

# Planning or marketing? Maternal malnutrition during pregnancy and adult education

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## Abstract

This paper evaluates the reform and opening-up policy in China, a transition from the central planned to market economy, on the increase of the child's educational attainment. Based on the individual-level population census data and a cohort difference-in-differences strategy, I find that the reform policy has a subtle but significantly positive effect on the increase of the child's educational attainment, especially in less educated areas. The results are robust to the inclusion of confounders and provide suggestive evidence that the market economy can ameliorate the maternal malnutrition and reduce the regional and gender education inequality caused by the inappropriate economic system.

*Keywords:* market economy, education, maternal malnutrition, inequality

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# 1 Introduction

After carrying out the central planned economy for nearly 30 years, China began to introduce the market mechanism in 1978, which is called as “the reform and opening-up policy”. Before the policy, the commodity market were highly planned and the food coupon policy was implemented strictly.<sup>1</sup> Under such a planned economy, people cannot purchase food and other daily necessities unreservedly without the related coupons. Thus, most people were suffering malnutrition in that period including the pregnant women. In this paper, I exploit the population census data to examine the positive effect of this marketization policy on child’s educational attainment by alleviating the maternal under-nutrition.

Since the “fetal origins” hypothesis is proposed by [Barker \(1992\)](#), there are extensive studies about the effect of in utero experience on the child’s outcomes. [Black et al. \(2013\)](#) find that maternal undernutrition contributes to fetal growth restriction, which increases the risk of neonatal deaths and, for survivors, of stunting by 2 years of age. The reform and opening-up policy under the previous social context gives two special aspects for the analysis of maternal malnutrition in this study. Firstly, before the reform policy, China strictly implemented the rules of planned economy. Food coupon is one of the most representative features for this economy. Under the central planning, the consumers’ needs were not satisfied because of the ignorance of the law of value and the role of market regulation. Thus, people were suffering from the simple dieting structure or even insufficient nutrition intake. Second, the reform began in the agricultural field, on which China’s economic development is highly dependent. Also, the agriculture is the key factor for the whole country’s food supply. Therefore, the reform may generate a sizable effect for the prenatal nutrition intake.

To estimate the effect of the reform to the marketing economy on child’s educational attainment, I combine the individual-level population census data with the market index from the China Market Index Database. Based on the special household registration system, *Hukou*, in China, I am able to exclude the those individuals whose census place is

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<sup>1</sup>In the late 1970s, food supplies and production were so scarce that officials thought there might be a repeat of the three years of hardship that killed millions during the Great Leap Forward ([Brandt and Rawski, 2008](#)).

not the same as the birth location.<sup>2</sup> Similar with the empirical strategy of [Chen et al. \(2020\)](#) and [Duflo \(2001\)](#), employing a cohort difference-in-difference (DID) identification strategy, I find the marketization policy significantly increased the education years of the affected cohorts (born after 1978). Specifically, a one standard deviation increase of the market index is associated with an increase 0.098 years of each individual's education on average, *ceteris paribus*. Further, I find the heterogeneity of this effect that the positive effect only exists in less educated areas, indicating the reform policy not only increased the overall education level, but also reduced the regional inequality on education. I also find higher probability to complete beyond junior high school for the cohorts born after the reform policy.

To rule out the concerns about the casual effect in this paper, the crucial assumption about the DID model, parallel-trend, must be satisfied. By the assumption, the education trend of different cohorts should not be correlated with the market index if there were no reform policy (no pre-trend). In order to prove the assumption, I estimate the dynamic treatment effect of the marketization policy on the child's educational attainment of different cohorts. The results suggest that after controlling the individual, regional characteristics and a rich set of fixed effects, there were no heterogeneous effects across the cohorts before the implementation of the policy. On the other hand, I also explore whether the potential confounder, the agricultural development, can threaten the main results, because the agricultural sector is of importance for the prenatal nutrition supply. The results show that the coefficient of interest is not be distorted after controlling this confounder. Additionally, I also find substitute effect between the policy effect and the agricultural development.

