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China's Pairing Poverty Alleviation Program: Insights from Xinjiang

Qizhou Luo, Shunfeng Song

Department of Economics, University of Nevada, Reno, USA
Email: qluo@unr.edu

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Abstract

This paper examined the pairing poverty alleviation policy implemented in Xinjiang, China, focusing on their impact across various poverty indicators. The research utilized difference-in-difference (DID), propensity score matching (PSM) and synthetic control method (SCM). We found that the combined efforts of poverty alleviation policies led to significant improvements in key economic metrics, such as GDP and GDP per capita, in the targeted regions of Xinjiang. Special attention was given to the effects on rural households. The study utilized county-level and province-level datasets from China spanning the years 2006 to 2015. Additionally, the pairing mechanism was scrutinized, revealing that the central government may have deliberately paired regions with similar economic sizes but differing levels of economic development.

Keywords

Poverty, China, Xinjiang

1. Introduction

1.1. Policy Background

In 2010, China initiated the Pairing Poverty Alleviation Program in Xinjiang. The Xinjiang Uyghur Autonomous Region (XUAR), situated in the northwest part of China, is a provincial-level autonomous region with an area covering 1.6 million square kilometers (620,000 square miles) and a population of approximately 25 million (National Bureau of Statistics of China, 2024). Positioned at the junctures of East Asia and Central Asia, Xinjiang holds notable importance due to its economic and geographical roles. Its size is comparable to the combined area of several European nations, including the UK, France, Spain, and Italy. Although

Xinjiang has rich natural resources, many of its inhabitants experience considerable poverty.

The area is vast geographically but economically deficient. Xinjiang has historically encountered financial difficulties. The idea of "pairing assistance" program was coined by the central government. It is a poverty alleviation initiative where economically advanced provinces and municipalities in China are paired with cities and counties in the less developed regions. Xinjiang's pairing program started in 2010. Eastern provinces were assigned to specific counties to provide direct investment and personnel support. After this program was conducted, it had reportedly invested more than a trillion yuan in Xinjiang's infrastructure and helped train over 1 million officials and civil servants (Ma, 2014). The pairing alleviation program in Xinjiang is part of China's broader initiative that has successfully lifted over 80% of its population out of poverty nationwide (see **Figure 1**).

Figure 1. Poverty population in China. Note: The population under poverty line dropped by 80% since the 1980s.

This research examines the impact of the policy on poverty reduction in Xinjiang. To address possible endogeneity concerns, it is essential that the pairing process avoids reflecting the economic traits of either the aiding or receiving regions. The matching is done randomly, and there is no indication that recipients have the freedom to choose their aid providers, nor do providers have this choice. In China, the central government holds substantial control over the macroeconomy, so when an aiding province is instructed, it must comply.

Before the policy was introduced, the eastern provinces had little economic incentive to favor certain areas, as these regions offered insignificant economic prospects, both instantly and in the long term. The financial benefits derived by the recipient counties in Xinjiang did not transfer back to the aiding provinces. The initiative encompassed nearly the entire Xinjiang region, excluding its capital, Urumqi, and the oil-rich city of Karamay.

The fiscal transfers from the central government did not exhibit a distinct preference for Xinjiang when compared to other northwestern provinces. There were

no other programs to assist Xinjiang poverty combat. The pairing program stands out as the sole major initiative in combating poverty in Xinjiang. Its extensive duration and substantial level of assistance guaranteed its effectiveness. Therefore, the disparity in fiscal transfers between Xinjiang and the other northwestern provinces after 2010 can primarily be attributed to the pairing alleviation program.

In eastern China, the economy is more developed due to its proximity to maritime routes. Consequently, the eastern and central provinces and cities were designated to support Xinjiang. For instance, Zhejiang Province was assigned to assist the counties under Aksu City in Xinjiang. We provided a detailed overview of the pairing regions between eastern and central China and Xinjiang. Through these pairings, the central government aimed to provide vital support to less developed regions in Xinjiang through financial, technical, and educational assistance (see Table 1 and Figure 2).

Table 1. Xinjiang counties and the aiding provinces.

Recipient	Aiding	Recipient	Aiding	Recipient	Aiding
Qiemo	Hebei	Luopu	Beijing	Hoboksar	Liaoning
Bohu	Hebei	Jimsar	Fujian	Tacheng	Liaoning
Heshuo	Hebei	Hutubi	Fujian	Tuoli	Liaoning
Hejing	Hebei	Qitai	Fujian	Shawan	Liaoning
Yuli	Hebei	Changji	Fujian	Yumin	Liaoning
Korla	Hebei	Mulei	Fujian	Emin	Liaoning
Yanqi	Hebei	Manas	Fujian	Yuepuhu	Shandong
Ruoqiang	Hebei	Jiashi	Guangdong	Shule	Shandong
Luntai	Hebei	Shufu	Guangdong	Yengisar	Shandong
Yiwu	Henan	Bole	Hubei	Makit	Shandong
Yizhou	Henan	Wenquan	Hubei	Yecheng	Shanghai
Barkol	Henan	Jinghe	Hubei	Bachu	Shanghai
Fuyun	Heilongjiang	Gaochang	Hunan	Zepu	Shanghai
Fuhai	Heilongjiang	Toxon	Hunan	Shache	Shanghai
Qinghe	Heilongjiang	Jimuno	Jilin	Kashgar	Shenzhen
Shanshan	Hunan	Habahe	Jilin	Taxkorgan	Shenzhen
Fukang	Shanxi	Burqin	Jilin	Wushi	Zhejiang
Yutian	Tianjin	Altay	Jilin	Kuqa	Zhejiang
Minfeng	Tianjin	Wuqia	Jiangsu	Xinhe	Zhejiang
Cele	Tianjin	Atush	Jiangsu	Keping	Zhejiang
Baicheng	Zhejiang	Yining	Jiangsu	Shaya	Zhejiang

