NBER WORKING PAPER SERIES

# THE CAUSAL LINK BETWEEN RELATIVE AGE EFFECT AND ENTREPRENEURSHIP: EVIDENCE FROM 17 MILLION USERS ACROSS 49 YEARS ON TAOBAO

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Working Paper 25318
http://www.nber.org/papers/w25318

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
November 2018

We are grateful to Tuan Phan, K. Sudhir, Pradeep Chintagunta, Baohong Sun, Song Yao, and seminar participants at New York University Shanghai and Fudan University for many helpful comments and suggestions. We thank Taobao for kindly providing data. We thank the National Natural Science Foundation of China (grant 71371056) for generous funding support. Corresponding Author: Yi Qian The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

The Causal Link between Relative Age Effect and Entrepreneurship: Evidence from 17 Million Users across 49 Years on Taobao

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NBER Working Paper No. 25318
November 2018
JEL No. I24,I38,J21,J24

## ABSTRACT

We use an extensive panel of 17 million individuals born between 1947 and 1995 from China's largest online marketplace, Taobao, to study the impact of RAE on the propensity to become an entrepreneur. Using events surrounding the Cultural Revolution and the issuance of the Compulsory Education Law whereby COD policies varied, we conceptualize a natural experiment to identify the RAE effects. The youngest students are 5.4% less likely to become an entrepreneur compared to the oldest within the cohort, translating to approximate 43.7 thousand additional sellers born in September with an estimated USD 1.29 billion in additional annual sales.

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## I. INTRODUCTION

Identifying factors that lead to a high propensity of people to engage in entrepreneurial activity has been a focus of research over the past four decades (Zhao and Seibert 2006). For example, openness to experience (Shane et al. 2010, Zhao and Seibert 2006), extraversion (Reichard et al. 2011, Shane et al. 2010), and conscientiousness (Zhao and Seibert 2006) have been found to be related to entrepreneurship, as are self-esteem (Thompson, Barnsley and Battle 2004), self-leading (Kamata et al. 2009), and impulsivity/sensation seeking (Derringer et al. 2010, Lesch et al. 1996). This paper will examine a new factor, relative-age effect (RAE), which has rarely been examined in the labor economics and entrepreneurship literature.

RAE refers to the age-based performance differential due to the cutoff date (COD) policy at the start of formal schooling (Angrist and Krueger 1991, Bedard and Dhuey 2006). Students in some countries, for example, can enroll in primary school only after their sixth birthday as of September 1 of the school year, thus making the oldest students 17% older than the youngest students within the same cohort. The COD policy, although easy to implement, systematically penalizes some younger students who are relatively less mature, both mentally and physically, while benefitting older ones born within the same school year.

Researchers in a variety of disciplines, including psychology, education, economics, sociology, and political science, as well as policymakers are interested in the COD policy's impact on individuals' outcomes, including sports (Allen and Barnsley 1993), academic performance (Angrist and Krueger 1991, Bedard and Dhuey 2006, Kuhn and Weinberger 2005, Plug 2001), and mental health (Thompson, Barnsley and Battle 2004). To the best of our knowledge, however, RAE has not been causally linked to entrepreneurship in the literature. Indeed, drawing a causal inference from RAE to long-term effects on entrepreneurship for large populations has been difficult due to the lack of long-term time series data, the statistical challenges and endogeneity issues, and the inability to run controlled interventions.

The lack of long-term data has limited studies to short-term outcomes, such as academic performance in primary school (McEwan and Shapiro 2008), secondary school (Cabus and De Witte 2011), and post-secondary school (Bedard and Dhuey 2006, Dhuey and Lipscomb 2008), and, thus, little is known about outcomes later in life. Bedard and Dhuey (2006) have argued that the long-term effects are of greater importance to the economy, as the short-term effects could eventually disappear with age. Although others provide evidence for short-term links between RAE and increased opportunities in the short term and between increased opportunities and entrepreneurship, this paper aims at establishing the long-term link between RAE and entrepreneurship.

Further, the inability to separate RAE from the birth-month effect creates a methodological challenge. Certain birth months have been associated with higher levels of dopamine receptors due to extended photoperiods in prenatal and postnatal periods (Chotai and Adolfsson 2002, Grosse and Davis 1999), which results in more sensation-seeking behavior (Benjamin et al. 1996, Derringer et al. 2010) and entrepreneurship (Joseph et al. 2009). Notably, RAE can benefit older students due to a higher level of maturity, which translates to better test scores (Jacob and Lefgren 2004), increased likelihood to enter a university (Bedard and Dhuey 2006), a higher propensity to be a leader in high school (Dhuey and Lipscomb 2008), and a greater likelihood of becoming a chief executive officer (CEO) (Du, Gao and Levi 2012).