This paper connects to the literature in several ways. Firstly, this paper adds to the literature of the effects on human capital accumulation in developing counties. Various factors affecting the human capital have been discovered by scholars, either from the demand side, such as land inequality ([Mariella, 2022](#)), women's bargaining power ([Li, Wu and Zhou, 2021](#)) or the supply side, such as school centralization ([Cappelli and Vasta, 2020](#)) and school infrastructure ([Duflo, 2001](#)). Additionally, [Andrabi, Daniels and Das \(2021\)](#) also uncover the natural disaster's severe disruptions in the accumula-

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<sup>2</sup>More details about the *Hukou* will be discussed in Section 3.

tion of human capital. The most related study to this paper is [Chen et al. \(2020\)](#), which utilizes the special historical event in China, the sent-down movement, to explore the human capital spillover effect from the exposure to higher educated sent-down youths during the child’s education ages. Different from [Chen et al. \(2020\)](#), this paper, from the demand side, studies how the economic transformation affects later life education attainment through the adequate in utero nutrition supply. To some extent, my findings also add to the literature of human capital accumulation and economic growth in China (see [Chen and Zhou \(2007\)](#) for a comprehensive review).

The second contributes to the growing “fetal origins” literature regarding the relationship between early childhood influences and later life outcomes. Economists have found that adverse prenatal environmental exposures can generate detrimental, persistent effects to the child’s future development. Several papers find that negative consequences can be caused by the prenatal exposure to the external shocks, such as natural disasters ([Almond, Edlund and Palme, 2009](#); [Currie and Rossin-Slater, 2013](#)), influenza pandemic ([Almond, 2006](#)), famine ([Chen and Zhou, 2007](#)), extreme high temperatures ([Hu and Li, 2019](#)), and air pollution ([Baliatti, Datta and Veljanoska, 2022](#)). Among various factors, maternal nutrition supply is one of the key determinants for the child’s early and later health outcomes ([Currie and Almond, 2011](#); [Black et al., 2013](#)). For instance, [Almond and Mazumder \(2011\)](#) find diet restriction associated with Ramadan fasting results in lower birth weight and mental (or learning) disabilities. This paper differs from the previous studies in two aspects. First, the intention of the central planned economy is the fast recovery from the economic disruption caused by the Sino-Japanese war, not the restriction of the nutrition intake as the Ramadan observance. On the other hand, this paper explores whether the market form, turning to the marketing economy, can be the remediation for the maternal malnutrition caused by the centralization.

The rest of this paper is organized as follows. Section 2 gives a brief description of the background of the reform policy. Section 3 presents the data sources and summary statistics. Section 4 and 5 introduce the empirical strategy and present the main results, respectively. Section 6 addressed the alternative explanation. I conclude in Section 7.

## **2 Background**

In 1949, 2858 bureaucrat-capitalist industrial enterprises were confiscated by the Chinese government. Meanwhile, Financial and Economic Commission of the CPC Central Committee and other central institutions were established to directly manage the nation's economic activities, which is a symbol of the formation of the early planned economy in China.

During the planning period, Beijing government first launched the purchase certificate of flour in 1953. After that, many local government issued a large number of food coupons with different names, quantities and uses. In 1955, food stamps were officially issued across the whole country. Under the government instructions, residents must use the specified food stamps when purchasing the related food. Also, only those urban residents have the right to receive the food stamps. However, rural people cannot be as free as today to work in cities. Farmers cannot receive the food stamps without the identity of urban citizen, so farmers cannot survive without the land.

After the reform and opening-up in 1978, the commodities market began to flourish and the strict food coupon system was getting looser. By 1983, only grain and edible oil were rationed by the state. After the second year of abolishing the system in Shenzhen, the pilot city, the state also abolished the system of exclusive purchase and distribution of agricultural products that had lasted for more than 30 years, which greatly stimulated farmers' enthusiasm for production. Since then, the dieting structure of city dwellers has also been improved and almost every household had surplus food stamps. In 1993, the food coupon system was abolished nationally by the central government.

