Can Poverty be Alleviated in China?

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Abstract: The 2000s witnessed the third poverty alleviation wave of China. Compared with its predecessors, the third wave distinguished itself by new interventions and redefined standards for the National Poor Counties. This paper evaluates the effectiveness of the new program using a data set consisting of 1,411 of China's western and central counties from 2000 to 2010. We combine the propensity score matching method with the difference-in-differences approach, which enables us to avoid selection bias and track the policy impact on variables of interest at each time point. It is found that the non-west local governments were inclined to restrict their economic growth to maintain the special transfer payments disbursed exclusively to the National Poor Counties. It is also shown that the program failed to improve the infrastructure and sanitary conditions in general.

JEL Classifications: H23, H71

Keywords: Average treatment effect on treated, Poverty alleviation, Propensity score matching, Receiver operating characteristic curve, The National Poor Counties

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1. Introduction

The 2000s experienced a new wave of poverty alleviation in China. Compared with its two predecessors, namely the initial wave (1986–1993) of China's poverty reduction and the second wave (1994–2000), which was also called the 8-7 Plan, the third wave was characterized by a dramatic change in the standard of poverty and the formulation of new policies against rural poverty. The world's largest regional poverty targeting program, which resulted in marvelous economic growth in China, was proved to be a huge success in poverty alleviation in the developing world, leading to a drastic reduction in the population of the poor from about 125 million in 1986, the first year of China's war against rural poverty, to around 32 million in 2000, the final year of the 8-7 Plan. In the third wave, the number of people living in poverty continued to decrease, to about 26.88 million in 2010.[3]

Although the first two waves were viewed as a template in China's war on poverty, there existed two main limitations behind the numerous merits. First, political factors had affected the selection of the National Poor Counties, which was the major intervention in each wave (Park et al., 2002). As time went by, the targeting program deteriorated, since lobbying efforts and political resistance forced the government not to take National Poor County status away from the initially designated counties, which had already passed the poverty line. Second, the distribution of the poor population also changed over time. At the beginning of the reform and opening-up policy, most of the poverty-stricken rural population mainly lived in contiguous areas. In 1993, the poverty-stricken population living in the National Poor Counties increased to about 72%, from 50% in 1986, and two-thirds of this population were located in the eastern and central provinces. However, the coverage of the counties shrank to about 60% in 2001, and the poverty level in the eastern provinces greatly decreased due to their soaring economic growth. In response to the newly apparent drawbacks of the old program, the Chinese government made two main changes in the

[3] During the third wave, China raised the poverty line and extended the coverage of the population living in poverty to benefit not only the previous rural poor but also the low-income population. The number here follows the new statistical criteria.

third wave. To avoid political obstacles, the Chinese government adopted a more comprehensive method when selecting new National Poor Counties, which was known as the "631 index" method. Furthermore, to increase the coverage of the rural poor population, along with county-level policies, the Chinese government began to consider including poor villages in the counties. It is also worth noting that since almost all the eastern counties shook off poverty in the first two waves, the Chinese government excluded all the counties in the eastern provinces from the new program in the third wave. This rationalizes our exclusive focus on central and western counties in this study. Table 1 describes the distribution of the poverty-stricken population in the third wave.

This paper is closely associated with the previous literature on anti-poverty programs in China, not only in terms of chronological order but also the empirical approach. The previous two poverty reduction waves are studied separately by Park et al. (2002) and Meng (2013). The former analysis exploits a four-period income growth model, estimates the impact of poverty investments, and uses the propensity score matching method as a robustness check. The main finding is that the National Poor Counties program increased the rural income per capita by 2.28% per year in the first wave. Taking advantage of the policy change in 1994, the latter paper employs a regression discontinuity approach, which uses the propensity score as an instrumental variable to estimate the impact of the second wave. The author finds that the second wave brought about a 38% increase in rural income for the newly designated National Poor Counties. Though the importance of the propensity score was limited in these two papers, the usefulness of the newly introduced method in the non-randomness environment is revealed. Thus, we believe that by combining with various matching methods, the propensity score can play a more important role in the program evaluation. Moreover, the existing literature mainly focuses on the impact of a program on income increment but ignores other changes brought about by the policy. It is reasonable for us to evaluate sanitary and infrastructure conditions, since China's central government for the first time explicitly included targets to improve health in the program, and reinforced the importance of increasing infrastructure conditions in

poor counties.

It has always been a great challenge to estimate the causal effects of a program when a randomized controlled trial is not attainable. However, when public interventions are based on manipulable variables, the causation can be found (Rubin, 1986). The manipulation may wrongly attribute the effect caused by the pretreatment characteristic difference between the treated and the control cohorts to the assigned treatment, if the two cohorts are unbalanced. Moreover, when we attempt to track the time-varying impact of the program using the difference-in-differences method, the pre-assigned imbalance will cause a further problem. To reduce the selection bias resulted from the problem of imbalance, we adopt the propensity score matching methods to transform the quasi-experimental studies into a randomized experimental approach.

Employing a panel data set consisting of 1,411 central and western Chinese counties over 11 years, we estimate reliable propensity scores by comparing seven differentiated matching methods, and evaluate the impact of the National Poor Counties program in China's third poverty alleviation wave by using the difference-in-differences approach. Our main findings include two parts. First, we identify two possible mechanisms through which the program functioned. Based on our estimation, the program generally has no or negative effects on the whole sample. However, rather than boosting the economy, non-west local governments preferred to limit their economic growth so as to maintain the special transfer payments disbursed exclusively to the National Poor Counties. Second, we found that the program failed to influence the western and central counties as a whole and achieve its diversified goals, which included the improvement of infrastructure and sanitary conditions. However, for certain subsamples, the program was found not totally in vain.

The remainder of this paper proceeds as follows. Section 2 comprehensively reviews the history of China's poverty alleviation waves, including the successes achieved in each wave. Section 3 validates and describes the selected variables to estimate the propensity score. Section 4 discusses the empirical strategies. Results are reported in Section 5. Finally, Section 6 offers the conclusion.

2. Background

2.1 Poverty in China

In China, there is no doubt that poverty is mainly a rural phenomenon (World Bank, 2001; Meng, 2013). It seems to be an inevitable result of the long existence of the dual economic structure in China's urban and rural areas. For a long time, the Chinese government had exclusively provided urban citizens with various social welfare services, to which rural residents had no access. The rigorous household registration system exacerbated the welfare disparity between households in the urban and rural areas even more. Soon after the reform and opening-up, a difference in incidence of rural poverty began to exist between opulent coastal and less developed inland areas. Since then, China's poverty has switched from a country-wide phenomenon to one that concentrated in the western and central parts. Moreover, residents in revolutionary based areas, minority autonomous areas, and certain remote areas were more prone to poverty than the rest of the rural population.

Three waves of regional poverty alleviation programs have been identified since 1986: the first wave was implemented from 1986 to 1993; the second wave, from 1994 to 2000; and the third wave, from 2001 to 2010. Because of its huge success in poverty reduction, we include the period from 1978 to 1985 as the prior wave as well, even though it lacked any explicit poverty reduction policy. Figure 1 shows the geographic distribution of the National Poor Counties in each wave. Points shaded in black stand for the National Poor Counties. We can see that as time went by, the government spent more efforts on poverty reduction in inland areas.

2.2 The prior wave (1978–1985):

Despite the absence of explicit poverty-targeted programs and coordination at the central government level prior to 1986, Chinese leaders never stopped their pace of the fight against poverty since the reform and opening-up. Given that more than 90 percent of the population living in poverty resided in rural areas, poverty in China was

mainly a rural phenomenon. According to a report by the National Bureau of Statistics of China[4], about 250 million Chinese people, accounting for 30.7% of the total rural population, were identified as poor. Members of this population had an annual income of below 100 Yuan. Then, based on a variety of surveys, three main causes of widespread poverty during this wave were proved to be system-related. The rural land system, which restricted rural productivity due to its lack of incentives, was indicated as the source of rural poverty. In addition, to accumulate funds for industry, the Chinese market system adopted a system of unified purchase and sale, and utilized the scissors gap between the prices of agricultural products and industrial products, which aggravated rural poverty. Meanwhile, as demonstrated by the household registration system, the employment system constrained the flow of the surplus rural labor force, which also exacerbated poverty.

