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ABSTRACT

Impact of Temporary Migration on Long-Run Economic Development: The Legacy of the Sent-down Youth Program

Fifty years ago, China sent more than 16 million urban youths aged 16–19 to rural villages to work and they spent between 1 and 10 years there. This is known as the 'sent-down youth' (SDY) program. This paper examines how this internal migration impacted rural economic development in the regions that received a larger number of SDY per capita relative to regions that received less. We find a sizeable and persistent impact of the SDY program on real per capita GDP and nighttime light in the years after the program ended. Surprisingly, although our results confirm that the SDY increased education level of relevant cohorts, the variation in the education level of these cohorts does not seem to contribute directly to rural GDP and nighttime lights. We provide suggestive evidence regarding mechanisms through which the SDY influenced rural economic development.

JEL Classification: O18, J61, R23, N00

Keywords: economic development, migration, sent-down youth, China

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1 Introduction

Economic development paths are often influenced by historical events that occurred long ago in ways that might not be intended or foreseen at the time. For example, the slave trade from centuries past which influenced African countries' social and political institutions still affect its economic growth today (Nunn, 2008; Nunn and Wantchekon, 2011). Variations in disease patterns influenced the development of institutions within colonies, shaping whether they were conducive to resource exploitation by colonisers or for colonisers themselves to settle; these institutional disparities, in turn, had differential impacts on the long-term economic development of the countries. (Acemoglu et al., 2001). The Jesuit missionary settlements 250 years ago sparked cultural changes and increased human capital accumulation that persist to this day (Caicedo, 2018). In the US, immigration during the past 130 years encouraged foreign direct investment flows, innovation, and economic growth which continue to shape the country today (Burchardi et al., 2019, 2021).

In this paper we examine the impact on economic development of a large-scale involuntary and temporary internal migration that took place 50 years ago in China. Between 1967 and 1980, approximately 16.5 million teenagers with 6–12 years of education were sent from cities to rural areas to be 'reeducated'. This vehicle was a resurrection of earlier initiative known as the 'sent-down youth' (SDY) program.

In 1966–1968, during the initial stage of the Cultural Revolution (CR), there was widespread political and economic chaos across the nation as ideological fervor led to mass mobilization of young people to criticise authorities, cleanse the Communist Party of bourgeois infiltration, and 'eradicate' the so-called 'four olds' — old customs, old cultures, old habits, and old ideas in the society at large. All levels of schools suspended normal educational activities, and many government offices and factories ceased normal operations. Millions young people at junior and senior high school age found themselves with neither school nor work to go to, resulting in significant unemployment issues. This situation exacerbated the social and political chaos during that period.

We estimate that, in the years 1968–1969 alone, approximately 10–12 million young people had no school and no job to go to, accounted for almost 20% of the total urban employment during that period.[1]. This staggering number is far more than the stagnating urban economies were able to absorb and in response to this dire situation, the government made the decision to revive and greatly expand the dormant SDY program.

The revamped SDY program operated throughout the entire CR period, coming to an end only in 1980 following the commencement of economic reforms in 1979. The vast majority of these youths returned to their cities of origin by the early 1980s. In total, 16.5 million urban youths spent somewhere between 1 and 10 years in rural China from 1967 to 1980 (Gu and Hu, 1996). Most of them endured significant hardships.

Studies examining the long-term consequences of the sent-down experience on these youths have yielded mixed results. Some found positive (or at least non-negative) effects on for example income, educational attainment, occupational status, and health (see, for example, Zhou and Hou, 1999; Xie et al., 2008; Li et al., 2010), while others have found long-term negative impacts on for example health, marriage rates, social networks, and happiness (Wang and Zhou, 2017; Ye et al., 2021; Yu and Dong, 2022).

This study asks a different question: rather than focusing on the impact of the experience on the SDY

[1] The calculation of these estimates is described in the next section.

themselves, we investigate whether their presence may have promoted long-term economic development in the regions that hosted them. Our purpose is not to legitimise forced migration or downplay the collective hardship endured by the SDY generation. Rather we are interested in whether the SDY program had positive effects in rural areas. The influx of over 16.5 million of the urban youth into economically underdeveloped rural regions may have had a significant impact on rural economic development through a range of channels.

One possible channel is the material benefits the SDY brought from the cities to the countryside. During the period, officials in rural areas used their connections with SDY and their families to obtain crucial equipment and materials for rural development from the cities where the SDY originated (Honig and Zhao, 2015).[2] Similarly, some cities took measures to improve the lives of their own SDY by providing highly needed goods and finance to the regions that hosted their SDY.[3] This material support may have assisted long-term economic development in the rural regions.

Another possible channel is the networks created by the SDY program that endured after the SDY left the countryside. Stronger networks may have contributed to long-term economic development in the rural regions in various ways. For example, during the era of fast economic development in the 2000s, rural-to-urban migration flows were highly correlated with the urban-to-rural migration flows during the SDY program (Kinnan et al., 2018), and rural-to-urban migrants brought back income, knowledge and skills. The SDY program may also have increased trust between the receiving and sending regions and thereby enabled more bilateral trade across regions (Xing and Zhou, 2018).

A third possible channel is the facilitation of rural human capital development. Throughout modern Chinese history, urban areas boasted higher levels of education and superior healthcare compared to rural areas in China.[4] Therefore, these urban, better-educated youths were a new resource for rural education. Some SDY became teachers, serving as role models for rural youth, and potentially elevating rural education levels and quality (Chen et al., 2020). Other SDY assumed roles as local health workers, often referred to as 'barefoot doctors', significantly contributing to the improvement of rural healthcare (Luo et al., 2023). No doubt, a better-educated and healthier labour force would have benefited the economic development in rural areas.

Even though the majority of SDY were not directly involved in rural education or healthcare, their interactions with the locals exposed the latter to new knowledge, perspectives and ideas, potentially inspiring innovation and entrepreneurship. Stories such as those presented in the novel/movie 'Balzac and the Little Chinese Seamstress' by Dai (2001, 2002) provide examples of how SDYs became sources of interest, information, and even entertainment for the culturally deprived locals during the CR.[5] These day-to-day interactions

[2] One of the anecdotes provided by Honig and Zhao (2015) goes 'Wei Min, a youth from Shanghai sent to work on a production brigade in Le'an county in Jiangxi province during the CR, found himself, one day in April 1971, summoned by the commune Party Secretary. Informed of his impending transfer to the county's industrial bureau, he was both pleased to be relieved of working in the fields and surprised by his seeming good fortune. He soon learned that his personal dossier, held by the local office for SDY, had been scanned by county officials who had learned that his father was the head of an electric wire factory. The officials had visited his father at home in Shanghai. His father then agreed to supply them with equipment to establish a similar factory in the county. Wei himself would be trained in Shanghai and then assigned to assist the operation of the local factory.'

[3] For example, Shanghai provided many highly demanded goods to the regions that received its SDY (Lin, 2011). Major goods provided included power-generating equipment, farm tools, equipment to produce small farm tools and other products, and various kinds of transportation equipment. In addition, Shanghai also provided interest-free loans to some economically backward counties and villages to enable them to purchase goods and equipments from Shanghai.

[4] In 1967, the average years of schooling for rural persons aged 16–60 was around 3.8 years, whereas the same figure for the urban hukou population was 6.4 years.

[5] In this story from the CR, the culturally deprived locals were very impressed with a young SDY's talent for storytelling. They gathered at the village centre every afternoon to listen to him telling stories and reading novels, including Balzac's novel 'Ursule Mirouët'.

between farmers and SDY may have sparked new ways of thinking and doing things. Later, during the phase of economic takeoff, these interactions could play an important role in facilitating growth.

To study the impact of the SDY program on rural economic development in China we compile a large county-level panel dataset with indicators of past and recent economic performance as well as the number of SDY received. The dataset covers all rural counties that have information about the number of SDY received. We first examine the relationship between real GDP per capita and nighttime light (NTL) per capita for the period after 1980 (1980-2013 for GDP and 1992-2013 for NTL due to data availability) and the total number of SDY received per capita between 1967 and 1980. We control for pre-program economic endowments, distances from the counties to major cities, and include provincial and year dummies. Our OLS estimation results show a strong positive association between the number of SDY received per capita in 1967–1980 and economic development in the 1980s to 2010s.

However, the correlation may not present a causal link because of potential omitted-variable and selection biases. For example, if the SDY were able to choose, many SDY could have chosen to go to the better developed rural regions, and the correlation might simply reflect these choices. Similarly, if better endowed rural regions were able (to choose) to receive more SDY, this would induce a positive correlation between the number of SDY received and rural economic development as well. Our review of the literature and historical documents has not provided definitive conclusions about how the destinations of the SDY were decided. We summarise our review of this literature in the next section.

To address potential endogeneity issues, we take an instrumental variable (IV) approach. For each county, the value of the instrument is constructed as a weighted sum of the number of youths sent out from the cities within the province. The weights are essentially defined as the normalised reciprocal distance between the county and each city within the province. Intuitively the instrument should be strongly correlated with the actual number of SDY the county received assuming distance was a major determinant in the allocation process. As will be discussed in the background section, the number of youths sent out was determined by the cohort size and labour demand in the sending cities, we suggest that by controlling for the county's initial economic conditions, the distances to nearby cities, as well as the distance-based weights used in constructing the instrument, this instrument may satisfy the exclusion restriction.

Studies examining the long-term economic development impact of a historical event often face the risk of bias due to confounding by later programs and events. The fact that our main outcome variables are measured from the year the SDY program ended helps reduce the likelihood of confounding.

Our IV estimation results confirm that the population share of SDY received during 1967–1980 indeed has a persistent positive impact on counties' long-term economic development from 1980 to 2013. The magnitude of the average impact is around 3.2 percent higher real GDP per capita and 4.3 percent more NTL per capita for counties with 10% higher SDY density (number of SDY per 100 locals). This effect persists during the entire period. For comparison, this level of effect is equivalent to being 50% closer to the provincial capital city. These conclusions are robust to several checks regarding the construction of control variables and sample exclusions.

In addition to the GDP and NTL outcomes, we also analyse the impact of the number of SDY received on the output value, revenue and employment for the rural industrial sector, which at the time was organised as

Commune and Brigade Enterprises and later rebranded as Township-Village Enterprises (TVEs). From the 1950s to the 1960s the rural industrial sector in China was marginal. In the 1970s, however, in light of the agricultural mechanisation and the availability of electricity in the rural area, industry started to play an important role (Zhang, 1999; Bramall, 2006). It was at this time that the SDY may have played a role in the early stages of the development of the rural industrial sector. The SDY may have brought or fostered the direct material and financial support from the SDY themselves, their families, and the cities they came from. Their presence could also have had the indirect effect of increasing local human capital levels, and of opening up locals eyes and minds and inducing more creativity and innovation, and hence increasing the probability of local entrepreneurship. These impacts could have laid the groundwork for the development of the rural industrial sector in the 1980s and 1990s. Thus, the analysis of the impact of SDY on local TVE development can serve as both a robustness check for our GDP and NTL results and as a channel through which SDY affected later economic development.

Our analysis of the SDY impact on TVE development suggests that the population share of SDY had a causal positive effect on the TVE outcomes during the period immediately after the end of the SDY program.The magnitudes of the effect of receiving SDY on TVE outcomes are larger than that for the GDP and NTL. A 10% increase in SDY density would have led to 5.8, 4.6, and 2.9 percent higher TVE output value, revenue, and employment, respectively.

We also analyse other channels through which the SDY may have affected the long-term economic development of their hosting regions. We confirm that there is a positive effect of SDY on educational outcomes for the relevant cohorts (Chen et al., 2020). We confirm that out-migration from rural areas is also strongly affected by the concentration of SDY in these areas (Kinnan et al., 2018).

Finally, we undertake an informal mediation analysis to assess the potential impact of the channels we investigated on the long-term economic growth of rural regions. Our findings indicate that incorporating TVE output value into the GDP per capita regression reduces the magnitude of the association between SDY density and GDP per capita by one third. However, including educational outcomes for the relevant cohorts and out-migration hardly alters the magnitude of the association between SDY density and GDP per capita. Importantly, in all cases, a substantial portion of the association between SDY and economic development remains.

Our study contributes to several strands of literature. One strand, already cited above, investigates effects of the SDY program on different regional economic outcomes including interprovincial trade, rural-to-urban migration, and rural educational attainment. Our study is the first to estimate the overall effect of the SDY program on rural economic development. In particular, we find large effects on GDP, NTL and TVE activities.

Our paper is also related to the literature on the impact of international or internal migration on the economic growth in the destination regions (see, for example, Rodriguez-Pose and von Berlepsch, 2014; Burchardi et al., 2019; Sequeira et al., 2020; Burchardi et al., 2021). In contrast to most other migrations studied in the literature, the SDY program was a large-scale involuntary and temporary migration. These characteristics give us some advantages in identifying causal effects on long-term economic development in the host regions. First, being an involuntary migration reduces the potential selection bias that may arise when migration is voluntary. Second, as a temporary event, our migration measure makes the interpretation of its legacy much cleaner than that of the permanent migration.

Another strand of literature to which our paper contributes is the impact of foreign aid or place-based policies designed to alleviate gaps in economic development across countries or regions (see, for example, Kline and Moretti, 2014; Asatullaeva et al., 2021). The redesigned SDY program was not intended as a place-based initiative to alleviate poverty, but by sending youths from more developed to less developed regions, it has place-based features. Our study sheds new light on the importance of support to the less developed regions. The overall positive effects from the SDY program are apparent. The support came in the form of embedding young urban people in rural communities and from material and financial aid sent from the cities. Our analysis indicates that controlling for certain potential channels does not eliminate the direct impact of the SDY on the economic development in the receiving regions, and we conjecture that the influence the SDY had on the mindset of rural people may have played a large role.

The remaining of the paper is organised as follows. The next section provides a detailed overview of the SDY program and summarises major historical events in rural development. Section 3 presents our estimation strategies. Section 4 discusses our data sources and the summary statistics. Section 5 presents our main results and robustness checks. Section 6 provides suggestive evidence about the channels through which the SDY program contributed to the long-term economic development of rural regions. The last section concludes the paper.

2 Background

2.1 The Sent-Down Youth Program

The SDY program was created in the late 1950s. As described by Gu and Hu (1996), the aims were partly to address urban unemployment, partly to improve upon the backwardness of rural economic development, and maybe more importantly to explore Mao's idea that knowledge learnt in classrooms has limited value and must be supplemented with knowledge gained in the real world. One of his sayings goes 'All intellectuals who can go to the countryside should go there happily. The countryside is a vast world, where you can make a real difference.' (Mao, 1999).

In the 1950s and early 1960s, participation was voluntary. The majority of SDY went to remote regions where there was uncultivated land. The number of youths who participated was relatively small compared to the involuntary mass migration that was to take place later.[6] The program was suspended in 1958–1961 during the 'Great Famine'. It resumed after the famine (depending on local conditions), but was once again suspended when the CR began in 1966.

During the first few years of the CR Chinese society was thrown into anarchy. Students and workers were encourage to criticise all levels of authority and soon there was widespread violence towards authority figures and between factions of students and workers (Walder, 2014). In May 1966, as soon as the central government announced the start of the CR, all urban schools, from primary schools to universities, ceased their

[6]For example, in the five years between 1962 and 1966 a total of around 1.3 million youth went to the countryside whereas in the years between 1967 and 1980 a total of around 16.5 million were sent down (Gu and Hu, 1996).

normal operations. Specifically, all formal teaching was suspended and no new students were enrolled. It was not until the fall of 1968 that some primary schools and junior high schools resumed operation. Senior high schools did not reopen until 1972.[7] Universities did not admit senior high school graduates until 1977 after the CR had ended (see, for example, Deng and Treiman, 1997; Meng and Gregory, 2002). Not only were all the schools closed, work also stopped at many factories, government offices, and other workplaces.[8]

The economy inevitably faced significant challenges during this tumultuous period. With schools shut, none of the youths aged 16 and above could pursue further education. The economy had come to a halt and job opportunities were limited.[9] Cities became inundated with 16- to 19-year-olds who found themselves with neither school nor work to attend. Their sheer presence amplified the social and economic turmoil in society. By 1968, after 2 years of upheaval, restoring order and addressing the plight of these youths became priorities.

But the demand for labour depends on economic activity and, at that time, the demand was extremely limited in the cities. When the CR started, the Chinese economy had just shaken off the shadow of the Great Famine. In 1964 and 1965, urban employment increased by around 5–6% per annum. The chaos created by the CR in the cities significantly reduced employment growth. In 1966 the urban employment growth rate was around 4%, in 1967 it dropped to 1.7%, and in 1968–1969 it went back a bit to around 3%. The exact number of urban 16-19 years old unschooled and unemployed youths at the time is not clear. Official figures are not publicly available, but we calculate that by 1969 there was a cumulative total of around 10–12 million. One year later, another 2–3 million children reached age 16 and were waiting for job assignments.[10] But, in 1968, the total urban employment was only around 56 million. That means that the total number of young people needing jobs was almost 20% of the total urban employment.[11] There is no way that the urban economy could absorb all of them.

It was under this enormous employment pressure that the government decided to resume the SDY program around April 1968 (Gu and Ma, 1996, p. 77). From that time, the nature of the SDY program changed from being a relatively minor social experiment to being a major policy instrument for tackling urban unemployment (Pan, 2002).

The SDY program continued during the entire CR period. A total of 16.5 million urban youth spent somewhere between 1 and 10 years in rural China during the period 1967–1980 (Gu and Hu, 1996). This accounted for 46% of the relevant birth cohorts, with the remaining assigned jobs in cities.[12] The program ended offi-

[7] Primary schools comprised years 1–6 for kids aged 7–12, junior high schools covered years 7–9 for kids aged 13–15, and senior high schools encompassed years 10–12 for kids aged 16–18.

[8] Most workplaces stopped operation during the CR due mainly to the violences between different factions within the workplaces (Walder, 2014). Although no official statistics are available on how long these workplaces ceased normal operation, according to Walder (2014) the number of violences occurred peaked between 1967 and 1969. Thus it should be reasonable to think that the workplaces that had stopped operation at the start of the CR probably gradually resumed work since 1970.

[9] The legal working age in China was (and is) 16 years. During the planned economy era, urban people who finished junior high school and did not continue their schooling were assigned jobs by the government.