Continued

Pishan	Anhui	Qapqal	Jiangsu	Wensu	Zhejiang
Hotan County	Beijing	Huocheng	Jiangsu	Aksu	Zhejiang
Hotan City	Beijing	Akto	Jiangxi	Awati	Zhejiang
Moyu	Beijing	Wusu	Liaoning		

Note: The table shows the aid-receiving counties in Xinjiang and aid-giving provinces in the East. Xinjiang's capital, Urumqi, the second largest city, Karamay, along with a couple of developed counties are not given aids. Thus, they are not included.

Figure 2. Xinjiang, control group and aiding provinces. Note: The provinces have been categorized into three groups: Xinjiang is represented in red, provinces in the control group are indicated in blue, aiding provinces are highlighted in green. Source: Ministry of Natural Resources of China, http://bzdt.ch.mnr.gov.cn/.

This pairing program differs from the traditional vertical financial transfers from the central government to localities. It exhibits a horizontal approach, where provinces collaborate to reduce poverty. By pairing these regions together, wealthier regions can offer detailed and customized assistance to the poorer regions in Xinjiang. This approach also allows the central government to conserve critical human and capital resources. The eastern provinces can assist Xinjiang either by transferring funds directly, providing technological support through enterprises, or by dispatching personnel to Xinjiang. The horizontal transfer also took advantage of a streamlined government. Evidence suggests that simplifying the government structure will improve poverty reduction efforts (Li, Lu, & Wang, 2016).

1.1.1. Case 1: Zhejiang Province's Support to Aksu Region

The pairing poverty alleviation projects between prosperous regions and less-

developed areas in Xinjiang have contributed significantly to poverty reduction efforts. Zhejiang Province, for instance, established a "command center" in Aksu in 2010, deploying over 300 personnel, including 130 officials. Zhejiang allocated a significant share of its local budget to these projects, supporting 252 initiatives from infrastructure to intellectual assistance, with an investment of over 4.65 billion yuan (Ma, 2014). The funds contributed to housing development, where Zhejiang provided subsidies along with central and local government contributions to reduce the financial burden on beneficiaries.

1.1.2. Case 2: Shenzhen City's Support in Kashgar

Similarly, Shenzhen took part in alleviation efforts in Kashgar and Taxkorgan by focusing on community welfare. Starting in 2011, Shenzhen funded projects including schools, hospitals, and social welfare centers, with over 3 billion yuan allocated over five years. These projects included the construction of educational facilities like Kashgar's 18th Elementary School, which had superior facilities compared to Shenzhen's standards (Ma, 2014). Other critical initiatives in this region included developing housing for urban and rural communities, infrastructure projects like road connectivity, and establishing industrial and technology centers, supporting long-term economic growth.

1.1.3. Case 3: Beijing's Aid to Hotan Region

Beijing's efforts in Hotan demonstrated a balanced focus on community well-being, economic development, and infrastructure. Between 2011 and 2015, Beijing invested approximately 7.26 billion yuan in various projects, primarily supporting housing, healthcare, education, and basic infrastructure. Beijing funded rural housing, social welfare projects, and an innovative forestry program to combat desertification while also investing in trade, tourism, and logistics. Additionally, Beijing allocated resources for skill-building and management training, although it notably lacked focus on bilingual teacher training, which remains critical in areas with a high Uyghur population like Hotan (Ma, 2014). These multi-faceted efforts illustrate the potential of targeted regional partnerships to create sustainable development and poverty alleviation.

This paper starts with a review of the literature, provides results, and analyzes the policy's influence across multiple dimensions. The next section delves into the relevant literature. The results section investigates the impact of the policy on GDP, GDP per capita, and the income disparity between rural and urban areas in the target regions. The policy has played a role in alleviating poverty in various aspects in Xinjiang. Furthermore, we will assess the model's performance and consistency using various techniques.

1.2. Literature Review

Poverty is an issue. It has prominent effects on people's well-being. In the case of China, it is not caused by the lack of resource, but by the uneven distribution. The distribution and mechanisms of the economy is often the main cause of poverty

(Sen, 1982). The bad governance and being landlocked by poor neighbors can also be factors (Collier, 2008). Xinjiang is far from the rich each coast of China and its neighboring provinces and countries are also underdeveloped. Poverty has profound impact on people's development. It limits people's right to pursue the life they want (Miletzki & Broten, 2017).

The poverty can be addressed by efforts (Banerjee & Duflo, 2011). As the field random experiments show, the small measures can have great impact on poverty alleviation. The financial help, technological aid, infrastructure investments and education can greatly help address poverty (Sachs, 2006). There are also limits about random controlled trial method because they are conducted in small scales and may not be applicable for the large-scale policy implementation (Tollefson, 2015). In this research, we measured poverty using GDP per capita as an indicator. (Ravallion, 2015).

