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Educational opportunity and children's migration: Evidence from China's Gaokao reform for children of migrant families☆

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ABSTRACT

This paper estimates the effect of the Gaokao reform on children's migration. The reform relaxes the Hukou restrictions in the Gaokao system, allowing eligible migrant children to take the Gaokao in the destination province and be admitted to higher education institutions based on the same criteria as local students. Using the CMDS 2011–2017 dataset and the difference-in-differences approach, we find that the reform significantly increases children's migration probability; the positive effect is weaker in provinces with more stringent requirements. While Gaokao reform does not affect parents' decisions of cross-province migration or destination of migration, parents' extend their migration duration.

1. Introduction

China has experienced unprecedented rural-urban migration since the early 1980s. During the first decade, most migrants migrated alone, leaving their spouses and children behind in their home villages. As urban employment became more stable in the late 1990s, their spouses and children began to join the migrants in the cities. Children who migrate with their parents are known as migrant children, while those who do not are left-behind children. In 2015, the number of rural migrant children under 17 was approximately 34 million (Lv et al., 2018). China's household registration (Hukou) system, which ties government-provided services including education to a registered location, however, poses a significant obstacle to rural migrant children's access to quality education from primary school to college.[1]

The central government has exerted considerable pressure on local governments to provide compulsory education for migrant

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[1] In China, formal education typically consists of nine years of compulsory education (including six years of primary school plus three years of junior secondary school), three years of senior secondary education, and tertiary education. Compulsory education and senior secondary education belong to basic education.

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children since the early 2000s. In 2001, it issued the "Decision on the Reform and Development of Basic Education," mandating that governments of the current residence of migrant children be responsible for their compulsory education.[2] Since then, continued pressure from the central government has greatly improved the access of migrant children to compulsory education.[3] Based on this achievement, some cities started releasing plans in 2003 to allow migrant children to take the high school entrance exam (Zhongkao) and attend local senior high schools (Han, 2021). By 2008, many cities with a large influx of migrant children had announced Zhongkao policies for migrant children (Wu, 2011). In contrast to the progress in migrant children's basic education, the issue of their higher education only started to receive attention in the past decade.

In China, the national college entrance exam (Gaokao) is the dominant means of admissions to tertiary education. However, the Gaokao system, like other public services, is tied to the Hukou, and children are forbidden to take the Gaokao outside of their Hukou place. To solve the Gaokao problem faced by migrant households, in 2012, the State Council issued "Opinions on Enabling Children of Migrant Workers to Take the Entrance Exam in the Place Where Their Parents Work and Live after Compulsory Education" (henceforth, Opinions).[4] The "Opinions" urged provincial governments to develop policies to allow eligible migrant children to take the Zhongkao and Gaokao in the province of current residence. While the Zhongkao policies for migrant children have been implemented in some places prior to the "Opinions", the Gaokao policies were not introduced until after the "Opinions." Despite differences in eligibility requirements and implementation time, 30 of the 31 provinces had announced Gaokao policies for children of migrant families by 2013.[5]

The reform is expected to give migrant children a fair opportunity in the Gaokao. Before the reform, migrant children had to return to their Hukou province to take the Gaokao, regardless of how long they or their families had lived in the destination province. Adapting to a new school, especially without parental care, is difficult. In addition, the exam content differed across provinces. Relearning the exam materials in a new high school at their hometown may hurt children's performance on this high-stakes exam. Thus, many parents had to leave their secondary school-aged children in their hometown for the entire secondary school stage to avoid the dramatic change and associated negative impacts of transferring schools just before the Gaokao. The Gaokao reform enables eligible migrant children to take the Gaokao in the destination province and get admitted based on the same criteria as local students. Consequently, more migrant parents may be encouraged to bring their children along. In this paper, we investigate how the Gaokao reform affects the migration of children of rural migrant households.

Our primary difference-in-differences analysis compares the change in migration probability of secondary school-aged children after the Gaokao reform was announced to that of pre- and primary school-aged children. Using the China Migrants Dynamic Survey (CMDS) data from 2011 to 2017, we find that the Gaokao reform significantly increased the migration probability for all secondary school-aged children. Specifically, after the Gaokao reform was announced, the migration probability of junior and senior secondary school-aged children increased by 2.6 and 4.4 percentage points, respectively, compared to pre- and primary school-aged children. Using a triple-differences approach, we estimate the heterogeneous effect of the Gaokao reform due to policy stringency and find the effect of the Gaokao reform to be greater in provinces with less stringent requirements for Gaokao eligibility. The results are robust to a series of sensitivity analyses and are not driven by various of confounding factors. Additionally, although migrant parents did not change their long-term residence intentions, they nevertheless prolonged their migration duration in the destination province.

This paper is related and contributes to three strands of the literature. The first is the literature on the equity implications of local provision of public education and the role of higher-level governments. Basic education tends to be provided by local governments, in particular in large countries (Glomm et al., 2011), on the premise that local governments can better satisfy the preferences of residents within their jurisdiction (Tiebout, 1956). Yet, locally financed public education may lead to severe inequality due to disparities in financial capacity across regions (Fernández and Rogerson 1999, 2003; Hannum and Wang 2006). Inter-governmental transfers can mitigate this problem. Hoxby, (2001), Card and Payne (2002), and Lafortune et al. (2018), among others, show that school finance equalization reforms in the U.S. has reduced the educational spending gap between wealthy and poor school districts. Since the mid 2000s, the Chinese central government has implemented and gradually expanded earmarked educational transfers to the rural areas, which help narrow the resource gap between urban and rural schools (Li et al., 2017; Yue et al., 2018). However, intergovernmental transfers are insufficient to solve the problem of the inequality of educational opportunities of the migrant children caused by institutional barriers of the Hukou system. Addressing this issue requires additional policy instruments. Our findings indicate that the mandate of the central government led the local governments to develop policies for children of migrant families, which incentivize them to migrate and take advantage of the richer educational resources in the urban area.

Second is the literature investigating the education of rural migrant children. Many studies have observed that migrant children do not have equal access to basic education as local urban children. Urban governments lack the incentive and financial resources to meet the educational needs of migrant children when educational budgets are allocated based on the number of students with local Hukou (Goodburn, 2009; Zhang, 2017; Chen and Feng 2013). They prioritize allocating limited public school resources to local urban

[2] 2011, "Decision on the Reform and Development of Basic Education." URL: http://www.gov.cn/ztzl/nmg/content_412402.htm.

[3] 2003, "Opinion on Further Improving Compulsory Education for Children of Migrant Workers in Urban Cities." URL: http://www.gov.cn/gongbao/content/2003/content_62453.htm. 2006, "Compulsory Education Law of the People's Republic of China." URL: http://www.gov.cn/flfg/2006-06/30/content_323302.htm. 2012, "State Council's Opinion on the Promotion of the Balanced Development of Compulsory Education." URL: http://www.gov.cn/zwgk/2012-09/07/content_2218783.htm.

[4] 2012, "Circular of the State Council: Opinions on Enabling Children of Migrant Workers to Take the Entrance Exam in the Place Where Their Parents Work and Live after Compulsory Education." URL: http://www.gov.cn/zwgk/2012-08/31/content_2214566.htm.

[5] Tibet did not issue the Gaokao policy for children of migrant families.

children, and migrant children may end up in privately run, low-quality migrant schools (Goodburn, 2016; Lai et al., 2014; Chen et al., 2015; Wang et al., 2017). These studies focused on difficulties faced by migrant children in receiving quality compulsory education. We contribute to the literature by showing that the Gaokao opportunity significantly increased the migration probability of children of migrant families, which may benefit rural children's human capital in two ways. First, migrant children no longer have to return to their Hukou province for the Gaokao, saving the cost of adapting to new schools, curricula, and environments (Hanushek et al., 2004; Rumberger and Larson 1998). Second, children migrating with their parents can avoid the negative impact of being left behind on their human capital accumulation (Antman, 2011; McKenzie and Rapoport 2011; Zhang et al., 2014).

Third, this paper relates to the literature on factors that affect migration. Many studies examine how economic factors such as income gaps, land rights, and wealth constraints affect internal migration decisions (Cai, 2020; Chernina et al., 2014; Dustmann and Okatenko 2014; Phan and Coxhead 2010). Only a few studies pay attention to the role of children in parental migration behavior. Démurger and Xu (2015) find that migrant parents with children in primary schools tend to delay the return to their hometowns. Xie and Zhang (2022) document that mothers are more likely to migrate to urban areas when their children transfer to urban schools following the rural school-merger reform. Wang et al. (2019) relate children's migration to parental settlement intention and show a positive correlation between these two. Our study adds to this literature by investigating how children's educational opportunities influence the migration behavior of their parents. While the Gaokao reform does not appear to affect parents' decisions of cross-province migration or destination of migration, parents' do extend their migration duration, consistent with Su et al. (2018) that migration is primarily to improve family economic conditions and with Liu and Xing's (2016) that increasing the availability of educational opportunities will facilitate rural-to-urban migration.

In the remainder of the paper, we first describe the institutional background of the Gaokao reform and lay out the conceptual framework. Section 3 describes the data and empirical strategy. Section 4 reports the effects of the Gaokao reform on children's migration. Section 5 addresses issues of potential confounding factors. Heterogenous effects are explored in Section 6. Section 7 concludes.

2. Institutional background and conceptual framework

2.1. Hukou restrictions in the gaokao system

The Gaokao is the dominant means of gaining entry to tertiary education in China. The exam is held in early summer annually, and students with scores above a province-specific cut-off are admitted. The exam is virtually the only path of upward mobility for most rural students (Li et al., 2015). Senior high school stage is the most important period for students to prepare for the Gaokao, when they spend most of their time both learning new test materials and reviewing these materials. Before the Gaokao reform, children must take the Gaokao in their Hukou province, which poses great difficulties for students migrating with their parents across provinces.[6]

First, migrant students have to return to their hometown senior high school for the Gaokao. Adapting to a new school alone under the great strain of the Gaokao is difficult. Besides, the Gaokao tests are based on each province's curriculum. Cross-province migrant children may have to relearn the exam materials in their Hukou province. Pressure from both the new environment and the curriculum can have a negative impact on their Gaokao performance. Second, the college admissions quota varies by province. The central and provincial governments have a substantial influence on the admissions quota in each province. The central government, for equity purposes, requires universities to reserve seats for students from western provinces where education is less developed. Provincial governments encourage universities to offer more seats to local students to benefit local economic development. Hence, for universities of similar quality, the admissions cut-off scores tend to be lower in western provinces and provinces with many higher education institutions (HEIs).[7] To protect local students, university admissions are strictly based on Hukou province, regardless of how long one has lived in a particular province. Both concerns deter rural students from migrating with their parents.

2.2. Gaokao reform and regional heterogeneity

The central government has been concerned about the Gaokao need of children of migrant families since the early 2000s. In 2010, the State Council issued "China's National Plan for Medium- and Long-term Education Reform and Development (2010–2020)."[8] This plan urged provincial governments to develop measures to include migrant children in the local Gaokao system. In 2012, the State Council issued "Opinions on Enabling Children of Migrant Workers to Take the Entrance Exam in the Place Where Their Parents Work and Live after Compulsory Education," mandating that all provinces release Gaokao plans for migrant children by the end of 2012. In response to the "Opinions," 30 provinces announced Gaokao policies for children of migrant families. Most of these policies were

[6] Calculated from the Chinese population census, out-of-province migrants account for 66% and 60% of all prime-age (16-65) rural migrants in 2000 and 2010 respectively.

[7] Higher education institutions (HEIs) in China are divided into several tiers based on educational quality. The first-tier universities have the highest educational quality and admit students with the highest Gaokao scores. Education quality of the second- and third-tier universities is relatively low. All universities offer bachelor's degrees. Three-year vocational colleges in mainland China do not offer degrees and the admissions scores are lower than those for degree-offering universities.