Therefore, to alleviate rural poverty, system changes were needed. In order to enhance the incentives for peasants, the household contract responsibility system replaced the highly collective people's commune system. From then on, rural households began to be independent in cultivating their farmlands. Meanwhile, the subsidized primary product sales (Park et al., 1994), which aimed to reduce the scissors gap between the prices of agricultural products and industrial ones, were announced. In 1979, the Chinese government increased the prices of ten kinds of agricultural products, including grain, cotton, and oil-bearing crops. From 1978 to 1985, the total income induced by the policy was 125.74 billion Yuan, accounting for a 15.5% increase in rural household income. Another policy was to encourage the growth of township enterprises. From 1983, township enterprises began to flourish. Within three years, the number of township enterprises increased from about 1.34 million in 1983 to 12.22 million in 1985, with the increase in total output value from 101.68 billion Yuan to 272.84 billion Yuan. Respectively, the above three reforms enhanced land productivity, increased agricultural income for farmers, and opened doors for peasants to embark on non-agricultural tasks; in the meantime, the series of policies was implemented to boost the rural economy, relieve rural poverty, and

[4] Data source: *Poverty Monitoring Report of Rural China 2000.*

ameliorate the industrial structure.

The achievement of this wave was outstanding. At the end of 1985, the population below the poverty line reduced from 250 million in 1978 to 125 million, with the poverty incidence decreased to 14.8% from 30.7%. Meanwhile, the average annual income increased from 134 Yuan to 397 Yuan.[5]

2.3 The first wave (1986–1993):

Benefiting from the nationwide economic growth drawn by the institutional reform in the last wave, an overwhelming majority of the rural population, who had suffered in poverty due to the lack of economic opportunities, shook off poverty by taking advantage of their superiority in geography and resources. This uneven development caused the rural poverty to become a regional problem, rather than a national phenomenon as it had been in the past 30 years. The rural poor were mainly distributed in the old revolutionary based regions (*lao qu*), minority autonomous areas (*minzu zizhiqu*), and certain inland parts, which basically connected 18 large areas. Geographically, the 18 areas presented an increasingly concentrated trend from the east to the west.

To address the newly appeared poverty regionality, the Chinese government launched the largest regionally targeted anti-poverty program in the developing world. In 1986, the State Council set up the Leading Group for Economic Development in Poor Areas (Leading Group hereafter), which was a specialized inter-ministerial anti-poverty institution consisting of all the ministers whose duties were associated with poverty alleviation, to administer and coordinate the new poverty alleviation program. As a major targeting device, the Leading Group enacted the National Poor Counties policy soon after its establishment. For national and political considerations, the Leading Group finally adopted a mixed set of standards to identify the National Poor Counties. The basic poverty line for selecting the National Poor Counties was to have a rural net income per capita of below 150 Yuan in 1985. However, for counties located in old revolutionary base regions or minority autonomous areas, the poverty

[5] Data source: *Poverty Monitoring Report of Rural China 2000.*

line was raised to 200 Yuan. The standard was further relaxed to 300 Yuan for counties in very important revolutionary base regions and minority autonomous areas in Inner Mongolia, Xinjiang, and Qinghai.[6] According to the above standards, 258 counties were initially designated as the National Poor Counties in 1986. In the following two years, another 70 counties were selected as National Poor Counties as well. By 1988, provinces identified an additional of 370 counties as provincial poor counties, which were supported by the provinces themselves. Compared to the National Poor Counties, the provincial ones usually needed to meet more rigorous standards but received fewer benefits.

The regional targeted poverty alleviation program was proved to be a huge success. The population living in poverty continued to decrease in this period, from 125 million in 1986 to 80 million in 1993. Correspondingly, the poverty incidence dropped from 14.8% following the last wave to 8.7% at the end of 1993. Meanwhile, rural net income per capita in the National Poor Counties increased from 206 Yuan to 484 Yuan.[7]

2.4 The second wave (1994–2000):

Although the regional targeted program in the first stage covered a sizeable amount of the rural poor, Park et al. (2002) claim that the heavy political compromise during the poor counties selection procedure undermined the program's efficiency. Certain qualified counties had to give up their eligibility to those politically favored counties which had a rural net income higher than the poverty line (World Bank, 2001). In addition, some researchers cast doubt on the validity of the poverty line used to select the National Poor Counties (Meng, 2013). In response to previous criticisms and the change in geographic distribution of the poor, the Chinese government instituted a new large-scale poverty alleviation program in 1994. Known as the 8-7 Plan, the Chinese government promised to lift the majority of the remaining 80

[6] In 1988, another standard was set up to include a few pastoral and semi-pastoral counties, based on the rural net income data from 1984 to 1986. Pastoral counties with an average net income per capita below 300 Yuan and semi-pastoral counties with an average net income per capita below 200 Yuan were identified as the new National Poor Counties.

[7] Data source: *Poverty Monitoring Report of Rural China 2000.*

million rural poor from poverty by 2000 (within seven years).

The entire program was still overseen by the Leading Group, which renewed the poverty line and hence the list of the National Poor Counties in 1994. The revised list initially included only 326 counties with a rural net income per capita of below 400 Yuan in 1992. However, facing political pressure from the National Poor Counties selected in the last wave, the Chinese government raised the poverty line for those counties to 700 Yuan. Finally, the 8-7 Plan covered 592 counties, which accounted for about 28% of all county-level administrative units in China. By 2000, the majority of the goals of the 8-7 Plan had been achieved. Rural net income per capita in National Poor Counties increased from 648 Yuan in 1993 to 1337 Yuan in 2000. Moreover, the population living below the poverty line kept on declining, from 80 million in 1993 to 32 million in 2000.[8]

2.5 The third wave (2001–2010):

The huge success in poverty alleviation of the 8-7 Plan shrank the majority of the remaining population living in poverty down to 14 large areas, most of which were located in the western and central parts of China. Meanwhile, there remained a number of isolated villages distributed in other parts. In spite of the unprecedented achievement, the second wave was still criticized for its compromise with political interference that might have led to mis-selection of the National Poor Counties. Moreover, the program only targeted the absolutely poverty-stricken population, whose living conditions were lower than the international standard. In response to the previous criticisms and the existence of both centralized and decentralized rural poor, the central government launched another anti-poverty program in 2001, aiming to relieve the remaining poverty-stricken people and enhance infrastructure, education, and health conditions in the targeted regions.

To improve the targeting accuracy, the Leading Group renewed the list and the poverty line again in 2001. The new standard was called the "631 index", which took

[8] Data sources: *Poverty Monitoring Report of Rural China 2000, Poverty Monitoring Report of Rural China 2001, and Poverty Monitoring Report of Rural China 2010.*

the poverty population proportion in the country (weighted at 60%), rural net income per capita (weighted at 30%), and annual per capita GDP and annual per capita local government revenue (weighted at 10%) into consideration. The basic poverty line was 1300 Yuan for rural net income per capita, 2700 Yuan for GDP per capita, and 120 Yuan for average per capita revenue. However, the standard rose to 2700 Yuan for rural net income per capita for counties with large minority populations and old revolutionary base areas. According to the new standard, the Leading Group finally designated 592 National Poor Counties, from which all the counties in the eastern coastal provinces were eliminated. In addition, in 2007, the Chinese government adopted a higher standard to expand the coverage of the anti-poverty program in order to include not only the absolutely poverty-stricken population but also the low-income population.

