Children Left Behind in China: The Role of School Fees*

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Abstract
The barriers faced by Chinese rural-urban migrants to access social services, particularly education, in host cities could help explain why the majority of them choose to leave their children behind. We propose a theoretical framework that allows for an explicit discussion of the linkage between school fees and the decision of migrant parents to bring their children to the city. We instrument the endogenous school fees with unexpected shocks to the city's public education spending and empirically test the theoretical predictions. Our findings suggest that higher fees deter migrant workers from bringing their children, especially their daughters, reduce the number of children they bring, and increase educational remittances to rural areas for the children left behind. Increases in school fees most affect vulnerable migrant workers, and are likely to have stronger impacts during an economic crisis. These findings hold for different model specifications and robustness checks.

Key Words: child migration, school fees, public education spending, urbanization, China
JEL Codes: I22, J61, O15

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1. Introduction

It is not easy to reach *a priori* conclusions about the net impact of parental migration on the children that are left behind in rural areas. Parental migration helps increase household income, which can lead to more resources being invested in children's education, but it also entails parental absence, which can result in lack of the parental supervision or support much needed by children in their formative years. Which effect dominates can depend on a host of context-specific factors; for example, if the remittances sent by parents are not put to good use, parental migration would likely result in lower education outcomes for their left-behind children (LBCs hereafter). On the contrary, if LBCs are taken good care of by their guardian(s), improved household resources and parental social capital at the destination area may benefit them over the long term. Evidence actually exists for both the positive and negative effects of parental migration on LBCs in different countries.[1] A better understanding of the interwoven connections between parental migration and child migration thus seems as relevant to guiding policy advice as studying the effects of parental migration.

We make several conceptual and empirical contributions in this paper. Our conceptual contribution is to investigate the effects of school fees on migrant parents' decision over whether or not they should bring their children with them. We explicitly model in our theoretical framework the role that school fees play in the migrant household's utility maximization problem. To identify the causal impacts of school fees, we employ in our empirical analysis a novel instrument—unexpected shocks to public spending on education. Our paper straddles two distinct literatures on developing countries: one related to education

[1] For example, parental migration is found to have positive effects on children left behind in terms of more education and reduced child labor in Mexico (Alcaraz, Chiquiar, Salcedo, 2012) and in the Phillipines (Yang, 2008), lower infant mortality rates and higher birth weights in Mexico (Hildebrandt and McKenzie, 2005), and better cognitive and nutrition outcomes in Nicaragua (Macours and Vakis, 2010). Other studies, on the contrary, find that parental migration has negative effects on child education in Mexico (McKenzie and Rapoport, 2011) and on child health in Tonga (Gibson et al, 2011). See Lall et al. (2006) for a detailed survey of internal migration in developing countries and Antman (2013) for a review of the literature on the impacts of migration on family members left behind.

policies and the other related to internal migration. To our knowledge, it is the first paper to shed light on the unique interaction between school fees and child migration.[2]

On the empirical front, we offer an empirical analysis of household survey data from China, which is a most interesting case to analyze the links between migration and access to education. Indeed, due to the *hukou* (household registration) system, migrant workers in China are only granted limited access, if any, to the subsidized education and other social services available to local city residents. This contributes to many migrants leaving their children behind when migrating to cities for work. As a result, more than one-fourth of all children in China age 0 to 17—amounting to almost 70 million children—are estimated to be left behind by their migrant parents (UNICEF, 2013).[3]

The focus on China offers relevant insights into important policy issues as recent studies overwhelmingly point to the detrimental impacts of parental migration on LBCs on educational outcomes including enrolment (Wang, 2014), grade attainment (Meyerhoefer and Chen, 2011), standardized test scores (Zhang et al., 2014; Zhou, Murphy, and Tao, 2014), and health outcomes including overweight and underweight measures (de Brauw and Mu, 2011) and anxiety levels and self-esteem (Bai et al., 2016). In addition to having worse education and health outcomes, Meng and Yamauchi (2015) find that LBCs spend less time studying after school, receive fewer tutoring lessons outside school, and are more likely to be enrolled in

[2] The literature so far has mostly focused on the impacts of school fees on enrollment. For China, Yi et al. (2015) find that an unconditional financial aid program (fee-reduction program) had small effects on upper secondary school enrolment for Grade 9 students, but no effects for Grade 7 students; Shi (2012) finds educational fee reductions to be matched by increased voluntary household educational spending. For South Africa, Selod and Zenou (2003) provide theoretical evidence that increased school fees prevent the poor from having access to better schools, and Borkum (2012) finds that the elimination of school fees in poor districts had small positive effects on secondary school enrolment. De Brauw and Giles (forthcoming) discuss the effects of reducing barriers to migration on urban employment opportunities and rural enrolment for middle school graduates in China. See also Dang and Rogers (2008) for a review on studies related to households sending their children to private tutoring (classes with extra fees) and Glewwe and Muralidharan (2016) for a recent review of other studies on education in developing countries.

[3] This number of left-behind children is slightly more than the total population of a country the size of France or the UK. Also note that migrant workers play a major role in the Chinese economy and account for 44 percent of total urban employment (World Bank and DRC, 2014).

lower-quality schools.[4] The LBC phenomenon has also attracted much attention from the media, which highlight the psychological costs of family separation that can potentially lead to suicides of left-behind children (see, for example, Xinhua news agency (2015) and The Economist (2015a, 2015b, 2016)). Against this background, the government of China has set a priority to make urbanization "more inclusive" for migrant workers and their families (World Bank and DRC, 2014).

We provide a framework of analysis that closely integrates theory and empirics. Both our theoretical and empirical evidence suggests that increases in school fees decrease the chance that migrant households bring their children to the city, the number of children they bring, as well as the likelihood that they bring a daughter given preferences for sons. These results especially hold for more vulnerable migrant workers and for those who place a lower value on non-schooling outcomes. Furthermore, the negative impacts of higher school fees may be amplified during an economic crisis. Our findings suggest that a 10 percent increase in median school fees results in a reduction of 2 percentage points (or 5 percent) in the probability that the migrant worker brings his children along, and 0.02 fewer children being brought along.[5]

This paper is organized as follows: we start by providing an overview of the country background in the next section before presenting our theoretical model in Section 3 and the empirical model and the data in Section 4. We then discuss estimation results, various robustness checks, and the heterogeneity analysis in Section 5. We offer further analysis of related outcomes in Section 6 and conclude in Section 7.

[4] These findings contrast with Chen et al. (2009) who reported evidence of the positive impacts of parental migration and Mu and de Brauw (2015) who found that parental migration has no significant effect on the height of children, but has positive effects on their weight.

[5] These empirical results are obtained using the latest data available from a household survey specially designed for the study of internal migration in China (i.e., the 2008/09 RUMIC data), which we discuss in more detail in the next section.

2. Overview of Education and School Fees

Confucian values that strongly encourage education have historically played a key role in Chinese parents' decision to enroll children in schools. The advent in 1986 of the 'Law of Compulsory Education' made school enrolment mandatory for all children age 6 and above and required all children to attend school for a minimum of 9 years. Grass-root enforcement and monitoring of this law by urban resident committees or rural village councils (the smallest administrative units in China) has helped rank the country among those with the highest school enrollment rates. The gross enrollment rate at the primary and secondary school levels reached 108 percent and 96 percent respectively in 2013 (UNESCO, 2016).

Universal compulsory education, however, does not fully alleviate the burden of school fees for families. The education system's finance is highly decentralized in China, leading to subnational governments bearing most of the costs of public education spending (approximately 95 percent) and the central government funding the rest (World Bank and DRC, 2014). These challenges gave rise to school fees as an important source of revenue for local governments' public education budget. These school fees are often collected by the local government (through schools) and then transferred back to each school, with the specific amounts being determined in negotiations between the former and the latter. Notably, migrant households are often asked to pay extra school fees, the exact amounts of which vary from city to city (see, e.g., Yuan, (2010)).[6]

No official data exist on school fees, but these can be estimated from household education expenditures. The Rural-Urban Migration in China (RUMiC) dataset (discussed in more detail

[6] Despite the repeated calls to give migrant children equal treatment, many public schools in China continue to impose higher tuition fees or other fees on migrant children, often with local government approval (World Bank and DRC, 2014). There are at least two main reasons for this. First, compulsory education for migrant children is supposed to be financed by the sub-national governments of migrant-sending areas rather than the sub-national governments of migrant-receiving areas. The latter lack motivation to finance the education of migrant children, and often have inadequate resources to do so given their already heavy fiscal responsibilities (Shen, Zhao and Zou 2014). Second, subnational governments tend to allocate public resources to activities related to short-term economic performance rather than to local public goods such as compulsory education (Shen, Zhao and Zou, 2014; Xu, 2011; Yuan and Zhang, 2015).

in Section 4.2 and Appendix 2) provides information on household expenditures on various types of school fees faced by migrants and local residents in 15 cities across China. Figure 1 graphs the distribution of mean (total) school fees paid by migrant households, which ranges from 1,100 yuan in Bengbu (a city with a dominant food industry in the Northern Anhui province) to more than 4,500 yuan in Shenzhen (the fastest growing migrant receiving city in the South).[7] School fees as a share of migrant households' consumption range from 4 percent in Hangzhou to 25 percent in Shenzhen, and represent, on average, 10 percent of migrant household consumption. For local households (i.e., urban residents with a *hukou*), school fees represent on average 11 percent of their consumption. School fees can be further broken down into different components, with tuition fees representing 40 percent and 31 percent of total school fees for migrants and urban residents respectively.

Figure 2 plots the shares of migrant households that bring school-age children with them against the median school fees at the city level. These two variables show a negative relationship, with a correlation coefficient of -0.28.[8] Tuition fees in rural areas were formally abolished by the central government in 2006, thus the urban school fees paid by migrant households represented additional education expenses to their budget (which they would not have to pay in rural areas). The central government announced the abolition of these fees in urban areas as well after 2008 (State Council, 2008), but in practice, migrant households still often have to pay various "hidden" school fees (Li, 2013; Lu and Zhou, 2013). Using the RUMiC survey, we estimate that migrant households received a school fee reduction of approximately 20 percent, but not 100 percent, in 2008 (Appendix 3, Table 3.4).[9]

[7] Unless stated otherwise, school fees are calculated from the sample of migrants with at least one child enrolled in a school in the city. One yuan was approximately equal to 0.14 US dollars in 2008 (World Bank, 2016).

[8] This correlation is somewhat stronger at -0.44 for the mean school fees. We describe how we construct different measures of school fees in section 4.2.

[9] Our estimates using the most recent household survey from China in 2012 (i.e., the China Family Panel Studies implemented by Peking University) also indicate that, four (six) years after the official abolition of school fees in urban (rural) areas, both urban and rural households still paid various school-related fees. See Figures 3.1a and 3.1b in Appendix 3 for more details.

This practice of charging school fees is likely to persist, particularly given the strong fiscal decentralization in the country, unless follow-up policy measures are implemented (such as interventions from the central government). Being the first study that attempts to offer rigorous quantitative evidence on the impacts of school fees on child migration in China, our research is relevant not just as an assessment of the impacts of existing policy practices, but also sheds useful light on potential policies accompanying child migration (e.g., whether the government should subsidize child migration to help better integrate migrant households in the city's economy).[10] We return to this discussion in the last section.

3. Theoretical Framework

We present in this section a framework to study how school fees can affect migration and schooling decisions, which can guide our subsequent empirical analysis.

3.1. General Setup

Let us consider a household that consists of a migrant worker and his (her) child, both of whom originate from a rural area $j \in \{1,..,J\}$. The worker must decide among three choices: (i) migrating alone to a city, (ii) migrating to a city with the child, or (iii) remaining in the rural area of origin with the child. In the rural area, the worker earns a real income w^R. The child attends a free school and obtains human capital H^R from attending that school. The child also obtains non-schooling outcomes $\boldsymbol{X}^R$ associated with growing up in the rural area. This vector includes all outcomes affecting the future productivity and well-being of the child, such as, for instance, health outcomes.[11] There are K cities indexed by $k \in \{1,..,K\}$. Each city k is characterized by a wage w_k^U, a school fee f_k, a schooling outcome H_k^U, and non-schooling

[10] Reviewing numerous studies on migration policies, McKenzie and Yang (2015) observe that the importance of obtaining rigorous evidence to evaluate policies cannot be overemphasized.

[11] We assume that all rural areas provide the same wage, schooling and non-schooling outcomes.

outcomes $\boldsymbol{X}_k^U$ associated with residence in the city. As cities offer better labor market outcomes and better schooling outcomes than rural areas, we assume that $w_k^U > w^R$ and $H_k^U > H^R$ for any city k. We also assume that $f_k < w_k^U$, implying that paying for an urban school is within the affordable choice set of migrants. These assumptions on the cost and quality of urban schooling are supported by both qualitative and quantitative studies on China (see Chen and Feng, 2013; Goodburn, 2009; and Lai et al., 2014). The migration cost from rural area j to city k is denoted $m_{j,k}$.[12]

We assume that the worker has a linear utility of the form

$$U = C + g(H, \boldsymbol{X}) \qquad (1)$$

where C is household disposable income, H is the child's human capital, and $\boldsymbol{X}$ the child's vector of non-schooling outcomes. $g(H, \boldsymbol{X})$ is a function which increases in both H and the components of $\boldsymbol{X}$ and captures the rate at which the child's schooling and non-schooling outcomes translate into expected future income and/or the parental valuation of the child's well-being from schooling and non-schooling outcomes. Note that we do not assume any particular specification for function g and allow for any level of complementarity between schooling and non-schooling outcomes.[13] Also note that our setting with a single school fee in each city is compatible with a more complex framework that would have migrants choose a school within a distribution of heterogeneous schools in each city that each produces different levels of human capital at different costs.[14]

[12] For simplicity and without any loss of generality, we assume that the cost for a household to migrate to a given city is the same whether or not the worker brings his child along with him.

[13] For example, choosing a CES specification $g(H, \boldsymbol{X}) = [\propto H^\gamma + (1-\alpha)W(\boldsymbol{X})^\gamma]^{\frac{1}{\gamma}}$ where W(.) is a welfare index associated with non-schooling outcomes would allow us to consider all cases from perfect substitutability to perfect complementarity depending on the value of γ.

[14] To see this, assume that the distribution of schools in each city k is represented by a continuum of schools producing human capital $H_k(f)$ for $f \geq f_k{}^{min}$, where H_k is a concave education production function increasing in f. It is easy to see that if the condition $\frac{\partial g}{\partial H_k}.\frac{\partial H_k}{\partial f} < 1$ holds, parents who bring their children to city k will optimally choose the cheapest and lowest human capital producing school in the city. This condition is likely to hold if (i) financial inputs do not have a strong impact on the production of education or (ii) returns to

When deciding whether and where to migrate and whether to take his child with him, a worker from a rural area j compares utilities in the following $2K+1$ possible situations

$$\begin{cases} V_{j,k}^{U,c} = w_k^U - m_{j,k} - f_k + g(H_k^U, \boldsymbol{X}_k^U) \text{ if migrating with the child to a city } k, \text{for } k \in \{1, \dots, K\} \\ V_{j,k}^{U,nc} = \mathrm{w}_k^{\mathrm{U}} - \mathrm{m}_{\mathrm{j,k}} + \mathrm{g}(H^R, \boldsymbol{X}^R) \text{ if migrating to a city } k \text{ without the child, for } k \in \{1, \dots, K\} \\ V^R = w^R + g(H^R, \boldsymbol{X}^R) \text{ if staying in the rural area} \end{cases} \quad (2)$$

Note that the utilities in the above equations are indexed by both j and k since they depend on the local parameters in the destination city k as well as on the migration cost between origin j and destination k. The worker makes the migration decision that provides the highest indirect utility over all possible choices.

Since our data is restricted to households that have already migrated to a set of urban areas, it is useful to characterize the set of migrants in a given city k. Let us denote $\tilde{V}_{j,k} = \max\{V_{j,k}^{U,c}, V_{j,k}^{U,nc}\}$ the highest utility net of the migration cost attainable in city k for a migrant originating from rural area j. The stock of migrants in city k is thus

$$S_k = \{i | k = \underset{l}{\operatorname{argmax}}\{\{\tilde{V}_{j(i),l}\}_{l \in K}, V^R\} \quad (3)$$

where $j(i)$ is the rural area of origin of worker $i \in \{1, .., I\}$. Equation (3) simply states that migrant workers in city k maximized their utility by choosing city k. Equation (3) also indicates that each individual's migrating decision depends on the wages, school fees and schooling and non-schooling outcomes in *all* possible destination areas as well on the migration costs between the rural area of origin and *all* possible destination areas.[15]

In the following subsections, we investigate the role of migration costs and school fees on migrations and schooling decisions. We will use Δ_k to represent the *gain in child outcomes associated with residence in city k over residence in a rural* area, which is defined as follows

$$\Delta_k = g(H_k^U, \boldsymbol{X}_k^U) - g(H^R, \boldsymbol{X}^R) \quad (4)$$

human capital are low (see, e.g., Li et al. (2012)). Under this condition, we can abstract from modeling within-city school choice.