[10] Our estimate of the number of graduates who were awaiting job assignment is based on the total number of people with urban hukou born between 1948 (i.e. who could have graduated from senior high schools in 1966) and 1953 (i.e. who reached junior high school graduation age in 1969). Ideally, we should exclude people who left school before the start of the CR since they would have been assigned jobs then. Our first estimate is based on the published tables from the 1964 census (National Bureau of Statistics, 1988). This is an overestimate since we are unable to exclude those who had left school at the start of the CR. Our second estimate is based on unit records from the 1% sample of the 1990 census, which has information about age, hukou and schooling. By excluding people born in 1948–1950 with no more than junior high school education, this estimate is perhaps less biased but more noisy since the sample is smaller. As it turns out, the numbers calculated from these data sources are not too far apart and we report the range here.

[11] The urban employment and growth figures are either directly from the NBS or calculated using their statistics (NBS, 1999).

[12] A small number of youths joined the army.

cially in 1980 at the start of the economic reform era, although the number of SDYs in 1978–1980 was very small. The overwhelming majority of the SDY had returned to their home cities by the early 1980s.

As the SDY program was mainly an employment device, cities with more employment opportunities sent less people to rural areas. The proportion sent varied significantly by cohort. The demand for labour in a particular year in a particular city depended on when the CR chaos came under control in that city as well as on the city's economic structure. In Beijing, for example, the people who turned 16 before the fall 1969 (the 1953 birth cohort), almost everybody were sent to the countryside in other provinces, just like the cohorts born in 1948-1952 had been in previous years. However, the cohort that turned 16 years of age in 1970 were mostly assigned jobs in factories or in service positions in Beijing city. This was because by 1970 the Beijing economy had begun to rebound from the earlier chaos, and the demand for labour in Beijing's factories and other work units had begun to recover.

The role the SDY program played in managing employment during the CR period is reflected in the correlation between the number youths sent down from the cities and the cities' industrial output. Using 1965 provincial-level data, we regress the log of the number of youths sent down from urban areas on the urban industrial output share of the total GDP and the log of the urban population. The estimated coefficient on industrial output share is -1.330 with 95% CI [-2.22, -0.44]. The R^2 is 90%. Similar results are found if we use available city level data (for 50 cities) from 10 provinces.[13]

Exactly how the cities decided where their youths would be sent to is rarely documented. The written documents collected by Gu and Hu (1996) suggest that the central government facilitated the discussions among different provinces at various National Working Group Meetings for Sent-Down Youth. Each province, each city, and each rural county gradually established their own Sent-Down Youth Working Groups/Offices to coordinate issues related to the SDY program (Bernstein, 1977, p. 70).

The costs of preparing to leave and the transportation costs for travelling to the receiving regions were covered by the sending cities. The central and provincial governments provided an amount of money to the receiving rural regions for each youth sent down. The funding was used mainly for their initial settlement and to cover their living cost during the first 6 to 12 months (Bernstein, 1977, p. 153). According to Gu and Hu (1996, pp. 220–222) the funding level increased over time from around 100–200 yuan in 1969 to 480–700 yuan in 1973 depending on the location and type (rural villages or state farms) of the destination.

As most provincial-level jurisdictions have both rural and urban regions, the SDY were mostly assigned to rural areas within the same province, possibly because this involved much lower settlement and travel costs, and possibly because it is much less disruptive from the point of view of the SDY families (i.e. the closer the destination the more likely the SDY can visit their families). Only when such assignment was too difficult did they need to persuade other provinces to accommodate their young people. Indeed, according to Gu and Hu (1996), among the total 17.8 million SDY only around 8% were sent to rural villages in other provinces.[14] For the 26 non-municipality provinces, only 1.2% of their total SDY were sent to other provinces. The three

[13] The data for this regression are obtained from (NBS, 1999). Because there are missing values on urban population and industrial output share for Inner Mongolia and Tibet, they are excluded from the regression. The total number of observation is therefore 27 provinces. The full results can be found in Appendix Table A1.

[14] The 17.8 million number includes the SDY occurred between 1962 and 1966 and only 16.5 million were from the period of 1967–1980. Because Gu and Hu (1996) do not separately report the cross-provincial SDY by year, we can only calculate the share of cross-provincial SDY for the period 1962–1980.

provincial-level municipalities, i.e. Beijing, Shanghai, and Tianjin, have limited rural areas within their jurisdictions and largely had to rely upon help from other provinces. Gu and Hu's (1996) figures suggest that between 40% and 59% of SDY from these three cities were sent to other provinces (see Appendix Table A2). The SDY who were sent away from their home province were largely sent to regions with relatively low population density and relatively more arable land, so North-East China and Inner Mongolia became important across-province SDY destinations (Gu and Hu, 1996; Jin and Jin, 2014).

Similarly to the inter-provincial flows, the Sent-Down Youth Working Groups/Offices at the provincial level also played a coordinating role to help the negotiations between the sending cities and the receiving counties within a province. We infer from much anecdotal evidence that distance played a major role. In the early period, it seemed that the cities first coordinated with the closest rural areas and only when the rural areas within the prefecture were unable to receive more SDY would the provincial government coordinate flows across prefectures. Later, in 1973, Zhuzhou city in Hunan province initiated a new model where a city work unit would coordinate directly with a nearby rural commun to arrange the hosting of their employees' children (see pp. 601, 3640–3641 in Jin and Jin, 2014). Presumably, the direct connection between urban work units and rural communs reduced the transaction costs. This experiment was highly praised by the central government, and afterwards many provinces followed their example.

Another important question is whether individual SDYs had a choice as to which particular rural village they would go to. Based on the literature and one of the authors' personal experience, the scope for individual choice was very limited. For context, during the entire planned economy era, urban people were assigned to jobs by the government and they rarely had much influence on their employment situtation. The SDY program simply gave the government the option of assigning them a job in a rural village or a state farm instead of a job in the city (see, for example, Chapter 2 in Liu, 2008). It is likely that many youths would have accepted their fates with stoicism or apathy. On the other hand, Bernstein (1977) reported that a group was in the news because they had declared that they would not try to negotiate about their destinations. This, perhaps, suggests that it was not uncommon to try to sway the decisions one way or the other. There are reports indicating that one way to take some control would be to volunterily to go to harsh and remote rural areas to be 'reeducated' as some Red Guards did in 1967 and 1968 (pp. 65–82, in Liu, 2008; pp. 115 in Bernstein, 1977). It appears that there were also a small number of people who were able to choose their own sent-down destination to be in the same location as their siblings or to go to their parental rural hometown (see, for example, pp. 113–116 in Bernstein, 1977). In addition, a few privileged individuals with connections were able to join the army instead of being sent down.

How did rural locals feel about the SDY program? The literature points out that there was a potential for rural people to resent the SDY (Bernstein, 1977). Potential points of conflict include the burden of having to manage a large number of teenagers who had recently lived in a chaotic and violent urban environment, the burden of having to house and feed additional people, and the possible reduction in rural per-capita resources and living standards (Bernstein, 1977; Gu and Hu, 1996). Indeed, during the SDY program period, the per capita arable land in rural China declined from 2.61 to 1.96 mu (Gu and Hu, 1996). However, it seems that the Sent-Down Youth Working Groups/Offices at the various levels of governments were monitoring the situation and implemented policies to mitigate potential tension (Bernstein, 1977; Gu and Hu, 1996).

For the analysis of the impact of the SDY program on later economic development, certain aspects of the SDY program are particularly important. First, the number of youths sent down from each city seems to be mainly determined by cohort sizes and the demand for labour in their sending city. While it seems that most of the youths didn't have a choice themselves, there could have been intentional or unintentional systematic selection involved in the assignment process. Second, the destination of the SDY may have been determined to minimise disruptions to the young people's normal lives as well as the operational costs of the program. Thus, it seems that distance between the sending cities and receiving rural villages played an important role. This can be seen from the fact that about 92% of the SDY were sent to rural areas within their own province. Third, for the 8% who crossed provincial borders, the distances might have played a lesser role in determining the destination location, and perhaps the combination of underutilised arable land with a low population density were more important.

2.2 Rural Economic Development

There are several distinctive phases in China's rural economic growth. Before 1949 Chinese agriculture was organised with a small number of landlords who owned the majority of the land and with millions of peasants who worked hard to survive. At the time the Communist Party of China came to power China was very backward economically. The new government's first initiative was to redistribute the land. By 1953 most farmers owned a small piece of land. Between 1949 and 1953 the gross value of agricultural outputs increased by 11% per annum (National Bureau of Statistics of China, 1987).

However, the government believed that industrialisation was the most important objective. To expedite industrialization in a shorter timeframe, a strategy was adopted to prioritize industrial development at the potential expense of agriculture. Specifically, within the planned economy regime, the government set the procurement prices of agricultural products low to ensure low input prices and low labour costs for the urban industrial sector (Feng and Li, 1993).

Unfortunately, agricultural productivity was quite low at the time. To achieve the main goal of industrialisation and to use the agricultural sector as the base to generate the savings that needed to support industrialisation, the government believed that they had to abandon privatisation and organise agriculture in a communal manner. Hence, soon after the land reform, farmers were encouraged and sometimes forced to organise collective production units with collective land ownership (Wang, 1956a,b). This eventually culminated in the establishment of the commune system. By 1957 more than 96% of farmers were participating in the commune system (p. 110, in Zhu et al., 1992).

In 1958 the party initiated the famous 'Great Leap Forward' program. The aim was to further speed up the industrialisation process. It moved a large number of rural labourers and resources into the production of steel and industrial goods. However, diverting labour and resources away from agricultural production during a period when agricultural productivity was very low became one of several factors that led to the 'Great Famine' between 1959 and 1961. The Great Famine resulted in the death of an estimated 16-40 million people, predominately in rural areas (see, for example, Peng, 1989; Yao, 1999; Li and Yang, 2005; Meng et al., 2015). Although not successful, in some areas this early industrialisation attempt became the embryo of the rural industrial sector, or the Commune and Brigade Enterprises (CBEs), which processed food and repaired agricultural tools (Byrd and Lin, 1990).

From 1962 to 1964 the Chinese economy was recovering from the disruptions of the Great Leap Forward program and the Great Famine. During this period, certain policies were implemented to enable better economic incentives. For example, the size of the plot each household could use for growing produce for their own consumption was increased and they were allowed to sell the surplus produce in the market (see, for example, Meisner, 1977).

The years 1966–1976 were dominated by the CR. During this period, any policies related to economic incentives and private ownership were abolished. However, with the memory of famine still fresh, there was a conscious effort to increase agricultural productivity. Electricity gradually became widely available in rural areas, and agricultural mechanisation became a priority promoted by the central government in the early 1970s. In many regions this facilitated further development of the rural CBEs (Byrd and Lin, 1990; Luo, 1990; Lei and Li, 2008; Xiao, 2021). Although the sector was small during the CR, it grew rapidly. The output value of the rural industrial sector increased from 9.2 billion yuan in 1970 to 27.2 billion yuan in 1976 (Byrd and Lin, 1990). During this period, many SDY were able to contribute to the development of the village agricultural and CBE sectors by helping to provide materials, machinery parts, technological knowhow, and financial support (Lin, 2011; Honig and Zhao, 2015).

After Mao's death in 1976, the Chinese people and the top party leaders were ready for a change. The economic reform began in the agricultural sector at the farmers' initiative. In 1978, poverty-stricken farmers in a village in Anhui province decided to implement a partial privatisation system, the 'household responsibility system', which provided households with incentives to be more productive. The central government soon recognised the effectiveness of this system and implemented it nationally. Communes were subsequently dismantled. As a consequence, China's agriculture productivity increased greatly. Between 1978 and 1984, food output increased by 5.2% per annum , and real rural per capita household income increased by 14.9% per annum (National Bureau of Statistics of China, 1986, 2022)

As a result of this increase in productivity, the rural economy generated a huge surplus and an increasing proportion of the agricultural workforce became redundant. However, at that time China forbade rural-to-urban migration. The combined effects of increase in rural agricultural productivity generated surplus, underutilised rural labour and migration barriers further progressed the rural CBEs. These businesses were rebranded as Township-Village enterprises (TVEs) from 1984.

In March 1984, the central government released an important document requiring governments at all levels to provide necessary support to the development of the TVEs. In 1985 the government promoted a shift rural production towards more labour-intensive industries to help resolve the issue of surplus rural labour (Meng, 2000; Lei and Li, 2008; Xiao, 2021). From then on, the TVE sector became the driving force in the rural economic development.

The 1990s saw the start of the deepening of the economic reforms in urban regions. From the mid-1990s the development of the special economic zones, the inflow of the foreign direct investment and the gradual reform of the state-owned enterprises generated momentum for the development of the private firms, foreign owned, and joint venture enterprises. From this time, both the rural and the urban Chinese industrial sectors are no longer only serving the domestic market. Exports became an important driving force in China's economic development.

In 1997 China implemented the Township-Village Enterprises Law (TVE-Law) which restricted the definition of TVEs as those located in rural areas, using rural resources and workforce, acting as support for agricultural productions, and formally registered with the State Administration for Industry and Commerce (TVE Bureau of Ministry of Agriculture, 1997). Prior to 1997, many TVEs operated without formal registration, functioning not merely as agricultural support but as autonomous manufacturing entities. The introduction of the TVE-Law complicated TVE statistical records, as we will elaborate on later, and potentially pushed many TVE firms to alter their ownership affiliations. Other factors contributing to this shift include the rapid expansion of private, foreign-owned, and joint-venture enterprises, along with the emergence of shareholding firms. These developments, coupled with the enactment of the TVE-Law, likely encouraged the TVEs to gradually undergo a restructuring into different forms of enterprises. The rural economic development since the late 1990s is still driven by the industrial sector, but the TVEs, as a form of business ownership, gradually lost their dominating position (Gu, 1999; Zhou and Xu, 2010; Zou, 2007).

Since the mid-1990s, as the urban economic reform deepened and FDI flows sped up, demand for labour in cities increased significantly. To increase labour supply, the rural-to-urban migration barriers were gradually lifted, prompting millions of rural workers to seek employment opportunities in urban areas. The remittances and technological know-how brought back by these migrant workers became important inputs for rural economic development (Démurger and Xu, 2011; Yu et al., 2017; Pan and Sun, 2024).

To summarise the discussion in this subsection, Figure 1 presents the trend and importance of the share of the rural economy in China's total economy and that of the share of the TVE sector in the rural economy. Panel A shows that the rural economy's share in the Chinese economy increased from just below 30% in 1978 to over 50% in 1997, then gradually declined during the urban economic reform era, before stabilising at around 42% from the mid-2000s.[15]

Panel B shows that the TVE employment share in total rural employment in 1978 was only 9%, and it remained at that level until 1983. Between 1984 and 1985, the share increased by over 8 percentage points, reaching almost 20%. After 1985 the share continued to increase, reaching a peak of 30% by 1996.[16] The TVE output value share was also stagnant at just above 20% between the late 1970s and the mid-1980s. However, between 1984 and 1985 this share increased by almost 20 percentage points to over 40%. Between 1985 and 1992, the share of TVE output value further increased from accounting for 40% of the rural output value to almost accounting for 70% of the rural output values.

[15] China's national accounting system underwent a transition from the Soviet-inspired Material Product System (MPS) to the System of National Accounts (SNA) (Van Heijster and DeRock, 2022). Thus, for the pre- and early-1990s period, China did not report GDP. Its economic performance is recorded as 'Social Output Values' (SOV). Hence, in Figure **??** we separately reported rural economy as the share of total economy based on two data series: its SOV share and its GDP share. In addition, under the MPS, rural, urban, and total output values were reported separately, while under the SNA system there is no separate report on GDP for the rural and urban economies. Rather it was reported at different level of administrative divisions, i.e. national total, provincial, prefecture, and county. To derive a 'rural' share of total GDP we subtract the urban districts' GDP from the prefecture level GDP to represent rural GDP. Since the non-urban-district area includes 'county-level cities', our estimation of the rural share of total GDP is an over estimate.

[16] As discussed above the introduction of the TVE-Law in 1997 introduced an chaotic situation in the TVE statistical recording, which will be discussed in detail in the data section. We therefore only use the TVE data up to 1996.

3 Empirical Strategy

Our aim is to investigate whether having received SDYs had lasting causal effects on a county's long-term economic outcomes. To do so, we consider regression models of the form

$$Y_{it} = \beta_1 R_i + \beta_2' X_i + \beta_3' D_i + \mu_{p(i)} + \tau_t + U_{it}, \tag{1}$$

where subscripts i and t denote the county and the year, while $p(i)$ denotes the province that county i belongs to, and the Greek letters represent parameters to be estimated.

On the left-hand side, Y_{it} is an outcome variable representing economic activity per capita in county i in year t after the SDY program ended. All our main outcome variables are measured in log format, and they include real GDP per capita, NTL per capita and TVE outcomes per capita. Later, in the channel analysis, we also consider average years of schooling for the 1953–1963 birth cohorts who were school-aged during the SDY program and rural-to-urban migration rates after the SDY program.

On the right-hand side, R_i is the total number of SDYs received per capita in county i aggregated over all years in log form. We refer it as the log of the SDY density hereafter. The vector X_i captures the pre-program level of economic development in county i as well as the potential for economic growth. It is important to control for these factors as they are likely correlated with both the number of SDYs received and, regardless of the number received, with actual economic development. For example, counties with more initial human capital and generally better initial economic conditions may have been better able and more willing to accept SDYs, and these counties could have developed faster than other counties anyway with or without SDY.

In choosing the control variables we are somewhat limited by data availability.[17] Ideally we would want to control for the pre-program level of real GDP per capita, but such data do not exist. We were able to get data on and have included in X_i the pre-program population size; the land area per capita (i.e. the reciprocal population density); the agricultural production per capita as measured by the cultivated area per capita, the area used for grain- and root-crops per capita; grain yield per capita; and estimates of the maximum potential agricultural grain crop output per capita as determined by the landscape and climate. All these variables are measured in log format.

In addition, to capture pre-program human capital we include in X_i controls for the average years of schooling for the cohorts whose education level could not have been affected by the SDY program. We designate cohorts born in 1952 and earlier, with rural hukou, as the 'unaffected cohorts'. Our rationale is that these cohorts would have completed junior high school before 1967–1968 (the onset of the SDY program). Given the scarcity of the senior high schools in rural areas in those days, and the limited number of rural individuals pursuing post-secondary education, we assume that the SDY mainly impacted primary and junior high school education levels. Recognising that the average level of education for the (better-educated) SDY was around junior high school level at the time of the program, our assumption might over-value the level of rural education the SDY could affect. Thus, in the sensitivity test, we modify the definition of the 'unaffected cohorts' from those born in 1952 and earlier to those born in 1955 and earlier, under the assumption that the SDY

[17] Data sources and data issues are discussed in Section 4 and Appendix B.

only affected rural primary school education and individuals who completed primary school before the SDY program implementation remained unaffected.