## **3 Data Sources**

### **3.1 Market Index**

The market index data comes from China Market Index Database established by National Economic Research Institute, which is one of the first non-government and non-profit economic theory and policy research institutions in China. The index measures the relative process of marketization in all provinces of China. The market-based

index is based on data from two sources: province-by-province data collected by statistical authorities and other government departments, as well as data from a sample survey of enterprises across the whole country.

The market index is constructed according to the characteristics of different aspects of marketization. There are 5 aspect indexes, under which there are 14 first-level sub-indexes, among which some first-level sub-indexes also have second-level sub-indexes. Specifically, the 5 aspect indexes are: (1) the relationship between government and market; (2) the development of the non-state economy; (3) the development of the product market; (4) the degree of development of factor market; (5) the development of market intermediary organization and legal system environment. Figure 1 displays the spatial distribution of the market index. Higher marketization progress can be seen in provinces which are closer to the coastal areas.

Since the index is formed from 1997, I use the 1997 market index for the proxy of marketization intensity in my identification strategy. Thus, in this paper, the potential hypothesis is that the relative difference of market process among provinces several years after the policy can represent the different degree of responses during the implementation of the policy. Although the index is only province-level and is not the real index in 1978 (the policy year), I will show that this proxy and the hypothesis can be convincing in Section 5.

### 3.2 Population Census

I employ the 1% sample of China's 2015 Population Census to explore the effect of marketization during pregnancy on children's later-life educational attainment. I focus on cohorts born between 1975 and 1984. I select the 1975-1978 cohorts as the control group and the 1979-1984 cohorts as the treatment group. Since the official announcement of the marketization is in late December of 1978, individuals born in 1978 suffers malnutrition and those who were born in 1979 are affected by the marketization policy. Thus, I define the 1979 cohort as a member of treatment group (following [Chen and Zhou \(2007\)](#)).

This paper uses 2015 census data for the following reasons. Firstly, almost all the cohorts in the treatment group had completed the education in 2015. The youngest treat-

ment cohort in this paper is 1984 cohort. In 2015, this cohort of individuals are in their thirties, in which most of them should have completed their education. Using the previous wave of the population census, 2010 census, can underestimate the results, because some people may still in the process of graduate education and these people are not included in the education completion questions of the census.

Second, the biggest concern in the census data is that the census location may not be the individual's birth place. However, I can specify those who were born in the same place of the census location by the question "whether you leave the place of your *Hukou* registration". *Hukou* is a household registration system in China: people are classified as rural (agricultural) or urban (non-agricultural) residents. The registration system greatly limits people's mobility since people with rural *Hukou* cannot enjoy the social welfare in the urban areas. Also, it is difficult to change the *Hukou* status once a person is born. Thus, by excluding those who have moved away from their *Hukou* registration place, the noise of migrates in the data is ruled out.

Table I presents the summary statistics for the census data. There is an obvious increase of the education years. Although the proportion of those who complete primary school increases by nearly 9%, I will show that this increase is not caused by the reform policy in Section 5.

## 4 Econometric Model

My identification lies on two variation sources. First, different provinces have different scores of the market progression - "the Market Index". Second, individual's age cohort. Only those who were born before 1979 have the in utero experience of such restriction policy. I select the control group as cohorts before 1979, since these cohorts experienced relatively insufficient food supply period.

To empirically test the effect of market economy on adult welfare outcomes, I design the cohort DID model using cross-sectional data following [Duflo \(2001\)](#); [Chen and Zhou \(2007\)](#); [Chen et al. \(2020\)](#):

$$Y_{i,c,g,p} = \beta_0 + \beta_1 MKT_p \times I(1979 \leq g \leq 1984) + \beta_2 \mathbf{X}_{i,c,g,p} + \gamma_c + \lambda_g + \Gamma_c \times \lambda_g + \epsilon_{i,g,c,p} \quad (1)$$

where  $Y_{i,c,g,p}$  refers to the welfare outcomes, including schooling years and some other alternative dependent variables, for individual  $i$  of cohort  $g$  in county  $c$  of province  $p$ .  $MKT_p$  is the province-level market index in province  $p$ .  $I(1979 \leq g \leq 1984)$  is a dummy which equals to 1 if cohort  $g$  belongs to the specified period 1979 – 1984.  $\mathbf{X}_{i,c,g,p}$  is a vector of individual-level controls, including gender and ethnicity.  $\gamma_c$  are county fixed effects which absorb the county-level characteristics, such as geography and local culture.  $\lambda_g$  are cohort fixed effects which accounts for different cohort characteristics. To avoid the serial correlation, standard errors are clustered at county level.