The concept of net fiscal equity theory developed by Buchanan (1950), which examines the balance and fairness in financial contributions and benefits among different sectors of an economy, has been a cornerstone in public finance. He thinks that the financial transfer should focus on long-term benefits rather than short-term economic profits. The reduction of financial transfer to the local can also reduce the own-source revenue of the local government (Stine, 1994).

Building on Buchanan's foundation, economists like Albouy (2012) have further refined and expanded these ideas. He proposed the "optimal financial transfer model" between governments, a significant advancement in fiscal theory. The interprovincial structure—with its information advantages, performance metrics, and incentive constraints—facilitates more effective aid allocation. Under assumptions about production, consumption, taxation, and public services across both donor and recipient regions, net fiscal benefits for Xinjiang can be enhanced (Xu & Liu, 2018).

Empirical studies such as Loayza and Raddatz (2010) have identified specific factors for alleviating poverty. The alleviation of poverty results not only from the size of the economy but also from the structure of the economy. The biggest contribution is seen from the primary and tertiary sectors. People in agriculture and manufacturing can work to improve the economy. The employment rate will increase as these sectors are labor intensive. However, for the tertiary sector, the contribution is not as significant as the labor-intensive sectors as it generally does not benefit most people in the economy. Among all three sectors, agriculture is the key to poverty reduction. In the poverty reduction, primary sector, which is mainly agriculture was the key driving force (Montalvo & Ravallion, 2010). However, concentrating solely on agriculture is not the definitive solution to poverty reduction. The evidence indicates that without a robust manufacturing sector, the region is likely to eventually fall back into poverty (Bulte, Xu, & Zhang, 2018).

Currently, there is limited English literature on poverty alleviation in China. Although several Chinese papers have explored this issue, there are relatively few that focus on "pairing poverty alleviation." This scarcity is primarily due to the

challenges in obtaining data related to pairing support. Databases concerning China's impoverished populations, such as the "China Poverty Population Tracking Survey Database," are limited to specific areas, such as Xin County in Henan Province. Renmin University of China developed this database by conducting surveys in Xin County in Henan Province in 2018. These databases are micro-level and household-based, restricting their applicability in cross-province poverty research. The literature provided has been translated from the Chinese language.

In studies of pairing poverty alleviation, M. Xu and Liu (2018) examined how interprovincial support affected the economic performance of recipient regions. It found that the policy significantly increased overall labor productivity and residents' incomes in the recipient region, with greater assistance to economically disadvantaged areas. In another paper by M. Xu (2022), he studied the impact of inter-provincial support on improving household living standards. The research revealed that inter-provincial support significantly increased per capita total living consumption expenditure in recipient areas. Although the pairing poverty alleviation program is a crucial and effective policy for reducing poverty in China, the study by Xu appears to be the sole research addressing this subject.

It's worth mentioning that G. Zhang et al. (2019) studied the economic growth effects and policy effectiveness of poverty alleviation reform pilot zones. The study found that policy implementation significantly promoted local economic development. Although this study did not focus on pairing poverty alleviation, the poverty alleviation reform pilot zone model shares similarities with inter-provincial pairing poverty alleviation, the difference being the former involves support within the same province while the latter involves support from outside the province.

Outside of government initiatives, there is also research on Chinese businesses' pairing poverty alleviation efforts. For instance, Zhen and S. Wang (2021) examined the impact of precision poverty alleviation on enterprise risk. The research found that higher levels of enterprise precision poverty alleviation participation were associated with lower stock market risk. The driving force behind companies or individuals participating in poverty reduction programs is largely altruistic. Once a certain income threshold is reached, those who contribute to poverty alleviation do so out of selfless intentions rather than personal gain (Lal & Sharma, 2009).

However, publicly listed companies typically engage in precision poverty alleviation at the village level, and economic data at the village level is challenging to obtain. Thus, as of now, there are virtually no papers studying the impact of precision poverty alleviation by publicly listed companies on recipient units. The involvement of listed companies in poverty programs might simulate efforts made by aiding provinces as both aim to enhance their reputations.

In the realm of research on China's pairing poverty alleviation, several critical issues have surfaced:

- Many studies have focused solely on assessing the impact of this policy on recipient areas, neglecting the equally important assisting regions.
- The intricate mechanisms underlying paired support have not received sufficient scrutiny, leaving a gap in our understanding of their operation.
- Existing studies often suffer from limited sample areas, failing to encompass all recipient regions. These limitations largely stem from the challenges associated with obtaining relevant data.

To address these shortcomings, our research takes a more comprehensive approach. It leverages a specific and detailed dataset to provide a more nuanced examination of the policy's effects. Moreover, the study delves deeply into the pairing mechanisms and thoroughly explores the economic conditions of both aiding and receiving regions, contributing to a more robust understanding of the program's dynamics.

2. Data

The data used in this study is sourced from the China Regional Statistical Yearbook, published by the China Statistical Bureau. It comprises a panel data set that encompasses all county-level regions in Xinjiang and four northwestern provinces. Shaanxi, Gansu, Qinghai, and Ningxia. The dataset spans from 2006 to 2015, covering the pivotal year of policy implementation in 2010.

Below we provided a comprehensive overview of the data, featuring dependent variables such as GDP, GDP per capita, and the rural to urban household income ratio. Independent variables encompass the total population of regions, population growth rates, and the ratios of the primary and secondary sectors to total output (see Table 2).

Table 2. Summary statistics: Xinjiang, control group and aiding provinces.