The inability to separate RAE from the birth-month effect can lead to overestimates or biased estimates. For example, those born in September might be more likely to become an entrepreneur due to climate and cultural factors rather than due to RAE. Previous studies on RAE have either ignored the birth-month effect by assuming that birth month is unrelated to unobservable factors, such as innate abilities, or relied on variations of starting month of school year across countries as a measurement instrument (Bedard and Dhuey 2006). The validity of such instruments rests on the assumption that school year CODs are randomly assigned across countries and not driven by systematic considerations,

such as climate, social, cultural, or economic conditions. Finally, truly randomized experiments may not be possible due to human-subject issues or political considerations.

To disentangle RAE from birth-month effects, we conceptualize a natural experiment to establish the long-term causal link by analyzing historical -data from China's largest online marketplace, Taobao, of 17 million randomly selected sellers and buyers born before, during, and after the Chinese Cultural Revolution (CR). Taobao is an online marketplace that allows for small businesses to sell directly to consumers with reduced efforts and costs. Sellers offer products across a variety of categories, including apparel, electronics, and household goods. The marketplace has become one of the largest platforms for entrepreneurship in China and has reached over 10 million active sellers and 423 million monthly active buyers with USD 294.4 billion in annual GMV as of March 2016.[i] It is ranked as the eleventh most visited website in the world and the third within China.[ii] The sellers on Taobao exemplify spirits of entrepreneurship and leadership, and serve as a valuable sample for our study.

To separate the causal link associated with RAE from other confounds, we analyze sellers and buyers born after 1947, including those affected by the CR that occurred between 1966 and 1976. Although China had admitted children into primary school in September prior to the CR (Gao 1985), many schools shifted the admission date to March during the CR between 1966 and 1976 or ceased normal operations at least in the first few years (Meng and Gregory 2002, Zhang, Liu and Yung 2007). As a result, those who were entering the school system during the CR are free of RAE that resulted from the COD policy associated with autumn admission both during the pre- and post-CR eras but still exhibit birth-month effects. During the post-CR era, several laws came into place. Most notably, the Compulsory Education Laws (Law 86), effective July 1, 1986, introduced a COD policy for all children who turned 6 years old by August 31 and required a minimum number of years of free education (Postiglione 1999). Although there is a lack of national-level statistics, we collected data from local and regional registries and school yearbook records to verify the COD policy and school age of students

who entered primary school between 1949 and 1990. These series of events provide a natural experiment context to test a causal link by focusing on four key periods: those unaffected, who entered primary school before the CR (born before 1960); those affected by CR (born between 1960 and 1970); those who attended primary school after CR but before Law 86 (born between 1971 and 1979); and those who faced the COD policy under Law 86 (born during or after 1980). The natural experimental framework allows us to draw causal inference based on historical and observational data, and is one "in which social and political processes, or clever research-design innovations, create situations that approximate true experiments" (Dunning 2012, p.2).

The findings of this study are presented as follows. Overall, the percentages of entrepreneurs are significantly higher for those born in September than that for those born in other months, especially June, July, and August. For example, the oldest cohort (i.e., those born in September) has a 5.4% premium in terms of possibility of becoming (as proxied by the percentage of those who become) entrepreneurs as compared to the youngest cohort (i.e., those born in August). When splitting the samples into different time periods, we find a striking pattern. Particularly, before the CR, RAE is significant. During the CR, however, the effect disappeared entirely. After the CR, RAE becomes visible again. After the Compulsory Education Law, RAE is the most salient among all of the historical periods that we examined. These findings are consistent with our theoretical prediction. More importantly, when splitting the samples by ethnic nationality regions, RAE is not significant for samples drawn from ethnic minority regions but is salient for ethnic majority regions, probably because the enforcement of the Compulsory Education Law was flexible in ethnic minority regions.

A series of statistical analyses are conducted to check the robustness of the findings in the baseline analysis. First, we redefine the CR-affected population according to the adjustments of schooling seasons we found in the archive data (born between 1966 and 1977) and obtained very similar results. Second, we suppose the school entry age to be 7, rather than 6, as in the baseline analyses. Third, we

limit our samples (sellers) to those who were still in the market as of the date of data collection, with the objective of excluding the attrition effects. Fourth, we limit entrepreneurs to the ones who established an online store and achieved a minimum of transactions and replicate the analyses above. This robustness check is designed to exclude casual sellers not committed to online start-ups. The empirical results are quite robust across all of those analyses, thus lending strong support to the causal link between the relative maturity in early childhood and the online entrepreneurship. Finally, we make sure that all the empirical results are not subject to Multiple Hypotheses Testing issues.

The current study makes the following contributions. First, it disentangles RAE and birth-month effect (seasonal effect) in a quasi-experimental setting as a result of the CR and the enforcement of the Compulsory Education Law in China. Second, it provides evidence for the significance of RAE in a new context—entrepreneurship. Third, we utilize big data that comprise aggregate information on millions of sellers and buyers. As the economy in the next century will be driven by innovation, the big gap in the rate of establishing new business for people born in different months has important implications for policymakers who are committed to educational fairness.