The coefficient of interest is  $\beta_1$ .  $MKT_p$  is absorbed in lower-level county fixed effects  $\gamma_c$ .  $I(1979 \leq g \leq 1984)$  is absorbed in cohort fixed effects  $\lambda_g$ . Thus, the model in equation (1) is a difference-in-difference identification.

However, there may be other factors that drive the differential response to the reform and opening-up policy and are correlated with our outcome variables - education. To rule out the concerns about the casual relationship, I add other covariates in the model, county base education which is represented by  $\Gamma_c \times \lambda_g$ . The county base education is calculated as the primary and junior high graduation rates of the control group in each county following [Chen et al. \(2020\)](#). By adding  $\Gamma_c \times \lambda_g$ , I allow the cohort trends to be related with the county's initial education level. Thus, the identification strategy relies on the selection-on-observable assumption. After controlling the interaction of all observable pre-policy covariates and cohort dummies,  $MKT_p \times I(1979 \leq g \leq 1984)$  has an independent effect on the education.

To assure the assumption of difference-in-difference method, parallel-trend should be satisfied. That is, there are no unobserved cohort-varying confounders, variables that change across cohorts and potentially correlate with both the outcome and the key interaction term, in the designed model. To rule out this concern, I estimate the following model to show the dynamic treatment effect:



$$Y_{i,c,g,p} = \beta_0 + \sum_{k=1972, \neq 1978}^{1990} \beta_{1,k} MKT_p \times I(g = k) + \beta_2 \mathbf{X}_{i,c,g,p} + \gamma_c + \lambda_g + \mathbf{\Gamma}_c \times \lambda_g + \epsilon_{i,g,c,p} \quad (2)$$

where  $I(g = k)$  indicates a series of dummy variables representing a specific year from 1975 to 1984. From equation (2), we can check whether  $\beta_{1,k}$  of pre-policy cohorts are close to zero, as the assumption says.

## 5 Results

### 5.1 Main results

The main results from equation (1) are presented in Table II. In column (1), I control for county and cohort fixed effects. Column (1) shows that a higher level degree of marketization, on average, is associated with a increase in the education years of 0.088 years. The estimate is statistically significant at the 1% level. In column (2) and (3), I use two alternative indicators of education, complete primary and junior high school respectively. Comparing column (2) and (3), I find the marketization only increases the probability of completing junior high school (by 0.0104) and has no significant effect on that of the completion of primary school. The difference indicates that after alleviating the maternal malnutrition, the increase of the education years mainly comes from the positive effect on the completion of junior high school.

I also conduct two placebo tests in column (4) and (5) in order to prove the validity of the main results. In column (4), I define the control group as 1970-1974 cohorts and placebo-treated group as 1975-1978 cohorts. Similarly, in column (5), I split the post-policy cohorts into the placebo-control group (1985-1990) and treated group (1979-1984) in placebo test II. Neither of these two tests has the statistically significant result. Thus, the main results are partially proved.

Next, I estimate the dynamic treatment effect of the marketization based on Equation (2) to test the parallel-trend assumption. The estimates of coefficients  $\beta_{1,k}$  are plotted in Figure 2. The cohort 1978, the cohort before the marketization policy, is selected as

the baseline. In Figure 2, the coefficients are all around zero before the 1979 cohort, which satisfies the parallel-trend assumption. On the other hand, the coefficients increase gradually after the 1979 cohort, because the later cohorts may experience richer nutrition intake during the pregnancy as the deepening marketization across the country.