To capture potential cultural differences across counties with regard to education, we also include a set of dummy variables representing the number of people from each county who passed the highest level of the imperial examination (Jinshi) during the Qing dynast

The vector D_i in Equation (1) consists of three distance variables in log form: the distance from the receiving county to the provincial capital city, the distance to the nearest prefecture-level city (which could be in a different province), and the inverse of a weighted index that depends on the reciprocal distances between the receiving county and all the sending cities within the province. The construction of index is explained below. We use these variables to proxy the influence on county i from economic development in nearby urban areas after the SDY program ended. While these influences are not directly observable, we expect they are related to the distance between county i and the urban areas.

Finally, $\mu_{p(i)}$ represent provincial fixed effects, τ_t represent year fixed effects, and U_{it} is the usual error term. Note that per-capita variables on the left-hand side use population figures for year t, while per-capita variables on the right-hand side use population figures from the 1964 census.

Our main interest is to estimate the coefficient β_1. However, the OLS estimate of β_1 in Equation (1) may not identify the causal effect of the SDY on the long-term economic development in the receiving counties. First, as we discussed in Section 2.1, the number of SDY a county received was not explicityly randomised. This means that the OLS estimate of β_1 may suffer from selection bias. Second, the counties were not on an equal footing before the the SDY program began, and our control variables may not fully capture all potential initial factors. This means that the OLS estimate of β_1 may suffer from omitted variable bias. In terms of Equation (1), these potentially confounding factors suggest that R_i may be correlated with U_{it} in which case the OLS estimate of β_1 does not identify the causal effect of receiving SDY on rural economic development. To address these problems we consider an IV estimation approach.

Our instrument is constructed from the number of youths sent down to each county i from all the cities within the same province and from the reciprocal distances between the counties and the cities.[18] Specifically, the instrument is constructed in the following form

$$I_i = \log\left(\frac{1}{F_i}\sum_{j\in p(i)} W_i^j S^j\right), \tag{2}$$

where W_i^j is a weight based on the distance D_i^j between county i and city j, S^j is the total number of youths sent down from city j, F_i is the population in county i in 1964, and the notation '$j \in p(i)$' means summing over all cities in the province that county i belongs to.

We normalise the weights so that they sum to 1 for each sending city across the counties that actually received SDY in that province. Specifically, if the unscaled weight is w_i^j, where w_i^j maybe specifies as $w_i^j = 1/(1+D_i^j)$, then $W_i^j = w_i^j/\sum_{k\in p(i)} w_k^j$ where '$k \in p(i)$' means summing over all counties that actually received any SDY in province $p(i)$.[19] Although our main estimates use $w_i^j = 1/(1 + D_i^j)$, we consider $w_i^j = 1/(1 + D_i^j)^2$

[18]Our dataset has information about the total number of youths received in county i and the total number sent from city j, but information about how many county i received from city j is very limited.

[19]Most counties not observed to have received SDY were relatively urbanised. Nevertheless, it is possible that our formula may

and $w_i^j = 1/\ln(1 + D_i^j)$ in the sensitivity analysis.

The unit of the instrument is the log of youths per capita. Intuitively, we can think of this as the (log of the) total number of SDY per capita county i would have received (from within the province) if the allocation was based solely on distance (according to the formula used in constructing the weights) and if all youths remained within their home province.

The instrument should be relevant and strong (i.e. highly correlated with SDY received per capita) in provinces where the counties received more SDY if they were closer to cities with more youths being sent out. As mentioned, Gu and Hu (1996) reported that about 92% of SDYs were sent from cities to counties within their own provincial borders. And, as described in Section 2.1, there is evidence that the allocation processes favoured sending youths to the nearest rural areas with the capacity to receive them. We therefore expect the instrument to be strong in most provinces.

However, in sparsely populated provinces the instrument may be weak. This is because the distances between counties and cities in these provinces may be less important in the allocation decisions. In addition these provinces often receive a substantial influx of SDY from beyond their borders, resulting in a potentially low correlation between the number of SDY sent from cities within the province and those received in nearby counties. For this reason, we analyse two samples. The 'full' sample includes essentially all provinces for which we have usable data. The 'core' sample excludes sparsely populated provinces. Further details about the two samples are provided in Section 4.4. To assess instrument relevance, we report statistics for tests of weak instruments in all tables with IV the estimation results.

As usual, instrument exogeneity is a complicated matter. Many relationships between counties and cities depend on distance and we do not assume that the distances themselves are exogenous. Instead, the idea is that the number of youths that needed to be sent away from the cities during the SDY program could be unrelated to the economic circumstances in the receiving counties after the program ended, provided we control for other links between the receiving counties and the sending cities. As explained earlier, the number sent out from each city depended largely on the cohort sizes and the labour demand in that city. Therefore, we suggest that the instrument may be conditionally uncorrelated with the error term in Equation (1) given that we control for many aspects of the counties' initial economic development and for the distance to nearby urban areas. In particular, to ensure our IV is free of the potential endogeneity from the distance related weight variable we used to construct the IV, we include the weight variable directly in the set of our control variables.

4 Data and Sample

4.1 Administralive Divisions

China has five levels of local administrative divisions, generally referred to as the province (1st), the prefecture (2nd), the county (rural) / district (urban) (3rd), the township (rural) / sub-district (urban) (4th), and the village (rural) /neighbourhood community (urban) (5th). The unit of observation in our data is observed at the county level. As a point of reference, in 2017 there were 2850 third-level (claimed) divisions, of which

assign zero weight to some counties that could potentially have received SDY.

955 were districts (urban), 1894 rural counties, and 1 forestry district. We compile data for the rural counties only, because only rural areas received SDY.

There have been many changes in the borders of administrative divisions over the years, as some counties have been merged or split, while others have been reorganised as urban districts in the general urbanisation process. These changes present a challenge to our data compilation and analysis. To ensure that our unit of analysis is consistent over time, we fix the county borders at the time when the SDY data were compiled. The SDY data were originally extracted from county-level gazetteers, which were complied and published in the late 1980s and early 1990s. For simplicity, we refer to the fixed border definitions as the 'SDY-data counties'. We deal with border changes before and after this time differently.

Border changes occurring prior to the compilation of SDY data have implications for the control variables representing pre-1967 economic development levels and the distances between counties and cities if counties or cities were changed their administrative affiliations from one province to another.To address these changes we first obtain the detailed information of border changes from gazetteers, Baidu Baike and a website about China's administration divisions (www.xzqh.org). Using this information we then calculate the potential share of the area or population affected by mergers or splits. Finally we impute values for these control variables in the split/merged counties based on either the changes in the population share or the changes in the land share, depending on whether the variable is population based (such as total population and average education level) or land based (includes cultivated land, yields, potential yields, etc.).[20] In our final sample there were 243 counties that experienced such mergers or splits.

Border changes that occurred after the compilation of the SDY data only impact our outcome variables. Within our final samples, only 10 counties experienced mergers or splits during the post-SDY data period. We address these changes in our analysis by excluding these counties from our sample for the years after the border change.

4.2 Variable Constructions and Data Sources

Our data come from many sources. In this subsection, we briefly discuss our data and their main sources, with more details provided in Appendix B.

The Outcome Variables

Both the GDP and the population data are from various statistical yearbooks. The earliest data for GDP are from the provincial-level retrospective statistical yearbooks, which were compiled and published in the late 1990s or the early 2000s.

The NTL data originally from NASA are obtained from the Payne Institute's website. These data cover the NTL over a fine grid of cells for the entire world. We aggregate the grid-cell NTL information to the county level using the 2005 county boundary data from the 2006 version of the National Basic Geographical Information Database and the QGIS software.

[20] As an example, suppose SDY-data counties C and D in 1990 were counties A and B before 1967, and that C is all of A plus 20% of B and that D is 80% of B according to their land areas. To impute the total area of cultivated land (one of our control variables for economic conditions before 1967) for C, we add 100% of the cultivated land for A plus 20% of the cultivated land for B. For D, we use 80% of the cultivated land of B. Note that in this scenario, there is both a split as B is divided into two parts and a merger as A is combined with part of the B.

The variables on TVE performance (output, revenue and employment) are mainly from provincial-level statistical yearbooks, supplemented with information from the county gazetteers. We ignore TVE data after 1996 because of inconsistencies in the statistical reporting after that year. As discussed in the Background section, in November 1996 the National People's Congress promulgated the 'Township-Village Enterprises Law' (TVE Law). The TVE Law stipulated that only firms formally registered with the State Administration for Industry and Commerce can be counted as TVEs in the official statistical reporting (TVE Bureau of Ministry of Agriculture, 1997). Prior to the introduction of the law, a large share of TVE firms were not formally registered. Enforcing the law would see a large fluctuation of the statistical record of the TVE sector. Consequently many provinces defied the law and continued to use the old rules. Realising the inconsistencies, the Ministry of Agriculture posted a notice (Ministry of Agriculture, 1998) advising the provinces to revert to the old reporting rules in 1998.[21]

All outcome variables in values, e.g. GDP, TVE output and TVE revenue, are measured in real term using the provincial-level GDP deflator, with 2010 set as 100.

We construct per-capita versions of the outcome variables using population estimates from the statistical yearbooks.

The Number of SDY Received

The number of SDY received comes from a seven-volume book by Jin and Jin (2014), with a few additions from the original gazetteers. The book collects all items about SDY from various types of gazetteers that were published since the 1980s. In Appendix B we present the distribution of the SDY density across different counties in Figure B1.

The Instrumental Variable

Our instrumental variable is derived from two variables, namely the total number of SDY sent to the countryside from each city (the S^j in equation (2)) obtained from Jin and Jin (2014) and the distances between each SDY receiving county to every city in the province that sent their youths to the countryside during the SDY program. The distance variable is used to generate the weight variable W_i^j in equation (2) and are obtained from the 2006 version of the National Basic Geographic Information Data Base.

We generate two distance variables using two different methods. In the first method we obtain longitudes and latitudes of the centres of the cities and the main town in the counties. We then calculate the great-circle distance between each county and each city. The second method is similar, except that instead of the centre of the main town in the county, we use a range of points within the county. The points are equally spaced in steps of 0.1 degree longitude and latitude (with a few extra points for irregularly shaped counties). We then calculate the distance between each county and each city by averaging over the county points. Our main estimates employ variables constructed using the first method. In the sensitivity analysis we use the second method.

[21]Figure B2 in Appendix B presents the number of TVE firms at the provincial level as reported in the 1978–2002 China TVEs Statistical Materials. The figure shows that seven provinces followed the new TVE Law in 1997 and continued to use this definition thereafter (Panel A); Beijing and Shandong also followed the new TVE Law in 1997, but reverted to the old reporting rule from 1998 (Panel B); while the remaining provinces never followed the rules of the TVE Law (Panel C).

Other Control Variables

We calculate the education level of rural hukou individuals born in or before 1952, the 'unaffected cohorts', using the 1% samples of unit records from the 1982 and 1990 population censuses. The 1990 census is used in our main estimates and the 1982 census in the sensitivity analysis. The advantage of the 1990 census is that it includes hukou information so our calculations can accurately measure the education for rural hukou population. The 1982 census did not have hukou information, instead we can only use their residential county location to approximate the 'rural hukou population'. But the advantage of the 1982 census is that fewer people born before 1952 would have died by the census date.

Information about the number of people from the county who passed the highest level of the imperial examination (Jinshi) during the Qing dynasty is extracted from Jiang (2007). We generate two dummy variables to indicate counties that had 1–9 Jinshi and counties had more than 10. The omitted category is for counties without any Jinshi.

The data for the pre-SDY period cultivated land area and the actual total grain crop yields in 1957 are from Planning Bureau of the Ministry of Agriculture of China (1959). These data are available at the county level for all provinces except Tibet and Ningxia.

Information about the potential yield is obtained from the agricultural potential yield estimates constructed by FAO-GAEZ.

The distance to the nearest city and to the provincial capital city are constructed using the same data and method as the distances between cities and counties used in constructing the instrumental variable. Note the nearest city may be in a different province.

We construct per-capita versions of the control variables using population estimates from the 1964 population census.

Channel Variables

In our channel analysis in Section 6, we focus on average years of schooling for the 1953–1963 birth cohorts who were school-aged during the SDY program and rural-to-urban migration rates after the SDY program.

The data on the average years of schooling for the 1953–1963 cohorts the are extracted from the 1% sample of the 1990 population census, the same source as the variable used to control for the average years of schooling for the cohorts born in 1952 and before.

The data on the out-migration share of the employed labour force are extracted from the 1% sample of the 1990, 2000 and 2010 population censuses and the 25% sample of the 2005 intercensal population survey ('mini census').[22]

[22] We do not use the 1982 census data because the rural-to-urban migration did not take off until the late 1990s (Frijters et al., 2015) and in 1982 almost no out-migration can be detected in the data. Our data show that even in 1990 the share of the employed workforce who migrated outside of their hukou county is only 2.3%. We construct the share of rural-to-urban migrants for county i as the share of employed individuals with rural hukou and with hukou registration in county i who was working outside their home county at the time of the census or intercensal survey. The definition of the variable we use to define migration was changed in the surveys over time. In 1990, the variable only included individuals who had left their hukou registration county for one year or longer; in 2000, the variable included individuals who left their hukou registration county for half year or more; in 2005 and 2010, the variable also included people who left their hukou registration county for less than half a year. In our estimation the differences in the definitions should be captured by the year dummies. In order to reduce measurement error, we use only counties that have at least 200 employed individuals in the census or intercensal survey data. Our estimation results are similar if we set the threshold at 100 employed individuals.

4.3 Sample

We exclude the provincial-level municipalities Beijing, Tianjin, and Shanghai from the samples on the grounds that nearby areas formally classified as rural have had suburban characteristics for a long time and that spillover from the recent economic growth in these megacities may overwhelm any effects of the SDY program. The focus of our paper is to study the legacy of SDY in underdeveloped regions, so omitting these municipalities is not a loss. We also exclude the provinces Tibet and Ningxia because we do not have information about their economic development before the SDY program. Thus, our full sample includes all provinces except Beijing, Shanghai, Tianjin, Tibet and Ningxia.

As discussed in Section 3, we expect the instrument to be weak in provinces that received many out-of-province SDY and in provinces with very low population density. For this reason, the core sample excludes provinces with less than 50 people per km^2, namely Inner-Mongolia, Heilongjiang, Yunnan, Gansu, Qianghai and Xinjiang.[23]

The sample sizes for different outcome variables are different as the data are available for different counties and for different years. In the sensitivity analysis we test our results using the sample size with the minimum common available counties and years to ascertain that the variation in the results are not due to different sample size. Table B1 in Appendix B presents the number of observations for each outcome variables in each year as well as the number of observations in the full and the core samples.[24]

4.4 Summary Statistics

We present time series plots of the means of our dependent variables for the full sample in Figure 3.[25] Panel A plots average log real GDP per capita and log NTL per capita over the period 1980–2013, while Panel B presents average log real TVE output, revenues, and employment per capita over the period 1980–1996. Steep upward trends are evident, reflecting the strong economic growth in China over this period. In Panel A we observe that real GDP per capita fell a little in 1989. There is a similar decline in real TVE revenue in that year in Panel B, while real TVE output remained more or less constant and decline in TVE employment happened in 1990. These falls could be due to the political upheaval that occurred in 1989 and the subsequent economic sanctions. The mean NTL per capita series shown in Panel A exhibits larger fluctuations.[26] This maybe due to different satellites providing the data in different years. The noise in the measurements are not particularly worrisome for two reasons. First, in general measurement error in the outcome variables are relatively innocuous. Second, we include time dummies in our regressions.

Table 1 presents means and standard deviations for the independent variables in our estimation samples. While the top panel is for the full sample, the bottom panel is for the core sample. These variables are time invariant, so the summary statistics are calculated across counties. On average for both samples, the coun-

[23]Figure 2 shows that the boundary between the excluded and included provinces in the core sample follows the famous Hu line fairly closely.

[24]The number of counties with GDP data is small in the 1980s due to the fact that many counties only estimated GDP from the early 1990s (Hu, 2015). The number of counties with TVE data is small in most years, because the TVE statistics were not systematically compiled and reported across counties and years.

[25]The summary statistics by year for each outcome variables are presented in Appendix Tables B2 and B3.

[26]The range of the nighttime light (NTL) measurements is 0–63. Due to the satellite sensor's limited radiometric resolution, measurements for urban areas with intense artificial lighting often attain the maxmimum value which obscures any differentiation between them. However, the limited NTL range should not affect our analysis given that we focus on rural areas.

ties received 0.02–0.03 SDY per capita with a standard deviation of 0.05. The overall mean of average years of schooling for the cohort born in 1952 or before is around 3.6–3.8 years. The average county population in 1964 is around 290,000 for the full sample and around 320,000 for the core sample, both with large standard deviations. The population density is around 175-185 persons for the full sample and around 220 persons per km^2 for the core sample, respectively. The mean cultivated land presented in the table is around 0.29 and 0.27 hectare per capita for the full and core samples, respectively. Converted into Chinese units, it is around 4.3 and 4.05 mu per capita. The average per-capita grain and root production yields in 1957 is more than 300 kg, whereas the potential yield per capita is around 1900 kg for the full sample and 2000 kg the core sample. The distance to the nearest city and to the provincial capital city is 55 and 215 km on average, respectively, for the full sample; and 49 and 186–190 km for the core sample. Finally around one third of our counties in the full sample had 1–9 Jinshi during Qing dynasty and another third had 10 or above. Both ratios are higher in the core sample.

5 Empirical Results

5.1 Results for GDP and NTL

The standard errors are clustered at the prefecture level in all regressions (with the prefecture borders fixed at time of the SDY program). In the sensitivity analysis, we show standard errors clustered at the province level.[27]

OLS Results

Table 2 reports OLS estimation results for regressions with log real GDP per capita and log NTL per capita as the outcome variables. Results for the full sample are shown in columns 1 and 2 and for the core sample in columns 3 and 4. Our main interest is the coefficient on the log of SDY received per capita. The magnitude of the estimate is roughly similar in both samples. We find that a county with 10% higher SDY density during 1967–1980 had on average around 1.2% higher annual real GDP per capita in 1980–2013 compared to an otherwise similar county. The association is slightly larger for NTL per capita. Counties with 10% higher density of SDY had on average around 1.6–1.8% higher NTL per capita for the period 1992–2013, everything else equal.

