “Selecting College Graduates to Work as Village Officials” program.

However, this aggregate effect may mask substantial sectoral heterogeneity. Columns (2) to (6) present the sector-specific impacts of VFSs on the number of newly registered rural firms of different industries. As expected in the main hypothesis, this study finds significant positive effects of VFSs on both agricultural and manufacturing firms. Specifically, the arrival of VFSs is associated with an estimated increase of approximately 0.092 agricultural firms (Column 2) and 0.165 manufacturing firms (Column 3) in treatment villages, corresponding to growth rates of approximately 44% and 29%, respectively, relative to their mean outcomes. In contrast, the estimated effects on retail (Column 4), catering and service (Column 5), and other firms (Column 6) are statistically insignificant, indicating limited impacts on service and other sectors. These patterns align with the theories of comparative advantage and structural specialization (Becker & Murphy, 1992; Matsuyama, 1992), where external leadership interventions are more effective in leveraging existing local resources, such as abundant agricultural resources and low-cost labor in rural regions, rather than fostering industries like retail, catering, and other services, which depend more on consumer demand, market size, and urban proximity (Sato et al., 2012; Hollenbeck & Giroldo, 2022).

Table 4. 3 Baseline Results

	(1)	(2)	(3)	(4)	(5)	(6)
Model	OLS					
Outcome	All Firms	Agriculture	Manufacturing	Retail	Catering & Service	Others
VFS	0.177 (0.623)	0.092*** (0.035)	0.165** (0.065)	-0.071 (0.576)	0.003 (0.034)	-0.012 (0.070)
Observations	4,284	4,284	4,284	4,284	4,284	4,284
R-squared	0.854	0.379	0.763	0.828	0.661	0.739
Mean of Outcome	6.544	0.208	0.574	4.845	0.325	0.592
Night Light Trend	Yes	Yes	Yes	Yes	Yes	Yes
Village FE	Yes	Yes	Yes	Yes	Yes	Yes
Province-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Cluster	Village	Village	Village	Village	Village	Village
Note: The outcome variables of this table are shown in each column. Robust standard errors clustered at the village level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.						

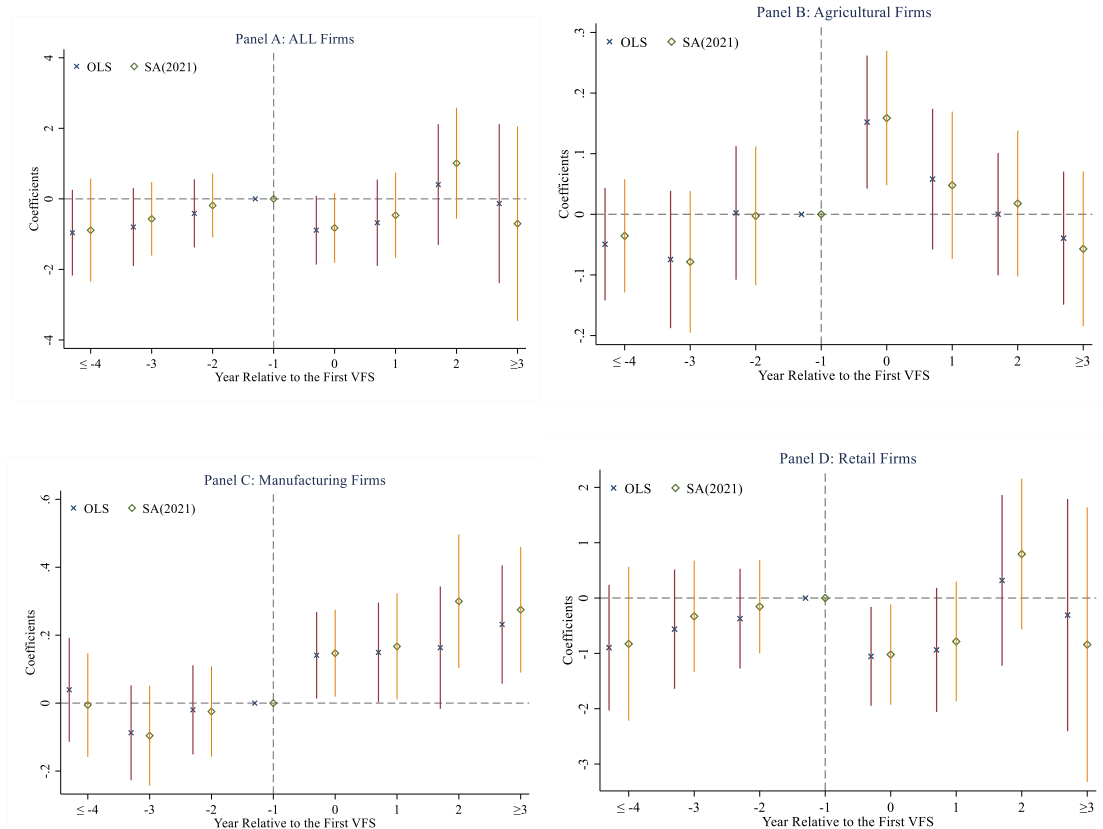
4.4.2. Robust checks

Parallel trend

The validity of the DID model relies on the assumption of parallel trends, which posits that, in the absence of VFS deployment, the treatment and control groups would have experienced similar trends in enterprise growth. This study tests the assumption using an event study model, as shown in Figure 4.3. In addition to the OLS estimator, this study provides dynamic estimators that are robust to heterogeneous treatment effects, following the approach of Sun & Abraham (2021). Across the estimators, the pre-treatment coefficients are consistently small in magnitude and statistically insignificant, supporting the validity of the assumption of parallel trends. In the post-treatment periods, consistent with the baseline results, this study observes significant growth in the number of agricultural and manufacturing firms, while the effects on retail, catering, and other service sectors remain statistically insignificant.

Notably, the growth patterns of agricultural and manufacturing firms differ after the deployment of VFSs. As shown in Panel B, agricultural firms exhibit an immediate but short-term increase in the first year following VFS deployment. This response pattern may stem from the inherent characteristics of agricultural enterprises (i.e., lower capital and technological input requirements), which enable rural entrepreneurs to rapidly establish new firms when policy incentives such as subsidies, training programs, and market access are introduced (Poulton et al., 2010). However, without stable market demand or continuous institutional support, these opportunity-driven firms often lack long-term sustainability (Audretsch et al., 2024). Unlike agriculture, manufacturing firms often require higher fixed costs and more complex market integration (Bell & Campa, 1997; Bulan, 2005). As a result, this study observes a gradual growth trend of manufacturing firms in Panel C. This delayed response may reflect the higher capital intensity and longer gestation period required for establishing manufacturing enterprises.

Panels D to F show the dynamic effects of VFSs on entrepreneurship in the tertiary industry. In Panel D, we observe a modest decline in the number of newly registered retail firms in the second year after VFS deployment, with a rebound effect occurring the year after. This temporary decline may be linked to the VFS's efforts to enhance information access and promote digital literacy, which could have increased e-commerce adoption among rural residents and clogged the demand for offline retail outlets. This study will formally test this hypothesis in the mechanism analysis section. Consistent with the baseline findings, Panels E and F reveal that the effects of VFS deployment on catering, service, and other miscellaneous sectors are negligible. The null effects are plausible, as the service-oriented industries, particularly those reliant on in-person interactions, depend on localized consumer demand and consumption behaviors—factors that are less sensitive to short-term institutional interventions (Hollenbeck & Giroldo, 2022; Sato et al., 2012).



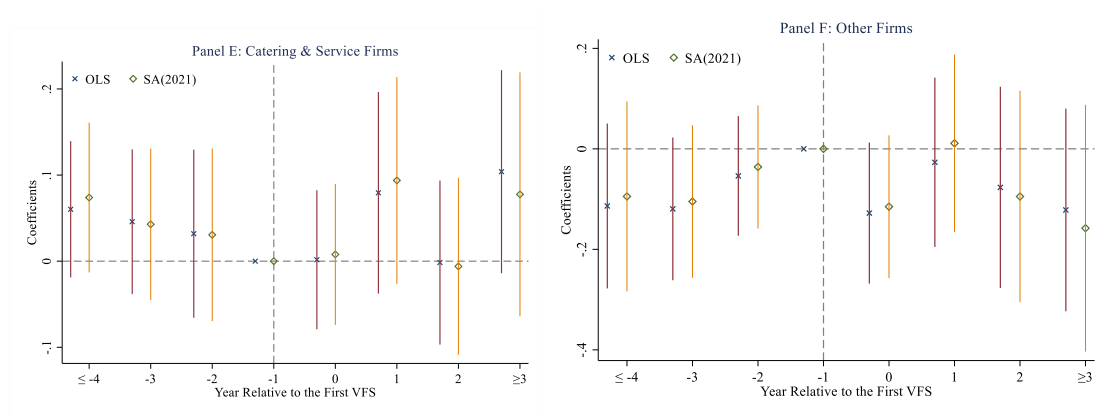


Figure 4. 3 Parallel Trends with Event Study Method

Note: This figure plots the event study coefficients, with the dependent variable representing the annual count of various types of registered enterprises in a given village. The regression model controls province-by-year and village fixed effects and the time trend of the predetermined nighttime light intensity. The vertical lines represent 90% confidence intervals for the respective point estimates.

Instrument variable

As mentioned earlier, a key caveat of our empirical design is that VFSs may not be randomly assigned to villages. Although this study controls economic growth trends in all regression models to alleviate selection bias, endogeneity concerns may still arise from other unobserved, time-varying village-level characteristics. To address this issue, this study follows the approach of Cao et al. (2022) and introduce an IV strategy, leveraging the interaction between historical political capital—proxied by the number of high-ranking officials originating from each village—and the timing of the first VFS deployment. This instrument is motivated by the potential hometown favoritism in China’s political resource allocation (Do et al., 2017; Fisman et al., 2018), capturing exogenous variation in political legacy while exploiting the temporal dimension of VFS deployment.

Table 4.4 presents the IV estimation results using a two-stage least squares (2SLS) approach. The first stage coefficient, reported in the lower panel of Table 4.4, confirms that historical political capital significantly predicts the likelihood of a village receiving a VFS. The Cragg-Donald Wald F-statistic is 691.1, well above the critical threshold of 16.38, suggesting that the instrument satisfies the assumption of strong correlation with endogenous variables. In the second stage, the results are closely aligned with our baseline findings, revealing substantial sectoral heterogeneity in the effects of VFS deployment.

Table 4. 4 IV Estimation

	(1)	(2)	(3)	(4)	(5)	(6)
Model	OLS					
Outcome	All firms	Agriculture	Manufacturing	Retail	Catering & Service	Others
Second Stage						
VFS	-1.010 (0.983)	0.125* (0.067)	0.218* (0.126)	-1.297 (0.917)	0.020 (0.065)	-0.076 (0.141)
First Stage (Outcome: VFS)						
Historical Leaders				0.357*** (0.027)		
CD Wald F-Statistics				691.1		

Observations	4,284	4,284	4,284	4,284	4,284	4,284
Mean of Outcome	6.544	0.208	0.574	4.845	0.325	0.592
Night Light Trend	Yes	Yes	Yes	Yes	Yes	Yes
Village FE	Yes	Yes	Yes	Yes	Yes	Yes
Province-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Village	Village	Village	Village	Village	Village

Note: The outcome variable of the second stage model is shown in each column, while that of the first stage model is the independent variable of our interest: the binary indicator equal to 1 if a village has a VFS in the year and any subsequent year following the initial assignment and 0 otherwise. The Stock-Yogo weak instrument critical value at the 10% level is 16.38. Robust standard errors clustered at the village level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Exclude competitive policies

Another concern with the findings arises from China's concurrent rural policies. This study considers five major overlapping policies that could confound the effects of VFSs: (1) the "Selecting College Graduates to Work as Village Officials" program, as discussed by He & Wang (2017), (2) rural collective assets reform, which aims to clarify and enhance the property rights of rural collective assets, (3) rural farmland rights reform, designed to formalize agricultural land rights and enable more flexible land transfers, (4) rural housing rights reform to facilitate idle house and homestead transfer, and (5) the village-to-community transformation policy, which promotes the conversion of administrative villages into urban-style communities. For each policy, this study records the treatment status and the initial implementation year at the village level, generating binary indicators to represent whether a village was treated under each policy during the sample period.

In Table 4.5, this study includes these five policy indicators as additional control variables in our regression models to isolate the net effect of VFS deployment on entrepreneurship across different sectors. After controlling for these competitive policies, significant positive impacts still hold on the number of agricultural and manufacturing firms (Columns 2 and 3). Importantly, the coefficients associated with most of these concurrent policies are statistically insignificant across sectors, suggesting that the observed sectoral effects of VFS deployment are unlikely to be driven by these confounding policies.

Table 4. 5 Exclude Competitive Policies

	(1)	(2)	(3)	(4)	(5)	(6)
Model	OLS					
Outcome	All Firms	Agriculture	Manufacturing	Retail	Catering & Service	Others
VFS	0.244 (0.654)	0.104*** (0.037)	0.171** (0.072)	0.031 (0.598)	-0.014 (0.037)	-0.048 (0.071)
CGVO	0.024 (0.029)	0.001 (0.001)	0.001 (0.002)	0.003 (0.028)	0.004** (0.002)	0.015*** (0.003)
Collective Assets	-0.525 (1.455)	-0.045 (0.055)	0.004 (0.105)	-0.577 (1.301)	0.108 (0.077)	-0.016 (0.123)
Farmland Reform	0.452 (0.658)	-0.058 (0.045)	-0.108 (0.097)	0.563 (0.589)	0.047 (0.061)	0.007 (0.094)
House Reform	-1.035 (0.848)	-0.024 (0.033)	-0.051 (0.084)	-0.985 (0.782)	-0.004 (0.049)	0.030 (0.082)
Village-to-Community	0.970* (0.558)	0.010 (0.041)	0.237* (0.121)	0.675 (0.498)	0.007 (0.045)	0.041 (0.098)
Observations	3,828	3,828	3,828	3,828	3,828	3,828
R-squared	0.841	0.370	0.773	0.810	0.649	0.740
Mean of Outcome	6.247	0.207	0.589	4.557	0.320	0.574
Night Light Trend	Yes	Yes	Yes	Yes	Yes	Yes
Village FE	Yes	Yes	Yes	Yes	Yes	Yes
Province-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Village	Village	Village	Village	Village	Village

Note: The outcome variable of this table is shown in each column. Robust standard errors clustered at the village level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Other sensitive checks

Finally, this study conducts two additional robustness checks, presented in Table 4.6, to further validate the reliability of our baseline findings. In Panel A, a Poisson regression model is employed to account for the count nature of our dependent variable—the number of newly registered firms. Compared to OLS estimation, the Poisson model is less sensitive to heteroskedasticity and zero-inflated outcomes. In Panel B, this study re-estimates the baseline regressions using standard errors clustered at the city or county level to account for potential correlations across villages within the

same city or county. Across these specifications, the core findings remain stable and robust, consistently showing that the VFS program promotes the number of new firms growing in the agricultural and manufacturing sectors. These robust checks further reinforce the credibility of the baseline results.