To support the whole program the Leading Group disbursed three main interventions, including the Food-for-Work program (yigong daizhen) supervised by the State Planning Commission, the budgetary grant program (fazhan zijin) overseen by the Ministry of Finance, and the subsidized loan program (tiexi daikuan) managed by the Agricultural Development Bank and the Poor Area Development Office (belonging to the Leading Group). Rather than merely financial supports, the central government proposed another three interventions, namely the Whole-Village Development (*Zhengcun Tuijin*), Labor Force Transfer Training (*Laodongli Zhuanyi Peixun*), and Agricultural Industrialization Poverty Alleviation (*Nongye Chanyehua Fupin*).

First, recognizing the decentralization of population living in poverty, along with the new National Poor Counties, the Chinese government identified 148,000 poor villages, covering about 80% of the total rural poor. The Whole-Village Development was a community-based program. Each targeted village committee could decide its own development plan according to a democratic process with the full participation of its village members. Since the central government believed that the amelioration of living conditions and improvement of productivity would increase household income, the plan focused on the improvement of infrastructure and social welfare services. By

2009, about 108400 villages had started their Whole-Village Development plan. Among these villages, about 38400 were located in revolutionary based areas, minority autonomous areas, and inland regions.

Second, the Labor Force Transfer Training program was a short-term job-training plan. The plan focused on training in work skills and agricultural techniques. After obtaining new skills in a short time, the higher quality rural labor force could be transferred to towns and cities to get job opportunities at higher wage levels. From 2004 to 2009, the central government arranged 3 billion Yuan for the program. About 400000 peasants participated in the training. Not surprisingly, 80% of these farmers accomplished the labor transfer program. A survey showed that a worker who was involved in the program usually had a 300 to 400 Yuan higher monthly salary than those who were not.

Third, the Agricultural Industrialization Poverty Alleviation program emphasized the development of large corporations in the industrialized agricultural industry. By subsidizing those companies, the Chinese government expected that the flourishing of large corporations would promote the regional economy and in turn indirectly increase rural household income. The Agricultural Industrialization Poverty Alleviation program was market-oriented, aggregating local pillar industries or superior products to form a complete industry chain. In 2004, the Leading Group identified 260 large corporations based on the recommendations of each province. Since then, 8000 targeted villages had been included in the program. By 2009, the program had received 1.2 billion Yuan from revenue investment, and more than 4 million households had lifted themselves out of poverty because of the program.

The success of this wave was also astonishing. The rural net income reached 5919 Yuan in 2010, about 1.6 times as much as it was in 2000. Table 2 depicts changes in the number of rural poverty-stricken people and the incidence of poverty from 2000 to 2010. Through the steadily increasing poverty line and the Leading Group's adoption of a more extensive standard to identify the poor during the decade, the rural population living in poverty decreased by more than 60% from almost 50 million in the National Poor Counties in 2002 to about 17 million in 2010. Moreover,

poverty incidence in the designated counties also decreased sharply after 2002, from 24.3 percent to less than 10 percent in 2010.

3. Data

Our sample contains county-level data from the year 2000 to 2010[9], covering 1,411 counties in the central and western regions of China. The majority of the data are obtained from China Data Online of the University of Michigan, which contains various important social and economic variables at county level, particularly GDP and local government revenue[10] per capita that the Chinese government used for the National Poor Counties designation as well as other social welfare variables we are interested in. To establish a more comprehensive database, we have supplemented the current data source with a threefold effort. First, since most of the rural household net income data are missing in China Data Online, we have collected the data for 2000 to 2010 in China National Knowledge Infrastructure (CNKI) database supported by China Statistics Press. Second, to explore the relation between fiscal support and poverty alleviation, we have added some fiscal data from the *Statistics on Public Finance of the Districts, Cities and Counties (Quanguo Di Shi Xian Caizheng Tongji Ziliao)*. Third, the lists of revolutionary base areas and minority autonomous areas are obtained from An Outline of Chinese Rural Economic Statistics by County 1988 (*Zhongguo Fenxian Nongcun Jingji Tongji Gaiyao 1988)*. Moreover, we referred to the CNKI database for the land frontier counties list with flat and mountainous counties lists. In addition, all the variables associated with money are measured in Yuan, taking the form of logarithm. They are as well deflated to the 2000 price level using price deflators calculated by annual CPI, which we also collected from the CNKI database.

Considering the successively appearing statistical covariate selection methods,

[9] To fulfill the common trend requirement, we include the information of six outcome variables in 1998 and 1999, namely two and three years before the implement of the National Poor Counties program.

[10] Local government revenue in China exclusively consists of various tax revenues. While transfer payments are included in the index named local government total revenue.

the causal relationships among potential outcomes, treatment assignment, and covariates should initially depend on theoretical bases and previously estimable analyses (Sianesi, 2004; Smith and Todd, 2005). Since the propensity score matching method only deals with the overt bias, to obtain a precise estimation of the propensity scores and avoid omitted variable bias, variables should not be excluded from our estimation unless the causal relationship fails both theoretically and statistically. In theory, only variables which can simultaneously affect the potential outcomes and treatment assignment should be included in our model. In practice, however, we face a trade-off between bias reduction and variance increment. Moreover, Cuong (2013) demonstrates with Monte Carlo simulations that when estimating the ATTs, more efficiency would be achieved if all the determinants of the outcome variable are included in the matching process. Therefore, besides the variables related to the potential outcomes and the treatment assignment, we also include determinants associated with the outcome variables.

Based on the principles mentioned above, we categorize matching covariates into four categories. Since the program is implemented in 2001, all the matching covariates are lagged one year (in 2000) to avoid the contemporaneous endogeneity. The first category includes variables that would affect the potential outcomes and treatment assignment simultaneously. They are six variables announced explicitly by the Leading Group to construct the "631 index", including pre-trend GDP per capita, rural households' net income, local revenue per capita, and three dummy indicators of revolutionary based areas, minority autonomous areas, and land frontier counties. In this paper, the first three are also variables of interest. We use GDP per capita to measure the degree of economic growth. There is little doubt that economic growth contributes significantly to poverty alleviation (Ravallion and Datt, 2002; Ravallion and Chen, 2007), especially in China. As for rural households' net income, it is the most direct assessment of a welfare program and has been widely used to evaluate the previous poverty alleviation waves (Park and Wang, 2010; Meng, 2013). Finally, to explore the revenue-generating ability of local governments, we measure the local revenue per capita.

The second category consists of another three variables of interest in pre-trend period. As mentioned in the plan of the program, the improvement of infrastructure was one of the main goals. Following Fan et al. (2004), we use the agricultural machinery power (AMP) per capita to measure the infrastructure condition. Moreover, Loayza and Raddatz (2010) argue that medical care would influence the capacity of poverty reduction programs. Thus, we employ the number of beds in hospitals and sanitation agencies owned by per million people to measure medical care. To support the newly emphasized social welfare aspects, the special transfer payments, which are allocated from higher governments to develop the targeted infrastructure, education and sanitary conditions, will be the main fund resource.

The third category includes the rest covariates in 2000. We use the counties' population density as the counties' basic information. Local government expenditure per capita reflects the magnitude of the governments. Average educational years are chosen to measure the local educational conditions. At last, we exploit the share of first industry and the share of second industry to estimate the counties' industrial structure.

To meet the common trend assumption required by DID estimator, the last category involves outcome variables in 1999 and 1998 for each specific logit regression. We summarize the variables for year 2000 in Table 3. Before matching, a significant difference exists between the control group and the treated group, except for the dummy of the inland frontier areas. Table 3 shows that the designated counties are generally those with lower economic development and social welfare conditions. They are as well more agricultural prone counties. It suggests that one might attribute the effects due to the pretreatment imbalance to the National Poor Counties program. Therefore, we need a certain remedy to rebalance the data, rather than performing a simple comparison.

4. Methodology

Since the pretreatment data set is unbalanced, we have to find certain methods to remove the potential selection bias. In this paper, we utilize the propensity score

matching method to balance the two groups. Rather than arbitrarily using one matching method, we perform various methods and then compare their extent of bias reduction.

