

Local Centralization and Human Capital: Evidence from Incorporating-County-into-Prefecture Reform in China

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Abstract

This paper examines the impact of the Incorporating-County-into-Prefecture (ICP) reform, a centralization reform of subnational governments in China, on human capital investment. Using county-level data from 1988 to 2013, the analysis finds that the ICP reform increased local high school enrollment by over 3 percentage points cumulatively within five years after implementation, with the treatment effect growing over time. Girls are found to benefit more from the reform. Empirical evidence suggests that the reform increased public education spending and enhanced economic performance in the incorporated counties, potentially serving as channels influencing schooling decisions.

Keywords: local centralization, human capital

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1 Introduction

In developing countries with multi-tier hierarchies and active government intervention in markets, subnational centralization or decentralization can function as a comprehensive policy tool, shaping urban economy and distribution of public services (Faguet, 2004; Kalirajan and Otsuka, 2012; Bo and Cheng, 2021; Han and Wu, 2024). This paper leverages the Incorporating-County-into-Prefecture (ICP) reform in China—through which prefecture-level governments consolidate administrative control over subordinate counties—to assess the potential impacts of local centralization on human capital accumulation and equality of opportunity.

The ICP reform, initiated in 1993 and still ongoing, is an administrative division adjustment in China that converts counties originally supervised by upper-level prefectures into urban districts directly governed by them. By dismantling vertical administrative barriers and integrating counties into the municipal governance system, the reform generally aims to facilitate more coordinated resource allocation and industrial development within prefectures. It centralizes urban planning and public service delivery while curtailing counties' fiscal and policy autonomy. To date, the reform has affected over 200 counties, accounting for approximately 10% of all county-level administrative units in China.

The study exploits this institutional shift as a quasi-natural experiment to explore whether local centralization influences regional human capital investment. The analysis uses data from 2,114 counties between 1988 and 2013, constructed by merging official statistical sources with high school enrollment rates calculated from the 2015 1% National Population Census. Using individual records from the population census, I compute the share of each county cohort that ever enrolled in high school or above. The main explanatory variable indicates whether the county had undergone an ICP reform by the time the cohort reached age 15, the typical age of middle school completion in China. The empirical strategy employs a staggered difference-in-difference design, and main regressions are replicated across multiple alternative samples to mitigate confounding concerns. A partially pooled synthetic control method is additionally employed as a robustness check. Placebo tests confirm the validity of the sample construction and the non-randomness of the main results.

The study further examines gender-specific effects of the ICP reform on schooling and finds that females are the primary beneficiaries, gaining expanded access to educational opportunities. The mechanism analysis investigates the reform's impacts on local public expenditure on education and GDP per capita, suggesting that ICP may raise high school enrollment either directly via increased education spending or indirectly through improved economic conditions.

The paper echoes three strands of literature. First, it relates to the literature on the impacts of place-based policies on regional human capital. Current studies have examined how human capital investment responds to various types of place-based policies such as infrastructure construction (Duflo, 2001; Adukia et al., 2020), special economic zones (Lu et al., 2023; Gallé et al., 2024; Koh et al., 2025), and anti-poverty programs (Reynolds and Rohlin, 2015). This paper considers changes in administrative status as a form of place-based policy, whose effects on human capital remain understudied.

Second, the study fits into the literature discussing the reorganization of subnational governments. Within the framework of fiscal federalism (Tiebout, 1956; Oates, 1972), decentralization has been generally advocated as a means to improve government accountability (Fisman and Gatti, 2002), foster economic growth (Iimi, 2005), and enhance public service delivery (Bardhan, 2002), and has been widely applied to national-provincial relations in developing and transition economies since the 1980s (Rondinelli et al., 1983; Qian and Weingast, 1997; Burki et al., 1999). However, in countries with multiple hierarchical tiers of government, such as Indonesia, India, and China, subnational centralization or decentralization often departs from simple fiscal federalism models, involving complex administrative and political dimensions (Bardhan, 2002). Moreover, such reorganizations of government structure usually serve broader policy objectives, including urbanization, poverty alleviation, and the removal of inter-regional market barriers (Han and Wu, 2024). By examining the educational impact of a local centralization policy in China, this study adds sub-provincial evidence for the argument that centralization affects the uniform provision of public goods between regions (Boffa et al., 2016).

Third, this paper adds to studies on China's series of administrative division adjustments (ADA), encompassing Province-Managing-County reform (PMC), County-to-City Upgrading (CCU), and Incorporating-County-into-Prefecture reform (ICP). While fiscal decentralization is the dominant feature of the former, the latter two entail changes in administrative division status, and therefore imply not only adjustments in fiscal authority, but also the transfer of decision-making power and the redistribution of executive responsibilities. Existing studies have explored the motivations behind these reforms (Chung and Lam, 2004; Wu, 2025), their interactions (Ye, 2025), and their effects on local fiscal performance (Li et al., 2023; Ain, 2025), urban system (Bo and Cheng, 2021; Zhang et al., 2023), economic development (Li et al., 2016; Han and Wu, 2024), and labor markets (Bo and Wang, 2025). Focusing on ICP, this paper complements the literature by analyzing policy impacts from a social welfare perspective and echoes existing research in the discussion of potential mechanisms.

The remainder of the paper is organized as follows. Section 2 explains the background

on China’s administrative structure and the ICP reform. Section 3 develops a simple model illustrating how the ICP reform may influence local schooling decisions. Section 4 details the construction of the data set. Sections 5 to 7 present the empirical strategy and results, including main findings, heterogeneity analysis, and mechanisms. Section 8 concludes and outlines implications for future research.

2 Background

2.1 China’s Administrative Structure and ICP Reform

China’s current administrative hierarchy is organized as a four-tier structure, which generally formed in late 1970s and was officially stated in the Ninth Five-Year Plan (1996-2000).¹ As illustrated in Figure 1, the national government sits at the top of the hierarchical structure, followed by provincial, prefectural and county-level governments. Each tier oversees and coordinates the administrative functions of the tier beneath it.

Within the county level, there are three major types of administrative divisions, counties, districts, and county-level cities. A district is a subdivision of a prefecture, with its government functioning as a dispatched agency of the prefecture government. A county is a subdivision of a province, and the prefectural government supervises it on behalf of the province. Compared to districts, counties typically have a higher share of agriculture in local economies and enjoy greater fiscal autonomy. A county-level city is another type of county-level administrative division which, compared with a county, has higher levels of urbanization and industrialization and more political authority. It is typically transformed from a former county and is also supervised by a prefecture as a subdivision of a province. Districts and counties constitute the majority of county-level administrative units in China. As for 2023, China had 2844 county-level administrative divisions, including 977 districts and 1299 counties.² These two types account for over 80% of all county-level divisions.

The Incorporating-county-into-prefecture (ICP) reform is an administrative manipulation that converts a county into a district. The standard procedure for ICP typically involves the following steps: the prefectural government first conducts preliminary evaluation on the targeted county; it then formulates a general plan for the conversion and consults with the county-level government to gather feedback. The overall proposal is subsequently submitted to the provincial government, which forwards it to the State Council for approval. The Ministry of Civil Affairs may provide suggestions regarding the new district’s name and ad-

¹The original document can be seen from the official website of the National Development and Reform Commission. The link is <https://www.ndrc.gov.cn/fggz/fzzlgh/gjzfggh>.

²The data is from China National Bureau of Statistics. The link is <https://data.stats.gov.cn>.

ministrative boundaries. Upon approval by the State Council and the provincial government, the prefectural government officially announces the administrative change.

In this procedure, the prefecture holds a dominant position, as the targeted county is administratively subordinate, and its leading officials rank below their prefectural counterparts. However, it does not imply the county entirely lacks agency. Economically strong counties—those with fiscal revenues and income levels exceeding the prefectural average—often resist top-down consolidation. For example, in 2013, Huzhou City in Zhejiang Province proposed converting Changxing County into its urban district. The proposal was widely viewed by Changxing residents and entrepreneurs as “resource expropriation” and encountered coordinated resistance from officials across county-level institutions. Huzhou authorities ultimately abandoned the initiative.³ At the same time, vertical competition between provincial and prefectural governments gives provinces strong incentives to convert counties to province-directly-managed ones or maintain their existing status (Lu and Tsai, 2019). The provincial government can establish a direct administrative relationship with counties through policies like the Province-Managing-County reform (PMC), while it has no authority to bypass the prefecture to share fiscal revenues with districts or allocate intergovernmental transfers to them. It faces a trade-off between strengthening the prefecture and turning the targeted county into a province-directly-managed unit. Consequently, incorporation proposals advanced by prefectural governments can be rejected or delayed at the provincial level. For instance, Suzhou City in Jiangsu Province once sought to incorporate six subordinate counties but received approval for only two: Wujiang and Wuxian (Han and Wu, 2024). Among all cases approved by the State Council, most incorporated counties were more comprehensively developed than other counties in the same prefecture, yet still lagged behind urban districts in public services or growth capacity.

ICP can be understood as a centralization effort on a regional level. A prefectural government’s attempt to convert a county into an urban district is primarily motivated by two factors: removing market barriers and promoting urbanization within its jurisdiction. As independent administrative units, counties and prefectures lay out transportation networks, land use, and logistics systems along jurisdictional boundaries, naturally resulting in fragmented regional markets. Under China’s fiscal decentralization and performance-based promotion system (Li and Zhou, 2005), local governments have even stronger incentives to practice protectionism to shield local firms (Young, 2000; Barwick et al., 2021). ICP is expected to reduce both the incentives and administrative capacity for such fragmentation. With respect to land use, the ICP removes constraints related to county-level arable land retention targets, simplifying land development procedures and expanding the supply of land

³The link for relative report is <http://www.ciudsrc.com/>.

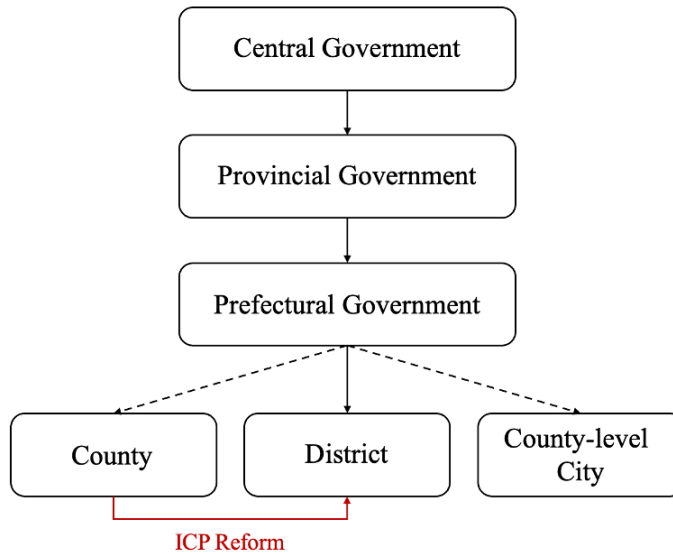


Figure 1: China’s Administrative Hierarchy

Notes: The figure illustrates the vertical structure of China’s administrative divisions. Solid arrows mean that the lower-level division is the subdivision of the upper-level division, while dashed arrows mean that the upper-level government only supervises the lower-level division on behalf of a higher government.

for urban use. This institutional shift can create more space for the growth of housing, industrial parks, and commercial complexes, and thus support urban expansion. Additionally, within the framework of vertical competition, some prefectural governments may also use ICP as a strategy to prevent provinces from directly managing developed counties through the Province-Managing-County reform, thereby safeguarding their tax base (Lu and Tsai, 2019; Ye, 2025).