[8] 2010, "China's National Plan for Medium- and Long-term Education Reform and Development (2010–2020)." URL: http://www.gov.cn/jrzg/2010-07/29/content_1667143.htm.

issued between December 2012 and March 2013.[9] These policies improve migrant children's educational opportunities by allowing them to take the Gaokao and be admitted just like local students.

The "Opinions" grant provincial governments the discretion to determine their own Gaokao eligibility requirements for children of migrant families and the implementation timeframe based on educational resources and the number of migrant households. Therefore, Gaokao policies for children of migrant families differ significantly across provinces, as summarized in Table 1.

First, the implementation time varies across provinces. Fourteen provinces implemented the Gaokao policy in 2013, eleven in 2014, and one in 2016 (Shaanxi). Once children of migrant families in the above provinces satisfy the respective requirements listed in Table 1, they are included in the Gaokao system in these provinces. Four provinces (Gansu, Inner Mongolia, Guangdong, and Xinjiang) relaxed their requirements initially between 2013 and 2014, but fully implemented their new policies only between 2015 and 2016.

Second, the employment and residence requirements and college-type restrictions differ. The common requirement is that migrant children must have been officially enrolled in a school in the residence province for a certain number of years. In addition, some provinces require parents to submit official documents of stable residence, legal and stable employment, and social insurance or income tax payment. Other provinces implement more stringent policies; for example, parents must satisfy the above conditions for a minimum number of years. Although 25 provinces allow migrant children to apply to any university or college, five provinces (Beijing, Tianjin, Shanghai, Yunnan, and Qinghai) restrict migrant children's choices to third-tier universities or higher vocational colleges, which typically admit students with low Gaokao scores.[10]

Based on the employment and residence requirements and college-type restrictions, we group provincial Gaokao policies into three types, as in Table 1. Type I policies allow migrant children to apply to any university or college and have no minimum year requirement for parental employment and residence. Type II policies also allow migrant children to apply to any university or college but have minimum year requirements for parental employment or residence. Type III policies only allow migrant children to apply to third-tier universities or higher vocational colleges. Type II and Type III policies are more stringent than Type I policies. Provinces implementing Type II or Type III policies are likely to have the following characteristics. First, they tend to have a large migrant population due to good job opportunities. Local governments shoulder a heavy financial burden to educate the large number of migrant children. Second, they tend to have a large admissions quota, and local students thus have a better chance of being admitted into universities. Local governments may worry that students from other provinces migrate to take advantage of the large quota and hence hurt local students.

2.3. Conceptual framework

In this section, we briefly discuss how the Gaokao reform affects children's migration. Based on the Chinese school system, we divide children into four age groups: preschool, primary school, junior secondary school, and senior secondary school, aged 3–5, 6–11, 12–14, and 15–17, respectively.[11] Before the Gaokao reform, Hukou restrictions forced migrant children to return to their Hukou provinces to prepare for the Gaokao. Switching schools entails a negative effect on students' academic performance (e.g., Hanushek et al., 2004). In our case, the adverse effect may be substantial. Migrant students must adapt to a new school under the intense pressure of the Gaokao without parental care, and they may have to relearn the exam materials since the Gaokao questions are based on the curriculum of the Hukou province.

The negative effect entailed by Hukou restrictions may deter secondary school-aged children, including both senior and junior secondary school-aged, from migrating with their parents. Senior secondary school-aged children may not migrate either because of the negative effect of switching schools in the middle of the senior high school years or because they have to sit for the exam in their Hukou province in their senior year. For junior secondary school-aged children, farsighted parents may leave them behind to attend junior high school, take the Zhongkao, and enroll in high schools in their home province, thus avoiding the negative impact of a later school transfer. Given that the migration of secondary school-aged children was negatively affected by Hukou restrictions before the Gaokao reform, we expect the Gaokao reform to raise their migration probability. In addition, the Gaokao issue is more pressing for senior secondary school-aged children than junior secondary school-aged children, so parents of the former are more likely to choose to leave their children behind due to the Gaokao issue than parents of the latter. Consequently, the migration of senior secondary school-aged children might be more deterred by the Hukou restrictions than that of junior secondary school-aged children, and the Gaokao reform thus may have a greater effect on the former.

In contrast, for pre- and primary school-aged children, it is still many years before they take the Gaokao. Intuitively, their parents may not concern about their Gaokao issue when they decide whether to bring them along. Thus, their migration is unlikely to be affected by the Gaokao reform. Though we cannot directly prove this statement, our data show that the migration behavior of pre- and primary school-aged children is not responsive to the Gaokao reform.

[9] Tianjin issued its policy at the end of 2013.

[10] Though Shanghai government allows children of migrant households with 120 residence permit points to apply to any university or college, this requirement is much too high for rural migrant parents with only secondary education to satisfy (Dong and Goodburn 2020). Thus, we classify Shanghai as a province that restricts the types of HEIs migrant children can apply to.

[11] Children under 2 are not considered in this paper since children in this age group usually stay with their mothers due to physical needs.

Table 1
Gaokao policies for children of migrant families by province.

Province	Implementation Year	Children		Parents					College type	Category
		Legal student identity	Residence	Employment	Residence	Residence permit	Social insurance	Tax	Restrictions	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Zhejiang	2013	3								I
Fujian	2014	3								I
Anhui	2013	3								I
Jiangxi	2014	1								I
Shandong	2014	3								I
Hebei	2013	2		Y		Y				I
Liaoning	2013	3		Y	Y					I
Jiangsu	2013	3		Y	Y					I
Heilongjiang	2013	3		Y	Y					I
Henan	2013	Y		Y	Y					I
Chongqing	2013	3		Y	Y					I
Sichuan	2014	3		Y	Y					I
Shanxi	2014	3		Y	Y					I
Hubei	2013	3		Y	Y					I
Gansu	2015	3		Y	Y		Y			I
Hunan	2013	3		Y	Y	1				II
Ningxia	2014	6		6	6		3			II
Shaanxi	2016	3				3	3			II
Inner Mongolia	2016	3		3	3		(3)	(3)		II
Guangxi	2013	6		3	3					II
Hainan	2014	6	6	Y	6		6			II
Guangdong	2016	3		Y	Y	3	3			II
Jilin	2013	3		Y	Y		3			II
Guizhou	2014	3		3	3	3	3			II
Xinjiang	2014	12		12		12	1	1		II
	2016	5		Y		5	2	2		
	2017	6		5		5	2	2		
Beijing	2014	3		6	6	Y	6		Y	III
Tianjin	2014	Y				Y			Y	III
Shanghai	2014	Y				Y			Y	III
Yunnan	2013	Y							Y	III
Qinghai	2013	Y				Y			Y	III

Source: The policy information is obtained from the websites of the provincial education bureaus and is available from the authors upon request.
Notes: In columns 2–9, "Y" indicates that the condition in the corresponding column is required. "Number" indicates the minimum-year requirements. Parentheses indicate that at least one of the two conditions is required. Policies that allow migrant children to apply to any university or college and have no minimum year requirements for parental employment and residence are categorized as Type I. Policies that allow migrant children to apply to any university or college but have year requirements for parental employment or residence are categorized as Type II. Policies that only allow migrant children to apply to third-tier universities or higher vocational colleges are categorized as Type III.

Table 2
Summary statistics of the sample children from the CMDS 2011–2017.

	Before (2011–2012)		After (2013–2017)	
	Control group (Preschool and Primary) (1)	Treatment group (Secondary) (2)	Control group (Preschool and Primary) (3)	Treatment group (Secondary) (4)
Panel A. Children				
Male=1	0.549	0.657	0.549	0.652
	(0.498)	(0.475)	(0.498)	(0.476)
Age	6.574	14.377	6.567	14.417
	(2.571)	(1.672)	(2.506)	(1.714)
Han ethnic=1	0.951	0.959	0.940	0.947
	(0.215)	(0.198)	(0.238)	(0.224)
Siblings under 18	1.562	1.398	1.631	1.389
	(0.608)	(0.540)	(0.624)	(0.552)
Migrating with parents	0.684	0.518	0.678	0.562
	(0.465)	(0.500)	(0.467)	(0.496)
Migrating without parents [1]	0.005	0.024	0.004	0.016
	(0.068)	(0.153)	(0.067)	(0.125)
Left-behind	0.312	0.458	0.318	0.422
	(0.463)	(0.498)	(0.466)	(0.494)
Panel B. Parents				
Father's age	33.492	40.618	33.403	41.637
	(4.914)	(3.747)	(5.390)	(4.128)
Mother's age	31.677	39.232	31.587	40.207
	(4.852)	(3.628)	(5.244)	(4.118)
Father's migrant duration	5.157	6.801	5.157	7.196
	(4.615)	(5.860)	(4.720)	(6.142)
Mother's migrant duration	4.704	6.517	4.622	6.856
	(4.147)	(5.558)	(4.200)	(5.745)
Father's education level [2]	3.064	2.852	3.155	2.894
	(0.649)	(0.637)	(0.703)	(0.659)
Mother's education level [2]	2.902	2.628	3.031	2.683
	(0.663)	(0.680)	(0.709)	(0.706)
Observations	39,542	14,385	133,296	41,324

Notes: The control group consists of pre- and primary school-aged children. The treatment group consists of secondary school-aged children. 1. Children migrating without parents and living outside of their hometown but not in the city where their parents stay. 2. Father's and mother's education levels are indicators: 1=no school; 2=primary school; 3=junior secondary school; 4=senior secondary school; 5=college; 6=undergraduate; 7=postgraduate or higher. Standard deviations are in parentheses.

3. Data and empirical strategy

3.1. Data and summary statistics

We use the 2011–2017 China Migrants Dynamic Survey data (CMDS 2011–2017) for the empirical analysis. The CMDS data are suitable for this study for three reasons. First, with an annual sample size of nearly 200,000 households, the data cover cities with large migrant populations in all provinces. Second, the data include not only the migration status of migrants themselves but also that of their family members, such as spouses and children. Third, the CMDS provides other basic information, such as age, education level, and marital status of migrants and their family members.

We focus on children aged 3 to 17 with both parents being cross-province migrant workers with rural Hukou. Following the discussion in the previous section, we define pre- and primary school-aged children as the control group and secondary school-aged (junior and senior secondary school-aged) children as the treatment group. We restrict our sample as follows. First, because parental decisions about their children's migration are interrelated, we exclude families with children belonging to both the treatment and the control group. Second, children from single-parent households are excluded. Third, senior secondary school-aged children in the labor market are excluded.[12] A small portion of senior secondary school-aged children may choose to work after compulsory education (Yi et al., 2012). Their migration is likely affected by local employment opportunities instead of the Gaokao reform. Additionally, Gaokao eligibility is unlikely to induce them to return to school. One reason is that they did not continue with high school due to either poor academic performance or family financial constraints (Knight et al., 2009; Loyalka et al., 2013); taking the Gaokao and seeking college admissions may not be a realistic goal for this group. Another reason is that most provinces require students to enroll in a local senior high school for three years for Gaokao eligibility. To return to school, one has to take the local Zhongkao, get admitted to a local senior high school, and enroll for three years; the direct and opportunity cost would be tremendous. Meanwhile, our estimates will be confounded by local labor market situations if we include this group in the sample. We will discuss this problem in detail in Section 5.3.

[12] We process the sample based on the information related to job status and migration reasons provided by each year's questionnaire.