4.1 Propensity score estimation

Propensity score is a predicted probability of a unit to get treated, usually obtained from a logistic regression. Combined with matching methods, it enables us to transform multi-dimensional matching into one-dimensional matching, which increases the matching efficiency dramatically. We can also remove the overt bias with the propensity score matching process. Second, compared with regular linear regression methods, we do not need a valid instrumental variable and can make use of the logistic function as follows:

$$\mathrm{P}(W_i \mid X_i = x_i) = E(W_i) = \frac{1}{1 + e^{-x_i \beta_i}} \tag{1}$$

where W_i stands for the binary treatment status of observation i (W_i = 1, if unit i is treated; W_i = 0, otherwise), X_i is a vector of conditional variables, and β_i is the coefficient of X_i.

In practice, we usually make the logarithmic transformation after the estimation. Since the logistic regression may underestimate the probability of rare events (Tomz et al., 2003), the rule of thumb is to choose a control group data set no more than nine times as large as the treatment group (Baser, 2006). In our sample, the control data set and treatment group ratio is about 2:1. Therefore, it is proper to apply logistic regression in our model.

4.2 Matching algorithms

In this part, we introduce the three most commonly used matching methods, from which our seven methods extend. The purpose of applying matching algorithms is to balance between the control group and the treated group. Due to the lack of randomly assigned treatments, the control units and the treated ones are usually unbalanced before the treatment. Hence, different outcomes may be attributed to those

pretreatment imbalances rather than the treatment effects. The matching algorithm with the highest quality is the one that can eliminate the difference between the treated and the control groups in the data set we analyzed.

Let I_1 and I_0 stand for sets of counties in the treated group and control group respectively, S_p the region of common support, and then the ATT for the National Poor Counties program is defined as follows:

$$\tau_{ATT}^{PSM} = \frac{1}{n_1}\sum_{i\in I_1\cap S_P}\left\{Y_{1i} - \sum_{j\in I_0\cap S_p} W(i,j)Y_{0i}\right\} \quad (2)$$

where n_1 denotes the number of units in the set of $I_i \cap S_p$, and W(i, j) is the matching weights, which will be allocated to those control counties to further form a reliable counterfactual. Depending on the choice of the function form of W(i, j), a variety of matching methods have been proposed, that is nearest-neighbor matching, radius matching, and kernel matching.

Nearest neighbor matching (NNM) compares the distance in terms of propensity score between non-participants and a participant, the closest one in the control group is chosen to be a matching partner for the treated individual (Caliendo and Kopeinig, 2008). Radius matching (RM) is a method combining NNM with a caliper, which is a sort of tolerance level associated with the maximum distance in terms of propensity score. While, as a non-parametric matching algorithm, in kernel matching (KM), treated members are matched with a weighted average of a subgroup of control members depending on the bandwidth we choose. In addition, based on NNM, the first variant is called NNM without replacement, which means that individuals in the control group can be chosen as a matching partner no more than once. The second variation is n-to-1 NNM. The main difference between this variant and NNM is that we can use the closest *n* control individuals in distance as matching partners for a treated individual.

To further eliminate unobservables that may affect the National Poor Counties' assignment and the outcome variable, drawn on the panel data, we adopt the difference-in-difference matching strategy (Heckman et al., 1997; Gebel and Voßemer,

2014). Rather than directly focusing on the outcome variable, this variation matches on the before-and-after-treatment differences in the outcome between the treated and the matched controls. In this way, besides the overt bias, we are able to further eliminate the constant hidden differences and additive selection bias, and thereby significantly improve the quality of our estimation results. The difference-in-difference propensity score matching (PSM-DID) estimator is defined in the following way:

$$\tau_{ATT}^{DID-PSM} = \frac{1}{n_1} \sum_{i \in I_1 \cap S_p} \left\{ (Y_{1ti} - Y_{1t'i}) - \sum_{j \in I_0 \cap S_p} W(i,j)(Y_{0ti} - Y_{0t'i}) \right\} \quad (3)$$

where Y_{1ti} (Y_{0ti}) and $Y_{1t'i}$ ($Y_{0t'i}$) are the outcome variables of interest for the treated (control) counties in time t and t', that is before and after the implementation of the National Poor Counties program.

5. Results

5.1 Propensity score estimation results

In this paper, we have six variables of interest, each of which has distinct determinants. Consequently, we apply logistic regression six times separately for those outcome variables. As displayed in Table 4, most of the covariates included in the logistic regression are significant and exhibit reasonable signs as expected. Basically, no matter what outcome variables we choose, the GDP per capita, rural households' net income, the local government expenditure, and sanitation conditions are negatively related to the probability of a county being chosen as a National Poor County. However, a county that is identified as a revolutionary based county and with a higher share of second industry and special transfer payment per capita is more likely to be selected as a National Poor County. Given six pseudo-R2 are all above 0.500, our equations explain more than 50% of the variation in the choice.

Moreover, to see the goodness of fit of our regression, we calculate the area under the receiver operating characteristic (ROC) curve. The greater the predictive power of our estimation, the more bowed the ROC curve, hence the larger the area created under the curve. Therefore, the area under the curve (C-statistics) can be used

to measure the predictive power of our logistic regression. To achieve a valid classification, the C-statistic should be greater than 0.80, which is met in our case that is shown in Figure 2.

5.2 Matching results

Since bad quality matching with small bias reduction and therefore imbalance between the treated and the control groups could lead to biased estimation of the average treatment effect on the treated, to find out the most suitable type of matching, we implement five matching algorithms, including nearest neighbor matching, nearest neighbor matching without replacement, 3-to-1 nearest neighbor matching, radius matching, and kernel matching. Since a caliper can significantly improve the matching quality, according to the rule of thumb, we impose 0.25*SD (standard deviation) calipers on each matching algorithm. By doing so, we rely on the fact that the performance of different matching methods varies case by case mainly according to the data set we use.

As exhibited in Table 5, we test the group balance before and after matching based on three criteria.[11] Firstly, we apply a t-test to calculate the t-statistics for the treated group and the control group after matching. Except for NNM without replacement, the other four algorithms perform equally badly, leaving around ten unbalanced variables between the participant and nonparticipant counties. As for the NNM without replacement, it induces no significant difference between two cohorts (all the p-values are greater than 0.100).

Secondly, we check the standardized percentage bias, which is the percentage difference of the sample means in the treatment and matching subsamples as a percentage of the square root of the average of the variances in the treated and the control cohorts (Rosenbaum and Rubin, 1985). Even without an explicit standard under which we can treat a standardized percentage bias as a success, 5%, 8% and 20% are commonly used as the sufficient threshold (Girma and Görg, 2007; Caliendo and

[11] Because of the limited space, all the balancing test results reported in this subsection are based on the PSM method when the outcome variable is the ΔLog(GDP). When the outcome variable varies, the balancing tests share the similar results.

Kopeinig, 2008). It is clear that the performance of NNM without replacement is also the best under this criterion. Figure 3 depicts the standardized percentage bias across covariates after NNM without replacement.

Lastly, we calculate the percentage bias reduction in the means of the independent variables after and before matching. The results are almost the same as those we obtain from the previous two criteria. As for the NNM without replacement, the percentage bias reductions of all the explanatory variables are more than 70.0% except for the land frontier, which are much higher than the results of other algorithms. Therefore, taking the three criteria into consideration, the best matching type for our data set is the NNM without replacement. In addition, we perform the sensitivity analysis by changing the caliper to more rigid ones, and the results vary little. Hence, we stick to NNM with 0.25*SD calipers for the following analysis.