In the remainder of this section we briefly comment on the signs of the control variable coefficients. The control variables capture the economic endowments before the SDY program and the influence of nearby urban centres.

Regarding the endowments, Table 2 shows that the human capital endowments (average years of schooling for people born in 1952 or earlier as well as the Jinshi dummy variables are strongly positively associated with economic activity for the period after the SDY program ended. The population density in 1964 is positively associated with real GDP per capita and NTL per capita in the period after the SDY program in all four regressions; however, the effect is not precisely estimated for the NTL per capita using full sample. The estimated relationships between the three agricultural endowment variables (log cultivated area per capita,

[27] In the sensitivity analysis we test whether the results alter much if we cluster at the province level.

log yield per capita, and log of potential yield per capita) and our outcome variables are negative in some regression and positive in others. We think there may be two reasons for these differences. First, in later years the secondary and tertiary industries dominate the real GDP and NTL per capita measures, so the correlation between the early agriculture endowments and the later levels of real GDP and NTL per capita could be negative. Second, the three variables used to capture these initial conditions are highly collinear, which may generate the 'unstable' results.

Regarding spillover from economic development in nearby cities, the estimated results for the distance variables (the distance to the nearest city and the distance to the provincial capital) are negatively associated with real GDP per capita and NTL per capita, and the variable used as the weight for our IV, the inverse of the normalised reciprocal distance between a county and cities in the province is positively associated. These suggest that there are strong positive influence of urban centres on nearby rural counties.

The fact that the OLS results for the full and the core samples are similar is reassuring. This suggests that the relationships between the number of SDY received per capita and our outcome variables are similar in the regions that are included and excluded in the core sample.[28]

IV Results

The results obtained from the OLS regressions may suffer from the endogeneity problems discussed in Section 3. In this subsection, we present results from IV regressions that may mitigate these problems.

The IV results together with selected first stage results are reported in Table 3. Again columns 1 and 2 report selected results for the full sample while columns 3 and 4 are for the core sample. The first stage results for the endogenous variable, log SDY received per capita, are reported in Panel B, while more detailed first stage results are relegated to in Table C1 in Appendix C. As expected, the first stage results indicate that our IV is quite strong for the core sample, and weaker for the full sample.

Turning to the second stage results in Panel A of Table 3, we find that the impact of receiving SDY on both real GDP and NTL per capita are larger and have smaller standard errors in the core sample than in the full sample. As the former is preferred, the discussion below focuses on core sample.

The coefficient on the log SDY density for the GDP regression is 0.33 with 95% CI [0.145, 0.525]. So a 10% increase in the density of SDY received increases real GDP per capita by around 3.2% (0.335*(log(0.0234)-log(0.0214))), other things equal. Based on the overall mean of the real GDP per capita for the core sample of 10,480 yuan with a SD of 13,353, the 10% increase in SDY density increases the real GDP per capita by 335 yuan, which is around 2.5% of the SD. In comparison, this level of effect is equivalent to being 50% closer to the provincial capital city. The impact on NTL is even larger. Counties with 10% higher SDY density had around 4.3% (0.454*(log(0.0242)-log(0.022))) more NTL per capita.

The estimates reported in Table 3 represent average effects of receiving SDY across all years. To examine whether the average effects are persistent or perhaps declining over the years, we also ran the IV regressions for each year separately. Figure 4 shows the estimated coefficients on the SDY variable in the real GDP and NTL regressions using the core sample. For both outcome variables, the IV estimates of the effects of having

[28] We have also run separate regressions for the non-core provinces only and the OLS results are very similar to those observed for the core sample.

received SDY over the entire period seems to be quite stable throughout the period, hovering between 0.3 and 0.4 for real GDP per capita and between 0.3 and 0.5 for NTL per capita.[29] It is interesting that there does not seem to be a decline in the effect over time, suggesting perhaps that the changes the SDY brought to the rural areas were somehow structural and permanent.

5.2 Results for TVE Outcomes

As discussed above, rural industrialisation was driven by the development of the TVE sector during the period of the SDY program. Regressing TVE outcomes on the number of SDY received may provide direct evidence on the impact of the SDY program on rural economic development. The expansion of the TVE sector can also be viewed as a channel through which the SDY program influenced rural long-term economic development. In this subsection, we look at the impact of the SDY program on TVE outcomes. In the next section, we investigate the issue of TVE development as a channel.

We use real TVE output value,real TVE revenue, and TVE employment, all in log format and in per capita terms, for 1980–1996 as the dependent variables in Equation (1). As with the real GDP and NTL results, the OLS estimates for the coefficients on the log SDY per capita in the TVE output, revenue and employment per capita regressions are similar in the full and the core samples. There is little else of note in the OLS results. In the interest of saving space they are relegated to Table C2 in Appendix C.

The IV results are reported in Table 4.[30] Our instrument is strong for the core sample. The estimated coefficients of the log SDY received per capita on TVE output value and revenue per capita for the core sample are 0.61(with the 95% CI [0.33, 0.90]), for output value and 0.49 (with the 95% CI [0.22, 0.75]), for revenue, which is a little larger than what we find for the log real GDP per capita and NTL per capita. Intuitively, using the standard crude approximation, a 10% increase in SDY per capita induced 6.1% higher TVE output value per capita and 4.9% higher TVE revenue per capita on average. For TVE employment per capita the coefficient is 0.30 (with the 95% CI [0.12, 0.48]), suggesting that a 10% increase in SDY per capita generated 3% more TVE employment per capita.

Figure 5 shows the estimated impact when running separate regressions for each year. The effect of receiving SDY on the TVE outcome variables are largely positive and statistically significant up to the mid-1990s. The effect on TVE employment per capita is also positive in the early years, although it seems to decline over time perhaps due to productivity improvements.

5.3 Robustness Checks

When analysing historical data, researchers make many choices as to how the important variables are measured, which particular variables are included, and what model specifications are used. This paper is no exception. To investigate whether our results are sensitive to the choices we made, this subsection discusses a range of robustness checks. We focus on the impact of having received SDY on real GDP per capita in these analyses and on the core sample. The results are reported in Table 5. For convenience, column 1 repeats the main estimate from Table 3.

[29] In the GDP estimations the number of observations for the year 1981, 1982, and 1983 are small, about 125 observations for each year. This is probably why the standard errors are large.

[30] The first stage results for the TVE outcomes are reported in Table C3 in Appendix C.

The first check is related to the fact that we fixed the county borders at the time when the SDY data were compiled. As explained in Section 4, we used simple rules to calculate values for the control variables for counties that experienced splits/merges before this time. In both the full and the core samples, around 10–12% of the counties were affected by mergers or splits. For the estimate in column 2, we included in the regression a dummy variable indicating whether the county was affected by a merger or a split during the data period. This increases the magnitude of the estimate slightly. In column 3, we reestimated the models excluding counties that experienced splits/merges. This also increases the magnitude of the estimate slightly. We conclude that our results are not sensitive to how we handle changes in county borders.

The second check is related to how we measure the distance between a county and a city. Three variables involve distances, namely the distance to the nearest city and to the provincial capital city, and the weight (the normalised inverse distance variable) used to construct the instrumental variable (and as a direct control as well). As explained in subsection 4.2, all distances are measured from the centre of the city to the centre of the main county town in our main estimations. In column 4 in Table 5, we use an alternative measure of distance, which is the average distance between the centre of the city and a set of grid points within the county. The estimated coefficient for log SDY received per capita using the alternative distance measure is larger in magnitude.

The third check concerns the sensitivity of our results to the specification of the control variables for the human capital endowment for birth cohorts that would not have been affected by the SDY program. Our main estimations use the *average years of schooling* for those born in 1952 and before. In column 5 we instead use three variables capture the *share of different level of education* as controls: the share of the population born in 1952 or before who were illiterate, the share with junior high school education or above, and the share with senior high school education or above. This alternative specification leaves the estimated impact virtually unchanged. The specifications in columns 6 and 7 are the same as columns 1 and 5, but based on data from the 1982 census instead of the 1990 census. The estimated impacts are somewhat smaller but still positive and large. In column 8, we control for the average education of the cohorts born in or before 1955 instead of the cohorts born in or before 1952 assuming that SDY only affect local primary school education . Again, the results are almost the same as before.

The fourth check pertains to the functional form of the instrumental variable. In our main estimations, we weighted the number of SDY sent from different cities to counties within the province by the reciprocal pairwise distances between each city and the county. In terms of Equation (2), the weights are based on $1/(1+D_i^j)$. In columns 9 and 10, we instead base the weights on $1/(1+D_i^j)^2$ and $1/\log(1+D_i^j)$. The point estimates of the impacts are similar. However, the magnitudes of the F-statistic for weak instruments are somewhat reduced.

In our main estimations standard errors are clustered at the prefecture level. To test the sensitivity of this decision we present in column 11 results with the standard errors clustered at the provincial level. This slightly increased the standard errors, but the coefficients remain the same.

Table 6 presents our main results using the subsample of counties and years without missing values for any of our main outcome variables. These restrictions result in a sample of 938 observations over the 5 year period 1992-1996. The core sample contains 472 counties in 83 prefectures. The estimations for this sample are slightly larger, but otherwise consistent with our main results presented in Tables 3 and 4.

6 Channel Analysis

We begin this section by examining whether receiving SDY had an impact on the education levels of the rural birth cohorts 1953–1963 who were of school age during the SDY program and on the share of people who migrated from rural to urban areas during the economic reform era. This is to complement and validate the robustness of previous findings using our data and using our (IV) approach.

The estimation results are reported in Table 7. The control variables are the same as used in the main regressions. The first two columns present the results for the relationship between the number of SDY received and average years of schooling of the 1953–1963 birth cohorts. To interpret the magnitude of the IV estimate, consider that the average number of SDY per 100 locals for the core sample is 2.14. The coefficient of 0.21 means that a 10% increase in SDY density (from 2.14 to 2.34 per 100 people) would have increased average years of schooling by around 0.02 years. Alternatively, a 1 percentage point increase in SDY density (from 2.14. to 3.14 per 100 people) would increase average years of schooling of the relevant cohort by 0.08 years. Our results confirms Chen et al.'s (2020) finding that the SDY program raised average years of schooling for the relevant cohorts. They estimated that a one percentage point increase (say from 2.2 to 3.2 per 100 people) in SDY density increased average years of education by 0.03 years.

Table 7 also reports estimation results from the out-migration regression. The IV estimate of 0.029 is large. A 10% increase in SDY received per capita increased the stock of rural migrants by an average of 0.26 percentage points. This is a large effect considering that the average out-migration rate is 7.2%. If we run the regression separately for each year, the IV results are 0.004, 0.047, 0.044, and 0.032 for 1990, 2000, 2005, and 2010, respectively. (The estimation results are in Table C4 in Appendix ??.) Thus, the effect is the largest from early to mid 2000s, which corresponds to the initial rural-to-urban migration period. This pattern is consistent with the view by Kinnan et al. (2018) and Xing and Zhou (2018) that the influence of the SDY on rural out-migration was mainly through a network effect. A network effect should be strongest in the early phases of the migration movement. Once out-migration became a widespread the original SDY network may be replaced with more up-to-date connections. The reason for the small estimated effect in 1990 may well be that out-migration was simply too small then for SDY to make a difference.

Next, we present an informal mediation analysis. While the impact of receiving SDY on the expansion of the TVE sector, the average years of schooling for the 1953–1963 birth cohorts, and rural-to-urban migration rates are interesting outcomes in their own right, these variables may also be considered channels for the impact of the SDY program on long-run economic development. We add TVE output, average years of schooling and rural-to-urban migration rates separately on the right-hand side in our main regression. This is to see how much adding a channel variable reduces the estimated impact of the SDY program and to provide an indication of how much these channels may have mattered for long-term economic development. For simplicity, we preset estimates only for real GDP per capita as the outcome variable and only for the core sample.

Mediation analysis is difficult and sometimes controvertial. Problems can arise for example if mediators are endogenous, if the set of observed mediators is incomplete, or if observed and unobserved mediators are correlated (see e.g. Lin et al., 2023, for a recent discussion). Recently developed methods for endogenous treatments and mediators are not applicable here, as they require either multiple instruments or strong unconfoundedness assumptions (Frölich and Huber, 2017; Dippel et al., 2020). Nevertheless, there may be interesting patterns to be discovered even if their interpretation is not entirely clear.

Table 8 presents OLS estimates from regression specifications as in Equation (1), but with the potential mediators added as extra control variables one at a time.[31] The estimation samples are different and smaller than that used for our main results (Table 2), because the mediator values are not available for all counties or all years. To verify that our main estimates are robust to the differences in sample size, we reestimated those regressions on the smaller samples. These results are reported in Table 8 under the label 'baseline model coefficients'.

In column 1, we investigate whether (log) real TVE output per capita may be a channel for the impact of SDY on long-run rural economic development. We lag TVE output five years, because TVE output feeds directly into contemporanous GDP and we are interested in the relationship between TVE output and long-run growth. The baseline coefficient estimate of 0.112 is virtually the same as the 0.117 we got in the original core sample. Adding the five-year lagged log TVE output per capita substantially reduces the estimated coefficient on SDY from 0.11 to 0.07, while the coefficient on lagged log TVE output per capita is 0.27.

Column 2 of Table 8 reports estimates from the regression that includes the average years of schooling for the 1953–1963 birth cohorts as mediator. This variable is constructed using 1990 data, and hence we only use the 1990 observations in the regression. Again, the estimated baseline coefficient of 0.109 is similar to the original estimate. Adding the mediator very slightly reduces the estimate to 0.104, while the coefficient on years of schooling is 0.07.

In column 3 we consider the three-year lagged out-migration share as a mediator. The timing of the (full and mini) censuses implies that the estimation sample involves GDP for 1993, 2003, 2008, and 2013.[32] The estimated baseline coefficient of 0.127 is slightly higher than the original estimate of 0.117. Adding the mediator leaves this estimate virtually unchanged at 0.127, while the coefficient on the log share of migrants is 0.52 with a fairly large standard error.

The IV estimates presented in the first part of this section and in Section 5.2 suggest that the density of SDY is strongly, positively and causally related to all three channel variables we considered. The informal mediation analysis in the second part of this section shows that including years of schooling and rural-to-urban migration in OLS regressions hardly affect the strength of the association between having received SDY and real GDP per capita. However, including real TVE output reduces that association by about a third. This suggests that the TVE sector played a far more important role than schooling and migration for the impact of the SDY program on rural GDP. Moreover, the fact that none of the mediators eliminate the association between having received SDY and GDP suggests that other channels played a role. Perhaps the exposure to new knowledge, perspectives and ideas led to an enhancement of innovation and entrepreneurship in the rural regions.

[31]The mediators are endogeneous, because they are correlated with the number of SDY received and the latter is correlated with unobservables. We do not have an additional instrument and hence we cannot pursue IV estimation.

[32]We do not use a five-year lag because our dataset only has GDP up to 2013 and using a five-year lag would reduce our sample size substantially. Using a four-year instead of a three-year lag yields similar estimates.

7 Conclusion

The SDY program, a temporary and involuntary migration, brought over 16 million urban youths to the less developed rural areas in the 1960s and 1970s. On average these youths spent 4–5 years, many for as long as 8–10 years, in the countryside and many endured significant hardship. The aim of this paper is to identify impacts of the SDY program on the economic development of the hosting regions. To help identify the causal effect of the SDY program we employ an IV strategy. The number of youths sent down from each city is arguably exogenous to rural economic development. Although there is no clearly written documentation, the governments at different levels had a strong incentive to minimise the cost of the relocations. Thus, as much as possible urban youths were sent to the rural regions that were closest to their urban origins. Using this pattern we construct an IV based on the number of youths sent down from cities within the province weighted by the distances between the sending city and the receiving county.

As mentioned in the Introduction, the economic literature has found that immigration often facilitates economic growth in host regions. This is due to fact that migrants often bring with them knowledge, skills and technology know-how as well as financial resources that are beneficial to economic development. Our study supports this general immigration story and finds that regions the received more SDY per capita had higher levels of real GDP and NTL per capita long after the program ended. The effect is highly persistent, the increases in real GDP and NTL remain even 30 years after the SDY returned to their home cities. Moreover, we find a large impact of the SDY program on rural regions' early industrialisation as measured by output values and revenues of the TVEs in the period immediately after the SDY program ended.

We also find that the arrival of SDY had a large positive impact on the education levels of people who were of school-age at the time and on later rural-to-urban migration. In an informal mediation analysis using OLS regressions, we examine whether including these two variables as well as the TVE output value were likely channels for the impact of receiving SDY on rural GDP. We find that only TVE output affects the magnitude of the impact of SDY. This suggests that the SDY's contribution to the TVE sector was an important channel for rural economic development.

Although the SDY program altered the life trajectory of a generation and brought about tragedy for many, on average it has left a positive legacy in the rural regions that hosted them.