In turn, an incorporated county cedes some administrative autonomy in exchange for being included in the urban core and gaining resources from the upper prefecture. Two changes in government behavior come directly with ICP reforms. The first is the modification in fiscal structure for the incorporated county, including both an increase in proportion of fiscal revenue shared with the upper-level government and a decrease in autonomy of spending. County-level governments’ fiscal revenue can be generally divided into three parts: budgetary revenue, extra-budgetary revenue, and off-budget revenue. The budgetary revenue, which covers most taxes, is allocated between the county-level government and the prefectural government. Compared with a county, a district shares higher proportion of it with the prefecture government. County governments on average retain 41% of the tax revenue, while district governments remain 27% (Wu et al., 2023). Regarding fiscal spending, a dis-

trict should put the money on specific use under the guidance of its upper-level prefectural government while a county can freely dispose of its fiscal expenditure.

The second change is the transfer of administrative responsibility. Although the prefectural government takes more fiscal revenue from the original county after the ICP reform, it alleviates the former county's stress in urban planning and construction. Before the ICP, counties are responsible for raising their own funds for infrastructure construction and public service, as related fiscal transfers from the prefectural government are typically limited. Once a county is converted to a district, its urban planning is incorporated into the prefecture's overall strategy. For example, Nanjing in Jiangsu Province included Lishui and Gaochun Districts in its network of general aviation airports after incorporating both counties in 2013 and 2014.⁴ Chengdu in Sichuan Province provided targeted funding for subway construction and shantytown redevelopment in Shuangliu District, which is formerly Shuangliu County and incorporated in 2015.⁵ Apart from providing fiscal support to newly established districts, some upper-level prefectures also mobilize other districts under its jurisdiction to offer assistance or guidance, thereby facilitating the new district's integration into the broader metropolitan area.

2.2 ICP Reform and Local Education

The shifts brought about by ICP are likely to have implications beyond governance itself. The following two features of ICP are expected to influence the education choice in treated counties.

First, ICP is likely to improve access to educational resources for a treated county, and thus is expected to promote high school enrollment. Driven by a combination of factors — including the tax-sharing fiscal framework (Jin et al., 2005), intergovernmental competition (Xu, 2011), and promotion incentives for local officials (Li and Zhou, 2005) — county-level governments tend to prioritize GDP-enhancing projects, such as infrastructure and industrial investment, while allocating comparatively fewer resources to social sectors such as education. Following the ICP reform, the share of fiscal spending allocated to educational sectors in the new district becomes more safeguarded under the supervision of the prefectural level government.

Furthermore, many prefectural governments implemented a variety of localized educational support programs targeting newly incorporated counties. For instance, Chenggong County under the supervision of Kunming City in Yunnan Province, was converted to Cheng-

⁴The earliest official document is *Nanjing Metropolitan Development Plan*, which can be found from <http://www.jiangsu.gov.cn/>.

⁵The link for relative report is <https://www.sc.gov.cn/>.

gong District in 2011. In 2010, only one middle school in the entire county met the National Urban School Infrastructure Standards issued by the Ministry of Education in 2002.⁶ The remaining middle schools were scattered across rural areas and did not have facilities to offer specialized courses such as art and computer science. In 2013, the Kunming government launched a plan to establish ten modernized middle schools in Chenggong District by 2020. Beginning in 2014, it earmarked an annual special fund of 100 million RMB to support the consolidation, renovation and construction of schools in the district’s rural areas.⁷ These efforts improved the quality of compulsory education and, consequently, increased the likelihood of high school admission, particularly for students from rural backgrounds.

Second, the ICP reform may alter the households’ expectations of returns to education, which makes its impact on educational choices ambiguous. Recent studies have shown that the ICP largely reduces travel time between the city center and the original county (Han and Wu, 2024; Bo and Wang, 2025), which is expected to encourage county residents to participate in the prefectural labor market. The incentive to invest in education can be promoted if the emerging job opportunities in urban areas demand higher human capital. Meanwhile, if the local industrial structure adjusts toward more labor-intensive sectors to align with the prefecture’s broader industrial layout (Lu et al., 2023) , the reform could weaken educational incentives within the original county. Although we cannot capture all changes about regional industries, the possibility of mixed effects emphasizes the necessity to empirically check the impact of ICP on local human capital investment.

3 A Simple Model

The ICP reform is expected to influence high school enrollment in a county both directly by altering public education expenditure and indirectly by shaping local economic conditions relevant to schooling decisions. This section presents a simple model to illustrate the mechanisms.

Let individual utility function be $U(w, S) = \ln w(S) - C(S)$ (Becker, 1967; Card, 1995), where $C(S)$ is the discounted cost of schooling level S while $w(S)$ denotes average earnings conditional on schooling level S . Following Card (1995), assume that the marginal return to

⁶The document link is <https://www.csdp.edu.cn/>.

⁷For the case of Chenggong District, a series of government documents can be seen from <http://www.kmccg.gov.cn/>, and the link for the relative report is <https://invest.km.gov.cn/>.

schooling and the marginal rate of substitution are linear functions:

$$\ln w_{ijc} = a_{ijc} + b_{ijc}S \quad (1)$$

$$C'_{ijc}(S) = r_{ijc} + kS \quad (2)$$

Here, i indexes individuals, j counties, and c cohorts. A cohort is defined as a group of individuals making schooling decisions in the same year. Individuals maximize their expected utility by choosing schooling levels. The optimal choice of schooling for individual i in county j and cohort c is thus:

$$S_{ijc} = \frac{E_c b_{ijc} - r_{ijc}}{k} \quad (3)$$

At the regional level, let b_{jc} denote the average return to education and r_{jc} the average substitution rate between schooling and future earnings for cohort c in county j , with $b_{ijc} = b_{jc} + v_i$ and $r_{ijc} = r_{jc} + w_i$. Figure 2 employs nonparametric methods to illustrate the relationship between high school enrollment rates and urban average wages using China's county-level data in 2000. The consistently positive and convex pattern indicates the plausibility of modeling the return to schooling as an increasing function of the county's education level, which aligns with Moretti (2004) and Davis and Dingel (2019). For simplification, suppose that the return to education is a linear function of county j 's average education level (S_j), the quality of education (q_{jc}), and local economic conditions (e_{jc}):

$$b_{jc} = 2\beta_1 S_j + \beta_2 q_{jc} + e_{jc} \quad (4)$$

Both the cost component r_{jc} and the return components q_{jc} and e_{jc} can be affected by the ICP reform.

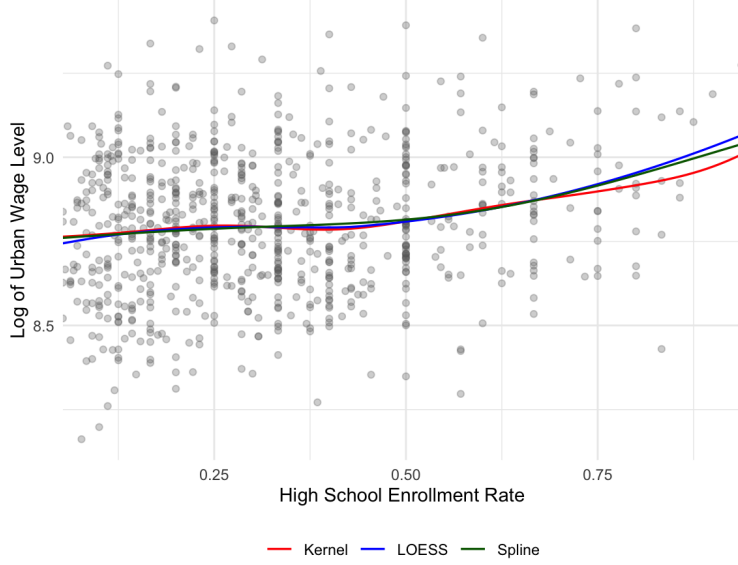


Figure 2: Relationship between High School Enrollment and Log of Urban Wage

Notes: The figure presents the relationship between urban log wages and high school enrollment at the county level in 2000, estimated using locally weighted regression (LOESS), kernel regression, and spline smoothing (GAM). Urban log wages are sourced from the 2000 China County Statistical Yearbook. High school enrollment is calculated using data from the 2015 1% National Population Census.

To simplify the analysis, assume that there are only two equally-sized cohorts (Duflo, 2000), denoted cohort 0 and cohort 1. Cohort 0 makes its schooling decisions before the ICP reform, while cohort 1 does so after the ICP reform. The average education level in county j is then $S_j = \frac{1}{2}(S_{j0} + S_{j1})$.

Assume that cohort 0 has no anticipation of the ICP reform and expects the quality of education to remain unchanged:

$$E_0 q_{j1} = q_{j0} \quad (5)$$

Under this setup, the change in schooling choice can be decomposed as (see Appendix A for the derivation):

$$S_{j1} - S_{j0} = t_1(q_{j1} - q_{j0}) - t_2(r_{j1} - r_{j0}) + t_2(e_{j1} - e_{j0}) + \eta_j \quad (6)$$

where $t_1 = \frac{\beta_2}{k-\beta_1}$, $t_2 = \frac{1}{k-\beta_1}$, and $\eta_j = -\frac{\beta_1}{k(k-\beta_1)}[E_0(e_{j1} - e_{j0}) - E_0(r_{j1} - r_{j0})]$. η_j is a county-level characteristic that captures cohort 0's expectation of changes in education cost and economic conditions.

Now introduce the treatment indicator D_j for whether county j is affected by the ICP reform. Let f_{jc} be fiscal expenditure on education, the difference of which is a county-specific

increasing function of the treatment ($\Delta f_j(D_j)$). Given that public education predominates in China’s pre-college system, we assume that education quality q is an increasing function of local fiscal expenditure on education. Additionally, an increase in fiscal expenditure on education can reduce the cost of schooling, implying $\frac{\partial r}{\partial f} < 0$. The difference in economic conditions ($e_{j1} - e_{j0}$) and the residual component of $r_{j1} - r_{j0}$ are also influenced by the reform. Therefore, equation (6) can be summarized as a function of the ICP treatment:

$$\Delta S_j = G(\Delta f_j(D_j), D_j) + \eta_j = F(D_j) + \eta_j \quad (7)$$

The following regressions in this paper examine the impact of the ICP reform on regional schooling decisions and potential mechanisms.

4 Data

Three sets of data were assembled for the main analysis: data on education, administrative division adjustments and county-level characteristics. The final panel covers 2114 counties from 1988 to 2013.

Data on Education. – The data on education are obtained from 2,003,563 records from the *2015 1% National Population Census*, which provides information on individuals’ education level, year of birth, county of residence and county of registered residence (*Hukou*). This study adopts high school enrollment rate as the indicator of regional human capital because the decision to attend high school is the first human capital investment over which a family has substantial autonomy. In China, the 1986 Compulsory Education Law stipulates that children aged between 6 and 15 should receive compulsory primary education for 6 years and middle school education for 3 years, so there is little variation in dropouts for children at the compulsory education level before entering high school. At the same time, compared to university enrollment rate, which is subject to universities’ annual adjustments in admission quotas across provinces, high school enrollment more consistently reflects the willingness to pursue higher education in a region.