5.3 Impact of the third wave

Although the National Poor Counties program was designed to promote economic growth and enrich the poor, the designated counties might well deviate from the original intention for their own interests. There were a couple of distinct potential responses of local governments to the beneficial program, leading to two opposite mechanisms by which the program functioned. Since economic growth would increase a local government's revenue by expanding the tax base, a local government has an incentive to develop the economy, which in turn benefits itself. It turns out to be a virtuous circle. Meanwhile, economic growth is supposed to enrich the poor through trickle-down effects. In the case of China, the National Poor Counties exclusively received various transfer payments from both central and provincial governments and enjoyed preferential policies implemented by them; however, all these would be cancelled if a county became so developed that it passed the poverty line. Therefore, there existed two ways of development for local governments. First, taking advantage of the various benefits brought by the program, they could spare more effort on local development to pass the poverty line and continue their economic and welfare growth without the previous transfer payments

and preferential policies. Second, being afraid of losing the previous financial and political support and even slipping into retrogression, the designated counties might attempt to maintain their benefits from their National Poor County identities by lowering their growth rate to avoid passing the poverty line.

Also, as mentioned in sections 2 and 3, the third wave was more ambitious than its predecessors in that besides regional economic growth and rural households' income growth as the main goals of the first two waves, the explicit target of the third poverty alleviation wave consisted of three parts, namely infrastructure promotion, educational and sanitary conditions improvement. Since the first wave, the three main interventions had reflected that the promotion of infrastructure was ranked as the first priority in poverty alleviation attempts. Moreover, the third wave for the first time explicitly included the improvement of health and education as a poverty alleviation measure. However, whether these goals have been achieved remains unknown. Therefore, in this subsection, we attempt to answer two questions. First, what was the main local governments' response to the program? Second, were those poverty alleviation goals achieved?

5.3.1 What was the main response of local governments to the program?

If the first mechanism functions, we would expect significantly positive coefficients for GDP and revenue in per capita form. However, if the second mechanism dominates, we would observe negative coefficients for GDP per capita at the end years of the program, which capture the attempts of local governments to limit their economic growth to maintain their identities in the next wave. We would as well expect significantly negative coefficients for revenue per capita, given the lower economic growth and consequently the shrunk tax base. In addition, since we assume that local governments are inclined to sacrifice GDP growth rate for higher transfer payments, some significantly positive coefficients for special transfer payment per capita are expected.

As shown in the first column from Table 6 to Table 9, DID estimators reflect the ineffectiveness of the National Poor Counties program for the whole sample. GDP

growth rates in Table 6 are significantly negative at the beginning of the program, and turn to insignificant since 2004. The local government revenue in Table 8 almost follows the same pattern. Table 7 reveals that the income disparity between participant and nonparticipant counties is larger after the implementation of the program. We provide two possible explanations for the results. First, since local governments were inclined to limit their economic growth, the trickle-down effect that would benefit the poor as the economy boomed collapsed. Second, after China's 20-year effort against poverty, the remaining poor residing in the most remote areas were still unable to share the benefits brought by national economic growth or the regional targeted poverty alleviation program. Thus, it was difficult to lift that part of the poor population out of poverty. In response to the bad economic performance, the central government allocates more transfer payments to support the designated counties since 2006, as the estimates become positively significant in Table 9.

From the estimation for the whole sample, we know little about the mechanism of the program except for the ineffectiveness. We therefore separate the sample to analyze the heterogeneity of subsamples, in order to identify which mechanism functions. We first identify the counties involved in the "Western Development Strategy" launched out in 2000 as the west counties; the rest as the non-west counties. The second column from Table 6 to Table 9 reveals a basically same pattern of the west counties as the whole sample. However, the special transfer payments received by west counties are insignificant in the sampled period. As for the non-west counties, the second mechanism functions. In the third column of Table 6, the GDP growth rate turns significantly negative since 2008 (-13.4% in 2008, -13.4% in 2009, and -17.9% in 2010), which means that for certain reasons the program hampered the economic growth of the non-west counties. It reflects that at the end of the third wave, the designated counties were worried about re-selection in the next wave and tried to limit their growth rate to maintain their identity in the following program. In addition, the coefficients of special transfer payment per capita are significantly positive in the most years, which reflect that the non-west counties are more likely to get access to the special transfer payments after the implementation of the program. The

aforementioned features demonstrate that the second mechanism was the main mechanism through which the National Poor Counties program affected local governments.

We further analyze the heterogeneity for counties located in flat areas and mountainous areas. The fourth and fifth columns from Table 6 to Table 9 show the results. While the program has different effect on the two types of counties from the whole sample, we find almost no difference between the two types. In 2000s, the program generally has the negative effect on those counties in terms of GDP growth, income level, and local government revenue. Unfortunately, however, those counties do not obtain substantial transfer payments to compensate their lower economic development.

5.3.2 Were those poverty alleviation goals achieved?

Restricted by the limited data, in the paper, we are only able to detect the impact of program on the infrastructure conditions and sanitary conditions. In general, Table 10 shows that the program has insignificant impact on the sanitary conditions at the beginning and end of 2000s, and significantly negative impact in the middle period. This is because after the special transfer payments increase since 2005, the negative effect on the sanitary conditions fades. The west counties and mountainous counties almost follow the same scenario with the whole sample. However, the program has no effect on the non-west counties in terms of sanitary conditions, for their all insignificant coefficients in the sample period. As for flat areas, there is a positive effect soon after the implementation of the National Poor Counties program (104.537, significant in 2001), though it lasts for only year.

As mentioned in section 3, we exploit the agricultural machinery power per capita to investigate the rural infrastructure level. In the first column of Table 11, the insignificant coefficients of the whole sample reveal that the attempt of the program to improve infrastructure was in vain. Following the same decomposition method as before, we find that the results of the subsamples of west, non-west, and flat counties coincide with those of the whole sample. As for mountainous areas, the program

basically has no effect except for 2008, where the agricultural machinery power per capita decreases by 9.5%, which is significant at the 5% confidence level. Combining with results with respect to the special transfer payments in Table 9, we find that although the transfer payments increase for the whole sample and non-west counties in certain years, it fails to improve the infrastructure and sanitary conditions in designated counties. Thus, the social welfare goals of the program fail to be achieved.

6. Conclusion

In this paper, we estimate the impact of the National Poor Counties program on those newly designated counties. To eliminate the overt bias to the largest extent, we compare five differentiated types of propensity score matching algorithms and find that the nearest neighbor matching (NNM) method is most suitable for our data set. We then combine NNM with the DID estimator to further control for the constant hidden differences and additive selection bias. We have two main findings. First, we distinguish two potential responses of local governments to the program. Based on our results, non-west local governments were inclined to limit their economic growth so as to maintain the special transfer payments disbursed exclusively to the designated counties. Second, we find that the targeted program had a negative effect on infrastructure in some years and failed to affect sanitary conditions in general. However, if we further decompose the whole sample into various types of counties, the National Poor Counties program would have different impacts on different subsamples. Our results show that the program was not totally in vain as it still worked in certain counties.

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Tables

Table 1

The distribution of poverty population in 2000, 2005 and 2010

	Year	2000	2005	2010
Poverty Population Share With "Low-Income Standard" (%)	All	10.2	6.8	2.8
	Eastern	2.9	1.6	0.4
	Central	8.8	6.6	2.5
	Western	20.6	13.3	6.1

Source: Poverty Monitoring Report of Rural China 2010

Table 2

The rural poverty population and the incidence of poverty

Year	Poverty Line Income Level (Yuan)	Rural Poverty Population (million)		The Incidence of Poverty (%)	
		Whole Country	National Poor Counties	Whole Country	National Poor Counties
2000	865	94.22	-	10.2	-
2001	872	90.3	-	9.8	-
2002	869	86.45	48.28	9.2	24.3
2003	882	85.17	47.09	9.1	23.7
2004	924	75.87	41.93	8.1	21
2005	944	64.32	36.11	6.8	18
2006	958	56.98	31.1	6	15.4
2007	1067	43.2	26.2	4.6	13
2008	1196	40.07	24.21	4.2	11.9
2009	1196	35.97	21.75	3.8	10.7
2010	1274	26.88	16.93	2.8	8.3