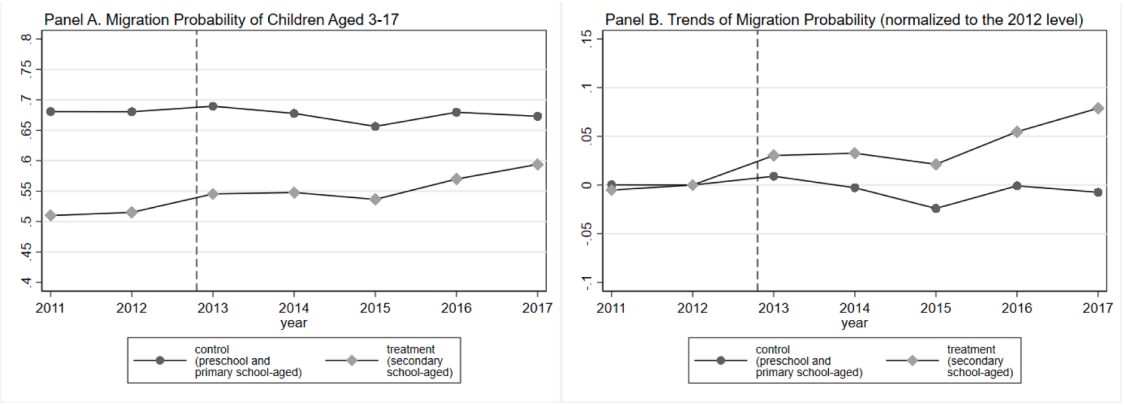

Fig. 1. Migration probability of children of cross-province migrant families.
Source: CMDS 2011–2017.

With these restrictions, the sample size is 172,838 for the control group and 55,709 for the treatment group.

We take 2013 to be the reform start year, when all provinces had announced Gaokao policies for children of migrant families. Even though the policy was not implemented until 2014 or 2015 in some provinces, migrant parents knew in 2013 whether their children would be eligible for the Gaokao in the destination province. This knowledge would help them decide whether to bring their children to the destination province.

Panel A of Table 2 reports the summary statistics of children in our sample. Relative to those in the control group, children in the treatment group are more likely to be male and have fewer younger siblings (siblings under 18). Before 2013, children migrating with their parents account for 68.4% of the control group and 51.8% of the treatment group; the gap between the two groups is similar in 2011 and 2012. After the Gaokao reform, however, while the share of migrant children in the control group remains virtually unchanged, it increases to 56.2% for the treatment group. Correspondingly, the share of children migrating without their parents or being left behind decreases for the treatment group. Panel B depicts the basic characteristics of parents. Unsurprisingly, parents in the treatment group are older than those in the control group, and they also have longer migration duration. While parents in the control group are slightly more educated than those in the treatment group, the education level of rural migrant parents is generally low and on average at the junior high school level.

3.2. Empirical strategy

We employ a difference-in-differences (DID) strategy to estimate the effect of the Gaokao reform, where we compare the migration probability of secondary school-aged children to that of pre- and primary school-aged children before and after the Gaokao reform. The regression equation is as follows:

$$Migrant_{ighpt} = \beta_0 + \beta_1 \times Treat_g \times Post_t + \Gamma X_{ig} + \gamma_{ht} + \mu_{pt} + \omega_{gh} + \sigma_{gp} + \varepsilon_{ighpt.} \quad (1)$$

In Eq. (1), the dependent variable, $Migrant_{ighpt}$, is an indicator variable that equals 1 if in year t child i of age group g from Hukou province h is observed to be with her migrant parents in destination province p and 0 otherwise. $Treat_g$ equals 1 for children in the secondary school age group (aged 12–17) and 0 for those in the pre- or primary school age group (aged 3 to 11). $Post_t$ equals 1 if year t is in or after the year when the Gaokao reform started (2013–2017) and 0 for before (2011–2012). X_{ig} is a vector of interaction terms between individual-level controls and age-group indicators. Individual-level controls include dummy variables for gender and ethnicity, number of siblings under 18 in the household, age of father and mother, and dummy variables for father's and mother's education level. The Hukou and destination province characteristics may influence parents' decisions about their children's migration. We include interactions between year indicators and Hukou province and destination province indicators (r_{ht} and μ_{pt}) to absorb all time-varying "push" and "pull" factors related to migration. Additionally, we include interactions between age-group indicators and Hukou province and destination province indicators (ω_{gh} and σ_{gp}) to allow the effects of time-invariant characteristics of the Hukou and destination provinces to differ across age groups. The coefficient of interest is β_1. Standard errors are clustered at the Hukou province by destination province level.

We also estimate a dynamic version of the model to capture the potential non-linear trends in migration probability of the treatment and control groups before and after the Gaokao reform as in Eq. (2):

$$Migrant_{ighpt} = \beta_0 + \sum_j \beta_1^j \times Treat_g \times I(t=j) + \Gamma X_{ig} + \gamma_{ht} + \mu_{pt} + \omega_{gh} + \sigma_{gp} + \varepsilon_{ighpt,} \quad (2)$$

where the year 2012 (j=2012) is the omitted category. β_1^j are the coefficients of interest, representing the effect of the Gaokao reform in year j.

Table 3
The effect of the Gaokao reform on children's migration.

	Secondary versus Preschool and Primary			Junior Secondary versus Preschool and Primary			Senior Secondary versus Preschool and Primary		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Treated_g \times Post_t$	0.040***	0.037***	0.035***	0.035***	0.032***	0.026***	0.046***	0.043***	0.044***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.008)	(0.007)	(0.009)	(0.009)	(0.009)
Adjusted R^2	0.100	0.102	0.111	0.082	0.085	0.095	0.098	0.100	0.110
Observations	228,723	228,540	228,539	202,224	202,062	202,062	199,467	199,309	199,308
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Parental controls	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Columns 1–9 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. "Baseline controls" consist of interactions between year indicators and Hukou province and destination province indicators (r_{ht} and μ_{pt}), and interactions between age group indicators and Hukou province and destination province indicators (ω_{gh} and σ_{gp}). "Child controls" are interaction terms between age-group indicators and dummy variables for child gender and ethnicity, and number of siblings under 18 in the household. "Parental controls" are interaction terms between age-group indicators and age of father and mother, and dummy variables for father's and mother's education level. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Our identification strategy depends critically on the parallel-trend assumption: the trend of the migration probability of secondary school-aged children is the same as that of pre- and primary school-aged children absent the Gaokao reform. While the counterfactual is unobservable, Fig. 1 provides supporting evidence. The left panel of Fig. 1 depicts trends of migration probability for children in the treatment and the control group, respectively. The right panel depicts the trends of migration probability normalized to the 2012 level within each group. Before 2013, the migration probability trend is similar between the treatment and the control group. After 2013, the migration probability for children in the control group remains stable, except for a slight decrease in 2015, whereas it increases substantially for children in the treatment group. Although these comparisons are based on raw data and may be confounded by various factors, they provide suggestive evidence for the parallel-trend assumption and non-negligible effects of the Gaokao reform.

4. Effects of the gaokao reform on children's migration

Table 3 reports the baseline results. We separately report estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample. Results in columns 1–3 show a positive effect of the Gaokao reform on the migration probability of secondary school-aged children. In column 1, we only control for baseline controls consisting of four sets of interaction terms, r_{ht}, μ_{pt}, ω_{gh}, and σ_{gp}. The result indicates that secondary school-aged children are 4 percentage points more likely to migrate after the Gaokao reform relative to before compared to pre- and primary school-aged children. We control for child characteristics and additionally parent characteristics in columns 2 and 3. Column 3 shows a similar treatment effect to column 1, with a 3.5 percentage point increase in the relative migration probability for all secondary school-aged children.

Columns 4–6 and 7–9 report the treatment effect for junior and senior secondary school-aged children, respectively. Taking columns 6 and 9 for example; relative to pre- and primary school-aged children, the Gaokao reform increases the migration probability by 2.6 percentage points for junior secondary school-aged children and by 4.4 percentage points for senior secondary school-aged children. The difference between the two is significant at the 10 percent level. This is anticipated. Because the Gaokao is a more pressing issue for senior secondary school-aged children compared to junior secondary school-aged children, once the Hukou restrictions in the Gaokao system are relaxed, the former are more willing to migrate with their parents.

Appendix Table A1 shows the robustness of our baseline results in columns 3, 6, and 9 of Table 3. First, children of migrant families may delay school enrollment due to parental migration. We thus redefine junior secondary school age as 12–15 years and senior secondary school age as 16–18 years. The larger estimates suggest that our baseline results are unlikely to overestimate the effect of the Gaokao reform when we assume that children are enrolled in school on time. Second, we exclude the five provinces (Beijing, Tianjin, Shanghai, Yunnan, and Qinghai) that only allow migrant children to apply to third-tier universities or higher vocational colleges. Estimates for all secondary and junior secondary samples in columns 2 and 5 are not significantly different from the baseline estimates. Column 8 shows that the estimate for the senior secondary sample (3.3 percentage points) is significantly lower at the 5 percent level than the baseline estimate (4.4 percentage points). These results indicate that even though they could not apply to first- and second-tier universities, some children of migrant families in the five provinces were willing to migrate to these provinces to pursue higher vocational education. This point will be discussed further below. Third, we exclude three provinces (Hunan, Shandong, and Chongqing) that voluntarily served as pilot provinces for China's "National Plan for Medium- and Long-Term Education Reform and Development (2010–2020)" at the end of 2010. While there is no evidence that pilot provinces are targeted to address the Gaokao issue of migrant children, the pilot province status may change the expectations of migrant parents about the Gaokao reform in these provinces and in turn affect their decisions about their children's migration. Estimates in columns 3, 6, and 9 are similar to the baseline results, suggesting that the pilot provinces do not bias our results.

We investigate the dynamic effect of the Gaokao reform and the pre-trends by estimating Eq. (2). The coefficient β_1^j captures the differential migration probability between the control and the treatment group in each year relative to 2012. The estimates in columns

Table 4
The dynamic effect of the Gaokao reform on children's migration.

	Secondary versus Preschool and Primary		Junior Secondary versus Preschool and Primary		Senior Secondary versus Preschool and Primary	
	Policy year: 2013 (1)	Policy year: implementation year (2)	Policy year: 2013 (3)	Policy year: implementation year (4)	Policy year: 2013 (5)	Policy year: implementation year (6)
Two periods before	−0.017	−0.036***	−0.019	−0.047***	−0.015	−0.023*
	(0.011)	(0.010)	(0.013)	(0.011)	(0.014)	(0.014)
Policy year	0.006	−0.002	0.004	−0.015	0.010	0.014
	(0.010)	(0.011)	(0.012)	(0.013)	(0.013)	(0.015)
One period after	0.019**	0.005	0.009	−0.012	0.031**	0.023*
	(0.010)	(0.012)	(0.012)	(0.015)	(0.012)	(0.014)
Two periods after	0.032***	0.023**	0.024**	−0.001	0.043***	0.052***
	(0.009)	(0.012)	(0.011)	(0.015)	(0.011)	(0.014)
Three periods after	0.032***	0.022**	0.020	0.001	0.047***	0.047***
	(0.010)	(0.011)	(0.012)	(0.014)	(0.012)	(0.016)
Four periods after	0.057***	0.063***	0.042***	0.038**	0.075***	0.092***
	(0.010)	(0.014)	(0.012)	(0.017)	(0.013)	(0.017)
Adjusted R^2	0.111	0.111	0.095	0.095	0.110	0.110
Observations	228,539	228,539	202,062	202,062	199,308	199,308
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns 1–6 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. Columns 1, 3, and 5 report estimates when we take the year 2013 to be the policy start year. Columns 2, 4, and 6 report estimates when we take the implementation year as the policy start year. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

1, 3, and 5 of Table 4 show a parallel trend in the migration probability between the treatment and the control group before the Gaokao reform, while the increase of the coefficients over time after 2013 indicates a progressive growth of the effect of the reform. There are two possible explanations for this increase. First, more provinces implemented their Gaokao policies over time. Second, it took time for migrant parents and children to meet the requirements of the Gaokao policy. As a result, more children of migrant families qualified for the Gaokao in the destination province and migrated with their parents as time passed. We also provide evidence that changes in migration probability began when a province announced the Gaokao policy for children of migrant families rather than when it implemented it. Columns 2, 4, and 6 present the impact of the Gaokao reform using the implementation time as the policy start year. The pre-trends indicate that the migration behavior of secondary school-aged children had changed before the implementation of the policy. As discussed above, children and migrant parents would respond to the Gaokao reform once they knew the policy details. Thus, choosing the policy announcement year as the start year is more appropriate.