## 5.2 Regional heterogeneity

In Table III, I estimate the heterogeneous effect of the market economy on the education years by level of development, following the criterion of Chen et al. (2020). Specifically, I divide the full sample into less- or more-educated counties according to the average education years of the control groups. In column (1) and (2), the education years of the affected cohorts are increased by the marketization in both types of counties. Through column (3) to (6), I find a similar result as that in the full sample, the positive effect of the marketization only exists in the completion of junior high school. Additionally, this effect is much larger in less educated counties and the magnitude is about threefold that on more educated counties. Thus, the marketization not only increased the overall education level, but also alleviated the educational inequality across different regions.

## 5.3 Gender difference

We have documented the heterogeneous effect of the marketization across counties with different education levels and the increase of overall education years is mainly driven by the higher probability of completing junior high school. We now explore the gender difference of such effect. Based on the key specification, we add one additional interaction between the male dummy and the previous key interaction of market index and cohort indicator.

The results of the new specification are presented in Table IV. The coefficients on male dummy across all the columns suggest that, without the marketization, males receive longer education years and have higher probability on the completion of primary school and junior high school. In stark contrast, there are better education outcomes in female groups when there is marketization (the third row). Also, this female supporting effect is more salient in those less educated counties for all the education measurement in this

paper. Therefore, besides the alleviation of regional education inequality, the marketization also contributes to the reduction of gender inequality, which may further benefit the future labor market performance of females.

## 6 Alternative Interpretation

This section discusses some potential confoundings in the identification strategy, which may cause the linkage of the marketization and child's education attainment.

### 6.1 Agricultural confounding

As the background in Section 2, the agriculture is the field where the reform begins. During the reform, the agricultural output met a great increase (Hunt, 2016), which sets a precedent for other areas' marketization. On the other hand, during the central planning period, nearly all the nation's food supply comes from the agricultural production in rural area. Thus, the success in agricultural field has a considerable effect on the nutrition intake of the families. Therefore, it could be possible that cohorts in provinces with different levels of agricultural development can have different education attainments.

To address the above concerns, I collected province-level agriculture added values of each year after the reform policy. Then I compute the percentage change of the added values in each year and take the average across all years. I use the average yearly agriculture added values percentage change as the indicator of each province's agricultural development.

In Table V, column (1) presents the main results as shown in Table II for comparison. In column (2), I add one more interaction between the agriculture added values% and the cohort dummy. After controlling the agricultural development, the coefficient of interest remains significant. Next, to explore the possible connection between the reform policy and the agricultural development, I additionally include the interaction term between the market index and the agriculture added values%. I find these two factors substitute with each other, that is, the reform's effect is larger in provinces with relatively less developed agriculture. This result is not surprising, because in provinces with greater agriculture development, the nutrition supply of the mothers during pregnancy could probably be

more than enough already regardless of the reform's effect. These results indicate that the reform policy's positive effects are not likely to be purely driven by the agricultural development.

## 6.2 Family income

The relationship of family income and child's achievement has long been discussed by scholars. In the context of this paper, families in those provinces with higher degree of marketization may have higher income accordingly. Also, many scholars find that higher family's income is a key determinant for the child's better education achievement or job performance (Acemoglu and Pischke, 2001; Dahl and Lochner, 2012; Bastian and Michels, 2018). Thus, higher educational attainment can be caused by the family income which could be a direct consequence of the marketization. To overcome this confounding factor, I exploit the question in the census data, whether the family has cars, as a proxy for the family's income level. In Table V, I control the proxy variable of family income level in column (4). The coefficient of interest decreases slightly, but remains statistically significant. Therefore, the estimated marketization effect from equation (1) is robust to the inclusion of this confounder.

In column (5) of Table V, I include all the confounders in the main model. As the result shows, the inclusion of these confounding factors exerts very small impact on the main result in column (1), which proves the validity of the estimation.

## 7 Conclusions

The implementation of the reform and opening-up policy is an important event for the economic transition of China. In this paper, I explored the effect of this policy on the affected cohorts' educational attainment in alleviating the prenatal malnutrition caused by the inappropriate economy, combining the population census data and the market index.