Source: Poverty Monitoring Report of Rural China 2010

Table 3

Descriptive table for treatment and control cohorts in 2000

Variables	Combined (N=1441)	Control (N=892)	Treatment (N=549)	Difference
	Mean	Mean	Mean	P-Value
Log(GDP)	8.152	8.403	7.746	0.657***
Log(income)	7.433	7.638	7.101	0.536***
Log(revenue)	4.991	5.197	4.656	0.541***
revolutionary	0.198	0.164	0.253	-0.090***
minority	0.335	0.266	0.448	-0.182***
land	0.066	0.062	0.073	-0.011
density	256.539	309.431	170.601	138.830***
Log(special)	4.057	3.856	4.383	-0.528***
Log(expenditure)	5.857	5.853	5.864	-0.011
AMP	0.485	0.570	0.347	0.223***
beds	1880.772	2063.155	1584.443	478.712***
education	6.953	7.270	6.439	0.831***
first	36.404	33.428	41.239	-7.811***
second	32.597	35.567	27.772	7.794***

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

Table 4

Estimation of propensity score with logit

	Outcome variables					
	ΔLog (GDP)	ΔLog (income)	ΔLog (revenue)	ΔLog (special)	Δbeds	ΔAMP
Log(GDP)	-1.658***	-2.367***	-2.669***	-2.151***	-2.448***	-2.861***
	(0.540)	(0.436)	(0.423)	(0.404)	(0.383)	(0.412)
Log(revenue)	-0.101	-0.031	0.314	0.170	0.225	-0.079
	(0.333)	(0.338)	(0.477)	(0.322)	(0.317)	(0.325)
Log(income)	-2.932***	-1.782***	-2.904***	-3.072***	-3.164***	-2.842***
	(0.392)	(0.474)	(0.386)	(0.392)	(0.373)	(0.375)
revolutionary	1.007***	1.133***	1.031***	0.879***	1.014***	1.118***
	(0.251)	(0.255)	(0.250)	(0.256)	(0.245)	(0.245)
minority	0.081	0.176	0.206	0.548	0.186	0.154
	(0.340)	(0.340)	(0.335)	(0.347)	(0.332)	(0.325)
land	0.463	0.305	0.335	0.601	0.268	0.290
	(0.434)	(0.438)	(0.431)	(0.435)	(0.415)	(0.419)
density	-0.001	-0.001	-0.001	-0.002**	-0.001*	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log(special)	1.740***	1.706***	1.786***	1.331***	1.666***	1.809***
	(0.271)	(0.272)	(0.269)	(0.272)	(0.263)	(0.269)
Log(expenditure)	-1.188**	-1.314**	-1.163**	-0.677	-1.262**	-1.810***
	(0.519)	(0.523)	(0.519)	(0.505)	(0.512)	(0.501)
AMP	-0.633	-0.639	-0.627	-0.966**		-0.717
	(0.398)	(0.405)	(0.399)	(0.411)		(0.447)
beds	-0.001***	-0.001***	-0.001***	-0.001***	-0.000*	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
education	-0.133	-0.008	-0.112	-0.042	-0.067	-0.182
	(0.165)	(0.171)	(0.164)	(0.164)	(0.155)	(0.158)
first	-0.006	-0.005	-0.006			0.002
	(0.014)	(0.014)	(0.014)			(0.013)
second	0.029**	0.025*	0.029**			0.038***
	(0.014)	(0.014)	(0.014)			(0.014)
outcome1999	0.654	-0.263	0.327	0.817**	-0.000	-0.023
	(0.752)	(0.671)	(0.607)	(0.317)	(0.000)	(0.094)
outcome1998	-2.009***	-2.235***	-0.992**	1.060***	-0.000	0.143
	(0.704)	(0.605)	(0.479)	(0.269)	(0.000)	(0.241)
N	1441	1441	1441	1441	1441	1441
Pseudo-R^2	0.545	0.552	0.540	0.566	0.529	0.527

Table 5

Balancing comparison (Outcome variable is ΔLog(GDP))

Variables	NNM with replacement	NNM without replacement	3-to-1 NNM	RM	KM
		Criterion 1: T-test P-values			
Log(GDP)	0.000	0.171	0.000	0.000	0.065
Log(income)	0.001	0.763	0.000	0.008	0.025
Log(revenue)	0.005	0.250	0.068	0.020	0.296
revolutionary	0.010	0.793	0.028	0.114	0.868
minority	0.117	0.812	0.489	0.335	0.619
land	0.184	0.693	0.200	0.315	0.654
density	0.196	0.342	0.589	0.202	0.263
Log(special)	0.344	0.332	0.003	0.002	0.172
Log(expenditure)	0.177	0.963	0.000	0.000	0.026
AMP	0.320	0.749	0.327	0.039	0.554
beds	0.005	0.741	0.001	0.001	0.010
education	0.156	0.498	0.001	0.023	0.029
first	0.000	0.332	0.005	0.048	0.042
second	0.000	0.300	0.004	0.042	0.062
Log(GDP1999)	0.000	0.297	0.000	0.004	0.066
Log(GDP1998)	0.000	0.393	0.000	0.000	0.030
		Criterion 2: The percentage bias			
Log(GDP)	-22.6	13.5	-21.3	-19.7	-10.9
Log(income)	26.4	3.7	29.8	20.5	18.6
Log(revenue)	-16.9	11.9	-11.2	-14.4	-6.8
revolutionary	16.1	-3.2	13.9	10.1	-1.3
minority	10.1	-2.7	-4.5	-6.3	3.7
land	7.6	5.1	7.4	5.9	2.8
density	-6.2	10.5	2.6	6.0	-6.9
Log(special)	-6.5	-12.5	-21.1	-21.0	-11.0
Log(expenditure)	-8.9	-0.6	-24.8	-25.9	-16.9
AMP	-4.1	3.2	-4.1	-9.0	-3.0
beds	-13.6	3.4	-17.2	-15.9	-15.6
education	12.4	8.3	30.2	20.7	19.5
first	24.8	-10.9	16.7	11.7	14.6
second	-25.1	11.8	-16.3	-11.8	-13.2
Log(GDP1999)	-23.6	10.4	-19.6	-16.3	-11.3
Log(GDP1998)	-29.6	8.8	-25.0	-20.2	-13.6
		Criterion 3: Percentage bias reduction			
Log(GDP)	83.1	90.4	84.9	86.0	92.3
Log(income)	83.7	97.7	81.6	87.3	88.5

Log(revenue)	82.2	87.5	88.2	84.9	92.8
revolutionary	27.5	85.8	37.5	54.3	94.3
minority	73.8	93.0	88.3	83.7	90.5
land	-70.4	-13.7	-64.7	-31.3	37.3
density	89.5	82.3	95.7	89.8	88.4
Log(special)	90.2	81.2	68.3	68.4	83.5
Log(expenditure)	-321.9	72.2	-1074.1	-1126.4	-700.9
AMP	93.0	94.6	93.0	84.7	94.8
beds	71.3	92.9	63.8	66.4	67.1
education	85.4	90.3	64.5	75.7	77.0
first	57.3	81.1	71.2	79.8	74.9
second	58.1	80.4	72.8	80.3	77.9
Log(GDP1999)	82.6	92.4	85.6	88.0	91.7
Log(GDP1998)	78.1	93.5	81.5	85.1	90.0

Table 6

The impact of the National Poor Counties on GDP growth

Δlog(GDP)	All	West	Non-west	Mountain	Flat
2001	-0.022**	-0.017	-0.022	-0.040***	-0.025
	(0.011)	(0.013)	(0.022)	(0.014)	(0.021)
2002	-0.040***	-0.041**	-0.024	-0.058***	-0.059**
	(0.014)	(0.021)	(0.024)	(0.022)	(0.025)
2003	-0.039*	-0.006	-0.037	-0.063*	-0.097*
	(0.021)	(0.031)	(0.034)	(0.033)	(0.053)
2004	-0.043	-0.051	-0.046	-0.109**	-0.089*
	(0.027)	(0.038)	(0.040)	(0.042)	(0.051)
2005	-0.047	-0.073	-0.068	-0.124**	-0.107
	(0.034)	(0.045)	(0.052)	(0.053)	(0.066)
2006	-0.050	-0.065	-0.090	-0.140**	-0.151*
	(0.038)	(0.050)	(0.057)	(0.060)	(0.081)
2007	-0.057	-0.091	-0.092	-0.161**	-0.166*
	(0.042)	(0.059)	(0.058)	(0.066)	(0.090)
2008	-0.067	-0.070	-0.134**	-0.160**	-0.209*
	(0.048)	(0.066)	(0.059)	(0.071)	(0.108)
2009	-0.068	-0.092	-0.134**	-0.154**	-0.188*
	(0.048)	(0.070)	(0.061)	(0.071)	(0.105)
2010	-0.073	-0.079	-0.179***	-0.160**	-0.199*
	(0.050)	(0.071)	(0.064)	(0.071)	(0.111)

Note: Standard errors are in parentheses. ***, ** and * denote statistical significance at the 1, 5 and 10% levels.