A county’s high school enrollment is defined as the proportion of individuals who received at least some high school education within a year-based cohort, while a cohort includes all individuals born in the same school year (from September to August). Cohorts are defined by the school year in which individuals are 15 years old, the typical age at which the decision to enroll in high school is made.⁸ For instance, the 2000 cohort comprises individuals born

⁸In most regions, children begin primary school at age six; however, in some rural areas during the 1990s, enrollment at age five was also permitted. Additionally, students may enter high school earlier or later than age 15 due to grade skipping or repetition. As a result, the construction of cohorts may contain minor

between September 1984 and August 1995, who generally faced the decision of attending high school in 2000.

The sample is further restricted to non-migrants, defined as individuals whose place of residence coincides with their registered residence (*Hukou*) at the time of the survey.⁹ Prior to 2014, China’s college entrance examination (*Gaokao*) system imposed strict regulations requiring students to take the exam in the locality of their registered residence; therefore, registered residence serves as a reasonable proxy for the county of high school attendance in most cases. A total of 1,781,295 non-migrants are identified across all high school entry-age cohorts, accounting for 88.91% of the full sample. Migrants are excluded primarily to reduce reverse causality that better-educated people may be attracted to treated counties. Nevertheless, concerns about migration remain. For example, if an individual moved to a new county after completing high school in his or her home county and updated his or her registered residence following long-term settlement, his or her record may introduce a downward bias for his or her home county. Although our data does not contain information on individuals’ place of residence at age 15, robustness checks show that including migrants has a negligible effect on the estimates, suggesting that migration-related bias is likely to be minor.

Data on Administrative Division Adjustments. – The information on county-level administrative division adjustments (ADA) is primarily sourced from the official websites of the *Ministry of Civil Affairs of the People’s Republic of China* and the *Central People’s Government of the People’s Republic of China*, and is further supplemented by prefecture-level *City Planning Books (Chengshi Zongti Guihua)*.

In addition to ICP, two other types of ADA policies were widely implemented nationwide during the sample period: the County-to-City Upgrading (CCU) and the Province-Managing-County reform (PMC). CCU converts a county with a qualifying population size into a county-level city, endowing it with city status and corresponding political, administrative, and fiscal authority. This policy was most popular during the 1980s and 1990s to create small cities (Fan et al., 2012), but was suspended by the State Council in 1997 due to concerns over pseudo-urbanization. It was reinstated in 2010 with more stringent review procedures. Unlike ICP and CCU, which involve changes in administrative classification, PMC restructures the vertical oversight relationship, with a particular emphasis on fiscal governance. It shifts a treated county from supervision by the prefectural government to direct supervision by the provincial government, hence eliminating the prefectural govern-

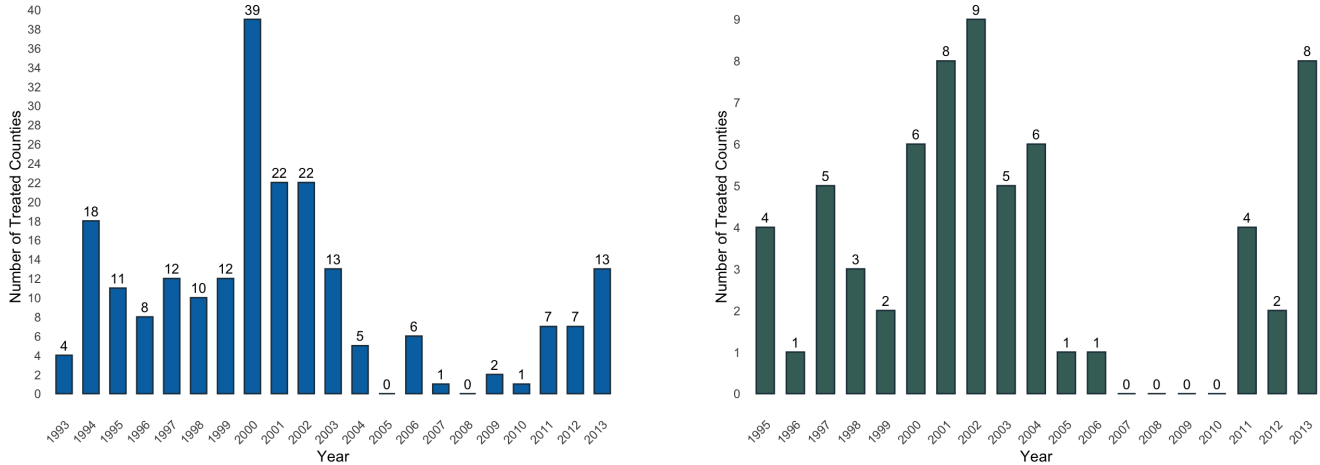
inaccuracies, and the estimation can be interpreted as the lower bound of true effects.

⁹The 2015 1% National Population Census does not directly report whether a person is a migrant. The definition of non-migrant in this study follows that used in the 2010 1% National Population Census.

ment as the intermediate layer between the province and the county (Liu and Alm, 2016; Li et al., 2016). By removing the sharing of fiscal revenues between the treated county and the prefecture, and stipulating that the provincial government directly and separately allocate transfers to both prefectures and treated counties, PMC aims to relieve financial strain on county-level governments.

The treatment of interest in this study is the ICP reform. To rule out the effects of other ADA policies, counties subject to CCU, PMC or boundary changes are excluded. Additionally, I dropped county-level administrative units with autonomy or special functions, including autonomous counties, autonomous banners, and forest districts.

Figure 3(a) illustrates the number of ICP cases nationwide from 1993 to 2013. A total of 213 counties were incorporated into their upper-level prefectures over the 20 years. The majority of ICP cases were concentrated around 2000. After excluding counties with the aforementioned characteristics and linking the treatment to the education panel, 65 treated counties remained in the sample. Figure 3(b) presents the year distribution of these treated counties.



(a) Numbers of counties incorporated nationwide (b) Numbers of counties incorporated in sample

Figure 3: Number of ICP Counties by Year (1993–2013)

Data on Other Characteristics. – A set of county-level characteristics is collected to construct control groups and explore potential mechanisms. County-level public education expenditure is sourced from the *Fiscal Statistics of Prefectures, Cities, and Counties (2001–2007)*, which provide consistent data on the composition of regional fiscal expenditure. My analysis only uses the public education expenditure from 2001 to 2007 due to limited access to fiscal data in subsequent years. To control for the effects of a series of poverty alle-

viation programs,¹⁰ I made a list of identified “poor counties” compiled from the *Poverty Monitoring Report of Rural China (2000–2013)* and the *China Rural Statistical Yearbooks (1985–2013)*. Economic and demographic variables are obtained from the *China County Statistical Yearbooks (2000)*. Table 1 presents summary statistics of all variables.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	Year Range
Treated county-level divisions					
High school enrollment rate (Age 15)	0.501	0.255	0	1	1988 – 2013
Public education expenditure measured in RMB (log)	9.158	0.742	7.141	11.229	2001 – 2007
Total area measured in square kilometers	1796.368	1219.420	277	4683	2000
Share of rural population (%)	81.945	12.648	22.222	97.297	2000
Share of secondary industry (%)	43.466	11.952	16.811	69.716	2000
Per capita savings measured in RMB (log)	12.037	0.796	10.723	13.805	2000
Never treated county-level divisions					
High school enrollment rate (Age 15)	0.403	0.278	0	1	1988 – 2013
Public education expenditure measured in RMB (log)	8.696	0.714	1.792	11.117	2001 – 2007
Total area measured in square kilometers	3322.625	8115.661	56	198794	2000
Share of rural population (%)	83.994	12.880	2.439	98.65	2000
Share of secondary industry (%)	32.083	13.107	3.019	84.698	2000
Per capita savings measured in RMB (log)	11.035	1.010	6.129	13.442	2000

5 Empirical Strategies and Main Analysis

5.1 Empirical Strategies

To test the impact of ICP on schooling, I started with the following difference-in-differences specification under the framework of two-way fixed effects:

$$Y_{it} = \beta ICP_{it} + \alpha_i + \omega_{pt} + \gamma Poor_{it} + \varepsilon_{it} \quad (8)$$

where Y_{it} is high school enrollment rate of county i in year t . The main coefficient of interest is β . ICP_{it} is an indicator variable that equals 1 for the treated county in years after incorporation, and 0 for all other cases. α_i is a county fixed effects term capturing time-invariant county characteristics. The term ω_{pt} estimates the province-specific yearly variation for province p in year t for county $i \in p$, allowing the year fixed effects to vary across provinces. In China, education-related policies, such as reforms of course structure

¹⁰During these program periods (1986–2020), the central government identified “poor counties” throughout the country and provided direct transfer payments and policy guidance to them. The qualification of a “poor county” was approved by the Office of the Leading Group for Poverty Alleviation and Development of the State Council, and there are four waves of approval in 1986, 1994, 2001 and 2012.

and changes in college admission quotas, are usually implemented at the provincial level. Controlling for province-specific year effects accounts for cross-year common changes within the same province. $Poor_{it}$ is a dummy variable which indicates whether county i in year t is an identified state-level poor county that enjoys favorable policies from the central government. The error term ε_{it} is clustered at the county level to allow for correlation over time within a county.

Recent studies have illustrated that a traditional two-way fixed effects model with staggered adoption of treatment risks bias when there exists heterogeneity of treatment effects (De Chaisemartin and d’Haultfoeuille, 2020; Callaway and Sant’Anna, 2021). The traditional DID framework tends to overestimate effects when treatment effects decline over time and underestimate them when treatment effects increase. With this concern, I further employ the difference-in-differences estimator proposed by De Chaisemartin and d’Haultfoeuille (2020), denoted as DID_M hereafter. The method can be conceptually expressed in the following form:

$$Y_{it} = \sum_{\substack{-L \leq k \leq U \\ k \neq -1}} \kappa_k D_{it}^k + \alpha_i + \omega_{pt} + \gamma Poor_{it} + \varepsilon_{it} \quad (9)$$

Denote s_i as the year when county i was incorporated. Let L and U be the largest numbers of years tested before and after s_i . Let $D_{it}^k = 1$ if $t - s_i = k$, and $D_{it}^k = 0$ otherwise for $-L \leq k \leq U$ and $k \neq -1$. Setting the year before the ICP reform as the base year, coefficients for all other years are calculated relative to it. This method directly presents a test of pre-treatment trend (κ_k for $k < -1$), and the average effect of ICP is obtained by averaging yearly treatment effects. I set $U = 5$ for the average effect reported in tables to show the short-term impact and set $U = 14$ to show the long-term trend in figures.

Figure 4(a) displays the average high school enrollment rates for the treated counties and the remaining county-level divisions by year, indicating a more rapid upward trend among the treated counties over the two-decade period. However, the higher level of the trend line for the treated group suggests potential endogeneity. The control group in the full sample includes many county-level divisions located in prefectures that never implemented an ICP reform, which may undermine the comparability between the treated and control groups. Concerns about unobserved confounders arise primarily from differences in industrial structure and cultural factors. In China, the industry structure is characterized at the prefecture level, and industrial policies, which may reshape labor market expectations and attitudes towards education, are also implemented at the prefecture level. In addition, counties within the same prefecture share similar cultural backgrounds, historical trajectories, and geographic conditions, which contribute to more homogeneous preferences related to education. To mitigate potential systematic differences between treated and control county-level divisions,

I restrict the control group to divisions within the same prefecture as the treated units and use it in baseline regressions. Figure 4(b) plots the average high school enrollment rates for the treated group and the modified control group, with the gap narrowing over time.