I find that the reform policy has a subtle but significantly positive effect on the increase of the child's educational attainment. Specifically, I also find higher probability of the completion beyond junior high school for the affected cohorts. Test of the heterogeneity shows that this effect is larger for the less educated areas, suggesting the

policy's active role in the reduction of regional inequality. In an alternative explanation, I addressed the concern for the causal relationship that the agricultural development may be a confounder. Also, I find the marketization and the agricultural development substitute with each other, since the nutrition may be enough in those areas with high development of the agriculture.

A key insight from the analysis of this paper is that the central planned economy has its own shortage and is less efficient than the market-oriented economy. However, some disadvantages of the market economy may exist. Whether the most vulnerable group is benefited by the marketization is still an unanswered question, since they may not be independent enough to make a living in an economy full of competition, without the nation's planning. This question is critical for future research.

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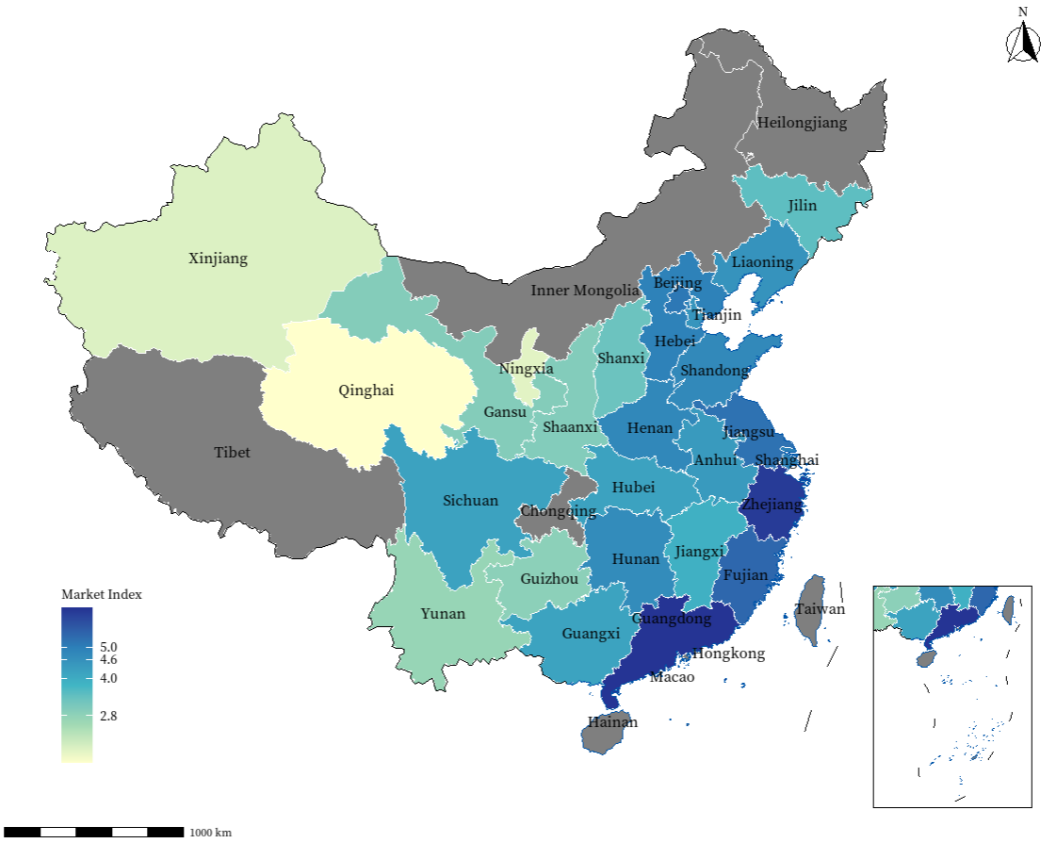
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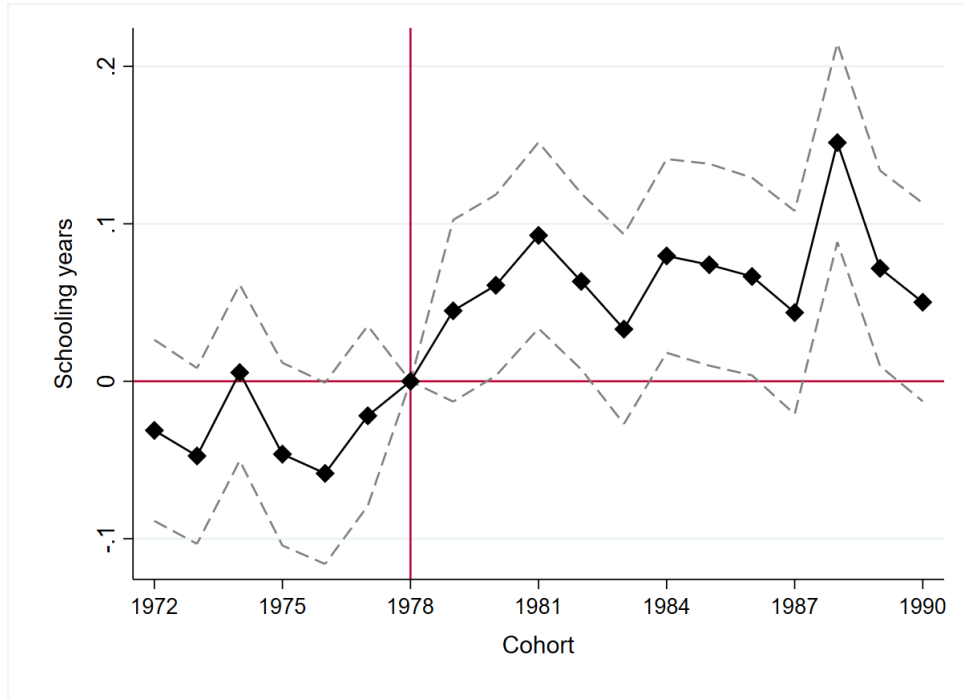
# Figures