As described in Section 2.2, provinces differ in the stringency of their Gaokao policies. While children in some provinces are eligible for the Gaokao as long as their parents provide documents of stable employment and residence (Type I), children in other provinces are eligible only when their parents have fulfilled the minimum year requirements for employment and residence (Type II). Five provinces only allow migrant children to apply to third-tier universities or higher vocational colleges (Type III). Stringent requirements may discourage children from migrating with their parents.

We estimate the heterogeneous effects by policy type in a triple-differences model of Eq. (3):

$$Migrant_{ighpt} = \beta_0 + \beta_1 \times Treat_g \times Post_t + \beta_2 \times Treat_g \times Post_t \times I_p^{TypeII}$$

$$+\beta_3 \times Treat_g \times Post_t \times I_p^{TypeIII} + \Gamma X_{igp} + \gamma_{ht} + \mu_{pt} + \omega_{gh} + \sigma_{gp} + \varepsilon_{ighpt.} \quad (3)$$

All indices and variables are defined as in Eq. (1). Furthermore, X_{igp} also includes triple interaction terms of parental characteristics, age-group indicators, and destination province indicators since parental education level and age might play a more important role in provinces with stringent requirements. I_p^{TypeII} equals 1 if province p implements Type II policies and 0 otherwise, and $I_p^{TypeIII}$ equals 1 if province p implements Type III policies. β_1 captures the impact of the Gaokao reform on children's migration in provinces with Type I policies, and β_2 and β_3, capture the differences in the impact of the reform in provinces with Type II and Type III policies relative to those with Type I policies, respectively. As discussed in Section 2.2, provinces with relatively large migrant populations or large college admissions quota are more likely to implement stringent Gaokao policies (Type II and III policies). Interaction terms between destination province indicators and year indicators and age-group indicators, μ_{pt} and σ_{gp}, help mitigate potential biases due to provincial characteristics. However, relative to children in the control group, if, after the Gaokao reform, children in the treatment group are

Table 5
Heterogeneous effects of the Gaokao reform by policy type.

	Secondary versus Preschool and Primary		Junior Secondary versus Preschool and Primary		Senior Secondary versus Preschool and Primary	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treated_g \times Post_t$	0.048***	0.048***	0.033**	0.033**	0.065***	0.066***
	(0.010)	(0.010)	(0.014)	(0.014)	(0.012)	(0.012)
$Treated_g \times Post_t \times I_p^{TypeII}$	−0.038***	−0.038***	−0.004	−0.004	−0.077***	−0.077***
	(0.014)	(0.014)	(0.017)	(0.017)	(0.019)	(0.019)
$Treated_g \times Post_t \times I_p^{TypeIII}$	−0.004	0.014	−0.018	−0.004	0.011	0.033*
	(0.015)	(0.016)	(0.018)	(0.019)	(0.019)	(0.020)
Adjusted R^2	0.115	0.118	0.099	0.102	0.114	0.117
Observations	228,465	214,859	202,010	190,069	199,251	187,441
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls*Destination province	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns 1–6 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. The samples in columns 2, 4, and 6 exclude Yunnan and Qinghai. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

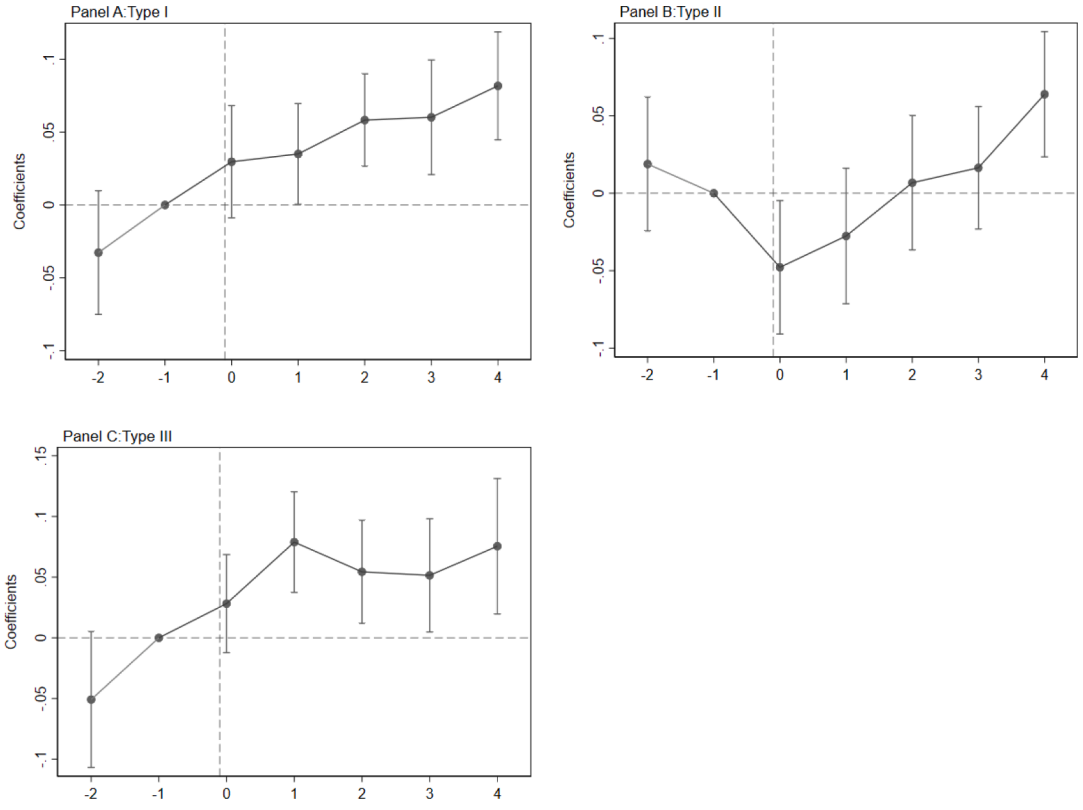

Fig. A1. The dynamic effect of the Gaokao reform on senior secondary school-aged children's migration by policy type.
Notes: The figure reports the estimated coefficients of Eq. (2) for each sample separately and their 95% confidence intervals.
Source: CMDS 2011–2017.

more attracted to provinces with Type II and Type III policies (relative to provinces with Type I policies) because of the relatively larger admissions quota and better job opportunities, estimates of β_2 and β_3 may underestimate the extent to which stringent Gaokao policies diminish the positive effect of the Gaokao reform.

Table 5 reports the estimation results of Eq. (3). Column 1 indicates that in provinces with Type II Gaokao policies, the effect of Gaokao reform on secondary school-aged children's migration is 3.8 percentage points (significant at 1% level) smaller than that in provinces with Type I policies. This is entirely driven by responses of senior secondary school-aged children; the estimate in column 5 is −0.077 and significant at 1% level. Stringent requirements cause the overall treatment effect for senior secondary school-aged children

Table 6
Gaokao reform and migration of primary school-aged children.

	Primary versus Preschool (1)	Primary versus Preschool (2)	Primary versus Preschool (3)	Secondary versus Preschool (4)	Junior Secondary versus Preschool (5)	Senior Secondary versus Preschool (6)
$Treated_g \times Post_t$	−0.003	−0.004	−0.005	0.031***	0.024***	0.041***
	(0.006)	(0.007)	(0.007)	(0.007)	(0.008)	(0.009)
$Treated_g \times I(Year > 2014)$		0.001	0.002			
		(0.005)	(0.004)			
Adjusted R^2	0.089	0.089	0.116	0.123	0.099	0.125
Observations	172,832	172,832	172,726	123,991	97,514	94,759
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes
City*Year	No	No	Yes	No	No	No

Notes: Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

in provinces with Type II Gaokao policies to be negative, albeit not statistically different from zero. One reason is that parents are deterred by the strict policies and are less likely to bring children along after the Gaokao reform compared to those in provinces with Type I policies. Another reason is that parents who kept their children in senior high school in the destination province before the reform realized they could not qualify their children for the Gaokao and decided to send them back home as soon as possible to prepare for the Gaokao. These conjectures are confirmed by anecdotes reported in the news media that migrant children attending senior high school in provinces with lenient policies stayed to take the Gaokao the year the Gaokao policy was announced, while parents in provinces with strict policies were sending their children back home.[13] Indeed, the negative effect of the Type II policies only occurred in the year the policy was announced as shown in Panel B of Fig. A1. Over time, as parents became more aware of the requirements of the Gaokao policy and had more time to become eligible, the positive effect of the Gaokao reform began to emerge. In contrast to the significantly different responses of senior secondary school-aged children, junior secondary school-aged children are not sensitive to policy stringency, as shown in column 3, perhaps because they are still several years from the Gaokao, which leaves their parents sufficient time to accumulate the minimum years of employment and residence required by Type II policies to qualify them for the Gaokao. One may be concerned that the estimates of β_2 may be biased as choices of Gaokao policies may be correlated with provincial employment and admissions opportunities. In Sections 5.3 and 6.2 below, we provide evidence that the estimated differences in the effect of Type I and Type II polices are unlikely biased by these confounding factors.

Though Type III policies are stricter than Type I policies, columns 1, 3, and 5 indicate that the Gaokao reform has a similar treatment effect in provinces implementing Type III policies as in provinces with Type I policies. Since provinces with Type III policies only allow migrant children to apply to higher vocational colleges or third-tier universities, this similarity is unlikely due to admissions opportunities but perhaps to employment opportunities. Children of relatively low academic abilities may choose to attend higher vocational colleges, and they choose to migrate to Beijing, Tianjin, and Shanghai for better employment prospects. To provide supporting evidence, columns 2, 4, and 6 report regression results excluding Yunnan and Qinghai, two less-developed provinces with Type III policies. The positive treatment effect of the Gaokao reform in column 6 for senior secondary school-aged children in Beijing, Tianjin, and Shanghai is even greater (3.3 percentage points) than in provinces implementing Type I policies (significant at 10% level). In Section 5.3 below, we provide evidence of the appeals of Beijing, Tianjin, and Shanghai to young migrants because of their ample job opportunities.

Overall, the differential estimates between Type I and Type II provinces are highly likely a result of the Gaokao policy variations. However, for Type III provinces of Beijing, Tianjin, and Shanghai, the estimate has a less clear interpretation. The positive estimate for these three provinces suggests that their appeals to migrant children likely stem from the job opportunities they can provide, rather than the Gaokao opportunities alone.

5. Addressing concerns of confounding factors

This section addresses issues of potential confounding factors that may cause biases in our estimation results due to contemporaneous changes in education policies or economic conditions and potential changes in the composition of treatment or control group. Specifically, we consider potential responses of primary school-aged children, impacts of the Zhongkao policies, changes in employment opportunities for low-skilled workers, parental migration decisions, and changes in family income.

[13] "More than 120,000 migrant children study in Changzhou city, and only 14 of them apply for the Gaokao." URL: www.changzhou.gov.cn/ns_news/541359419103383. "Family with migrant children." URL: www.chinatoday.com.cn/ctchinese/reports/article/2013-05/14/content_542843.htm.