Table 4. 6 Other Sensitive Checks

Model	(1)	(2)	(3)	(4)	(5)	(6)
Outcome	All firms	Agriculture	Manufacturing	Retail	Catering & Service	Others
Panel A: Poisson Regression						
VFS	0.019 (0.101)	0.412** (0.169)	0.400** (0.182)	-0.084 (0.141)	0.107 (0.177)	0.033 (0.149)
Observations	4,284	4,284	4,284	4,284	4,284	4,284
Mean of Outcome	6.544	0.208	0.574	4.845	0.325	0.592
Control * Trend	Yes	Yes	Yes	Yes	Yes	Yes
Village FE	Yes	Yes	Yes	Yes	Yes	Yes
Province-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Village	Village	Village	Village	Village	Village
Model	(1)	(2)	(3)	(4)	(5)	(6)
Outcome	All firms	Agriculture	Manufacturing	Retail	Catering & Service	Others
Panel B: Different Clusters						
VFS	0.177 (0.698)	0.092*** (0.035)	0.165** (0.066)	-0.071 (0.660)	0.003 (0.040)	-0.012 (0.059)
Cluster	City	City	City	City	City	City
VFS	0.177 (0.656)	0.092*** (0.033)	0.165** (0.066)	-0.071 (0.608)	0.003 (0.036)	-0.012 (0.073)
Clster	County	County	County	County	County	County
Observations	4,284	4,284	4,284	4,284	4,284	4,284
R-squared	0.854	0.379	0.763	0.828	0.661	0.739
Mean of Outcome	6.544	0.208	0.574	4.845	0.325	0.592
Night Light Trend	Yes	Yes	Yes	Yes	Yes	Yes
Village FE	Yes	Yes	Yes	Yes	Yes	Yes
Province-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: The outcome variable of this table is shown in each column. Robust standard errors clustered at the village level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

4.4.3. Heterogeneous analysis

Heterogeneous by village characteristics

This study further investigates the heterogeneous effects of the VFS program associated with village characteristics. From this section onward, this work focuses exclusively on the number of agricultural and manufacturing firms, as these are the sectors where we observe significant effects. First, this study examines heterogeneity by village location. Villages are categorized into two groups: central villages (i.e., urban villages and peri-urban villages) located near the urban centers and remote villages, which are less developed and located farther from urban centers. As shown in Panel A of Figure 4.4, the arrival of VFSs significantly promotes the growth of agricultural and manufacturing firms only in central villages. This pattern suggests that central villages with better access to entrepreneurial complements, such as infrastructure and market connectivity (Kim & Orazem, 2017b), benefit more from external leadership intervention. These findings align with existing literature on the distribution effects of state interventions in underdeveloped regions. For example, Asher & Novosad (2020) and Burlig & Preonas (2024) find that remote areas often continue to lack economic opportunities despite improvements in physical capital. Together with their work, the results of this work imply that government interventions aimed at reducing development disparities may inadvertently widen regional gaps.

Next, this study investigates the heterogeneity effects of VFSs across villages with different levels of clan culture. This study defines a village with a clan temple as one with a strong clan culture. The results are reported in Panel B of Figure 4.4, which indicates that the VFS program has a more pronounced positive impact on agricultural and manufacturing entrepreneurship in villages with weaker clan cultures. This finding suggests that strong clan cultures may increase social friction and foster rent-seeking behaviors, which can undermine the effectiveness of external leadership interventions (Greif, 1993; Chen et al., 2024).

This study also explores the moderating role of the education level of local collaborators, i.e., locally elected village committee directors. The results in Panel C of Figure 4.4 indicates that the entrepreneurship growth in the agricultural and manufacturing sectors, driven by VFSs, is significantly amplified in villages led by

highly educated committee directors. The result implies the complementary effects between VFSs and well-educated local heads. Educated local collaborators may better understand and leverage the resources brought by VFSs, coordinate village affairs more efficiently, and create an environment enabling entrepreneurship (Khwaja, 2009). Overall, the findings in this section echo the growing literature emphasizing the interplay between leadership quality and local contexts (Jones & Olken, 2005; Besley et al., 2011; Fang, Ren, et al., 2023), indicating that better entrepreneurial complements, lower social frictions, and better-educated collaborators can amplify the effects of high-quality leaders.

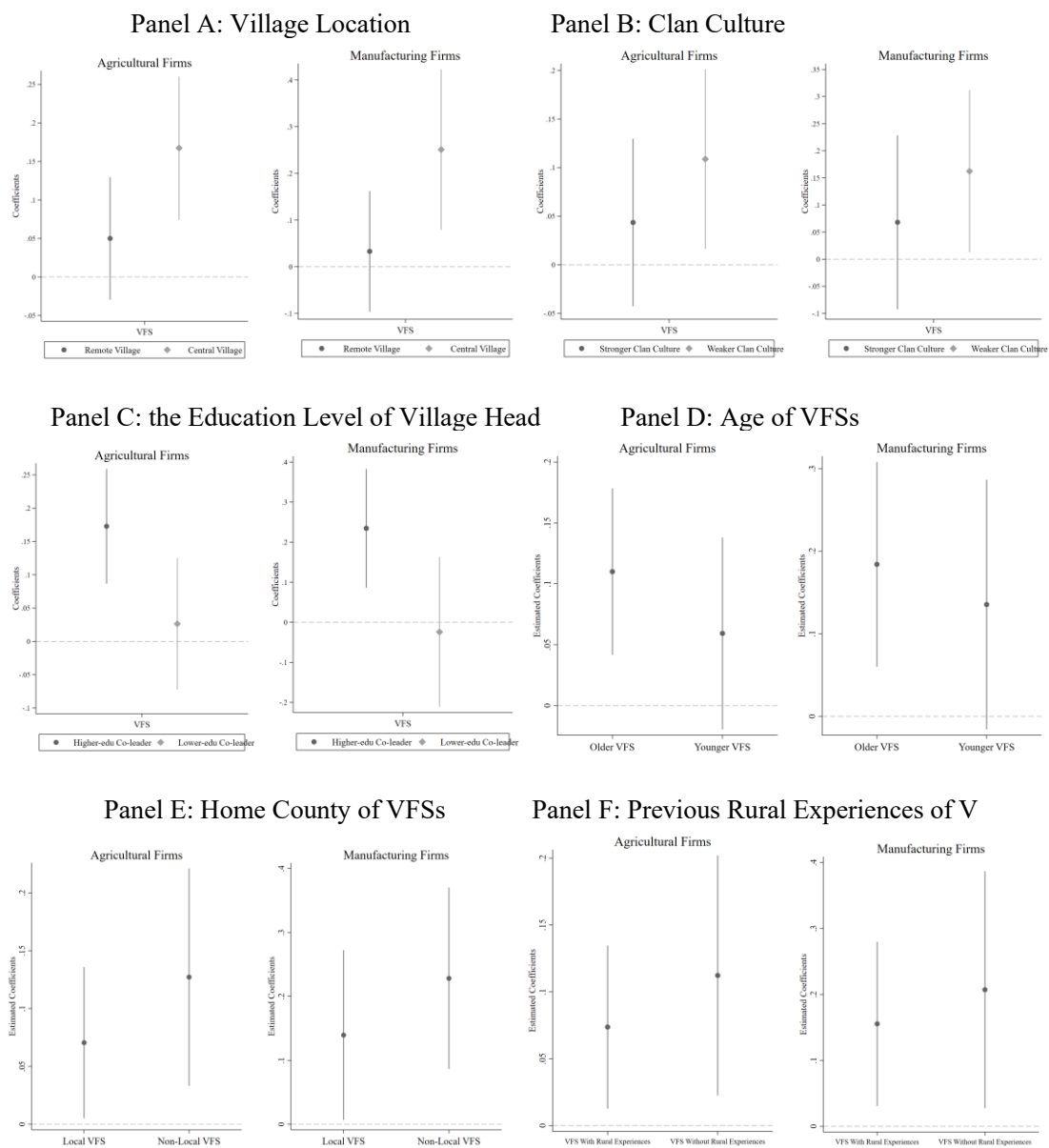


Figure 4. 4 Heterogeneity by Village and VFS Characteristics

Note: The outcome variable of this figure is the raw number of newly registered agricultural and manufacturing enterprises aggregated at the village-year level. The regression model controls province-by-year and village fixed effects and the time trend of the predetermined nighttime light intensity. The vertical lines represent 90% confidence intervals for the respective point estimates. Panels A to C show the heterogeneity by village characteristics, such as village location, clan culture, and the educational level of village leaders. Panels D to E show the heterogeneity by attributes of VFSs, including their age, home county, and previous rural experiences. This study divides the VFSs into older and younger groups based on their mean age in our sample.

Heterogeneous by VFS characteristics

Another dimension of heterogeneity relates to the characteristics of VFSs, an area largely overlooked in previous studies of human capital reallocation projects due to data restrictions (He & Wang, 2017). To bridge the gaps in rural leaders' attributes, this study categorizes VFSs by their age, hometown, and previous experience in rural affairs, interacting these characteristics with a dummy indicating their first arrival. The estimations yield several key insights. First, as shown in Panel D of Figure 4.4, the entrepreneurship promotion effect of older officials appears stronger than younger VFSs. This finding aligns with the broader literature on leadership and experience, suggesting that older leaders can better leverage their professional experience and broader networks to coordinate resources (Lau & Redlawsk, 2008; Alesina et al., 2019).

Second, in Panel E of Figure 4.4, this study observes that both local and non-local VFSs contribute to rural firm growth, but non-local VFSs have a larger impact compared to the local counterparts. Consistent with the findings of Xu et al. (2018), non-local officials are less embedded in local power structures, which may enhance their impartiality in decision-making and position them to introduce complementary resources that differ with local contexts.

Interestingly, as illustrated in Panel F of Figure 4.4, prior rural work experience does not significantly influence the effectiveness of VFSs. Both experienced and inexperienced VFS officials can significantly promote agricultural and manufacturing firms' growth. This unexpected result may be attributed to China's dual-leadership structure in rural governance, where locally elected village heads complement the role of external VFSs by providing deep local knowledge and familiarity with village affairs.

4.4.4. Mechanism

To gain a deeper insight into the underlying mechanisms, this study theorizes and examine three channels that may explain the relationship between these external leaders and rural entrepreneurial activity: knowledge transfer, institutional capital support, and social trust building.

Knowledge transfer

The study first examines whether VFSs promote the growth of rural entrepreneurial activity by transferring their novel knowledge to rural residents. Grounded in the theoretical frameworks of knowledge spillovers (Yli-Renko et al., 2001; Andrews, 2023), this channel highlights that external leadership can foster local innovation by reducing informational barriers and enhancing the technical capabilities of rural residents. This study tests this channel through two approaches.

First, this study defines two types of knowledge-intensive VFSs in our sample: (1) those with higher education levels and (2) VFSs recognized for contributing new ideas to rural development by local elected village heads. Specifically, this study classifies VFSs with a bachelor's degree or higher as having a higher education level. To identify VFSs who contributed new ideas to village development, this work introduces the subjective evaluations provided by village committee directors. In the survey, directors were asked, "Do you agree that the arrival of the VFS has introduced new ideas (i.e., new agricultural techniques, sales channels, or production methods) for the village's economic development?" VFSs recognized by village committee directors for introducing new technologies, sales channels, or development approaches are defined as More-idea VFSs. The heterogeneous evidence is reported in Table 4.7, where entrepreneurial growth in the agricultural and manufacturing sectors is primarily driven by villages with these two types of knowledge-intensive VFS officials.

Table 4. 7 Heterogeneous Effects of VFS with Different Knowledge Intensity

	(1)	(2)	(3)	(4)
Model	OLS			
Outcome	Agriculture	Manufacturing	Agriculture	Manufacturing
Higher-edu VFS	0.112***	0.147*		

	(0.039)	(0.080)		
Lower-edu VFS	0.064	0.255**		
	(0.059)	(0.113)		
More-ideas VFS			0.097***	0.155**
			(0.037)	(0.070)
Less-ideas VFS			-0.033	0.236
			(0.078)	(0.178)
Observations	4,188	4,188	4,176	4,176
R-Squared	0.382	0.764	0.381	0.764
Mean of Outcome	0.209	0.581	0.207	0.585
Night Light Trend	Yes	Yes	Yes	Yes
Village FE	Yes	Yes	Yes	Yes
Province-by-Year FE	Yes	Yes	Yes	Yes
Cluster	Village	Village	Village	Village

Note: The outcome variable of this table is shown in each column. Robust standard errors clustered at the village level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Secondly, and more directly, this study introduces a cross-sectional dataset at the resident level to examine whether the arrival of VFSs enhances local residents' ability to acquire information and develop career skills. Three alternative outcome variables are incorporated to test this channel: (1) work-related internet use, which captures whether residents utilize the internet to seek employment and entrepreneurial opportunities or access market-related information; (2) participation in career training programs, which reflects rural residents' capacity to actively absorb new knowledge and expand their skill sets; and (3) e-commerce consumption, which indicates both residents' broader digital engagement and shifts in consumption behavior that may reduce demand for offline retail. To mitigate potential endogeneity, this study controls for more detailed village attributes, including predetermined nighttime light intensity, village location, clan culture, and a range of resident demographics, such as their gender, age, education level, health conditions, and prior-year income. Additionally, the study leverages the number of historical high-ranking officials originating from each village as an instrument to enhance the causality. The results are presented in Table 4.8, with OLS estimates reported in the odd columns and IV estimates (preferred estimates) in the even columns.