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Table 1: Summary Statistics for Different Samples

	GDP	NTL	TVE Outp	TVE Rev	TVE Emp
	(1)	(2)	(3)	(4)	(5)
			Full Sample		
Per capita SDY (person)	0.02	0.02	0.03	0.03	0.02
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Mean years of schooling (coh<=1952)	3.62	3.62	3.67	3.66	3.65
	(1.22)	(1.22)	(1.21)	(1.24)	(1.20)
Population in 1964 (1,000 persons)	290.38	290.28	293.78	280.03	287.28
	(203.52)	(203.46)	(207.20)	(201.00)	(200.86)
Density in 1964 (1000 persons/km^2)	184.23	184.35	184.55	175.97	183.20
	(186.79)	(186.92)	(169.86)	(169.76)	(169.79)
Cultivated land pc (hect/person)	0.29	0.29	0.28	0.28	0.28
	(0.31)	(0.31)	(0.19)	(0.19)	(0.20)
Food yield pc (kg/person)	313.69	313.55	309.96	300.66	308.22
	(185.64)	(185.65)	(158.54)	(150.82)	(156.07)
Potential crop pc (kg/person)	1956.51	1956.76	1884.89	1828.14	1858.38
	(1683.32)	(1682.72)	(1418.93)	(1254.74)	(1401.18)
Distance to nearest city (km)	54.05	54.01	54.68	55.57	54.63
	(36.03)	(36.05)	(36.96)	(37.27)	(36.97)
Distance to prov cap city (km)	214.28	214.33	216.06	216.76	214.45
	(149.26)	(149.22)	(144.29)	(138.68)	(142.50)
Normalised average distance	0.01	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Dummy for Jin Shi 1–9	0.32	0.32	0.32	0.35	0.33
	(0.47)	(0.47)	(0.47)	(0.48)	(0.47)
Dummy for Jin Shi >=10	0.32	0.32	0.31	0.28	0.31
	(0.47)	(0.47)	(0.46)	(0.45)	(0.46)
IV Dist adj potential SDY	6869.47	6872.81	7393.27	6559.22	6542.03
	(9794.16)	(9792.52)	(9995.37)	(9165.69)	(8103.44)
No. of counties	1529	1530	1179	1105	1157
			Core Sample		
Per capita SDY (person)	0.02	0.02	0.02	0.02	0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Mean years of schooling (coh<=1952)	3.70	3.70	3.79	3.79	3.77
	(1.11)	(1.10)	(1.06)	(1.11)	(1.05)
Population in 1964 (1,000 persons)	323.05	322.90	334.94	315.22	323.11
	(209.53)	(209.47)	(214.60)	(211.28)	(209.35)
Density in 1964 (1,000 persons/km^2)	218.10	218.22	226.70	214.77	223.48
	(192.39)	(192.53)	(171.33)	(174.48)	(173.62)
Cultivated land pc (hect/person)	0.27	0.27	0.26	0.26	0.26
	(0.20)	(0.20)	(0.16)	(0.15)	(0.17)
Food yield pc (kg/person)	307.24	307.07	302.26	290.40	299.95
	(163.40)	(163.43)	(149.04)	(136.39)	(145.29)
Potential crop pc (kg/person)	2009.36	2009.63	1919.70	1836.54	1869.30
	(1730.30)	(1729.52)	(1398.79)	(1164.94)	(1373.26)
Distance to nearest city (km)	49.34	49.29	48.95	49.90	48.90
	(27.77)	(27.80)	(27.64)	(28.00)	(27.45)
Distance to prov cap city (km)	186.94	187.03	186.19	190.99	186.88
	(103.88)	(103.88)	(106.43)	(108.07)	(105.29)
Normalised average distance	0.01	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Dummy for Jin Shi 1–9	0.36	0.36	0.37	0.40	0.38
	(0.48)	(0.48)	(0.48)	(0.49)	(0.48)
Dummy for Jin Shi >=10	0.38	0.38	0.38	0.34	0.38
	(0.49)	(0.49)	(0.49)	(0.47)	(0.49)
IV Dist adj potential SDY	7327.72	7331.55	8077.66	6909.90	6906.35
	(10489.93)	(10487.28)	(10873.01)	(9915.79)	(8596.41)
No. of counties	1217	1218	893	836	885

Note: The column title (i.e., GDP, NTL, etc.) mean the sample for that dependent variable.

Table 2: Selected OLS Results of GDP and NTL: 1988–2010

	Full Sample Estimation		Core Sample	
	Log(GDP pc)	Log(NTL pc)	Log(GDP pc)	Log(NTL pc)
	(1)	(2)	(3)	(4)
Log SDY received per pop64	0.122***	0.179***	0.117***	0.155***
	(0.016)	(0.020)	(0.017)	(0.022)
Average YOS (cohort born <=1952)	0.076***	0.077***	0.064***	0.060***
	(0.013)	(0.020)	(0.013)	(0.023)
Log Total population in 1964	-0.142***	-0.175***	-0.130***	-0.133***
	(0.024)	(0.038)	(0.028)	(0.046)
Population density in 1964 (pop(1,000)/(km^2))	0.448***	0.160	0.548***	0.277**
	(0.121)	(0.148)	(0.131)	(0.138)
Log Cultivated area 1957 per pop64	-0.133**	-0.007	-0.001	0.227
	(0.060)	(0.086)	(0.122)	(0.184)
Log Yield in 1957 per pop64	-0.007	-0.211***	0.039	-0.176**
	(0.059)	(0.074)	(0.053)	(0.074)
Log Potential crop per pop64	0.020	0.032	-0.107	-0.179
	(0.038)	(0.057)	(0.107)	(0.153)
Log Distance to nearest city	0.037	-0.036	-0.006	-0.151**
	(0.033)	(0.055)	(0.035)	(0.062)
Log Distance to provincial capital	-0.090***	-0.222***	-0.113***	-0.208***
	(0.028)	(0.039)	(0.029)	(0.045)
Log normalised distant	0.272***	0.335***	0.183**	0.189
	(0.079)	(0.127)	(0.079)	(0.155)
Dummy for no. of Qing Jinshi (1-9)	0.051**	0.038	0.043*	0.062
	(0.025)	(0.046)	(0.025)	(0.050)
Dummy for no. of Qing Jinshi (>=10)	0.112***	0.099*	0.104***	0.121**
	(0.036)	(0.055)	(0.036)	(0.059)
Provincial fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
No. of observations	38739	32075	30059	25340
No. of clusters	238	239	177	178
No. of Counties	1529	1530	1217	1218
Adj. R^2	0.797	0.663	0.806	0.683

Note: Robust standard errors in parentheses, which are clustered at the prefecture level with the prefecture borders fixed at time of the SDY program. Significance code: * p<0.10, ** p<0.05, *** p<0.01.

Table 3: Selected IV Results of GDP and NTL: 1980–2013

	Full Sample Estimation		Core Sample	
	Log(GDP pc)	Log(NTL pc)	Log(GDP pc)	Log(NTL pc)
	(1)	(2)	(3)	(4)
Panel A:		Second Stage Estimation		
Log SDY received per pop64	0.109	0.321	0.335***	0.454***
	(0.159)	(0.243)	(0.097)	(0.139)
Average YOS (cohort born <=1952)	0.077***	0.059	0.037*	0.022
	(0.026)	(0.038)	(0.019)	(0.030)
Log Total population in 1964	-0.148*	-0.108	-0.035	-0.002
	(0.081)	(0.117)	(0.052)	(0.075)
Population density in 1964 (pop(1,000)/(km^2))	0.445***	0.199	0.579***	0.322**
	(0.133)	(0.166)	(0.134)	(0.149)
Log Cultivated area 1957 per pop64	-0.133**	-0.007	-0.069	0.140
	(0.059)	(0.088)	(0.166)	(0.263)
Log Yield in 1957 per pop64	-0.004	-0.247**	-0.028	-0.270***
	(0.068)	(0.098)	(0.063)	(0.095)
Log Potential crop per pop64	0.019	0.040	-0.067	-0.130
	(0.041)	(0.062)	(0.147)	(0.224)
Log Distance to nearest city	0.036	-0.019	0.004	-0.139**
	(0.038)	(0.062)	(0.038)	(0.063)
Log Distance to provincial capital	-0.092***	-0.201***	-0.074**	-0.161***
	(0.035)	(0.057)	(0.037)	(0.058)
Log normalised distant	0.272***	0.332***	0.133	0.111
	(0.078)	(0.126)	(0.087)	(0.158)
Dummy for no. of Qing Jinshi (1-9)	0.051*	0.035	0.038	0.053
	(0.027)	(0.048)	(0.028)	(0.057)
Dummy for no. of Qing Jinshi (>=10)	0.114**	0.073	0.072*	0.076
Panel B:		First Stage Estimation		
	Log(GDP pc)	Log(NTL pc)	Log(GDP pc)	Log(NTL pc)
Log weighted potential SDY within prov	0.321***	0.332***	0.751***	0.753***
F for Weak IV Test	12.33	12.82	53.19	54.93
No. of observations	38739	32075	30059	25340
No. of clusters	238	239	177	178
No. of Counties	1529	1530	1217	1218

Note: Robust standard errors in parentheses, which are clustered at the prefecture level with the prefecture borders fixed at time of the SDY program. Significance code: * p<0.10, ** p<0.05, *** p<0.01.

Table 4: Selected IV Results of TVE Outcomes: 1980–1996

	Full Sample Estimation				Core Sample	
	Ln(Otp pc)	Ln(Rev pc)	Ln(Emp pc)	Ln(Otp pc)	Ln(Rev pc)	Ln(Emp pc)
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:			Second Stage Estimation			
Log SDY received per pop64	0.739***	0.639***	0.609**	0.614***	0.484***	0.300***
	(0.236)	(0.223)	(0.266)	(0.146)	(0.134)	(0.090)
Average YOS (cohort born <=1952)	-0.001	0.048	-0.020	-0.004	0.073**	0.025
	(0.049)	(0.044)	(0.049)	(0.039)	(0.033)	(0.026)
Log Total population in 1964	0.245*	0.287**	0.301**	0.225*	0.232**	0.156**
	(0.133)	(0.123)	(0.139)	(0.122)	(0.101)	(0.065)
Population density in 1964 (pop(1,000)/(km^2))	1.984***	0.929***	1.295***	1.761***	0.735***	0.857***
	(0.385)	(0.299)	(0.369)	(0.343)	(0.252)	(0.207)
Log Cultivated area 1957 per pop64	0.110	-0.185	-0.076	0.130	0.004	0.020
	(0.141)	(0.139)	(0.102)	(0.226)	(0.230)	(0.109)
Log Yield in 1957 per pop64	-0.176	0.044	-0.084	-0.156	0.038	-0.062
	(0.124)	(0.111)	(0.106)	(0.132)	(0.123)	(0.101)
Log Potential crop per pop64	-0.074	0.056	0.083	-0.265	-0.311	-0.142
	(0.102)	(0.108)	(0.064)	(0.217)	(0.213)	(0.108)
Log Distance to nearest city	0.156**	0.050	0.150**	0.138*	0.079	0.147**
	(0.071)	(0.065)	(0.073)	(0.072)	(0.080)	(0.059)
Log Distance to provincial capital	-0.161**	-0.236***	-0.055	-0.146**	-0.252***	-0.062*
	(0.065)	(0.065)	(0.050)	(0.069)	(0.066)	(0.037)
Log normalised distant	0.333**	0.159	0.239**	0.369*	0.292	0.395**
	(0.134)	(0.141)	(0.112)	(0.190)	(0.227)	(0.162)
Dummy for no. of Qing Jinshi (1-9)	0.062	0.083	0.028	0.108	0.139**	0.086*
	(0.077)	(0.073)	(0.071)	(0.076)	(0.065)	(0.051)
Dummy for no. of Qing Jinshi (>=10)	0.092	0.192*	0.042	0.129	0.236***	0.140*
	(0.116)	(0.101)	(0.106)	(0.112)	(0.090)	(0.073)
Panel B:			First Stage Estimation			
	Ln(Otp pc)	Ln(Rev pc)	Ln(Emp pc)	Ln(Otp pc)	Ln(Rev pc)	Ln(Emp pc)
Log weighted potential SDY within prov.	0.333***	0.282***	0.242**	0.739***	0.622***	0.808***
	(0.101)	(0.101)	(0.106)	(0.103)	(0.120)	(0.118)
F for Weak IV Test	13.59	11.04	7.18	67.44	29.09	55.52
No. of observations	7188	6905	7248	5450	5126	5071
No. of clusters	226	203	218	168	148	163
No. of Counties	1179	1105	1157	893	836	885

Note: Robust standard errors in parentheses, which are clustered at the prefecture level with the prefecture borders fixed at time of the SDY program. The Kleibergen-Paap Wald rk F statistic is reported for the weak IV test. Significance code: * p<0.10, ** p<0.05, *** p<0.01.

Table 5: Sensitivity Tests (Selected IV Results of GDP Per Capita, Core Sample)

	Original	Test Mergers/Splites		Alt Dist.		Alternative Education			Alternative IV		Cluster at
		add dum	excl. m/s		1990 levels	1982 YOS	1982 level	<=1955 coh.	$Dist^2$	ln(Dist)	prov level
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Log SDY received per pop64	0.335***	0.337***	0.344***	0.333***	0.330***	0.286***	0.274***	0.335***	0.328***	0.349***	0.335***
	(0.097)	(0.097)	(0.101)	(0.100)	(0.096)	(0.101)	(0.096)	(0.097)	(0.116)	(0.095)	(0.115)
Dummy for mergers/spliters		0.096**									
		(0.038)									
Proportion with < primary (1990)					-0.488***						
					(0.179)						
Proportion with >= junior high (1990)					-0.517						
					(0.495)						
Proportion with >= senior high (1990)					0.582						
					(0.916)						
Average YOS (cohort born <=1952)						0.140***					
						(0.036)					
Proportion with less than primary school							-1.364***				
							(0.227)				
Proportion with junior high school or above							-1.092				
							(0.883)				
Proportion with senior high school or above							0.712				
							(1.892)				
Average years of schooling								0.036*			
								(0.019)			
F for Weak IV Test	53.19	53.47	51.89	30.73	52.38	46.06	47.28	53.22	32.98	49.22	47.33
No. of obs.	30059	30059	26649	30059	30059	30151	30151	30059	30059	30059	30059
No. of Clusters	177	177	171	177	177	179	179	177	177	177	18
No. of Counties	1217	1217	1069	1217	1217	1224	1224	1217	1217	1217	1217

Note: Robust standard errors in parentheses, which are clustered at the prefecture level with the prefecture borders fixed at time of the SDY program. The Kleibergen-Paap Wald rk F statistic is reported for the weak IV test. Significance code: * p<0.10, ** p<0.05, *** p<0.01.

Table 6: Consistent sample for all outcome variables: IV results for the core sample

	GDP and Nighttime Light		TVE Outcome Variables		
	ln(GDP pc)	ln(NTL pc)	ln(Output pc)	ln(Reve pc)	ln(Emp pc)
	(1)	(2)	(3)	(4)	(5)
Log SDY received per pop64	0.395***	0.657***	0.793***	0.767***	0.379***
	(0.135)	(0.218)	(0.237)	(0.232)	(0.129)
F for Weak IV Test	20.268	20.268	20.268	20.268	20.268
No. of observations	938	938	938	938	938
No. of clusters	83	83	83	83	83
No. of counties	472	472	472	472	472

Note: Robust standard errors in parentheses, which are clustered at the prefecture level with the prefecture borders fixed at time of the SDY program. The Kleibergen-Paap Wald rk F statistic is reported for the weak IV test. Significance code: * p<0.10, ** p<0.05, *** p<0.01.

Table 7: Selected Results from the Channel Analysis: Education and Migration

	Average years of schooling of SDY cohort		Migration as share of working pop	
Data period	1990		1990, 2000, 2005, 2010	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Log SDY received per pop64	0.055**	0.211*	0.001	0.029***
	(0.022)	(0.117)	(0.002)	(0.010)
F for Weak IV Test		35.32		53.45
No. of observations	1233	1233	4203	4203
No. of clusters	186	186	175	175
No. of counties	1233	1233	1167	1167

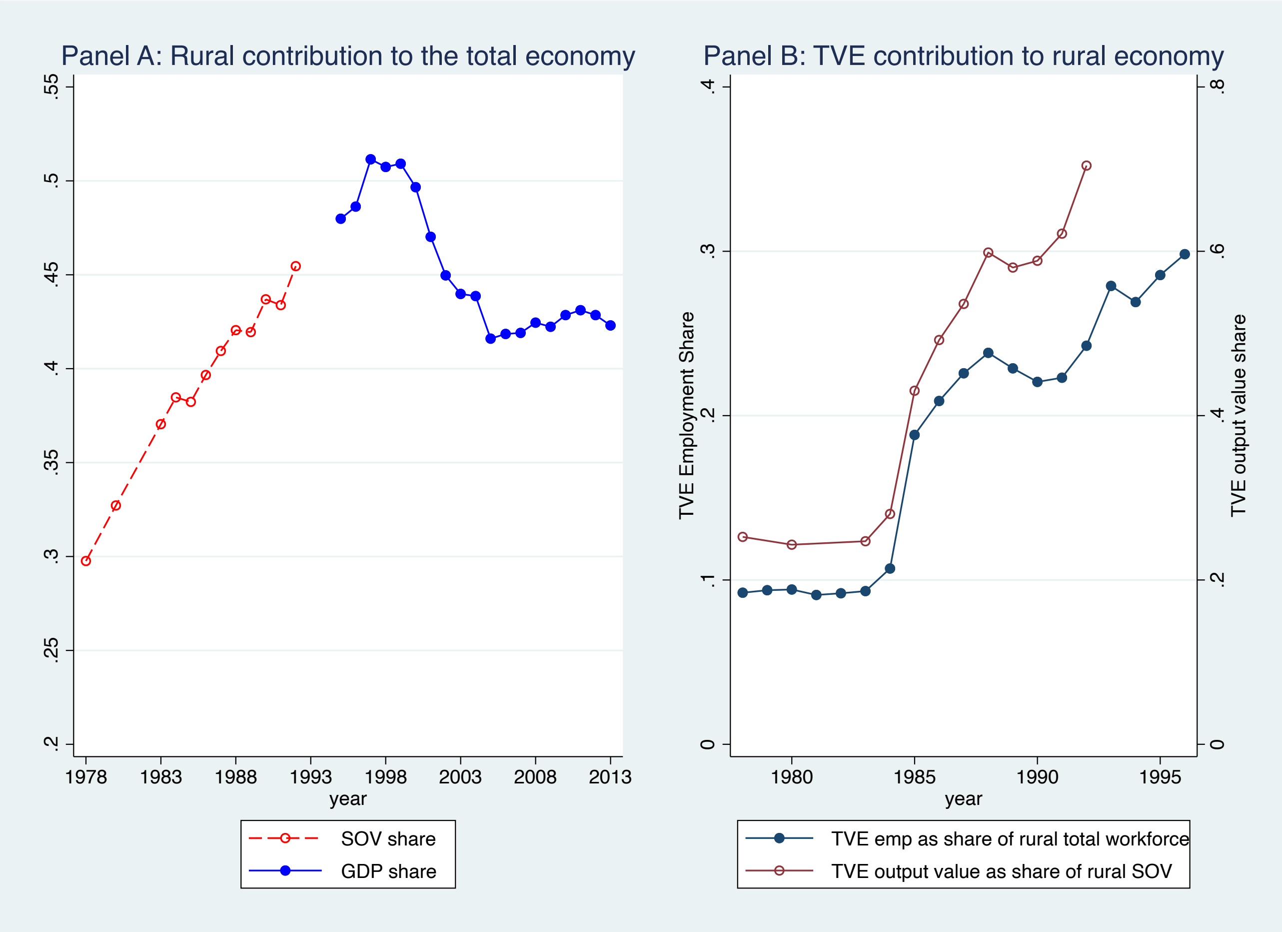
Note: Robust standard errors in parentheses, which are clustered at the prefecture level with the prefecture borders fixed at time of the SDY program. The Kleibergen-Paap Wald rk F statistic is reported for the weak IV test. Significance code: * p<0.10, ** p<0.05, *** p<0.01.