The rest of the paper is organized as follows. Section II provides a review of the literature on RAE and birth-month effect. Section III offers background information on the CR and Compulsory Education Law. Section IV presents the sample used in the analysis and summary statistics. Section V describes the empirical results. Section VI concludes through a discussion of the implications of the findings.

## II. Literature Review

Training and selection characterize nearly all education systems. Recent studies, however, provide evidence that the selection process is subject to systematic error (Allen and Barnsley 1993, Deaner, Lowen and Cobley 2013). This is caused by the relative maturity of children, which is not distinguishable from ability, and the fact that those who are older have been given more training

opportunities, which is referred to as the *relative age effect* (RAE) (Angrist and Krueger 1991, Bedard and Dhuey 2006, Dhuey and Lipscomb 2008). A short-term and mid-term RAE were found in many areas, including sports (Allen and Barnsley 1993, Hancock, Young and Ste-Marie 2011), education (Allen and Barnsley 1993, Angrist and Krueger 1991, Bedard and Dhuey 2006, Hauck and Finch 1993, Plug 2001), and psychology (Joinson and Nettle 2005, Thompson, Barnsley and Battle 2004). What remains unclear is whether such effects persist in the later stage of one's life cycle. Although some studies indicate that RAE does persist (Angrist and Krueger 1991, Bedard and Dhuey 2006, Deaner, Lowen and Cobley 2013, Du, Gao and Levi 2012, Kuhn and Weinberger 2005, Plug 2001), other studies suggest that such effects will eventually disappear after one enters the labor market (Black, Devereux and Salvanes 2011, Dobkin and Ferreira 2010, Fredriksson and Ockert 2014, Fredriksson and Ockert 2005, Hauck and Finch 1993, Hurwitz, Smith and Howell 2015, Nam 2014).

Chetty, Hendren and Katz (2016) show that children grow up in high exposure to innovation are much more likely to become inventors, and exposure to better environment during childhood improves children's overall mental health and IQ (Aghion et al. 2017). In addition to simple exposure to innovations, exposure to same-gender inventors during childhood is shown to increase the chance that children grow to be inventors due to psychological effect (Yglesias 2017). Overall, there are supportive evidences that education, parental background (including multiple generations), individuals' openness to innovations/disruption, timing of innovation, income and social mobility are positively associated with likelihood to have inventions (Acemoglu, Akcigit and Celik 2014, Akcigit, Grigsby and Nicholas 2017, Bell et al. 2017). We include as many of these factors as we are able to collect data for as control variables in our analyses. This paper adds to the literature by providing an examination of the causal link between early maturity and online entrepreneurship behaviors.

Although educational policies vary from country to country, virtually all have a single COD of school entrance. This causes big differences in students' age as of the school entry. For example, in an

education system in which the minimal age of primary school entry is 6 years, students born in the first eligible month are, on average, 17% older than are students born in the last eligible month (Angrist and Krueger 1991, Bedard and Dhuey 2006). This endows children who are relatively older with a significant advantage. Because innate capability cannot be directly observed independent of relative maturity, relatively mature infants are given more opportunities in the course of learning, as exemplified by greater chances of being classroom monitors, sports team captains, and chairs of extracurricular clubs (Dhuey and Lipscomb 2008). In school systems in which students are grouped by ability, those who receive more training time and better experience are selected to the top tier when they are young and, thus, are more likely to be selected to the top tier again when they are older (Allen and Barnsley 1993, Deaner, Lowen and Cobley 2013).

It is a common notion that older children usually out-perform among peers because they are more mature in cognition and emotional development. However, in long run, this advantage is not significant. Moreover, there is evidence that entering school late reduces educational attainment, which eventually reduces lifelong earnings due to late labor-market entries (Deming and Dynarski 2008). Researchers analyzing kindergarten-entering age and academic performances show that kids who enter kindergarten early will initially perform worse than older kids, but this effect diminishes when kids enters third grade. However, there is no evidence showing that age of entering school could affect a child's social skills, school engagement and interpersonal relationships (Stipek and Byler 2001).

RAE was first observed in sports. In the National Hockey League in Canada, in which the COD of ice hockey school registration is January 1, twice as many players were born in the first quarter of the year as in the last (Allen and Barnsley 1993, Deaner, Lowen and Cobley 2013). In addition, RAE in terms of academic performance was found for students in different stages of learning, including primary school (McEwan and Shapiro 2008), secondary school (Cabus and De Witte 2011), post-secondary school (Dhuey and Lipscomb 2008), and even university attendance (Bedard and Dhuey 2006). A few

studies focus on the salience of RAE in post-university stages of human life, including earnings/wages (Angrist and Krueger 1991, Fredriksson and Ockert 2005, Kuhn and Weinberger 2005, Plug 2001) and becoming a CEO (Du, Gao and Levi 2012).