Table 7
Zhongkao policies and effects of Gaokao reform on migration.

	Secondary versus Preschool and Primary		Junior Secondary versus Preschool and Primary		Senior Secondary versus Preschool and Primary	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treated_g \times Post_t$	0.035***	0.064***	0.028***	0.058***	0.043***	0.072***
	(0.008)	(0.014)	(0.009)	(0.020)	(0.011)	(0.019)
$Treated_g \times Post_t \times EarlyZK_c$	0.000		−0.004		0.005	
	(0.012)		(0.015)		(0.017)	
$Treated_g \times Post_t \times I_p^{zkII}$		−0.024		−0.037*		−0.010
		(0.015)		(0.021)		(0.020)
$Treated_g \times Post_t \times I_p^{TypeII}$		−0.035**		0.001		−0.076***
		(0.014)		(0.018)		(0.018)
Adjusted R^2	0.111	0.123	0.095	0.110	0.110	0.121
Observations	228,539	166,613	202,062	147,001	199,308	145,196
EarlyZK*Year	Yes	No	Yes	No	Yes	No
EarlyZK*Age Group	Yes	No	Yes	No	Yes	No
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls*Destination province	No	Yes	No	Yes	No	Yes

Notes: Columns 1–6 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. The samples in columns 2, 4, and 6 exclude the five provinces that only allow migrant children to apply to third-tier universities or higher vocational colleges (Beijing, Tianjin, Yunnan, Qinghai, and Shanghai). Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.1. Potential responses of primary school-aged children

Migration of primary school-aged children may be affected by the Gaokao reform, rendering them an inappropriate control group. Though it is at least six years before they take the Gaokao, Gaokao eligibility may motivate particularly visionary parents to bring their primary school-aged children along. To address this concern, we first conduct a placebo test by using primary school-aged children as the treatment group and preschool-aged children as the control group. Parents bring their preschool-aged children along primarily for caregiving and family reunion as opposed to educational opportunities. Column 1 of Table 6 shows no treatment effect of the Gaokao reform on primary school-aged children. However, this result may be confounded by the population control policy started in 2014 in cities with a population of over 5 million (Gao et al., 2023; Zhang et al., 2019), which may impede the migration of primary school-aged children by tightening Hukou restrictions and shutting down migrant schools. To mitigate effects of this policy, we include an interaction term between indicators for being primary-school aged and for years after 2014 in column 2 and additionally city-by-year fixed effects in column 3 to absorb time-varying characteristics of cities. The estimates in the first row of columns 2 and 3 represent the effect of the Gaokao reform on primary school-aged children before the population control policy. We again find no migration response from primary school-aged children.

Next, we use only preschool-aged children as the control group in columns 4, 5, and 6 and obtain similar treatment effects to the baseline results. We further estimate the dynamic model of Eq. (2) using preschool-aged children as the control group. As reported in Appendix Table A2, we find no effects of the Gaokao reform on the migration of primary school-aged children and similar effects on secondary school-aged children to the baseline results. Thus, we keep the primary school-aged children in the control group to enlarge the sample size and improve the precision of our estimates.

5.2. The zhongkao policy for migrant children

Many cities with a large influx of migrant population had announced Zhongkao policies for migrant children since 2008; the 2012 "Opinions" further required provincial governments to develop policies to allow migrant children to take the Zhongkao at their current residence. It is plausible that Zhongkao eligibility will have a positive effect on the migration of secondary school-aged children, directly for those of junior secondary school age and indirectly for those of senior secondary school age who will need the local school enrollment record to be eligible for the Gaokao. Ignoring the Zhongkao policy changes may lead to an over-estimation of the effect of the Gaokao reform.

To address this concern, we control for the presence of early Zhongkao policies in our baseline model. We define an indicator variable $EarlyZK_c$, which equals 1 for provinces (cities/counties) with Zhongkao policies for migrant children before the Gaokao reform,[14] and estimate the heterogeneous effects of the Gaokao reform in places with or without early Zhongkao policies. If the migration of secondary school-aged children had already been increased by the Zhongkao policy, the Gaokao reform may have a smaller effect in

[14] According to Wu, (2011), 5 provinces (Tianjin, Shanghai, Anhui, Fujian, Hainan), 16 cities (Shijiazhuang, Shenyang, Changchun, Harbin, Taiyuan, Wuhan, Guangzhou, Shenzhen, Guiyang, Xi'an, Lanzhou, Urumqi, Anshan, Qiqihar, Daqing, Xuchang), and 4 counties (one in Yantai, one in Yichang, and two in Huzhou) had Zhongkao policies for migrant children before the Gaokao reform.

places with early Zhongkao policies compared to those without. We find no such evidence, as reported in columns 1, 3, and 5 of Table 7. In Appendix Table A3, using the 2011–12 sample, we provide further evidence that the early Zhongkao policy by itself has no significant effect for cross-province migrant children, as shown in columns 1, 3, and 5. In contrast, when examining the effect of the early Zhongkao policy on children whose parents are within-province cross-city migrants (columns 2, 4, and 6), we observe a significantly positive effect for junior secondary school-aged children in column 4. The lack of responses from cross-province migrant families to the early Zhongkao policy suggests that they are mainly concerned about the Gaokao issue. If their children cannot take the Gaokao in the destination province, eligibility for senior high school admissions is unattractive.

While the Zhongkao policy by itself do not appear to motivate children of cross-province migrant families to migrate, it may interact with the Gaokao reform and mediate its effects. Because official enrollment in a local senior high school is required for Gaokao eligibility, the Gaokao reform may have a smaller effect in provinces with stricter Zhongkao policies. In particular, if the stringency of a province's Gaokao policies and that of its Zhongkao policies are intertwined, our estimates of the heterogeneous effects of different types of Gaokao reform will be confounded by the Zhongkao policy.

To examine this possibility, we compile official Zhongkao policies for migrant children (Appendix Table A4).[15,16] Compared to Gaokao policies, Zhongkao policies are generally less strict. Zhongkao policies in all provinces other than Beijing and Guangdong have only one year or no year requirement for parental employment, residence and social insurance.[17] Similar to their Gaokao policies, Zhongkao policies in Beijing, Tianjin and Shanghai strictly limit the types of high schools to which migrant children can apply.

We group Zhongkao policies into three types similarly to how we group Gaokao policies. Type I policies only require children to officially enroll in a school in the destination province for a certain number of years to be eligible for the Zhongkao and admissions to high school. Type II policies additionally require parents to provide documents for stable employment and residence. Type III policies only allow migrant children to apply to vocational high schools. We use I_p^{zkI}, I_p^{zkII}, and I_p^{zkIII} to indicate the Zhongkao policy type. Columns 2, 4, and 6 of Table 7 report estimated effects of different types of Gaokao reform on children's migration taking into account of Zhongkao policies. Because Beijing, Shanghai, and Tianjin are the only provinces adopting Type III Zhongkao policies, we are unable to simultaneously estimate the effects of Type III Zhongkao policies and Type III Gaokao policies. We therefore drop provinces adopting Type III Gaokao policies in these regressions and compare only the effects of Type I and Type II Gaokao policies. Coefficient estimate on $Treated_g \times Post_t$ captures the effect of the Gaokao reform in provinces that implement both the Type I Zhongkao policy and the Type I Gaokao policy; it is positive and significant in all three columns. The coefficient estimate on the triple interaction term $Treated_g \times Post_t \times I_p^{zkII}$ in column 4 (−0.037 and significant at 10% level) indicates that more stringent Zhongkao policies deter migration of junior secondary school-aged children even after the Gaokao reform, whereas they have no effects on migration of senior secondary school-aged children who already cleared the Zhongkao hurdle (column 6). Importantly, coefficient estimates on the triple interaction terms with Gaokao type $Treated_g \times Post_t \times I_p^{TypeII}$ in columns 2, 4, and 6 are virtually identical to those in columns 2, 4, and 6 of Table 5.

In sum, while more stringent Zhongkao policies diminishes the effect of the Gaokao reform for junior secondary school-aged children, they do not overwhelm the effect of the Gaokao reform. Importantly, the estimated effect of the Gaokao reform on senior secondary school-aged children, who are not affected by the Zhongkao policy, continues to be significant both economically and statistically.

5.3. Employment opportunities

One possibility is that secondary school-aged children migrate with their parents because of employment opportunities in the destination province rather than Gaokao opportunities. In our main regressions, we excluding senior secondary school-aged children already in the labor market from our sample to mitigate this concern. Nevertheless, it is also possible that students currently enrolled in secondary school plan to work rather than attend universities after completing basic education. If demand for low-skilled workers also increases in the destination province around the time of the Gaokao reform announcement, migration with parents will become more attractive to children in the treatment group but not children in the control group, leading to an overestimation of the effect of the Gaokao reform on children's migration.

To address this concern, we conduct our baseline regressions using the non-college educated children aged 18 to 20 from rural migrant households as the treatment group.[18] This group will be affected by local job opportunities but unlikely the Gaokao reform. Regression results are reported in Table 8. The dependent variable in columns 1 and 3 is the same as that in our baseline specification, i.e., whether children migrate with their parents. Since children older than 18 may migrate by themselves, we use an alternative

[15] Many cities implemented the Zhongkao policy for children of migrant families before the Gaokao reform. We compile the requirements of the Zhongkao policy from the official documents issued after the Gaokao reform to capture how the Zhongkao policy affects the impact of the Gaokao reform. Because Zhongkao is administered at the municipal level, for provinces that did not issue Zhongkao policies for migrant children at the provincial level, we use the policy of the capital city to represent the province's policy.

[16] Qinghai and Tibet did not issue Zhongkao policies for migrant children.

[17] Fourteen provinces (Jiangsu, Hubei, Gansu, Chongqing, Ningxia, Guizhou, Hunan, Inner Mongolia, Jilin, Guangdong, Guangxi, Xinjiang, Hainan and Shanxi) have lower thresholds for Zhongkao eligibility than for Gaokao eligibility; eight provinces (Anhui, Jiangxi, Sichuan, Shanxi, Hebei, Henan, Liaoning, Heilongjiang) have similar thresholds for both; and three provinces (Shandong, Zhejiang, and Fujian) have higher thresholds for Zhongkao eligibility than for Gaokao eligibility.

[18] We exclude full-time college students and include children already in the labor force.

Table 8
Migration probability of children aged 18–20.

	(Children aged 18–20) versus Preschool and Primary				
	Migration (1)	Migration2 (2)	Migration (3)	Migration2 (4)	Migration2 (5)
$Treated_g \times Post_t$	−0.124***	−0.131***	−0.138***	−0.142***	−0.142***
	(0.010)	(0.010)	(0.015)	(0.013)	(0.013)
$Treated_g \times Post_t \times I_p^{TypeII}$			−0.008	−0.019	−0.018
			(0.023)	(0.020)	(0.020)
$Treated_g \times Post_t \times I_p^{TypeIII}$			0.053**	0.056**	0.062**
			(0.022)	(0.023)	(0.026)
Adjusted R^2	0.094	0.084	0.098	0.088	0.091
Observations	202,076	202,076	202,019	202,019	189,888
Baseline controls	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes
Parental controls*Destination province	No	No	Yes	Yes	Yes

Notes: Columns 1–5 use children aged 18–20 as the treatment group. The dependent variable in columns 1 and 3 is the same as our baseline specification. In columns 2, 4, and 5, the dependent variable equals 1 for all migrant children, regardless of whether they migrate with parents, and 0 for left-behind children. The samples in column 5 exclude Yunnan and Qinghai. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 9
Parents' migration responses to the Gaokao reform.