Table 7

The impact of the National Poor Counties on income growth

Δlog(income)	All	West	Non-west	Mountain	Flat
2001	-0.082***	-0.064**	-0.055	-0.072**	-0.007
	(0.025)	(0.030)	(0.046)	(0.034)	(0.068)
2002	-0.090***	-0.062**	-0.081	-0.081**	-0.044
	(0.027)	(0.031)	(0.051)	(0.040)	(0.064)
2003	-0.110***	-0.030	-0.134**	-0.097**	-0.073
	(0.030)	(0.031)	(0.057)	(0.042)	(0.079)
2004	-0.135***	-0.053	-0.138**	-0.087*	-0.103
	(0.031)	(0.034)	(0.054)	(0.045)	(0.073)
2005	-0.166***	-0.078**	-0.205***	-0.116**	-0.157*
	(0.033)	(0.036)	(0.064)	(0.047)	(0.081)
2006	-0.183***	-0.083**	-0.248***	-0.119**	-0.192**
	(0.033)	(0.038)	(0.061)	(0.048)	(0.076)
2007	-0.164	0.009	-0.253***	-0.017	-0.234***
	(0.112)	(0.182)	(0.064)	(0.202)	(0.072)
2008	-0.177***	-0.102**	-0.251***	-0.116**	-0.183**
	(0.038)	(0.043)	(0.070)	(0.051)	(0.084)
2009	-0.179***	-0.117***	-0.232***	-0.119**	-0.265***
	(0.038)	(0.044)	(0.067)	(0.052)	(0.084)
2010	-0.203***	-0.122***	-0.253***	-0.116**	-0.284***
	(0.041)	(0.045)	(0.074)	(0.055)	(0.089)

Note: Standard errors are in parentheses. ***, ** and * denote statistical significance at the 1, 5 and 10% levels.

Table 8

The impact of the National Poor Counties on local government revenue growth

Δlog(revenue)	All	West	Non-west	Mountain	Flat
2001	-0.054**	-0.059*	-0.037	-0.027	-0.077
	(0.022)	(0.031)	(0.029)	(0.036)	(0.049)
2002	-0.038	-0.056	-0.068*	0.003	-0.126*
	(0.027)	(0.037)	(0.041)	(0.045)	(0.073)
2003	-0.050	-0.015	-0.109**	0.034	-0.183*
	(0.034)	(0.041)	(0.052)	(0.048)	(0.099)
2004	-0.071	-0.003	-0.213***	-0.055	-0.206
	(0.049)	(0.060)	(0.068)	(0.064)	(0.140)
2005	-0.090	-0.017	-0.268***	-0.089	-0.296*
	(0.064)	(0.086)	(0.085)	(0.084)	(0.175)
2006	-0.069	0.060	-0.311***	-0.074	-0.287
	(0.075)	(0.103)	(0.100)	(0.102)	(0.192)
2007	-0.094	0.013	-0.309***	-0.148	-0.272
	(0.075)	(0.104)	(0.100)	(0.106)	(0.194)
2008	-0.081	0.048	-0.302***	-0.134	-0.279
	(0.077)	(0.106)	(0.101)	(0.114)	(0.207)
2009	-0.061	0.050	-0.248**	-0.157	-0.172
	(0.076)	(0.105)	(0.099)	(0.113)	(0.196)
2010	-0.035	0.112	-0.229**	-0.153	-0.191
	(0.076)	(0.108)	(0.101)	(0.117)	(0.204)

Note: Standard errors are in parentheses. ***, ** and * denote statistical significance at the 1, 5 and 10% levels.

Table 9

The impact of the National Poor Counties on special transfer payments

Δlog(special)	All	West	Non-west	Mountain	Flat
2001	0. 156	-0.622	0.328**	-0.353	-0.714
	(0.322)	(0.520)	(0.148)	(0.499)	(1.001)
2002	0.178	-0.548	0.310**	-0.342	-0.520
	(0.313)	(0.501)	(0.148)	(0.495)	(0.966)
2003	0.182	-0.486	0.232	-0.336	-0.683
	(0.308)	(0.496)	(0.142)	(0.487)	(0.955)
2004	0.170	-0.529	0.293*	-0.306	-0.550
	(0.317)	(0.506)	(0.154)	(0.500)	(0.995)
2005	0.172	-0.489	0.332**	-0.311	-0.502
	(0.316)	(0.502)	(0.142)	(0.499)	(0.988)
2006	0.067	-0.022	0.104*	0.037	0.053
	(0.057)	(0.077)	(0.062)	(0.073)	(0.147)
2007	0.115*	-0.003	0.101	0.006	0.105
	(0.059)	(0.083)	(0.076)	(0.069)	(0.129)
2008	0.111*	0.034	0.062	0.070	0.061
	(0.066)	(0.102)	(0.072)	(0.099)	(0.125)
2009	0.145**	0.067	0.121*	0.095	0.174
	(0.065)	(0.101)	(0.071)	(0.102)	(0.123)

Note: Standard errors are in parentheses. ***, ** and * denote statistical significance at the 1, 5 and 10% levels.

Table 10

The impact of the National Poor Counties on sanitary conditions

Δbeds	All	West	Non-west	Mountain	Flat
2001	32.760	19.351	95.493	6.506	104.537*
	(61.302)	(94.632)	(58.683)	(96.522)	(58.245)
2002	-97.631*	-108.005	-28.597	-141.834	-37.544
	(57.513)	(93.748)	(70.557)	(100.158)	(99.627)
2003	-96.508	-157.799	4.671	-149.775	-1.549
	(63.539)	(101.428)	(78.580)	(111.954)	(105.363)
2004	-48.427	80.143	-11.111	57.456	-228.461
	(100.371)	(173.361)	(80.316)	(191.723)	(173.881)
2005	-221.573***	-195.712*	-0.056	-272.632**	-118.135
	(64.907)	(106.546)	(80.078)	(111.355)	(184.418)
2006	-215.116***	-167.429	8.652	-346.602**	-120.604
	(79.023)	(128.923)	(96.165)	(135.893)	(205.085)
2007	-257.892***	-312.690**	8.743	-452.620***	-169.256
	(85.900)	(137.376)	(90.670)	(150.648)	(198.815)
2008	-31.028	-91.375	104.983	-217.273	109.191
	(78.824)	(120.948)	(107.253)	(137.516)	(147.481)
2009	16.327	-13.267	50.651	-245.055*	16.459
	(88.677)	(132.591)	(107.253)	(141.006)	(194.845)
2010	-18.913	-35.633	-59.864	-225.896	178.465
	(95.764)	(136.258)	(113.728)	(153.169)	(214.334)

Note: Standard errors are in parentheses. ***, ** and * denote statistical significance at the 1, 5 and 10% levels.