Past literature on entrepreneurship emphasizes the role of accumulating resources over the life-cycle, from the perspectives of human-capital (e.g., Lucas 1978; Kihlstrom and Laffont 1979; Dunn and Holtz-Eakin 2000, Fairlie and Robb 2007, Gruber et al. 2008), education and experience (e.g., Iyigun and Owen 1998; Lazear 2004, 2005; Amaral et al. 2011, Jones and Weinberg 2011, Lafontaine and Shaw 2014), and access to finance (Florin et al. 2003; Gompers et al. 2005, 2010). A recent study analyzed the ages of entrepreneurs and the success of the venture using administrative data at the U.S. Census Bureau (Azoulay et. al. 2018). The authors found that the high-growth start-up founders are middle-aged, although their childhood relative age of education were not traced. To the best of our knowledge, no prior study has directly examined the relationship between RAE and entrepreneurship.[iii]

Examining the long run effects of RAE poses major challenges in terms of identification methods. The majority of the studies that examine RAE take advantage of the fact that birth-month is exogenous and unrelated to unobservable factors such as innate abilities. Therefore, it is possible to obtain consistent estimates of RAE by using birth-month as an instrument, and Bedard and Dhuey (2006) supplied evidence to support the existence of RAE. They found significant long-lasting effects of initial maturity on students' academic performance across OECD countries[iv] in which the school CODs vary. However, the validity of such evidence rests on the assumption that the school entry COD is randomly assigned. The findings might be called into question if the choices of school entry CODs in different nations were based on certain systematic reasons, such as social and economic conditions locally. In this regard, the literature highlights seasonal patterns that concur with the school entry CODs, including level of food stocks (Eisenberg et al. 2007, Huber and Fieder 2009, Lummaa and Tremblay 2003), risk of diseases, such as influenza (Currie and Schwandt 2013) and monsoons (Lokshin and Radyakin 2012).

In our research context, birth month could be related to online entrepreneurship for at least two theoretical reasons, both of which have strong support in the literature. The RAE account emphasizes selection bias due to the unobservable innate ability and the single school entrance CODs that favor older students. Hence, any individual differences due to RAE are the result of training/education systems that are in effect after one's birth. In line with this argument, the literature provides evidence that older students have better achievement-test scores (Bedard and Dhuey 2006, Datar 2006, Jacob and Lefgren 2004), are more likely to occupy leadership positions in high school (Dhuey and Lipscomb 2008), to enter into universities (Bedard and Dhuey 2006), and to become CEOs later in their lives (Du, Gao and Levi 2012). It follows that the benefits accrued from the education system could enable them to become entrepreneurs who are characterized by a self-leading personality (Kamata et al. 2009), extraversion (Reichard et al. 2011, Shane et al. 2010), openness to experience (Shane et al. 2010, Zhao and Seibert 2006), and conscientiousness (Zhao and Seibert 2006). Further, if such effects were found in the context of entrepreneurship, this could be seen as the salience of RAE in adulthood, complementing the literature on the short-term and medium-term effects of RAE.

One alternative explanation for the overrepresentation of people with certain birth months in entrepreneurship (if found) points to the birth-month (or seasonal) effect. The birth-month account of individual differences highlights the fact that "all men are *not* created equal." That is, systematic differences among people born in different months come into existence well before the intervention of the education/training system. In particular, season of birth has been found to be associated with diverse physiological and psychological traits, such as birth weight (Currie and Schwandt 2013, Tanaka et al. 2007), adult height (Tanaka et al. 2007, Weber, Prossinger and Seidler 1998), life expectancy (Doblhammer and Vaupel 2001, Flouris et al. 2009, Lowell and Davis 2010, Ueda et al. 2013), and novelty/sensation seeking (Benjamin et al. 1996, Ebstein et al. 1996, Lesch et al. 1996), among others.

The novelty-seeking trait is particularly relevant to the current paper. The entrepreneurship literature has established that novelty seeking is a distinguishing characteristic of entrepreneurs (in comparison to non-entrepreneurs) (Derringer et al. 2010, Hur and Bouchard 1997, Joinson and Nettle 2005, Roberti 2004, Savitz and Ramesar 2004). As long as starting a new business is accompanied by high risk, it requires the spirit of novelty seeking for one to give up a "safer" job (Stewart Jr and Roth 2004). In 1996, a series of articles reported the findings on the genetic basis of the novelty-seeking trait, which is the dopamine receptor genes (Benjamin et al. 1996, Ebstein et al. 1996, Lesch et al. 1996). The research suggests that entrepreneurship propensity is heritable from parents. By exploring the data from monozygotic identical (twins) and dizygotic (fraternal) twins, Nicolaou and colleagues were able to compare a twin's creative personality score with his or her co-twin's score on the tendency to start a business to determine whether these cross-characteristic, cross-twin correlations are greater for monozygotic than for dizygotic twins (Nicolaou and Shane 2009, Nicolaou et al. 2008, Nicolaou et al. 2009, Shane and Nicolaou 2015). They determined that genetic factors account for a significant fraction of the correlation between creative personality and the tendency to start a business.