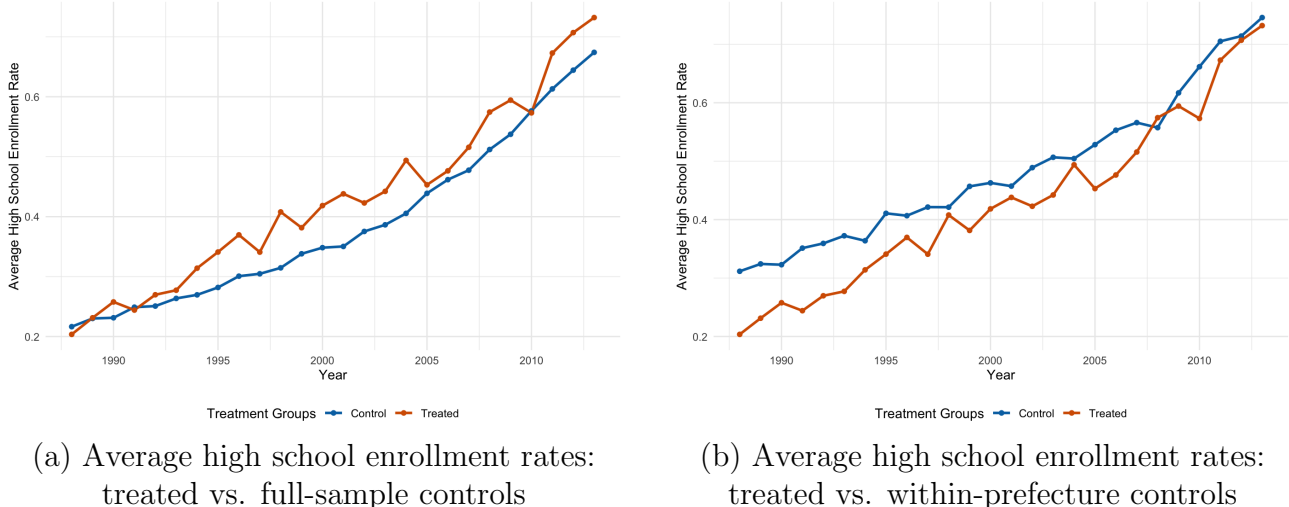


Figure 4: Average High School Enrollment Rates by Year and Treatment Status

5.2 Main Analysis

Table 2 presents estimates of the effects of ICP on the county-level high school enrollment. Column (1) uses the traditional two-way fixed effects model controlling for county and year fixed effects. Column (2) introduces province-year dummies to allow for variation of year fixed effects across provinces. The inclusion of province-year dummies only slightly changes the estimate. The DID estimate in Column (2) suggests that being incorporated into a prefecture increases the county-level high school enrollment rate significantly by 4.5 percentage points. Column (3) reports the average cumulative effect of ICP over the five years following its implementation (from $k = 0$ to $k = 5$), estimated using the DID_M method with never-treated county-level divisions as the control group. The estimate is smaller than the TWFE estimates, but still significant at the 1% level. It suggests that ICP increases local high school enrollment by 3.02 percentage points. Column (4) includes not-yet-treated county-level divisions into the control group, yielding a slightly larger estimate of 3.11 percentage points.

Columns (3) and (4) also report three pre-treatment estimators to test the parallel trends. $DID_M^{pl,1}$, $DID_M^{pl,2}$, and $DID_M^{pl,3}$ compare the difference in high school enrollment rate between ICP counties and non-ICP units in $k = -1$, $k = -2$, $k = -3$ with the difference in $k = 0$. All pre-treatment estimates in both Columns (3) and (4) are small and not significantly different

from 0, which indicate that before incorporation, incorporated counties did not experience significant changes in high school enrollment compared to those not treated ones. Including not-yet-treated counties in the control group has little impact on pre-treatment estimates.

Table 2: Effects of ICP on High School Enrollment Rates

	(1)	(2)	(3)	(4)
	TWFE		DID _M	
<i>ICP</i>	0.0415 (0.0123)	0.0450 (0.0127)		
<i>DID_M</i>			0.0302 (0.0137)	0.0311 (0.0138)
<i>DID_M^{pl,1}</i>			0.0163 (0.0173)	0.0180 (0.0170)
<i>DID_M^{pl,2}</i>			0.0225 (0.0186)	0.0251 (0.0187)
<i>DID_M^{pl,3}</i>			-0.0216 (0.0182)	-0.0218 (0.0182)
<i>N</i>	10, 217	10, 217	3, 085	3, 266
<i>Adj.R²</i>	0.635	0.642		
County fixed effects	Y	Y	Y	Y
Year fixed effects	Y	N	N	N
Province × year fixed effects	N	Y	Y	Y
Poor county controlled	Y	Y	Y	Y

Notes: Standard errors in parentheses are clustered at the county level. Columns (1) and (2) report results from TWFE models with different fixed effects. Columns (3) and (4) report dynamic effects estimated using the *DID_M* estimation suggested by de Chaisemartin and D’Haultfoeuille (2020). *N* in Columns (1) and (2) refers to the number of observations. *N* in Columns (3) and (4) denotes the number of post-treatment observations contributed by switching units.

Figure 5 plots both pre-treatment and post-treatment estimates. Before the treatment, the differences in high school enrollment between ICP counties and non-ICP counties are not significant. The estimates became significantly different from 0 three years after the treatment, indicating that there may exist a lag of the policy effect. The fluctuations may reflect genuine variations in policy effects or result from sample selection, as fewer counties are included in the estimation of the longer period. Generally, there is an increasing trend for the effect of ICP on high school enrollment in treated counties.

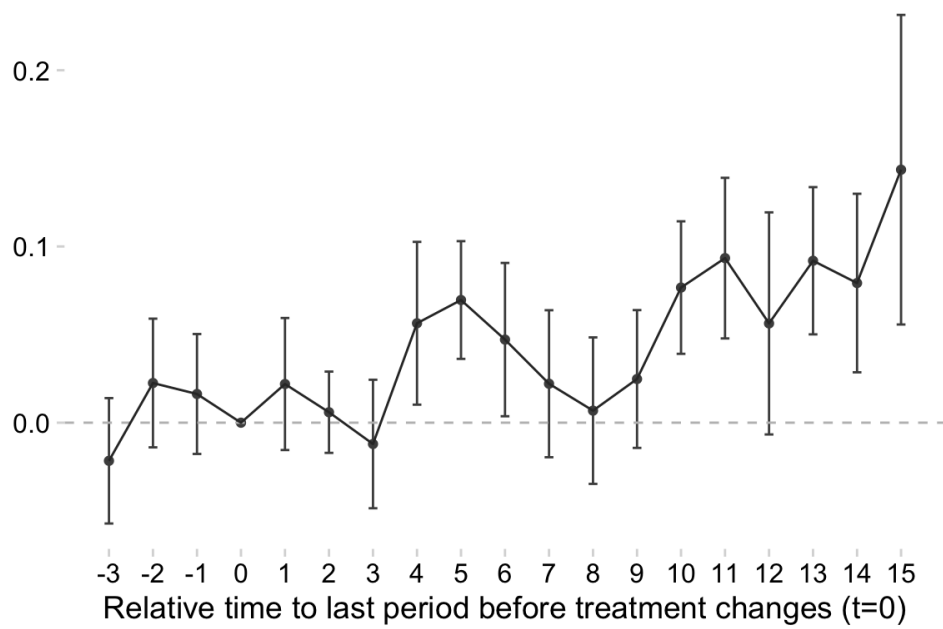


Figure 5: Effects of ICP on High School Enrollment Rates

Notes: The figure plots point estimates along with their corresponding 95% confidence intervals for κ_k according to Equation (9) using the DID_M estimation suggested by de Chaisemartin and D'Haultfoeuille (2020).

5.3 Robustness Checks

5.3.1 Alternative Control Groups

Several alternative control groups are constructed to examine the validity of the main findings. First, I examined the sensitivity of the results to sample selection related to migration. I recalculated county-level high school enrollment rates by including the migrants whose place of residence differs from their registered residence. Column (1) of Table 3 reports the TWFE estimate, which is slightly larger than the corresponding estimate based on the non-migrant sample and remains statistically significant at 1%. Columns (2) and (3) of Table 3 present the DID_M estimates excluding and including not-yet-treated units in the control group, respectively. The magnitudes of the reform effects are nearly identical to those in the baseline regressions. These results suggest bias caused by migration issues, if any, does not materially affect the estimation.

Second, to further alleviate concerns about unobserved confounding, I dropped counties from the control group and restricted it to districts only. Since counties function as independent economic and administrative units, they tend to exhibit more variation in social conditions, even within the same prefecture. Given that counties selected for the ICP reform often resemble urban districts in terms of demographic and industrial characteristics,¹¹ it is reasonable to consider districts as a more comparable control group. The results are reported in Columns (4) to (6) of Table 3. The TWFE estimate in Column (4) reaches 8.67 percentage points and remains significant at the 1% level. The DID_M estimates in Column (5) and (6) are close to those in the main analysis, suggesting that the average cumulative effect of ICP over the five years post-implementation is approximately 3 percentage points.

Third, I constructed a control group employing one-to-one nearest-neighbor propensity score matching. To date, there is no unified standard regarding the prerequisites for being selected as an incorporated county. The Standards for Establishing Municipal Districts issued by the Ministry of Civil Affairs in 2014 emphasizes population and industrial structure as key criteria. Specifically, the document recommends that candidate counties should have at least 75% of total output from non-agricultural sectors or a non-agricultural population share of at least 70%. Therefore, I used the county area, the proportion of rural population, the share of industrial output in total output, and per capita household savings to calculate the propensity scores. These variables respectively reflect county size, population structure, industrial structure, and living standards. The matching procedure uses data from 2000,

¹¹The selection of incorporated counties is not subject to a unified standard. The only advisory guideline is The Standards for Establishing Municipal Districts, issued by the Ministry of Civil Affairs in 2014, which recommends that the ICP be implemented in areas with a sufficient level of urbanization. Earlier ICP cases generally adhered to this principle as well.

the earliest year for which comprehensive county-level characteristics are available. Counties that underwent the ICP reform before 2000 were dropped, and each remaining treated county was matched to one control county from the same prefecture, with a caliper of 0.25 imposed to ensure match quality. In the end, there are 19 pairs of counties in the matched sample (see Appendix C for details on the matching process).