Table 8: Selected OLS Results from the Channel Analysis: Contribution of Various Channels

	Dependent variable: Log per capita GDP		
	Incl. TVE output	Incl. 53-63 YOS	Incl. mig share
Data period	1988-2001	1990	93, 03, 08, 13
	(1)	(2)	(3)
Log SDY received per pop64	0.070***	0.104***	0.127***
	(0.019)	(0.016)	(0.018)
5-Year lagged TVES output pc	0.267***		
	(0.021)		
Average years of schooling (cohort 1953-1963)		0.073***	
		(0.022)	
3-Year lagged out migration			0.521**
			(0.214)
Baseline model coeff.: Log SDY received per pop64	0.112***	0.109***	0.127***
	(0.025)	(0.017)	(0.018)
No. of obs.	4463	1021	3858
No. of Clusters	163	155	174
No. of Counties	853	1021	1157

Note: Robust standard errors in parentheses, which are clustered at the prefecture level with the prefecture borders fixed at time of the SDY program. Significance code: * p<0.10, ** p<0.05, *** p<0.01.

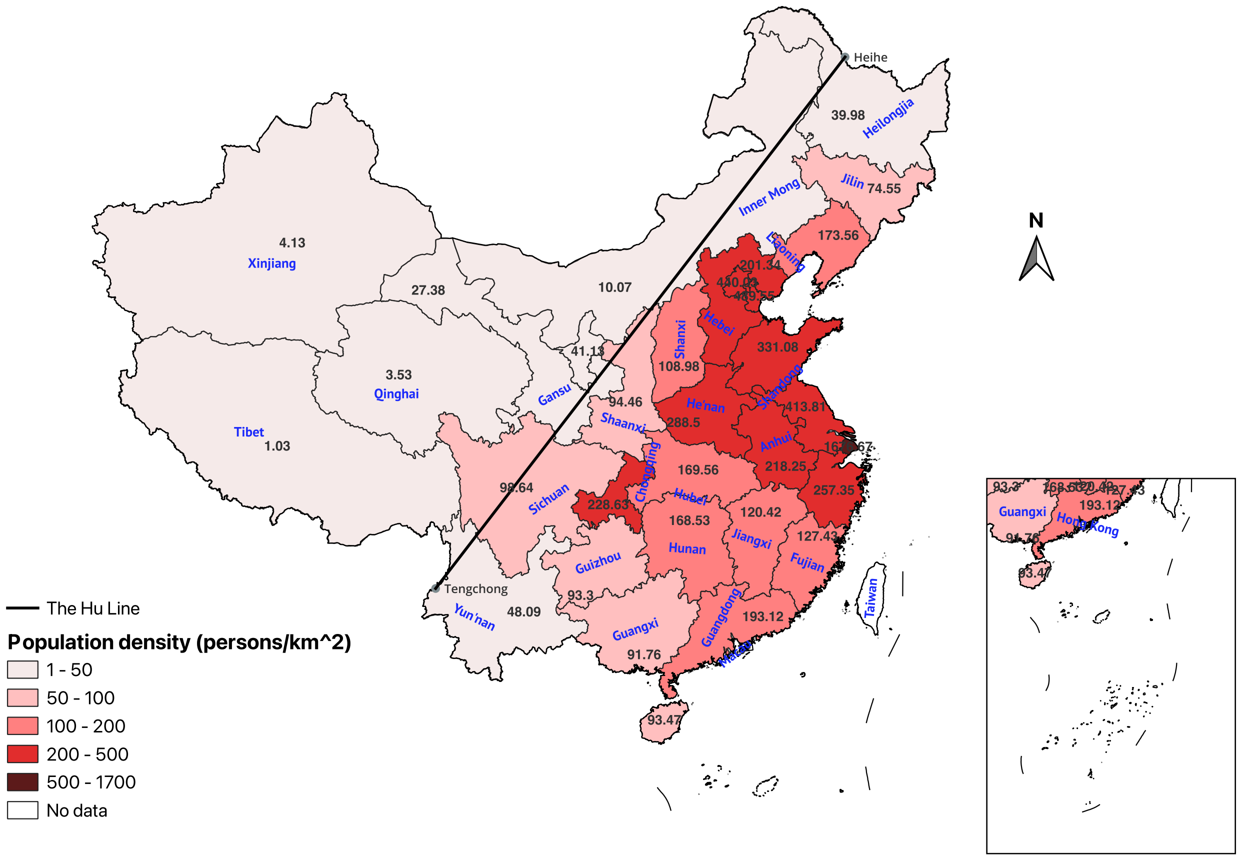
Figure 1: Importance of rural economy and TVE sector: 1978-2010



Note: SOV is social output value; GDP share includes county level cities.

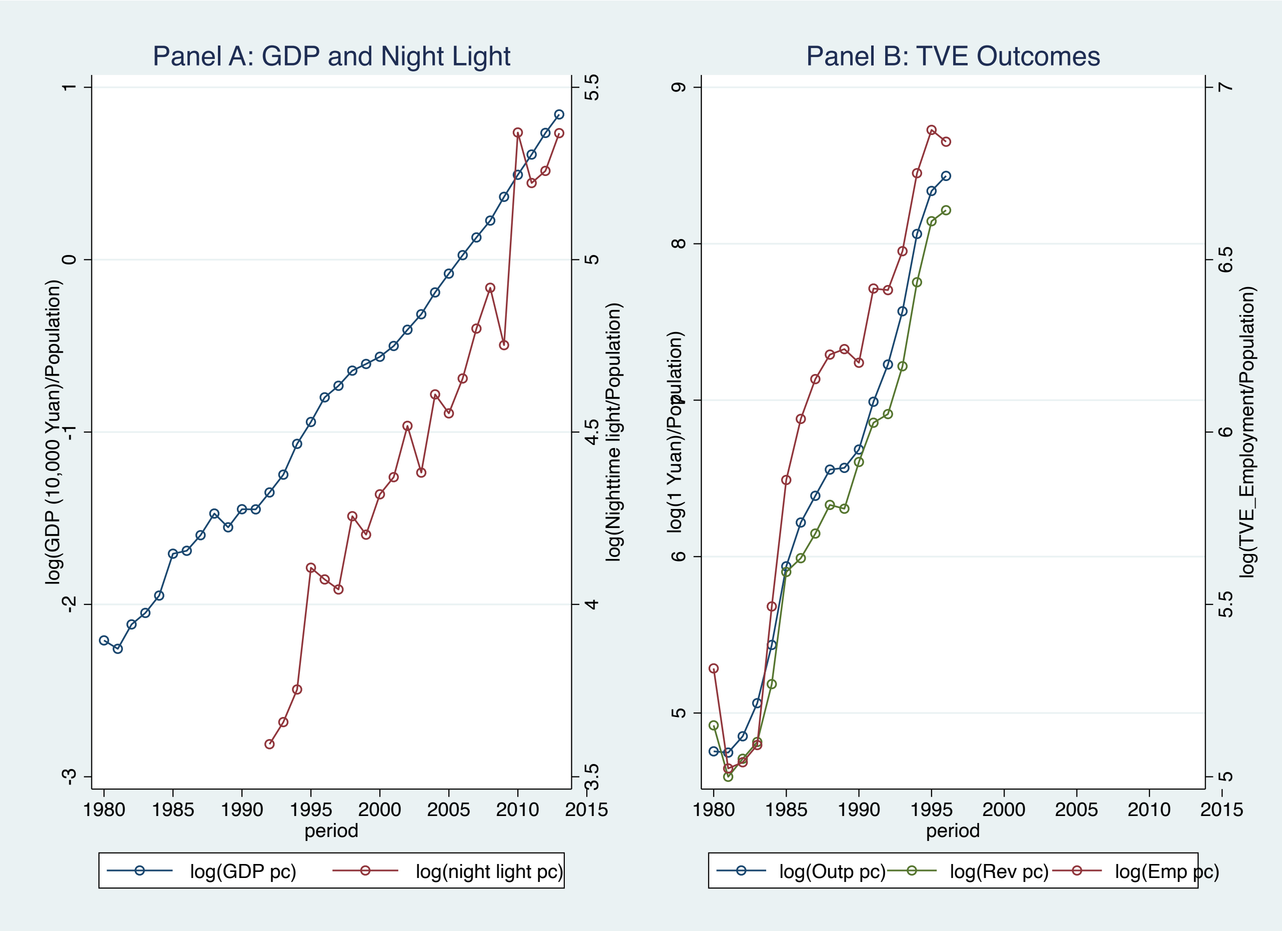
Data sources: various statistical yearbooks; see the details in Appendix B.

Figure 2: The 1960 Population density map



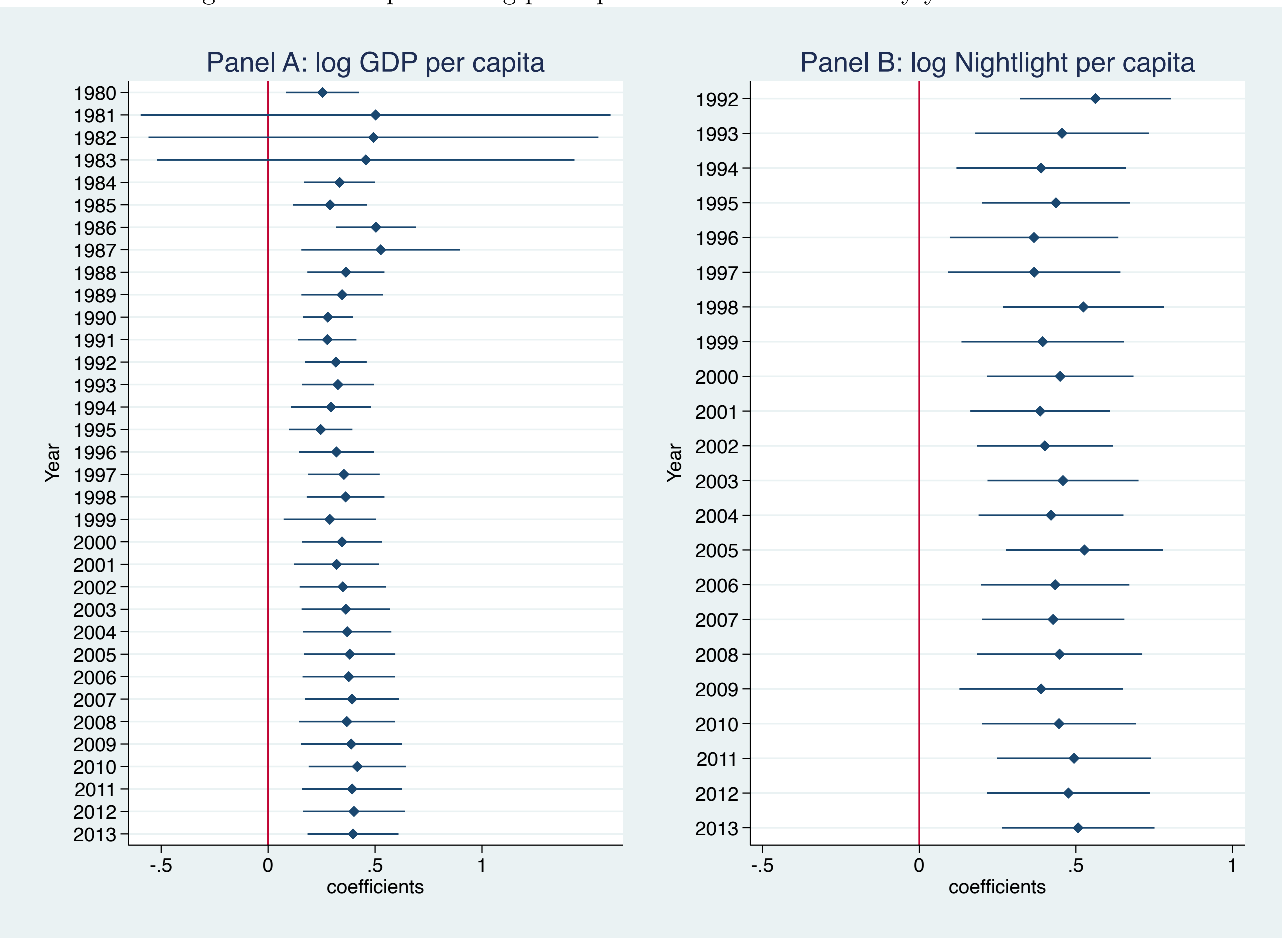
Data source: The 2006 China Civil Affairs Statistical Yearbook; China Compendium of Statistics 1949-2008.

Figure 3: Log per capita real GDP, TVE output and revenue, and night-time light: 1980-2013



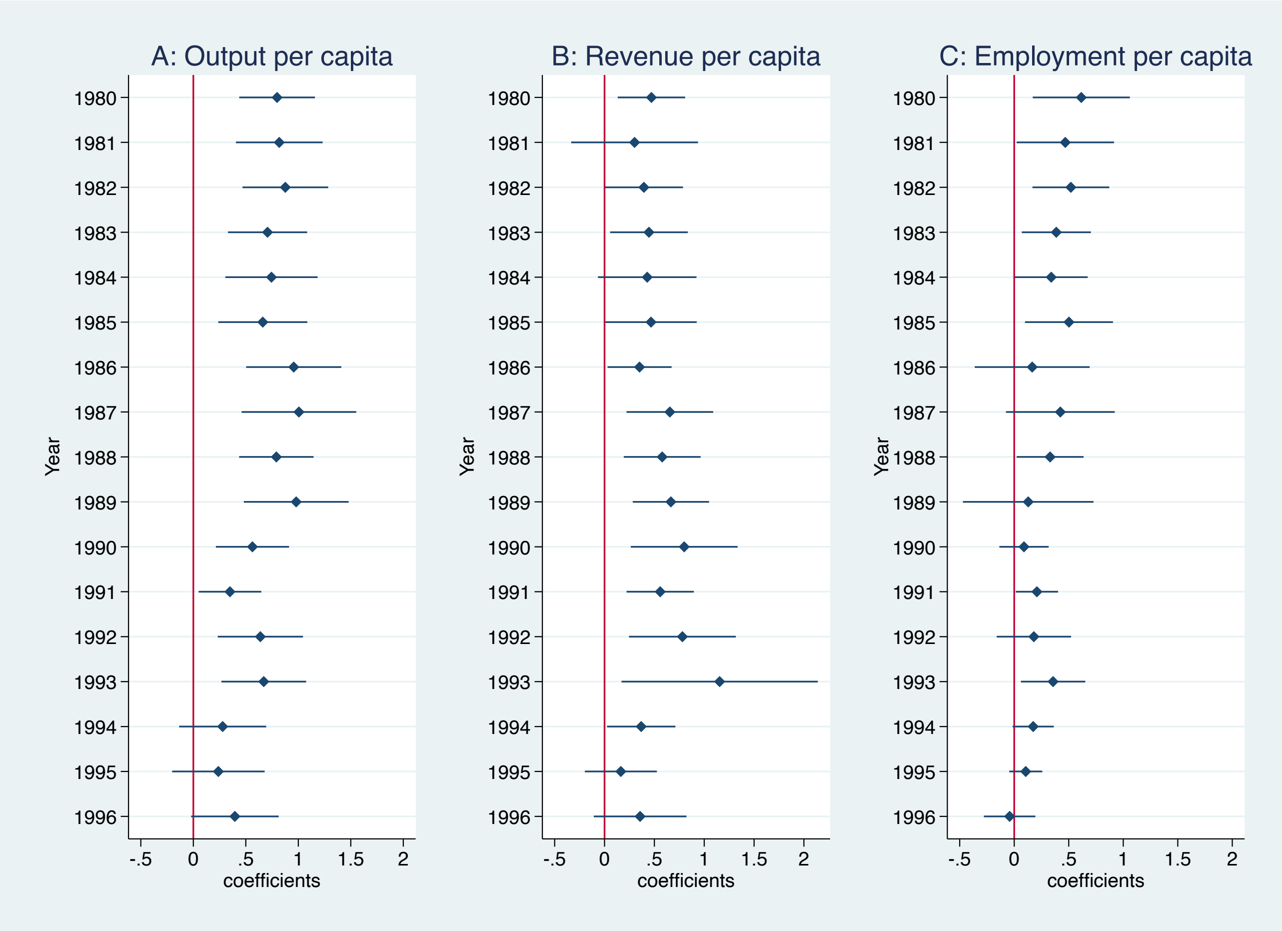
Data sources: various statistical yearbooks, see details in Appendix B.

Figure 4: SDY impact on log per capita real GDP and NTL by year: 1980-2013



Note: The horizontal bars in figures represent the 95% confidence interval.

Figure 5: Log per capita real TVE output value and TVE revenue by year: 1980-1996



Note: The horizontal bars in figures represent the 95% confidence interval.

APPENDIX A Detailed SDY Information

Table A1: The pattern of the size of SDY sent from cities

	provincial data		city data
VARIABLES	(1)	(2)	(3)
Industrial sector output share to the social total output	-1.501***		
	(0.408)		
Industrial sector GDP to the total GDP		-1.330***	
		(0.431)	
Log urban population	1.291***	1.220***	
	(0.090)	(0.086)	
Second industry sector GDP to the total GDP			-2.285**
			(1.023)
Log number of staffs in state- and collective-owned working units			1.802***
			(0.251)
Constant	-3.008***	-2.891***	5.610***
	(0.439)	(0.459)	(1.484)
Provincial fixed effects	No	No	Yes
No. of observations	27	27	50
R-squared	0.910	0.899	0.759

Note: Columns (1) and (2) utilize the provincial data, while column (3) employs the prefectrual-level city data. All independent variables are from year 1965. Due to missing urban population for Inner Mongolia and industrial output/GDP share for Tibet, the provincial sample comprises 27 provinces. The industrial sector GDP for Jiangxi province is unavailable in 1965; therefore, we estimate the industrial sector GDP for Jiangxi province in 1965 using the second industry sector GDP and the ratio of the industrial sector to the whole second industry sector GDP from the closet available year.
Standard errors in parentheses. Significance code: *** p<0.01, ** p<0.05, * p<0.1.