	(1)	(2)	(3)	(4)	(5)
	Matched	T	C	T - C	*p*-value
gdp	397004.3	342229.7	416036.2	−73806.4	0.00
gdppc	17352.05	17532.17	17282.38	249.79	0.00
pop	25.96	21.01	27.68	−6.67	0.00
rural	4032.41	4926.37	3712.3	1214.07	0.00
primary_ratio	0.27	0.34	0.25	0.09	0.00
secondary_ratio	0.38	0.31	0.4	−0.09	0.00
Observations	323	82	241		

Note: Column (1) presents a matched sample including both the treatment and control groups. Column (2) lists the average values for the treatment group. Column (3) displays the average values for the control group. Column (4) indicates the mean differences. Column (5) reports the *p*-values for the differences between the treatment and control groups. These statistics pertain to the year 2009.

Regarding control variables, we included multiple factors within the model.

GDP and GDP per capita are affected by elements such as population size, population growth, and the economic structural composition. Attaining a significant degree of industrialization is crucial for regional advancement.

In this analysis, we converted the values to their logarithmic equivalents to enhance clarity and facilitate interpretation. As a result, the findings will be expressed in percentage points.

3. Estimation Framework

In this study, we initially examined the mechanism of pairing. This is explored by analyzing pairwise correlation coefficients.

To analyze the impact of the policy, we used a difference-in-difference (DID) model to assess the impact of the pairing poverty alleviation program, which was started in 2010. In this context, the years preceding 2010 are considered the pre-policy period, while the years from 2010 onward are considered the post-policy period. To construct the key DID variable, we multiplied the treatment indicator (1 for aid receiving regions in Xinjiang) by the post-policy indicator (1 for years including and after 2010).

The treatment group comprises the aid-receiving regions in Xinjiang, while your control group consists of both the remaining regions in Xinjiang and regions in Shaanxi, Gansu, Qinghai, and Ningxia. These control group provinces share similarities in geographical and economic characteristics, including being landlocked and economically underdeveloped. Additionally, they exhibit the feature of multiethnicity, which is a common trait with Xinjiang.

The four regions in the control group along with Xinjiang are categorized as the northwestern region in China. While bordering Xinjiang, Tibet is not considered as the same group with these regions for it is situated on the high plateau. The economic characteristics are drastically different from Xinjiang and the control group. Xinjiang and the four regions have relatively lower elevation than Tibet. Therefore, Xinjiang is compared with the four regions excluding the neighboring Tibet.

The model specification is presented in the following equation:

$$Y_{it} = \beta_0 + \beta_1 \mathrm{DID}_{it} + \beta_2 \mathrm{Control}_{it} + \gamma_t + \delta_i + \epsilon_{it} \quad (1)$$

where y_{it} represents the outcome variable for individual or entity i at time t.

β_0 is the intercept, representing the baseline value of the outcome variable.

β_1 is the interaction term, representing the specific effect of the treatment by measuring the difference in changes over time between the treatment and control groups.

$\mathrm{Control}_{it}$ represents the control variables, including logarithmic population, foreign direct investment and college graduate numbers.

γ_t is the year fixed effect, which controls for time-specific effects.

δ_i is the county fixed effect, which controls for time-invariant factors that differ between regions.

ϵ_{it} represents the error term.

The model integrates both regional influences and year-fixed effects. To precisely evaluate the average treatment effect in a difference-in-differences (diff-in-diff) framework, it's crucial to consider these influences. Therefore, I've incorporated controls for both region and year fixed effects into the model.

After reviewing the literature, we identified the main indicators for assessing policy implementation. Consequently, I propose the following hypotheses.

- H1: The pairing poverty alleviation program has a positive impact on increasing the GDP and GDP per capita of the aided regions.
- H2: Pairing with rich provinces can better help the poverty alleviation
- H3: There exists heterogeneous effects in resource cities.
- H4: There are spillover effects in the nearing counties.
- H5: Pairing alleviation program is effective through increasing rural household incomes.

We believe that the policy is likely to have a beneficial effect on important economic metrics, including GDP and GDP per capita, in the provinces receiving it. It is designed to assist with poverty reduction, particularly targeting rural areas where the majority of the impoverished population lives. Consequently, rural households are expected to experience a comparatively larger increase in income than urban households. Thus, we suggest that the policy will raise the income ratio of rural to urban areas.

To evaluate these hypotheses, we will carry out three distinct analyses. We assume that the policy has had a significant impact on all three aspects, which are interrelated. Specifically, if GDP grows, it is likely to have a positive effect on the income of both rural and urban households. Furthermore, the income ratio between rural and urban households depends on the policy's influence. This study seeks to determine whether the policy primarily benefits urban or rural households.

The models employed may differ for each dependent variable due to distinct deterministic factors influencing them. Moreover, the results may vary depending on whether or not we account for year and city effects. Consequently, we will present the results in parallel to facilitate comparison.

4. Results

4.1. Baseline Estimates

There is a positive correlation between the GDPs of pairing and recipient regions. Conversely, the correlation between their GDP per capita is negative. This suggests that the central government deliberately matched regions with similar economic sizes while aligning poorer recipient areas in Xinjiang with wealthier donor regions in the east. Additionally, the negative and significant correlations regarding the ratios of primary sectors to GDP imply that advanced provinces were paired with the more agrarian counties in Xinjiang. Consequently, we conducted additional analyses based on these findings (see **Table 3**).