Studies in the discipline of behavioral genetics provide theoretical justification of these findings. Dopamine is a catecholamine neurotransmitter that plays a key role in reward and reinforcement (Neve 2009). High-sensation seekers are prone to have dopamine receptor gene variations that increase the arousal necessary to achieve a given level of dopamine in the central nervous system (Van Tol et al. 1991), and this higher arousal threshold leads to greater chances of sensation-seeking activity, including entrepreneurship (Nicolaou et al. 2011). Further, multiple single-nucleotide polymorphisms in dopamine genes were found to account for significant variance in sensation-seeking behavior among individuals (Derringer et al. 2010). Medical evidence on the increased risk for drug abuse and schizophrenia for entrepreneurs support these findings (Derringer et al. 2010, Joseph et al. 2009).

The metabolism of dopamine, however, is not fully genetically determined. It also is affected by environmental factors, such as the photoperiod during a baby's gestation period (Chotai and Adolfsson 2002, Chotai et al. 2001, Chotai et al. 2002, Chotai, Lundberg and Adolfsson 2003, Eisenberg et al. 2007). A well-recognized finding in the field of genetics is that the mutually inhibitory systems of dopamine and melatonin are the paracrine signals of day and night, respectively (Grosse and Davis 1999). Thus, the maternal entrainment of these systems during the prenatal period are different for those born during the short photoperiod of October–March as compared to those born during the longer photoperiod period of the year (Chotai et al. 2002). Stated differently, those born during October–March are more likely to be novelty seeking due to higher levels of dopamine, which may lead to more entrepreneurial activities. Therefore, the birth-month effect is potentially confounded with RAE in earlier studies and is particularly relevant in our research in the context of entrepreneurship.

In this study, we use a novel method to disentangle RAE and birth-month effect. Specifically, we leverage two special periods in the history of education in China: the CR and enforcement of the Compulsory Education Law. In China, the minimal age of primary school registration has been 6 years since the 1920s (Gao 1985). During CR (1966–1976), however, the school entry date was subject to a major adjustment, and people who attended primary school during this period were free of RAE (Meng and Gregory 2002, Zhang, Liu and Yung 2007). After the issuance of Compulsory Education Law, which mandates that parents to have their children at age 6 entered into primary schools by August 31 of the corresponding schooling year, RAE should be salient again. Further, the Compulsory Education Law specifies that pupils who live in ethnic minority regions can register for primary school as late as age 7 (Postiglione 1999). This, in effects, blurs the COD of school registration in these areas and cancels out RAE. Using this unique quasi-experimental setting, we are able to identify RAE by conducting both treatment-removal and treatment-reintroduction studies.

## III. Cultural Revolution and Compulsory Education Law

### III.A. The Cultural Revolution (1966-1976)

Similar to many industrialized nations, China adopted a U.S.-style school system with a "6-3-3-4/5" structure beginning in 1922 (Deng and Treiman 1997, Gao 1985).[v] For the first four years after the People's Republic of China was founded (1949–1952), no consensus was reached on when to enroll new students in primary schools. While some enrolled students in the spring (typically in March), others registered in the fall (usually in August or September), while yet others took in students in both spring and fall (two times in each year). To resolve such inconsistencies, the Ministry of Education in China issued a new policy titled, "Directions on the implementation of the 5 years' education system in primary schools," in November 1952, requiring all primary schools to start the new semester in the fall. The majority of the primary schools shifted to the new system from 1953 until the beginning of the CR in 1966.

At the beginning of the CR in 1966, all primary schools in China were closed for two to three years. During this period, no formal education was available, and, thus, no new students were admitted (Meng and Gregory 2002, Zhang, Liu and Yung 2007). The widespread resumption of the normal curriculum occurred in 1976, when the CR ended (Meng and Gregory 2002, Zhang, Liu and Yung 2007). During the period of the CR, many educational reforms were carried out in reaction to Chairman Mao's decree, "The term should be shortened, and the education system should be revolutionized" (published on May 5, 1966). In particular, between 1966 and 1968, most schools ceased operation. In the following years, between 1969 and 1973, many schools shifted from a fall to a spring COD. From then to 1976, all schools reverted to the September COD, but with significant variation in implementing the change across schools and provinces. By the time that the CR ended in 1976, the majority of the schools had changed back to admitting students in September. In January 1978, the Ministry of Education published

a new policy, "Pilot scheme for the teaching plan of primary and secondary schools," that set forth a national decree, requiring primary schools to admit students only on September 1.