Data source: China Compendium of Statistics 1949-2008; Compilation of Historical Statistical Data of Provinces, Autonomous Regions and Municipalities 1949-1989; Anhui Sixty Years (1949-2009); Glorious 60 Years of Shandong; Glorious 60 Years of Shanxi; Guangdong Fifty Years; Zhejiang Statistical Compendium for 60 Years; Glorious Fifty Years of Fujian; Glorious 60 Years of Liaoning; Heilongjiang Sixty Years (1949-2009).

Table A2: Total Number of SDY to and from Each Province (10,000 persons, %)

	(1) Total SDY from own prov (2)+(5)-(3)	(2) Total No. SDY to own prov (1)+(3)	(3) Total Rcvd from other prov	(4) % Rcvd from other prov (3)/(2)	(5) Total No. sent to other prov	(6) % being sent to other prov (5)/(1)
Beijing	63.63	38.42	0	0.00%	25.21	39.62%
Tianjin	46.51	19.36	0	0.00%	27.15	58.37%
Hebei	38.44	51.05	13.27	25.99%	0.66	1.72%
Shanxi	26.43	31.29	4.86	15.53%	0	0.00%
Inner Mongolia	19.38	29.93	10.55	35.25%	0	0.00%
Liaoning	201.34	201.8	0.46	0.23%	0	0.00%
Jilin	99.14	105.26	6.12	5.81%	0	0.00%
Heilongjiang	151.92	192.22	40.3	20.97%	0	0.00%
Shanghai	125.22	53.23	0	0.00%	71.99	57.49%
Jiangsu	82.84	86.12	5.1	5.92%	1.82	2.20%
Zhejiang	64.62	59.59	3.2	5.37%	8.23	12.74%
Anhui	57.65	72.55	14.9	20.54%	0	0.00%
Fujian	37.23	37.23	0	0.00%	0	0.00%
Jiangxi	50.45	62.25	11.8	18.96%	0	0.00%
Shandong	51.29	49.27	0	0.00%	2.02	3.94%
Henan	67.3	67.3	0	0.00%	0	0.00%
Hubei	88.66	87.86	0	0.00%	0.8	0.90%
Hunan	63.58	63.58	0	0.00%	0	0.00%
Guangdong	97.32	97.32	0	0.00%	0	0.00%
Guangxi	43.48	43.48	0	0.00%	0	0.00%
Sichuan	147.24	142.74	0	0.00%	4.5	3.06%
Guizhou	21.35	22.41	1.06	4.73%	0	0.00%
Yunnan	23.25	33.91	10.66	31.44%	0	0.00%
Tibet	0.34	0.34	0	0.00%	0	0.00%
Shaanxi	46.31	49.03	2.72	5.55%	0	0.00%
Gansu	24.52	26.43	1.91	7.23%	0	0.00%
Qinghai	4.36	5.1	0.74	14.51%	0	0.00%
Ningxia	4.92	5.75	0.83	14.43%	0	0.00%
Xinjiang	27.76	41.66	13.9	33.37%	0	0.00%
Total	1776.48	1776.48	142.38	8.01%	142.38	8.01%

Data source: Gu and Hu (1996).

APPENDIX B Data

APPENDIX B.1 Data Sources

Jin and Jin (2014): This is our main source of information about the number of SDYs received in each county and the number sent from each city. This book presents comprehensive information about the SDYs program at the county/city level compiled from the gazetteers (see below). Our research assistants entered the data manually into electronic files.

Gazetteers: These provided us with information about TVE activities and about the school expansion during the Cultural Revolution. The gazetteers were published by offices at different levels of the Chinese administration (county, city, prefectural, provincial and sector/industry) between the late 1980s and the early 1990s. We have downloaded scanned PDF copies from various Chinese libraries and processed with OCR software.

Gu and Hu (1996): This is our source for aggregate statistics on inter-provincial flows of SDYs. The editors and authors were provincial officials directly involved with the SDY program at the time and had access to unpublished historical documents. Our research assistants entered the data manually into electronic files.

Statistical yearbooks: These provided us with information about county-level population size, land area, GDP statistics, and TVE statistics. Some books have retrospective information for some regions. The yearbooks were published by offices at different levels of the Chinese administration (China county statistical yearbooks, provincial statistical yearbooks, TVE statistical yearbook, the 30/50/60-year statistical materials, and the 1987/1988/1989 China Population and Labor Force Statistical Yearbooks). We combined information from many different yearbooks because the information published in the individual volumes is often incomplete (especially for the early years). Electronic versions of the yearbooks (PDF scans, files with OCR output of PDF scans) data are available from the private companies 'China Data Online' and 'CNKI' (China National Knowledge Infrastructure). We edited some suspicious values and filled some missing values by comparing with print publications or with Wikipedia or Baidu Baike.

Census books: The 1964 Census book is our source for the 1964 population figures. We used census books for other years to impute missing values and to deal with counties that were split or abolished.

Census micro data for 1982 and for 1990 (one percent samples): These electronic files provided data on the proportion of people who completed primary school, junior high school and senior high school. These files exist on the web, but it is unclear who created and published them.

Nighttime light data: These electronic files provided us with the amount of NTL for a fine grid of cells covering the entire world. We downloaded the source data from Payne Institute's nighttime light website. `https://eogdata.mines.edu/products/dmsp/#v4_dmsp_download`

Agricultural potential yield data: These provided us with estimates of the potential grain output given soil composition and climate for a fine grid of cells covering the entire world. We downloaded from FAO-GAEZ web site. `https://gaez.fao.org/pages/theme-details-theme-3`.

County boundary map data: These electronic files are used for aggregating data within each county. The files also contain estimates of the county land area. We used the county area and map file from the 1999 boundaries published in the 2006 version of the National Spatial Information Infrastructure Data Base by a Chinese government institution. If there were changes in borders before 1999, we adjust the county area using the yearbook data.

Agricultural Production Statistics 1957: This book provided us with data on the percentage of the county's land area that was cultivated, the percentage that was used for food production, and the total grain yield in 1957. We used PDF scans available from the library of Southwestern University of Finance and Economics and OCR processing to create compatible statistics to the 1999 boundaries of counties.

CNRDS (Chinese Research Data Services Platform): This database provides concise biographies for Chinese government officials and it is our source for the number of officials born in each county. It provides the electronic data through the website of https://www.cnrds.com.

Jiang (2007) 'Qing Chao Jin Shi Ti Ming Lu': This book provides information about people who passed the highest level ('Jinshi') of the examination for government officials during the Qing dynasty. The exam was usually conducted every three years. Our research assistants digitalise the hard copy, and then match the county name in Qing Dynasty of each person's birth place with the current name. Finally, we calculate the number of Jinshi in Qing Dynasty in each county.

Changes in county boundaries: These information are mainly from gazetteers, Baidu Baike and the website http://www.xzqh.org. They includes the history of each administrative division of China.

EPSDATA database: This database (https://www.epsnet.com.cn) provides the year over year deflators of GDP. Using this, we transform all of the monetary variables into the 2010 price.

The 2006 version of the National Basic Geographic Information Data Base: This database includes the longitude and latitude coordinates information of the county towns and city locations, land area and boundaries in 1999.

APPENDIX B.2 Tracking County Boundaries Over Time

China has five levels of local administrative divisions, generally referred to as the provincial level (1st), the prefecture level (2nd), the county level (3rd), the township level (4th), and the village level (5th). The unit of observation in our data is the county level. There are several types of divisions at each level. As a point of reference, in 2017 there were 2850 third-level (claimed) divisions of which 954 were districts (urban), 366 county-level cities (rural); 1,359 counties (rural), 117 autonomous counties (rural), 49 banners (rural), 3 autonomous banners (rural), 1 special district, and 1 forestry district. We compile data for the rural divisions only, because only rural areas received SDY. For simplicity, we refer to all rural divisions as 'counties'.

Changes in the administrative divisions over time are not uncommon. Some changes are simple, such as changes in the name or the administrative code. We keep track of these changes and continue to link data as appropriate. Complicated changes include splits and mergers. If a county was split, we have either imputed values for the pre-split variables in the post-split counties using data on pre- and post-split size of the land or the population. Or we have dropped these counties from the analysis if the imputation was difficult. Similarly, if two or more counties merged were merged, we aggregate pre-merger data for the combined counties. A few changes involved both splits and mergers. (E.g. a county was abolished and its parts were merged with several different neighbouring counties.) In most cases, we have dropped these counties from the analysis.

Information about changes in the administrative divisions comes from website of www.xzqh.org, gazetteers, and Baidu Baike.

APPENDIX B.3 Variables

Many of the variables are log-transformed in the regression analysis, as indicated in the tables of estimation results. Per capita economic outcome variables are normalised using the same-year county population size. Per capita control variables are normalised using the 1964 county population size.

Economic Outcome Variables

Population size 1979–1999: The main source for population estimates are the statistical yearbooks. It is surprisingly difficult to obtain a consistent measure of population size across time and counties. This is partly because many counties did not provide annual population estimates in the 1970s and 1980s, and partly because the population concept varies between the permanent, the registered, and the current population. In cases were we have multiple figures to choose from, we have generally prioritised the current over the permanent over the registered population. Some outliers have been edited manually using historical information from e.g. Wikipedia and Baidu Baike. Where possible, we have imputed missing population values for 1979–1981 and 1983–1986 using the average growth rate between 1982 and 1987. `https://international.ipums.org/international/`

GDP per capita 1979–1999: The main source for GDP estimates are the statistical yearbooks. We deflate nominal GDP using the provincial-level GDP price index. It is surprisingly difficult to obtain a consistent measure of GDP across time and counties, especially in the early years. This is partly because some counties in some years reported GDP figures excluding the service sector. Some outliers have been edited manually using historical information from e.g. Wikipedia and Baidu Baike. `https://international.ipums.org/international/`

NTL per capita 1982–1999: The data source is NTL data and the county boundary map data. We aggregated the grid-cell information to the county-level using the county boundary data and the QGIS software.

TVE activity per capita 1979–1999: The main source is the statistical yearbooks, supplemented with information from the gazetteers. For activities, we consider the total number of TVE per capita, total TVE employment per capita, and total TVE revenue per capita (deflated by the provincial-level GDP price index). If the TVE data are both available in the gazetteers and statistical yearbook, and are not consistent, we compare with the trend and other county-level variables and choose the one with smooth trend in either with TVE variables or in the correlation with other variables. Fortunately, they are basically consistent when they are available in both gazetteers and statistical yearbooks.

County-level Control and Instrumental Variables

Population size: This variable is based on estimates taken from the 1964 census.

Number of SDY received per capita: This variable is based on Jin and Jin (2014) and the 1964 census.

Number of SDY sent from cities: Totally 263 prefectures/cities have the records of the number of youths sent to the rural areas.

Education prior to the SDY program: Using census micro data for 1982 and 1990, we compute three variables for the proportion of people born no later than 1952 who has not completed primary school, who has completed at least junior high school, and who has completed at least senior high school.

Area per capita: Our main source of the county land area is the county county map data, supplemented with data from the statistical yearbooks when missing or misleading. In some cases it is unclear whether islands and lakes are included in the area or not.

Area of cultivated land per capita: This variable comes from the agricultural production statistics 1957.

Area of land used for food production per capita: This variable comes from the agricultural production statistics 1957.

Grain yield per capita: This variable comes from the agricultural production statistics 1957.

Potential crop yield per capita: This variable is based on the agricultural suitability and potential yield data. Potential constraint-free crop yields are estimated by FAO-GAEZ using their AEZ biomass model which takes into account 'temperature, radiation and moisture regimes prevailing in the respective grid-cells' (1961–1990). We aggregated the grid-cell information to the county-level using the county boundary data and the QGIS software. We take the maximum potential output (measured in kg) of the potential wheat, rice, or maize crop yield with either rain-fed or irrigation as the water supply system.

Distance from main county town to nearest city and to provincial capital: We have two measures of the distances between counties and cities. The first method calculates the distance between the main town in the county (2006 version of the National Basic Geographical Information Database) and the city centres (2006 version of the National Basic Geographical Information Database). The second method averages over the distances between a grid of equispaced points within the county and the city centres. The grid points are 0.1×0.1 degree apart, where 0.1 degree is approximately 10 km. The distance refers to the great-circle distance, the shortest distance between two points on the surface of a sphere.

Imperial Scholars: The historical number of people from the county who passed the highest level of the imperial examination (Jinshi) during the Qing dynasty is estimated using information from Jiang (2007).

Channel variables

Education of cohorts born in 1953–1963: We calculate average years of schooling for the 1953–1963 cohorts using the 1% sample of the 1990 population census.

Rural-to-urban migration: We calculate the out-migration share of the employed labour force using the 1% sample of the 1990, 2000 and 2010 population censuses and the 25% sample of the 2005 intercensal population survey.

APPENDIX B.4 Summary Statistics

Table B1: Numbers of observations for different dependent variables at different year

					TVE Sample					
	GDP sample		NTL		Output value		Revenue		Employment	
Year	Full	Major	Full	Major	Full	Major	Full	Major	Full	Major
1980	558	358			289	251	249	209	376	321
1981	272	125			254	217	171	135	289	236
1982	272	125			266	231	181	142	299	247
1983	274	125			282	247	185	147	302	250
1984	392	242			313	270	204	162	330	272
1985	670	464			503	403	294	245	497	421
1986	448	295			237	200	286	200	307	208
1987	656	502			244	210	229	199	264	221
1988	883	728			234	190	233	193	253	199
1989	906	750			234	153	260	180	251	160
1990	1309	1021			531	360	474	363	542	367
1991	1181	945			654	456	670	568	541	341
1992	1210	974	1512	1207	734	493	660	439	454	228
1993	1095	859	1280	987	444	245	568	321	440	191
1994	1155	920	1351	1083	653	505	774	537	624	392
1995	1279	989	1520	1210	658	515	798	613	737	506
1996	1347	1052	1461	1167	658	504	669	473	742	511
1997	1490	1179	1494	1184						
1998	1503	1192	1510	1198						
1999	1514	1202	1522	1210						
2000	1471	1160	1476	1165						
2001	1465	1154	1465	1154						
2002	1463	1152	1463	1152						
2003	1462	1152	1462	1152						
2004	1460	1150	1462	1152						
2005	1460	1151	1461	1152						
2006	1460	1151	1461	1152						
2007	1461	1151	1462	1152						
2008	1437	1129	1458	1148						
2009	1425	1125	1453	1145						
2010	1442	1140	1453	1145						
Total	38739	30059	32075	25340	7188	5450	6905	5126	7248	5071

Table B2: Summary satistics for the dependent variable in the full sample

	GDP per capita (Yuan)		NTL per capita		TVE output value per capita (Yuan)		TVE revenenue per capita (Yuan)		TVE employment per 10,000 persons	
Year	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Total	10148.06	18178.32	166.96	297.70	3001.88	6989.14	2408.04	5595.35	702.45	669.84
1980	1225.17	675.38			197.19	255.16	316.94	1299.67	313.21	673.25
1981	1188.76	623.14			203.03	291.70	153.14	168.22	201.99	150.05
1982	1353.19	673.53			233.62	338.39	194.86	377.36	212.71	181.05
1983	1456.38	740.32			296.10	432.80	204.64	296.11	233.61	346.87
1984	1648.66	1626.01			414.30	556.19	278.80	288.45	353.81	324.31
1985	2160.81	1613.84			701.77	1024.11	657.96	986.97	522.48	519.84
1986	2323.27	2011.95			880.68	1366.50	585.36	691.24	532.05	357.19
1987	2368.39	2086.83			1017.30	1324.36	689.76	661.62	618.13	408.53
1988	2811.58	3408.94			1150.30	1401.03	883.51	1116.24	643.99	448.87
1989	2387.40	1365.39			1106.24	1342.67	847.29	1054.47	623.83	369.87
1990	2673.65	1863.35			1991.41	12120.95	2084.23	15198.52	662.74	711.45
1991	2697.78	1773.45			2668.74	8565.20	1590.74	2237.62	770.15	800.93
1992	3003.76	1912.64	79.61	169.43	2677.84	4270.18	1837.79	3365.35	780.86	998.25
1993	3425.08	2473.49	93.44	210.26	3291.59	4187.92	2300.73	3301.33	811.22	497.13
1994	4171.66	3184.83	89.03	150.36	5588.87	7425.02	3688.06	4569.46	991.84	560.93
1995	4724.99	3604.68	117.25	196.43	7460.36	10128.50	5319.95	5959.26	1140.23	713.31
1996	5469.74	4059.01	120.38	276.86	7701.17	8620.61	5641.33	5438.22	1094.34	621.59
1997	5846.51	4200.38	111.51	265.90						
1998	6383.48	4590.91	121.30	225.97						
1999	6751.99	4955.43	114.45	168.49						
2000	7004.49	5230.61	127.24	179.96						
2001	7503.45	5690.04	130.59	185.88						
2002	8260.46	6358.20	143.18	214.31						
2003	9157.46	7289.49	125.84	192.24						
2004	10443.14	8434.86	157.88	224.50						
2005	11623.52	9712.22	152.71	233.06						
2006	13162.78	11747.55	166.24	245.14						
2007	14789.20	13999.76	183.92	246.11						
2008	16304.25	15619.97	208.21	271.25						
2009	18713.22	18934.49	194.12	277.06						
2010	21549.84	22494.56	325.82	415.66						
2011	24275.39	25758.97	284.38	470.20						
2012	27438.76	29348.17	299.64	491.80						
2013	30372.29	31326.57	326.16	557.70						

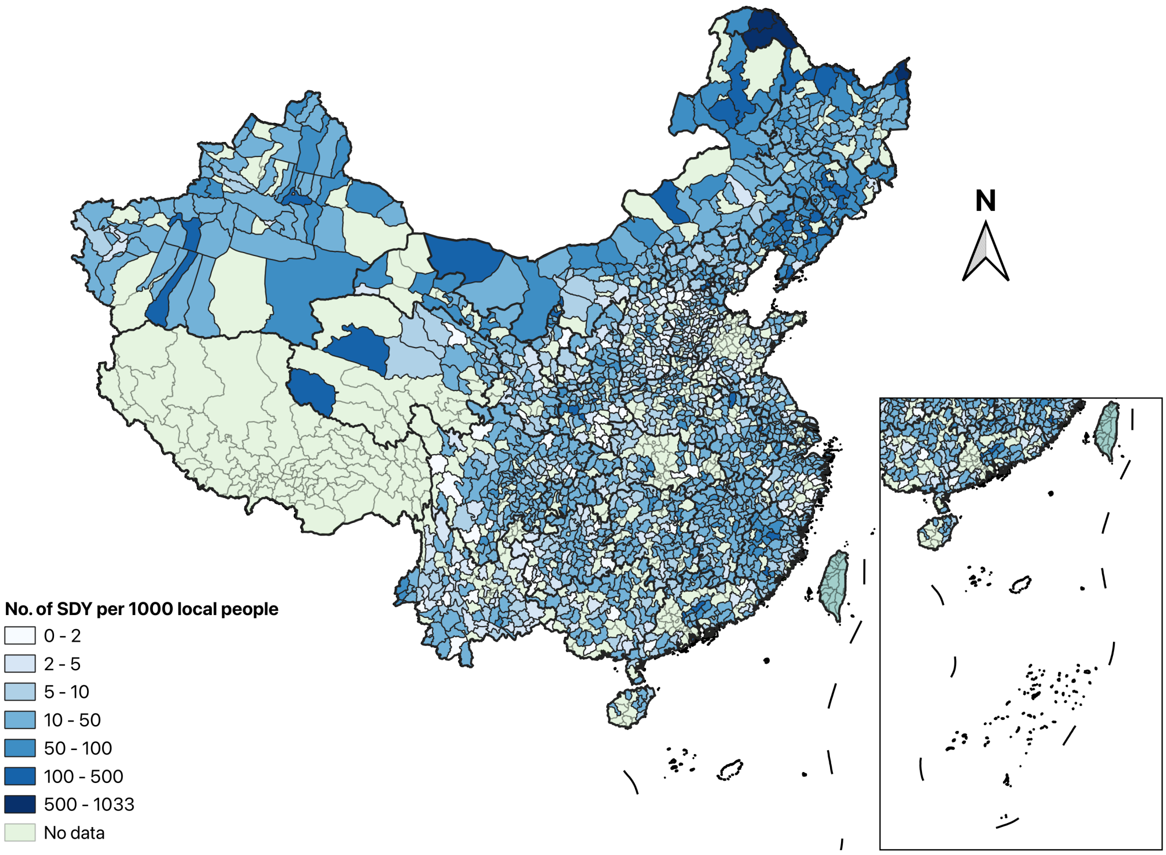
Notes: All the monetary variables are deflated to price of year 2010.