Table 3. Correlation matrix of variables.

Panel A				
	gdp	gdppc	p_gdp	p_gdppc
gdp	1			
gdppc	0.5434*	1		
p_gdp	0.1160*	0.0731	1	
p_gdppc	0.0366	−0.0916*	0.4002*	1
Panel B				
	primary_ratio	secondary_ratio	p_pr	p_sr
primary_ratio	1			
secondary_ratio	−0.7449*	1		
p_pr	−0.1143*	0.1490*	1	
p_sr	−0.0466	0.0502	0.7303*	1

Note: Panel (A) shows the correlation coefficients of GDP, GDP per capita of treated counties, along with the GDP and GDP per capita of the paired provinces. Panel (B) shows the correlation coefficients of the ratios of primary and secondary sectors in treated counties and the ratios of sectors in the paired provinces.

The policy's effects were clearly depicted in the graphical analyses. we generated graphs to demonstrate the models' outcomes, and it was clear that the key variables, including GDP, GDP per capita, and income ratio, were notably greater for Xinjiang than for other provinces in northwestern China (please refer to Figure 3).

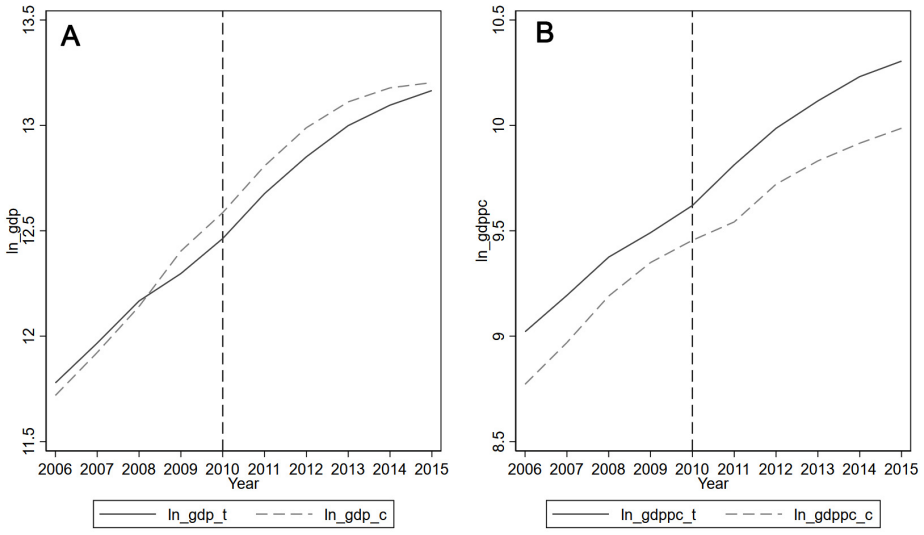

Figure 3. Policy effect on GDP and GDP per capita. Note: Panel (A) to the left shows the GDP and Panel (B) to the right shows the GDP per capita. The solid lines depict the GDP and GDP per capita in Xinjiang and the dashed lines show the indicators in control groups.

There was a notable policy impact on GDP growth. Before 2010, there was a

considerable gap between the GDP of the Xinjiang regions and the other northwestern areas. By 2015, however, these regions had shown signs of convergence.

The graph on the right illustrates that Xinjiang's GDP per capita saw substantial growth compared to other northwestern regions. Notably, the gap between the two regions widened after the policy was implemented in 2010 (see Figure 3).

Evidence shows that the pairing poverty alleviation program has a significant and positive impact on the GDP of the receiving regions. In column (2), it is shown that with control variables added, there is a substantial 46% increase in GDP in these regions after the policy implementation—a strong indication of its effectiveness (see Table 4).

Table 4. Baseline regressions.

	(1)	(2)	(3)	(4)
	ln_gdp	ln_gdp	ln_gdppc	ln_gdppc
did	−0.107	0.464***	0.268**	0.344***
	(0.120)	(0.0800)	(0.109)	(0.0726)
pop		0.0350***		−0.0101***
		(0.00226)		(0.00188)
primary_ratio		−1.012**		−0.174
		(0.431)		(0.332)
secondary_ratio		2.339***		2.691***
		(0.296)		(0.234)
Year FE	✓	✓	✓	✓
County FE	✓	✓	✓	✓
F	0.794	143.1	5.991	113.0
N	3181	3000	2280	2273
r^2	0.178	0.720	0.244	0.674

Note: Column 1 shows the effect on GDP without control variables. Column 2 shows the effect on GDP with controls. In Column 3, the dependent variable is GDP per capita. In Column 4, it shows the model with GDP per capita as dependent variable and with controls. Standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

The policy effect on GDP per capita is notably significant. In the receiving regions, GDP per capita experiences a substantial growth of approximately 27%, as evidenced by the baseline models in column (3). This effect persists, with a 34% increase, even when control variables are included, as illustrated in column (4).

4.2. Heterogeneous Effects

Additionally, we conducted analyses of heterogeneity effects on counties by aiding provinces. For instance, Yili received funding from Jiangsu province, while Tacheng received aid from Liaoning province. It's worth noting that Jiangsu, located in the south of Liaoning, had higher GDP and GDP per capita during the

treatment period. However, even relatively poorer provinces participated in aiding Xinjiang because they were still comparatively wealthier than the receiving regions.