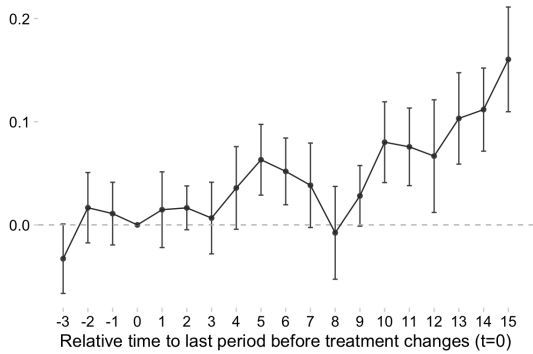
Columns (7) to (9) of Table 3 present results estimated using the matched sample. The TWFE estimate in Column (7) becomes negative and statistically insignificant, possibly due to the issue of negative weighting in staggered adoption settings (Goodman-Bacon, 2021), which can be exacerbated in the small sample. The DID_M estimates in Columns (8) and (9) excluding and including not-yet-treated counties in the control group suggest a sizable average treatment effect about 12 percentage points. The larger magnitude of the estimated effects may indicate that the matching procedure improves comparability between treated and control units.

Table 3: Effects of ICP on High School Enrollment Rates using Alternative Control Groups

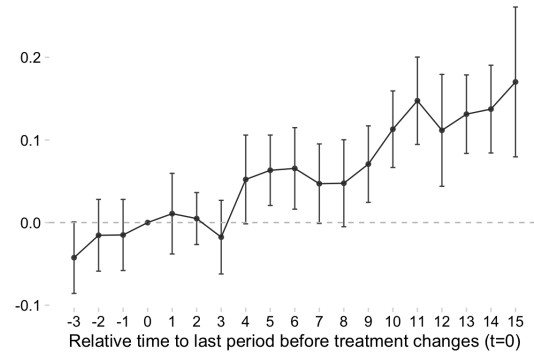
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	TWFE	DID_M		TWFE	DID_M		TWFE	DID_M	
<i>ICP</i>	0.0480 (0.0127)			0.0867 (0.0138)			-0.0108 (0.0290)		
<i>DID_M</i>		0.0305 (0.0123)	0.0303 (0.0124)		0.0281 (0.0169)	0.0301 (0.0165)		0.1203 (0.0261)	0.1319 (0.0289)
<i>DID_M^{pl,1}</i>		0.0094 (0.0158)	0.0109 (0.0155)		-0.0150 (0.0219)	-0.0114 (0.0204)		0.0266 (0.0230)	0.0244 (0.0285)
<i>DID_M^{pl,2}</i>		0.0148 (0.0173)	0.0167 (0.0174)		-0.0154 (0.0222)	-0.0070 (0.0215)		0.0583 (0.0298)	0.0501 (0.0298)
<i>DID_M^{pl,3}</i>		-0.0330 (0.0170)	-0.0328 (0.0172)		-0.0424 (0.0220)	-0.0432 (0.0216)		0.0397 (0.0393)	0.0232 (0.0378)
<i>N</i>	10,256	3,106	3,287	5,755	1,796	1,992	971	211	246
<i>Adj. R²</i>	0.623			0.601			0.477		

Notes: Control variables include county fixed effects, province \times year fixed effects, and poor-county dummies. Standard errors in parentheses are clustered at the county level. Columns (1)–(3) report results using the sample including migrants. Columns (4)–(6) use control units limited to districts. Columns (7)–(9) employ a matched sample based on propensity scores.

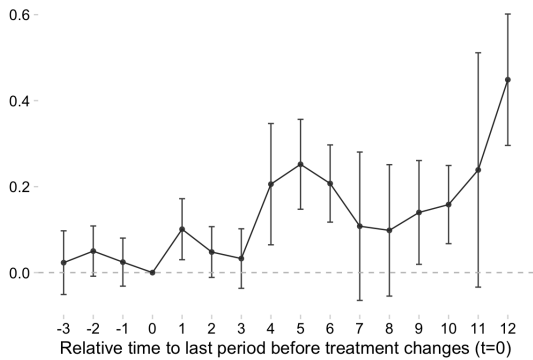
Figure 6 consists of three panels illustrating pre-treatment and post-treatment estimates using alternative control groups. Despite some fluctuations, all three panels show upward trends consistent with the baseline analysis. The estimated pre-treatment effects are all insignificant, lending support to the parallel trends assumption.



(a) Sample including migrants



(b) Sample limited to districts



(c) Sample matched by propensity scores

Figure 6: Effects of ICP on High School Enrollment Rates using Alternative Control Groups

Notes: Each graph plots point estimates along with their corresponding 95% confidence intervals for κ_k according to Equation (9), using the DID_M estimator proposed by de Chaisemartin and D’Haultfoeuille (2020).

5.3.2 Synthetic Control

To further guarantee the parallel trend assumption, I implemented the “partially pooled” synthetic control proposed by Ben-Michael et al. (2022), which extends the synthetic control framework to staggered treatment adoption and focuses on outcomes. The method constructs synthetic controls for treated units by minimizing a weighted combination of pooled and individual-specific pre-treatment imbalances:

$$\min_{\Gamma \in \Delta} \nu \cdot \tilde{q}_{\text{pool}}^2 + (1 - \nu) \cdot \tilde{q}_{\text{sep}}^2 + \lambda \|\Gamma\|_F^2 \quad (10)$$

where Γ denotes the matrix of synthetic control weights, λ is the regularization parameter, and the hyperparameter $\nu \in [0, 1]$ controls the trade-off between pooled and separate fit. The two imbalance terms are defined as:

$$\tilde{q}_{\text{pool}}^2 = \frac{1}{J} \sum_{j=1}^J \sum_{\ell=1}^{L_j} \left(Y_{j,T_j-\ell} - \sum_{i=1}^N \gamma_{ij} Y_{i,T_j-\ell} \right)^2,$$

$$\tilde{q}_{\text{sep}}^2 = \sum_{j=1}^J \sum_{\ell=1}^{L_j} \left(Y_{j,T_j-\ell} - \sum_{i=1}^N \gamma_{ij} Y_{i,T_j-\ell} \right)^2,$$

where $Y_{j,T_j-\ell}$ denotes the ℓ -th pre-treatment outcome of treated unit j , and γ_{ij} are the weights assigned to control unit i for constructing the synthetic control of unit j .

The estimated average treatment effect on the treated counties (ATT) over the five post-treatment years is 4.5 percentage points, slightly larger than the baseline estimate. Figure 7 plots the dynamic treatment effects over a 14-year window, with each point representing the difference between treated units and their synthetic controls at a given relative year. It illustrates a generally increasing trend of high school enrollment after the ICP reform with fluctuations over years. Details on the selection of the pooling parameter ν and the regularization parameter λ are provided in Appendix D.

5.3.3 Placebo Tests

To rule out the possibility that the results are driven by chance, two placebo tests are performed in this section. First, I examined whether age 15 is a valid exposure age for high school enrollment decisions. I replicated the main regression in Column (3) of Table 2 using hypothetical exposure ages from 13 to 17. If age 15 correctly captures the timing when students decide to attend high school, estimates based on false enrollment ages should be attenuated or statistically insignificant due to misclassification. When a lower exposure age

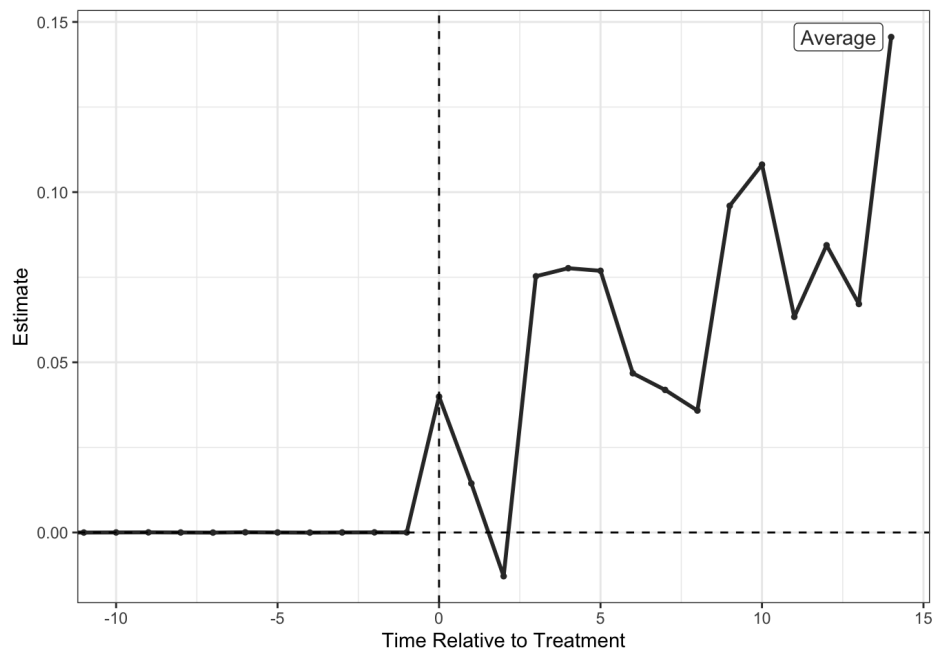


Figure 7: Effects of ICP on High School Enrollment Rates Estimated by Partially Pooled Synthetic Control

Notes: The figure displays estimated average treatment effects over event time, based on the partially pooled synthetic control method. The horizontal axis indicates years relative to treatment adoption, and the vertical axis reports the estimated effect on treated units. The pooling parameter ν is set to 0.85. The regularization parameter λ , which penalizes the complexity of the synthetic control weights, is set to 10^{-3} .

is assumed, the first year of treatment is artificially shifted forward in the panel, leaving some treated counties incorrectly in the control group. Conversely, assuming a higher exposure age leads to the erroneous inclusion of not-yet-treated counties in the treatment group. Figure 8 plots the estimated effects under each assumed exposure age, along with their 95% confidence intervals. The insignificant effects under placebo exposure ages supports the validity of age 15 as the exposure age.

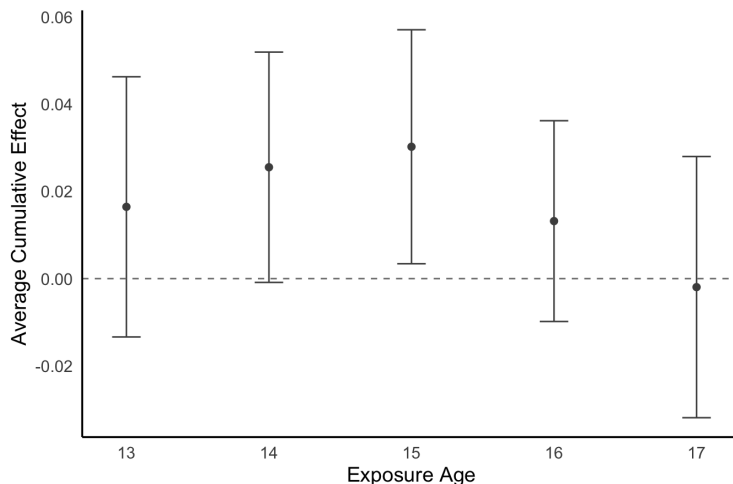


Figure 8: Effects of ICP on High School Enrollment Rates at Different Exposure Ages

Notes: The figure plots the coefficients along with their corresponding 95% confidence intervals for the effect of ICP assuming different exposure ages. The coefficient is the average cumulative effect over the 5 years following the reform using the DID_M estimation by de Chaisemartin and D’Haultfoeuille (2020)

Second, a placebo treatment test is conducted. Specifically, for each year with ICP cases, I recorded the number of treated counties and randomly assigned placebo treatment to the same number of counties. A placebo DID_M estimate was then obtained from this sample. The process was repeated 1,000 times, and Figure 9 presents the distribution of placebo estimates. Most placebo estimates cluster around zero. Only 18 placebo estimates lie on the right side of the true estimate 0.0302, suggesting that the observed impact of ICP on county-level high school enrollment is unlikely to be due to chance.