[15] Although our setting is very general, we do not account for general equilibrium effects and assume that wages, schooling and non-schooling outcomes are fixed in each city.

3.2. Migration and the Decision to Bring the Children

The one child model

Let us consider a worker originating from a rural area j who considers moving to city 1. To reduce the dimensionality of the problem, we assume that $\min\{V_{j,1}^{U,c}, V_{j,1}^{U,nc}, V^R\} > \max\{\tilde{V}_{j,k}\}_{k\neq 1}$. Under this case, which is likely to occur when migration costs to remote cities are high, the problem boils down to comparing three scenarios only: migrating to city 1 with the child, migrating to city 1 without the child, or remaining in the rural area with the child.[16]

We have the following proposition regarding the impacts of school fees on the migrant worker's decision to bring his child along.

Proposition 1. School fees and family migration
The worker will migrate to the city if the wage gain net of migration costs is positive ($w_1^U - w^R - m_{j,1} > 0$). If migrating, the worker will take the child with him if the gain in child outcomes exceeds the urban school fee ($f_1 < \Delta_1$).
Proof: Appendix 1, Part A.[17]

The intuition beyond Proposition 1 is straightforward. The condition for the migrant worker to bring his child with him simply indicates that the cost of education must be lower than the worker's valuation of his child's gain in schooling and non-schooling outcomes. In fact, the result can be restated by noticing that, for any given school fee and any school quality gap between the urban and the rural area, the migrant worker brings his child with him if non-schooling outcomes provide sufficient benefits in urban areas. This result naturally follows from Proposition 1 and is stated in the following corollary.

Corollary 1.1. Non-schooling outcomes and family migration
The greater non-schooling outcomes in urban areas, the more likely the migrant worker is to bring his child with him.
Proof: Appendix 1, Part A.

[16] We analyze the more general case of several potential destination areas in Appendix 1, Lemma 1.
[17] In our framework, parental migration is strictly motivated by labor market outcomes (see Stark 1991). Under a simple condition (see Appendix 1), we rule out the unlikely case where the worker's only incentive to migrate would be to improve his child's outcomes in spite of an otherwise net income loss from migration.

The two children model

We now extend the model to the situation where the household has two children.[18] We further assume that the migrant worker may give different weights in his utility function to each child's education. This can occur if the worker has a boy and a girl and has gender preferences regarding investment in education (for instance, preferring to invest in boys rather than in girls),[19] or if there is gender discrimination in the labor market that results in lower incomes for female workers, rendering investments in female education less profitable. The utility function of the worker in the two children case (with a boy and a girl) is

$$U = I + v(H_b, H_g, \boldsymbol{X}_b, \boldsymbol{X}_g)$$

where, similar to equation (1), H is the child's human capital and $\boldsymbol{X}$ the non-schooling outcomes, with the subscript indexing either boys (*b*) or girls (*g*), and *v* is the function valuing children outcomes. For illustrative purposes, we can write out this utility function using the additive form

$$v(H_b, H_g, \boldsymbol{X}_b, \boldsymbol{X}_g) = \alpha_b \, g(H_b, \boldsymbol{X}_b) + \alpha_g \, g(H_g, \boldsymbol{X}_g) \qquad (5)$$

where *g* is the outcome valuation function as previously defined, and α_b and α_g reflect worker preferences or differing labor market outcomes of boys and girls with $\alpha_b > \alpha_g$. We assume that H_b, H_g, $\boldsymbol{X}_b$ and $\boldsymbol{X}_g$ only depend on where the children live. Hence, if the boy and the girl live in the same place, they will have the same schooling and non-schooling outcomes, but we allow the parental valuation of child well-being to differ for boys and girls.

We have the following proposition.

Proposition 2. School fees and selection in children migration
If migrating, the worker takes both children with him if the school fee is sufficiently low ($f_1 \leq \alpha_g \Delta_1$). He leaves both children behind if the school fee is sufficiently high ($f_1 > \alpha_b \Delta_1$). He only takes the boy with him in the intermediate case ($\alpha_g \Delta_1 < f_1 \leq \alpha_b \Delta_1$).

[18] The model is easily generalizable to more than two children. Very few households, however, have more than two children in China, hence our focus on one child or two children for the discussion.
[19] See, for example, Chen et al., (2013) and Ebenstein (2011) for recent studies on son preference in China.

Proof: Appendix 1, Part A.

Proposition 2 is an extended version of Proposition 1 and implies that a higher school fee can decrease the number of children brought by the migrant worker. It also implies that, given son preference, a higher school fee may induce migrant workers to bring with them their sons rather than their daughters.

3.3. School Fee Increases after Rural-Urban Migration

We now return to the one child model to focus more on the ideas and keep the derivations tractable. Consider the case where the worker already migrated to city 1 with his child and faces an (unanticipated) increase in the school fee from f_1 to $\tilde{f}_1 > f_1$. To characterize the response to the school fee increase, we need to compare the utilities under the following scenarios: the worker remains in city 1 with his child; the worker remains city 1 but sends his child back to the rural area; and the worker moves to another city with or without his child (the "next best" city, denoted city 2).[20] We have the following proposition.

Proposition 3. Response to an urban school fee increase
Let us consider the school fee thresholds

$$\begin{cases} f_1^* = \Delta_1 \\ f_1^{**} = \Delta_1 - \Delta_2 + (w_1^U - w_2^U) + (f_2 + m_{1,2}) \\ f_1^{***} = \Delta_1 + (w_1^U - w_2^U) + m_{1,2} \end{cases} \quad (6)$$

where $m_{1,2}$ is the migration (relocation) cost from city 1 to city 2, and Δ_1 and Δ_2 are defined by equation (4).
i) If $min\{f_1^*, f_1^{**}, f_1^{***}\} = f_1^*$, an increase in the school fee to $\tilde{f}_1$ will cause the worker to send his child back to the rural area if and only if $\tilde{f}_1 > f_1^*$.
ii) If $min\{f_1^*, f_1^{**}, f_1^{***}\} = f_1^{**}$, an increase in the school fee to $\tilde{f}_1$ will cause the worker to relocate to city 2 with his child if and only if $\tilde{f}_1 > f_1^{**}$.
iii) If $min\{f_1^*, f_1^{**}, f_1^{***}\} = f_1^{***}$, an increase in the school fee to $\tilde{f}_1$ will cause the worker to relocate to city 2 and send his child back to the rural area if and only if $\tilde{f}_1 > f_1^{***}$.
Proof: Appendix 1, Part A.

[20] For simplicity and without loss of generality, we assume that sending the child back to the rural area of origin does not involve any cost.

The key take-away message from Proposition 3 is that the migrant worker's decisions respond to school fees. Depending on how wages, schooling and non-schooling outcomes compare between the two cities, and depending on the migration/relocation cost between the two cities, an increase in the urban school fee may result in the migrant worker sending the child back to the rural area (case (i)) or relocating to another city with or without the child (cases (ii) and (iii) respectively). It is easy to see that when the relocation cost is sufficiently large, both $f_1^* < f_1^{**}$ and $f_1^* < f_1^{***}$ hold, so that case (i) prevails. We thus have the following corollary.

Corollary 3.1. School fee increases and relocation decisions
If relocation costs are sufficiently large, an increase in the school fee will only affect the decision to bring the child as the worker will remain in the city.
Proof: Appendix 1, Part A.

Corollary 3.1 is relevant in the case of China and helps explain that, given prohibitive relocation costs across Chinese cities, migrants typically do not relocate after migrating to a city (see, for example, Chen et al., 2010). Put differently, under Corollary 3.1, S_1, the set of migrants in city 1 defined in equation (3), is likely to remain the same after the change in school fee, which supports the internal validity of our empirical results using post-migration data in destination areas.

Moreover, note that higher school fees may place vulnerable households (i.e., poorer households or households with precarious jobs or without health insurance) at a particular disadvantage. These households are likely to expect lower (non-)schooling outcomes in the city, and would thus benefit most from social protection policies.[21] The following corollary to Proposition 3 helps shed light on their response to higher school fees.

Corollary 3.2. School fees and vulnerable households
Vulnerable migrant households are more likely to respond to an increase in the school fee by sending their children back to the rural area.

[21] Households with lower education levels, for example, may not know how to access information about the city's services and, thus may not have access to these services.

Proof: Appendix 1, Part A.

Finally, in the following corollary, we characterize how the relationship between urban school fees and child migration changes when macro-economic conditions affect the returns to education.

Corollary 3.3. School fees, child migration and economic crisis
Under an economic crisis, the gain from child migration is reduced and households are more likely to respond to an increase in the school fee by sending their children back to the rural area.
Proof: Appendix 1, Part A.

In summary, our theoretical framework suggests that higher school fees decrease the probability that a migrant worker brings his children with him to the city (Propositions 1 and 3), the number of children he may bring, and the probability that he brings a daughter given possible preference for boys over girls (Proposition 2). These effects may be more pronounced for more vulnerable migrant workers (Corollary 3.2) and during an economic crisis (Corollary 3.3). Our framework also implies that, other things equal, the migrant worker brings his children along if he values non-schooling outcomes more (Corollary 1.1). Although we abstract from modelling remittances to rural areas, our framework is also compatible with the scenario where, faced with high urban school fees, the migrant worker decides to leave one or several children in the rural area and to send remittances to support these children.[22] We will discuss the data and estimation models in the next section before validating these theoretical predictions in the empirical analysis.

[22] Remittances would occur to the extent that investing in left-behind children provides greater utility than own consumption in the city. Denoting r the remittance to the rural area and $g(H(r), \boldsymbol{X}(r))$ the valuation of children outcomes as a function of remittances, it is easy to see from the utility function (1) that, budget permitting, the migrant will increase his utility by remitting r if $g(H(r), \boldsymbol{X}(r)) > r$. Because of lower outcomes in rural compared to urban areas, the remittance must be less than the fees the household would have spent on urban education.

4. Empirical Model

4.1. Empirical Model

We estimate the migrant worker's decision to bring his children along using the following region fixed effects model

$$Y_{ik} = \delta + \lambda Fee_{ik} + \theta' \boldsymbol{Z}_{ik} + \mu_j + \varepsilon_{ik} \qquad (7)$$

where Y_{ik} is a dummy variable indicating whether the migrant worker (or the head) in household i in city k brings his children along, and Fee_{ik} is the school fees faced by household i in city k. Consistent with our theoretical predictions that a higher school fee induces the worker not to bring his children (Proposition 1), we expect the coefficient on school fees (λ) to be negative. The control variables $\boldsymbol{Z}_{ik}$ represent the household head's characteristics such as age, gender, educational achievement, working status, original residence, and city-level characteristics including the growth rate of the student-teacher ratio and housing prices. The dummy variable μ_j indicates that the migrant worker originates from region j.[23] We estimate equation (7) using a linear probability model.[24]

School fees, however, may be prone to measurement errors or potentially be correlated with some unobserved city-level characteristics that also affect the migrant worker's decision to bring his children. For instance, if a city is observed to have been able to offer lower school fees thanks to more resources being allocated to education spending, migrants may factor this fact into their decision. There may even be reverse causality if, say, the influx of migrant children turns out to exceed the capacity of schools in the city; in this case, the city government

[23] Provinces with few out-migrants are collapsed with their neighboring provinces into regional dummy variables (e.g., in our estimation sample, because Gansu has 6 migrants, Qinghai 3 migrants, Shaanxi 12 migrants, Xinjiang 1 migrant, we created a northwestern province dummy for these four provinces). In the end, we constructed 8 regional dummy variables: central province (Chongqing, Henan, Hubei, Hunan, Sichuan), eastern province (Jiangsu, Shanghai), northwestern province (Gansu, Qinghai, Shaanxi, Xinjiang), northern province (Shandong, Heibei, Tianjin), northeastern province (Heilongjiang, Jilin, Liaoning), south central province (Anhui, Jiangxi), southeastern province (Guangdong, Fujian, Zhejiang), and southwestern province (Guangxi, Guizhou, Yunan).

[24] We use the linear probability model for easier interpretation of the coefficients. Estimates using a probit model are similar and shown in Appendix 3. We provide robust standard errors clustered at the city level for all the regressions. See also Cameron and Miller (2015) for a discussion on various standard error correction procedures.

may raise fees to obtain more revenue. Given our theoretical predictions that a higher school fee has a negative impact on the migrant worker's decision to bring his children, these endogeneity issues would bias estimates upward toward zero. But the magnitude of this upward bias is clearly an empirical issue.

Therefore, we use an instrumental variable (IV) framework to identify the impacts of school fees and jointly estimate equation (7) and the following first-stage equation for the year 2007

$$Fee_{ik,2007} = \tau + \omega Shock_{ik,2006} + \phi' \boldsymbol{Z}_{ik} + \nu_j + \eta_{ik} \qquad (8)$$

where the instrumental variable $Shock_{k,2006}$ is the lagged cyclical component of public education spending in 2006 (i.e., obtained after detrending city education spending from 2002 to 2006). This IV satisfies all the conditions of a good IV, that is relevance, exogeneity, and exclusion conditions. We start first with discussing the relevance condition.

As discussed earlier, the funding of the Chinese education system is strongly decentralized. Households are required to pay tuition and miscellaneous fees to supplement school operating expenses, and these fees are set by the local government and schools. Although the Education Law stipulates that public education spending should grow faster than regular government revenues, in practice, local governments are not held accountable to meet specific spending targets. This leaves local governments the flexibility to make up for the shortfall in public spending with contributions from households. A recent study by Yuan and Zhang (2015) finds that increases in public education spending are associated with significant decreases in urban household spending on public school tuition.

This situation is particularly relevant to migrant households, for whom the negative association between local public education spending and school fees is likely to be stronger. Since the funding of school does not follow migration (World Bank and DRC, 2014), the education of migrant children is only partially funded by the local government in the destination area. Migrant children are required to pay extra fees on top of the regular fees;

furthermore, these fees are less regulated than tuition fees and may be adjusted according to school needs. Figure 3 plots city-level school fees against public education spending shocks. To remove contemporaneousness issues, we use one-year lagged shocks rather than the current shocks as instrumental variable (i.e., the fees are in 2007 but the spending shocks are in 2006). There is a clear positive relationship between school fees and lagged education spending shocks (with a correlation coefficient of 0.47). A natural explanation is that, if the local government overspent in the previous year, they tend to compensate for the current fiscal deficit by raising current-year school fees.[25]

We now turn to discuss why the cyclical components of public education spending shocks are exogenous to the migrant households' decision to bring their children, and why these shocks only affect this decision through school fees. In China, households, and particularly migrant workers, have little power to influence local governments' decisions. Local budgeting is largely influenced by a few top local officials and does not involve local residents (Wang et al., 2012; Liu et al., 2015). Because these officials are appointed, evaluated, and promoted mostly based on local economic performance and tax revenues, they have strong incentives to allocate public resources to activities directly oriented toward these objectives, rather than to the provision of local public good—such as education—that would meet the needs of local residents (Xu, 2011). A recent study (Tsai, 2016) also suggests that local public spending responds to political cycles, which are completely exogenous to the migrant workers' decision.[26] In addition, public education spending has traditionally been invisible to migrants—as local budgeting was not publicly disclosed until recently—and migrants are usually not interested nor informed about

[25] Due to mean reversion, our positive correlation between current school fees and lagged education spending shocks is consistent with Yuan and Zhang (2015)'s negative correlation found for current school fees and *current* education spending shocks. In other contexts including the European Union, public spending shocks are found to result in budget deficits (Beetsma and Giuliodri, 2011); see also Ramey (2011) for a recent review of related studies.

[26] Tsai (2016) shows that two years prior to the National Congress of the Communist Party (NCCP), politicians are likely to shift public spending toward capital expenditures, such as innovation funds and capital construction, and away from current expenditures, such as agricultural subsidies, social expenditures and government administration.

local public affairs. Consequently, even if we assumed that migrants could somehow predict the trend of local public education spending, the shocks to education spending would remain unexpected and unforeseeable. It thus seems reasonable to consider these shocks as exogenous in our empirical setting.