Consistent with the media anecdotal evidence with VFSs, Columns (2) and (4) indicate that VFSs significantly increase the likelihood of residents' work-related

internet adoption and participating in career-related training programs. The participation growth in internet access and career training may reduce residents' informational and technical barriers, thereby expanding their access to business opportunities (Hjort & Poulsen, 2019; Deller et al., 2022b). The results also observe a positive impact of VFSs on residents' e-commerce consumption, although the IV estimate in Column (6) is not statistically significant. This finding may help explain the insignificant decline in the number of retail firms observed in our baseline Table 4.3. The rise in e-commerce demand could have crowded out offline retail businesses in villages, aligning with prior research on the disruptive impact of digital platforms on traditional retail sectors (Forman et al., 2009; Hortaçsu & Syverson, 2015). Our findings support the argument that external leadership can drive rural development by enhancing residents' technical capacities and reducing informational barriers.

Table 4. 8 Effect of VFS on Local Residents' Information Acquisition

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	OLS	2SLS	OLS	2SLS
Outcome	Any Internet Use for Work		Any Career Training		(Log) E-Commerce Consumption	
Any VFS	0.114**	0.393*	0.097	0.566*	0.874**	2.359
	(0.053)	(0.225)	(0.061)	(0.332)	(0.351)	(1.758)
First Stage (Outcome: Any VFS)						
Historical Leaders		0.118***		0.115***		0.118***
		(0.043)		(0.043)		(0.043)
CDW F-Statistics		73.79		61.70		68.28
Observations	1,463	1,463	1,362	1,362	1,326	1,326
Mean of Outcome	0.777	0.777	0.393	0.393	5.296	5.296
Village Control	Yes	Yes	Yes	Yes	Yes	Yes
Resident Control	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Village	Village	Village	Village	Village	Village

Note: The outcome variable of the second stage model is shown in each column, while that of the first stage model is the dummy equal to 1 if there is any VFS in the village. Robust standard errors clustered at the village level are in parentheses. This study controls for county fixed effects, detailed village attributes, including predetermined nightlight intensity, village location, village clan culture, and abundant residents' demographics, such as their gender, age, education level, health conditions, and prior-year income in each column. The Stock-Yogo weak instrument critical value at the 10% level is 16.38. Robust standard errors clustered at the village level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Institutional capital support

This study next examines whether VFSs promote rural entrepreneurial activity by enhancing institutional capital and resource availability at the village level. This channel emphasizes the role of institutional support in fostering economic growth, drawing on theories of resource dependence and governance capacity (Pfeffer & Salancik, 2006; Mathews, 2021).

To test this mechanism, VFSs are classified into two categories of institutional capital-intensive leaders: (1) those appointed from higher levels of government and (2) VFSs acknowledged for their ability to attract new resources. Specifically, the survey collected detailed information on the dispatching unit of each VFS. This study defines VFSs from governments as those appointed by government agencies, while VFSs sent from state-owned enterprises (SOEs) are categorized as VFSs from firms. The underlying assumption of the classification is that government-appointed VFSs tend to have stronger institutional ties and a greater capacity to coordinate public resources, such as fiscal support, policy incentives, and administrative assistance (Zhang et al., 2021).

Table 4. 9 Heterogeneous Effect of VFS with Different Institutional Capital

	(1)	(2)	(3)	(4)
Model	OLS			
Outcome	Agriculture	Manufacturing	Agriculture	Manufacturing
VFSs from Governments	0.092** (0.037)	0.168** (0.071)		
VFSs from Firms	0.071 (0.087)	0.141 (0.124)		
More-resources VFS			0.099*** (0.036)	0.168** (0.069)
Less-resources VFS			-0.071 (0.085)	0.123 (0.200)
Observations	4,212	4,212	4,188	4,188
R-Squared	0.376	0.764	0.382	0.764

Mean of Outcome	0.203	0.580	0.206	0.584
Control * Trend	Yes	Yes	Yes	Yes
Village FE	Yes	Yes	Yes	Yes
Province-by-Year FE	Yes	Yes	Yes	Yes
Cluster	Village	Village	Village	Village

Note: The outcome variable of this table is shown in each column. Robust standard errors clustered at the village level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In addition, following the approach used to identify VFSs with more ideas, this study uses village committee directors' evaluations to assess whether a VFS has attracted new resources to their dispatched villages. Directors were asked, "Do you agree that the arrival of the VFS has brought new resources to the village's development, such as financial support, policy incentives, or infrastructure projects?" VFSs with positive responses are classified as those with more resources. Table 4.9 reports the heterogeneous effects of these different VFSs, which shows that only institutional capital-intensive VFSs (those from governments or with more resources) can promote rural entrepreneurial activity in the agriculture and manufacturing sectors.

This study further utilizes village-level panel data to directly investigate whether the arrival of VFSs improves village infrastructure and policy support received from higher-level governments. Two types of institutional support are defined: (1) capital-intensive infrastructure support, measured by the number of road facilities (i.e., bus and highway toll stations), the number of public service facilities (i.e., public toilets, cell towers, and emergency shelters), and road density (m/km²) within the village and (2) capital-light support, captured by the introduction of a computer center or policy support related to residents' property rights (i.e., the introduction of land and house reform) in a given year.

Table 4.10 presents these findings in detail. Columns (1) to (3) report the effects on large-scale physical infrastructure, while Columns (4) to (6) document the impact on capital-light infrastructure (i.e., computer center) and policy support. As shown in Table 4.10, while this study observes null effects of VFSs on the development of large-scale, capital-intensive physical infrastructure, significant improvements can be found in capital-light infrastructure and policy support at the village level. Specifically, following the arrival of VFSs, villages are more likely to establish a computer center

(Column (4)) and receive property-related policy support (Columns (5) and (6)), such as the implementation of land rights and housing rights reform to enhance villagers' access to financial capital (Wang, 2012). These results suggest that the resource mobilization capacity of VFS officials is limited with respect to large-scale physical infrastructure. Instead, their impact is concentrated on soft resources, particularly in improving capital-light infrastructure and facilitating policy support.

Table 4. 10 Effect of VFS on Local Facilities and Policy Support

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS					
Outcome	Road Facility	Public Facility	Road Density	Computer	Land Reform	House Reform
VFS	0.036 (0.025)	0.027 (0.043)	0.007 (0.342)	0.054** (0.023)	0.093** (0.040)	0.060* (0.034)
Observations	2,142	2,142	2,499	4,224	4,128	4,164
R-squared	0.880	0.665	0.912	0.650	0.826	0.713
Mean of Outcome	0.0556	0.235	5.573	0.0374	0.371	0.114
Night Light Trend	Yes	Yes	Yes	Yes	Yes	Yes
Village FE	Yes	Yes	Yes	Yes	Yes	Yes
Province-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Village	Village	Village	Village	Village	Village

Note: The outcome variable of this table is shown in each column. Robust standard errors clustered at the village level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Social trust building

The third channel examines the trust-building effect of external leaders. Trust is widely recognized as a critical factor in fostering cooperative behaviors and enabling risk-taking activities (Das & Teng, 1998; Welter & Smallbone, 2006). To assess whether VFSs contribute to the trust environment within village communities, this study introduces three resident-level dummy indicators: (1) any conflicts perceived by local villagers, (2) villagers' preference for formal conflict resolution²⁴, and (3) direct trust

²⁴ This measures villagers' preference for resolving disputes through formal institutions, such as village committees or township governments, rather than informal kinship.

evaluations for locally elected village committee directors. The first two indicators measure social trust from residents' revealed preferences, capturing their actual experiences and behavioral tendencies in conflict situations, while the third is based on residents' stated preferences, directly measuring their expressed trust in local village heads.

Table 4.11 presents the results, with OLS estimates reported in the odd-numbered columns and the preferred IV estimates in the even-numbered columns. Contrary to prior studies, such as He & Wang (2017) and Xu et al. (2018), which highlight the potential for external agents to reduce corruption and prevent elite capture, this study finds consistently insignificant effects across all three proxies of social trust. The findings suggest that trust-building channels may not function effectively in the context of short-term interventions from external leadership. This observation complements the argument of Welter & Smallbone (2006), who contend that trust-building is a gradual process that often requires sustained engagement rather than short-term interventions.

Table 4. 11 Effect of VFS on Local Trust

	(1)	(3)	(4)	(6)	(7)	(9)
Model	OLS	IV	OLS	IV	OLS	IV
Outcome	Any Conflicts		Conflict Resolution Preference		Trust for Village Head	
VFS	0.064 (0.080)	-0.207 (0.268)	0.025 (0.055)	0.089 (0.265)	-0.030 (0.049)	0.181 (0.249)
First Stage (Outcome: Any VFS)						
Historical Leader		0.128*** (0.040)		0.119*** (0.043)		0.121*** (0.042)
CDW F-Statistics		86.93		73.56		80.18
Observations	1,357	1,357	1,455	1,455	1,449	1,449
R-Squared	0.450	-0.009	0.272	0.007	0.334	-0.008
Mean of Outcome	0.496	0.496	0.825	0.825	0.817	0.817
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Village Control	Yes	Yes	Yes	Yes	Yes	Yes

Resident Control	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Village	Village	Village	Village	Village	Village

Note: The outcome variable of the second stage model is shown in each column, while that of the first stage model is the dummy equal to 1 if there is any VFS in the village. Robust standard errors clustered at the village level are in parentheses. This study controls for county fixed effects, detailed village attributes, including predetermined nightlight intensity, village location, village clan culture, and abundant residents' demographics, such as their gender, age, education level, health conditions, and prior-year income in each column. The Stock-Yogo weak instrument critical value at the 10% level is 16.38. Robust standard errors clustered at the village level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.5. Conclusion

Leveraging the staggered rollout of China's VFS program across villages, this study provides the first empirical evidence of the causal impact of high-calibre external leaders on rural entrepreneurial activity. The analysis yields several important findings by combining detailed information on VFS characteristics with enterprise registration records from 2009 to 2020. First, the VFS program does not significantly increase the overall number of newly registered firms in treated villages. However, this aggregate effect masks substantial sectoral heterogeneity. Specifically, the arrival of a VFS is associated with a 44% increase in agricultural firms and a 29% rise in manufacturing firms. The positive effects are primarily driven by the knowledge and network advantages of VFSs, which can help mitigate information and resource gaps within villages, rather than by trust-building from better external supervision (He & Wang, 2017; Platteau, 2004). These results are consistent with comparative advantage and specialization theories (Becker & Murphy, 1992; Matsuyama, 1992), where high-calibre leadership uses its advanced knowledge and broad network to facilitate structural adjustment in line with pre-existing resource endowments.

Secondly, this study identifies abundant heterogeneity associated with village and VFS attributes. Aligning with the findings from other rural interventions (Asher & Novosad, 2020a; Burlig & Preonas, 2024), VFSs favor the growth of agricultural and manufacturing firms in central villages with better entrepreneurial complements. Further heterogeneity analysis supports a substitute effect between VFSs and clan culture and a complement effect between VFSs and highly educated collaborators. Specifically, villages with weaker clan cultures and those led by highly educated village

committee directors experience more profound growth in agricultural and manufacturing firms. In terms of VFS characteristics, which are often overlooked by existing rural studies due to data availability, our results indicate that older and non-local VFSs are more effective in promoting the development of rural firms, given their broader social capital and resource complementarity (Lau & Redlawsk, 2008; Alesina et al., 2019; G. Xu et al., 2018). Interestingly, contrary to the literature that emphasizes familiarity with the local context (Bhavnani & Lee, 2018; Balán et al., 2022), prior rural work experience does not appear to significantly impact the effectiveness of VFSs. Evidence suggests that both experienced and inexperienced VFS officials can substantially promote the growth of agricultural and manufacturing firms. The unexpected results may be driven by China's dual-leadership structure in rural governance, where the locally elected village heads can complement the role of external VFSs by providing deep local knowledge and familiarity with village affairs.

The findings of this work indicate that hiring high-quality external bureaucrats can improve local development to some extent, especially in industries where regions have comparative advantages, such as agriculture and manufacturing sectors in rural areas. However, the success of such efforts depends on local resources and governance capacity, like better access to entrepreneurial support, fewer social conflicts, and well-educated collaborators. This work helps explain the economic effects of relocating human capital in grassroots regions. Specifically, because VFSs serve short-term durations, it highlights the impact of temporarily assigning high-skilled leaders to rural communities and provides insights for other developing countries working to reduce poverty.

Chapter 5. Digital Infrastructure and Rural Entrepreneurial Activity

5.1. Introduction

This chapter examines how digital capital—broadband—affects rural entrepreneurial activity. Governments worldwide are working to promote broadband equity initiatives, such as the ReConnect Program in the U.S. and the Village Broadband Program in China and India, to provide internet access for the one-third of the global population living in rural and developing areas. (ITU, 2023). This kind of digital infrastructure can empower rural prosperity by creating new jobs, reaching distant products and customers, and reducing production costs, such as searching costs and information frictions (Gaspar & Glaeser, 1998; Hjort & Poulsen, 2019; Litan & Rivlin, 2001; Martellini & Menzio, 2020). However, the economic costs of laying or upgrading existing cables for that last mile may be prohibitive, which therefore calls for a scientific evaluation of the welfare effects of these government-led extensive investments.