5.3.4 Leave-one-year-out Analysis

A leave-one-year-out analysis is conducted to assess whether the estimated treatment effect is disproportionately driven by counties treated in a particular year. In this procedure, counties treated in one specific year were excluded from the sample in each iteration, and the DID_M estimator in Equation (9) with $U = 5$ was calculated using the remaining data.

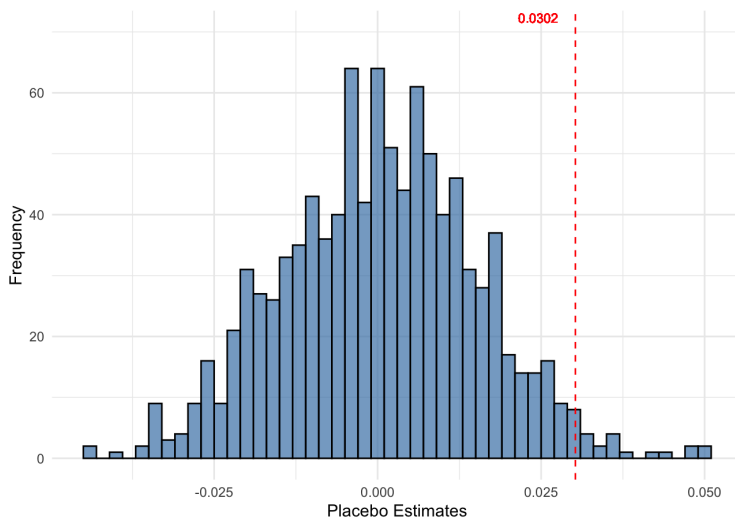


Figure 9: Distribution of Placebo Estimates

Notes: This figure displays the distribution of placebo estimates from 1,000 simulations, where placebo treatment was randomly assigned to counties with the same treatment timing and number as the actual ICP cases. The vertical dashed line indicates the actual estimated treatment effect.

Figure 10 shows the estimates. The estimates cluster around 0.03, ranging from a lower bound of 0.0168 (excluding year 2003) to an upper bound of 0.0498 (excluding year 1997). Although there is some variation in magnitude, all estimates remain positive and statistically significant, indicating that the positive reform effect is robust across treatment timings.

6 Gender Heterogeneity

In this section, I calculated county-level high school enrollment rates separately for boys and girls to check whether the policy effects differ across gender. Table 4 shows a significant increase in girls' enrollment following the reform (Columns (4)-(6)), while no statistically significant effect is observed for boys (Columns (1)-(3)). Among boys, both TWFE and DID_M estimates are insignificant, and the DID_M estimators either excluding or including not-yet-treated counties (Columns (2) and (3)) are close to zero. For girls, the DID_M estimate using never-treated divisions as the control group in Column (5) suggests that the reform raises high school enrollment by 6.23 percentage points—a substantial magnitude. Including not-yet-treated counties into the control group in Column (6) makes the estimate slightly larger, reaching 6.79 percentage points. Although splitting the sample by gender may reduce statistical precision due to smaller cohort sizes, the divergence in the estimates across the two groups supports that girls benefit more from the reform in terms of human

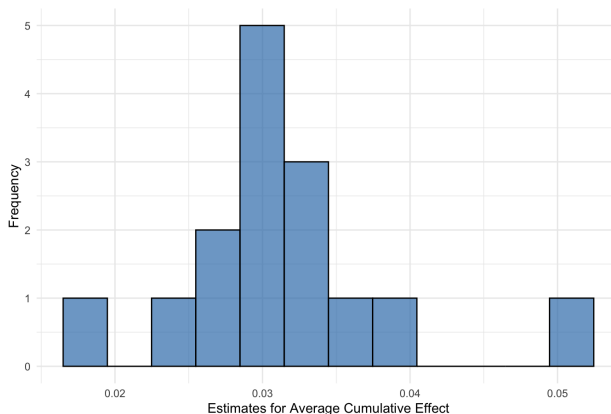


Figure 10: Distribution of Leave-one-year Estimates

Notes: The figure displays the distribution of leave-one-year-out estimates. The horizontal axis shows the estimated treatment effects obtained by excluding one year with treatment from the full sample, while the vertical axis indicates the frequency of these estimates.

capital investment.

This pattern may reflect some pre-existing gender biases in rural educational investment, whereby boys were traditionally prioritized. By improving access to schooling in rural areas, ICP may have partially alleviated such disparities. Moreover, by strengthening integration with prefectural-level urban centers and accelerating local urban development, the reform likely expanded access to non-agricultural employment opportunities for women, potentially raising the returns to female education.

Figure 11 presents pre-treatment and post-treatment estimates for boys and girls. For boys, panel (a) shows no discernible policy effect. In contrast, panel (b) reveals a noticeable jump for girls starting in the fourth relative period, with the positive impact of the policy persisting steadily thereafter.

7 Mechanism Analysis

The previous analysis shows the positive impact of the ICP reform on local high school enrollment in the sample year. Based on the conceptual framework in Sections 2 and 3, I further empirically examined two potential mechanisms: the fiscal channel and the income channel.

First, I tested whether the ICP reform increases the original county's public expenditure on education. The analysis focuses on the 2001-2007 subsample, during which county-level educational fiscal data are available from the Fiscal Statistical of Prefectures, Cities, and

Table 4: Heterogeneity Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
	TWFE	DID _M		TWFE	DID _M	
<i>ICP</i>	0.0339 (0.0173)			0.0960 (0.0158)		
<i>DID_M</i>		0.0001 (0.0123)	-0.0007 (0.0245)		0.0623 (0.0284)	0.0679 (0.0287)
<i>DID_M^{pl,1}</i>		-0.0084 (0.0298)	-0.0102 (0.0296)		0.0046 (0.0396)	0.2111 (0.0387)
<i>DID_M^{pl,2}</i>		-0.0266 (0.0249)	-0.0240 (0.0248)		0.0445 (0.0353)	0.0570 (0.0357)
<i>DID_M^{pl,3}</i>		-0.0087 (0.0284)	-0.0066 (0.0286)		-0.0354 (0.0342)	-0.0378 (0.0323)
<i>N</i>	9,766	3,166	3,346	5,490	1,626	1,815
<i>Adj. R²</i>	0.481			0.506		

Notes: Control variables include county fixed effects, province \times year fixed effects, and poor-county dummies. Standard errors in parentheses are clustered at the county level. Columns (1)–(3) report results for boys. Columns (4)–(6) report results for girls. *N* in columns for TWFE estimates refers to the number of observations, and *N* in columns for *DID_M* estimates denotes the number of post-treatment observations contributed by switching units.

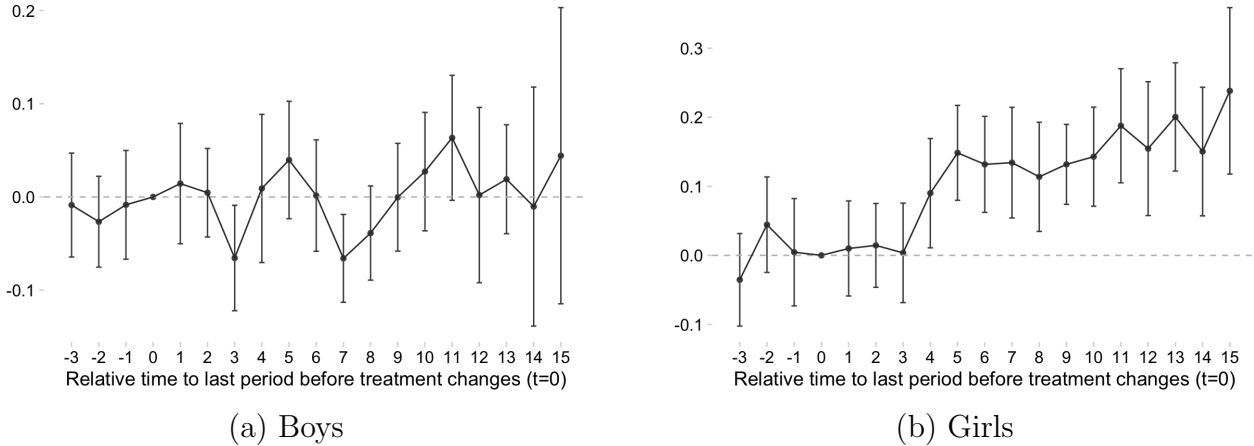


Figure 11: Effects of ICP on High School Enrollment Rates by Gender

Notes: Each graph plots point estimates along with their corresponding 95% confidence intervals for κ_k according to Equation (9), using the *DID_M* estimator proposed by de Chaisemartin and D’Haultfoeuille (2020).

Counties. The dependent variable in Equations (8) and (9) is replaced by the logarithm of county-level educational fiscal expenditure. In the DID_M specification, I report and plot the estimates with $U = 5$ and $L = 3$, the maximum periods of pre-treatment and post-treatment that can be calculated in the subsample. The TWFE estimate in Column (1) of Table 5 is significant at 5% level, suggesting that the ICP reform increases local investment in education by 10.53%. The DID_M estimators in Columns (2) and (3), excluding and including not-yet-treated counties, show an average cumulative effect of approximately 17 percent over five post-treatment years. The sizable effects provide support for educational fiscal expenditure as a plausible channel. Panel (a) in Figure 12 displays a visible rise in educational spending following treatment.

Second, the ICP is expected to influence local household income, and thus influence families' investment in education. Due to limited access to consistent county-level income data, GDP per capita was used as a proxy, drawn from the China County Statistical Yearbooks for the years 2000–2013. Again, I replaced the dependent variable with the logarithm of GDP per capita and repeated regressions employing Equations (8) and (9). The TWFE estimate in Column (4) of Table 5 suggests an 8.26 percent increase, though not statistically significant. The DID_M estimates in Columns (5) and (6) indicate that the reform raises GDP per capita by around 10 percent on average over five post-treatment years. These pronounced effects point to the influence of the reform's impact on local economic development, which can play a role in people's schooling decisions. Panel (b) in Figure 9 presents the corresponding event-study plot.

8 Conclusion and Discussion

This paper finds that the Incorporating-County-into-Prefecture reform had a positive impact on educational attainment over the period 1988–2013. Estimates from the main staggered DID specifications suggest that the reform increased local high school enrollment by at least 3 percentage points cumulatively over the five years following implementation. Quantitatively, for every 100 students, an additional 3 were encouraged to attend high school if their home county had experienced the ICP reform when they finished middle school at approximately 15 years old. Given that the average high school enrollment rate across county-level divisions before the reform is 44.92% with a standard deviation of 0.25¹², this estimated effect is non-trivial in magnitude. The event study approach further illustrates a rising trend in the treatment effects over time. These findings highlight the role of local centralization in

¹²The average high school enrollment rate and its standard deviation are calculated based on combined cross-sectional data of treated counties in the year before treatment.