Table B3: Summary satistics for the dependent variable in the core sample

	GDP per capita (Yuan)		NTL per capita		TVE output value per capita (Yuan)		TVE revenenue per capita (Yuan)		TVE employment per 10,000 persons	
Year	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Total	10483.22	13351.2	141.95	179.65	3485.48	6393.61	2742.47	4461.76	773.53	749.06
1980	1158.94	460.02			213.54	267.94	354.89	1414.52	341.26	722.99
1981	1270.47	635.96			218.75	307.76	163.68	172.30	217.36	152.53
1982	1419.32	664.28			248.95	353.37	210.36	414.17	227.14	187.75
1983	1494.63	712.41			317.23	451.57	216.46	314.62	250.13	373.78
1984	1692.51	1972.47			441.46	574.43	295.18	290.02	378.68	298.40
1985	2216.39	1685.24			807.27	1109.00	717.20	1048.46	563.54	543.67
1986	2608.21	2337.00			966.14	1447.02	639.44	771.22	593.28	382.18
1987	2506.18	2300.61			1107.96	1382.16	711.88	658.93	655.42	414.49
1988	2960.98	3703.18			1272.68	1491.38	934.10	1182.61	706.96	468.34
1989	2446.99	1389.32			1329.60	1548.18	956.58	1187.38	676.12	397.49
1990	2586.74	1491.44			1891.96	2596.37	1652.20	2452.35	767.20	825.41
1991	2716.89	1801.76			2318.89	2965.87	1782.81	2374.85	955.08	943.16
1992	3046.26	1932.51	72.11	110.31	3608.03	4931.11	2368.55	3997.53	1051.82	1331.69
1993	3680.68	2603.94	77.90	134.55	4788.69	5028.49	3162.02	4084.81	1092.86	555.32
1994	4496.73	3385.12	87.67	149.02	6788.12	8027.79	4590.56	5173.47	1173.91	591.51
1995	4957.89	3482.49	107.47	150.70	8992.13	10921.41	6211.93	6452.02	1301.03	733.09
1996	5802.13	4032.07	105.39	214.65	9313.08	9192.91	6583.75	5989.90	1196.48	672.44
1997	6231.38	4362.89	96.12	110.84						
1998	6822.41	4798.61	105.69	105.67						
1999	7190.03	5159.02	101.63	97.38						
2000	7482.66	5432.16	109.13	106.40						
2001	8004.18	5941.02	113.45	108.48						
2002	8806.00	6636.45	123.11	109.13						
2003	9766.27	7575.37	109.77	103.24						
2004	11071.99	8683.38	136.74	135.30						
2005	12209.67	9804.08	129.71	140.80						
2006	13719.36	11546.42	143.36	159.39						
2007	15292.66	13325.09	158.91	164.43						
2008	16591.47	13667.53	179.79	197.12						
2009	18680.50	15274.01	161.70	193.99						
2010	21591.91	18315.95	267.45	286.33						
2011	24152.62	20190.29	233.68	245.55						
2012	27112.31	22251.84	241.83	256.13						
2013	30181.77	24667.74	262.24	255.57						

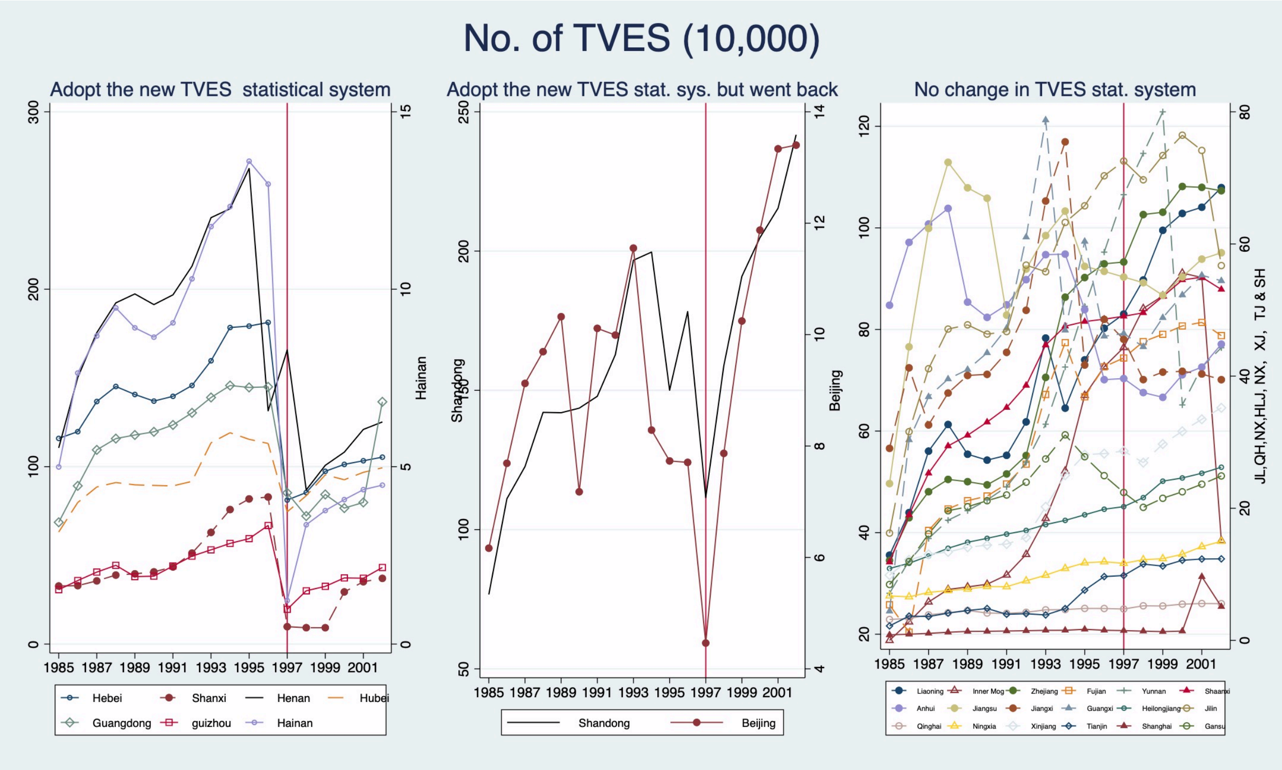
Notes: All the monetary variables are deflated to price of year 2010.

Figure B1: The ratio of SDY to local population



Data source: Jin and Jin (2014), various gazetteers, and 1964 census.

Figure B2: Statistical Reporting Issue for TVE Since 1997



Data sources: the 1978-2002 TVE statistical Material.

APPENDIX C Additional Results

Table C1: Selected First Stage Results for GDP and NTL: 1980–2013

	Full Sample Estimation		Core Sample	
	Log(GDP pc)	Log(NZTL pc)	Log(GDP pc)	Log(NTL pc)
	(1)	(2)	(3)	(4)
Log weighted potential SDY within prov	0.321***	0.332***	0.751***	0.753***
	(0.091)	(0.093)	(0.103)	(0.102)
Average YOS (cohort born <=1952)	0.119***	0.117***	0.108***	0.110***
	(0.027)	(0.026)	(0.029)	(0.027)
Log Total population in 1964	-0.201*	-0.178*	0.258**	0.259**
	(0.103)	(0.102)	(0.120)	(0.118)
Population density in 1964 (pop(1,000)/(km^2))	-0.304	-0.299	-0.211	-0.218
	(0.223)	(0.201)	(0.229)	(0.203)
Log Cultivated area 1957 per pop64	0.006	-0.000	0.166	0.111
	(0.123)	(0.108)	(0.296)	(0.289)
Log Yield in 1957 per pop64	0.202**	0.210**	0.185*	0.197*
	(0.089)	(0.087)	(0.108)	(0.102)
Log Potential crop per pop64	-0.075	-0.039	0.028	0.084
	(0.079)	(0.065)	(0.273)	(0.271)
Log Distance to nearest city	-0.120**	-0.122**	-0.117*	-0.121*
	(0.051)	(0.051)	(0.067)	(0.068)
Log Distance to provincial capital	-0.061	-0.050	-0.009	0.019
	(0.057)	(0.056)	(0.065)	(0.063)
Log normalised distant	-0.169	-0.149	-0.395**	-0.366*
	(0.133)	(0.135)	(0.195)	(0.193)
Dummy for no. of Qing Jinshi (1-9)	0.039	0.029	0.024	0.031
	(0.065)	(0.066)	(0.066)	(0.067)
Dummy for no. of Qing Jinshi (>=10)	0.193***	0.176**	0.131*	0.140*
	(0.072)	(0.073)	(0.074)	(0.075)
Provincial fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
F for Weak IV Test	12.33	12.82	53.19	54.93
No. of observations	38739	32075	30059	25340
No. of clusters	238	239	177	178
No. of counties	1529	1530	1217	1218

Note: Robust standard errors in parentheses, which are clustered at the prefecture level with the prefecture borders fixed at time of the SDY program. Significance code: * p<0.10, ** p<0.05, *** p<0.01.

Table C2: Selected OLS Results of TVE Outcomes: 1980-1996

	Full Sample Estimation			Core Sample		
	Ln(Outp pc)	Ln(Rev pc)	Ln(Emp pc)	Ln(Outp pc)	Ln(Rev pc)	Ln(Emp pc)
	(1)	(2)	(3)	(4)	(5)	(6)
Log SDY received per pop64	0.164***	0.153***	0.083***	0.162***	0.161***	0.082***
	(0.034)	(0.028)	(0.020)	(0.040)	(0.034)	(0.024)
Average YOS (cohort born <=1952)	0.090***	0.123***	0.063***	0.062**	0.115***	0.056***
	(0.022)	(0.020)	(0.016)	(0.026)	(0.025)	(0.021)
Log Total population in 1964	-0.028	0.065	0.044	0.002	0.087	0.050
	(0.057)	(0.052)	(0.032)	(0.070)	(0.065)	(0.038)
Population density in 1964 (pop(1,000)/(km^2))	1.459***	0.678***	0.751***	1.437***	0.633***	0.687***
	(0.253)	(0.215)	(0.171)	(0.277)	(0.224)	(0.183)
Log Cultivated area 1957 per pop64	-0.072	-0.148	-0.117	0.062	0.140	0.024
	(0.124)	(0.109)	(0.076)	(0.252)	(0.214)	(0.124)
Log Yield in 1957 per pop64	0.039	0.206**	0.059	0.060	0.211**	0.027
	(0.091)	(0.084)	(0.062)	(0.106)	(0.101)	(0.078)
Log Potential crop per pop64	-0.031	-0.037	0.043	-0.219	-0.420**	-0.139
	(0.090)	(0.086)	(0.050)	(0.205)	(0.193)	(0.108)
Log Distance to nearest city	0.060	-0.029	0.027	0.134**	0.060	0.114**
	(0.063)	(0.053)	(0.045)	(0.066)	(0.065)	(0.052)
Log Distance to provincial capital	-0.245***	-0.319***	-0.137***	-0.218***	-0.310***	-0.100***
	(0.047)	(0.045)	(0.029)	(0.056)	(0.054)	(0.031)
Log normalised distant	0.346**	0.114	0.170	0.549***	0.357*	0.424***
	(0.148)	(0.135)	(0.113)	(0.166)	(0.184)	(0.134)
Dummy for no. of Qing Jinshi (1-9)	0.102	0.125**	0.062	0.144**	0.174***	0.099**
	(0.063)	(0.054)	(0.045)	(0.070)	(0.054)	(0.047)
Dummy for no. of Qing Jinshi (>=10)	0.201**	0.266***	0.155***	0.214**	0.274***	0.177***
	(0.080)	(0.076)	(0.054)	(0.085)	(0.079)	(0.061)
No. of observations	7188	6905	7248	5450	5126	5071
No. of clusters	226	203	218	168	148	163
No. of counties	1179	1105	1157	893	836	885
Adj. R^2	0.787	0.786	0.635	0.811	0.802	0.658

Note: Robust standard errors in parentheses, which are clustered at the prefecture level with the prefecture borders fixed at time of the SDY program. Significance code: * p<0.10, ** p<0.05, *** p<0.01.

Table C3: Selected First Stage Results of TVE Outcomes: 1980–1996

	Full Sample Estimation			Core Sample		
	Ln(Outp pc)	Ln(Rev pc)	Ln(Emp pc)	Ln(Outp pc)	Ln(Rev pc)	Ln(Emp pc)
	(1)	(2)	(3)	(4)	(5)	(6)
Log weighted potential SDY within prov	0.390***	0.380***	0.311***	0.824***	0.764***	0.944***
	(0.106)	(0.114)	(0.116)	(0.100)	(0.142)	(0.127)
Average YOS (cohort born <=1952)	0.144***	0.139***	0.149***	0.119***	0.108***	0.121***
	(0.033)	(0.035)	(0.033)	(0.032)	(0.039)	(0.033)
Log Total population in 1964	-0.125	-0.121	-0.212*	0.280**	0.270	0.420**
	(0.123)	(0.129)	(0.126)	(0.136)	(0.181)	(0.164)
Population density in 1964 (pop(1,000)/(km^2))	-0.911***	-0.516**	-1.038***	-0.746**	-0.346	-0.864**
	(0.322)	(0.253)	(0.322)	(0.357)	(0.259)	(0.344)
Log Cultivated area 1957 per pop64	-0.330**	0.056	-0.119	-0.238	0.336	-0.176
	(0.163)	(0.166)	(0.166)	(0.324)	(0.340)	(0.333)
Log Yield in 1957 per pop64	0.324***	0.263**	0.228**	0.348**	0.371**	0.242*
	(0.118)	(0.119)	(0.109)	(0.147)	(0.155)	(0.145)
Log Potential crop per pop64	0.105	-0.142	-0.030	0.279	-0.158	0.305
	(0.099)	(0.115)	(0.108)	(0.321)	(0.332)	(0.343)
Log Distance to nearest city	-0.168**	-0.145**	-0.221***	-0.082	-0.099	-0.199**
	(0.072)	(0.073)	(0.071)	(0.091)	(0.089)	(0.100)
Log Distance to provincial capital	-0.017	-0.051	-0.046	0.049	0.029	0.105
	(0.061)	(0.062)	(0.065)	(0.064)	(0.058)	(0.064)
Log normalised distant	-0.165	-0.250	-0.254	-0.228	-0.292	-0.523*
	(0.172)	(0.168)	(0.171)	(0.230)	(0.271)	(0.272)
Dummy for no. of Qing Jinshi (1-9)	0.083	0.090	0.077	0.065	0.080	0.042
	(0.097)	(0.093)	(0.098)	(0.109)	(0.096)	(0.108)
Dummy for no. of Qing Jinshi (>=10)	0.168	0.129	0.205*	0.135	0.056	0.134
	(0.109)	(0.106)	(0.110)	(0.135)	(0.114)	(0.129)
F for Weak IV Test	13.59	11.04	7.18	67.44	29.09	55.52
No. of observations	7188	6905	7248	5450	5126	5071
No. of clusters	226	203	218	168	148	163
No. of counties	1179	1105	1157	893	836	885

Note: Robust standard errors in parentheses, which are clustered at the prefecture level with the prefecture borders fixed at time of the SDY program. The Kleibergen-Paap Wald rk F statistic is reported for the weak IV test. Significance code: * p<0.10, ** p<0.05, *** p<0.01.

Table C4: Migration by year

	(1)	(2)	(3)	(4)
	1990	2000	2005	2010
	b/se	b/se	b/se	b/se
Log SDY received per pop64	0.004	0.047***	0.044***	0.032
	(0.005)	(0.017)	(0.013)	(0.020)
F for Weak IV Test	68.916	59.256	32.600	39.015
No. of observations	1119	1138	913	1033
No. of clusters	175	173	165	165
No. of counties				

Note: The migration rate is defined as the ratio of out-migrants to the total working population, and only the county with at least 200 observations are used. Robust standard errors in parentheses, which are clustered at the prefecture level with the prefecture borders fixed at time of the SDY program. The Kleibergen-Paap Wald rk F statistic is reported for the weak IV test. Significance code: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.