Coastal provinces in the southeast, known for their vibrant private sectors and pro-business culture, adopted different approaches to aid. They typically provided a more comprehensive package of assistance, ranging from financial and technological aid to educational support.

However, the following table shows a negative relationship between the GDP per capita of the aiding provinces and recipient counties. The closer the economic development level, the better aiding was provided. It further shows that the higher the primary and secondary sector ratios of the aiding provinces, the higher the effect on Xinjiang's recipient regions, probably because of the better agricultural and manufacturing aids (see Table 5).

Table 5. Heterogeneous effects.

	(1)	(2)	(3)	(4)	(5)
	ln_gdppc	ln_gdppc	ln_gdppc	ln_gdppc	ln_gdppc
did_1	−1.208***				
	(0.254)				
did_2		975.4***			
		(267.1)			
did_3			146.1*		
			(83.31)		
did_4				0.627***	
				(0.169)	
did_5					1.536***
					(0.317)
Controls	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓
F	22.60	13.34	3.074	13.81	23.51
N	690	690	690	2280	2280
r^2	0.406	0.339	0.279	0.258	0.265

Note: Column 1 shows the effects of the GDP per capita of the aiding provinces. Column 2 shows the effect of aiding provinces' ratios of primary sector. Column 3 shows the effect of aiding provinces' ratios of secondary sector. Column 4 shows the effect of resource cities. Column 5 shows the effect of spillover effect. Standard errors in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

The resource cities in Xinjiang seemed to benefit more from the policy. These counties are more likely to generate revenue from selling their natural resources. This is an easier way compared to selling agricultural and industrial products in

other counties.

The spillover effects are also significant. The policy not only benefited the recipient counties in Xinjiang, but also in the neighboring counties in other provinces. This was probably caused by the transportation. The roads leading to Xinjiang need pass Gansu province.

We conducted a series of regressions on the interaction terms of the treatment group and years. The regression coefficients in the before the policy year (2010) are significantly lower than those after the policy year. The coefficients before 2010 are insignificant and the coefficients after 2010 are significant. It implies that the policy was effective after the year of implementation (see Figure 4).

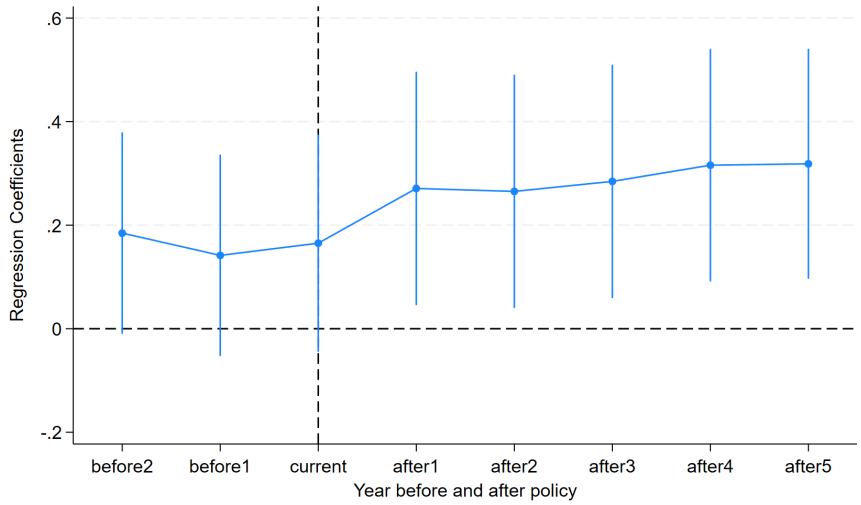

Figure 4. Dynamic effects. Note: The graph shows the dynamic effects of the policy. The solid line shows the coefficients of regression in different years. The vertical line segments are the 95% confidence intervals.

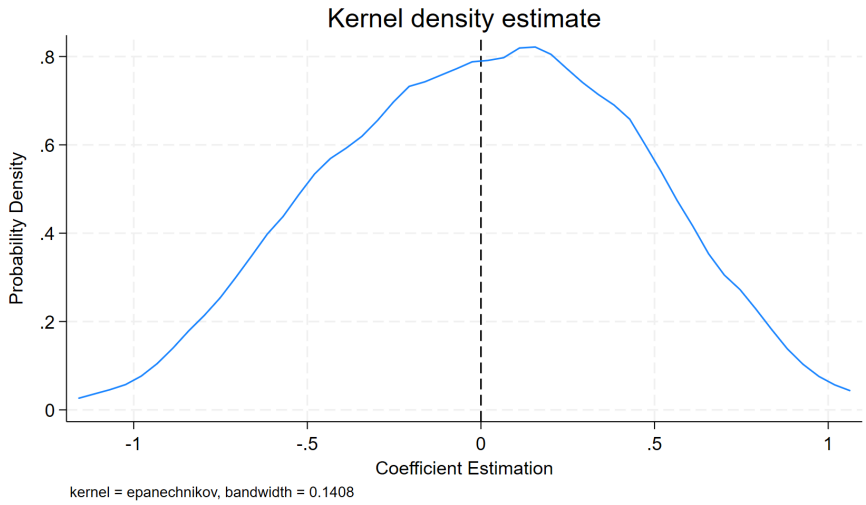

Figure 5. Placebo tests. Note: We created a false policy implementation year 2007 and ran a DID model using the false year. To increase the identification ability. I repeated the process 50 times. The coefficients are centered around 0, implying that the false DID is ineffective.