This study investigates the causal effect of broadband on rural entrepreneurial activity, which can serve as a reasonable measure of the economic impact of broadband because it helps rural growth and reduces poverty by introducing innovative products and services, creating new jobs, and increasing rural employment flexibility. Previous studies have documented mixed effects of broadband on rural entrepreneurial activity. On one hand, internet access can encourage rural start-ups through increased market and credit opportunities, as well as reduced input or training costs (Cumming & Johan, 2010; Deller et al., 2022a). On the other hand, it may crowd out rural retailers, given the better access to urban products for local customers (Goldmanis et al., 2010). Other scholars report negligible or context-based effects of rural broadband and argue that the growth of firms is primarily driven by rural communities close to urban areas (Conley & Whitacre, 2016; Kandilov & Renkow, 2010). From this perspective, the Internet allows businesses in near-center regions to “borrow size” from big cities without the costs associated with agglomerations (de Vos et al., 2020).

One reason for the inconsistent findings is the disproportionate scholarly attention given to certain sectors. Previous studies, while insightful, tend to focus on farmers’

small businesses and specific industrial sectors, such as retail and knowledge-intensive sectors. (Li & Hu, 2024; Mack et al., 2011; Tran, 2021). Even in studies that incorporate a cross-section of industries (Deller et al., 2022a; Duvivier et al., 2021), the analysis often documents these differential impacts without systematically identifying the boundary conditions that explain why these effects vary. To reconcile these seemingly contradictory outcomes, this study proposes a critical boundary condition: the remote substitutability of an industry's goods and services. This study classifies rural industries into two broad categories: non-substitutable sectors, whose products and services are inherently local (e.g., agriculture, catering, and other local services), and substitutable sectors, which are susceptible to competition from non-local producers (e.g., retail, manufacturing, and other tradable industries). This study hypothesizes that for non-substitutable sectors, broadband primarily acts as an enabling technology, offering the efficiency gains and market access opportunities. Conversely, in sectors that can be replaced remotely, broadband increases competition and displacement pressures, which ultimately hinder local business entry.

The empirical work builds on the staggered roll-out of China's Rural Broadband Program and subsequent Universal Telecom Service (UTS) Program, which jointly provide an ideal empirical setting to investigate the causal impact of broadband on rural entrepreneurial activity. These two programs, while targeting different regions, share the common goal of achieving full broadband coverage at the village level within their designated areas. Using a panel dataset from 2012 to 2020 covering 30833 towns in 2520 counties, 349 prefecture cities, and 27 provinces, this study investigates the impact of broadband on rural entrepreneurial activity. To distinguish the potential heterogeneous impacts on remote substitutable industries and non-substitutable industries, the study measures the outcome variables as the number of newly registered enterprises of the two sectors for each town-year cell. Building on the DID estimator, we observe that broadband access significantly crowded out remote-substitutable industries, such as manufacturing, retail, and other tradable industries. At the same time, broadband access significantly promotes the growth of non-substitutable industries, such as agriculture, accommodation, catering, and other local services, such as repair. This heterogeneity is robust when applying event study estimators to test potential parallel trends, and consistent when introducing other confounding policies, excluding

counties with multiple treatments, and utilizing different specifications for our outcome variables.

The study further investigates whether the impact of broadband is varied across regions with different baseline economic conditions and remoteness. The results show that both the positive impact on non-substitutable sectors and the negative impact on substitutable industries is almost entirely concentrated in remote and less-developed towns. This pattern is consistent with the theory of diminishing marginal returns to infrastructure. Less-developed areas suffer from more severe market frictions, such as poor information access and high transaction costs (Kosec & Wantchekon, 2020). Broadband can provide larger marginal benefits in these areas by alleviating the most severe pre-existing constraints. In contrast, more developed towns already have a higher degree of market integration; therefore, the additional impact of broadband is smaller. This geographic pattern aligns with studies of Atasoy (2013), which found larger effects of broadband in rural and initially less-advantaged US counties. This favor in remote and less-developed regions robustly demonstrates that broadband is not a one-size-fits-all policy. Instead, it is a technology that simultaneously introduces the outside competition and unprecedented opportunity for place-based businesses to overcome the historic disadvantages of remoteness.

This work contributes to a growing literature estimating the impacts of extensive investments in rural infrastructure. Numerous studies have documented the welfare effects of physical infrastructure, such as rural roads and electricity (Aggarwal, 2018; Asher & Novosad, 2020a; Burlig & Preonas, 2024; Qin & Zhang, 2016). Built on their insights, this study investigates the effects of broadband, a representative digital infrastructure that is still unavailable to a larger number of the world's population. While there is growing attention on broadband equity and its effects on developing regions (Canzian et al., 2019; Deller et al., 2022a; Kim & Orazem, 2017a), these case-based studies are usually limited in their generalizability as they only focus on several cities or developed countries. This work is the first large-scale study on rural broadband in developing countries.

This study also adds heterogeneous perspectives to the existing literature on broadband impact. Previous studies have documented mixed effects of broadband, with either a positive, limited, or context-specific impact on entrepreneurship (Conley &

Whitacre, 2016; Cumming & Johan, 2010; Deller et al., 2022a; Goldmanis et al., 2010). This consistency is largely attributed to disproportionate academic attention paid to specific entrepreneurial types, which narrows the general picture of broadband impact on different industries. This work joins the previous debate by providing a critical boundary condition: the remote substitutability of an industry's goods and services, which contributes to reconciling the existing mixed outcomes.

The rest of this chapter is organized as follows. In Section 5.2, this study briefly introduces China's rural broadband expansion programs. Section 5.3 summarizes the data, sample area, and model specifications. Detailed empirical evidence is provided in Section 5.4 and the whole work is concluded in Section 5.5.

5.2. Institutional background

Over the past decade, China has stood out for its expansion of rural digital infrastructure and internet users. By 2021, China had the largest number of global rural internet users and penetration rate (CNNIC, 2021; ITU, 2021), providing a representative case to study the efforts of rural broadband. This rapid popularization was not a purely market-driven phenomenon but was largely orchestrated through two key national initiatives designed to address market failures in telecommunications, where private operators often lack incentives to invest in sparsely populated, low-income areas (Reddick et al., 2020).

The first major initiative, the Rural Broadband Program, launched in 2014²⁵, marked the beginning of systematic state-led efforts to improve rural network coverage. This pilot was implemented in selected counties of Sichuan and Yunnan provinces—20 counties in each—aiming to extend fixed-line broadband to administrative villages, upgrade backbone transmission facilities, and lower access costs for rural households and businesses. These two provinces are characterized by complex mountainous terrain and significant ethnic diversity, where the marginal cost of infrastructure is exceptionally high. Unlike the later nationwide program, this initial pilot focused on breakthrough investments in some of China's most geographically isolated regions. Consequently, the entrepreneurial response in these 40 counties may reflect a catching

²⁵ See https://www.gov.cn/xinwen/2014-06/18/content_2703143.htm.

up effect from a near-zero baseline of connectivity. The second is the UTS program, which was rolled out nationwide from 2016, with the goal of expanding rural broadband in the remaining regions through a co-funding model where the central government subsidized telecom operators to complete network infrastructure construction. This new program has undergone six subsequent rounds of expansion. By 2021, every administrative village in China was equipped with broadband connectivity, ensuring the completion of last-mile digital infrastructure construction.

A crucial feature of these programs, particularly the early UTS batches central to this study, is their official needs-based selection criteria. Local governments apply for funding by demonstrating that their villages either lack connectivity or fall below national network speed standards. Then, upper governments will review these applications and select the final list of pilot areas based on the submitted evidence and national strategic priorities. This kind of application-based design makes two factors particularly salient in determining the final pilot selection. First, it is plausible that counties with lower levels of economic development were prioritized, as the central government often links infrastructure projects to broader poverty alleviation goals. Second, the political connections between local and upper-level governments might have played a role in securing the pilot status and associated funding (S. Wang & Yang, 2025). The potential influence of these factors could challenge the assumption that the broadband rollout can be treated as a strictly exogenous shock. This study therefore conducts a formal balancing test in Section 3.3 to empirically examine whether pre-existing economic development levels and political connections were, in fact, key determinants in the pilot selection process.

The local benefits of these large-scale broadband initiatives are evident. For example, they are expected to lower communication costs, expand market reach, and improve access to information for rural producers and consumers. For rural enterprises, however, the effects may differ by sector. In remote substitutable industries—such as manufacturing, wholesale and retail—enhanced connectivity can intensify competition from outside markets, potentially displacing local firms (Goldmanis et al., 2010). In contrast, non-substitutable industries—including agriculture, restaurants, and repair services—may benefit from stronger local demand linkages and more efficient supplier-customer matching enabled by broadband access (Deller et al., 2022a). Understanding

how these differential forces shape firm entry is crucial for assessing the broader economic impact of rural broadband policy. This study, therefore, moves beyond the aggregate effect to quantify these opposing dynamics.

5.3. Data and methodology

5.3.1. Data

This work combines the following three datasets: (1) county-level rural broadband roll-out agenda; (2) public enterprise registration records; and (3) other County-level Socioeconomic Attributes.

County-level rural broadband roll-out agenda

To construct the sample, this work manually collects the rural broadband pilot counties and corresponding years of implementation from the government's official website or reliable news coverage²⁶. Specifically, this study focuses on the implementation agenda of the Rural Broadband Program and the UTS Program. The Rural Broadband Program was introduced in 2014, with an initial phase targeting 20 designated counties each in Yunnan and Sichuan provinces. The UTS Program was launched in 2016 and subsequently rolled out in six batches. It's worth noting that the first four batches designated prefecture-level cities, districts, or counties as the pilot units, whereas from the fifth batch onward, the focus of the UTS Program shifted to the administrative village level. As the analysis is conducted at the county level, this study focuses on the pilots from the first four batches of the UTS program from 2016 to 2018. This sample provides extensive coverage, encompassing all provinces and the vast majority of prefecture-level cities nationwide.

Enterprise registration records

This study measures the outcome variables as the number of newly registered firms in substitutable and non-substitutable industries of each town-year cell, to investigate the heterogeneous impact on rural entrepreneurial activity across different sectors. Specifically, non-substitutable industries are those whose goods and services are

²⁶ For example, <https://fiber.ofweek.com/2016-01/ART-210022-8120-29053772.html> and <http://www.iccsz.com/site/cn/News/2014/12/17/20141217011926228400.htm>.

usually consumed locally (Jensen et al., 2005), such as agriculture, accommodation and catering, and repair services. Substitutable industries, which face broader competition, include manufacturing, retail, and a range of other services. The raw data is obtained from the National Enterprise Credit Information Publicity System (NECIPS), which records detailed corporate information in China, including enterprise name, address, registration date, industrial type, registered capital, and scope of business, operating status, etc. This study obtains the geographic coordinates (latitude and longitude) of each enterprise based on its address and merge them with a map of Chinese town administrative divisions in 2021, which allows to aggregate the number of rural firms at town-year cells. Given the significant amount of missing industry information (about 45%), this study develops a machine learning technique that utilizes the Term Frequency-Inverse Document Frequency (TF-IDF) vectorization method and the Multinomial Naive Bayes algorithm to predict the industries based on company names. Specifically, the study trains the model year by year with non-missing samples to identify correlations between company names and industries and validate it on annual missing samples to classify industries with unlabelled companies.

County-level socioeconomic attributes

This study also introduces a series of county-level socioeconomic attributes as covariates to test the predetermined difference between our treatment and control groups. According to the selection rule for rural broadband pilot counties mentioned in Section 2, this study selects a series of predetermined social economic attributes, such as country distance to city center, nightlight intensity, total GDP ($\ln_gdp$), total population ($\ln_pop$), GDP of first industry ($\ln_first_GDP$), fixed investments ($\ln_fixed_inv$), the number of rural employees ($\ln_rural_employee$), lending balance of financial institutions ($\ln_lending_balance$), saving balance of residents ($\ln_saving_balance$), the number of primary students ($\ln_primary$), the number of middle students ($\ln_middle$), and the number of welfare beds ($\ln_welfare_beds$). All variables are selected from 2012 to 2013 to compare the pre-determined attributes of the treatment and control group before the first treatment year, 2014.

5.3.2. The Sample

Figure 5.1 shows the sample area, which covers 30833 towns in 2520 counties, 349 prefecture cities, and 27 provinces. Given the unique resource endowments and economic status of Chinese municipalities, we follow Lin et al. (2025) and exclude the four municipalities in our sample. The sample spans from 2012 to 2020, with policy shocks happening from 2014 to 2018. All the streets are excluded in the sample counties because they are usually considered urban regions in China.

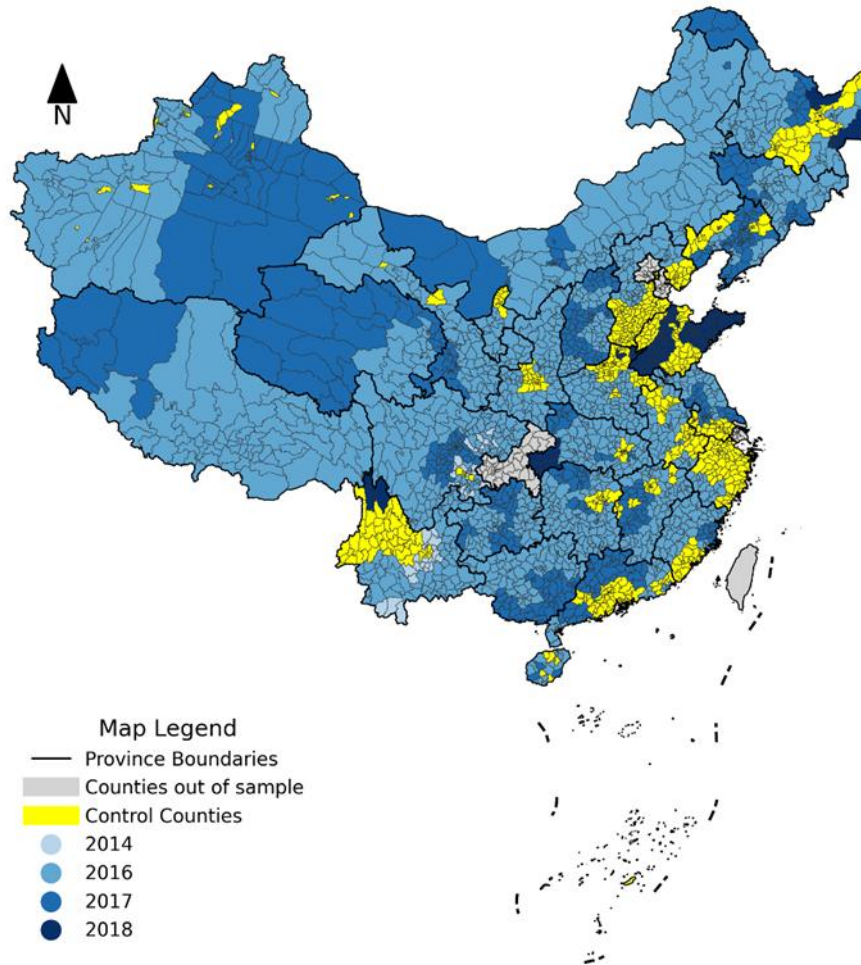


Figure 5. 1 Roll-out distribution of the Rural Broadband and the UTS program

5.3.3. Balance test

One caveat about the identification is that the pilot counties of the rural broadband program were not randomly selected, which may bias our results because of the pre-existing differences between treatment and control groups. To alleviate the concern,

this study conducts a balance test following Feigenbaum & Gross (2024) and Niu et al. (2022). The results are shown in Table 5.1, which tests whether pre-existing characteristics can predict the deployment status of rural broadband programs. Specifically, this study introduces a series of socio-economic county attributes from the pre-treatment period (2012-2013) to test whether they can predict a county's future pilot status.