As noted in the literature, official national-level statistical reports are not available for the period during the CR to confirm these key events (Law 1999). To develop a detailed picture of the effect of the policy changes, we gathered yearbooks from local schools' and local governments' annals records. We searched using keywords such as "school entry," "school registration," and "season of entry" in one of the major Chinese online databases, Wanfang Data (s.g.wanfangdata.com.cn). This yielded 206 county records and school yearbooks with accurate documentation on the COD of primary school students in Mainland China since the 1940s. These yearbooks and annals cover 124 prefecture-level cities in 28 provinces, autonomous regions, and municipality cities. For the Qinghai province and Tibet autonomous regions, we did not find any yearbook or annals with information on the school season.[vi]

The trends for the percentage of counties that took in students in spring, fall,[vii] or both are depicted in Figure I. The education system in China in terms of registration seasons can be categorized into four distinct periods. The first period, between 1949 and 1952, is characterized by incongruence across the country. The second period, from 1953 to 1965, is dominated by fall enrollment. The third period, between 1966 and 1977, during the CR, is characterized by the changing admission dates, with most schools' ceasing operations between 1966 and 1968. Finally, the last period, starting in 1978, is characterized by primary schools' admitting students only in the fall.

[FIGURE I ABOUT HERE]

In addition to determining the COD, we further establish the actual age of entering students by conducting an additional search through local and provincial documents. Because no official reports are available on the school age for primary school students in our observation period across the country,

we again rely on the yearbooks and annals for local education found in the Wanfang database. We used keywords such as “school age,” “minimum age,” and “years old.” This search resulted in 263 county annals and yearbooks for local education history for 29 provinces, autonomous regions, and municipality cities. The only province-level region for which we do not have any information is Tibet.[viii] On average, we found 62.4 yearbooks and annals with sufficient information for each year, with more records for more recent years.

We plotted the mean of the minimum entry age and the mean of the maximum entry age for each year of the trend in Figure II. First, we note that the minimum entry age and maximum entry age in the yearbooks and annals reflect the actual age of school entry, rather than those specified in the law decrees. Second, the actual age of school entry is often distributed non-uniformly, with more students who are younger. However, only a small portion of the yearbooks and annals have detailed statistics on the ratio of each age cohort as of school entry for certain years.

[FIGURE II ABOUT HERE]

We note the following from Figure II. First, the minimum school age is consistent across the years, at about 7 years from 1952 to 1977, and dropped a little from 1978, which is consistent with the end of the CR, and remained almost unchanged until 1985. After 1986, the minimum schooling age had a slight drop to 6.5 years and remained stable after that. The small but significant drop in minimum age of entering students since 1986 is related to the issuance of the Compulsory Education Law. Compared to the minimum school age, the maximum age of students who entered the educational system reflects only a small portion of the children who missed their chance of entering primary school at their earliest age. Figure II shows that the maximum ages are consistent and have little fluctuation from 1952 to 1982.

The ages rose significantly from 1983 to 1985 but dropped to a lower level in 1986 and have remained stable since then.

The increase in the maximum school age of entering students might reflect the efforts of the educators and government officials to absorb children during the CR and prior years into the new system. During this period, local governors were evaluated on the "percentage of primary school entry for children between 7 and 12 years old." Similar to what is seen for minimum school age, the data suggest that the decline in the maximum age of entering students in 1986 is linked to the enforcement of the Compulsory Education Law in the same year. Using the results from Figure II to determine individuals' school cohort, we assume that students are 6 years old. We also will show that the statistical results are robust if we assume the schooling age to be 7.

### III.B. The Compulsory Education Law

After the CR, the National People's Congress (the highest lawmaking body) enacted *Compulsory Education Law* (enforced on July 1, 1986 [Law 86]) as an integral part of the national rebuilding efforts (Law 1999). It is the first time in the history of China that the basic rights of children to access a minimum period of free schooling was protected and enforced by law (Law 1999). More importantly, it clearly specifies the age of entry and, thus, in effect, reduces the variance of schooling age across the country and, hypothetically, makes RAE more significant.

Law 86 specifies: "The state shall implement nine-year compulsory education. All children who have reached the age of **six** [emphasis added], irrespective of gender, ethnicity, or race, shall enter schools to receive compulsory education for the stipulated number of years."

In principle, compulsory education was free of charge: "The state shall waive collection of school fees from students receiving compulsory education." In terms of financing, Law 86 also specified the responsibilities for different administrative levels. Local governments were allowed to collect education

taxes to finance compulsory education. In particular, "The state shall provide subsidies toward the funds for implementing compulsory education in regions that have economic difficulties." To promote the enforcement of Law 86, it contains the requirement that "all organizations or individuals are prohibited from recruiting and employing school-age children and juveniles who should be receiving compulsory education."