Figure 1: Spatial Distribution of the Market Index



*Notes:* This figure shows the market index for each provinces. The dark grey areas are not covered in this paper.

Figure 2: Dynamic Effect of Market Economy on the Education Attainment



Notes: Point estimates are shown by the black line with dots. The gray dashed line is the associated 95% confidence intervals. Coefficients of the interaction terms of market index and cohort dummies from equation (2) are plotted. 1978 cohort is selected as the base group. Standard errors are clustered at county level.

# Tables

Table I: Summary Statistics

Cohort:	Control group (1975-1978)		Treatment group (1979-1984)	
	(1)	(2)	(3)	(4)
Sample:	Less educated	More educated	Less educated	More educated
Education years	8.607 (2.689)	11.186 (2.988)	9.237 (2.766)	11.606 (3.117)
Age	38.571 (1.132)	38.528 (1.131)	33.502 (1.697)	33.533 (1.675)
Complete junior high	0.966 (0.182)	0.997 (0.059)	0.974 (0.158)	0.996 (0.066)
Complete primary school	0.745 (0.436)	0.944 (0.230)	0.831 (0.374)	0.958 (0.200)
<i>Male</i> = 1	0.501 (0.500)	0.500 (0.500)	0.507 (0.500)	0.497 (0.500)
<i>Han</i> ethnic = 1	0.846 (0.361)	0.948 (0.221)	0.838 (0.368)	0.947 (0.223)
Observations	37,837	27,741	52,258	40,153

Notes: Standard deviations are in parentheses.

Table II: The Effect of Market Economy on the Educational Attainment

Dependent variables:	Education Years	Complete primary	Complete junior high	Placebo I (1970-1974) v.s (1975-1978)	Placebo II (1979-1984) v.s (1985-1990)
	(1)	(2)	(3)	(4)	(5)
Market index × affected cohorts (1979-1984)	0.0880*** (0.0161)	0.0002 (0.0006)	0.0104*** (0.0016)		
Market index × affected cohorts (placebo)				0.0140 (0.0299)	0.0119 (0.0525)
Observations	157,365	157,365	157,365	174,444	199,841
$R^2$	0.941	0.986	0.896	0.934	0.945
Individual Controls	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓
Cohort FE	✓	✓	✓	✓	✓
Base education × cohort FE	✓	✓	✓	✓	✓

Notes: The sample of column (4) and (5) are those whose birth years are before and after 1979 respectively. Individual controls include gender and ethnics. Standard errors are clustered at county level. Base education is the local primary and junior high graduation rates of control group.  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.10.