Column (1), which only includes year fixed effects, reveals significant and systematic differences between the treatment and control groups across multiple dimensions. For instance, broadband pilot counties have significantly lower baseline GDP, rural employment, and savings, but higher registered populations and middle school student numbers. This indicates that a simple comparison between the two groups would be severely biased, as the pilot selection is clearly not unconditionally random. In Column (2), this study introduces province fixed effects to account for time-invariant differences across provinces. This specification compares broadband pilot counties only to non-pilot counties within the same province. The results show that the differences between the two groups substantially converge. Most variables become statistically insignificant, suggesting that much of the initial disparity was driven by cross-province heterogeneity. However, the coefficient of GDP remains negative and highly significant, indicating that within a given province, counties with lower economic output are more likely to be selected as pilots.

Finally, in Column (3), this study augments the model by including interactions between year fixed effects and our two key proxies for the main potential determinants of selection mentioned in Section 5.2: local economic development (measured by nighttime light intensity) and political connections (measured by the distance to the prefecture-level city). After including these crucial controls, the pre-treatment differences across all observable characteristics become statistically indistinguishable from zero. The results from our final specification strongly support the conditional random assignment assumption: once province-level heterogeneity and pre-existing trends related to economic development and political proximity are accounted for, the allocation of broadband pilots is plausibly exogenous. As a result, this study incorporates province fixed effects and the interaction between year fixed effects and

critical controls, including predetermined nightlight intensity and county distance to prefecture cities, in the following empirical models.

Table 5. 1 Balance Test

Outcome	(1)	(2)	(3)
	Dummy for Broadband Pilot Counties		
ln_gdp	-0.071** (0.031)	-0.084*** (0.026)	-0.038 (0.025)
ln_hukou_pop	0.161*** (0.041)	0.033 (0.024)	0.024 (0.022)
ln_first_industry	-0.010 (0.025)	0.024 (0.024)	-0.012 (0.023)
ln_fa_invest	0.042 (0.027)	-0.001 (0.023)	0.000 (0.023)
ln_rural_employ	-0.167*** (0.042)	0.007 (0.037)	-0.027 (0.037)
ln_loans	0.013 (0.015)	-0.009 (0.012)	0.000 (0.012)
ln_savings	-0.110*** (0.017)	0.002 (0.013)	0.020 (0.013)
ln_primary_students	-0.128*** (0.045)	-0.005 (0.027)	0.025 (0.026)
ln_middle_students	0.224*** (0.043)	0.037 (0.033)	0.026 (0.033)
ln_welfare_beds	-0.028** (0.012)	-0.014 (0.013)	-0.012 (0.013)
Observations	1,539	1,538	1,538
R-squared	0.120	0.410	0.437
Year FE	Yes	Yes	Yes
Province FE	No	Yes	Yes
Controls	No	No	Yes
Cluster	County	County	County

DV Mean	0.782	0.782	0.782
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Note: This table presents the balance test results. The outcome variable is the dummy indicating 1 if the county is designated as a broadband pilot county and 0 otherwise. This study introduces a panel sample from 2012 to 2013 in each column. Columns (1) only include year fixed effects, while Columns (2) and (3) gradually incorporate province fixed effects and the interaction between year fixed effects and critical controls, including predetermined nightlight intensity and county distance to prefecture cities. This study takes a logarithmic transformation for the numerical independent variables to mitigate inconsistent scales and heteroskedasticity. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

5.3.4. Model specification

This study follows Burlig & Preonas (2024) and introduces a staggered DID model and an Event Study model to provide average treatment effects as well as the dynamic effects for the whole sample. Specifically, the study combines the Rural Broadband Program and UTS Program and utilizes the staggered roll-out of rural broadband services across the counties to construct the staggered DID model. The specification is set as follows:

$$\text{Enterprises}_{i,c,p,t} = \beta_0 + \beta_1 \text{Broadband}_{c,p,t} + f(\text{Control}_c^{\text{pre}}, t) + \gamma_{p,t} + \mu_i + \varepsilon_{i,c,p,t} \quad (1)$$

where $\text{Enterprises}_{i,c,p,t}$ is the number of enterprises established in town i of county c and province p in year t . The explanatory variable of our interests, $\text{Broadband}_{c,p,t}$ is a binary indicator equal to 1 if county c has been selected as a Rural Broadband Program county or UTS county in year t and any subsequent year following the initial assignment, and 0 otherwise. $f(\text{Control}_c^{\text{pre}}, t)$ denotes the interaction between predetermined covariates—including the average nighttime light intensity in 2012 and 2013, and the distance from county c to its prefecture cities—and year fixed effects, accounting for potential differences in baseline economic activity and growth trajectories across counties. $\gamma_{p,t}$ and μ_i represent the province-by-year and town fixed effects, which capture the province-specific shocks that vary over time and time-invariant characteristics at the town level, respectively. The error term is denoted by $\varepsilon_{i,c,p,t}$, and standard errors are clustered at our treatment level, namely the county level.

To understand the dynamic effects of broadband on rural enterprises, this study

introduces an Event study model as specified in equation (2).

*Enterprises*_{*i,c,p,t*}

$$= \beta_0 + \sum_{k=-6}^6 \beta_k \text{Broadband}_{c,p,t,k} + \gamma_{p,t} + f(\text{Control}_c^{\text{pre}}, t) + \mu_i + \varepsilon_{i,c,p,t} \quad (2)$$

Broadband_{*c,p,t,k*} is a set of indicators that takes the value of one if year *t* is *k* years relative to the Rural broadband program or UTS program in county *c*. In the preferred setting, the year before the actual year (namely, *k* = −1) is designated as the reference group that will be omitted from the regression. Other variables are specified the same as in equation (1).

5.4. Empirical results

5.4.1. Baseline results

Table 5.2 presents the baseline results, examining the heterogeneous impact of broadband expansion on new firm entry. The outcome variable is the logarithmic number of newly registered enterprises of each type aggregated at the town-year level. The odd columns only control town fixed effects and province by year fixed effects without any covariates, while the even-numbered columns control the interaction of year fixed effects and predetermined light as well as distance to prefecture cities. Columns (1) and (2) show a consistently negative and statistically significant relationship between broadband access and firm entry in substitutable industries. The preferred specification in Column (2) reports that the introduction of rural broadband is associated with an approximate 4.2% decrease in the number of new enterprises in these sectors. In stark contrast, Columns (3) and (4) reveal a positive and statistically significant impact on non-substitutable industries. The coefficient in Column (4) implies that broadband access is associated with a 3.1% increase in new firm registrations in industries oriented towards local customers.

These findings provide strong evidence for the central hypothesis: broadband's effect on rural entrepreneurial activity is critically dependent on an industry's susceptibility to remote substitution. For substitutable industries, broadband, by

reducing trade and search costs, intensifies remote competition and allows more efficient non-local firms to displace local ones (Goldmanis et al., 2010). While for industries like local services and agriculture, broadband acts as a complementary tool that enhances productivity and market reach without exposing them to direct substitution. This finding is consistent with studies that document the positive effects of internet access on operational efficiency and market access for rural businesses (Deller et al., 2022a).

Table 5. 2 Baseline Results

Outcome	(1) Substitutable Industries	(2) Substitutable Industries	(3) Non-substitutable Industries	(4) Non-substitutable Industries
Rural Broadband	-0.046** (0.019)	-0.042** (0.019)	0.033** (0.014)	0.031** (0.014)
Observations	265,189	265,189	265,189	265,189
R-squared	0.887	0.887	0.709	0.709
Town FE	Yes	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes
Cluster	County	County	County	County

Note: This table presents the impact of broadband on firm entry in substitutable and non-substitutable industries. The outcome variable of this table is the logarithmic number of newly registered enterprises of each type aggregated at the town-year level. The odd columns only control town fixed effects and province by year fixed effects without any covariates, while the even-numbered columns control the interaction of year fixed effects and predetermined light as well as distance to prefecture cities. Robust standard errors clustered at county levels are in parentheses, *** p<0.01, ** p<0.05, * p<0.1

5.4.2. Robustness check

Parallel trend

The validity of the DID strategy relies on the assumption of parallel trends, which posits that the treatment and control groups would have experienced similar enterprise growth trends in the absence of broadband deployment. This study tests this assumption

with an event study model as specified in equation (2). Figure 5.2 provides the pre-trend and dynamic effects based on equation (2). Apart from the OLS estimator, this study provides dynamic estimators robust to heterogeneous treatment effects based on Sun & Abraham (2021). Across the estimators, this study consistently finds a significant decrease in the number of substitutable enterprises (Panel A) and growth in the number of non-substitutable enterprises (Panel B) during the post-reform period, while prior to the broadband deployment, the coefficients are small in magnitude and nonsignificant, which supports the underlying parallel trend assumption.

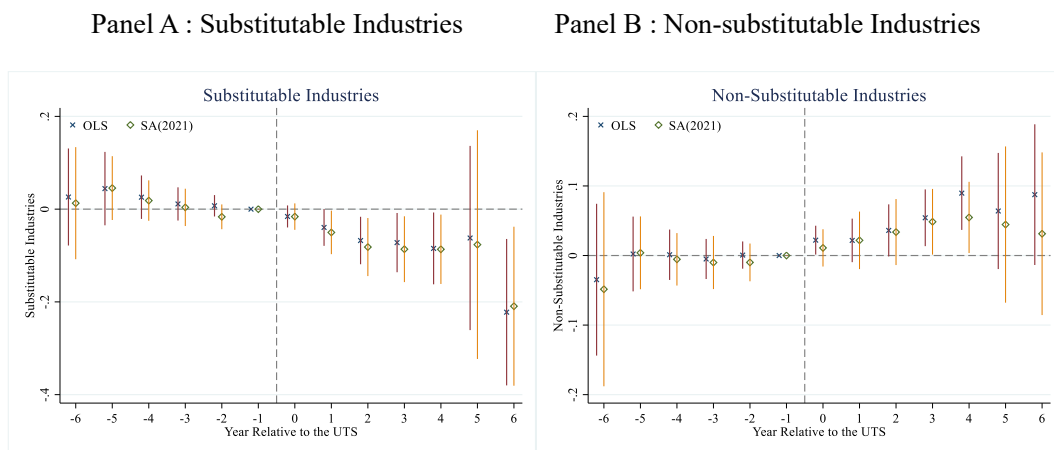


Figure 5. 2 Parallel Trends with Event Study Method

Note: This figure plots the event study coefficients, where the dependent variable consists of the annual number of registered enterprises in substitutable or non-substitutable industries for a given town. The regression model controls for province-by-year and town fixed effects. The vertical lines represent 95% confidence intervals for the respective point estimates.

Other robustness checks

This study performs a series of robust tests to illustrate the reliability of the main findings in Table 5.3. First, in Columns (1) and (2), this study controls other competitive broadband and entrepreneurial policies to rule out the confounding bias from competitive policies. Specifically, two main policies are considered: (1) urban broadband policy, the Broadband China launched since 2013, which similarly aimed to expand broadband access but prioritize urban regions; and (2) the Rural Returnees' Entrepreneurship Supportive Program (RRESP), launched in 341 counties over three waves from 2016 to 2017, aiming to lower the institutional barriers for returnee

entrepreneurs to engage in rural businesses, especially the rural E-Commerce. As shown in Columns (1) and (2), the coefficients of rural broadband remain consistently significant after accounting for the bias from the two confounding policies. Second, this study excludes the counties with multiple treatments during our sample period to avoid the risks of overestimation. During the broadband roll-out period, it's observed that more than 25% of counties, particularly those in less-developed regions, were repeatedly selected as pilot areas across different batches of the UTS program. To ensure the estimates are not driven by these intensively treated areas, this study removes them from the sample. The results of this robustness check are presented in Columns (3) and (4) of Table 5.3, which remain consistent with the baseline findings. Finally, in Columns (5) and (6), this study tests the sensitivity of our results to the specification of the outcome variable. Specifically, the study replaces the conventional log-transformed outcome with its inverse hyperbolic sine (IHS) transformation, which allows for more flexible handling of zero values and extreme values in outcome variables (Burbidge et al., 1988). Across the two columns, the results are statistically significant and remarkably close in magnitude to our baseline results, which strengthens the confidence in the conclusion that broadband has strong, heterogeneous effects on rural entrepreneurial activity.