The central government made a concerted effort to promote the 9-years' compulsory education law.[7] For example, the decrees were broadcast and discussed in the major national newspapers (e.g., *People Daily*, *Guangming Daily*, *China Education Daily*) in 1986 and the years that followed. Hundreds of counties that did a good job of promoting compulsory education were praised on Teacher's Day, a new holiday in China that was first proclaimed in 1985 to acknowledge educators' contributions. In addition, compulsory education laws in the province level were enacted. By the end of 1986, 10 provinces had passed detailed decrees and execution plans for compulsory education (Zong 2010). Official statistics show that, at the end of 1988, 97% of the children were enrolled in primary schools in their schooling years and that 66% of the counties has been accredited to meet the 9-years' compulsory education requirements (Li 1990).

Law 86 also allows some flexibility for certain geographical areas to overcome the difficulties in implementing the law on a national scale. In particular, it stipulates that, "In regions that lack the conditions for doing so, entry into school may be deferred until seven years of age."

Although Law 86 did not specify which areas are "regions that lack the conditions for doing so," autonomous administrative regions clearly fall into this category. In fact, China has a tradition of enforcing favorable policies in Han minority areas since the founding of the nation in 1949. In the *Law of the People's Republic of China on Regional National Autonomy*,[ix] which was enforced two years prior to Law 86 (Postiglione 1999), Article 36 specified:

"In accordance with the state's educational policies and in line with the stipulations of the law, the organs of self-government in areas of national self-government decide on the educational plans as well as the facilities, educational systems, forms of operation, teaching contents, languages used for teaching, and student recruitment methods for schools of various levels and categories in their own areas."

The freedom of parents to enroll their children in primary school at age 6 or age 7, together with the flexibility in enforcing Law 86 in ethnic minority regions, could, in effect, blur the COD of school entry. For children born right before August 31 of the academic year, but who are psychologically or physically underdeveloped, the parents could choose late entry (i.e., at age 7) to avoid their children's having to compete with older peers. Alternatively, younger children who are psychologically and physically well-developed could opt for school entrance at age 6. Thus, "self-selection" could mitigate or even cancel out RAE in regions with lax enforcement.

To reinforce our conjecture on the effects of Law 86 on schooling age in Han majority and Han minority areas, we split the schooling age samples into two groups. For the Han majority group, it includes the 25 provinces and municipality cities; for the Han minority group, it includes the four autonomous regions (with a total of 16 counties or prefectures). Although the sample size for the autonomous regions is quite small, the sub-sample analyses yield some interesting findings (Figure III). First, before the ending of the CR in 1977, both the minimum schooling age and maximum schooling age are larger for Han minority regions than that of Han majority regions. This reflects the fact that Han minority regions are relatively tardy in initiating children's primary education. After the CR, but before Law 86, the maximum schooling age of Han minority regions dropped somewhat, although the minimum schooling age is almost identical to that for Han majority regions. From 1986 on, one striking finding is that the minimum schooling age for Han minority regions stays unchanged, while that for Han majority regions drops significantly. This finding is consistent with the decrees in Law 86, which push the minimum schooling age downward in Han majority regions, while leaving the education

system in Han minority regions less affected. As for the maximum schooling age, it goes down for Han majority regions but goes up a little for Han minority regions. This finding is also consistent with Law 86, which gives parents in the Han minority regions more flexibility in deciding when to enter their children in school. Putting this statistical evidence together, we conjecture that RAE will become stronger for Han majority regions but weaker or even disappear for Han minority regions after 1986.

[FIGURE III ABOUT HERE]

## IV. Data and Sample Statistics

In collaboration with Taobao, we collected a random sample of 9 million sellers and 8 million buyers among registered users up to September 2013[x]. We narrow our analyses to those born after September, 1947 because (1) the number of sellers and buyers before 1947 are relatively small, and (2) those born in 1947 entered into primary school in 1953 (assuming that the schooling age is 6), the first year in China that a majority of the schools enrolled students in the fall. The data were anonymized and contained only the user's birth year, birth month, birth location at the province level, and gender. Similar to other major online marketplaces in China, Taobao requires sellers to provide government-issued identification. This policy is enforced to counter opportunistic or fraudulent behavior and is the primary source of our data.[xi]

Table I reports the sample statistics for sellers and buyers included in the analyses. Sellers are 29.3 years old on average, which is a little bit younger than buyers (30.0 years old averagely). As to the gender distribution, 47.5% of entrepreneurs are females, while this ratio is 44.4% for buyers. Therefore, although female sellers are fewer than 50%, they represent a relatively larger proportion relative to the ratio of female buyers. Finally, in terms of geographical distributions, we have more sellers and buyers coming from economically developed regions (such as Guangdong, Zhejiang, and Jiangsu).

Comparatively, fewer sellers and buyers originate from economically underdeveloped areas (such as Tibet, Qinghai, and Ningxia).