Table 11

The impact of the National Poor Counties on infrastructure conditions

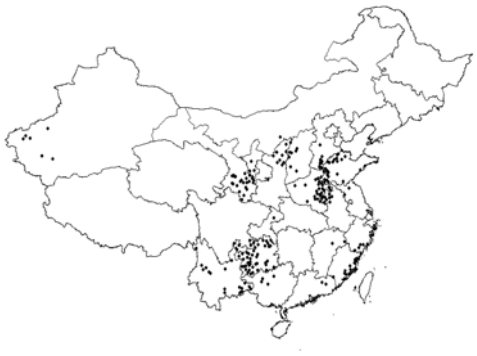
ΔAMP	All	West	Non-west	Mountain	Flat
2001	0.008	-0.001	-0.005	-0.012	0.023
	(0.008)	(0.012)	(0.010)	(0.012)	(0.021)
2002	-0.001	-0.007	-0.005	-0.007	0.036
	(0.010)	(0.012)	(0.012)	(0.014)	(0.029)
2003	0.010	0.003	0.002	0.005	0.019
	(0.012)	(0.014)	(0.016)	(0.016)	(0.037)
2004	0.017	0.026	0.009	0.002	0.011
	(0.015)	(0.019)	(0.020)	(0.019)	(0.043)
2005	0.008	0.006	-0.007	-0.023	0.004
	(0.018)	(0.022)	(0.025)	(0.022)	(0.050)
2006	0.006	-0.009	0.017	-0.029	-0.001
	(0.029)	(0.036)	(0.045)	(0.038)	(0.065)
2007	0.015	-0.016	-0.030	-0.016	-0.014
	(0.029)	(0.039)	(0.038)	(0.046)	(0.061)
2008	-0.017	-0.018	-0.032	-0.095**	0.050
	(0.029)	(0.041)	(0.043)	(0.039)	(0.068)
2009	-0.002	-0.031	-0.009	-0.065	0.014
	(0.036)	(0.053)	(0.049)	(0.043)	(0.085)
2010	0.029	0.029	-0.045	-0.016	0.014
	(0.053)	(0.086)	(0.054)	(0.090)	(0.095)

Note: Standard errors are in parentheses. ***, ** and * denote statistical significance at the 1, 5 and 10% levels.

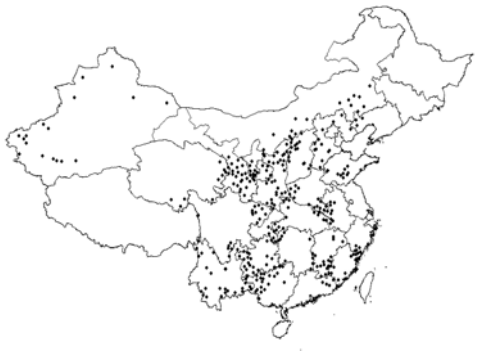
Figures

Figure 1

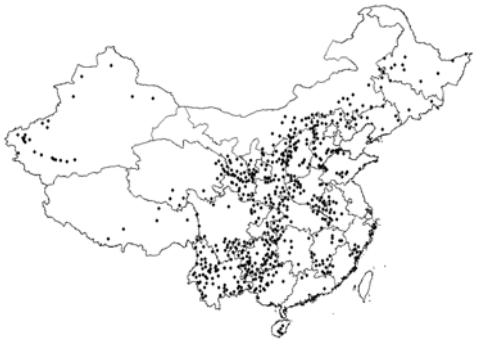
The distribution of National Poor Counties



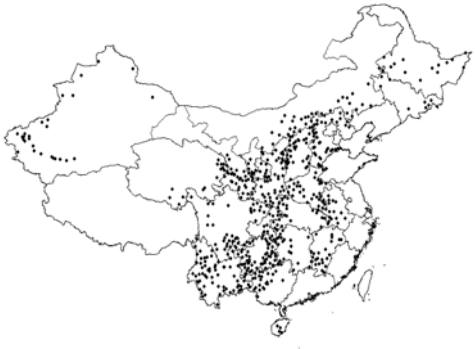
Prior wave: 1978–1985[12]



First wave: 1986–1993



Second wave: 1994–2000

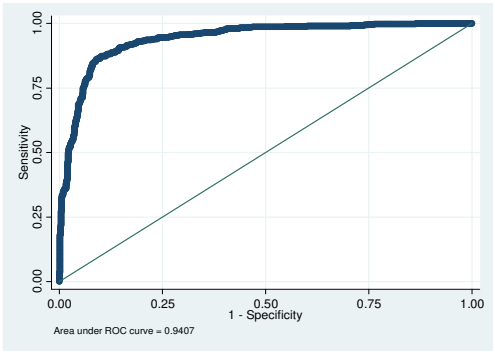


Third wave: 2001–2010

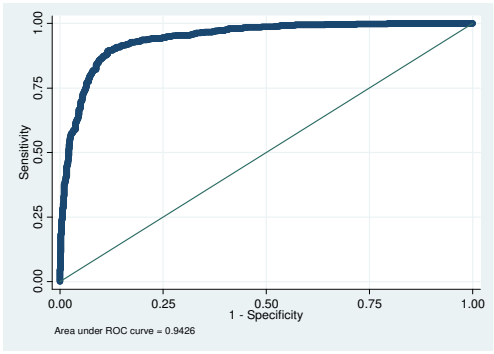
[12] Since the National Poor Counties program was not yet established in this wave, we use "the poor counties list 1977–1979" instead.

Figure 2

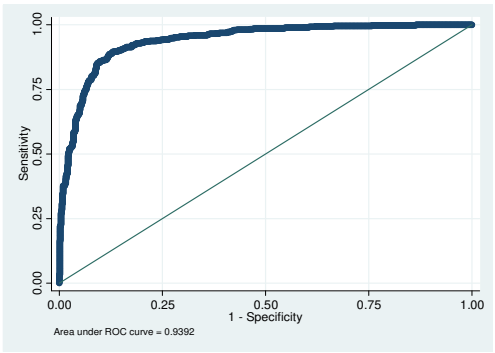
Receiver operating characteristic curve and C-statistics[13]



(a)



(b)



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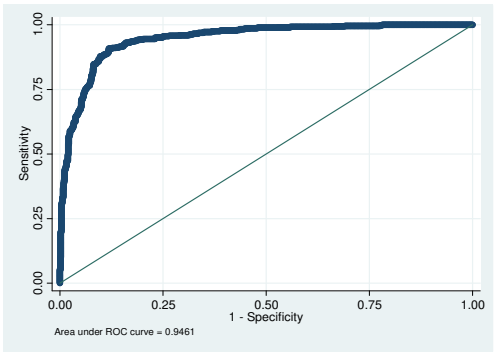

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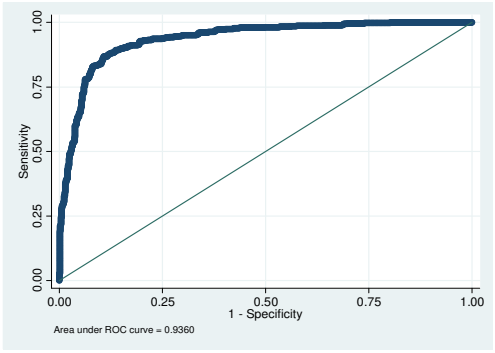

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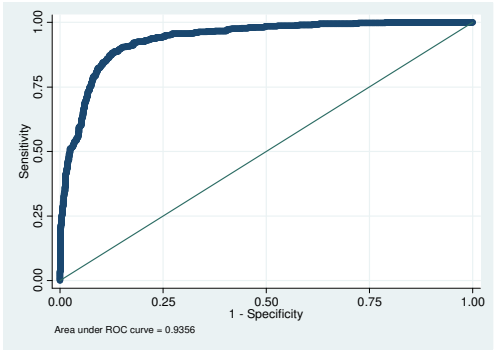

(f)

[13] From (a) to (f), the outcome variables are ΔLog(GDP), ΔLog(income), ΔLog(revenue), ΔLog(special), Δbeds and ΔAMP in order.

Figure 3

Standardized percentage bias across covariates (a)