	Both parents migrate cross-province (1)	Father migrates cross-province (2)	Mother migrates cross-province (3)	Type I Gaokao policy provinces (4)	Lower admission scores provinces (5)	More HEIs provinces (6)
$Treated_g \times Post_t$	0.004	−0.084	−0.078	0.006	−0.010	0.006
	(0.003)	(0.062)	(0.056)	(0.008)	(0.006)	(0.006)
Adjusted R^2	0.134	0.871	0.902	0.101	0.347	0.419
Observations	361,321	361,321	361,321	228,538	228,538	228,538
Hukou city*Age group	Yes	Yes	Yes	No	No	No
Hukou city*Year	Yes	Yes	Yes	No	No	No
Hukou province*Age group	No	No	No	Yes	Yes	Yes
Hukou province*Year	No	No	No	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes

*Notes:*In columns 1–3, the data come from the 2010 Population Census and the 2015 1% National Population Survey. Dependent variables are indicator variables for whether both parents migrate cross-province migrants, whether the father migrates cross-province, and whether the mother migrates cross-province, respectively. In columns 4–6, the data come from CMDS 2011–2017. Dependent variables are indicator variables for whether parents migrate to provinces that implement Type I Gaokao policies, have lower college admissions cutoff scores, and have more HEIs than Hukou province, respectively. The definition of "Child controls" are interaction terms between age-group indicators and dummy variables for child gender and ethnicity, and number of siblings under 18 in the household. "Parental controls" are interaction terms between parental characteristics (the dummy variables for father's and mother's age, father's and mother's education level) and the age group indicators and interaction terms between parental characteristics and year indicators. Standard errors in parentheses are clustered at the Hukou city level in columns 1–3 and at the Hukou province by destination province level in columns 4–6. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

dependent variable in columns 2, 4, and 5, an indicator equal to 1 for all migrant children, regardless of whether they migrate with parents, and 0 for left-behind children. The negative and significant estimates on the interaction term in columns 1–2 suggest reduced job opportunities in the destination province. Thus, job opportunities are unlikely to drive our main results. If anything, they make it more difficult to find a positive effect of the Gaokao reform.[19]

Results in columns 3–4 of Table 8 indicate that the relative decrease in the probability of migration for the 18–20-year olds is similar in provinces with Type I and Type II Gaokao policies. However, the decrease in provinces with Type III policies is smaller. When only Beijing, Tianjin, and Shanghai are included as provinces with Type III policies (column 5), the difference between these provinces and others is even larger. These results again suggest the appeal of Beijing, Tianjin, and Shanghai to young migrants for their ample job

[19] Appendix Table A5 reports the baseline results using the sample including children in the labor market. Estimates on the interaction term in all three columns are smaller than those in columns 3, 6, 9 of Table 3. In particular, the treatment effect for senior secondary school-aged children decreased by more than half, consistent with negative effects of job opportunities found in Table 8. Nevertheless, we continue to find a significantly positive effect of the Gaokao reform.

opportunities, including those who may choose to attend higher vocational colleges in these three cities.

5.4. Parental migration decisions

Another concern is that the Gaokao reform may affect migrant decisions of rural parents with secondary school-aged children, leading to an overestimation of the policy effect on children's migration. We address this concern by directly estimating parents' migration behavior.

First, parents more concerned about their children's education may be more encouraged to migrate cross-province by the Gaokao opportunities. We employ data from the 2010 Population Census and the 2015 mini-census and estimate the following regression equation:

$$Y_{igct} = \alpha_0 + \alpha_1 \times Treat_g \times Post_t + \Gamma X_{igt} + \rho_{cg} + \delta_{ct} + \varepsilon_{igct}. \quad (4)$$

Dependent variables Y_{igct} is one of three indicator variables. The first equals 1 if both parents migrate cross-province and 0 otherwise; the second equals 1 if the father migrates cross-province and 0 otherwise; and the third equals 1 if the mother migrates cross-province and 0 otherwise. c represent Hukou city, and other indices and variables are defined as in Eq. (1). Furthermore, X_{igt} also includes interaction terms of parental characteristics and year indicators to allow parental education level and age to play a different role before and after the Gaokao reform. ρ_{cg} are interactions between Hukou city indicators and age-group indicators to allow the effects of time-invariant characteristics of the Hukou city to differ across age groups. δ_{ct} are Hukou city-by-year fixed effects to control for time-varying Hukou city characteristics such as employment opportunities. Regression results reported in columns 1–3 of Table 9 indicate that parents of secondary school-aged children are no more likely to migrate cross-province after the Gaokao reform.

Second, parents may choose the destination province taking account of their children's educational opportunities. For example, after the Gaokao reform, parents may choose provinces with less stringent eligibility requirements or provinces with lower college admissions cut-off scores or more HEIs than their Hukou provinces. We construct an indicator variable for each scenario and use it as the dependent variable in Eq. (4).[20] We estimate Eq. (4) using our baseline sample from CMDS 2011–2017. Because the CMDS data do not contain information on Hukou city, we use interactions between Hukou province indicators and age-group indicators and Hukou province-by-year fixed effects to replace ρ_{cg} and δ_{ct}. The results in columns 4–6 of Table 9 suggest that the Gaokao reform does not motivate cross-province migrant parents to relocate for their children's education. As a robustness check, we further estimate Eqs. (1) and (3) using the sample of children whose parents migrated to the current residence before 2013, i.e., before provinces announced their Gaokao policy. Results in Appendix Table A6 and Table A7 are similar to those in Table 3, Table 5 and Table 7 (columns 2, 4, and 6), respectively.

The above findings that parents are not more likely to migrate cross-province or change their destination provinces for their children's higher education after the Gaokao reform are consistent with the general belief that improving economic conditions is the primary motivation for the rural-to-urban migration (Su et al.2018), and support that our results are not biased by sample selection. However, it does not mean that the Gaokao reform has no effect on parents' migration. Parents who are already in the destination province may extend their migration duration. First, parents may stay longer in the city to satisfy the minimum year requirements of stable residence and employment. Second, if Gaokao eligibility in the destination province encourages children to migrate with their parents, parents may be more willing to stay in the city now that the entire family is together (Wang et al., 2019). Third, if the Gaokao opportunity enables children to continue their education in the destination province, migrant parents may prolong their stay to accompany their children.

We construct two dependent variables to examine the effects of the Gaokao reform on parent long-term migration intention and duration. One is an indicator variable, ltr_{ighpt}, which equals 1 if the parents intend to live in the current city for more than five years and 0 otherwise.[21] The other is migration duration, calculated as the difference between the survey year and the year parents migrate to the current city. Columns 1, 4, and 7 of Table 10 show that the Gaokao reform does not affect parents' long-term residence intentions. This finding again is consistent with previous studies, which argue that economic factors are the most important determinant of the intention of permanent urban settlement (Cao et al., 2015; Hao and Tang 2015; Hu et al., 2011). However, rural migrant parents in practice stay for longer time. As reported in the remaining columns of Table 10, parents of all secondary school-aged children increase their migration duration by 0.3 years. Parents of junior secondary school-aged children experience a larger increase than those of senior secondary school-aged children, but the differences are insignificant.

[20] The indicator variable for whether parents migrate to provinces with less stringent Gaokao policies is defined by whether the destination province implements Type I Gaokao policies. The indicator variable for whether parents migrate to provinces with lower admissions scores is defined by whether the admission scores for both arts and sciences in the destination provinces are lower than those in the Hukou province in three consecutive years before the Gaokao reform (2010, 2011, and 2012). The indicator variable for whether parents migrate to provinces with more HEIs is defined by whether the ratio of the number of HEIs to the number of senior high school graduates in 2012 in the destination province exceeds that in the Hukou province.

[21] The CMDS has a question for parents' plan for a long-term stay except for the 2011 and 2013 surveys, which accounts for the smaller number of observations in columns 1, 4, and 7.

Table 10
The effect of the Gaokao reform on parent migration intention and duration.

	Secondary versus Preschool and Primary			Junior Secondary versus Preschool and Primary			Senior Secondary versus Preschool and Primary		
	Long-term residence intention (1)	Father's migrant duration (2)	Mother's migrant duration (3)	Long-term residence intention (4)	Father's migrant duration (5)	Mother's migrant duration (6)	Long-term residence intention (7)	Father's migrant duration (8)	Mother's migrant duration (9)
$Treated_g \times Post_t$	0.006	0.325***	0.332***	0.008	0.403***	0.365***	0.005	0.229**	0.287***
	(0.008)	(0.076)	(0.076)	(0.009)	(0.086)	(0.087)	(0.011)	(0.106)	(0.100)
Adjusted R^2	0.078	0.125	0.138	0.081	0.121	0.133	0.078	0.121	0.135
Observations	162,686	228,539	228,539	144,745	202,062	202,062	142,412	199,308	199,308
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns 1–9 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. In columns 1, 4, and 7, the dependent variable is whether the parents intend to live in the current city for more than five years. In columns 2, 5, and 8, the dependent variable is the father's migrant duration, and in columns 3, 6, and 9, the dependent variable is the mother's migrant duration. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 11
Changes in income of migrant families.

	Secondary versus Preschool and Primary Log(income) (1)	Junior Secondary versus Preschool and Primary Log(income) (2)	Senior Secondary versus Preschool and Primary Log(income) (3)
$Treated_g \times Post_t$	−0.003	−0.003	−0.003
	(0.006)	(0.007)	(0.008)
Adjusted R^2	0.185	0.186	0.186
Observations	228,317	201,870	199,116
Baseline controls	Yes	Yes	Yes
Child controls	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes

Notes: The dependent variable is the natural logarithmic of monthly family income. Columns 1–3 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.5. Family income

While public schools at the compulsory education stage are prohibited from charging school choice fees, migrant families are often required to pay this fee to enroll their children in local schools. School choice fees are more common for senior high schools since they are not in the compulsory education stage. Thus, children's migration may also be affected by family income. If parents with secondary school-aged children who have higher earning abilities were more incentivized to migrate by the Gaokao reform since they are more able to pay for the school fees, we would also observe more migration of children in the treatment group relative to those in the control group, and parents' earning abilities may not be fully controlled for by their observed characteristics. We estimate Eq. (1) using monthly family income as the dependent variable and report the results in Table 11.[22] Results suggest that income remains relatively unchanged for families with secondary school-aged children after the Gaokao reform compared to those with pre- and primary school-aged children. Dynamic estimates reported in Appendix Table A8 again indicate no relative income increases for migrant families with secondary school-aged children after the Gaokao reform. In sum, migration of parents with higher earning abilities post of the Gaokao reform is unlikely to be driving our empirical findings.

[22] We first winsorize the top and bottom 2.5% in each year's family income distribution and then deflate the income by CPI.

Table 12
The effect of the Gaokao reform on long-term and short-term migration.

	Secondary versus Children aged 9–11			Junior secondary versus Children aged 9–11			Senior secondary versus Children aged 9–11		
	Migration	Short-term	Long-term	Migration	Short-term	Long-term	Migration	Short-term	Long-term
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Treated_g \times Post_t$	0.036***	0.027***	0.035***	0.027***	0.021**	0.032***	0.046***	0.032***	0.041***
	(0.008)	(0.009)	(0.010)	(0.009)	(0.010)	(0.012)	(0.010)	(0.010)	(0.011)
Adjusted R^2	0.126	0.134	0.157	0.105	0.120	0.136	0.131	0.137	0.154
Observations	101,240	66,127	75,258	74,759	47,364	53,870	72,008	47,569	53,228
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns 1–9 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. The sample includes children aged 9–17. Columns 1, 4, and 7 report the baseline results. Columns 2, 5, and 8 report the estimates for short-term migration; Columns 3, 6 and 9 report the estimates for long-term migration. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 13
Heterogeneous effects of Gaokao reform in other characteristics.