Table 5: Mechanism Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
	TWFE	DID _M		TWFE	DID _M	
<i>ICP</i>	0.1053 (0.0495)			0.0826 (0.0563)		
<i>DID_M</i>		0.1691 (0.0239)	0.1689 (0.0239)		0.1006 (0.0192)	0.1010 (0.0185)
<i>DID_M^{pl,1}</i>		0.0129 (0.0111)	0.0111 (0.0112)		-0.0030 (0.0044)	-0.0022 (0.0043)
<i>DID_M^{pl,2}</i>		0.0082 (0.0194)	-0.0240 (0.0248)		-0.0001 (0.0114)	0.0009 (0.0113)
<i>N</i>	2,703	1,400	1,407	2,893	825	851
<i>Adj. R²</i>	0.961			0.978		

Notes: Control variables include county fixed effects and province \times year fixed effects. Standard errors in parentheses are clustered at the county level. Columns (1)–(3) report results for fiscal educational expenditure. Columns (4)–(6) report results for GDP per capita.

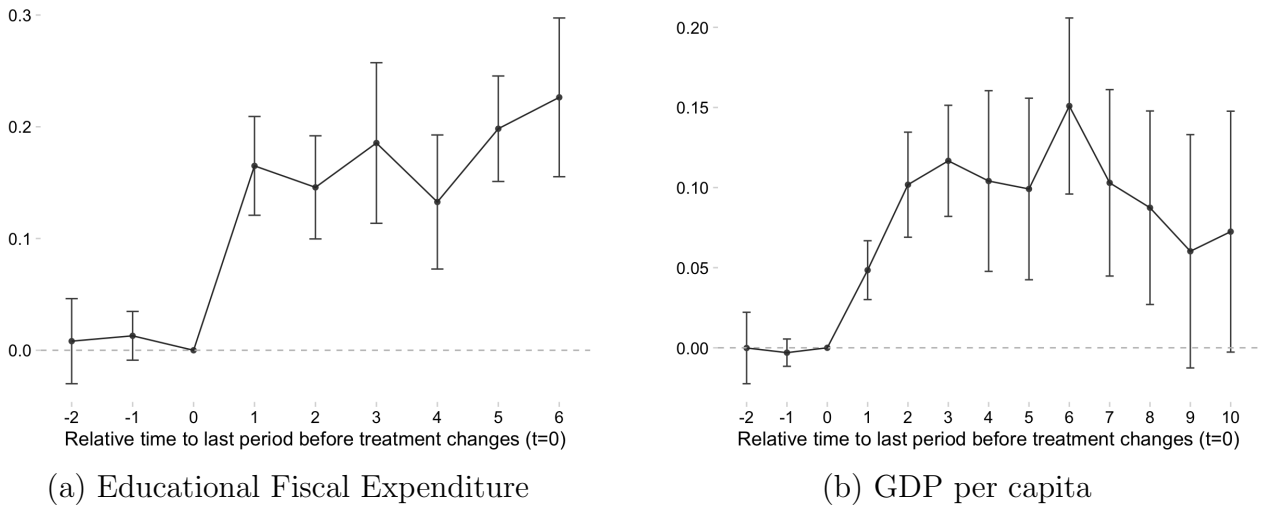


Figure 12: Effects of ICP on High School Enrollment Rates by Gender

Notes: Each graph plots point estimates along with their corresponding 95% confidence intervals for κ_k according to Equation (2), using the *DID_M* estimator proposed by de Chaisemartin and D’Haultfoeuille (2020).

supporting long-term human capital accumulation.

Furthermore, heterogeneity analysis reveals that female students were the primary beneficiaries of the ICP reform in terms of education: their high school enrollment rates rose by more than 6 percentage points, twice as large as the overall average. Mechanism analysis suggests that the reform may have promoted schooling through two channels: a direct channel via increased local public spending on education, and an indirect channel through improved economic performance and potential higher household income.

Several questions remain open for future research. First, the underlying mechanisms deserve further investigation. While this paper proposes two possible channels, it does not examine how the reform may have reshaped regional labor markets, which is an important factor in schooling decisions. Future work may explore it using county-level industrial or employment data.

Second, the spatial consequences of the reform deserve closer attention. Due to data limitations, this study does not explore the heterogeneity in enrollment gains between urban and rural areas. However, the sizeable high school enrollment increase among girls suggests that the reform may have had a greater impact in rural counties, where gender gaps in education were larger. The finding implies that, prior to the 2014 formal abolition of the rural–urban household registration divide¹³, the ICP reform may have contributed to partially reducing rural–urban inequality of opportunity in certain regions—a hypothesis deserving further empirical scrutiny. In addition, whether the observed improvements in incorporated counties came at the expense of other county-level divisions within the same prefecture is still unclear, which can have implications for the broader evaluation of such reorganization of local governments.

¹³See Opinions on Further Advancing the Reform of the Household Registration System, issued by the State Council in 2014.

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Appendix

A Derivation of Equation (6)

Take the expectation of cohort 0' regarding the schooling decisions of cohorts 0 and 1' in equation (3), and apply equation (4) and (5):

$$\begin{aligned}
 E_0 S_{j1} &= \frac{E_0(E_1 b_{j1} - r_{j1})}{k} \\
 &= \frac{E_0(2\beta_1 S_j + \beta_2 q_{j1} + e_{j1} - r_{j1})}{k} \\
 &= \frac{2\beta_1 E_0 S_j + \beta_2 q_{j0} + E_0(e_{j1} - r_{j1})}{k} \\
 E_0 S_{j0} &= \frac{E_0(E_0 b_{j0} - r_{j0})}{k} \\
 &= \frac{2\beta_1 E_0 S_j + \beta_2 q_{j0} + E_0(e_{j0} - r_{j0})}{k}
 \end{aligned}$$

Then we have:

$$E_0 S_{j1} = E_0 S_{j0} + \frac{E_0(e_{j1} - e_{j0}) - E_0(r_{j1} - r_{j0})}{k} \quad (\text{A.1})$$

From equation (3), we have:

$$\begin{aligned}
 k S_{j0} &= E_0 b_{j0} - r_{j0} \\
 &= \beta_1 S_{j0} + \beta_1 E_0 S_{j1} + \beta_2 q_{j0} + e_{j0} - r_{j0}
 \end{aligned}$$

Substituting $E_0 S_{j1}$ from (A.1) yields:

$$(k - \beta_1) S_{j0} = \beta_1 S_{j0} + \beta_1 \frac{E_0(e_{j1} - e_{j0}) - E_0(r_{j1} - r_{j0})}{k} + \beta_2 q_{j0} + e_{j0} - r_{j0} \quad (\text{A.2})$$

From equation (3), we also have:

$$\begin{aligned}
 k S_{j1} &= E_1 b_{j1} - r_{j1} \\
 &= \beta_1 S_{j0} + \beta_1 S_{j1} + \beta_2 q_{j1} + e_{j1} - r_{j1}
 \end{aligned}$$

which is equivalent to:

$$(k - \beta_1) S_{j1} = \beta_1 S_{j0} + \beta_2 q_{j1} + e_{j1} - r_{j1} \quad (\text{A.3})$$

Combine (A.2) and (A.3), then we get:

$$S_{j1} - S_{j0} = \frac{1}{k - \beta_1} [\beta_2(q_{j1} - q_{j0}) - (r_{j1} - r_{j0}) + (e_{j1} - e_{j0}) - \beta_1 \frac{E_0(e_{j1} - e_{j0}) - E_0(r_{j1} - r_{j0})}{k}]$$

Define $t_1 = \frac{\beta_2}{k - \beta_1}$, $t_2 = \frac{1}{k - \beta_1}$, and $\eta_j = -\frac{\beta_1}{k(k - \beta_1)} [E_0(e_{j1} - e_{j0}) - E_0(r_{j1} - r_{j0})]$, then the equation simplifies to:

$$S_{j1} - S_{j0} = t_1(q_{j1} - q_{j0}) - t_2(r_{j1} - r_{j0}) + t_2(e_{j1} - e_{j0}) + \eta_j \quad (\text{A.4})$$

which is exactly Equation (6).

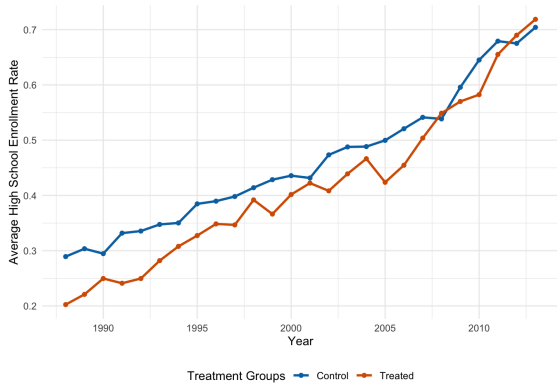
B Trends in High School Enrollment Rates

Figure B.1 shows average high school enrollment rates by treatment status in three alternative samples. Panels (a) and (b) resemble the pattern in Figure 2(b). Panel (c), based on the matched sample, displays more variability, possibly due to the smaller sample size.

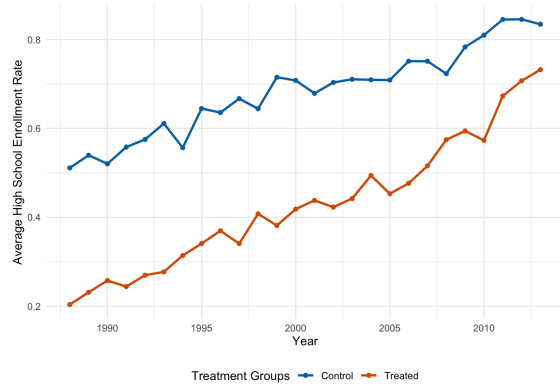
C Covariate Balances and Distribution of Propensity Scores

In the robustness checks, I implemented the nearest-neighbor propensity score matching based on four variables: county area, proportion of rural population, share of industrial output in total output, and per capita savings. These variables respectively capture county size, population structure, industrial structure, and living standards. Each treated county was matched to a control county within the same prefecture. Covariate balance before and after matching is reported in Table C.1 and visually summarized in Figure C.1. After matching, standardized mean differences for all variables fall below 0.1, indicating that the procedure improves balance on observed confounders. All covariates are standardized prior to matching.

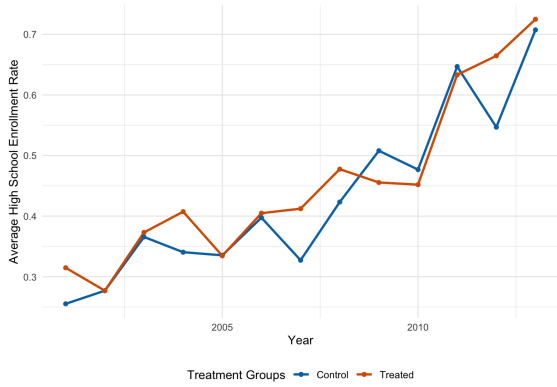
Figure C.2 shows the density of estimated propensity scores by treatment status before and after matching. Before matching, the distribution of the control group is concentrated near zero. After matching, the distributions exhibit substantial overlap, suggesting improved common support between treated and control units.