To evaluate the placebo effect, we created a fictitious policy year 2007 and discovered that the coefficients for 2007 are predominantly zero. The policy year passed the placebo tests. There was no confounding policy that had clear effects on the GDP per capita of the treatments (see Figure 5).

4.3. Robustness Checks

There could be endogeneity issues about receiving the aid between the treatment and control groups. Heckman, Ichimura, and Todd (1997) developed the propensity-score matching model. We tested the economic characteristics of the two groups and kept only the matched counties. The DID is significant with the PSM.

We also tried other robustness checks. The DID variable is significant for lagged controls, keeping non-resource counties and in the shortened period after the policy was implemented. These results show that the policy has significant impact when different constraints are applied (see Table 6).

Table 6. Robustness checks.

	(1)	(2)	(3)	(4)
	PSM	Lagged	Non-res	Shortened
	ln_gdppc	ln_gdppc	ln_gdppc	ln_gdppc
did	0.357***	0.360***	0.295***	0.361***
	(0.0721)	(0.0731)	(0.0790)	(0.0759)
Controls	✓		✓	✓
L.Controls		✓		
Year FE	✓	✓	✓	✓
County FE	✓	✓	✓	✓
N	2264	1974	2063	1105
r^2	0.678	0.653	0.667	0.614

Note: Column 1 shows the results of differences in differences with the propensity score matching (PSM-DID). Column 2 shows the results of one-year lagged variables. Column 3 shows the results of resource cities in Xinjiang. Column 4 is the DID analysis of a shortened period from 2010 to 2015. Standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Even when resource-rich cities are excluded, the policy remains significant and effective. Non-resource cities, which suffer from the disadvantage of lacking natural resources, may face reduced incentives for assistance from eastern provinces. However, the analysis demonstrates that these cities still benefited from the policy, with noticeable improvements in their agriculture and manufacturing sectors. The policy's significance also holds when the analysis period is shortened. By excluding the years prior to the policy implementation, the policy remains significant, indicating that its impact is solely attributed to the post-policy period. This suggests that the observed significance from 2010 onward is directly due to the policy itself and not influenced by pre-existing trends.

4.4. Policy Effectiveness

The policy had a significantly positive effect on the rural-to-urban income ratio, with a pronounced impact on increasing rural household income. These policies were predominantly aimed at addressing poverty in rural areas, and consequently, they contributed to narrowing the income gap between rural and urban households. The wealth gap in China is primarily driven by the income disparity between rural and urban areas (Yao et al., 2004). Chen and Cai (2017) highlighted that in the "post-economic state" era, governments might shift their focus from purely economic growth to prioritizing social equity. Policies focused on rural development have the potential to address this issue.

Table 7. Policy effectiveness analysis.

	(1)	(2)	(3)
	ln_rural	ln_urban	income_ratio
did	0.272***	0.0141	0.170***
	(0.0565)	(0.0390)	(0.0321)
Controls	✓	✓	✓
Year FE	✓	✓	✓
County FE	✓	✓	✓
N	2937	1674	1679
r^2	0.597	0.739	0.00624

Note: Column 1 shows the effect of policy on rural household income. Column 2 shows the effect on urban household income. Column 3 represents the effect on rural-to-urban household income ratio. Standard errors in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

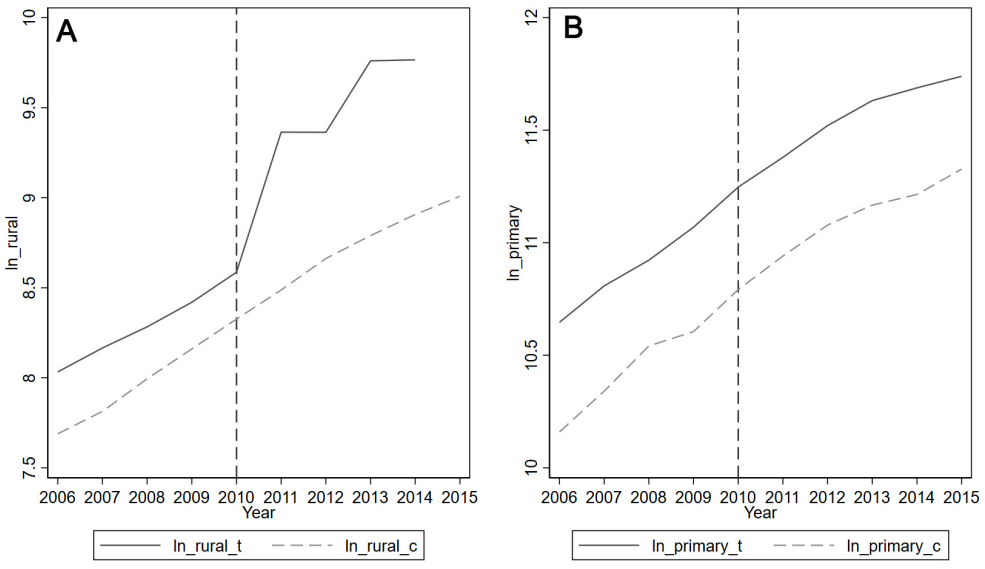

Figure 6. Rural household income and primary sector size. Note: The graph to the left shows the rural household income. The graph to the right shows the size of primary sectors. The solid lines represent Xinjiang. The dashed line represent the control group.