	Male	Formal residence	Top 50% income	Top 25% income	Lower Admission Scores	Lower Admission Scores	Same exam papers
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A							
$Treated_g \times Post_t \times I_i^{char}$	0.004	0.058***	0.001	0.006	0.019	0.020	−0.012
	(0.010)	(0.016)	(0.012)	(0.014)	(0.014)	(0.014)	(0.021)
$Treated_g \times Post_t$	0.032***	0.024***	0.033***	0.034***	0.024***	0.040***	0.036***
	(0.009)	(0.007)	(0.008)	(0.007)	(0.009)	(0.011)	(0.006)
$Treated_g \times Post_t \times I_p^{TypeII}$						−0.037***	
						(0.013)	
Adjusted R^2	0.111	0.119	0.112	0.114	0.119	0.119	0.111
Observations	228,539	188,975	228,453	228,453	166,680	166,680	228,539
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age group$*I_i^{char}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year$*I_i^{char}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Panel B							
$Treated_g \times Post_t$	0.035***	0.033***	0.035***	0.035***	0.032***	0.032***	0.035***
	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)
Adjusted R^2	0.111	0.114	0.111	0.111	0.119	0.119	0.111
Observations	228,539	188,975	228,453	228,453	166,680	166,680	228,539
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Panel A presents estimates for the whole secondary sample. Panel B replicates regressions of the baseline specification using the same sample as the corresponding column in Panel A. The samples in columns 5 and 6 exclude five provinces that only allow migrant children to apply to third-tier universities or higher vocational colleges (Beijing, Tianjin, Yunnan, Qinghai, and Shanghai). Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

6. Heterogenous effects

6.1. Long-term and short-term migration

One goal of the Gaokao reform is to enable children who have lived in a province for a long time to continue their education locally. In this section, we examine whether the reform achieves this goal.

We define two indicator variables based on children's migration duration. $Short\_term_{ighpt}$ equals 1 if children migrated with their parents for less than five years and 0 if they did not migrate; $Long\_Term_{ighpt}$ equals 1 if the child migrated for at least five years and 0 if the child did not migrate. The latest year of our data is 2017, so the long-term migrant children we observed after the reform were those who first migrated before the Gaokao reform and continued their migration after. If the Gaokao reform encouraged migrant children to continue their education, we would observe the probability of long-term migration of secondary school-aged children to increase more after the reform compared to children in the control group. To remove the mechanical effect of age on migration duration for children in the control group, we restrict the age of our sample children to be at least 9 years old in this section. In our new sample, 58% of the

Appendix Table A1
Robustness checks.

	Secondary versus Preschool and Primary			Junior Secondary versus Preschool and Primary			Senior Secondary versus Preschool and Primary		
	Age+1	Exclude five provinces	Exclude pilot provinces	Age+1	Exclude five provinces	Exclude pilot provinces	Age+1	Exclude five provinces	Exclude pilot provinces
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Treated_g \times Post_t$	0.040*** (0.006)	0.032***	0.036***	0.028***	0.031***	0.028***	0.060***	0.033***	0.045***
		(0.007)	(0.006)	(0.007)	(0.009)	(0.008)	(0.009)	(0.010)	(0.009)
Adjusted R^2	0.117	0.119	0.112	0.100	0.107	0.096	0.115	0.118	0.111
Observations	233,907	166,680	222,376	209,018	147,048	196,736	195,627	145,247	194,083
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns 1–9 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. In columns 1, 4, and 7, we redefine the junior secondary school age as 12–15 years and the senior secondary school age as 16–18 years. In columns 2, 5, and 8, we exclude five provinces that only allow migrant children to apply to third-tier universities and higher vocational colleges (Beijing, Tianjin, Shanghai, Yunnan, and Qinghai). In columns 3, 6, and 9, we exclude three provinces (Hunan, Shandong, and Chongqing) that voluntarily served as the pilot provinces for China's "National Plan for Medium and Long-Term Education Reform and Development (2010–2020)" at the end of 2010. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A2
The dynamic effect of the Gaokao reform.

	Primary versus Preschool	Primary versus Preschool	Secondary versus Preschool	Junior Secondary versus Preschool	Senior Secondary versus Preschool
	(1)	(2)	(3)	(4)	(5)
Two periods before	−0.003	−0.004	−0.020	−0.022	−0.019
	(0.010)	(0.010)	(0.012)	(0.015)	(0.015)
Current	−0.005	−0.008	0.000	−0.001	0.003
	(0.009)	(0.009)	(0.011)	(0.013)	(0.013)
One period after	−0.005	−0.006	0.015	0.005	0.026**
	(0.008)	(0.008)	(0.011)	(0.013)	(0.013)
Two periods after	−0.006	−0.006	0.027***	0.020	0.037***
	(0.009)	(0.009)	(0.010)	(0.013)	(0.012)
Three periods after	0.004	0.003	0.033***	0.021	0.047***
	(0.008)	(0.008)	(0.010)	(0.013)	(0.013)
Four periods after	−0.011	−0.011	0.048***	0.033**	0.065***
	(0.008)	(0.008)	(0.011)	(0.014)	(0.014)
Adjusted R^2	0.089	0.116	0.123	0.099	0.126
Observations	172,832	172,726	123,991	97,514	94,759
Baseline controls	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes
City*Year	No	Yes	No	No	No

Notes: Columns 1–2 report the differential trends between pre- and primary school-aged children. Columns 3–5 report the dynamic effects of the Gaokao reform with only preschool-aged children as the control group. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

migrant children are long-term migrants.

We estimate Eq. (1) using the two indicator variables defined above as dependent variables to investigate the effect of the Gaokao reform on short-term and long-term migration separately. Results in Table 12 show that the Gaokao reform has a positive effect on both short-term and long-term migration. For junior secondary school-aged children, the Gaokao reform increases the probability of short-term migration by 2.1 percentage points and long-term migration by 3.2 percentage points. For senior secondary school-aged children, the effects of the Gaokao reform on short-term and long-term migration are 3.2 and 4.1 percentage points, respectively. In Appendix Table A9, we obtain similar results when restricting the age of the control group to 5–11, 6–11, 7–11, 8–11, and 10–11.

The larger, positive effect on long-term migration suggests that the Gaokao reform has helped migrant children to continue their study in the destination province. Before the Gaokao reform, they had to return to their Hukou province for Gaokao eligibility. Adapting to the new curriculum and school environment could harm their performance on the Gaokao. The Gaokao reform saved them the hassle of returning to their hometown, which could help improve their performance on the exam. Additionally, the positive effect

Appendix Table A3
Effects of early Zhongkao policies on migration of secondary school-aged children before Gaokao reform.

	Secondary versus Preschool and Primary		Junior Secondary versus Preschool and Primary		Senior Secondary versus Preschool and Primary	
	cross-province	cross-city	cross-province	cross-city	cross-province	cross-city
	(1)	(2)	(3)	(4)	(5)	(6)
$Treated_g \times EarlyZK_c$	0.017	0.029	0.022	0.059**	0.009	−0.004
	(0.019)	(0.022)	(0.022)	(0.024)	(0.026)	(0.026)
$EarlyZK_c$	−0.018	−0.072	0.004	−0.098	−0.040	−0.066
	(0.054)	(0.083)	(0.057)	(0.090)	(0.052)	(0.090)
Adjusted R^2	0.135	0.111	0.112	0.098	0.134	0.115
Observations	53,910	30,306	47,163	26,269	46,267	25,711
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The sample is from CMDS 2011–2012. Columns 1, 3, and 5 include children whose both parents are cross-province migrant workers. Columns 2, 4, and 6 include children whose both parents are cross-city migrant workers. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level in columns 1, 3, and 5, and at the city level in columns 2, 4, and 6. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

of the reform on short-term migration is also illustrative. Short-term migrant children may have migrated to the destination province before or after the reform. Children who migrated before benefited from the reform because their migration duration was extended due to Gaokao eligibility. They could continue their study in the destination province. Children who migrated after may also benefit - these new migrant children no longer suffer the negative effects of being left behind alone in their home villages.

6.2. Heterogeneity in other characteristics

This subsection assesses whether the effect of the Gaokao reform is heterogeneous in other dimensions, such as children's gender, household economic status, whether the destination province has a lower college admissions cutoff score than the Hukou province, and whether the destination and Hukou provinces share the same exam paper. We employ a triple-differences model as in Eq. (5) and report the results in Table 13:

$$Migrant_{ighpt} = \beta_0 + \beta_1 \times Treat_g \times Post_t \times I_i^{char}$$

$$+\beta_2 \times Treat_g \times Post_t + \Gamma X_{igt} + \gamma_{ht} + \mu_{pt} + \omega_{gh} + \sigma_{gp} + \varepsilon_{ighpt}. \quad (5)$$

I_i^{char} is an indicator variable equal to 1 for children with the characteristics listed in the corresponding column of Table 13, and 0 otherwise. In addition to controls as in Eq. (1), X_{igt} also includes interaction terms of I_i^{char} with year and age-group indicators. β_1 is the coefficient of interest, representing the different treatment effects of the Gaokao reform between children with and without the respective characteristic. Panel A of Table 13 reports the estimates of Eq. (5). Panel B replicates regressions of the baseline specification using the same sample as the corresponding column in Panel A.

We first examine heterogeneity by children's gender (column 1) since rural households are generally believed to have son preferences (Das Gupta et al. 2003). The lack of a differential effect by gender may be explained by two factors. First, children's economic value is an important determinant when parents allocate limited resources (Qian, 2008). High school and post-secondary education are expensive, and pragmatic migrant parents will invest more in children with better academic performance, regardless of gender. Second, long-term migrants may have assimilated into the urban value system and have less son preferences (Ling, 2017).

Columns 2–4 report heterogeneity results by households' economic conditions. Results in column 2 indicate that living in a formal residence significantly increases the relative probability of children's migration (0.058, significant at 1% level); this is expected as parents can more easily provide documents for stable residence and satisfy the policy requirements. Results in columns 3–4 however suggest that the migration rate of children of households with above-median or top quartile monthly income is not significantly different from those in households with below-median or bottom three quartile monthly income. One explanation is that the income of rural migrant households is generally low, and the difference in monthly income is quite modest.[23] Alternatively, regardless of the income level, rural migrants tend to work in the informal sector and generally have difficulties providing documents for employment and particularly payment of social security and income taxes.

We next investigate whether the Gaokao reform has a greater effect on children of families migrating to provinces with lower

[23] The monthly income gap between the above-median and below-median income groups is 4,265 yuan and 5,566 yuan between the top quartile and bottom three quartiles.

Appendix Table A4
Zhongkao policies for children of migrant families by province.

Province	Year	Students		Parents					School type	Category
		Legal student identity	Residence	Employment	Residence	Residence permit	Social insurance	Tax	Restrictions	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Anhui	2013	Y								I
Jiangxi (Nanchang)	2015	Y								I
Gansu	2013	2								I
Jiangsu	2013	Y								I
Chongqing	2015	2							Limited high school admissions	I
Hubei	2013	Y								I
Hunan	2013	Y								I
Guizhou (Guiyang)	2015	9								I
Ningxia (Yinchuan)	2016	Y								I
Yunnan	2014	3								I
Liaoning	2013	Y		Y	Y					II
Zhejiang (Hangzhou)	2013	3		Y	Y		1			II
Fujian	2013	3		Y	Y		Y			II
Henan (Zhengzhou)	2016	3		Y	Y		1			II
Shandong	2013	Y		Y	Y		Y			II
Heilongjiang	2013	Y		Y	Y					II
Sichuan	2014	Y		Y	Y					II
Shanxi (Taiyuan)	2016	1		1	1					II
Shaanxi	2014	Diploma				Y	1			II
Guangxi	2013	3		1	1					II
Hainan	2013	1		Y	Y					II
Jilin (Changchun)	2017	Y				Y				II
Xinjiang (Wulumuqi)	2017	2		Y						II
Inner Mongolia	2013	1		1	1		1			II
Hebei (Shijiazhuang)	2016	Y		Y					Private or vocational schools	II
Guangdong (Guangzhou)	2014	3		3	3		3		No more than 8% of regular high schools	II
Beijing	2013	3		3	3	Y	3		Vocational schools	III
Tianjin	2014					Y			Vocational schools	III
Shanghai	2014					Y			Vocational schools	III

Source: The policy information is obtained from the websites of the provincial or municipal education bureaus and is available from the author upon request.
Notes: In column 1, the year refers to the policy requirements in the corresponding year, not the policy implementation year. In columns 2–9, "Y" indicates that the condition in the corresponding column is required. "Number" indicates the minimum-year requirements. Policies that only require children to officially enroll in a school in the destination province for a certain number of years are categorized as Type I. Policies that additionally require parents to provide documents for stable employment and residence are categorized as Type II. Policies that only allow migrant children to apply to vocational schools are categorized as Type III.