(a) Sample including migrants



(b) Sample limited to districts



(c) Sample matched by propensity scores

Figure B.1: Average High School Enrollment Rates in Alternative Samples

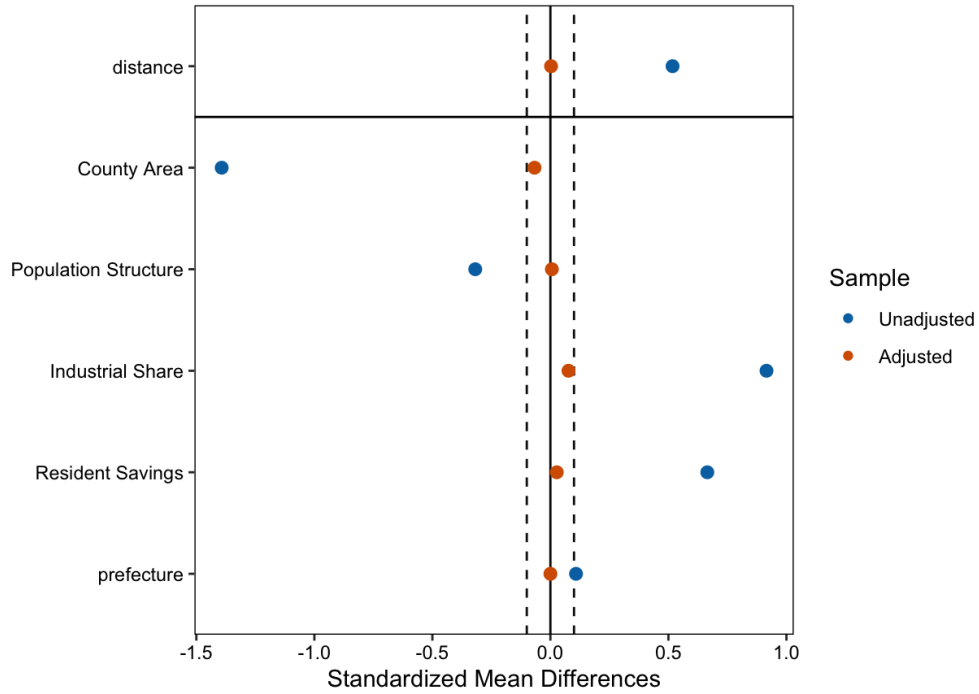
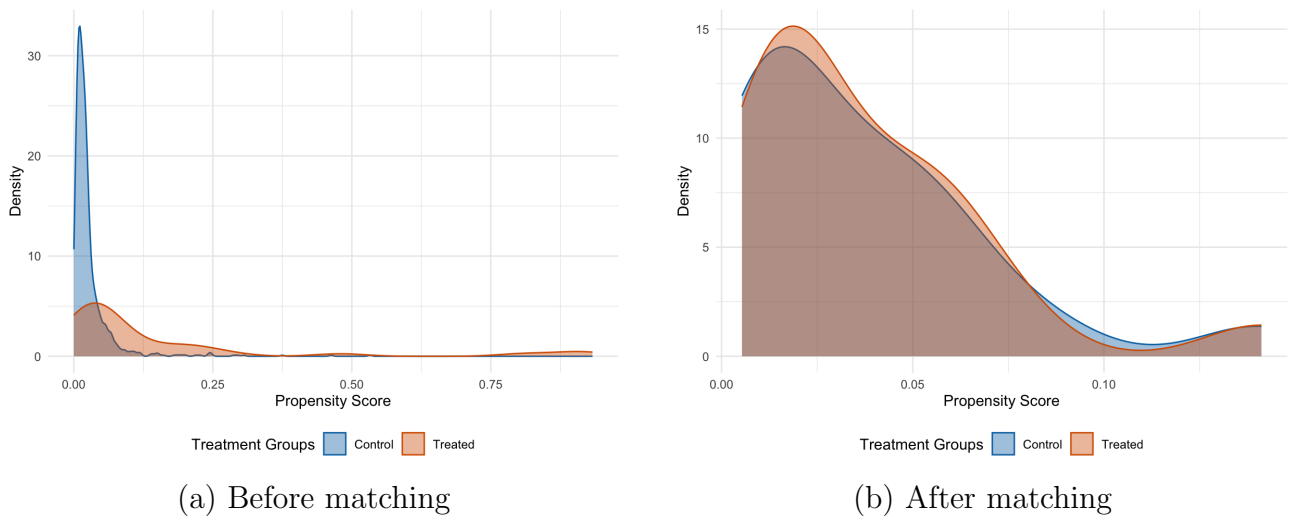


Figure C.1: Standardized Mean Differences Before and After Propensity Score Matching

Notes: This figure displays standardized mean differences (SMD) for each covariate before and after matching. The dashed vertical line indicates the balance threshold of 0.1.



(a) Before matching

(b) After matching

Figure C.2: Density of Estimated Propensity Scores

Table C.1: Covariate Balance before and after Matching

Variables	Mean		Std. Mean Diff.	Var. Ratio
	Treated	Control		
Before matching				
Area	-0.1986	0.0063	-1.3927	39.0506
Share of rural population	-0.3568	0.0112	-0.3184	1.3541
Share of industrial output	0.8267	-0.0260	0.9155	0.8828
Per capita savings	1.5651	-0.0493	0.6647	7.6492
After matching				
Area	-0.1554	-0.1455	-0.0672	1.4837
Share of rural population	-0.0346	-0.0418	0.0062	0.4091
Share of industrial output	0.3404	0.2691	0.0766	0.8396
Per capita savings	0.3684	0.3025	0.0271	0.4720

D Hyperparameter Selection in the Partially Pooled SCM

In the partially pooled synthetic control method, the hyperparameter $\nu \in [0, 1]$ controls the relative importance of the pooled fit and the separate fit. Panel (a) of Figure D.1 plots the balance possibility frontier (Ben-Michael et al., 2022), where the vertical axis shows the pooled imbalance q_{pool} and the horizontal axis shows the unit-level imbalance q_{sep} . The curve traces their evolution as ν increases from the separate SCM solution (upper left) to the pooled SCM solution (lower right). Given the strong ‘kink’ shape of the curve, $\nu = 0.85$ is chosen, beyond which gains in pooled fit come at the cost of substantial deterioration in unit-level fits. Panel (b) shows values of q_{pool} and q_{sep} versus ν , which are both normalized by their values for separate SCM. The dashed red line indicates the selected value $\nu = 0.85$, after which the pooled imbalance increases sharply.

With $\nu = 0.85$, Figure D.2 plots values of q_{pool} and q_{sep} across different penalty parameters λ . Based on the figure, λ is set to 0.001 to maximize regularization while keeping both pooled and separate imbalances from increasing substantially, thereby mitigating concerns of overfitting in the synthetic control method.

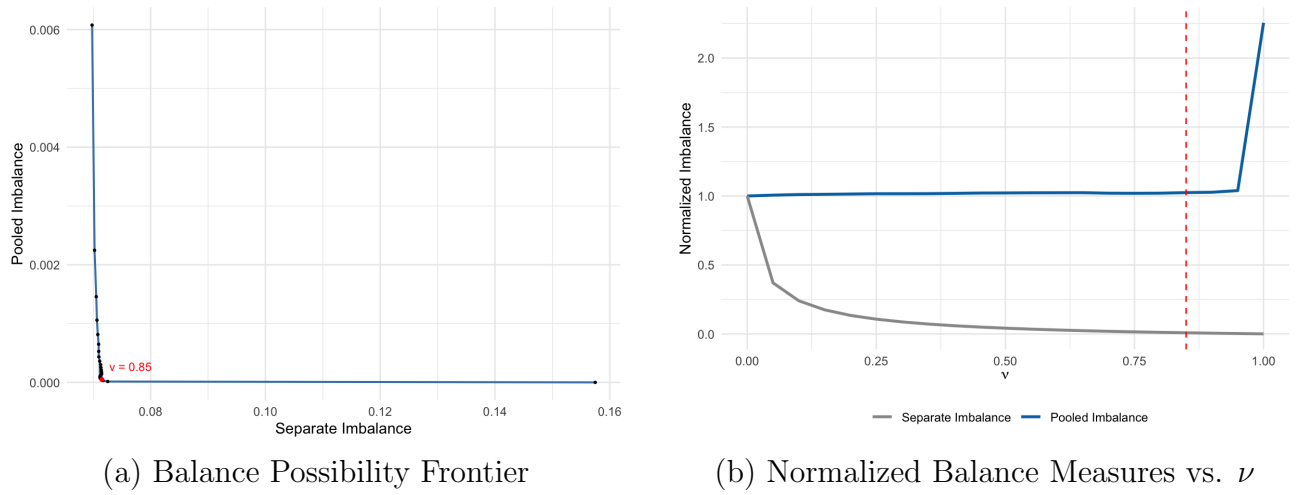


Figure D.1: Trade-off between q_{pool} and q_{sep}

Notes: Panel (a) plots the balance possibility frontier, illustrating the trade-off between pooled and unit-level imbalance as the hyperparameter ν increases. The red dot marks the selected value $\nu = 0.85$. Panel (b) shows normalized values of q_{pool} and q_{sep} as functions of ν , with a dashed red line indicating the selected ν .

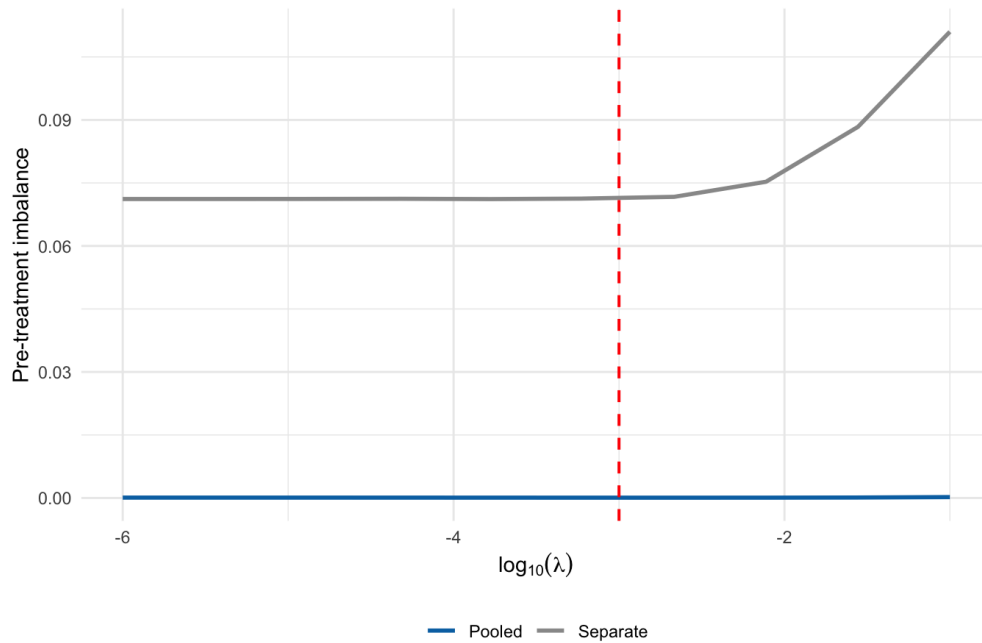


Figure D.2: Balance Measures vs. Penalty Parameter λ

Notes: This figure shows values of q_{pool} and q_{sep} as functions of λ with $\nu = 0.85$, with a dashed red line indicating the selected λ .