As for the exclusion restriction, the most viable mechanism through which shocks to public education spending could affect the migrant workers' decision to bring their children is increased school fees. As discussed above, the budgeting process appears so far removed from migrant households (and local households) that it is unlikely to affect these households directly. Moreover, even if we generously allowed the one-year lagged shocks to education spending to affect other city-level characteristics that are directly related to the migrant households' decision—an example could be that the education budget surplus may lead to the recruitment of more teachers or the construction of new schools—such scenarios are typically multi-year projects. They would take much longer than the IV's short time span of one year to develop. Furthermore, in the context of China, information about these projects may even take longer to percolate to migrant households and subsequently affect their decision.[27]

Still, it could be argued that if unexpected shocks to public education spending are somehow correlated with other types of social welfare spending such as spending on health or security, and if such social welfare spending can help improve the non-schooling outcomes for migrant workers' children, these shocks may also affect child migration through this channel. This would result in biased estimates. This argument, however, is unlikely to hold since, as discussed earlier, migrant households generally have limited access to (and little information about) social services in urban areas. Consequently, increases (or decreases) in other types of public spending would likely have little effect on their decision over child migration. The area of healthcare furnishes a good illustration. In 2006, only 28 percent of the urban population

[27] Note that we control for the growth rate of student-teacher ratio in equations (7) and (8).

were covered in the government basic urban health-care insurance scheme, which does not cover migrant workers (Hu et al., 2008). Furthermore, migrant workers tend to underuse health services in their destination cities, as almost two-thirds of migrant workers who report illness do not visit a doctor (Gong et al., 2012). Another type of public spending—social protection spending—provides similar evidence.[28] In the 15 cities of our estimation sample, the correlation between social protection spending and public education spending shocks is almost 0 (i.e., -0.06).[29]

Nevertheless, we employ two different strategies to provide additional layers of robustness checks on the exclusion restriction. First, we employ different model specifications that control for a number of variables in estimating equations (7) and (8). These include the migrant worker's (household head's) demographics, employment, and dummy variables indicating his work industry, province of origin, and whether he migrates within the same province. If somehow there is a reason to believe that the city-level shocks to public education spending can have differential effects on different occupations and migrant workers coming from different locations, these variables can help net out such effects. Furthermore, we explicitly control for social protection spending in a robustness check. If the estimated coefficient on school fees does not lose its statistical significance (or change significantly) when social protection spending is included, this would provide supportive evidence for the validity of the exclusion restriction. Second, we apply a bounding method recently developed by Chernozhukov, Lee, and Rosen (2013) that does not require the exclusion restriction. This second strategy, in fact, generally allows for the violation of the exclusion restriction to occur

[28] Social protection spending is defined in the China City Statistical Yearbooks as being composed of social security benefits, employment subsidies, and unemployment grants.

[29] This result is consistent with the fact that migrant workers generally have no access to other social welfare benefits—which are closely tied with residence status—such as social security, housing, transportation, and medical benefits (Wang and Zuo, 1999; Wong et al., 2007; Song et al., 2008; World Bank and DRC, 2014).

due to any reason. We describe this method and our implementation in more detail in Appendix 1, Part B.

4.2. Data Description and Construction of Variables

We bring together various data sources for the empirical analysis. Our main dataset is the Rural-Urban Migration in China (RUMiC) survey, which consists of three independent modules: a migrant household module, an urban household module, and a rural household module. It collects rich data on the socioeconomic characteristics of rural-urban migrants and their left-behind children, including information on co-residence status, schooling status, and household expenditures on various types of school fees for their children. We restrict our sample to households that have at least one school-age children (age 6-16) as we focus on the impacts of school fees on child migration. This leaves us with a working sample of 1,349 households. We provide a more detailed description of this survey and other data sources in Appendix 2.

While we analyze two rounds of the RUMiC dataset, we focus in this paper on the 2008 (first) round for two main reasons. First, as discussed earlier, local governments typically relied on raising revenues through school fees before 2008 to compensate for the lack of funding transfer from the central government to pay for the education of migrant children. The abolition of school fees in 2008 resulted in local governments being no longer able to collect revenues this way, at least in theory. Thus there could be (almost) no correlation between schools fees and budget deficits, which violates the relevance condition of our IV for 2009. Second, the linkage between shocks to public education spending and school fees is also likely to be weakened during an economic crisis. This is because local governments would typically be constrained by competing spending priorities in such times, thus would unlikely have total discretion over their education budget. For example, they might not be able to spend the surplus from the education budget generated in the previous year on education in the following year,

which prevents them from lowering school fees.[30] Our theoretical results (Corollary 3.3), however, suggest that migrant households' decision on child migration may be more affected by school fees during a crisis; thus our use of the 2009 round will be limited to supplementary analysis.

There are challenges with measuring school fees. First, the administrative measures of city-level school fees are not available; second, even if these data were available, it is impossible to predict the counterfactual school fees that migrant households who left their children behind would have paid if they had taken them along. For these reasons, we compute the mean and the median of migrant households' per child expenditures on all school-related fees as measures of the school fees faced by migrant households.[31] To reduce endogeneity concerns with school fees, we exclude each household before implementing this calculation (i.e., for each migrant household, the mean (median) is based on the expenditures of all the migrant households in the sample except theirs). For robustness checks, in addition to the mean (median), we also compute alternative measures such as the 25th percentile and the 75th percentile of the household education expenditures.

As another check, we also compute alternative measures of school fees based on urban residents' school expenditures in the same cities. The school fees that they pay can be viewed as another measure of school fees in the city (e.g., because of a different sampling frame for the urban households in the same city).[32] Thus, while the fees obtained from the migrant household sample vary for each migrant household, the fees obtained from the urban household

[30] We do not explore the panel feature of the dataset between 2008 and 2009 since despite substantial efforts to track individuals over time, the panel data suffer from exceptionally heavy attrition (58.4 percent). This is due to the mobile nature of migrant workers and the consequences of the financial crisis that hit China in 2009 (Akgüç, Giulietti, and Zimmermann 2013). An option is to construct synthetic panel data that can allow dynamic analysis (Dang et al., 2014), but we leave this for future research.

[31] These fees include tuition, food and accommodation, remedial classes, other fees (e.g. school uniforms and so on) and "sponsorship fees/boarding fees/selecting school fees". Unless otherwise noted, all numbers are our estimates from the RUMiC survey.

[32] Figure 1, however, reassuringly indicates that there is no systematic difference between school fees obtained from the rural household sample or the urban household sample. See also Carletto, Larrison, and Ozden (2014) for a detailed discussion on the construction of proper sampling frames for collecting migration data.

sample are, by construction, the same for all migrant households in a given city. Both measures provide estimates of the average school fees that each migrant household is (exogenously) faced with when migrating to the city.

Yet, these school fee measures may still be endogenous at the city level if unobserved city-level events occur that affect both a city's school fees and its migrant workers' decisions regarding child migration. As discussed earlier in the presentation of the empirical model, we address this issue by instrumenting school fees with the one-year lag of unexpected shocks to the city government's education spending. We gathered the historical city-level education spending as a share of local public spending in the 15 cities (metropolitan areas) covered by RUMiC 2008 for the period 2002-2007 from the China City Statistical Yearbooks. For each city, using different detrending techniques (i.e., Hodrick-Prescott (HP) filter and linear filter), we decomposed the time series records into a trend component and a cyclical component.

We constructed a measure for the trend in city education services with the growth rate of the student-teacher ratio in 2007 based on the number of students and teachers in metropolitan areas in 2006 and in 2007 using the China City Statistical Yearbooks. As a proxy for migration distance between the original and the destination areas, we constructed a dummy variable that equals 1 if the migrant household is from a rural area within the same province and equals 0 if the migrant household is from another province. Since city-level Consumer Price Index data are not available for China, we proxy for living costs with city-level housing prices in 2007 from the China Urban Life and Price Yearbook 2008.

Table 1 shows the summary statistics for household and city characteristics. The average age of household heads in our sample is 36.7, with around one-fourth (26 percent) of households being female-headed. About half of all household heads are primary school graduates and less than one-third (29 percent) of them hold a junior high school diploma or higher. 38 percent of migrant households bring their children with them to the city, and a

migrant household has on average 0.46 migrant children; out of these households, 7 percent bringing two children or more, and less than half (43 percent) of the migrant children are girls (not shown). About two-thirds of migrant households have both spouses living together, and more than half (57 percent) of the migrant households are from the same province (suggesting that within-province migration costs are lower; see Appendix 1, Lemma 1). About half (47 percent) of the migrant households currently live in coastal cities. Almost all (97 percent) of all household heads are employed and slightly more than one-third (36 percent) are self-employed. Only one-third of all household heads have a long-term work contract. The average annual education remittance migrant households sent back home in 2007 was 1,100 yuan, amounting to about 5 percent of a migrant household's annual income. Overall, the student-teacher ratio in 2007 did not change much compared with that in 2006, even though the change was larger (up to 7 percent) in some cities. Lastly, the average housing price in 2007 was about 5,600 yuan per square meter in these 15 cities, with the price in the most expensive city being about 6 times greater than in the least expensive city.[33]

5. Impacts of School Fees

5.1. Estimation Results

We use three model specifications to estimation equation (7) (and equation (8)) for both comparison purposes and robustness checks. Specification 1 is the most parsimonious and only controls for the household head's characteristics (including age, gender, educational achievement). Specification 2 adds to Specification 1 the head's employment characteristics (including whether the head is working and whether the head is self-employed), a dummy variable indicating whether the head migrated within the same province, as well as dummy

[33] The sample for the 2009 round is somewhat different from the 2008 round. For example, households are less likely to bring their children to the city but have slightly more income per capita, and more household heads are female (Appendix 3, Table 3.4).

variables indicating the industry the head works in.[34] Finally, Specification 3 adds to Specification 2 the city-level housing prices to proxy for living costs in the city. To further help with the comparison, we use two different estimates for school fees to estimate these three specifications: one using median school fees and the other using mean school fees (with fees measured on the natural logarithm scale). The regressions using median fees are our preferred specifications, since the median is likely less affected by outlier observations than the mean.

While the variables further added to Specification 1 can help increase the goodness-of-fit of the model, they are more likely to be endogenous to the migrant worker's decision (e.g., the migrant worker may decide to be self-employed or to migrate within the same province to take better care of his children). But if estimation results are (qualitatively) similar for all three specifications, it would provide stronger evidence for the impacts of school fees. For this reason, although Specification 3 is our preferred specification, we also refer to the other specifications when interpreting the estimation results.

We provide in Table 2 the estimation results for equations (7) and (8) using the linear probability model, where the non-IV estimates are shown at the bottom of the table to save space. These estimates for Specifications 1 and 2 using either the mean school fees (Table 2, columns 1 and 2) or the median school fees (Table 2, columns 4 and 5) point to a negative and statistically significant relationship between school fees and the migrant worker's decision to bring his children. Adding housing prices to the regression (columns 3 and 6) renders this relationship statistically insignificant but does not change the negative sign. This result is broadly consistent with our theoretical prediction that a higher school fee decreases the migrant worker's probability of bringing his children along (Proposition 1). However, as discussed

[34] We have five industry dummy variables for the following sectors: manufacturing, construction, wholesale and retail trade, hotel and catering services, and an "other" sector. The first four sectors absorb about 80 percent of the migrants. We do not control for the head's income because of potential endogeneity issues (e.g., as households may jointly decide on the type of job they do and thus on the pay they get and whether to bring their children along). We will return to this issue later in the section on robustness checks.

earlier, the non-IV estimates mask the true impacts of school fees since they are biased upward toward zero. Put differently, they should be considered as the lower bound estimates in absolute magnitude of the true impacts.

We then instrument school fees with the shocks to local governments' education spending and show the full estimation results in the upper part of Table 2.[35] The lowest value of the F statistics (from the first stage regression) is 8.3 (column 1) and is somewhat lower than the rule of thumb (F>10) suggested by Stock and Yogo (2005); however, all the other F statistics are above this threshold, suggesting that our instrument is a reasonably good instrument.[36]

All the estimated coefficients on the school fees variables are still negative and now statistically significant at the 5 percent level or less. Furthermore, these coefficients are between two and three times larger in absolute magnitude than those from the non-IV regressions. This confirms the negative impacts of school fees on migrant workers' decisions to bring their children along, and supports our hypothesis that the non-IV estimates are biased upward toward zero. Since school fees are in natural logarithm, for small changes in school fees the magnitude of the impacts (semi-elasticity) can be read directly from the estimated coefficients. A 10 percent increase in school fees results in approximately between a 2 percentage point decrease (Table 2, column 3) to a 4 percentage point decrease (column 1) in the probability that the migrant worker brings his children along.[37] Given that 38 percent of migrant households bring their children with them to the city, these figures are equivalent to a 5 percent (=2/38) and 11 percent decrease respectively in the probability that the migrant worker brings his children along. These changes are slightly larger if we consider the impacts of mean school fees (columns 4 to 6).

[35] The first-stage regression results are reported in Table 3.1 in Appendix 3.

[36] Note that Stock and Yogo's rule of thumb applies to identically and independently distributed errors, whereas our estimates are obtained with robust standard errors. Our IV also passes the Anderson-Rubin test for weak-instruments (not shown), which is valid with robust standard errors.

[37] An alternative interpretation is to estimate and plot the predicted probabilities at different levels of school fees; see Figure 4 for this approach.

Estimation results for the other control variables (columns 2, 3, 5, and 6) show the expected impacts on the migrant worker's decisions. In particular, if the migrant worker is self-employed or migrated to a city within his original province, he is more likely to bring his children along. The first result may be explained by the fact that self-employment may give the migrant worker a more flexible work schedule that permits better care of children; the second result suggests that within-province migration may provide migrant children with better prospects, perhaps because of either lower migration costs or similar languages or cultural proximity (see Corollary 1.1). Surprisingly, the growth rate of the student-teacher ratio has a negative effect on the migrant worker's decision, but this result is not strongly statistically significant.[38]

Table 3 shows the impacts of school fees on the number of children the migrant worker brings to the city. The estimated coefficients on school fees are negative and strongly statistically significant as predicted by our theoretical model (Proposition 2) apart from column (6) were the effect is only significant at the 10 percent level. A 10 percent increase in the median school fees (Table 3, column 3) would lead to 0.02 fewer children being brought along. Other coefficients largely remain in the same order of magnitude as those in Table 2 (not shown).

We then examine whether school fees result in gender discrimination against girls. Put differently, we want to know if, conditional on having at least one school-age girl, the migrant workers bring their sons instead of their daughters in response to an increase in school fees as predicted by our theoretical model (Proposition 2). For each migrant household having at least one daughter, we define a variable indicating girl "representativeness", which is the share of girls in the number of children brought along over the share of girls in the household's total number of children. If this variable is larger (smaller) than one, then girls are "over-presented" ("under-represented") as migrants. Estimation results restricted to the sample of migrants that have at least one daughter are shown in Table 4.

[38] We have also estimated the reduced form of our model and obtained coefficients that are all significant.

All the estimated coefficients on school fees are negative, but only marginally statistically significant at the 10 percent level under columns (1) and (4). This result can thus provide some supportive, but not very strong, evidence for girl discrimination when school fees increase. However, note that the weak significance may also result from the smaller sample size—which is less than half of that in Tables 2 and 3—when we restrict the estimation sample to migrant households with at least one school-age girl.

5.2. Robustness Checks

Our estimation results remain stable against different robustness checks. Overall, out of all the robustness checks in Table 5, only three (columns 4, 14, and 18) lose some negligible statistical significance, and become statistically significant at the 6 percent level. We discuss next the specific checks.

Alternative measures of school fees

To rule out the concerns that our results may be driven by how the school fee variable is defined, we examine below four different options to construct this variable and present the estimation results in Table 5. For comparison purposes, we show the same estimates from columns 3 and 6 of Table 2 in columns 1 and 2 of this table. First, instead of looking at total school fees (which consists of tuition fee, food and accommodation, remedial class, and other fees), we focus on its major component—the tuition fee. The rationale behind this is that schools uniformly charge tuition fees across the country, whereas the use of other fees may vary from city to city. Estimation results (Table 5, columns 3 and 4) are qualitatively similar to those under columns 1 and 2, even though they are unsurprisingly slightly smaller in magnitude.

Second, to allay the concern that the median or the mean fees may not be the best measure, we consider other measures such as the 25^{th} and the 75^{th} percentiles of the distribution of school expenses. These percentiles provide further checks against the possibility that outliers may possibly dominate the distribution of school fees and affect the results. Estimates shown under

columns 5 and 6 are qualitatively similar to those under columns 1 and 2, and are even slightly larger in magnitude. Third, instead of converting the school fees into logarithmic form, we consider them in units of thousand yuan. Estimation results shown under columns 7 and 8 are, again, qualitatively similar. Finally, instead of using the fees paid by migrant households, we use the fees paid by urban households in the same city. As discussed earlier, the school fees that they pay can offer another measure of the distribution of school fees in the city. We show estimates for both the median and mean total fees (columns 9 and 10) and the median and the mean tuition fees (columns 11 and 12), which are qualitatively similar even though smaller in magnitudes.

Public versus private schools

Since public schools are generally considered to have higher quality than private schools in urban China (see, e.g., Goodburn, 2009), to what extent could our results be affected by the mix of school supply in different cities? Besides this quality difference, there can be a cost difference between these two types of school as well (e.g., public schools can charge migrant households the additional school selection (*Jie Du* fee). As such, could migrant households consider sending their children to the higher-quality (and possibly more expensive) public schools or leave them behind, rather than choosing the (possibly less expensive) private schools? To investigate this issue, we implement several robustness checks as follows. First, we compare the various fees between public schools and private schools measured at the city level, which turn out not to be statistically different (except for the higher *Jie Du* fee charged by public schools, but the difference for this fee is only significantly different at the 10 percent level; not shown). Second, we rerun the estimates in Table 2 after dropping all the migrant children that attend a private school in the destination cities. Estimation results (Table 3.2 in Appendix 3) are very similar to those in Table 2. Finally, we rerun the estimates in Table 2 but focus only on the sample of migrant children that currently live in the cities, and convert the dependent

variable to a dummy variable that respectively equals 1 or 0 if the migrant child attends a public school or a private school. This regression can help us detect whether school fees can have an impact on the type of schools in the cities that migrant children attend; estimation results, however, indicate that the estimated coefficients on schools fees are not statistically significant (not shown).[39]

Additional control variables and empirical modelling options

One concern is that the negative impacts of school fees could be caused by their correlation with migrant workers' income. We address this issue by controlling for income in the regressions (columns 13 and 14). Estimates are slightly smaller in magnitude, but still qualitatively similar. An alternative modelling option besides the linear probability model is the probit model. The latter may be more appropriate if predictions from the former do not fit well in the range [0, 1] or the variance of the error terms heavily depends on the estimated model coefficients. Estimation results using the IV probit model, however, provide similar results (see Table 3.3 in Appendix 3).

Alternative IV construction and method

We offer two additional ways to construct the IV. First, we apply the HP filter to generate shocks, and second, we use the total sum of the shocks in the past two years. Estimation results are displayed in columns 13 to 16, which provide qualitatively similar results. Second, Figure 4 plots the predicted probabilities (based on Models 1 and 3 in Table 2) that the migrant worker brings his children and their upper bounds and lower bounds based on the Chernozhukov et al. (2013) method against the median school fees. The predicted probabilities reassuringly fall within the bounds.[40]

[39] Yet, as a further check, we re-estimate Table 2 and control for public schools as a share of the total number of schools in the cities. Estimation results (not shown) remain very similar.

[40] Since the predicted probabilities from Model 2 are rather similar to those from Model 3, we do not plot them to make the graph easier to read.

5.3. Heterogeneity Analysis

Vulnerable migrant households

We check whether our estimation results still hold for different groups of migrant households, particularly the vulnerable and disadvantaged groups (as predicted by Corollary 3.2). For this, we stratify the sample in various ways and estimate our main specification (column 3 from Table 3) on each subsample. Table 6 reports the impacts of the instrumented median school fee on the migrant worker's decision to bring the child for (some of) these subsamples.

We first stratify the sample by income, defining as poor those who fall in the lower half of the household income distribution, and non-poor the remaining households. Table 6 (row 1) shows that higher school fees indeed deter poor migrants from bringing their children with them. These results, however, do not hold for the non-poor group. We then stratify the sample by insurance (or social benefits) status, and find that the same results hold for the migrants who do not have any access to these benefits (row 2).[41]

The impacts of school fees are statistically significant for households who migrated to non-coastal cities: Zhengzhou, Luoyang, Hefei, Bengbu, Chongqing, Wuhan and Chengdu (row 3). For households that migrated to coastal cities (Guangzhou, Dongguan, Shenzhen, Shanghai, Nanjing, Wuxi, Hangzhou and Ningbo), the impacts are only significant after controlling for housing prices (not shown).

We then stratify the migrant workers sample into two groups according to their work status: those with a permanent (or long-term) contract (one year or more) and those with a short-term contract (less than one year) or without a contract (including the self-employed, family business helpers, part-timers, workers in a probationary period or interns, apprentices or hourly workers).

[41] For each migrant worker, RUMiC records the enrollment status of four major social insurances/benefits: unemployment insurance, pension insurance, work injury insurance, and housing fund (*San Xian Yi Jin*), which are mandated by the Social Insurance Law. We define a migrant worker as insured if he/she has access to at least one of these insurances/benefits.

Migrant households with a short-term contract are affected by higher school fees (row 4), while those with a permanent or long-term contract are not (not shown).

Next, we divide the sample by two subjective indicators: whether the household head is planning to stay in the city for a long time, and whether the household head is depressed based on Center for Epidemiological Studies Depression Scale (CES-D10) questions.[42] Estimation results, however, are similar for these different groups, even though the depressed migrant workers appear to be more impacted by changes in school fees (with the estimated coefficients being larger than those in Table 3, column 3) (row 6).

We then compare the impacts for migrant households with more than one child and migrant households with only one child. The estimation results show that households with only one child (row 7) are more likely to be affected by school fees. Migrant households with both spouses in the city (row 8) or with only one spouse (not shown) are both sensitive to school fee changes. The same result holds for both employees (not shown) and the self-employed (row 9).

Overall, the estimation results in Table 6 suggest that the vulnerable groups (including the poor, the uninsured, those without permanent contracts, and to some extent, the depressed) are more sensitive to changes in school fees. These results are consistent with our theoretical results.

School fees and child migration during the economic crisis

Our theoretical results suggest that child migration would increase in response to the reduced school fees in 2009 (Propositions 1 and 3), but would decrease during the economic crisis in this same year (Corollary 3.3). Which effect would dominate child migration? Estimation results using the 2009 wave of the RUMiC survey show that the non-IV estimates (Table 7, row 1) are negative, and are between 60 percent and twice larger in absolute magnitude than those for 2008 (bottom of Table 2). Since the upward biased non-IV estimates

[42] We recode the answers to the questions about depression such that higher scores imply a more intense state of depression. We define a person as depressed if the summation of his/her scores is greater than 22.

provide lower bound estimates of the true impacts of school fees, this offers evidence that the negative effects of the economic crisis dominate the positive effects coming from a reduction in school fees. Furthermore, even though our IV is severely weakened for the crisis year (as discussed in section 4.2) and thus could only offer statistically significant estimates in two specifications (columns 1 and 4), the IV estimates have the expected negative sign and are two to three times larger than those of the non-IV estimates. These results concur with those for Table 2.[43]

6. Further Analysis of Related Outcomes

6.1. Health Outcomes for Migrant Children

Our theoretical model predicts that children brought along by migrant households may have better health outcomes (Corollary 1.1). This result is strongly supported by most, if not all, of the recent studies on China as discussed earlier. We re-examine this result with the RUMiC data, and investigate whether moving with parents impacts children's height, their body mass index (BMI) and the underweight/overweight status.[44] We regress these child health outcomes on a dummy variable indicating whether the child is living in the city with the migrant household, controlling for children's and the household heads' characteristics. The endogenous variable here is the child migration dummy variable and the IV is the public education spending shocks (the first-stage regression in this case is the reduced form regression). Unlike the previous regressions that were run at the household level, we run these regressions at the individual level for all the school-age children in the sample. Estimation results (Table 8)

[43] Since we do not have data on migrants' province of original residence for 2009, we do not control for these dummy variables. An alternative modelling option is to pool the 2008 and 2009 rounds of the RUMiC for analysis. While this option allows us to employ a richer econometric model by controlling for the year and city (fixed) effects, it does not offer more insights into the crisis year as discussed above. Estimation results on the pooled data (not shown) nevertheless confirm that school fees have a negative and statistically significant impacts on child migration.

[44] The Body Mass Index (BMI), a measure of tissue mass (muscle, fat and bone) in an individual, is computed as the ratio of weight (in kilograms) to squared height (in meters). Using WHO's guidelines, we consider that children with a BMI less than 18.5 and equal or greater than 25 are respectively underweight and overweight.

indicate that moving with parents is associated with greater height, even though these impacts is marginally statistically significant at the 10 percent level. Moving with parents is associated with a lower probability of being overweight (column 3) but has no statistically significant correlation with being underweight (columns 2 and 4).

6.2. School Fees and Education Remittances

A migrant worker may leave his children behind and send remittances back home rather than bring his children to the city if school fees are unaffordable. As discussed earlier, this is the migrant worker's best response to higher school fees, since the remittances in this case would be less than the expenses that would have been required for the children in the city given the higher school fees (see footnote 20 in Section 3). We assess the impacts of the school fees on the educational remittances sent back home and provide estimation results in Table 9. Since about 45 percent of the household reported zero educational remittances, we resort to an IV-Tobit model to address the left-censoring issue. Estimation results suggest that the higher the school fees in urban areas, the more migrant households remit back home. A 10 percent increase in school fees results in an increase of between 241 and 304 yuan in the annual remittances (Table 9, columns 1 to 3).[45] This lends further support to our theoretical intuition that higher school fees prevent migrant workers from bringing their children with them to the city, and thus encourages them to send education remittances back home instead. However, greater remittances may not necessarily result in better outcomes for LBCs; as a recent study by Demurger and Wang (2016) points to a strong negative impact of remittances on education expenditures in remittances-receiving households. This suggests that leaving the children behind and sending remittances may not be the optimal decision for migrant workers.

[45] We include the remittances used for education-related expenditures including tuition fees, food and accommodation, remedial class, and other fees. Other interesting results in Table 9 indicate that older household heads send more remittances back home, while those who are self-employed and within-province migrants send less remittances, and that educational achievement does not have any impact on remittances.

7. Conclusion

We add to the literature by investigating a major constraint to parental migration—school fees—that affects their children's welfare. We provide new theoretical and empirical evidence that points to the harmful effects of increased school fees (across major cities in China) on migrant households' decisions over whether to bring with them their children, the number of children to bring, and the gender of the children they bring. Moving with parents could benefit migrant children with better health outcomes and lower risks of being overweight. These effects are robust to different measures of school fees as well as to different techniques used to construct the instrumental variable. Further heterogeneity analysis shows that vulnerable migrant households are more impacted by school fee changes, and the negative effects of higher school fees may possibly be larger during an economic crisis.

Our study is relevant to the Chinese context or any other country that is undergoing -urban migration. Remarkably, China's growing rural-urban dualism creates social tensions and increasingly becomes a constraint for further labor-market integration, urbanization, and economic development. Even though the country has abolished school fees starting in late 2008, in practice, migrant households are still found to be obliged to pay various school-related fees. Thus, our results can lend quantitative supportive evidence to the removal of school fees by the government, and similar policies aimed at improving migrants' access to public service irrespective of their place of residence (see, for example, Hu et al., 2008). Our findings also suggest that the central government may consider better targeted budget transfers to local governments that would specially address migrant children's education. If inclusive urbanization is to be accomplished, local governments could focus on achieving social welfare objectives (in particular better access to education for migrants) besides purely economic objectives.

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Table 1: Summary Statistics from the RUMiC sample, China 2008

	(1) N	(2) mean	(3) sd	(4) max	(5) min
Household characteristics					
Head's age	1,349	36.77	4.99	62	20
Head is female	1,349	0.26	0.44	1	0
Head's highest education level is primary school and above	1,349	0.82	0.39	1	0
Head's highest education level is middle school and above	1,349	0.29	0.46	1	0
Head lives with spouse	1,349	0.65	0.48	1	0
Head lives with child	1,349	0.38	0.49	1	0
Number of school-age children living with head	1,349	0.46	0.65	3	0
Migrated within province	1,349	0.57	0.50	1	0
Remittances sent out for educational purposes ('000 yuan)	1,349	1.10	2.23	18	0
Household per capita income ('000 yuan)	1,349	1.34	1.01	12	0
Head is working	1,349	0.97	0.16	1	0
Head is self-employed	1,349	0.36	0.48	1	0
Destination city characteristics					
Growth rate of student-teacher ratio	1,349	1.02	2.19	6.56	-2.58
Education spending shocks (HP filter, lagged one year)	1,349	-0.29	0.93	1.05	-2.66
Education spending shocks (linear filter, lagged one year)	1,349	-0.46	1.27	1.02	-3.82
Education spending shocks (HP filter, lagged two years)	1,349	-0.64	0.96	0.39	-3.50
Housing prices in 2007 ('000 yuan)	1,349	5.60	2.62	13.37	2.29
Mean school fees (in migrant sample) (Ln)	1,349	7.76	0.36	8.65	6.86
Median school fees (in migrant sample) (Ln)	1,349	7.38	0.45	8.05	6.48
Coastal city	1,349	0.47	0.50	1	0
Guangzhou	1,349	0.07	0.25	1	0
Dongguan	1,349	0.05	0.22	1	0
Shenzhen	1,349	0.04	0.19	1	0
Shanghai	1,349	0.11	0.31	1	0
Nanjing	1,349	0.06	0.24	1	0
Wuxi	1,349	0.03	0.16	1	0
Hangzhou	1,349	0.08	0.27	1	0
Ningbo	1,349	0.04	0.20	1	0
Zhengzhou	1,349	0.07	0.26	1	0
Luoyang	1,349	0.04	0.19	1	0
Hefei	1,349	0.09	0.29	1	0
Bengbu	1,349	0.06	0.23	1	0
Chongqing	1,349	0.09	0.29	1	0
Wuhan	1,349	0.08	0.27	1	0
Chengdu	1,349	0.10	0.30	1	0

Source: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008.

Table 2: Effects of school fees on child migration, China 2008

	(1)	(2)	(3)	(4)	(5)	(6)
	Median school fees			Mean school fees		
School fee measure (Ln)	-0.428**	-0.168***	-0.160**	-0.511***	-0.224***	-0.211**
	(0.169)	(0.057)	(0.068)	(0.187)	(0.084)	(0.099)
Head's age	0.004	0.004	0.004	0.004	0.004	0.004
	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)
Head is female	0.092	0.025	0.025	0.087	0.026	0.025
	(0.058)	(0.045)	(0.045)	(0.059)	(0.045)	(0.045)
Head's highest education level is primary school and above	0.013	-0.013	-0.012	-0.000	-0.014	-0.013
	(0.036)	(0.030)	(0.029)	(0.030)	(0.029)	(0.029)
Head's highest education level is middle school and above	0.009	0.024	0.023	0.018	0.025	0.025
	(0.028)	(0.028)	(0.027)	(0.027)	(0.027)	(0.027)
Head is working		-0.115**	-0.112*		-0.142***	-0.136**
		(0.057)	(0.060)		(0.053)	(0.059)
Head is self-employed		0.281***	0.279***		0.279***	0.277***
		(0.032)	(0.033)		(0.032)	(0.034)
Migrated within province		0.133***	0.123***		0.144***	0.131***
		(0.048)	(0.038)		(0.046)	(0.037)
Growth rate of student-teacher ratio		-0.014**	-0.013		-0.004	-0.003
		(0.007)	(0.008)		(0.005)	(0.007)
Housing price in 2007 ('000 yuan)			-0.004			-0.005
			(0.008)			(0.009)
Constant	3.413***	1.500***	1.467***	4.203***	2.005***	1.934***
	(1.233)	(0.406)	(0.464)	(1.424)	(0.644)	(0.737)
Observations	1,349	1,349	1,349	1,349	1,349	1,349
Original province FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	YES	YES	NO	YES	YES
RMSE	0.493	0.432	0.432	0.486	0.431	0.430
Prob>chi2	0.000	0.000	0.000	0.000	0.000	0.000
First stage F statistic	8.273	21.165	15.146	10.781	17.004	12.115
Non-Instrumented Regressions	-0.141**	-0.072**	-0.042	-0.212**	-0.119***	-0.089
	(0.062)	(0.034)	(0.042)	(0.087)	(0.045)	(0.058)

Note: Each column presents the results from separate IV regressions with different school fee measures and different independent variables, where the IV is the one-year lag of shocks to public education spending. The dependent variable is a *dummy variable that equals 1 if there is at least one child living with the household head, and 0 otherwise*. The first three columns ((1)-(3)) use the median school fees reported in the migrant household sample as a regressor, and the last three columns ((4)-(6)) use the mean school fees reported in the migrant household sample as a regressor. Different sets of control variables are included in different columns. R-squared values are not reported, instead, root-mean-square error (RMSE), the sample standard deviation of the differences between the predicted values and observed values, is reported under each column. Standard errors in parentheses are clustered at the city level. Prob>chi2 is the p-value of the chi-square test of overall significance. F statistics of the first stage regressions are also reported. *** p<0.01, ** p<0.05, * p<0.1.
Sources: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008.

Table 3: Effects of school fees on the numbers of children brought to the city, China 2008

	(1)	(2)	(3)	(4)	(5)	(6)
	Median school fees			Mean school fees		
School fee measure (Ln)	-0.536**	-0.211**	-0.205**	-0.639**	-0.282**	-0.271*
	(0.227)	(0.089)	(0.103)	(0.256)	(0.137)	(0.157)
Observations	1,349	1,349	1,349	1,349	1,349	1,349
Household head's demographics	YES	YES	YES	YES	YES	YES
Household head's employment variables	NO	YES	YES	NO	YES	YES
Within-province migration dummy variable	NO	YES	YES	NO	YES	YES
Growth rate of student-teacher ratio	NO	YES	YES	NO	YES	YES
Housing prices in 2007	NO	NO	YES	NO	NO	NO
Original province FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	YES	YES	NO	YES	YES
RMSE	0.493	0.432	0.432	0.486	0.431	0.430
Prob>chi2	0.000	0.000	0.000	0.000	0.000	0.000
First stage F statistic	8.273	21.165	15.146	10.781	17.004	12.115

Note: Each column presents the results from separate IV regressions with different school fee measures and different independent variables, where the IV is the one-year lag of shocks to public education spending. The dependent variable is *the numbers of children living with their parents in the household*. The first three columns ((1)-(3)) use the median school fees reported in the migrant household sample as a regressor, and the last three columns ((4)-(6)) use the mean school fees reported in the migrant household sample as a regressor. Different sets of control variables, which are similar to Table 2, are included under each column. R-squared values are not reported. Instead, root-mean-square error (RMSE), the sample standard deviation of the differences between the predicted values and observed values, is reported under each column. Standard errors in parentheses are clustered at the city level. Prob>chi2 is the p-value of the chi-square test of overall significance. F statistics of the first stage regressions are also reported. *** p<0.01, ** p<0.05, * p<0.1
Sources: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008.

Table 4: Effects of school fees on the gender of children brought to the city, China 2008

	(1)	(2)	(3)	(4)	(5)	(6)
	Median school fees			Mean school fees		
School fee measure (Ln)	-0.417*	-0.086	-0.082	-0.493*	-0.114	-0.106
	(0.234)	(0.085)	(0.096)	(0.254)	(0.118)	(0.131)
Observations	662	662	662	662	662	662
Household head's demographics	YES	YES	YES	YES	YES	YES
Household head's employment variables	NO	YES	YES	NO	YES	YES
Within-province migration dummy variable	NO	YES	YES	NO	YES	YES
Growth rate of student-teacher ratio	NO	YES	YES	NO	YES	YES
Housing prices in 2007	NO	NO	YES	NO	NO	NO
Original province FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	YES	YES	NO	YES	YES
RMSE	0.491	0.420	0.420	0.483	0.420	0.420
Prob>chi2	0.040	0.000	0.000	0.192	0.000	0.000
First stage F statistic	6.926	19.696	12.374	9.505	17.679	10.824

Note: Each column presents the results from separate IV regressions with different school fee measures and different independent variables, where the IV is the one-year lag of shocks to public education spending. The dependent variable is *girl representativeness* - defined as girls as a share of the number of migrant children divided by girls as a share of the total number of children in the household. The first three columns ((1)-(3)) use the median school fees reported in the migrant household sample as a regressor, and the last three columns ((4)-(6)) use the mean school fees reported in the migrant household sample as a regressor. Different sets of control variables, which are similar to Table 2, are included under each column. R-squared values are not reported, instead, root-mean-square error (RMSE), the sample standard deviation of the differences between the predicted values and observed values, is reported under each column. Standard errors in parentheses are clustered at the city level. Prob>chi2 is the p-value of the chi-square test of overall significance. F statistics of the first stage regressions are also reported. *** p<0.01, ** p<0.05, * p<0.1.
Sources: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008.

Table 5: Alternative measures of school fees and other robustness checks, China 2008

	Panel A									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	School fees		Tuition fees		School fees		School fees ('000, yuan)		School fees, Urban	
	Median	Mean	Median	Mean	p25	p75	Median	Mean	Median	Mean
School fee measure	-0.160**	-0.211**	-0.127**	-0.181*	-0.167***	-0.236**	-0.107**	-0.104**	-0.094**	-0.104**
	(0.068)	(0.099)	(0.057)	(0.093)	(0.052)	(0.111)	(0.043)	(0.046)	(0.047)	(0.049)
	Panel B									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	Tuition fees, Urban		Control for income		Control for Social Protection Spending		HP filter		2-Year lagged shock	
	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean
School fee measure	-0.115**	-0.128**	-0.137**	-0.181*	-0.188**	-0.230**	-0.157**	-0.207*	-0.198**	-0.258**
	(0.051)	(0.063)	(0.064)	(0.094)	(0.080)	(0.105)	(0.072)	(0.106)	(0.085)	(0.124)
Household heads' demographics	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Household heads' working variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Within province dummy variable	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Growth rate of student-teacher ratio	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing prices in 2007	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Original province FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: Each column presents the results from separate IV regressions with different school fee measures and different independent variables, where the IV is the one-year lag of shocks to public education spending. The dependent variable is a dummy variable that equals 1 if there is at least one child living with the household head in urban areas, and 0 otherwise. The different measures of school fees under Columns (1)–(12) are defined as follows: Columns (1)-(2), log median and mean school fees (including tuition fees, food and accommodation, remedial classes, and other fees) reported in the migrant sample; Columns (3)-(4), log median and mean tuition fees reported in the migrant household sample; Columns (5)-(6), log 25th percentile and 75th percentile school fees reported in the migrant household sample; Columns (7)-(8), median and mean school fees (in thousand yuan) reported in the migrant household sample; Columns (9)-(10), log median and mean school fees reported in the urban household sample; Columns (11)-(12), log median and mean tuition fees reported in the urban household sample. Columns (13)-(20) use the same measures of school fees as in columns (1)-(2). In columns (13)-(14), household income per capita is included as a control variable. In Columns (15)-(16), social protection spending per capita at the city level is included as a control variable. In columns (17)-(18), the shocks generated by Hodrick-Prescott (HP) filter with smoothing parameter 6.25 is used as instrument. In columns (19)-(20), the sum of the public education spending shocks in 2005 and 2006 (linear filter) are used as instrument. Standard errors in parentheses are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

Sources: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008.

Table 6: Heterogeneity analysis, China 2008

	(1)	(2)	(3)
Sub-Samples			
(1) Poor	-0.368**	-0.191**	-0.206**
	(0.152)	(0.075)	(0.087)
(2) Not insured	-0.382***	-0.176***	-0.152**
	(0.124)	(0.051)	(0.059)
(3) Hinterland migration	-0.171**	-0.092	-0.101**
	(0.087)	(0.057)	(0.051)
(4) Short-term work	-0.377***	-0.195***	-0.202***
	(0.139)	(0.065)	(0.077)
(5) Not likely to move	-0.380***	-0.173*	-0.159
	(0.133)	(0.098)	(0.103)
(6) Depressed	-0.814**	-0.310	-0.339*
	(0.406)	(0.193)	(0.191)
(7) With only one child	-0.421***	-0.195***	-0.194***
	(0.158)	(0.060)	(0.072)
(8) With spouse	-0.454**	-0.195***	-0.173*
	(0.189)	(0.069)	(0.091)
(9) Self-employed	-0.281***	-0.161***	-0.091
	(0.107)	(0.054)	(0.069)
Household head's demographics	YES	YES	YES
Household head's employment variables	NO	YES	YES
Within-province migration dummy	NO	YES	YES
Growth rate of student-teacher ratio	NO	YES	YES
Housing prices in 2007	NO	NO	YES
Original province FE	YES	YES	YES
Industry FE	NO	YES	YES

Note: The estimated coefficients in this table present the results from separate IV regressions using 9 different sub-samples and different control variables, where each row presents estimation results from different sub-samples. The dependent variable is a *dummy variable that equals 1 if there is at least one child living with the household head in urban areas, and 0 otherwise*. Different sets of control variables, which are similar to Table 2, are included under each column. The 9 different sub-samples are defined as follows: in row (1), poor households are those who fall in the lower half of the household income distribution; In row (2), the insured are those who have access to at least one of the job-related insurances/benefits (unemployment insurance, pension insurance, work injury insurance, and housing fund); In row (3), hinterland migration is to non-coastal cities (Zhengzhou, Luoyang, Hefei, Bengbu, Chongqing, Wuhan and Chengdu); Row (4), short-term workers are those who are without permanent contracts and long-term contract (one year or more) as; In row (5), not likely to move characterizes household heads who plan to stay in the city forever; In row (6), we define depressed migrants based on Center for Epidemiological Studies Depression Scale (CES-D10) questions (see footnote in the text for more details); In row (7), we consider migrants with only one child (versus migrants with more than one child); In row (8), the focus is on migrants who are living with their spouses; Row (9) corresponds to self-employed migrants. Standard errors in parentheses are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.
Sources: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008.

Table 7: School fees and child migration during the economic crisis, China 2009

	(1)	(2)	(3)	(4)	(5)	(6)
	Median school fees			Mean school fees		
School fee measure (Ln), OLS	-0.226***	-0.148***	-0.121***	-0.281***	-0.225***	-0.180**
	(0.043)	(0.046)	(0.044)	(0.090)	(0.073)	(0.076)
School fee measure (Ln), IV	-0.449***	-0.440	-0.408	-0.656**	-0.372*	-0.322
	(0.154)	(0.311)	(0.359)	(0.324)	(0.202)	(0.205)
Observations	1,005	1,005	1,005	1,005	1,005	1,005
Household head's demographics	YES	YES	YES	YES	YES	YES
Household head's employment variables	NO	YES	YES	NO	YES	YES
Growth rate of student-teacher ratio	NO	YES	YES	NO	YES	YES
Housing prices in 2008	NO	NO	YES	NO	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES
First Stage F Statistic	22.310	3.371	1.605	9.697	13.647	8.485

Note: Each column presents the results from separate IV regressions with different school fee measures and different independent variables, where the IV is the one-year lag of shocks to public education spending. The dependent variable is a *dummy variable that equals 1 if there is at least one child living with the household head*, and 0 otherwise. The first three columns ((1)-(3)) use the median school fees reported in the migrant household sample as a regressor, and the last three columns ((4)-(6)) use the mean school fees reported in the migrant household sample as a regressor. Different sets of control variables, which are similar to Table 2, are included under each column. R-squared values are not reported, instead, root-mean-square error (RMSE), the sample standard deviation of the differences between the predicted values and observed values, is reported under each column. Standard errors in parentheses are clustered at the city level. Prob>chi2 is the p-value of the chi-square test of overall significance. F-statistics of the first stage regressions are also reported. *** p<0.01, ** p<0.05, * p<0.1.

Sources: Rural Urban Migration in China (RUMiC) 2009 and China City Statistical Yearbook 2002-2009.

Table 8: Child migration and well-being, China 2008

	(1) Height	(2) Underweight	(3) Overweight	(4) Child Health
Migrated with parent(s)	15.563*	0.023	-0.214**	0.263
	(9.302)	(0.252)	(0.105)	(0.292)
Child's age	5.564***	0.001	-0.017***	0.002
	(0.270)	(0.007)	(0.005)	(0.007)
Child's gender	-2.905***	0.065***	-0.020*	0.038
	(0.880)	(0.023)	(0.012)	(0.032)
Head's age	-0.102	-0.007	0.003	-0.004
	(0.176)	(0.006)	(0.002)	(0.005)
Head is female	3.446**	0.032	-0.001	-0.062
	(1.488)	(0.044)	(0.025)	(0.063)
Head's height	0.257***	-0.003	0.001	0.006
	(0.086)	(0.003)	(0.001)	(0.004)
Head's highest education level is primary school and above	1.283	-0.070**	-0.016	0.108***
	(1.110)	(0.028)	(0.026)	(0.041)
Head's highest education level is middle school and above	-0.282	0.020	-0.000	-0.006
	(0.778)	(0.033)	(0.022)	(0.039)
Constant	30.069**	1.293***	0.220	3.298***
	(14.882)	(0.436)	(0.209)	(0.780)
Observations	1,617	1,556	1,556	1,673
Original province FE	YES	YES	YES	YES
RSME	15.125	0.495	0.287	0.682
Prob>chi2	0.000	0.000	0.000	0.000
First Stage F Statistic	20.945	20.901	20.901	23.231

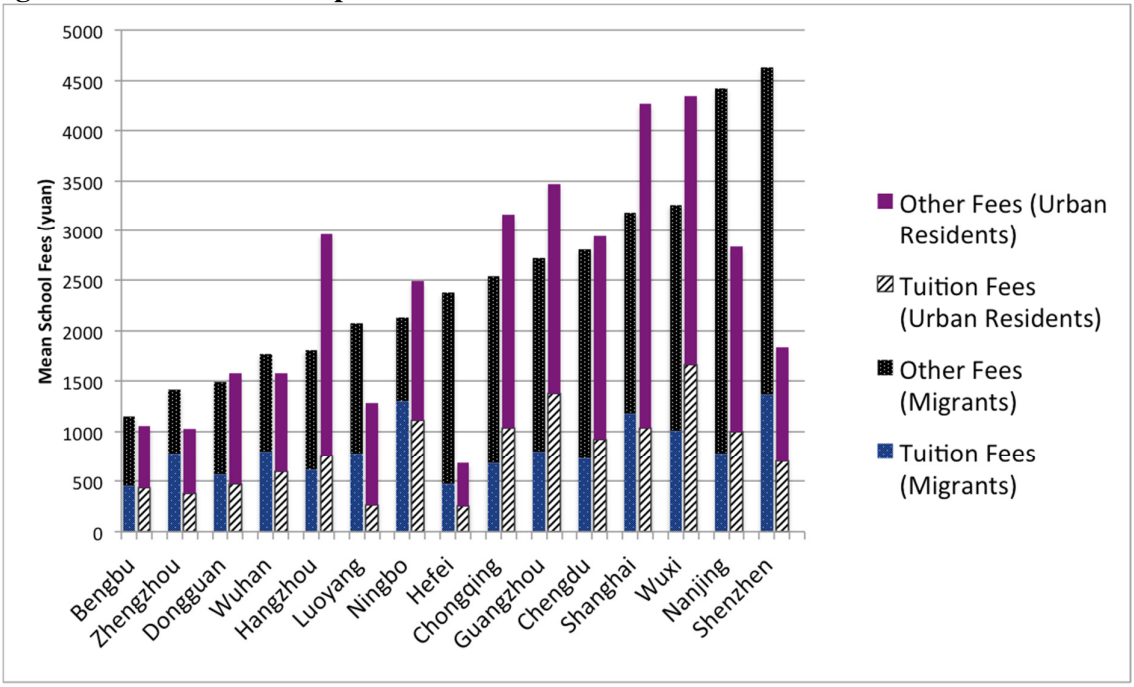
Note: Each column presents the results from separate IV regressions with different school fee measures and different independent variables, where the IV is the one-year lag of shocks to public education spending. The dependent variables in Column (1)-(4) are defined as follows: Column (1), height in centimeters (cm); Column (2), dummy variable indicating underweight (BMI<18.5); Column (3), dummy variable indicating overweight (BMI>25); Column (4), ubjective health score on a 1-5 scale, with a larger score indicating more satisfaction; for migrant children, this question is answered by themselves; for left-behind children, this question is answered by their migrant parents. R-squared values are not reported. Instead, the root-mean-square error (RMSE), the sample standard deviation of the differences between the predicted values and observed values, is reported under each column. Standard errors in parentheses are clustered at the city level. Prob>chi2 is the p-value of the chi-square test of overall significance. F statistics of the first stage regressions are also reported. *** p<0.01, ** p<0.05, * p<0.1.
Sources: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008.

Table 9: School fees and education remittances, China 2008

	(1)	(2)	(3)	(4)	(5)	(6)
	Median school fees			Mean school fees		
School fee measure (Ln)	3.040***	2.184***	2.411***	3.622***	2.927***	3.192***
	(1.097)	(0.621)	(0.666)	(1.145)	(1.018)	(1.151)
Head's age	0.133***	0.127***	0.129***	0.132***	0.127***	0.128***
	(0.035)	(0.032)	(0.032)	(0.036)	(0.033)	(0.032)
Head is female	-0.020	0.312	0.301	0.020	0.311	0.301
	(0.378)	(0.319)	(0.322)	(0.395)	(0.327)	(0.330)
Head's highest education level is primary school and above	0.176	0.308	0.339	0.267	0.317	0.345
	(0.395)	(0.332)	(0.329)	(0.354)	(0.327)	(0.322)
Head's highest education level is middle school and above	-0.257	-0.287	-0.298	-0.315	-0.307	-0.318
	(0.206)	(0.223)	(0.221)	(0.211)	(0.228)	(0.226)
Head is working		0.763	0.863*		1.125***	1.243***
		(0.490)	(0.505)		(0.363)	(0.465)
Head is self-employed		-0.686**	-0.747**		-0.666**	-0.718**
		(0.322)	(0.292)		(0.329)	(0.296)
Migrated within province		-0.376	-0.680*		-0.519	-0.796**
		(0.325)	(0.377)		(0.337)	(0.393)
Growth rate of teacher-student ratio		0.091	0.121*		-0.035	-0.020
		(0.082)	(0.065)		(0.095)	(0.076)
Housing price in 2007 ('000 yuan)			-0.127			-0.111
			(0.103)			(0.130)
Observations	1,349	1,349	1,349	1,349	1,349	1,349
Province FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	YES	YES	NO	YES	YES
Prob>chi2	0.000	0.000	0.000	0.000	0.000	0.000

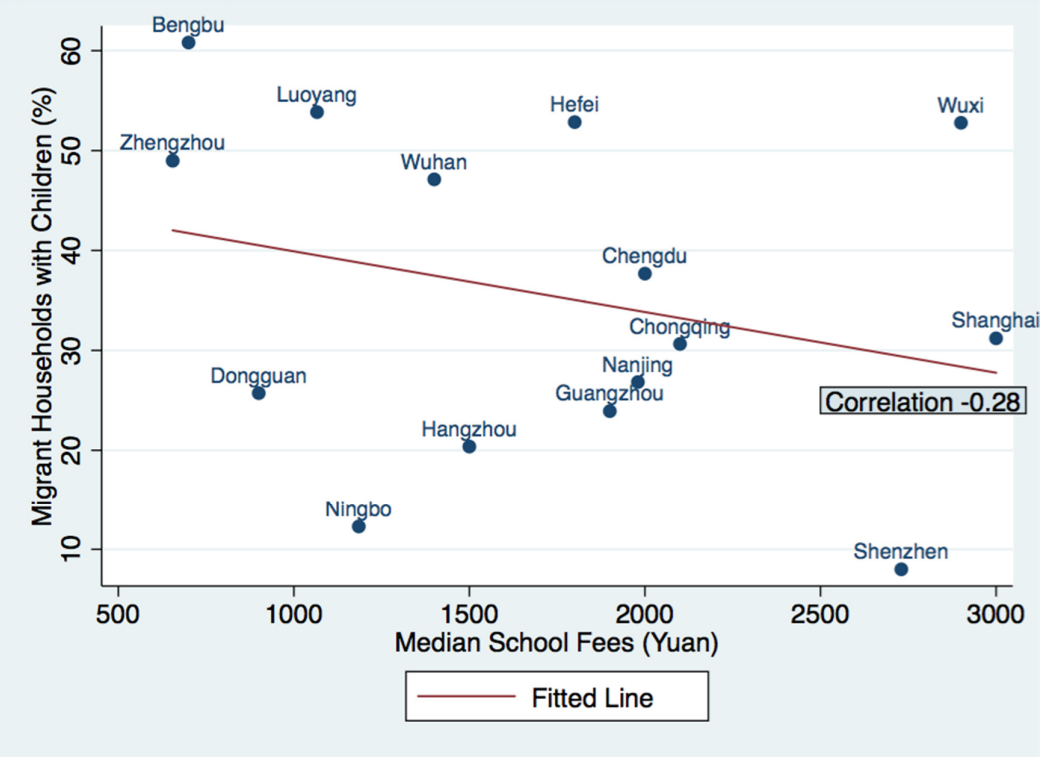
Note: Each column presents the results from separate IV-Tobit regressions with different school fee measures and different independent variables, where the IV is the one-year lag of shocks to public education spending. The dependent variable is *education remittances* - remittances used for education-related expenses including tuition fees, food and accommodation, remedial classes, and other fees (uniform and other sponsorship fees etc.). Different sets of control variables, which are similar to those in Table 2, are included under each column. Standard errors in parentheses are clustered at the city level. Prob>chi2 is the p-value of the chi-square test of overall significance. *** p<0.01, ** p<0.05, * p<0.1.
Sources: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008.

Figure 1: School fee decomposition



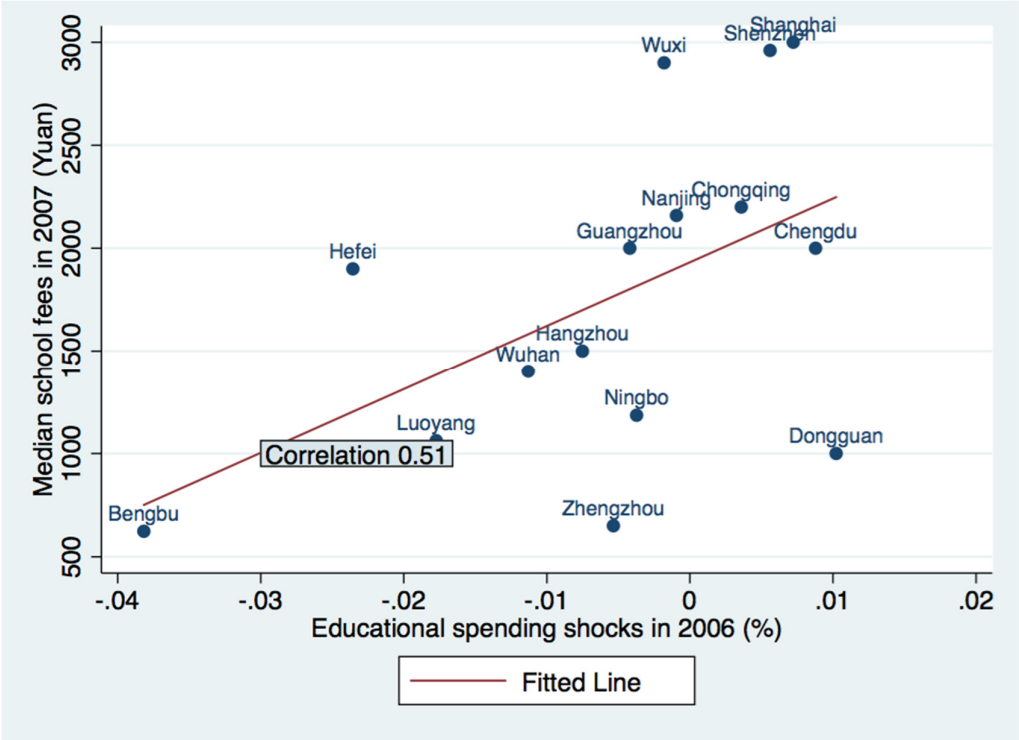
Note: City-level mean school fees of urban residents/migrants are decomposed into two components: (1) tuition fees, (2) other fees (including food and accommodation, remedial classes, uniform and other sponsorship fees etc.)
Source: Rural Urban Migration in China (RUMiC) 2008.

Figure 2: Child migration vs. school fees



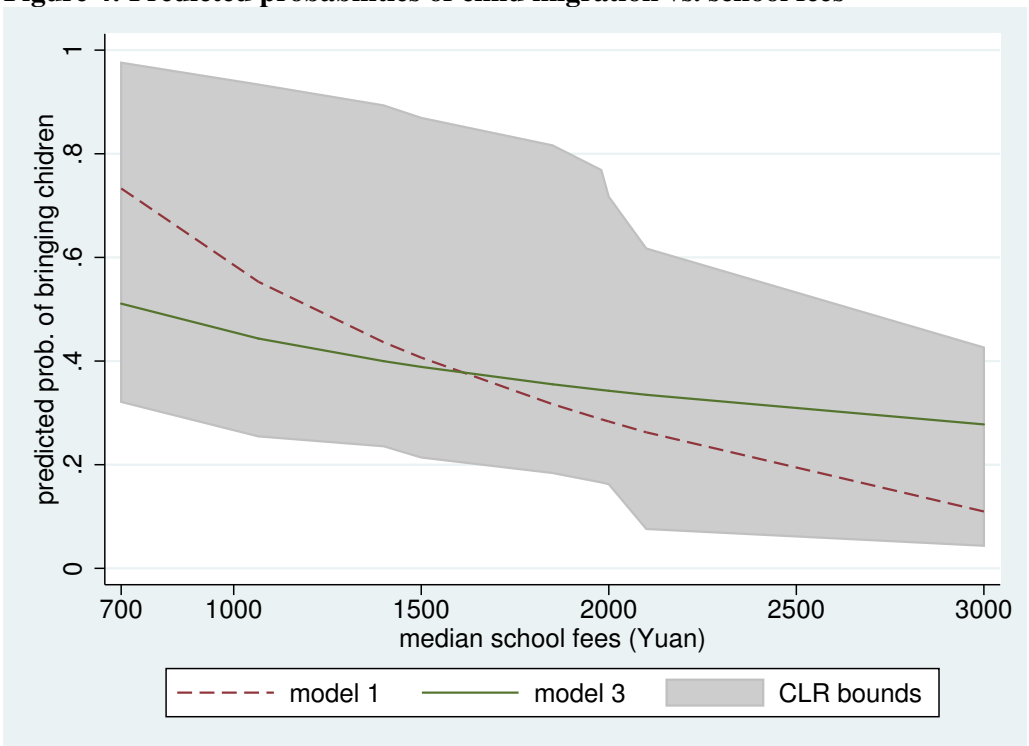
Note: We plot the shares of migrant households living with children for each city against the median school fees paid by migrants.
Source: Rural Urban Migration in China (RUMiC) 2008.

Figure 3: School fees vs. lagged education spending shocks



Note: We plot the median school fees paid by migrants in 2007 against the city-level education spending shocks in 2006 (linear filter).
Sources: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008.

Figure 4: Predicted probabilities of child migration vs. school fees



Note: We plot the predicted probabilities of the migrant worker bringing his children along against the median school fees paid by migrants. Estimates based on Model 2 are similar to those of Model 3 so are not plotted for easier reading. The lower and upper bounds are obtained using Chernozhukov, Lee, and Rosen (2013) method.
Sources: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008.

Appendix 1: Proofs and Estimation Procedures
Part A: Proofs for the theoretical model

■ We start by proving a short lemma which shows under which condition the case of migration to a single city can be envisioned.

Lemma 1: *If migration costs are high, households may only consider migration to the nearest city.*
Proof of Lemma 1: Let us consider a rural area of origin *j* and its nearest city denoted city 1 (i.e. city 1 is the city for which $m_{j,1} < m_{j,k}$ for $k \neq 1$). From (2), it is easy to see that there exist thresholds $m_{j,k}^{min}$ for $k \neq 1$ such that the condition $m_{j,k} > m_{j,k}^{min}$ ensures that $V_{j,1}^{U,c} > V_{j,k}^{U,c}$, $V_{j,1}^{U,c} > V_{j,k}^{U,nc}$, $V_{j,1}^{U,nc} > V_{j,k}^{U,c}$ and $V_{j,1}^{U,nc} > V_{j,k}^{U,c}$.[46] In this case, migration to city 1 is always preferable to migration to any other city. The additional assumption that $V^R > \max\{\tilde{V}_{j,k}\}_{k\neq 1}$ ensures that the household only considers whether to migrate to city 1 or remain in the rural area.

■ Next, we show how migration costs, school fees and non-schooling outcomes affect the decision to migrate and to bring one's child along (Proposition 1 and Corollary 1).

Proof of Proposition 1: Let us assume $w_1^U - w^R \geq m_{j,1}$. It follows that $V_{j,1}^{U,nc} - V^R = w_1^U - w^R - m_{j,1} \geq 0$, which implies that the worker prefers migrating without his child over staying in the rural area. In this case, the worker prefers bringing his child with him if and only if $V_{j,1}^{U,c} > V_{j,1}^{U,nc}$, which is tantamount to $f_1 \leq \Delta_1$. Let us now assume that $w_1^U - w^R < m_{j,1}$. This implies $V_{j,1}^{U,nc} < V^R$ and the worker prefers staying in the rural area over migrating without his child. We rule out the possibility that migration with the child could be preferred over staying in the rural areas by having the additional assumption that $f_1 > \Delta_1 + \left(w_1^U - w^R - m_{j,1}\right)$, which implies that $V_{j,1}^{U,c} < V^R$. This is a reasonable assumption to have since the contrary assumption $f_1 \leq \Delta_1 + \left(w_1^U - w^R - m_{j,1}\right)$ would have the gain in child outcomes net of school fees trump the worker's otherwise net utility loss from labor migration, a very unlikely situation. QED.

Proof of Corollary 1.1: It is easy to see that the greater $g(H_1^U, \boldsymbol{X}_1^U)$, the more likely $f_1 \leq \Delta_1 = g(H_1^U, \boldsymbol{X}_1^U) - g(H^R, \boldsymbol{X}^R)$ will hold. QED.

■ We then provide some insights regarding the more general case where workers may consider migration to different cities.

Lemma 2: *Whether the migrant brings the child along can depend on labor opportunities in competing destination areas.*
Proof of Lemma 2: We relax the assumption that $\min\{V_{j,1}^{U,c}, V_{j,1}^{U,nc}, V^R\} > \max\{\tilde{V}_{j,k}\}_{k\neq 1}$ and replace it with $\min\{V_{j,1}^{U,c}, V_{j,2}^{U,nc}\} > \max\left\{\{\tilde{V}_{j,k}\}_{k\neq 1,2}, V^R, V_{j,1}^{U,nc}, V_{j,2}^{U,c}\right\}$, which corresponds to the general case where the best two options for a worker originating for rural area *j* are migrating to a city with the child (denoted city 1 without any loss of generality) and migration to another city without the child (denoted city 2). The worker will choose to migrate to city 1 with his child if and only $V_{j,1}^{U,c} > V_{j,2}^{U,nc}$, which comes down to $\Delta_1 - f_1 > -[w_1^U - m_{j,1} - (w_2^U - m_{j,2})]$. This condition simply states that the net gain from child outcomes in city 1 exceeds the possibly net loss from a lower wage associated with migration to city 2.

[46]The exact formulas are $m_{j,k}^{min} = m_{j,1} - (w_1^U - w_k^U) + \max\{0, -f_k + \Delta_k, f_1 - \Delta_1, f_1 - f_k - (\Delta_1 - \Delta_k)\}$ for $k \neq 1$.

■ We now address the issue of migrant children selection (in the case of a household with a boy and a girl) and provide the proof for Proposition 2.

Proof of Proposition 2: Recognizing that households that bring only one child to the city will always choose to bring the most "valued" child (under our assumption, the boy, since $\alpha_b > \alpha_g$), the set of the relevant utilities expands as follows[47]

$$\begin{cases} V_{j,1}^{U,b} = w_1^U - m_{j,1} - f_1 + \alpha_b g(H_1^U, \boldsymbol{X}_1^U) + \alpha_g g(H^R, \boldsymbol{X}^R) \text{ if migrating with the boy to city 1} \\ V_{j,1}^{U,bg} = w_1^U - m_{j,1} - 2f_1 + (\alpha_b + \alpha_g) g(H_1^U, \boldsymbol{X}_1^U) \text{ if migrating with the boy and the girl to city 1} \\ V_{j,1}^{U,nc} = \mathrm{w}_1^{\mathrm{U}} - \mathrm{m}_{\mathrm{j},1} + (\alpha_b + \alpha_g) g(H^R, \boldsymbol{X}^R) \text{ if migrating alone to city 1} \\ V^R = w^R + (\alpha_b + \alpha_g) g(H^R, \boldsymbol{X}^R) \text{ if staying in the rural area} \end{cases} \quad (1.1)$$

Let us again first consider the case where $w_1^U - w^R \geq m_{j,1}$. It is easy to see that $V_{j,1}^{U,bg} \geq V_{j,1}^{U,b}$ if and only if $f_1 \leq \alpha_g \Delta_1$, i.e. if the cost of education is lower than the valuation of girls' schooling and non-schooling outcomes. Similarly, $V_{j,1}^{U,b} \geq V_{\mathrm{j},1}^{U,nc}$ if and only if $f_1 \leq \alpha_b \Delta_1$, i.e. if the cost of education is lower than the valuation of boys' schooling and non-schooling outcomes. Recognizing that $\alpha_g \Delta_1 < \alpha_b \Delta_1$, a migrant brings both children along if $f_1 \leq \alpha_g \Delta_1$, only his boy if $\alpha_g \Delta_1 < f_1 \leq \alpha_b \Delta_1$, and leaves both children behind if $\alpha_b \Delta_1 < f_1$. When $w_1^U - w^R < m_{j,1}$, the migrant prefers to stay in rural area *j*. In this case, similarly to what we did for Proposition 1, we rule out the unrealistic case of migration that would only be child driven under the assumption that the school fee is sufficiently large.[48] QED.

■ We now focus on the response of migrants to an increase in the urban school fee (Proposition 3 and Corollaries 3.1, 3.2, and 3.3).

Proof of Proposition 3: Observe that we are focusing on possible relocations from city 1 so that the relevant utility functions (net of migration costs) are now

$$\begin{cases} V_{1,k}^{U,c} = w_k^U - f_k + g(H_k^U, \boldsymbol{X}_k^U) - m_{1,k} \; if \; relocating \; to \; city \; k \; with \; the \; child, for \; k \in \{1, \dots, K\} \\ \mathrm{V}_{1,\mathrm{k}}^{U,nc} = \mathrm{w}_k^{\mathrm{U}} + g(H^R, \boldsymbol{X}^R) - \mathrm{m}_{1,\mathrm{k}} \; if \; relocating \; to \; city \; k \; without \; the \; child, for \; k \in \{1, \dots, K\} \\ \mathrm{V}^R = w^R + g(H^R, \boldsymbol{X}^R) \; if \; relocating \; to \; the \; rural \; area \end{cases} \quad (1.2)$$

where $m_{1,k}$ denotes the migration cost between city 1 and city $k \in \{1, \dots, K\}$, with $m_{1,1}$=0, and where migration back to the rural area occurs at no cost. We denote $\tilde{V}_{1,k} = \max\{V_{1,k}^{U,c}, V_{1,k}^{U,nc}\}$ the highest utility net of migration costs attainable in city *k* for a migrant originating from city 1.

Let us consider the "next best" city where the household could relocate. Under the assumption that $\tilde{V}_{1,2} > \max\{\{\tilde{V}_{1,k}\}_{k \neq 1,2}, V^R\}$, the next best city is city 2. We distinguish two cases depending on whether or not it is optimal for the worker to bring his child with him when choosing to relocate to city 2, i.e. depending on whether f_2 is smaller or greater than $\leq \Delta_2$ (Proposition 1).

Case 1: Let us assume that $f_2 \leq \Delta_2$ where $\Delta_2 = g(H_2^U, \boldsymbol{X}_2^U) - g(H^R, \boldsymbol{X}^R)$ as defined by equation (4). Under this assumption, Proposition 1 implies that if moving to city 2, the worker would bring along his child. Under Case 1, the utilities associated with the different options are thus

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[47] Using the notations introduced below, we now implicitly assume that $\min\{V_{j,1}^{U,bg}, V_{j,1}^{U,b}, V_{j,1}^{U,nc}, V^R\} > \max\{\tilde{V}_{j,k}\}_{k \neq 1}$ so that the migrant worker makes a choice only between migrating to city 1 with or without children and staying in the rural area.

[48] In this version of the model with two children, the assumption that rules out child-driven-only migration when $w_1^U - w^R < m_{j,1}$ is $f_1 > \alpha_b \Delta + (w_1^U - w^R - m_{j,1})$.

$$\begin{cases} V_{1,1}^{U,c} = w_1^U - \tilde{f}_1 + g\left(H_1^U, \boldsymbol{X}_1^U\right) \textit{ if staying in City 1 with the child} \\ \mathrm{V}_{1,1}^{U,nc} = \mathrm{w}_1^{\mathrm{U}} + g(H^R, \boldsymbol{X}^R) \textit{ if staying in City 1 but sending back the child to the rural area} \\ V_{1,2}^{U,c} = w_2^U - f_2 - m_{1,2} + g(H_2^U, \boldsymbol{X}_2^U) \textit{ if moving to City 2with the child} \end{cases} \quad (1.3)$$

Observe that $f_1^* = \Delta_1$ is the school fee threshold under which the worker prefers to remain in city 1 with his child over sending him to the rural area (i.e. $V_{1,1}^{U,c} \geq V_{1,1}^{U,nc}$ if and only if $\tilde{f}_1 \leq f_1^*$). As for f_1^{**}, it is the school fee threshold under which the worker prefers to stay in city 1 with his child over relocating to city 2 with his child (i.e. $V_{1,1}^{U,c} \geq V_{1,2}^{U,c}$ if and only if $\tilde{f}_1 \leq f_1^{**}$).[49] Furthermore, the worker prefers relocating to city 2 with his child over staying in city 1 without his child ($V_{1,2}^{U,c} \geq V_{1,1}^{U,nc}$) if and only if $V_{1,2}^{U,c} - V_{1,1}^{U,nc} = (w_2^U - w_1^U) - f_2 - m_{1,2} + \Delta_2 = f_1^* - f_1^{**}$ is positive. Let us now consider two subcases depending on the ordering of f_1^* and f_1^{**}.

Subcase 1.1: $f_1^* \leq f_1^{**}$

In this subcase, relocating to city 2 is never an option as it is dominated by the strategy consisting in staying in city 1 without the child ($V_{1,2}^{U,c} < V_{1,1}^{U,nc}$). The only relevant comparison is then between staying in city 1 with the child or without the child, depending on whether $\tilde{f}_1$ is lower or greater than f_1^*.

Subcase 1.2: $f_1^* > f_1^{**}$

In this subcase, staying in city 1 without the child is dominated by migration to city 2 with the child ($V_{1,2}^{U,c} \geq V_{1,1}^{U,nc}$). The only relevant choice is then between staying in city 1 with the child or relocating to city 2 with the child. If $\tilde{f}_1 \leq f_1^{**}$, then the worker chooses to stay in city 1 with his child (as). Otherwise, if $\tilde{f}_1 > f_1^{**}$, then the worker migrates to city 2 with his child.

Case 2: Let us now assume that $f_2 > \Delta_2$. According to Proposition 1, this implies that if moving to city 2, the worker would send his child back to the rural area. The utilities associated with the different options are thus

$$\begin{cases} V_{1,1}^{U,c} = w_1^U - \tilde{f}_1 + g\left(H_1^U, \boldsymbol{X}_1^U\right) \textit{if staying in City 1 with the child} \\ \mathrm{V}_{1,1}^{U,nc} = w_1^U + g\left(H^R, \boldsymbol{X}^R\right) \textit{if staying in City 1 but sending back the child to the rural area} \\ V_{1,2}^{U,nc} = w_2^U - m_{1,2} + g\left(H^R, \boldsymbol{X}^R\right) \textit{if moving to City 2 and sending the child back to the rural area} \end{cases} \quad (1.4)$$

Observe that f_1^{***} is the school fee threshold under which the worker prefers staying in city 1 with his child over relocating to city 2 without his child (as $V_{1,1}^{U,c} \geq V_{1,2}^{U,nc}$ if and only if $\tilde{f}_1 \leq f_1^{***}$).[50] The worker will prefer relocating to city 2 without his child over staying in city 1 without his child if and only if $V_{1,2}^{U,nc} - V_{1,1}^{U,nc} = (w_2^U - w_1^U) - m_{1,2} = f_1^* - f_1^{***}$ is positive.

[49] We necessarily have $f_1^{**} > f_1$, , implying that the case $\tilde{f}_1 < f_1^{**}$ is a possibility. Indeed, since we are in a case where the worker chose to bring his child to city 1 over bringing his child to city 2 in the first place, we know, by definition, that $(w_1^U - w_2^U) + \Delta_1 - \Delta_2 > (m_{j,1} - m_{j,2}) + (f_1 - f_2)$, which comes down to $f_1^{**} > f_1 + m_{1,2} + m_{j,1} - m_{j,2}$. Under the condition that $m_{1,2} > ||\, m_{j,1} - m_{j,2}||$ (which clearly holds when migration costs reflect straight-line transport costs), we have $f_1^{**} > f_1$.

[50] We necessarily have $f_1^{***} > f_1$, implying that the case $\tilde{f}_1 < f_1^{***}$ is a possibility. Indeed, since we are in a case where the worker chose to bring his child to city 1 over migrating alone to city 2, we know that $w_1^U - w_2^U + \Delta_1 > m_{j,1} - m_{j,2} + f_1$, which comes down to $f_1^{***} > f_1 + m_{1,2} + m_{j,1} - m_{j,2}$. As previously, under the same condition $m_{1,2} > \left|\left|m_{j,1} - m_{j,2}\right|\right|$, we have $f_1^{***} > f_1$.

Similar to our discussion above, let us now consider two subcases depending on the ordering between f_1^* and f_1^{***}.

Subcase 2.1: $f_1^* \leq f_1^{***}$

In this subcase $V_{1,2}^{U,nc} < V_{1,1}^{U,nc}$, relocating to city 2 is never an option. The only relevant comparison is then between staying in city 1 with the child or without the child, depending on whether $\tilde{f}_1$ is lower or greater than f_1^*.

Subcase 2.2: $f_1^* > f_1^{***}$

Under this subcase, staying in city 1 without the child is dominated by migration to city 2 without the child ($V_{1,2}^{U,nc} \geq V_{1,1}^{U,nc}$). If $\tilde{f}_1 \leq f_1^{***}$, then the worker chooses to stay in city 1 with his child. Otherwise, if $\tilde{f}_1 > f_1^{***}$, then the worker migrates to city 2 with his child.

Comparing cases 1 and 2, we see that $f_1^{***} - f_1^{**} = \Delta_2 - f_2$. Case 1 ($f_2 \leq \Delta_2$) thus corresponds to the case where $f_1^{***} \geq f_1^{**}$ and Case 2 ($f_2 < \Delta_2$) to the case where $f_1^{***} < f_1^{**}$. It is easy to see that Subcase 1.1 (which corresponds to the condition $f_1^* \leq f_1^{**} \leq f_1^{***}$) and Subcase 2.1 (which corresponds to the condition $f_1^* \leq f_1^{***} < f_1^{**}$) can be grouped together under the condition $min\{f_1^*, f_1^{**}, f_1^{***}\} = f_1^*$. It is also easy to see that the condition for Subcase 1.2 is $f_1^{**} \leq f_1^{***}$ and $f_1^{**} < f_1^*$, which can be expressed as $min\{f_1^*, f_1^{**}, f_1^{***}\} = f_1^{**}$ and that the condition for Subcase 2.2 is $f_1^{***} < f_1^{**}$ and $f_1^{***} < f_1^*$, which can be expressed as $min\{f_1^*, f_1^{**}, f_1^{***}\} = f_1^{***}$. This yields Proposition 3. QED

Proof of Corollary 3.1: If $m_{1,2}$ is sufficiently large, it is easy to see that both $f_1^{***} - f_1^* = (w_1^U - w_2^U) + m_{1,2}$ and $f_1^{**} - f_1^* = (w_1^U - w_2^U) - \Delta_2 + f_2 + m_{1,2}$ will be positive. In this case $min\{f_1^*, f_1^{**}, f_1^{***}\} = f_1^*$ and, according to Proposition 3, the worker never relocates to city 2. QED.

Proof of Corollary 3.2: Vulnerable households have characteristics that differ from the rest of the migrant population and that unfavorably affect their children's outcomes in the city. We account for this heterogeneity by rewriting outcomes as a function of a vector of characteristics $\boldsymbol{C} \in \{\underline{\boldsymbol{C}}, \overline{\boldsymbol{C}}\}$, implying that, in any city $k \in \{1, .., K\}$, $H_k^U(\underline{\boldsymbol{C}}) < H_k^U(\overline{\boldsymbol{C}})$ and each component $\boldsymbol{X}_k^U(\underline{\boldsymbol{C}})$ is smaller than the corresponding component of $\boldsymbol{X}_k^U(\overline{\boldsymbol{C}})$. Proposition 1 now applies separately for vulnerable and non-vulnerable households and $f_1^*(\underline{\boldsymbol{C}}) = g\left(H_1^U(\underline{\boldsymbol{C}}), \boldsymbol{X}_1^U(\underline{\boldsymbol{C}})\right) - g(H^R, \boldsymbol{X}^R) < g\left(H_1^U(\overline{\boldsymbol{C}}), \boldsymbol{X}_1^U(\overline{\boldsymbol{C}})\right) = f_1^*(\overline{\boldsymbol{C}})$. Because vulnerable households face a lower f_1^* threshold, for them an increase in the school fee is more likely to result in $\tilde{f}_1 > f_1^*$. An increase in the school fee such that $f_1^*(\underline{\boldsymbol{C}}) < \tilde{f}_1 < f_1^*(\overline{\boldsymbol{C}})$ will cause the children of vulnerable households to be sent back to the rural area whereas the children of non-vulnerable households will remain in the city. QED.

Proof of Corollary 3.3: Let us denote $\Delta_k(\eta) = g(H_k^U, \boldsymbol{X}_k^U|\eta) - g(H^R, \boldsymbol{X}^R)$ as the gain from child migration conditional on macro-economic conditions, where $\eta = 1$ indicates the time of economic crisis and $\eta = 0$ the non-crisis (normal) period. In the case of a global financial crisis such as that of 2008, it is reasonable to assume that cities are more affected than rural areas so that the utility derived from outcomes in rural areas is not a function of η. Because returns to migrant workers' human capital are lower in times of crisis (see, e.g., Zhi et al. (2013)), we have $g(H_k^U, \boldsymbol{X}_k^U|\eta = 1) < g(H_k^U, \boldsymbol{X}_k^U|\eta = 0)$. We can thus rewrite Proposition 3 and substitute $f_1^*(\eta)$ for f_1^*, noting that $f_1^*(\eta = 1) = \Delta_k(\eta = 1) < \Delta_k(\eta = 0) = f_1^*(\eta = 0)$. It follows that the probability that $\tilde{f}_1 < f_1^*(\eta = 1)$ is greater than the probability that $\tilde{f}_1 < f_1^*(\eta = 0)$. QED.

Observe that in Corollary 3.3, we focused on case (i) where $min\{f_1^*(\eta), f_1^{**}(\eta), f_1^{***}(\eta)\} = f_1^*(\eta)$ and for which $f_1^*(\eta = 1)$ is always smaller than $f_1^*(\eta = 0)$. In case (ii) (respectively (iii)), it cannot be stated which of $f_1^{**}(\eta = 1)$ and $f_1^{**}(\eta = 0)$ (respectively $f_1^{***}(\eta = 1)$ and $f_1^{***}(\eta = 0)$) is smaller without making further assumptions on how economic crises differentially affect wages across cities.

Part B: Description of Chernozhukov, Lee and Rosen (2013) bounds and application procedures

Focusing on the instrumented impacts of school fees through the one-year lag of shocks to public education spending only, we can rewrite equation (7) in a more general form as a conditional expectation

$$E\{Y_{ik,t}(Fee)|Shock_{ik,t-1} = \xi\} \quad (1.5)$$

where the outcome of interest (or indicator function) $Y_{ik,t}$ is defined at time *t* as before, and ξ the different values of shocks to public education spending at time *t-1*. Only two assumptions are required for the Chernozhukov et al. bounds. One is the *monotone instrumental variable* (MIV) assumption, where the conditional expectation in (1.5) is assumed to weakly increase in ξ, for all values of school fees. The other assumption is the *monotone treatment response* (MTR) assumption, where the indicator function $Y_{ik,t}$ is assumed to increase in the level of school fees.

There is an inverse relationship between the migrant worker's decision over his child migration and shocks to public education spending or school fees, thus we multiply both the school fees and shocks variables with -1 to make this relationship positive. This does not affect our estimation results since estimates can be plotted against the original values of school fees. The MIV assumption is then satisfied, given a strong correlation of 0.69 between $Y_{ik,t}$ and the shocks variable; the MTR assumption is satisfied as discussed earlier (see Figure 2). Besides these two assumptions, no additional assumption is made about the IV.

To obtain meaningful analysis, the support of *Y* needs to be bounded. We can consider the probability that the migrant worker brings his children along to the city, which is defined as follows

$$P^* = P\{Y_{ik,t}(Fee) \geq 1|Shock_{ik,t-1} = \xi\} \quad (1.6)$$

Under the MIV and MTR assumptions, the Chernozhukov et al.'s upper bound and lower bound are respectively

$$P^* \leq inf_{u \geq \xi} E\left\{1\left(Y_{ik,t} \geq 1\right) * 1\left(Fee \leq \Psi_{ik,t}\right) + 1\left(Fee \geq \Psi_{ik,t}\right)|Shock_{ik,t-1} = u\right\} \quad (1.7)$$

and

$$P^* \geq sup_{u \leq \xi} E\{1\left(Y_{ik,t} \geq 1\right) * 1\left(Fee \geq \Psi_{ik,t}\right)|Shock_{ik,t-1} = u\} \quad (1.8)$$

where *1(.)* is the indicator function. We set ξ at its median value 0.36, and the support values for the lower bound and the upper bound thus range from -1.04 (its minimum value) to 0.36 and 0.36 to 3.82 (its maximum value). By varying the bounds in (1.7) and (1.8) over the whole range of values of school fees ($\Psi_{ik,t}$), we can then trace out these bounds. We estimate these bounds using the Stata command "*clr2bound*" provided in Chernozhukov et al. (2015).

Appendix 2: Data Sources

Rural-Urban Migration in China (RUMiC) 2008
Rural-Urban Migration in China (RUMiC) is a longitudinal survey that is specifically designed to study migration in China. The survey consists of three parts: the Urban Household Survey (5,000 households), the Rural Household Survey (8,000 households) and the Migrant Household Survey (5,000 households). It was initiated by a group of researchers at Australian National University, University of Queensland and Beijing Normal University and was supported by Institute for the Study of Labor (IZA), which provides the Scientific Use Files. Financial support for RUMiC was obtained from Australian Research Council, Australian Agency for International Development (AusAID), Ford Foundation, IZA, and the Chinese Foundation of Social Sciences.

Our analysis is mainly based on the migrant household module of 2008. The migrant household sample covers 15 cities of the nine-largest provinces sending and receiving migrants. These are: Bengbu, Chongqing, Dongguan, Guangzhou, Hefei, Hangzhou, Luoyang, Nanjing, Ningbo, Shanghai, Shenzhen, Wuhan, Wuxi, Zhengzhou. The sampling frame of migrant households was generated on the basis of the census conducted by the RUMiC project team. Data are collected on household members' characteristics, education, employment, health, general wellbeing, income, expenditure and assets, as well as left-behind household members.
Websites: https://www.rse.anu.edu.au/research/centres-projects/rural-urban-migration-in-china-and-indonesia/ and http://idsc.iza.org/?page=27&id=58

China City Statistical Yearbook 2002-2008
The China City Statistical Yearbook is an annual statistical publication. The China City Statistical Yearbook 2002-2008 compiles various statistical data for the period 2001-2007 of 657 organizational system cities (including cities at and above prefecture-level and county-level cities). We use the education spending at metropolitan area level from 2001-2007.
Website: http://www.stats.gov.cn/tjsj/ndsj/
Compiling institution: National Bureau of Statistics of China
Publisher: China Statistics Press

China Urban Life and Price Yearbook 2008
The *China Urban Life and Price Yearbook* is a compilation of information from *China Urban Household Income and Expenditure Compendium* and *Price Yearbook of China*. It contains urban household income and expenditure records, the main indicators of general urban development, the main indicators of urban life quality, and urban price levels. We use the 2007 housing price records at the city (metropolitan area) level.
Website: http://tongji.cnki.net/overseas/engnavi/YearBook.aspx?id=N2009030074&floor=1
Compiling institution: National Bureau of Statistics of China
Publisher: China Statistics Press

Appendix 3: Additional Tables and Figures

Table 3.1. Effects of education spending shocks on median/mean school fees (first stage), China 2008

	(1)	(2)	(3)	(4)	(5)	(6)
	Median school fees			Mean school fees		
Education spending shocks (linear, lagged one year)	0.202**	0.235***	0.206***	0.170***	0.175***	0.156***
	(0.081)	(0.063)	(0.068)	(0.059)	(0.053)	(0.056)
Head's age	-0.002	-0.002	-0.003	-0.001	-0.001	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Head is female	0.027	-0.002	0.004	0.013	-0.001	0.004
	(0.031)	(0.035)	(0.035)	(0.028)	(0.025)	(0.025)
Head's highest education level is primary school and above	0.043	0.030	0.009	0.011	0.019	0.005
	(0.079)	(0.065)	(0.062)	(0.051)	(0.046)	(0.046)
Head's highest education level is middle school and above	-0.011	-0.001	0.004	0.007	0.006	0.010
	(0.017)	(0.015)	(0.016)	(0.014)	(0.012)	(0.014)
Head is working		-0.029	-0.081		-0.141	-0.176
		(0.065)	(0.072)		(0.119)	(0.136)
Head is self-employed		-0.060	-0.019		-0.051	-0.023
		(0.073)	(0.062)		(0.054)	(0.041)
Migrated within province		0.014	0.181		0.059	0.173
		(0.135)	(0.145)		(0.086)	(0.111)
Growth rate of student-teacher ratio		-0.054	-0.064		0.003	-0.004
		(0.048)	(0.045)		(0.036)	(0.033)
Housing price in 2007 ('000 yuan)			0.070			0.048
			(0.043)			(0.041)
Observations	1,349	1,349	1,349	1,349	1,349	1,349
Province FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	YES	YES	NO	YES	YES
R-Squared	0.341	0.417	0.500	0.392	0.419	0.480
F Statistic	8.273	21.165	15.146	10.781	17.004	12.115

Note: Each column presents the results from separate regressions and different independent variables. The dependent variables are median school fees reported in the migrant household sample under columns (1)-(3), and mean school fees reported in the migrant household sample under columns (4)-(6). Different sets of control variables are included under different columns. Standard errors in parentheses are clustered at the city level. Estimation results are obtained using the bias-reduced linearization (BRL) procedure following (McCaffrey and Bell 2002). F-statistics of overall significance are also reported. *** p<0.01, ** p<0.05, * p<0.1.
Sources: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008

Table 3.2: Effects of school fees on child migration, after dropping migrant children attending private school, China 2008

	(1)	(2)	(3)	(4)	(5)	(6)
	Median school fees			Mean school fees		
School fee measure (Ln)	-0.474**	-0.197***	-0.195***	-0.563***	-0.261***	-0.255**
	(0.191)	(0.060)	(0.068)	(0.208)	(0.090)	(0.103)
Head's age	0.008**	0.008**	0.008**	0.008**	0.007**	0.008**
	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)
Head is female	0.086	0.029	0.029	0.080	0.029	0.028
	(0.061)	(0.050)	(0.051)	(0.060)	(0.051)	(0.051)
Head's highest education level is primary school and above	0.045	0.010	0.010	0.032	0.009	0.010
	(0.038)	(0.025)	(0.024)	(0.032)	(0.024)	(0.024)
Head's highest education level is middle school and above	0.002	0.020	0.019	0.015	0.022	0.022
	(0.031)	(0.029)	(0.029)	(0.030)	(0.029)	(0.028)
Head is working		-0.092	-0.091		-0.125**	-0.122**
		(0.057)	(0.062)		(0.055)	(0.061)
Head is self-employed		0.260***	0.259***		0.258***	0.257***
		(0.030)	(0.031)		(0.031)	(0.032)
Migrated within province		0.152***	0.149***		0.165***	0.158***
		(0.051)	(0.050)		(0.050)	(0.051)
Growth rate of student-teacher ratio		-0.017**	-0.016*		-0.006	-0.005
		(0.008)	(0.010)		(0.007)	(0.008)
Housing price in 2007 ('000 yuan)			-0.001			-0.003
			(0.010)			(0.012)
Constant	3.530**	1.498***	1.490***	4.400***	2.079***	2.044***
	(1.415)	(0.433)	(0.474)	(1.594)	(0.683)	(0.762)
Observations	1,232	1,232	1,232	1,232	1,232	1,232
Original province FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	NO
RMSE	0.477	0.412	0.412	0.468	0.411	0.410
Prob>chi2	0.000	0.000	0.000	0.000	0.000	0.000
First stage F statistic	8.842	21.229	15.624	11.723	17.719	12.924

Note: Each column presents the results from separate IV regressions with different school fee measures and different independent variables, where the IV is the one-year lag of shocks to public education spending. All migrant children that attend urban private schools are dropped. *The dependent variable is a dummy variable that equals 1 if there is at least one child living with the household head is sent to urban public school, and 0 otherwise*. The first three columns ((1)-(3)) use the median school fees reported in the migrant household sample as a regressor, and the last three columns ((4)-(6)) use the mean school fees reported in the migrant household sample as a regressor. Different sets of control variables are included in different columns. R-squared values are not reported, instead, root-mean-square error (RMSE), the sample standard deviation of the differences between the predicted values and observed values, is reported under each column. Standard errors in parentheses are clustered at the city level. Prob>chi2 is the p-value of the chi-square test of overall significance. F statistics of the first stage regressions are also reported. *** p<0.01, ** p<0.05, * p<0.1.
Sources: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008.

Table 3.3. The impact of total school fees on the decision to bring children (IV probit, marginal effects), China 2008

	(1)	(2)	(3)	(4)	(5)	(6)
	Median school fees			Mean school fees		
School fee measure	-0.403***	-0.179***	-0.151*	-0.490***	-0.238**	-0.196
	(0.140)	(0.066)	(0.088)	(0.166)	(0.100)	(0.129)
Head's age	0.004	0.005	0.005	0.004	0.005	0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Head is female	0.089	0.029	0.029	0.085	0.029	0.029
	(0.057)	(0.052)	(0.052)	(0.059)	(0.053)	(0.053)
Head's highest education level is primary school and above	0.011	-0.016	-0.014	-0.001	-0.017	-0.014
	(0.035)	(0.038)	(0.037)	(0.031)	(0.037)	(0.037)
Head's highest education level is middle school and above	0.009	0.030	0.029	0.017	0.031	0.030
	(0.028)	(0.035)	(0.035)	(0.028)	(0.035)	(0.035)
Head is working		-0.133**	-0.125*		-0.163**	-0.148**
		(0.066)	(0.070)		(0.064)	(0.073)
Head is self-employed		0.292***	0.290***		0.292***	0.289***
		(0.034)	(0.036)		(0.034)	(0.036)
Migrated within province		0.153***	0.129***		0.165***	0.134***
		(0.056)	(0.040)		(0.053)	(0.037)
Growth rate of student-teacher ratio		-0.017**	-0.016*		-0.007	-0.008
		(0.008)	(0.009)		(0.006)	(0.008)
Housing price in 2007 ('000 yuan)			-0.012			-0.015
			(0.012)			(0.013)
Observations	1,349	1,349	1,349	1,349	1,349	1,349
Original province FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	YES	YES	NO	YES	YES
Prob>chi2	0.000	0.000	0.000	0.000	0.000	0.000

Note: Each column presents the marginal effects obtained from separate IV probit regressions with different school fee measures and different independent variables, where the IV is the one-year lag of shocks to public education spending. The dependent variable is a *dummy variable that equals 1 if there is at least one child living with the household head*, and 0 otherwise. The first three columns ((1)-(3)) use the median school fees reported in the migrant household sample as a regressor, and the last three columns ((4)-(6)) use the mean school fees reported in the migrant household sample as a regressor. Different sets of control variables are included in different columns. R-squared values are not reported, instead, root-mean-square error (RMSE), the sample standard deviation of the differences between the predicted values and observed values, is reported under each column. Standard errors in parentheses are clustered at the city level. Prob>chi2 is the p-value of the chi-square test of overall significance. *** p<0.01, ** p<0.05, * p<0.1.
Sources: Rural Urban Migration in China (RUMiC) 2008 and China City Statistical Yearbook 2002-2008.

Table 3.4. Comparison of the RUMiC samples in 2008 and 2009

	2008	2009	Difference
Head's age	36.77	36.60	-0.18
	(4.99)	(5.04)	(0.21)
Head is female	0.26	0.30	0.05**
	(0.44)	(0.46)	(0.02)
Head's highest educational level is primary school and above	0.82	0.84	0.02
	(0.39)	(0.37)	(0.02)
Head's highest educational level is middle school and above	0.29	0.31	0.02
	(0.46)	(0.46)	(0.02)
Head lives with spouse	0.65	0.61	-0.04*
	(0.48)	(0.49)	(0.02)
Head lives with child	0.38	0.31	-0.07***
	(0.49)	(0.46)	(0.02)
Number of school-age children living with head	0.46	0.34	-0.12***
	(0.65)	(0.55)	(0.02)
Remittances sent out for educational purposes ('000 yuan)	1.10	1.25	0.15
	(2.23)	(2.65)	(0.10)
Household per capita income ('000 yuan)	1.34	1.55	0.21***
	(1.01)	(0.99)	(0.04)
Head is working	0.97	0.96	-0.01
	(0.16)	(0.20)	(0.01)
Head is self-employed	0.36	0.32	-0.03
	(0.48)	(0.47)	(0.02)
Housing price in the survey sear	5.60	5.26	-0.33**
	(2.62)	(2.13)	(0.10)
Mean school fees ('000 yuan)	2.49	1.94	-0.55***
	(0.90)	(0.46)	(0.03)
Median school fees ('000 yuan)	1.76	1.45	-0.31***
	(0.70)	(0.49)	(0.02)
Mean urban school fees ('000 yuan)	2.42	2.04	-0.38***
	(1.15)	(0.76)	(0.04)
Median urban school fees ('000 yuan)	1.23	1.12	-0.11***
	(0.78)	(0.58)	(0.03)

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard deviations/errors are in parentheses. T-tests assume unequal variances for the two distributions.

Figure 3.1a: Urban school fee by provinces in 2012

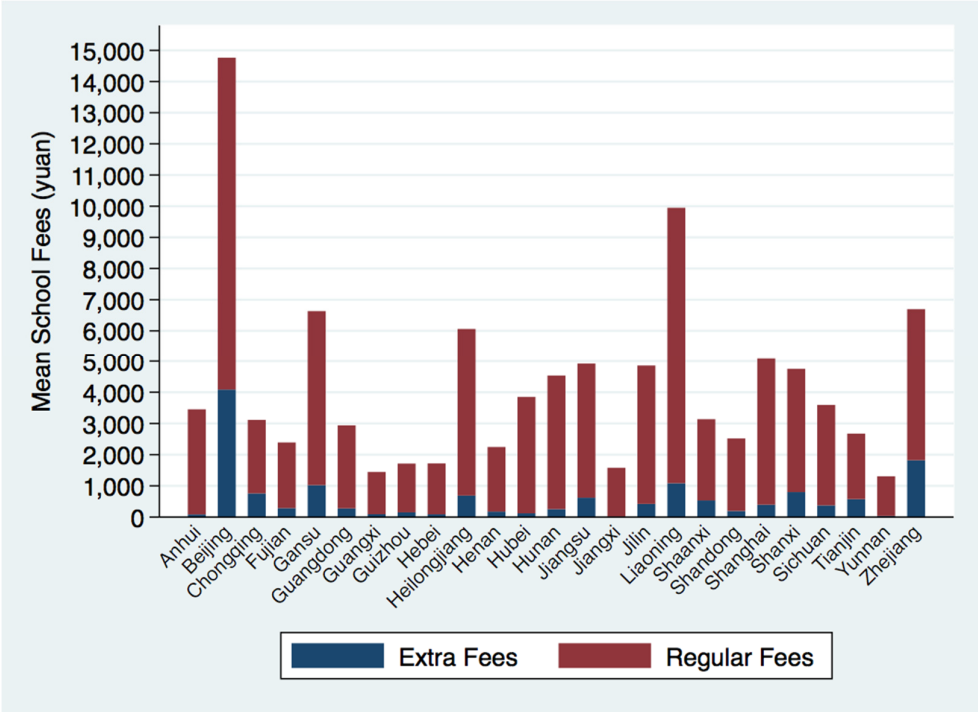
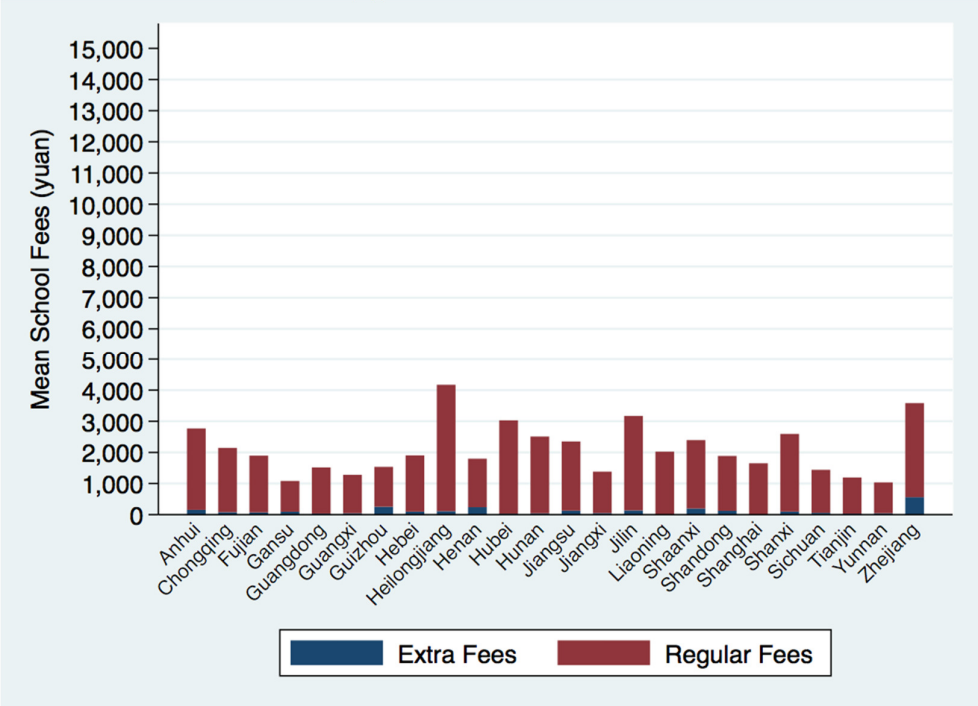


Figure 3.1b: Rural school fee by provinces in 2012



Note: Regular fees include tuition fees, book fees, remedial class fees, accommodation fees, and traffic fees. Extra fees include all the other fees.
Source: China Family Panel Studies (CFPS) 2012