Table 5. 3 Other Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
Model	Control other shocks		Drop multiple treated		Other Outcome Specifications	
Outcome	Substitutable	Non-substitutable	Substitutable	Non-substitutable	Substitutable	Non-substitutable
Rural Broadband	-0.043** (0.019)	0.029** (0.014)	-0.033* (0.019)	0.036** (0.014)	-0.044** (0.021)	0.037** (0.018)
Urban broadband	-0.005 (0.020)	-0.063*** (0.013)				
Entre-policy	0.025 (0.028)	0.011 (0.017)				
Observations	265,189	265,189	207,926	207,926	265,189	265,189
R-squared	0.887	0.710	0.901	0.718	0.880	0.702
Town FE	Yes	Yes	Yes	Yes	Yes	Yes
Province * Year	Yes	Yes	Yes	Yes	Yes	Yes
FE						
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Cluster	County	County	County	County	County	County
Note: This table presents the robust impact of broadband on firm entry in substitutable and non-substitutable industries. The outcome variable of this table is the logarithmic number of newly registered enterprises of each type aggregated at the town-year level. Robust standard errors clustered at county levels are in parentheses, *** p<0.01, ** p<0.05, * p<0.1						

5.4.3. Heterogeneity analysis

This study further explores the heterogeneous effects of broadband by examining how its impact varies with baseline local economic conditions and geographic remoteness. The results are shown in Table 5.4, which reveals a consistent and powerful pattern: both the positive and negative impacts of broadband are significantly more pronounced in towns that are initially less developed and more remote. Columns (1) and (4) provide baseline results. In Columns (2) and (5), this study interacts the broadband treatment with an indicator for high local economic development, proxied by nighttime light intensity. The results show that the effects of broadband are substantially stronger in less-developed (low light intensity) areas. For substitutable industries (Column (2)), the interaction term is positive and significant, which implies that the negative crowding-out effect is more profound in less-developed towns (approximately 7.3%), while in more-developed towns, the effect is muted and close to zero (1.7%). Similarly, for non-substitutable industries (Column (5)), the negative and significant interaction term indicates that this positive enabling effect is concentrated in less developed towns (6.4%) and almost entirely erased in more developed towns (0.3%). The analysis in Columns (3) and (6) tells a similar, perhaps even starker, story by interacting broadband access with an indicator for remote towns. The results shows that both the positive and negative effects of broadband are almost entirely concentrated in remote towns.

This pattern is consistent with the theory of diminishing marginal returns to infrastructure. Less-developed areas suffer from more severe market frictions, such as poor information access and high transaction costs (Kosec & Wantchekon, 2020). Broadband can provide larger marginal benefits in these areas by alleviating the most severe pre-existing constraints. In contrast, more developed towns already have a higher degree of market integration; therefore, the additional impact of broadband is smaller. The geographic pattern also aligns with studies of Atasoy (2013), which found larger

effects of broadband in rural and initially less-advantaged US counties. This favor in remote and less-developed regions robustly demonstrates that broadband is not a one-size-fits-all policy. Instead, it is a technology that simultaneously introduces the outside competition and unprecedented opportunity for place-based businesses to overcome the historic disadvantages of remoteness.

Table 5. 4 Heterogeneity

Outcome	(1)	(2)	(3)	(4)	(5)	(6)
	Substitutable			Non-Substitutable		
Broadband	-0.042** (0.019)	-0.073*** (0.024)	-0.021 (0.019)	0.031** (0.014)	0.064*** (0.017)	0.003 (0.015)
# High Light Intensity		0.056** (0.024)			-0.061*** (0.017)	
# Remote Towns			-0.044*** (0.011)			0.057*** (0.007)
Observations	265,189	265,189	265,189	265,189	265,189	265,189
R-squared	0.887	0.887	0.887	0.709	0.710	0.710
Town FE	Yes	Yes	Yes	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	County	County	County	County	County	County
DV Mean	3.202	3.202	3.202	1.204	1.204	1.204

Note: This table presents the heterogeneous impact of broadband on firm entry in substitutable and non-substitutable industries across regions with different baseline local economic conditions and geographic remoteness. The outcome variable of this table is the logarithmic number of newly registered enterprises of each type aggregated at the town-year level. Robust standard errors clustered at county levels are in parentheses, *** p<0.01, ** p<0.05, * p<0.1

5.5. Conclusions

The ongoing debate over the economic impact of rural broadband has produced mixed and often conflicting findings. This study aims to clarify this literature by proposing and testing a new theoretical framework focused on the remote substitutability of industries. The study hypothesizes that broadband activates two opposing forces: an enabling effect for local, non-substitutable enterprises and a crowding-out effect for substitutable businesses facing new, remote competition. Using the staggered, state-led deployment of broadband infrastructure across thousands of

rural towns in China as a quasi-experimental setting, the empirical analysis strongly supports this hypothesis. Specifically, the results find that broadband access significantly encourages rural firm entry in non-substitutable sectors such as local services and agriculture, while simultaneously discouraging new firm formation in substitutable sectors like retail and manufacturing. Furthermore, this study shows that these dual effects are not uniform; they are notably more intense in China's most remote and less-developed regions, where broadband can act as a powerful catalyst for market integration.

This work makes several key contributions. Most importantly, it establishes a clear and testable boundary condition—remote substitutability—that clarifies earlier inconsistent findings in the literature. By shifting the focus from whether broadband promotes entrepreneurship to which types of businesses it benefits and under what conditions, we offer a new perspective on how digital infrastructure transforms rural economies. The findings of this work also have important policy implications. First, they warn against viewing broadband as a one-size-fits-all solution for rural economic growth. While connectivity is vital, policymakers must recognize its dual effects. Simply providing internet access might inadvertently weaken local retail and manufacturing sectors. Therefore, complementary policies are crucial. These could include programs to help businesses adapt, such as digital literacy training for local retailers to establish an online presence or support for transitioning to new business models. Second, the heterogeneity analysis indicates that directing broadband investments toward the most remote and disadvantaged areas can yield the highest marginal returns, as these regions face the greatest challenges of distance and the potential for digital technology to stimulate growth is most significant.

Finally, it is imperative to recognize that while digital infrastructure acts as a powerful catalyst for market integration, technological empowerment cannot serve as a substitute for capability building. The observed dual effects of broadband highlight a critical capability gap: while connectivity grants rural firms access to larger markets, it also exposes them to intense competition from sophisticated urban entrants. Without a corresponding investment in the human capital and digital literacy of local residents, the empowerment provided by technology may remain underutilized or even lead to the displacement of traditional local businesses. Therefore, the long-term success of rural

digitalization depends on a holistic policy approach that shifts focus from hardware connectivity to software competency. Future interventions should prioritize complementary programs, such as digital business training, e-commerce mentorship, and managerial skill development, to ensure that rural entrepreneurs possess the agency and capacity to effectively leverage the digital tools at their disposal.

Chapter 6. Conclusions

6.1. The achievement of research objectives and major findings

This dissertation explores the main research question: Which production factors within the entrepreneurial ecosystem promote the growth of rural entrepreneurial activity? To answer this, the study examines three key production factors: land, human capital, and digital infrastructure. Consequently, the dissertation has three main objectives: first, to analyze the impact of communal land rights on rural entrepreneurial activity in China; second, to evaluate the effects of external human capital initiatives; and third, to study how digital infrastructure influences the rural entrepreneurial environment.

Chapter 3 addresses the first research objective by examining how collective land transfer rights affect rural entrepreneurial activity. Leveraging China's ambitious land reform—which allows rural collectives to directly sell or lease construction land to enterprises—this chapter finds that these rights increase rural entrepreneurial activity by a notable 25%. This entrepreneurial growth is not uniform; it is entirely concentrated in regions where collective coordination is less costly, such as in less rugged areas or those with denser clan networks. Two specific pathways behind the entrepreneurial growth are identified: lower land-use costs for firms and increased land-based wealth for local residents. The reform also promotes expansion in non-farm wage employment, a result driven by higher labor market participation rather than a decline in agriculture. This chapter emphasizes the vital role of communal rights and collective negotiation in reducing coordination costs, offering new insights for promoting rural development in developing countries.

To achieve Objective 2, Chapter 4 assesses the effectiveness of external leaders—specifically, high-calibre bureaucrats—in driving development within underdeveloped regions characterized by weak institutions. The analysis uses the quasi-experimental setting of China's VFS program, which deploys skilled cadres to rural villages on a temporary basis. Using a DID estimator on a panel dataset of 357 villages, this study measures the sector-specific effects of VFS appointments on rural entrepreneurial activity. The results are significant: a VFS appointment increases firm growth by 44%

in the agricultural sector and 29% in manufacturing. This impact is stronger in villages with better access to entrepreneurial supports, weaker clan cultures, and highly educated local collaborators. The analysis indicates that their success comes from the transfer of knowledge and institutional capital—which reduces local information and resource gaps—rather than from trust-building, which usually requires longer-term engagement. These findings offer valuable insights for developing countries, showing that short-term, high-skill leadership assignments can be an effective tool for poverty reduction.

Chapter 5 addresses the third objective by examining how digital infrastructure impacts rural entrepreneurial activity in different ways. To clarify the ongoing debate and mixed results seen in previous research, this chapter introduces and tests a new theoretical framework focused on how industries can be remotely substituted. The main idea is that broadband creates two opposite effects: an enabling effect for local, non-substitutable businesses, and a crowding-out effect for substitutable businesses facing new remote competition. Using China's phased, state-led broadband rollout as a quasi-experimental setting, the analysis strongly supports this idea. The results show that broadband access significantly boosts firm entry in sectors that are not easily replaced, such as agriculture, catering, and other local services, while it decreases entry in sectors that are more easily replaced, like retail and manufacturing. These effects are not the same everywhere; they are especially strong in China's most remote and less-developed regions, emphasizing broadband's role as a key driver of market integration.

This dissertation contributes the literature on rural development and entrepreneurship by providing novel wisdom on the role of land rights, human capital and digital infrastructure. Firstly, moving beyond the simple focus on private land titling, this research reveals that strengthening communal rights can be a potent mechanism to overcome coordination failures, a vital insight for institutionally weak environments where collective action is paramount. Secondly, contrary to theories emphasizing long-term, trust-based leadership for rural development, this study demonstrates that short-term, high-skill external leadership can effectively drive firm growth by injecting crucial knowledge and institutional capital, offering a scalable policy alternative. Finally, this work introduces a novel remote substitutability framework that resolves the ambiguous findings in prior literature on broadband's

impact. By showing that digital infrastructure simultaneously enables non-substitutable local businesses while crowding out substitutable ones, this dissertation provides a more comprehensive model for understanding the dual-edged effects of digitalization on rural economies.

6.2. Policy implications

The findings of this dissertation provide valuable insights for developing countries aiming to boost rural entrepreneurial activity. Based on the empirical analysis of three key production factors—land, human capital, and digital infrastructure—this study offers multi-layered policy recommendations designed to build a more effective rural entrepreneurial ecosystem. These policy implications align closely with the trajectory of China’s rural revitalization policies, which provide empirical validation for the efficacy of collective empowerment, external leadership, and digital technology in resource-constrained environments.

6.2.1. Empowering collectives to reduce coordination costs

While traditional land policy has often focused on clarifying individual property rights, this research reveals that in contexts of fragmented land ownership, empowering rural collectives and reducing their internal coordination costs is the key to unlocking land potential and stimulating entrepreneurship.

To ensure the implementation of collective land transfer rights, first, an institutional support system is necessary, including standardized contract templates, transparent land transaction platforms, legal advisory services, and effective dispute resolution mechanisms. These measures can greatly reduce the complexity and risks involved in collective land negotiations.

Second, in areas with weaker clan networks and collective action capability, the government should support the establishment of formal, standardized land-share cooperatives to compensate for the lack of informal social capital with modern corporate governance.

6.2.2. Maximizing knowledge and capital advantages of external leaders

This research challenges the common belief that external leaders need long-term involvement to build trust and promote development. It shows that short-term assignments of highly skilled leaders can be a very cost-effective strategy, mainly providing quick transfer of knowledge and institutional resources.

To maximize the benefits of external leaders' knowledge and resources, first, a precise matching system for deploying these leaders should be implemented. The success of such policies relies not only on the leaders' skills but also on how well those skills align with local needs. Governments should create a thorough needs assessment process to identify a village's main challenges—such as limited agricultural technology, marketing channels, or project management expertise—before sending external cadres.

Second, the mandate for external leaders should prioritize capital transfer over abstract institution building. Given their short tenures, policy goals need to be specific and measurable. For example, their key performance indicators could include successfully establishing a new agricultural supply chain, securing a designated amount of investment for the village, introducing and promoting a new technology, or training a local cooperative management team to operate independently. Such practical goal setting ensures that external leaders maximize their impact as essential connectors for information and resources within their limited timeframe.

6.2.3. Provide complementary support for broadband deployments

One of the key findings of this research is that digital infrastructure, like broadband, has a dual impact on rural entrepreneurial activity, both enabling and potentially crowding out local businesses. Therefore, policy should go beyond just installing broadband and include a complementary industrial support strategy.

First, non-substitutable local industries must be actively supported. Following broadband deployment, governments should launch targeted support programs for sectors that are less susceptible to remote competition, such as local services, experiential tourism, and specialty agriculture. Specific measures could include providing specialized e-commerce and online marketing training for local guesthouse and restaurant owners, establishing regional branding and online sales platforms for agricultural products, and offering subsidies to encourage local businesses to adopt digital technology to improve service quality and customer experience.

Second, a buffer mechanism and transition support must be established for substitutable industries. Policymakers must anticipate that local retail and basic manufacturing sectors will face intense competition from external markets. In response, the government needs to provide a safety net. This could involve establishing transition funds to help these businesses digitize and pivot from serving only the local market to exploring broader e-commerce opportunities. Concurrently, large-scale vocational retraining programs should be offered to workers displaced by this competition, helping them transition to new roles in the service or digital economy. Neglecting this crowding-out effect risks exacerbating economic inequality within rural areas.

6.3. Limitations and further research directions

While this dissertation offers strong evidence and valuable insights, it is essential to recognize its limitations to guide future research. First, the empirical analysis is based on China's unique institutional context, particularly its communal land systems. The magnitude and even the direction of the effects might be different in other developing countries with different property rights regimes, political structures, and cultural norms. A cross-country comparison involving Southeast Asia, Africa, or Latin America is necessary, especially one that examines how countries with private property rights address coordination issues for firm creation, such as through market-based negotiation mechanisms or by appointing bargaining representatives.