Appendix Table A5
Including children aged 15–17 in the labor market in the analysis sample.

	Secondary versus Preschool and Primary (1)	Junior Secondary versus Preschool and Primary (2)	Senior Secondary versus Preschool and Primary (3)
$Treated_g \times Post_t$	0.022***	0.025***	0.020**
	(0.006)	(0.008)	(0.008)
Adjusted R^2	0.105	0.095	0.103
Observations	229,986	201,128	200,755
Baseline controls	Yes	Yes	Yes
Child controls	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes

Notes: Columns 1–3 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A6
Excluding children whose parents migrated after 2012 from the analysis sample: average estimates.

	Secondary versus Preschool and Primary (1)	Junior Secondary versus Preschool and Primary (2)	Senior Secondary versus Preschool and Primary (3)
$Treated_g \times Post_t$	0.028***	0.021***	0.038***
	(0.006)	(0.008)	(0.009)
Adjusted R^2	0.111	0.090	0.109
Observations	183,080	160,604	158,137
Baseline controls	Yes	Yes	Yes
Child controls	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes

Notes: Columns 1–3 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A7
Excluding children whose parents migrated after 2012 from the analysis sample: estimates by policy type.

	Secondary versus Preschool and Primary			Junior Secondary versus Preschool and Primary			Senior Secondary versus Preschool and Primary		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Treated_g \times Post_t$	0.042***	0.042***	0.060***	0.028*	0.029**	0.053**	0.059***	0.060***	0.070***
	(0.011)	(0.011)	(0.015)	(0.015)	(0.014)	(0.021)	(0.013)	(0.013)	(0.019)
$Treated_g \times Post_t \times I_p^{TypeII}$	−0.034**	−0.034**	−0.030**	−0.000	0.000	0.006	−0.072***	−0.072***	−0.071***
	(0.015)	(0.015)	(0.015)	(0.019)	(0.018)	(0.020)	(0.020)	(0.020)	(0.019)
$Treated_g \times Post_t \times I_p^{TypeIII}$	−0.011	0.004		−0.025	−0.013		0.003	0.021	
	(0.015)	(0.016)		(0.019)	(0.020)		(0.019)	(0.020)	
$Treated_g \times Post_t \times I_p^{zkII}$			−0.027*			−0.038*			−0.015
			(0.016)			(0.022)			(0.021)
Adjusted R^2	0.115	0.117	0.121	0.094	0.097	0.104	0.113	0.115	0.118
Observations	182,996	172,413	130,664	160,546	151,397	114,315	158,072	149,001	112,701
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls* Destination province	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns 1–9 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. The samples in columns 2, 5, and 8 exclude Yunnan and Qinghai. The samples in columns 3, 6, and 9 exclude five provinces that only allow migrant children to apply to third-tier universities or higher vocational colleges (Beijing, Tianjin, Shanghai, Yunnan, and Qinghai). Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A8
The dynamics of income of migrant families.

	Secondary versus Preschool and Primary Log(income) (1)	Junior Secondary versus Preschool and Primary Log(income) (2)	Senior Secondary versus Preschool and Primary Log(income) (3)
Two periods before	0.022**	0.021	0.023*
	(0.011)	(0.014)	(0.014)
Current	0.014	0.012	0.018
	(0.010)	(0.012)	(0.013)
One period after	0.013	0.018	0.009
	(0.010)	(0.012)	(0.013)
Two periods after	0.009	0.006	0.015
	(0.011)	(0.012)	(0.013)
Three periods after	0.001	−0.004	0.008
	(0.010)	(0.012)	(0.012)
Four periods after	−0.015	−0.010	−0.020
	(0.011)	(0.013)	(0.014)
Adjusted R^2	0.185	0.186	0.186
Observations	228,317	201,870	199,116
Baseline controls	Yes	Yes	Yes
Child controls	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes

Notes: Columns 1–3 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

college admissions cutoff scores relative to their Hukou provinces, as children may have a better chance of university admissions.[24] Results reported in column 5 suggest that lower admissions cutoff scores may attract children in the treatment group to migrate more after the Gaokao reform, but the effect is insignificant. When we control additionally for the stringency of the Gaokao policy in column 6, the results are similar.

Finally, we examine whether the Gaokao reform has a smaller effect when the destination and Hukou provinces share the same exam papers. As discussed above, the negative effect of returning to hometown high schools is substantial and deters children's migration. However, for children of families migrating to provinces with the same exam content as their Hukou provinces, the adverse effect may be smaller, even though they still have to return to their Hukou provinces and adapt to a new school under the Gaokao pressure. Thus, their migration may be less affected by the Hukou restrictions before the Gaokao reform, and the reform may have a smaller effect on them. In column 7, $I_i^{char} = 1$ if the destination province adopted the same exam papers for all subjects as the Hukou province in 2012.[25] The results in column 7 suggest the Gaokao reform has a smaller effect on children of families migrating to provinces with the same exam papers as their Hukou provinces, but the difference is not statistically significant. However, with only 7.2% of our sample children with the characteristic, the results should be interpreted with caution.

Overall, whether or not households can satisfy the Gaokao requirements – partly facilitated by having formal residence – appears to be a more important factor in determining children's migration rate post of the reform.

7. Conclusions

To address the Gaokao problem for migrant children, in 2012, the Chinese central government required all provinces to formulate policies by the end of 2013 to enable migrant children to take the Gaokao locally. This Gaokao reform is expected to reduce Hukou restrictions in the Gaokao system and benefit children from migrant households. In this paper, we investigate the impact of the reform on children's migration.

Employing a difference-in-differences empirical strategy, we find that the Gaokao reform has a significantly positive effect on the migration probability of secondary school-aged children of migrant families, which is weaker in provinces with more stringent eligibility requirements. This positive effect is not driven by confounding factors such as Hukou policies affecting the migration of primary school-aged children, the Zhongkao reform, employment opportunities for low-skilled workers, and the self-section in parental migration. Girls benefit equally as boys, and migrant children from households with different income levels also benefit equally. Having formal residence in the destination province, however, raises children's migration probability as they are more likely

[24] We exclude the five provinces (Beijing, Tianjin, Shanghai, Yunnan, and Qinghai) that only allow migrant children to apply to third-tier universities or higher vocational colleges.

[25] Ten provinces (Hebei, Shanxi, Inner Mongolia, Jilin, Heilongjiang, Henan, Hainan, Yunnan, Ningxia, Xinjiang) adopt "New Curriculum Standard National Exam Paper." Five provinces (Guangxi, Guizhou, Tibet, Gansu, Qinghai) adopt "National Exam Paper (old curriculum standard)." Sixteen provinces (Beijing, Tianjin, Liaoning, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Hubei, Hunan, Guangdong, Chongqing, Sichuan, Shaanxi) have their own exam papers, of which Liaoning, Jiangxi and Hubei adopt the "New Standard" for the comprehensive liberal arts and science tests.

Appendix Table A9
The effect of the Gaokao reform on long-term and short-term migration: different age ranges of control group.

	Secondary versus Control group			Junior secondary versus Control group			Senior secondary versus Control group		
	Migration	Short-term	Long-term	Migration	Short-term	Long-term	Migration	Short-term	Long-term
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: control group aged 5–11									
$Treated_g \times Post_t$	0.037***	0.022***	0.042***	0.029***	0.017*	0.038***	0.047***	0.029***	0.047***
	(0.006)	(0.007)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
Adjusted R^2	0.116	0.136	0.142	0.098	0.118	0.133	0.116	0.135	0.143
Observations	182,647	122,313	126,648	156,168	103,555	105,257	153,416	103,758	104,620
Panel B: control group aged 6–11									
$Treated_g \times Post_t$	0.036***	0.023***	0.039***	0.028***	0.017*	0.035***	0.047***	0.030***	0.044***
	(0.007)	(0.008)	(0.008)	(0.008)	(0.009)	(0.010)	(0.009)	(0.010)	(0.010)
Adjusted R^2	0.117	0.134	0.143	0.099	0.116	0.133	0.118	0.134	0.144
Observations	160,249	106,240	113,229	133,770	87,482	91,844	131,017	87,683	91,201
Panel C: control group aged 7–11									
$Treated_g \times Post_t$	0.036***	0.022***	0.038***	0.028***	0.016*	0.035***	0.046***	0.029***	0.043***
	(0.007)	(0.008)	(0.008)	(0.008)	(0.009)	(0.010)	(0.009)	(0.010)	(0.010)
Adjusted R^2	0.121	0.135	0.146	0.102	0.118	0.135	0.123	0.136	0.148
Observations	138,758	91,546	99,755	112,278	72,787	78,369	109,526	72,988	77,727
Panel D: control group aged 8–11									
$Treated_g \times Post_t$	0.034***	0.023***	0.035***	0.026***	0.017*	0.031***	0.044***	0.029***	0.040***
	(0.007)	(0.008)	(0.009)	(0.008)	(0.009)	(0.010)	(0.010)	(0.010)	(0.011)
Adjusted R^2	0.123	0.135	0.148	0.104	0.119	0.135	0.126	0.137	0.150
Observations	118,957	78,044	86,954	92,475	59,281	65,567	89,725	59,486	64,925
Panel E: control group aged 10–11									
$Treated_g \times Post_t$	0.035***	0.028***	0.034***	0.026***	0.021**	0.029**	0.046***	0.035***	0.040***
	(0.008)	(0.010)	(0.011)	(0.009)	(0.011)	(0.012)	(0.010)	(0.011)	(0.012)
Adjusted R^2	0.128	0.133	0.152	0.108	0.123	0.138	0.134	0.136	0.156
Observations	84,907	55,637	64,126	58,430	36,876	42,738	55,675	37,077	42,094
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns 1–9 present estimates for the whole secondary sample, the junior secondary sample, and the senior secondary sample separately. Columns 1, 4, and 7 report the baseline results. Columns 2, 5, and 8 report the estimates for short-term migration; Columns 3, 6 and 9 report the estimates for long-term migration. Definitions of control variables are the same as in Table 3. Standard errors in parentheses are clustered at the Hukou province by destination province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

to satisfy the eligibility requirements for the local Gaokao. Meanwhile, post of the reform, parents extend their migration duration either to meet the requirements of the Gaokao policy or to accompany their children who continued their education in the destination province.

China's unprecedented rural-to-urban migration during the past three decades, the so-called "population dividend," has greatly contributed to the overall economic development. Children of migrant workers constitute a crucial portion of China's future labor force. Improving their education opportunities to foster their human capital formation is essential for a successful transition of China's economic growth model to an innovation-driven one. The Gaokao reform is a significant step toward integrating rural migrant children into the higher-quality urban education system. Further reducing the requirements for eligibility will allow these children to more fully take advantage of the reform.

Appendix

Appendix Table A5

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