We analyzed the policy effects on rural and urban household income and rural-to-urban income ratios. With county and year fixed effects, the rural household income experienced substantial growth, with an increase of 55%, as indicated in column (1). The income ratio exhibited significant growth, with a 17% increase (see Table 7).

The rural-to-urban income ratio exhibited rapid growth following the policy's implementation, with Xinjiang maintaining its leadership in this growth among the northwestern regions (see Figure 6).

4.5. Synthetic Control Estimates

Furthermore, we utilized the synthetic control method to generate a synthetic Xinjiang as its control group. The graphs clearly demonstrate that Xinjiang outperformed its peers and diverged positively from its previous trajectory after 2010. These results intuitively illustrate the significant implementation of the policy.

The synthetic control method removed the treatment selection bias. It allows for a comprehensive view of the development level in China in comparison to the Xinjiang Region. In contemporary policy evaluation research, the SCM enjoys extensive use (Abadie & Gardeazabal, 2003; Abadie, Diamond, & Hainmueller, 2010). It enables the creation of a control group through the synthetic combination of various potential control areas. Consequently, the control group's trend can mimic that of the treatment group.

It shows that the GDP of Xinjiang was significantly higher than the control group after 2010. For GDP per capita, the gap was shown from 2012. The GDP per capita of Xinjiang grew significantly faster than the synthesized control group (see Figure 7).

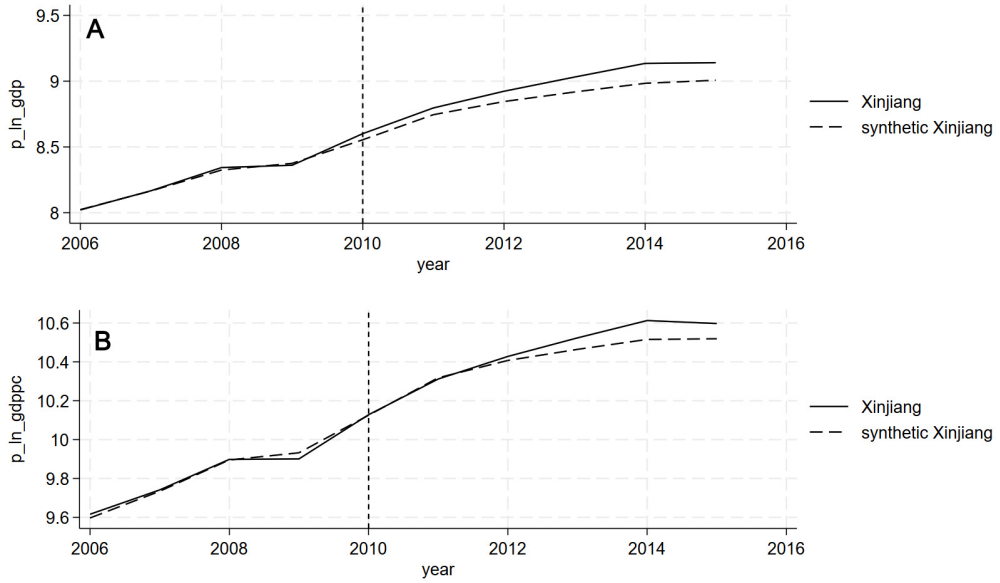

Figure 7. GDP of Xinjiang and Synthetic Xinjiang. Note: In Panel (A), the control group was synthesized by 0.72 times Gansu and 0.28 times Heilongjiang. In Panel (B), the control group was synthesized by 0.16 times Gansu and 0.84 times Heilongjiang.

5. Conclusion

Through the pairing poverty alleviation program, Xinjiang's counties saw a 46% increase in average GDP and a 34% rise in GDP per capita, significantly improving local living standards. Pairing arrangements generally matched counties of similar size but different economic levels, with stronger results observed when counties had comparable economic structures. Resource-rich counties, in particular, showed notable gains, and the policy's benefits even extended to neighboring counties, confirming its spillover effects. Results are robust with propensity score matching (PSM), and the policy was especially beneficial for rural residents, helping reduce the income gap between rural and urban areas.

The pairing poverty alleviation program has demonstrated a remarkable ability to significantly boost the economies of receiving regions in Xinjiang. It serves as a substantial natural experiment with considerable implications for economic analysis. Not only has this policy led to dramatic economic growth in the affected regions, but it has also delivered substantial benefits to individuals within those areas.

Although the policy has effectively addressed inter-provincial economic imbalances, there is still room for improvement in several areas. The pairing mechanism, in particular, could be refined. Provinces providing aid should share similar economic strengths with the recipient regions. For instance, agriculturally dominant regions should be paired with provinces that have robust agricultural sectors, while manufacturing-focused counties should be matched with provinces that excel in manufacturing. Throughout the program, the power dynamics between aiding and recipient regions should be closely monitored. If the economic gap between them is too wide or their economic compositions are too different, the partnership may deteriorate, necessitating adjustments. Over time, the pairings should be revised accordingly to ensure continued effectiveness.

China's experience in implementing this program holds promise for broader global dissemination. It serves as a compelling example of a horizontal financial transfer mechanism within a country. This approach has the potential to narrow the wealth gap between affluent and less affluent regions, ultimately contributing to a more balanced economic development nationwide.

However, the successful implementation of such programs is highly dependent on robust central government supervision. Addressing corruption and ensuring proactive engagement are crucial facets to consider. Additionally, incentivizing government officials to effectively implement the policy can play a pivotal role in its success.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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