Second, this dissertation primarily relies on formal firm registration data to measure entrepreneurship. This approach may not fully capture the informal and subsistence-level entrepreneurial activities that are common in many rural economies. Therefore, a useful area for future research is to investigate how shifts in production factors—like land rights, human capital, and digital access—impact informal entrepreneurship. This type of study would be especially valuable if it explored the dynamic interaction between the formal and informal sectors, such as whether the growth of formal businesses drives out or encourages informal economic activities.

Finally, this dissertation provides some preliminary evidence of gender inequality in entrepreneurial activities. An important focus for future research would be to explore this area more deeply, especially examining how changes in production factors can influence gender equality in entrepreneurship. Such research could offer valuable

insights into how increasing land rights for women or enhancing their access to digital infrastructure can empower female entrepreneurs, potentially unlocking a major but often overlooked driver of rural economic growth.

Appendices: Supplementary Information

Appendix A: Other Details for Chapter 3

A-1: Details of confounding policies

This section introduces the details of each concurrent policy that may confound the baseline results in Section 3.4.1. For each policy, the study describes its background, implementation schedule, overlap with the sample, and the construction of the corresponding time-varying indicator used in the empirical analysis.

(1) Nationwide Land Titling Reform

The Land Titling Reform is a major nationwide initiative aimed at strengthening rural households' land tenure security by issuing formal certificates for their contracted farmland. The reform was rolled out progressively by the Ministry of Agriculture in four main phases: (1) 2009-2010, initial village-level pilots; (2) 2011-2013, expanded pilots at the township level across several hundred counties; (3) 2014, launch of whole-province pilots in three provinces; and (4) post-2014, expansion of the whole-province pilot model to an additional nine provinces, eventually aiming for nationwide coverage by the end of 2018.

Due to limitations in the accessibility of historical government websites, this study was only able to obtain the list of counties and their specific implementation years from 2013 onwards. This limitation is unlikely to significantly bias the results, as Bu & Liao (2022) note that only about 0.2% of counties had completed the titling process before 2013. Given that the titling reform has been rolled out nationwide during the sample period, all counties in the sample of chapter 3 were eventually targeted. To account for the effects of land titling, we construct a time-varying indicator, "Land Titling", which equals one for each county in all years during and after the year when it officially implemented the titling reform, and zero otherwise.

One may easily conflate the two reforms, as land titling and the reform of the focus of this study are both related to rural land property rights. However, they differ in property rights nature, targeted land assets, and theoretical mechanisms that may affect rural entrepreneurial activity. As shown in Table A-1, in essence, the two reforms

represent the fundamental divide between private and communal land rights. The Land Titling reform aims to improve individuals’ tenure security over their contracted agricultural land, while the transferability reform aims to improve land market efficiency by allocating construction land transfer rights to rural collectives.

Specifically, there are three-dimensional differences between the two reforms. (1) The nature of property rights. Land titling focuses on security, while our reform focuses on transferability or alienability of property rights. (2) Target land assets. In China, the two reforms operate on administratively distinct and non-overlapping land categories: the titling reform focuses on contracted agricultural land, whereas the transferability reform focuses on non-agricultural construction land. This non-overlap attribute limits the scope for direct interaction between the two reforms. While one might easily consider that collective transfer rights and individual tenure are to some extent in tension, strengthening titles on farmland does not mechanically diminish collective control over other construction lands. (3) Mechanisms for entrepreneurship. The distinction in specific rights and rights holders naturally leads to different mechanisms through which the two land reforms may affect entrepreneurship. Specifically, the Land Titling reform may encourage small-scale and home-based businesses by freeing up household labor for off-farm work or improving access to land-related credit for individual farmers. The land transferability reform, however, can solve land assembly problems through collective negotiation and lower contiguous land use costs for large firms.

Table A - 1 Comparison of Land Titling Reform and the Land Transferability Reform

Dimension	Land Titling Reform (e.g., Bu and Liao, 2022)	Land Transferability Reform (Focus of this study)
Policy Goals	To strengthen tenure security for individuals’ farmland by allocating land titles	To improve the land market efficiency by allocating land transfer rights the right to sell or rent land) to rural collectives
Who holds the rights	Individual farmers	Rural collectives

Essence	Private rights	Communal rights
Nature of Rights	Security	Transferability
Target Land Asset	Agricultural Land	Non-agricultural Construction Land
Main Mechanisms	(1) Free up labor from agriculture, and (2) enhance land-related credit access for individual farmers	(1) Solve land assembly problems through collective negotiation and lower contiguous land use costs for firms; and (2) wealth effects for collectives and individual farmer members

(2) The Rural Returnees' Entrepreneurship Supportive Program

The Rural Returnees' Entrepreneurship Supportive Program (RRESP) is a pilot program designed to foster a favorable entrepreneurial ecosystem for returnees, focusing on improving the institutional environment rather than providing direct subsidies. The program was rolled out in three main waves across a total of 341 pilot counties: the first batch of 90 counties in 2016²⁷, the second batch of 116 counties in 2017²⁸, and the third batch of 135 counties in 2018²⁹.

The full sample contains 101 of these RRESP pilot counties. However, the overlap with the land reform treatment group is minimal, with only 9 treatment counties also being part of the returnee program. To test whether the results are driven by the RRESP, this study creates a time-varying indicator, Returnee, which equals one for a designated

²⁷ See National Development and Reform Commission (NDRC) et al. (2016), "Notice on Approving the Pilot Program for Supporting Migrant Workers and Other Personnel to Return to Their Hometowns for Entrepreneurship...", Document No. Fajgaijiuye [2016] 395. Available at: https://www.ndrc.gov.cn/xxgk/zcfb/tz/201706/t20170628_963593.html (accessed June 26, 2025).

²⁸ See National Development and Reform Commission (NDRC) et al. (2017), "Notice on Supporting the Second Batch of Pilot Areas for Returnee Entrepreneurship...", Document No. Fajgaijiuye [2017] 121. Available at: https://www.ndrc.gov.cn/xxgk/zcfb/tz/201701/t20170105_962855.html (accessed June 26, 2025).

²⁹ See National Development and Reform Commission (NDRC) et al. (2018), "Notice on Supporting the Third Batch of Pilot Areas for Returnee Entrepreneurship...", Document No. Fajgaijiuye [2018] 1355. Available at: https://www.ndrc.gov.cn/xxgk/zcfb/tz/201711/t20171102_962582.html (accessed June 26, 2025).

pilot county in all years during and after its specific implementation wave (2016, 2017, or 2018), and zero otherwise. For all non-pilot counties, this variable is always zero.

(3) The Rural Housing Mortgage Program

To improve rural access to credit, the central government launched a pilot program in 2016 that allowed rural households in 59 designated counties to use their residential properties (houses) as collateral for bank loans³⁰.

This policy has a significant overlap with this study. The sample includes 29 of these pilot counties, 23 of which are also in the land reform treatment group. This high degree of overlap makes it a particularly important policy to account for. Specifically, this study creates a time-varying indicator, Mortgage, which equals one for a designated pilot county for all years from 2016 onwards, and zero otherwise.

³⁰ See The Central Committee of the Communist Party of China and The State Council (2016), "Notice on Authorizing the Temporary Adjustment of Relevant Legal Provisions in 59 Counties...". Available at: <http://politics.people.com.cn/n1/2016/0324/c1001-28224966.html> (accessed June 26, 2025).

A-2 Land price prediction grounded in random forest

This study follows the methodology of Grange et al. (2018) to obtain comparable land prices across different regions. The specific procedures for training the random forest model are outlined below:

First, the study trains the random forest model to capture the potential association between land price and predictors. The predictors include three types of variables: (1) Land characteristics such as land use type, grade, transaction mode, plot ratio, area, source, and distance to the prefecture-level city center and the county center. (2) Cyclical factors. This study contains a cyclical predictor, which determines the specific day of the year when the land transaction date occurs, to account for the variation in land prices due to the cyclical nature of economic activities. (3) Variables that uniquely identify every parcel of land. The study includes a variable (`unix_id`) that can define each land parcel to identify the actual land price after isolating land characteristics and cyclical factors. The land transaction data from 2009 to 2019 are randomly divided into a training set (80% of the sample data) and a test set (20% of the sample data). The training set is used to construct a random forest model by randomly extracting a certain number of sample units and generating 300 decision trees. The minimum unit of each leaf node is five, and the number of variables that each node may use for segmentation is equal to the square root of the total number of predictors.

Second, after completing the model training, this study generates multiple land value predictions by randomly assigning predictors and then calculate the real land price by taking the mean value. For each prediction, this study randomly selects land characteristics and cyclical factors from the original data while keeping the unique land identifier (`unix_id`) constant. This procedure enables us to determine the predicted land value by considering the randomly assigned land characteristics and cyclical factors, all while maintaining the fundamental attributes of the land parcels. The study iterates the aforementioned process 300 times and calculate the mean of all the predicted values to determine standardized land prices that isolate locational attributes.

Appendix B: Other Tables

B-1 Sensitivity tests for the specification of clustering methods

Table B - 1 Robustness Checks with Different Specifications of Clustering Methods

	(1)	(2)	(3)	(4)
Outcome	Newly Registered Enterprises			
Reform	33.442** (14.959)	33.442** (15.425)	33.442** (14.047)	33.442** (14.003)
Observations	85,603	85,603	85,603	85,603
R-squared	0.850	0.850	0.850	0.850
Town FE	Yes	Yes	Yes	Yes
Province by Year FE	Yes	Yes	Yes	Yes
Wild Bootstrap	No	Yes	No	No
Cluster	City	Province	County and Province by Year	County and City by Year
DV Mean	131.575	131.575	131.575	131.575
Wild P-value	No	0.022	No	No

Note: This table presents robustness checks using different specifications of clustering methods. The outcome variable of this table is the number of newly registered enterprises aggregated at the town-year level. Column (1) clusters the standard errors at the city level, while Column (2) clusters at the province level and reports the wild bootstrap p-values to account for small cluster problems (31 clusters). In Columns (3) and (4), this study introduces two-way clusters at the county and province by year or city by year. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

B-2 Sensitivity tests for other specifications

Table B - 2 Robustness Checks with Different Specifications

	(1)	(2)
Method	OLS	Poisson
Outcome	(Log) Number of Newly Registered Firms	Number of Newly Registered Firms
Reform	0.181*** (0.068)	0.111*** (0.042)
Observations	85,603	85,603
R-squared	0.896	NA
Province by Year FE	Yes	Yes
Town FE	Yes	Yes
County FE	No	No
City by Year FE	No	No
County Trend	No	Yes
Cluster	County	County
DV Mean	3.969	131.575

Note: This table presents robustness checks using different specifications of outcome and estimation strategies. Column (1) utilized logarithmically transformed number of newly registered enterprises aggregated at the town-year level as outcome variable, while Column (2) introduces the raw counts but utilizes a Poisson regression model to account for the count nature of the firm numbers. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

B-3 Sensitivity tests for alternative controls and samples

Table B - 3 Alternative Controls and Samples

	(1)	(2)	(3)	(4)
	Town-Year Level		County-Year Level	
Outcome	Newly Registered Enterprises			
Reform	33.442**	17.065*	442.047**	442.047**
	(13.934)	(10.294)	(189.844)	(190.294)
Observations	85,603	85,603	7,326	7,326
R-squared	0.850	0.875	0.838	0.838
Town FE	Yes	Yes	No	No
County FE	No	No	Yes	Yes
Province * Year FE	Yes	Yes	Yes	Yes
County Trend	No	Yes	No	Yes
Cluster	County	County	County	County
DV Mean	131.575	131.575	1537.431	1537.431

Note: This table presents robustness checks using alternative controls and sample aggregation methods. The outcome variables of Columns (1) and (2) are the number of newly registered enterprises aggregated at the town-year level, while those of Columns (3) and (4) are aggregated at the county-year level. The first two columns control the town and province by year fixed effects, while the remaining two columns control the county and province by year fixed effects. In Columns (2) and (4), this study additionally incorporates the linear time trend of each county. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

B-4 Heterogeneity by state ownership

Table B - 4 Heterogeneity by State Ownership

	(1)	(2)	(3)	(4)	(5)	(6)
	Agricultural		Manufacturing		Service	
Outcome	State ownership	Non-state ownership	State ownership	Non-state ownership	State ownership	Non-state ownership
Reform	-0.000 (0.002)	-0.456** (0.218)	-0.000 (0.005)	1.016* (0.593)	0.028 (0.026)	32.854** (13.580)
Observations	85,603	85,603	85,603	85,603	85,603	85,603
R-squared	0.126	0.596	0.175	0.886	0.330	0.841
Town FE	Yes	Yes	Yes	Yes	Yes	Yes
Province *	Yes	Yes	Yes	Yes	Yes	Yes
Year FE						
Cluster	County	County	County	County	County	County
DV Mean	0.005	3.761	0.022	10.716	0.162	116.909

Note: This table presents heterogeneous effects by state-ownership. The outcome variables are the number of newly registered enterprises aggregated at the town-year level by industrial types and state ownership. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

B-5 Selective attrition of different types of firms

Table B - 5 Selective Attrition of Different Types of Firms

Outcome	(1) Firms Missing Registered Capital	(2) Firms Missing Surviving Status	(3) Firms Missing Predicted Gender of Entrepreneur
Reform	8.367 (7.231)	-0.038 (0.033)	0.131 (0.099)
Observations	85,603	85,603	85,603
R-squared	0.734	0.262	0.503
Town FE	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes
Cluster	County	County	County
DV Mean	45.497	0.036	0.679

Note: This table tests whether the land reform is systematically correlated with the attrition of different types of firms. The outcome variables are the number of enterprises missing specific attributes aggregated at the town-year level. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

B-6 Selective attribution of yields and planting area

Table B - 6 Selective Attribution of Yields and Planting Area

Outcome	(1) Missing Total Yields	(2) Missing Total Planting Area	(3) Missing Yields Per Planting Area
Reform	-0.004 (0.031)	0.004 (0.019)	0.007 (0.019)
Observations	7,326	7,326	7,326
R-squared	0.894	0.955	0.947
County FE	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes
Cluster	County	County	County
DV Mean	0.361	0.494	0.510