Table III: Heterogeneous Effect of Market Economy

Dependent variables:	Education Years		Primary	Junior	Primary	Junior
Sample:	Less educated counties	More educated counties	Less educated counties	More educated counties	Less educated counties	More educated counties
	(1)	(2)	(3)	(4)	(5)	(6)
Market index $\times$ affected cohorts (1979-1984)	0.0888*** (0.0192)	0.0949*** (0.0275)	0.0002 (0.0011)	0.0145*** (0.0023)	0.0002 (0.0004)	0.0048*** (0.0018)
Observations	89,472	67,893	89,472	89,472	67,893	67,893
$R^2$	0.932	0.949	0.979	0.843	0.996	0.956
Individual Controls	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓
Cohort FE	✓	✓	✓	✓	✓	✓
Base education $\times$ cohort FE	✓	✓	✓	✓	✓	✓

*Notes:* Individual controls include gender and ethnics. Less- or more- educated counties are defined as whether the average education years of the control group below or above the average. Standard errors are clustered at county level. Base education is the local primary and junior high graduation rates of control group. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10.

Table IV: The Gender Difference of the Market Economy

Dependent variables:	Education Years		Primary	Junior	Primary	Junior
Sample:	Less educated counties	More educated counties	Less educated counties	More educated counties	Less educated counties	More educated counties
	(1)	(2)	(3)	(4)	(5)	(6)
Male	0.4983*** (0.0259)	0.2685*** (0.0287)	0.0190*** (0.0019)	0.0775*** (0.0040)	0.0004 (0.0007)	0.0173*** (0.0027)
Market index $\times$ affected cohorts (1979-1984)	0.1033*** (0.0196)	0.1060*** (0.0279)	0.0015 (0.0011)	0.0185*** (0.0024)	0.0001 (0.0004)	0.0057*** (0.0018)
Market index $\times$ affected cohorts (1979-1984) $\times$ male	-0.0304*** (0.0070)	-0.0229*** (0.0077)	-0.0026*** (0.0004)	-0.0086*** (0.0010)	0.0002 (0.0002)	-0.0017*** (0.0006)
Observations	89,472	67,893	89,472	89,472	67,893	67,893
$R^2$	0.173	0.249	0.184	0.218	0.023	0.069
Individual Controls	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓
Cohort FE	✓	✓	✓	✓	✓	✓
Base education $\times$ cohort FE	✓	✓	✓	✓	✓	✓

*Notes:* *Male* is a dummy variable indicating whether the individual is male. Individual control is ethnics. Less- or more- educated counties are defined as whether the average education years of the control group below or above the average. Standard errors are clustered at county level. Base education is the local primary and junior high graduation rates of control group. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10.

Table V: Addressing the confoundings

Dependent variables:	Education Years				
	(1)	(2)	(3)	(4)	(5)
Market index $\times$ affected cohorts (1979-1984)	0.0880*** (0.0161)	0.0974*** (0.0176)	0.2203*** (0.0473)	0.0838*** (0.0157)	0.0916*** (0.0173)
Ag added values% $\times$ affected cohortss (1979-1984)		-0.0674* (0.0401)	0.3640** (0.1663)		-0.0563 (0.0392)
Market index $\times$ Ag added values% $\times$ affected cohorts (1979-1984)			-0.0858*** (0.0316)		
Observations	157,365	157,365	157,365	157,365	157,365
$R^2$	0.941	0.941	0.941	0.944	0.944
Individual Controls	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓
Cohort FE	✓	✓	✓	✓	✓
Base education $\times$ cohort FE	✓	✓	✓	✓	✓
Owning cars				✓	✓

*Notes:* Individual controls include gender and ethnics. Less- or more- educated counties are defined as whether the average education years of the control group below or above the average. Standard errors are clustered at county level. Base education is the local primary and junior high graduation rates of control group. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .