# Rising Class Inequality of Higher Education in China: Industrialization, Educational Expansion, or Labor Market Incentive?

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## ABSTRACT

This study examines three possible causes of rising class inequality in college attendance: industrialization, educational expansion, and labor market incentives as drivers for the competition for college. The industrialization hypothesis emphasizes the public's increase in preference for more education. The educational expansion hypothesis underscores two consequences of the same demographic process—growing size of the competition pool for college admissions, and the decreasing scarcity of educational qualification arising from the expansion. The market incentive hypothesis stresses that competition intensifies with a rising college earnings premium. Drawing on the 2006 Chinese General Social Survey and macro statistics on 405 province-by-year units, our analysis produces three central findings: (1) Labor market incentive but not industrialization nor expansion hypothesis explains the rising inequality. (2) Class-differentiated family investments in education widen the class divide in a unidimensional contest for college admission. (3) Rising market incentives intensify class adaptation by the time compulsory education ends.

**Keywords**:

higher educational inequality, industrialization, educational expansion, market incentive, competition for college admission, China

# Introduction

Higher education has been expanding rapidly around the world over the past half century. Sociologists are particularly interested in the impact of this expansion on the effects of family origin on educational outcomes or how the educational expansion affects the inequality of educational opportunity (IEO). This literature has long emphasized the persistence of IEO despite rapid educational expansion (Shavit and Blossfeld 1993). The most influential interpretation and its variant are called the maximally maintained inequality perspective (MMI) (Raftery and Hout 1993) and the effectively maintained inequality perspective (EMI) (Lucas 2001). However, recent cross-national studies based on larger datasets cast some doubt on the apparent persistence of IEO (e.g., Breen, Luijkx, Müller, and Pollak 2009; Tam and Ganzeboom 2009). New evidence suggests that, overall, IEO in most of the societies studied declines across cohorts amid educational expansion.

These diverse trends of IEO suggest that educational expansion per se may not be the main cause or may be just a correlate of a fundamental cause for the changes in IEO. Drawing on sociological and economic theories from the educational inequality literature, we distinguish three hypotheses of IEO evolution: industrialization, educational expansion, and market incentive hypotheses. To directly test these causal forces and investigate how they shape changes in IEO requires a case with sufficient variations in the key explanatory factors and one not easily confounded by attributes that change over time. China is composed of thirty non-overlapping college admission districts and markets, rendering it a statistically efficient case for examining the causal forces of the changes in IEO. Moreover, China has been undergoing dramatic higher education expansion since 1999 while IEO has increased sharply over the same time period (Liu

2006; Guo and Wu 2008; Yang 2006).[1] The scale and rate of this expansion are unprecedented in the history of higher education, making China a temporally compressed case ideal for studying the interplay of college expansion and rising IEO.

The empirical analysis is based on a nationally representative sample of the 1988-2002 college admission cohorts (i.e., 1971-1984 birth cohorts) from the 2006 Chinese General Social Survey (CGSS) augmented with provincial-level official statistics. Results show that only the market incentive for college (as measured by college earnings premium) can fully account for the rising IEO in transition from upper secondary education to college. The stronger the market incentives, the greater the benefit of having a better class origin for a student's transition to college.

# Institutional Context

College admissions are largely decided by students' scores on standardized entrance examinations (*gaokao*) (Hannum, An, and Cherng 2011; Wang et al. 2011). The performance on *gaokao* mainly determines which students can go to junior college, ordinary university, or key university. In applying for admission to college, students have to submit a list of colleges and majors in order of personal preference (*zhiyuan* form). The provincial educational authorities match students to colleges and majors according to students' performance and their choices. At the end of the matching process, a student is assigned a college and a major (Loyalka et al. 2013; Wang et al. 2011).

[1] Later in this paper, we will show evidence that the IEO for college has surged after the expansion of Chinese higher education was initiated in 1999 (Panel a of Figure 2).

## *Provincial Admission System*

In 1958, the central government initiated a decentralization of the admission system such that provincial governments organized admissions (Central Committee of the Communist Party of China 1958; Ministry of Education of China 1958).[2] The provincial admission quota system decides how many students can go to college within each provincial division (MOE 1999, item 3; State Education Commission of China 1987, items 6 and 7; 1996, item 3). Each institution can independently propose an Admission Plan that includes a detailed breakdown of the number of students each major course of study can accommodate and how many students from each province the school will accept. The local provincial governments and the MOE then deliberate and decide on the final quotas at the school and program level (National People's Congress of China 1998, item 32; SEC 1996, item 3; MOE 1999, item 3).

The national system of college admissions consists of thirty relatively independent arenas of competition. The provincial admission quotas are explicit and broken down into local students (within the same provincial division as the institution) and non-local students (a subset of specific other provincial divisions). But the vast majority of enrollees in any admission district are local students. As provincial governments are the main providers of funding for local colleges and supervise budget planning and implementation (NPC 1998, item 60 and 62),[3] local colleges thus have a compelling reason to favor the admission of local students.

[2] The provincial level is the highest Chinese administrative division. Currently there are 33 such divisions (22 provinces, 4 municipalities, 5 autonomous regions, and 2 special administrative regions). Since Hong Kong and Macau are not part of the National College Entrance Examination system, there are only 31 admission districts in the system.

[3] Take one top college in Shanghai as an example. The Shanghai government invested 0.6 billion RMB in this college with the requirement that it raise the local admission quota (Guo 2010). The great majority of colleges are under the direct supervision of provincial governments. Only about 7.7% of colleges are supervised by the MOE or other government ministries (Wan 2006). These non-local institutions have a much more national distribution of quotas.

To local students, local colleges are far more attractive than colleges outside their admission districts. First, putting local institutions as their first choice can increase the chance of admission to college and reduce the risk of being assigned a college of substantially lower priority.[4] Second, attending local colleges has financial and emotional benefits, as students can economize by living at home and preserve existing social networks while building new ones (Frenette 2004; Spiess and Wrohich 2010; Turley 2009). Therefore, students prioritize local colleges for practical reasons and the vast majority attends local colleges.[5]

College admissions are competitive in contemporary China. The college admission system has a crucial structural aspect central to understanding the institutional context of competition for college admission: the provincial admission district largely defines the relevant pool of competition for each candidate, and the local provincial admission quotas are the main college opportunities for students to compete.

# Theoretical Framework

## *Alon's Model of Changing Inequality*

After decades of empirical research on the generality of the persistence of IEO, Alon (2009) has developed a theoretical framework for interpreting the evolution of IEO in a society. She

[4] The college assignment system in China strongly penalizes students whose first choice rejects them (i.e., students who over-estimate their admissibility to their first choice school) (Zhou and Wang 2009). So securing entry to one's first choice school is an imperative that greatly favors matching local students to local colleges.

[5] A recent study shows that the percentage of local students at a college in Jiangsu Province was 96% in 1952-1981 and 81% in 1982-2002 (Liang et al. 2012). Similarly, the percentage of local students at a college in Guangdong Province was 90% (Xia and Zhu 2009). The overall percentage of local students for all colleges was 79% in 1990 and 2000, and 86% in 2005 (Wu and Zhang 2010).

incorporates class adaptation and organizational exclusion as the crucial mediating mechanisms between class origin and college transition.[6] The intensity of adaptation reflects the class-differentiated intensity of individual investment in better performance for admissions. The intensity of exclusion refers to the importance of an admission criterion in which upper class has an advantage. Thus Alon's framework decomposes a rise (decline) in IEO into a rise (decline) in adaptation and/or exclusion. Alon further incorporates competition for admissions as a determinant of changes in adaptation and/or exclusion.[7] Panel A in Figure 1 presents a path model representation of the postulated relationships among the key concepts.

[Figure 1 about here]

Alon argues that in the United States, competition for college admissions drove the increase of class adaptation and therefore the rise of IEO from 1982 through 1992.[8] We apply a similar argument to interpret China's dramatic rise in IEO during 1988-2002. Since college admissions in China have been almost completely determined by entrance exam scores in this period, the exclusion mechanism has been virtually constant and thus cannot possibly explain the rise in IEO. As a result, we postulate that intensified competition drives an increase in class adaptation and then the rise in IEO. Panel B of Figure 1 captures this theoretical idea with a modified path model. Our central research objective is to identify the exogenous causes of the

[6] Following Alon, we use class as an alternative label for the socioeconomic background of a person's family of origin.

[7] Exogenous factors that may influence the intensity of competition for college admission are absolute size of college-age population, high school graduation rate, macroeconomic conditions, and wage premiums for college graduates (Alon 2009: 734).

[8] In the American case, changes in IEO are more context-dependent than Alon suggests. For example, when competition intensified, class adaptation was the dominant mechanism in accounting for the rise in IEO. When competition decreased, organizational exclusion was the main mechanism for the decline in IEO (self-identifying reference, forthcoming).

rising IEO in college transitions. However, both competition for admissions and entrance exam scores are unobserved in available data. Hence the empirical model we can examine is better represented by Panel C in Figure 1.

## *Industrialization Hypothesis*

Many early studies of educational inequality are guided by the classic industrialization hypothesis. This theory suggests that industrialization leads to greater social openness and a preference for more education (e.g., Shavit and Kraus 1990; Treiman 1970; Treiman and Yip, 1989). We think the openness and preference shift mechanisms of the industrialization thesis have opposite implications for IEO. Prior studies yielded inconsistent results.[9]

Exemplifying the emphasis of the prior literature, Buchmann and Hannum (2001: 89-90) suggest that the changes arising from industrialization lead to the erosion of ascription in educational selection and a shift from particularistic to universal bases of achievement. The direct influence of father's educational and occupational status on son's educational attainment should decline during industrialization. The focus on openness thus emphasizes the IEO reduction effect of industrialization. However, the preference shift mechanism would emphasize the IEO enhancing effect of industrialization. The rising demand for more education should result in intensified competition for education. Better families would invest more to secure better educations for their children, and socioeconomic background effect on educational attainment would increase.

[9] For example, Featherman and Hauser (1976) reported a historical decrease of the association between the effect of socioeconomic background and educational attainment, while some studies suggest that socioeconomic background remained stable in determining educational achievement across cohorts (e.g., Halsey, Heath, and Ridge 1980; Shavit and Kraus 1990; Simkus and Andorka 1982). In addition, Smith and Cheung (1986) found that the effect of socioeconomic background on log-odds of the conditional probability of transitions fluctuated and even increased.

For the 1988-2002 college admission cohorts in China, admission was based on entrance exam scores. This stability of criteria implies that the openness mechanism is hardly at play. We thus argue that the preference shift should dominate the prediction of the industrialization hypothesis for the period under study.

## *Educational Expansion Hypothesis*

The educational expansion hypothesis suggests two consequences of the educational expansion that increase college competition: increasing pool size and declining positional value. Expansion of upper secondary education leads to a larger number of potential competitors for college slots, thus intensifies competition for college admissions. Meanwhile, the expansion of upper secondary and/or college education result in deflation of positional value of upper secondary education, which also drives competition for college admissions.

### Increasing pool size

The increasing pool size argument underscores that the expansion of upper secondary education intensifies competition for limited college slots. A study basing on pool data of 13 countries provides supporting evidence that the effect of social origin on educational transition depended on the relative number of students facing that specific transition (Rijken 1999: 69-70).

Gerber and Hout (1995) explicitly discuss the bottleneck effect arising from upper secondary education expansion when college expansion fails to keep pace with the expansion of upper secondary education. They found that larger expansion in upper secondary education than college in the Soviet-era Russia imposed a bottle neck on college admission, leading to greater inequality in higher education. There is a squeeze created by so many graduates of secondary education competing for relatively few college slots. Educational inequality increases because advantaged groups usually fare better than disadvantaged groups in the competition for college

admission. Supporting evidence was found in Russia for the late-Soviet and post-Soviet cohorts (Gerber 2007). Guo and Wu (2008) also found the bottle neck effect of college transition in China during the expansion of upper secondary education and that the IEO in college admission increased significantly in this time frame.[10]

## Decreasing positional value

The positional value deflation argument focuses on the changes in positional value of upper secondary education during the expansion of upper secondary and/or college education. The cornerstone of this argument is the idea that education functions as "a positional good" (Hirsch 1976; Sørensen 1979). The value of an educational credential is not absolute but mainly determined by its relative ranking in the hierarchy of credentials. The more people reach an educational level or above it, the lower the position value of this level of education. If the value of an educational level deflates, people need more education in order to maintain a given level of social standing (Van de Werfhorst 2009). Even if the positional value of college is stable, the decreasing positional value of upper secondary education would intensify college competition. In addition, there is also a pressure to stratify horizontally across college types. For those who previously expect to be winners, now winning requires getting into selective colleges.

[10] It is worth noting that their study was handicapped by design flaws. First, the results are drawn from small number of cases in the Chinese Health and Nutrition Survey (CHNS). CHNS collects data from a nonrandom subset (9 of 32) of province-level administrative units, and there are only 184 cases for the most recent cohort group that is solely responsible for the evidence of rising IEO. Second, CHNS is a household survey and does not directly ask respondents for information on family origin. The authors infer family background information for youth at the time of the interview by matching them with the data records of parents residing in the same household. However, Yang and Wang (2011) present an informative critique of this approach, and suggest that qualitatively different results can be obtained depending on whether one adjusts for sample selection bias due to systematic missing data on fathers.

## *Labor Market Incentive Hypothesis*

The labor market incentive hypothesis suggests the balance of labor market supply and demand (reflected in the college earnings premium) determines the competition for college admission. The starting point of this hypothesis is a focus on how the labor market regulates the supply of college graduates. Specifically, how the labor market induces families to invest in education in order to meet the demands of employers for college graduates. Labor economists have a longstanding interest in the evolution of supply and demand as it pertains to higher education. Goldin and Katz's (2008) celebrated treatise on the United State's human capital century exemplifies how useful the college wage premium (i.e., the wage advantage of college graduates over high school graduates) is in tracking the dynamics of changing supply and demand for college graduates in the U.S. economy. The same analytic strategy is extended by Acemoglu and Autor (2012) to explain additional puzzles of labor market inequality by taking seriously the heterogeneity of skills and the diversity of tasks. People respond systematically to labor market incentives, and the college premium provides the price signal needed to coordinate the supply and demand of college graduates. When relative supply is low, the college premium rises to induce an increase. Conversely, when relative supply is high, the college premium declines.

Thus, the market incentive model supports the college premium as the main driver of demand for college admission. The rising college premium should intensify the competition for college transition because a rising premium strongly affects the anticipated payoff to college and the option value of an upper secondary education.[11] Moreover, the advantaged class is more

[11] Option value is the economic concept that refers to the value of preserving an option for an individual even if the individual is not likely to take advantage of it. But if a student does not continue with upper secondary education, the chances of ever returning to school and continuing on to college are extremely low.

responsive to the rising incentives than the disadvantaged class. The intensified competition for admissions enlarges the class difference in admissions success, and the class inequality in higher education increases.

All three hypotheses differ fundamentally as to what drives competition for college, although they hold that students of higher socioeconomic origin are better endowed to succeed in getting into college. The industrialization hypothesis emphasizes individuals' aspirations and desires for more education resulting from industrialization. The educational expansion hypothesis underscores the increasing pool size and decreasing positional value of educational credentials arising from expansion of college and upper secondary education. The market incentive hypothesis focuses on the balance of labor market supply and demand (reflected in the college earnings premium). These theoretical assumptions have sharp empirical predictions that distinguish the hypotheses and can be empirically tested.

# Empirical Predictions

The crucial tests for the three hypotheses are to examine whether the explanatory factors can account for the rising cohort trend of class effect on college transition. The industrialization hypothesis suggests that industrialization leads to a preference shift for more education, and thus intensified competition for college. According to Alon's model, students of better class origin are better-equipped to successfully respond to intensifying college competition, hence aggravating IEO for college transition. The industrialization hypothesis implies that the rising IEO is due to the process of industrialization over the past few years. Specifically, the hypothesis suggests the following:

*Prediction 1* The rise of class effect on college transition can be explained by industrialization.

The educational expansion hypothesis suggests that intensified competition for college transition is due to the increase in pool size for college arising from the expansion of upper secondary education, and decrease in the positional value of upper secondary and college education arising from the expansion of upper secondary and college education. An increase in competition for college admissions leads to rising IEO in college transition. The educational expansion hypothesis implies the following:

*Prediction 2.1* The rise of class effect on college transition can be explained by the expansion of upper secondary education (the increase in pool size).

*Prediction 2.2* The rise of class effect on college transition can be explained by the expansion of upper secondary and college education (the decline in the positional value of upper secondary and college education).

The market incentive hypothesis recognizes the role of market incentives in driving competition for college transition. When the market incentive for college transition rises, advantaged families invest more in education in order to win a college slot for their child, and class inequality thus increases. If the market incentive is measured by the college earnings premium, we would have the following prediction:

*Prediction 3.1* The rise of class effect on college transition can be explained by college earnings premium.

It is worth taking the incentive hypothesis one step further. The implicit behavioral logic of this hypothesis is that rising college premiums intensify the competition for college

admissions. But there are two ways in which information on college premiums may be processed. If students (or parents) act like econometricians (Manski 1993), they will produce approximately correct estimates of future college premiums based on past observations. The timing of causally relevant information will likely be the anticipated time of *college graduation*. Yet if students and parents do not do any fancy econometric estimations but behave as highly bounded rational actors,[12] they are likely to draw on more recent observations about college premiums when they have to make a critical decision about education investment, potentially long *before college admission*. Indeed, China is notorious for its information closure.[13] In the context of heavily restricted information flow, students and parents are unable to act like optimizing econometricians. During the period 1985-1999 (the period under study), the transition to upper secondary school is a critical decision point that affects one's chances of college transition, as the transition rate of upper secondary education were remarkably low, ranging from 38 to 51 percent (Wu and Zhang 2010). If the incentive hypothesis is valid for China, then, the estimated college premium at the time of transition to upper secondary school should be a better indicator of the market incentives that drives college competition. To capitalize on the different behavioral assumptions required to interpret the performance of the two premiums, the final test evaluates two measures of the college premium: (a) premiums expected at the time of graduation from

[12] Future college premiums are much harder to anticipate—the more distant into the future, the greater the uncertainty due to the joint influence of a host of shifting market factors.

[13] The private information market is highly underdeveloped. Even informal information networks did not have the means to coordinate and make an appreciable social impact until the explosive growth of Chinese internet social media in the late 2000s.

college (respondent at age 22) and (b) premiums observed before entering upper secondary school (respondent at age 15).[14]

*Prediction 3.2* Compared to the premium at age 22, the estimated premium at age 15 can better account for the rise of class effect on college transition.

If the premium at age 22 trumps the premium at age 15, the market incentive hypothesis would need to call on a strong assumption of rational expectation to interpret the finding. This finding would somewhat undermine the credibility of the incentive hypothesis. If the premium at age 15 is superior, the incentive hypothesis can interpret the finding without having to make any strong behavioral assumption and that would reinforce our confidence in the hypothesis.

# Data and Methods

It is well known that the Cultural Revolution has had a dramatic and unique impact on the schooling career of a whole generation of Chinese (Deng and Treiman 1997; Li 2006; Zhou, Moen and Tuma 1998). To avoid complications regarding interpretation and without compromising the purposes of this study, we opt for a restrictive sample of respondents who started school under the post-Cultural Revolution system. Hence, our sample includes only cohorts born in 1970 and after (imputed as the 1988 college admission cohort and beyond). Moreover, the 1984 birth cohort (imputed as the 2002 college admission cohort) is the youngest one that did not report any individuals still in upper secondary school. The proportion reporting highest education as college also shows a credible continuity with those of older cohorts.

[14] We expect the college premium at age 15 to be no less relevant than premiums at earlier ages. After all, our estimates of college premiums are based on moving averages. The estimate of premium at age 15 takes into account information from the two previous (lagged) and the two subsequent (forward) years. But if we had enough data to estimate the college premium when the oldest cohorts were in primary school, we would also evaluate such a measure.

## *Data*

We have pooled data from multiple sources. The data source is detailed in Online Supplement[15]. The individual-level data are from the 2006 CGSS, which is the first and latest publicly available CGSS that allows us to infer the college admission district of a respondent. The cross-sectional time-series data for 405 contextual units (15 time points and 27 admission districts) are based on the annual issues of *Educational Statistics Yearbook of China* (SEC 1988-1997; MOE 1998-2002), *China Statistical Year Book* (National Bureau of Statistics of China 1985-2006), *China Population Statistics Yearbook* (NBS 2000: 80-163), and the Chinese Household Income Project (CHIP 1988, 1995, and 2002).

## *Individual-level Variables*

The measurement of individual-level variables is detailed in Online Supplement. The main dependent variable is whether a respondent succeeds in the transition to higher education given completion of upper secondary education. The individual-level variables include father's education, father's occupational status (SEI), father's *hukou*, college admission cohort, and gender.

## *Macro-level Variables*

Crucial to the empirical test for the three hypotheses are the measures for industrialization, educational expansion, and market incentives. The institutional organization of college admissions has important implications for the unit of analysis. The national system of college admissions defines not just non-overlapping clusters of college opportunities but also the

[15] The Online Supplement is available at https://dl.dropboxusercontent.com/u/21846947/IEO15PAAJiang%26Tam_OnlineSupplement.pdf.

relevant pools of peers in competition for college admissions. The admission district is the most appropriate unit for measuring educational expansion. Furthermore, the admission district is also an appropriate unit of analysis for the purpose of measuring market incentive. We estimate that more than 96% of college graduates from the 1988-2002 admission cohorts works in the same province as their college admission districts.[16] However, 42% of these college graduates has moved across counties.[17] These findings strongly suggest that it is appropriate to measure market incentives at the provincial level but not the county level. Moreover, provincial divisions are also the main site for the influence of industrialization. A case in point is television broadcast. All television viewers have access to two types of broadcasts: China Central Television (CCTV is the national channel controlled by the central government) and a local TV station run by the provincial government. Before the advent of the Internet as a source of mass media, the perception and expectations of the Chinese people were effectively formed under the monopolistic influence of the central and provincial governments.

## Indicator of industrialization

Industrialization refers to technological change, and this change usually results in changes in distribution of the labor force (Treiman 1970). Therefore, this study follows early studies (e.g., Golden 1957; Soares 1966) to measure industrialization by the proportion of the labor force not engaged in agriculture. To distinguish industrialization from the level of economic development, this study includes provincial GDP per capita as a macro-level control variable. Log GDP per

[16] This estimate is the weighted percentage of college graduates in the 2006 Chinese General Social Survey. See the Data and Methods section for details.

[17] This estimate is the weighted percentage of college graduates in the 2008 Chinese General Social Survey who reported working in a county-level district different from where they were born.

capita is the log transformation of per capita gross domestic product within a college admission district in an admission cohort.

## District-level indicators of educational expansion

According to the educational expansion hypothesis, the increased pool size for college admissions results from the expansion of upper secondary education, while the deflation of position status of upper secondary education results from college expansion. This study uses year and district-specific enrollment rates of college and graduation rates of upper secondary education to track expansion in college and upper secondary education. For both measures, we use graduates from primary education as the denominator, i.e. the estimated number of people in a respondent's age cohort ($N^{P}_{T-6}$). Specifically, the admission-district college enrollment rate for year *T* is "the number of students enrolled in college for a district in year *T*" divided by "the number of graduates from primary schools for the same district in year *T* minus 6 ($N^{P}_{T-6}$)". The graduation rate of upper secondary education is "the number of students graduated from upper secondary education in year *T*" divided by "the number of graduates from primary schools for the same district in year *T* minus 6 ($N^{P}_{T-6}$)." Both measures are rescaled from percent as a unit to 10 percent as a unit and centered at the global mean.

## Indicators of market incentives

We use the college earnings premium to measure market incentives for higher education, as it is a simple indicator of the relative strength of labor market supply and demand for college graduates. Because the college premium is a ratio rather than an absolute value of the earnings for college graduates, it is free from the influences of variation in living standards across admission districts and inflation over time. We estimate college earnings premiums for

respondent at ages 15 and 22, both of which take the form of an earnings ratio minus one. The ratio is the predicted annual earnings of college graduates over the predicted annual earnings of upper secondary education graduates. We also distinguish three types of college premiums according to the heterogeneity assumption of the premium within China. The premium with low heterogeneity signals the national earnings premium, while the other two premiums with higher heterogeneity are different ways to introduce local variations. The measurement of market incentives is detailed in the Online Supplement.[18]

## *Statistical Models*

We analyze educational inequality with the conditional logistic regression model that decomposes educational attainment into sequential educational transitions from a level of education to the next. Equation 1 is an explanatory model for the cohort trend of IEO:

$$Y^* = \lambda^X Cohort + \gamma^X Class + \alpha^X Cohort \times Class + \beta' \mathbf{X} \times Class + \delta^{X'} \mathbf{Z} + u \qquad (1)$$

Where $Y^*$ is a latent variable denoting the propensity of college transition, *Class* is measured by father's education and SEI, **X** is a vector of explanatory variables (industrialization, educational rates, and college earnings premium), **Z** is a vector of control variables (GDP per capita, gender, and father's *hukou*), and *u* is a logistic random error. By comparing $\alpha^X$ under different specifications of **X**, we would be able to identify how, and the extent to which, an explanatory variable X accounts for the cohort trend of class effect on college transition. To facilitate interpretation, we center all the key explanatory variables at their global means. Hence, $\gamma^x$

[18] See Figure 1 of Online Supplement for the comparison of earnings premiums with different heterogeneity, supplementary Table 1 for descriptive statistics for all variables, and supplementary Table 2 for the correlations among explanatory variables used in the analysis.

reflects the class effect for the person facing the average industrialization, educational rates, or college premium.

When examining competing explanatory variables of cohort trend, it would be best to include all competing variables and cohort interactions in the same model. In practice, however, our sample size is not large enough to avoid having large standard errors when the most important interaction terms are highly correlated. The models presented are therefore restricted to a maximum of two interaction terms.

It is well known that the coefficient of a given variable normally cannot be compared across nonlinear probability models such as educational models (Cameron and Heckman 1998; Tam 2002; Mood 2010; Xie 2011). To avoid this problem, all the coefficients presented in our tables have been subjected to the Y-standardization method (Winship and Mare 1983:74). Thus the size of the rescaled coefficient of a variable X is the expected effect of a unit change in X, measured in a unit of standard deviation of the latent dependent variable $Y^*$.[19]

# Main Findings

We begin our analysis with a standard binary logit model of college transition. Table 1 compares two dimensions of class inequality—the effects of socioeconomic origin on respondents' college transition adjusting for provincial GDP per capita, gender, cohort, and father's *hukou*. The results of Models 1-2 show that both father's education and SEI appear to predict college transition. However, the results of Models 3-5 show that only the effect of father's education increases

[19] Strictly speaking, the standard errors of the Y-standardized coefficients have to be inflated to account for the statistical uncertainty in the adjustment factor. Bootstrap sampling is a nonparametric approach to do that (Karlson, Holm, and Breen 2012). In practice, however, the additional uncertainty is too small to make any difference in the results.

across cohorts and so father's education can effectively capture the phenomenon of rising class inequality in college transition.[20] This finding is consistent with previous studies (e.g., Yang 2006; Guo and Wu 2008).

[Table 1 about here]

Our interpretation of the overwhelming significance of parental education for the academic success of students is the underdevelopment of shadow education. For the cohorts under study, there were limited market alternatives to (i.e., substitutes for) direct parental involvement in students' homework assignments and lesson reviews. If a student has an educated parent, it was a major advantage that even children of wealthy families could not usually compensate for with other means.

## *Do the Hypotheses Explain the Cohort Trend?*

Table 2 investigates which hypothesis can explain the cohort trend of father's education in college transition, i.e. the trend of IEO. Model 1 repeats Model 4 of Table 1 and presents the baseline cohort trend of IEO. Models 2-5 include different predictors of the cohort trend suggested by three hypotheses. By examining the coefficients of FED × Cohort, we identify which hypothesis can explain the cohort trend of IEO.

[Table 2 about here]

In Model 2, the interaction of father's education and industrialization is statistically insignificant at the .05 level, while the cohort trend of IEO remains statistically significant. The

[20] We also use the Bayesian information criterion (BIC) statistic to compare the fit of alternative models. The BIC statistic unambiguously indicates that Model 3 of Table 1 offers the best fit (see note to Table 1), thus confirming our argument that the rising IEO for college transition is largely the growing advantage of having educated parents.

results suggest that industrialization cannot explain the cohort trend of IEO, and contradicts the prediction of industrialization hypothesis (Prediction 1). Similarly, the interaction of positional status in Model 4 is statistically insignificant at the .05 level, suggesting that the results do not support the prediction about positional status in the educational expansion hypothesis (Prediction 2.2).

Unlike Models 2 and 4, the cohort trend of IEO becomes small and statistically insignificant at the .05 level after controlling for pool size (shown in Model 3). Pool size, as measured by the graduation rate of upper secondary students, successfully accounts for the rising IEO. Pool size numerically accounts for 56% of the baseline cohort trend (1-(0.776/1.766). The results support the second prediction of the educational expansion hypothesis (prediction 2.1) to qualify pool size as a potential explanation of the rising IEO in college.

The final model examines the explanatory power of the market incentive hypothesis. Results indicate that the cohort trend of IEO becomes negative and statistically insignificant at the .05 level after controlling for the college premium. The effects of socioeconomic origin depend on the college earnings premium, and this interaction effect can *fully* account for the rising class inequality (Prediction 3.1). Thus, the findings also support the incentive hypothesis to qualify it as a potential explanation for the rising IEO.

## *Educational Expansion or Market Incentives?*

Since empirical results appear to support both hypotheses, we now examine the test designed to pit the two hypotheses against each other within a single model. Model 6 of Table 2 performs this test by including the interaction of father's education with both pool size and college

premium.[21] The results are striking: the pool size interaction becomes small and statistically insignificant at the .05 level whereas the college premium interaction remains significantly positive at .01 level. This finding suggests that college premium is more fundamental than pool size as a moderator of IEO. Market incentives, not the expansion of upper secondary education, explain the rising IEO.

Given the consistent evidence for the incentive hypothesis, the apparent explanatory power of pool size at college admission-cohort is also interpretable under the incentive hypothesis. The pool size at college admission cohort reflects policy responses to earlier signals of labor market demand for college graduates. In this light, the expansion of upper secondary education does not drive competition for admission; instead, it is driven by the college premium observed at an earlier time, just as the market incentive model predicts.

Yet another test of the incentive hypothesis is based on a comparison of the explanatory power of two college premiums—observed premiums before entering upper secondary school (age 15) versus premiums expected at the time of graduation from college (age 22). Model 1 and Model 2 of Table 3 compare the role of premiums at age 15 and age 22, respectively, in accounting for the cohort trend of IEO. Although the cohort trend of IEO becomes small and statistically insignificant, there is qualitative difference between the coefficients of the

[21] In order to compare the three hypotheses, we have three supplementary analyses that: (1) Examine whether IEO in college transition varies with industrialization, expansion, and incentive. Results show that the effect of father's education does vary with these factors respectively (for details see Models 1-4 in supplementary Table 3). (2) Use the BIC statistic to compare the fit of models in analysis 1. The BIC overwhelmingly favors the model with earnings premium (for details see supplementary Table 4). (3) Compare the effects of industrialization and expansion with market incentive on IEO in college transition, respectively. The findings show that the earnings premium trumps industrialization and expansion in affecting the IEO in college transition (for details see Models 5-7 in supplementary Table 3). All these results consistently suggest that market incentive is more fundamental in affecting the effect of father's education on college transition.

interactions between father's education and the premiums at the two ages. The interaction of premium at age 22 is relatively small and insignificant at the .05 level, while the interaction of premium at age 15 is relatively large and significant at the .05 level. The contrast is especially remarkable given that both sets of premiums are estimated in the same way. Any measurement errors bias will similarly affect both sets of premiums. Hence the college premium at age 15 clearly trumps the premium at age 22 in accounting for the cohort trend of IEO, confirming the third prediction of the market incentive hypothesis (prediction 3.2). Since premium at age 15 is compatible with a bounded rational assumption of educational investment decision, this finding adds credibility to the market incentive hypothesis.

[Table 3 about here]

To determine the age(s) at which college earnings premiums may exert a causal influence on IEO, Figure 2 matches the trends of college premiums at ages 15 and 22 with the trend of IEO (as measured by the effect of father's education on the transition to college). The verdict is clear: only the trend of earnings premium at age 15 matches well with the trend of IEO. In fact, the two trends display the same striking uptake for the admission cohort of 1998. This finding corroborates the results of Table 3 that the estimated premium at age 15 is superior to the premium at 22 as a measure of market incentive for college. It means that the market incentive hypothesis does not have to make any strong assumption about rational expectation in order to interpret the findings. Family investment in education appears to be a bounded rational decision.

[Figure 2 about here]

A sensitivity analysis has been applied to investigate whether the effect of earnings premium is sensitive to the assumption about heterogeneity. Results of Models 3-5 of Table 3 shows that the coefficients of interaction terms between father's education and premium with

different heterogeneity[22] are consistently large and statistically significant at the .05 level. In other word, the premium effect is robust.

# Discussion

A close scrutiny of our model and data reveals two aspects about the structure of IEO for college: (1) There are losers despite the fact that both the premium and likelihood of college transition are growing rapidly. (2) Pre-existing family inequality widens even in a unidimensional contest for college admissions that is widely perceived to be meritocratic, transparent, and fair to students of any origin. In fact, the higher the stakes, the greater the widening class inequality.

## *The Losers*

Even though class inequality has escalated since 1999, higher education also expanded manyfold over the same period. Are all classes winners, with some winning more than others? Under the market incentive model, students of educated fathers (upper class) are always among the winners when college incentives rise and class inequality widens. Because upper class students are more responsive to rising incentives, they are more able to capture the expanded educational opportunity. The same cannot be said about students of less-educated fathers (lower class). Consider a thought experiment: The college premiums of all admission districts are raised and college capacities endogenously expand in response. As Figure 3 shows, there are three potential scenarios of winners and losers:

[22] All the premiums with different heterogeneity are premiums at age 15. The premium with medium heterogeneity is used for the analyses in early tables.

(1) All are winners. Students from all the classes are able to capture some of the new opportunities, but the lower class wins less. That is, the log-odds of college transition increase with premium among all students.

(2) Only upper-class students are winners. The upper class captures all the new opportunities, while the lower class can only maintain its pre-expansion odds of attending college. In other words, the log-odds of transition increase with premium among upper-class students but not among lower-class students.

(3) Lower class students are losers. The upper class does not just capture all of the new opportunities but also takes over part of the share originally held by the lower class. Statistically, the log-odds of transition increase with premium among upper class students but decrease with premium among lower-class students.

[Figure 3 about here]

To determine which scenario fits the China case, Figure 4 presents a three-dimensional plot that shows the interaction of college premium and father's education in determining the log-odds of college transition. This model controls for covariates (father's *hukou*, father's SEI, and gender) but not the expansion of the education system, thus allowing college capacities to endogenously expand in response to the rise of premiums. Without this interaction, the college premium has a significantly positive effect on college transition. The 3D graph clearly supports the third scenario for China: stronger market incentive does not only have an asymmetric impact on the two tails of the class distribution, it affects adaptation in such a class-differentiated way that rising college premium depresses the chance of college transition for students of less-educated fathers. In short, students of less-educated fathers are the losers, while students of educated fathers are the winners.

[Figure 4 about here]

## *The Unidimensional Contest and Rising Inequality*

As we have discussed, the organizational exclusion mechanism in China is overwhelmingly based on performance on a nationally standardized and centralized exam—the National College Entrance Examination. If exam scores determine who gets into which college, the unidimensional contest for college transition should manifest in a model based on the assumption of a one-dimensional latent trait as the real dependent variable.[23]

The results of Table 4 provide the evidence for this unidimensional contest argument. We report the conventional estimates of our incentive model using binary and multinomial logistic regression. The interactions between earnings premium and father's education in both models are significantly positive at the .001 level, and the corresponding coefficients are very similar across all equations. In fact, a likelihood ratio Chi-squared test based on the generalized ordered logit model (Williams 2006) is not significant at the .05 level (p-value = .93), indicating that an ordinal logit model of junior and four-year colleges fits the proportional odds assumption very well.[24] Underlying the model of differentiated college destination is a one-dimensional latent trait of college admissibility. This finding supports the common belief that public entrance exam scores determine who gets into which kind of college in China, but it also shatters the common myth that the public, exam-based admission system can protect the disadvantaged class from losing ground in the contest.

[23] There is a bonus point system that allows exam scores to be "adjusted" upward for a tiny fraction of students, but the admission criterion is effectively unidimensional.

[24] The proportional odds property also *implies* that if father's education is a predictor of college transition, the logit coefficient for a more selective outcome (four-year college) would be larger than the coefficient for a less selective outcome (junior college). This is indeed what we find under the multinomial model.

[Table 4 about here]

# Conclusion

While many countries around the world have undergone a decline of higher education inequality, China has recently witnessed an explosive rise of class inequality in access to higher education amid a spectacular expansion of higher education. This study develops and tests three theoretical explanations for this phenomenon. Adding to the literature on educational stratification, we present a labor market incentive model that emphasizes the role of the college earnings premium in driving competition for education, which further triggers class-differentiated family investments in education. As students with educated parents are better endowed to respond to increased incentives, family behavioral responses endogenously widen pre-existing class inequalities.

The methodological challenges for testing the incentive model are formidable and aggravated by the strong correlations among time and the key explanatory concepts of competing theoretical models. To overcome the challenges, we draw on the 2006 CGSS—the latest publicly available and nationally representative survey that permits the effective identification of college admission districts to which an individual belongs before college transition. Our study incorporates official statistics from 405 contextual units (i.e., 15 time points and 27 admission districts) and individual-level models of college transition, this research design thus renders much greater statistical power than a three-wave comparative design for disentangling confounded processes associated with time. In addition, we explicitly measure the competing theoretical concepts (industrialization, educational expansion, and market incentives). Equally significant, we make maximal use of widely used micro surveys and official statistics to effectively estimate college earnings premium estimated by fitting a reduced-form earnings

model. The estimated premiums perform just as the incentive hypothesis predicts. Although China affords many advantages as a test case, there are also obvious limitations. First and foremost, we do not have direct measurements of exam scores and class-differentiated adaptation strategies because China does not yet have any large-scale student survey comparable to the well-known series of national educational surveys in the United States. Second, we can only provide relatively indirect but informative tests of the micro processes. Third, we could not have estimated the historical college premiums for each admission district without making assumptions. Above all, our evidence is based on a modest-sized sample and just a few post-expansion cohorts. Thus our work in progress will draw on forthcoming datasets to provide substantially larger samples and younger respondents to increase the representation of post-expansion cohorts. Family economic resources will likely play an increasingly significant role in the schooling success of younger cohorts.

Nevertheless, this study makes two important contributions to the literature on higher education inequality. First, this study is the first in which the industrialization, educational expansion, and incentive hypotheses are tested against each other. We do not only test them within the same empirical framework but also directly compare their explanatory powers within the same statistical model, spanning the periods before and after the initial surge of college enrollment and introducing enough variation to disentangle the influences of confounded factors. Second, we found considerable supportive evidence for the market incentive hypothesis that explains the dramatic rise of class inequality in China. We take our results to suggest that (a) the apparent influence of pool size arising from the expansion of upper secondary education is spurious, (b) rising market incentives fully account for the rise of class inequality from 1988-2002, and (c) rising market incentives appear to induce competition for college and consequently depress the odds of college transition for students with the least-educated parents.

Finally, our model specification tests confirm that the outcome of the contest for admissions is indeed as unidimensional as it appears. Paradoxically, class inequality can grow and escalate even when the admissions criterion is strictly confined to the scores from a standardized and centralized exam—widely perceived to be the most meritocratic, transparent, and fair system by Chinese of all classes. Multiple admission criteria are not the necessary condition for a system to favor the upper class. Nor is preferential treatment to the affluent or powerful a necessary condition for generating an increase of class inequality. When market incentives are in place to motivate family investment in education, the incentives also indirectly promote rising class inequality. We believe this is true not only for contemporary China but also across many societies of diverse cultures. Future research on higher education stratification should pay close attention to the role of changing market incentives.

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**Table 1. Logit Models of College Transition: Comparing Two Dimensions of Class Inequality (*N* = 1,225)**

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| Log GDP per capita[a] | .180* | .189* | .187* | .189* | .192* |
| | (.082) | (.083) | (.081) | (.083) | (.081) |
| Gender (1 = female) | .033 | .039 | .030 | .039 | .030 |
| | (.084) | (.085) | (.084) | (.085) | (.084) |
| Father's *hukou* (1 = urban) | .198* | .200* | .181 | .201* | .117 |
| | (.097) | (.100) | (.096) | (.100) | (.104) |
| Cohort[b] | -.041 | -.026 | -.834** | -.116 | -.864** |
| | (.160) | (.161) | (.278) | (.194) | (.275) |
| *Two Dimensions of Class Inequality* | | | | | |
| Father's education (FED) | .602* | | -.597 | | -.966* |
| | (.271) | | (.460) | | (.493) |
| Father's SEI | | .405* | | .169 | .659 |
| | | (.194) | | (.344) | (.375) |
| *Trends in Class Inequality* | | | | | |
| FED × Cohort | | | 1.766*** | | 2.118*** |
| | | | (.522) | | (.585) |
| SEI × Cohort | | | | .336 | -.492 |
| | | | | (.389) | (.433) |
| Pseudo R-squared | 3% | 3% | 5% | 3% | 5% |

**Note:** Coefficients are estimated from binary logistic regression weighted by the official sampling weight of 2006 CGSS. The coefficients are y-standardized, i.e., by setting unit variance for the hypothetical latent dependent variable underlying the binary outcome. Estimated intercepts are not presented for parsimony. Robust standard errors are in parentheses. We also use the Bayesian information criterion (BIC) statistic to compare the fit of Models 4-6. The BIC statistics for Models 4-6 are 1300.098, 1318.146, and 1309.962, respectively.

[a] Log GDP per capita is the log transformation of per capita gross domestic product within a college admission district in an admission cohort.

[b] Cohort was originally coded as college admission year but rescaled into fraction of a decade since 1988, ranging from 0 to 1.4.

*** $p < .001$. ** $p < .01$. * $p < .05$.

**Table 2. Logit Models of College Transition: Explaining Cohort Trend of Class Inequality (*N* = 1,225)**

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| Log GDP per capita | .187* | .403* | .168 | .142 | .198* | .160 |
| | (.081) | (.175) | (.122) | (.104) | (.086) | (.095) |
| Gender (1 = female) | .030 | .035 | .035 | .032 | .027 | .034 |
| | (.084) | (.083) | (.082) | (.082) | (.083) | (.082) |
| Father's *hukou* | .181 | .203* | .172 | .172 | .176 | .171 |
| (1 = urban) | (.096) | (.096) | (.094) | (.094) | (.095) | (.094) |
| Father's education (FED) | -.597 | -.111 | .412 | .147 | 1.126 | .914*** |
| | (.460) | (.485) | (.599) | (.562) | (.817) | (.277) |
| Cohort | -.834** | -.902* | -.359 | -.490 | .179 | |
| | (.278) | (.354) | (.346) | (.322) | (.532) | |
| *Drivers of Competition* | | | | | | |
| Industrialization | | -2.317* | | | | |
| | | (.954) | | | | |
| Pool size | | | -.295* | | | -.213 |
| | | | (.143) | | | (.129) |
| Positional value | | | | -.347 | | |
| | | | | (.205) | | |
| Earnings premium | | | | | -4.419* | -2.479* |
| | | | | | (2.020) | (1.158) |
| *Trend in Class Inequality* | | | | | | |
| FED × Cohort | 1.766*** | 1.384** | .776 | 1.098 | -.593 | |
| | (.522) | (.537) | (.659) | (.604) | (1.056) | |
| *Predictors of the Trend* | | | | | | |
| FED × Industrialization | | 3.103 | | | | |
| | | (1.597) | | | | |
| FED × Pool size | | | .627* | | | .463 |
| | | | (.273) | | | (.238) |
| FED × Positional value | | | | .782 | | |
| | | | | (.411) | | |
| FED × Earnings premium | | | | | 10.007* | 5.503* |
| | | | | | (4.175) | (2.323) |
| Pseudo R-squared | 5% | 5% | 5% | 5% | 5% | 6% |

**Note:** Coefficients are estimated from binary logistic regression weighted by the official sampling weight of 2006 CGSS. The coefficients are y-standardized. Estimated intercepts are not presented for parsimony. Robust standard errors are in parentheses.

[a] Industrialization is cohort- and admission-district specific, and measured by the proportion of labor force engaging in non-agriculture industries. It is centered at its global mean.

[b] Pool size is cohort- and admission-district specific, and defined as the ratio of upper secondary school graduates to the size of age cohort. It is rescaled from percent as a unit to 10 percent as a unit, and centered at its global mean.

[c] Positional value is cohort- and admission-district specific, and operationalized as the ratio of college enrollment to the size of age cohort. It is rescaled from percent as a unit to 10 percent as a unit, and centered at its global mean.
[d] Earnings premium is defined as earnings ratio minus one, and earnings ratio is earnings of college graduates to upper secondary graduates. It is centered at its global mean.
*** $p < .001$. ** $p < .01$. * $p < .05$.

**Table 3. Logit Models of College Transition: Comparing Different Measures of Earnings Premium (*N* = 1,225)**

| | Based on Premiums at Different Ages | | Based on Premiums with Varying Heterogeneity at Age 15 | | |
|---|---|---|---|---|---|
| | 22 | 15 | Medium | Low | High |
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
| Log GDP per capita | .212** | .198* | .198* | .205* | .190* |
| | (.081) | (.086) | (.086) | (.083) | (.087) |
| Gender (1 = female) | .019 | .027 | .027 | .025 | .026 |
| | (.084) | (.083) | (.083) | (.083) | (.083) |
| Father's *hukou* (1 = urban) | .163 | .176 | .176 | .172 | .170 |
| | (.096) | (.095) | (.095) | (.095) | (.095) |
| Father's education (FED) | 1.159 | 1.126 | 1.126 | 2.326 | 1.349 |
| | (1.018) | (.817) | (.817) | (1.200) | (.781) |
| Cohort | .453 | .179 | .179 | .755 | .340 |
| | (.573) | (.532) | (.532) | (.768) | (.506) |
| *Trend in Class Inequality* | | | | | |
| FED × Cohort | -.559 | -.593 | -.593 | -2.195 | -.801 |
| | (1.261) | (1.056) | (1.056) | (1.589) | (.991) |
| *Different Measures of Premium* | | | | | |
| Earnings Premium | -2.305* | -4.419* | -4.419* | -6.468* | -5.178** |
| | (1.023) | (2.020) | (2.020) | (2.894) | (1.990) |
| FED × Earnings Premium | 4.033 | 10.007* | 10.007* | 15.397** | 11.149** |
| | (2.258) | (4.175) | (4.175) | (5.929) | (4.068) |
| Pseudo R-squared | 5% | 5% | 5% | 5% | 6% |

**Note:** Coefficients are estimated from binary logistic regression weighted by the official sampling weight of 2006 CGSS. The premiums at ages 15 and 22 are the premiums with medium heterogeneity. See Data and Methods section and supplementary material for details about different measures for premiums. The coefficients are y-standardized. Estimated intercepts are not presented for parsimony. Robust standard errors are in parentheses. See notes to Table 1 for definitions of Log GDP per capita and notes to Table 2 for earnings premium.

*** $p < .001$. ** $p < .01$. * $p < .05$.

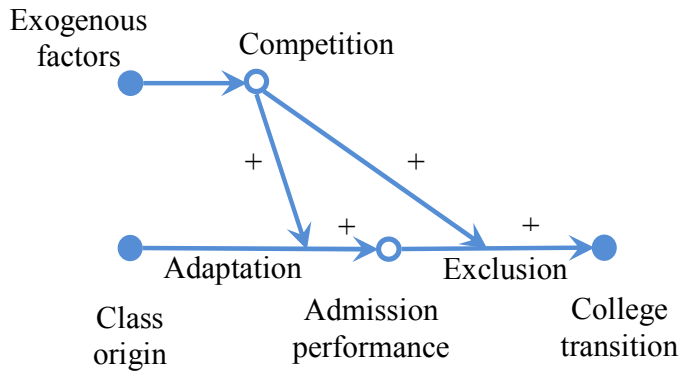
**Table 4. Binary, Multinomial, and Ordinal Logistic Regression of College Transition (*N* = 1,225)**

| | Binary Model | Multinomial Model | | Ordinal Model |
|---|---|---|---|---|
| | | Junior college | Four-year college | |
| | (1) | (2) | (3) | (4) |
| Log GDP per capita | .341** | .344** | .337* | .315** |
| | (.118) | (.131) | (.157) | (.113) |
| Gender (1 = female) | .054 | .211 | -.226 | -.014 |
| | (.160) | (.184) | (.213) | (.151) |
| Father's *hukou* (1 = urban) | .341 | .306 | .401 | .335 |
| | (.182) | (.208) | (.261) | (.177) |
| Father's education (FED) | 1.341** | .968 | 2.007** | 1.331** |
| | (.510) | (.580) | (.748) | (.486) |
| Earnings Premium | -7.123*** | -7.021** | -7.019* | -6.324*** |
| | (1.995) | (2.279) | (2.773) | (1.821) |
| FED × Earnings Premium | 15.440*** | 14.326** | 16.592** | 13.961*** |
| | (3.992) | (4.458) | (5.389) | (3.559) |
| Pseudo R-squared | 5% | 4% | | 4% |

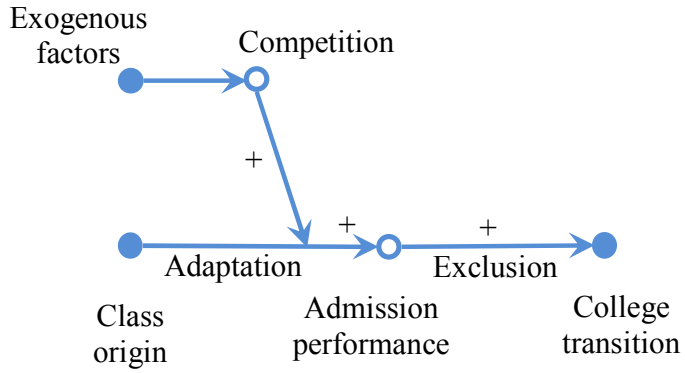
**Note:** Coefficients are estimated from binary logistic regression weighted by the official sampling weight of 2006 CGSS. The coefficients are y-standardized. See notes to Table 1 for definitions of Log GDP per capita, and notes to Table 2 for earnings premium. A likelihood ratio Chi-squared test based on a generalized ordered logit model (Williams 2006) shows that the data are strongly consistent with the proportional odds assumption of a standard ordered logit model. Estimated constants are not presented for parsimony. Robust standard errors are in parentheses. *** $p < .001$. ** $p < .01$. * $p < .05$.

**Figure 1. Path Models of College Transition**

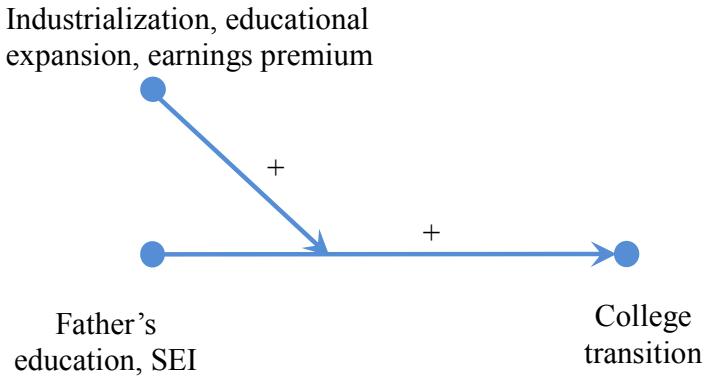
**(a) Alon's Theoretical Model**




**(b) Theoretical Model for China, 1988-2002**



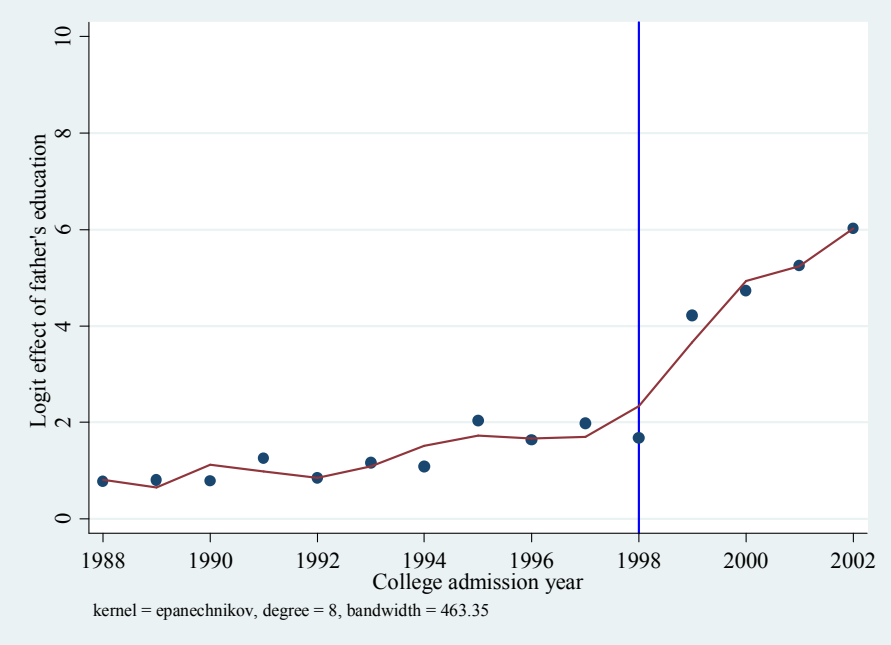

**(c) Empirical Model for China, 1988-2002**



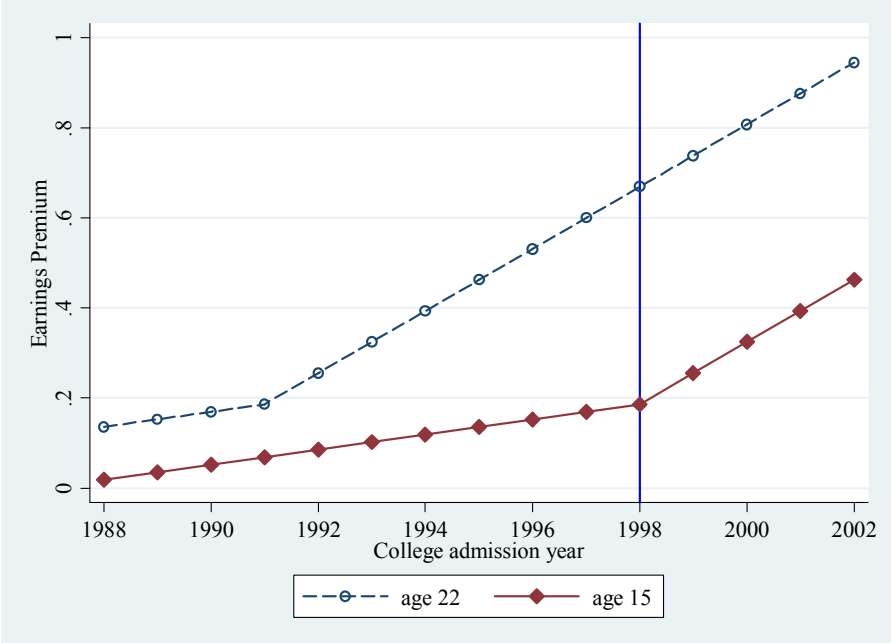

**Note:** This diagram shows the linkage between Alon's theoretical model and the models for China. According to Alon (2009), some exogenous factors may influence the intensity of college competition. A hollow dot denotes an unobservable variable.

**Figure 2. Match the Trend of Father's Education on College Transition with the Trends of College Premiums at Different Ages**

**(a) Trend of Effect of Father's Education on College Transition**




**(b) Trend of National Earnings Premium at Different Ages**




**Note:** Each dot in Panel (a) is an estimated effect of father's education on college transition for a specific college admission year according to a logistic regression model of educational transition. In addition to the interactions between father's education and college admission year, the logistic regression model also controls for gender, urban origin, and father's SEI. The nonlinear curve is estimated by a Kernel-weighted local polynomial smoothing procedure with a degree of 8. The

earnings premium in Panel (b) is estimated from the data extracted from NBS (1985-2006), NBS (2000: 80-163), and 1988, 1995, and 2002 CHIP. See Data and Methods section and supplementary material for details. The reference lines display the same uptake cohort for the trends of father's education and premium at age 15.

**Figure 3. Graphical Summary of Three Scenarios during Rising Market Incentive**

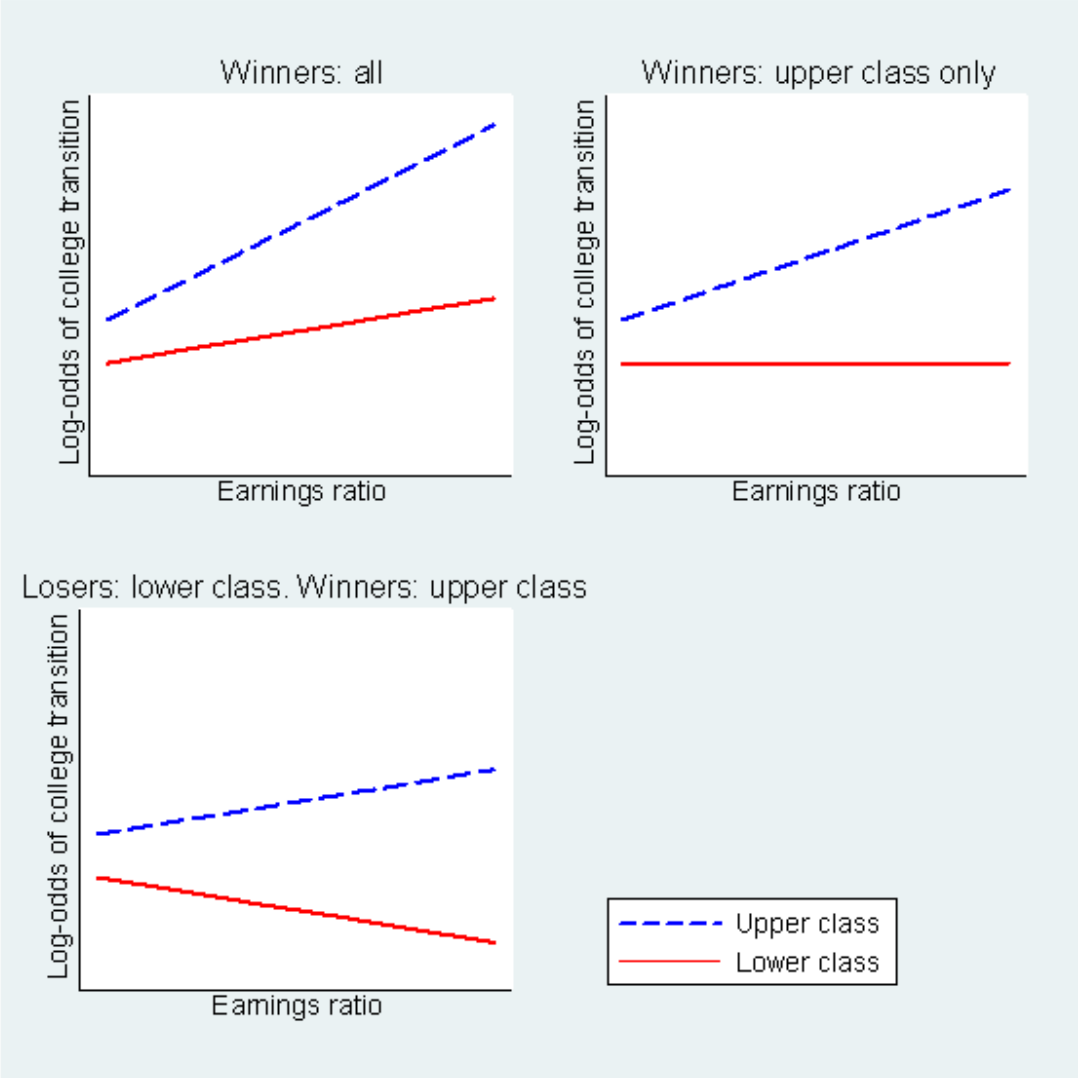
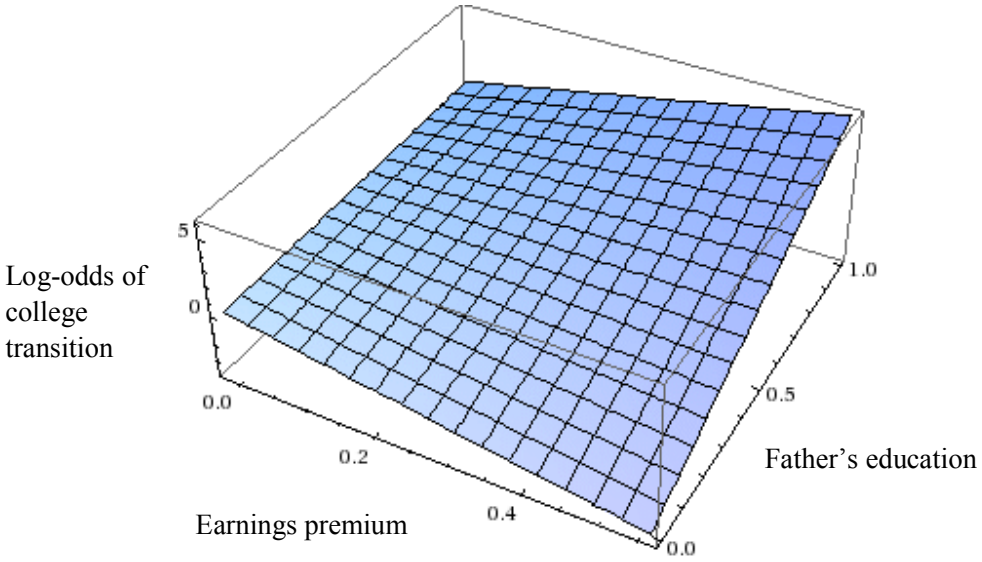


**Figure 4. Three-dimensional View of the Interaction Effect between Earnings Premium and Father's Education**




**Note:** The plot reflects the following equation where the constant is set at zero without loss of generality: -7.123 × *Epremium* + 1.341 × *Fedu* + 15.440 × *Epremium* × *Fedu* (Model 1 of Table 5). The coefficients are based on a logit model that controls for three basic covariates (GDP per capita, respondent's gender, and father's *hukou*). Earnings premium (*Epremium*) is centered at its global mean. Father's education (*Fedu*) is years of schooling but standardized to a range of [0–1].