Note: This table tests whether the land reform is systematically correlated with the attrition of a county's self-reported agricultural output data. The outcome variables in Columns (1), (2), and (3) are indicator variables equal to 1 if a county-year observation is missing data for total yields, total planting area, or yields per planting area, respectively, and 0 otherwise. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

B-7 Composition effects on household entrepreneurship

Table B - 7 Composition Effects on Household Entrepreneurship

Outcome	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Land Income		Household Entrepreneurship		Property Management-related Entrepreneurship		Other Entrepreneurship	
Reform	909.200*	2,098.439***	-0.027	0.067***	0.002	-0.000	-0.030	0.067***
	(484.761)	(427.175)	(0.044)	(0.020)	(0.003)	(0.004)	(0.044)	(0.020)
Reform * Remote Village		-1,793.988**		-		0.004		-
		(740.061)		0.151***		(0.004)		0.157***
				(0.056)				(0.055)
Observations	7,926	7,926	14,223	14,223	14,164	14,164	14,164	14,164
R-squared	0.389	0.389	0.713	0.713	0.397	0.397	0.705	0.706
household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province * Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	County	County	County	County	County	County	County	County
DV Mean	751.367	751.367	0.186	0.186	0.006	0.006	0.177	0.177

Note: This table examines the effect of land transferability reform on household land income and entrepreneurial decisions. The outcome variable in Columns (1) and (2) is land-related property income for rural households. In Columns (3) and (4), the outcome is a dummy equal to 1 if a rural household reports that they have run a business, and 0 otherwise. Columns (5) to (8) decompose the business into property management-related businesses and other businesses. Robust standard errors clustered at county levels are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix C: Other Figures

C-1: Pretreatment trends of covariates

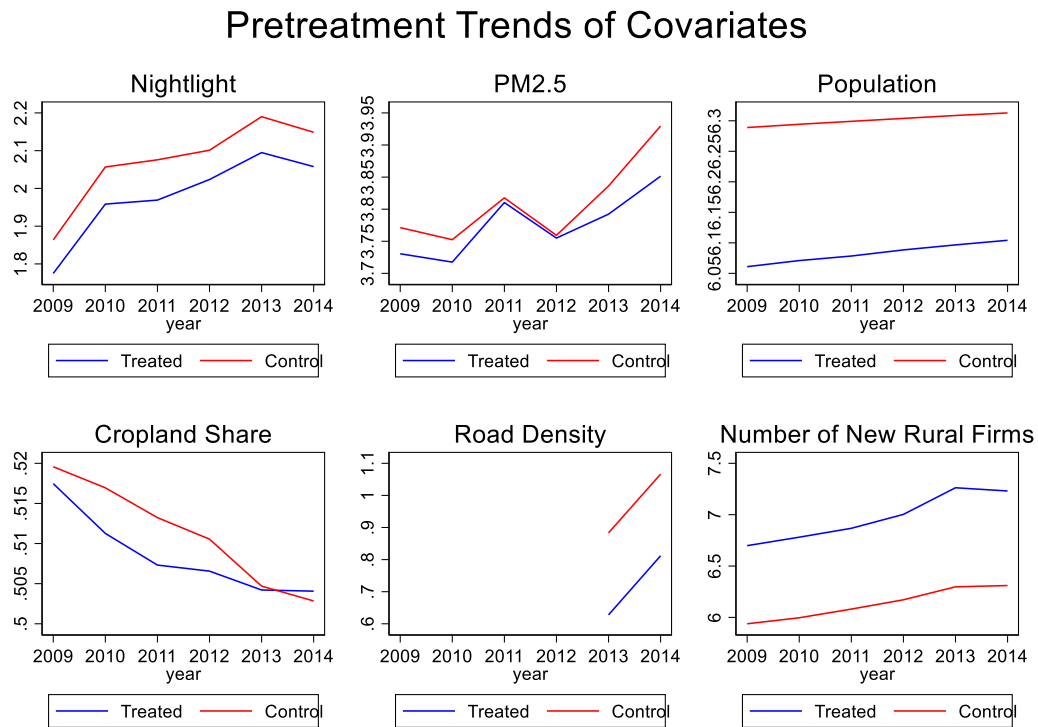


Figure C - 1 Pretreatment Trends of Main Covariates

Note: This figure plots the pretreatment trends of our covariates and outcome variables to strengthen the parallel trends assumption. The blue line shows the variable trends of the land reform counties, while the red line shows the trends of other control counties.

C-2: Parallel trends with other estimators

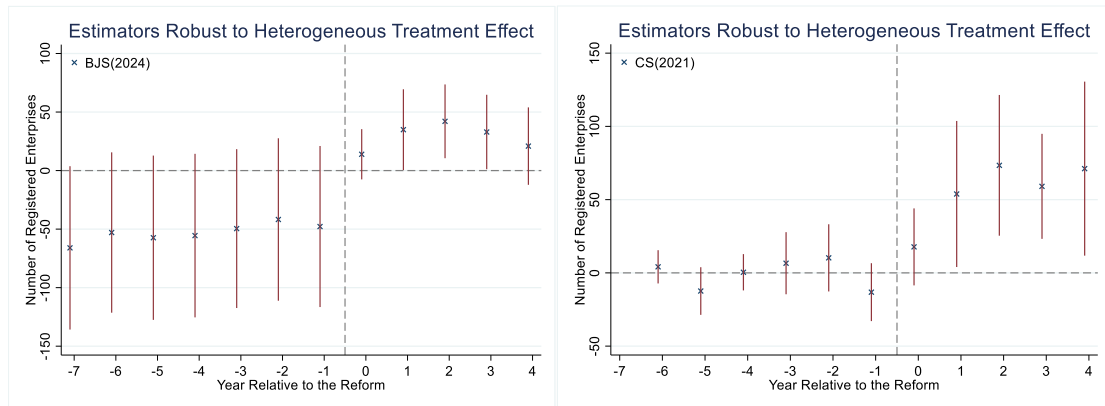


Figure C - 2 Parallel Trends with Other Estimators

Note: This figure plots the event study coefficients based on the method from Borusyak et al. (2024) and Callaway & Sant'Anna (2021), where the dependent variable consists of the annual number of registered enterprises for a given town. The regression model controls for province-by-year and town fixed effects. The vertical lines represent 95% confidence intervals for the respective point estimates.

C-3: Sensitivity test for parallel trends

Figure C-3 shows the sensitivity analysis results for non-parallel trends, following Rambachan & Roth (2023). Specifically, this study compares the original confidence intervals of each post-reform coefficient against a set of robust confidence intervals. These robust intervals account for the uncertainty of the pre-trends and allow for period-specific departures from the linear trends up to the chosen smoothness parameter M . As shown in Appendix Figure C-3, all post-reform coefficients are highly robust to a linear trend violation ($M=0$). Notably, the results allow for M values up to 6.5, which is equivalent to 50% of the corresponding standard error for the coefficient of the first post-reform year (L_1).

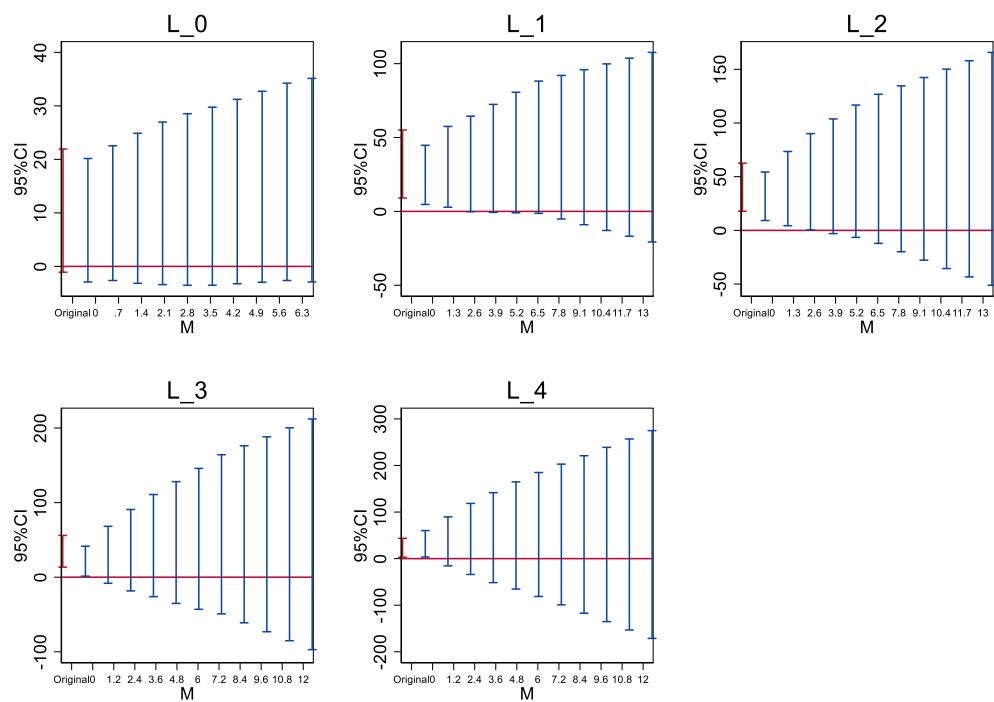


Figure C - 3 Sensitivity Analysis for Non-Parallel Trends

Note: The figures plot 95% robust confidence intervals of each post-reform coefficient specified in equation (2), following the approach of smoothness restrictions proposed by Rambachan & Roth (2023). The red bar represents the 95% confidence interval of each post-reform OLS estimate as displayed in Figure 3. Blue bars represent the corresponding 95% fixed-length confidence intervals when allowing for per-period violations of parallel trends of up to M . $M = 0$ corresponds to allowing a linear trend. $M > 0$ allows for increasingly more varied nonlinear trends.

C-4: Placebo tests

This study introduces a placebo test, as implemented by Li et al. (2016) & Cantoni et al. (2017), to rule out the influence of unobserved time-varying factors specific to each county. Specifically, the study randomly selects two rounds of reform counties from the 666 counties within the sample area to constitute a fake treatment group, implement the DID model in equation (1), and repeat this process 500 times. According to Figure C-4, the coefficients obtained from the fake treatment groups are predominantly insignificant at a 90% confidence level and centered around zero, a value considerably distant from the baseline result of 33. This finding implies that the original results (significant positive coefficients) are unlikely to be driven by other unobserved confounding factors.

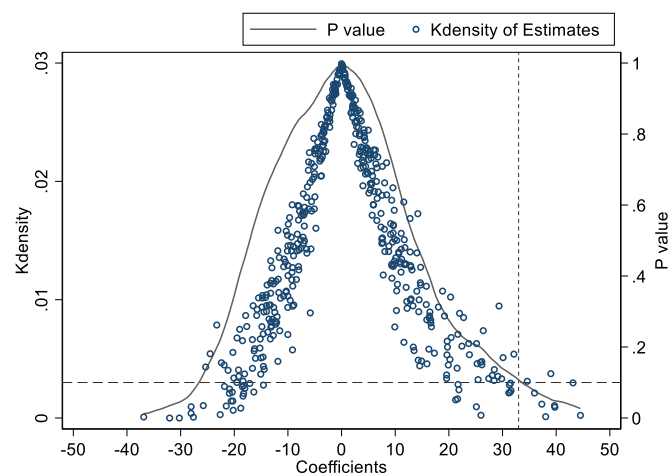


Figure C - 4 Placebo Test

Note: The figure shows the cumulative distribution density and P-value of the estimated coefficients from 500 simulations randomly assigning treated status to counties. The vertical line presents the baseline result of Column 1 in Table 2.

C-5: Heterogeneity by specific industrial type (Poisson Regression)

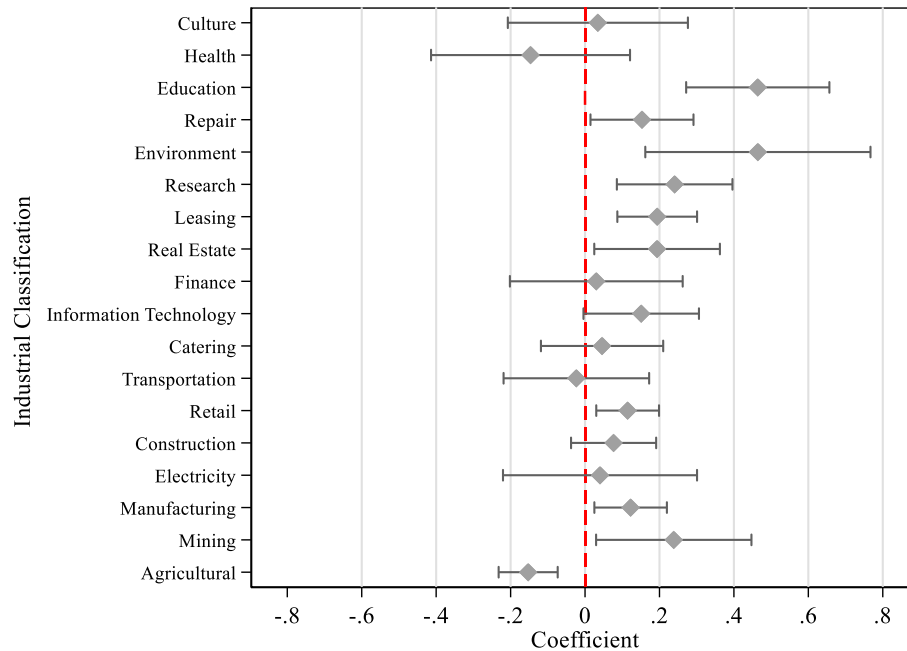


Figure C - 5 Heterogeneity by Industrial Type

Note: This figure shows the heterogeneity in firm growth across 18 one-digit industrial types. The outcome variable of this figure is the raw number of newly registered enterprises of each industry aggregated at the town-year level. This study utilizes Poisson regression to account for the zero-inflated problem and control for town and province-by-year fixed effects in each specification. The vertical lines represent 95% confidence intervals for the respective point estimates.

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