[TABLE I ABOUT HERE]

Figure IV presents the mean-centered birth rates across three decades from the 1998 census data from the China Population Information Center and from our data of buyers and sellers on Taobao.[xii] Overall, we find consistent birth rate patterns between census data and Taobao users for both sellers and buyers. There are higher birth rates in September through December. The largest difference comes in October, with a birth rate that is 18.7% and 28.2% above the yearly average from census data and Taobao users, respectively. The lowest birth rates come in May, with 12.8% and 13.3% below the yearly average offline and among Taobao users, respectively. Later decades also experience a greater skew. Online users also are more skewed toward the later months in the year than from census data. This can be driven by sundry factors that affect adoption of the online platform. For example, the birth rates across months may vary over different income groups that also may have different propensities of Internet adoption. There are similar rates, however, for both sellers and buyers. Thus, we use the ratio of sellers to buyers in every subgroup on Taobao to measure the propensity of being sellers for that subgroup.

[FIGURE IV ABOUT HERE]

Second, we compute the average of the ratio of sellers to buyers on Taobao for each birth month. We use the ratio to control for selection bias, such as accessibility to the Internet and adoption of the site. We also count all sellers (i.e., those who ever registered as sellers) and not just successful sellers to avoid survival bias (Henrekson and Sanandaji 2014).[xiii] Figure V shows the mean-centered

percentage differences in the ratio of sellers and buyers according to birth month for all birth years. It shows that those born in the last quarter of the year (September through December) are more likely to become entrepreneurs, with a peak in September at 2.54% and a minimum in July at -3.53%, relative to the mean across all 12 months.

[FIGURE V ABOUT HERE]

## V. Regression Analysis

### V.A. Estimates for the Entire Sample

We conduct a regression analysis to quantify the impact of RAE on entrepreneurship. We aggregate users into subgroups by birth year, birth month, gender, and province. We estimate the following model for each subgroup $i$[xiv]:

$$Y_i = \alpha + \beta_1 Age_i + \beta_2 Gender_i + \beta_3 P_i + \beta_4 Q_i + \beta_5 T_i + \beta_6 RAE_i + \varepsilon$$

where Y is the natural log of the ratio of sellers and buyers for a particular subgroup, Age is the age of the subgroup by the time of data collection, Gender is the gender dummy variable (1 for female), P is the vector of province dummy variables, and Q is the vector of dummy variables for each calendar quarter (i.e., Q2, Q3, and Q4 as dummies) using the first quarter (Q1) as the baseline. We use quarters rather than monthly dummies to avoid collinearity with RAE. T is the time elapsed (in months) that are subgroup-specific since the establishment of the online stores. We construct RAE as the relative month according to the COD, using integers between 1, representing the oldest in the cohort born in September, and 12, representing the youngest in the cohort born in August of the following calendar year. $\beta_6$ reflects the causal impact of one fewer month of maturity of a student in a given cohort.

Table II presents the coefficient estimates for different subgroups. Column (1) provides the ordinary least squares (OLS) results for all users across all age groups, ranging from 18 to 66 years.

Columns (2), (3), (4), and (5) present the OLS results for age cohorts who attended primary school before the CR (born between 1947 and 1959), during the CR (born between 1960 and 1970), post-CR (born between 1971 and 1979), and after Law 86 (born between 1980 and 1995), respectively. While controlling for birth-month effects, using quarters, we find that, overall, RAE has a significant and negative effect on the seller-buyer ratio at the $p<0.001$ level (Column 1). Similarly, before the CR, RAE is also significant at the $p<0.001$ level and negative (Column 2). However, we find that, during the CR, RAE has a non-significant effect on entrepreneurship (Column 3). The post-CR (but prior to Law 86) period experienced a significant (at the $p<0.001$ level) negative effect (Column 4). RAE is strongest, however, after Law 86 was enforced (Column 5). For each additional month within a cohort after Law 86, individuals were 0.49% less likely to become a seller on Taobao. Those born in August are 5.4% less likely to become entrepreneurs as compared to their peers born in September.[xv] Based on the number of active sellers (10 millions) and retailing GMV (USD 294.4 billion) for Taobao, this translates to approximately 43,700 additional sellers born in September, with an estimated USD 1.29 billion in additional sales every year. We also find that females are 19.46% more likely to become entrepreneurs on the platform. Younger individuals also are more likely to use the platform as a seller.

[TABLE II ABOUT HERE]

According to Figure I, the schooling season is inconsistent in 1977, one year after the ending of the CR. Thus, we considered the CR a period from 1966 to 1977 and redid the analyses. The corresponding results as in Table III are consistent with the baseline analysis in Table II.

[TABLE III ABOUT HERE]

So far, we assume that students enter primary school at age 6. Although this holds true in most cases, some schools in some administrative regions admit students when they reach age 7 (one year late). Table IV presents the analyses while redefining the age cohorts by considering the alternative school entry ages. The major findings remain the same as in the baseline analyses, providing further support to our theoretical arguments.

[TABLE IV ABOUT HERE]

To determine whether there are any differences in RAE for different geographical regions, we dichotomize the entire sample into groups, such as north/south provinces, rural/urban provinces, and high/low level of education provinces, and observe the findings.[xvi] No obvious differences were found for those dichotomized groups of samples. Therefore, weather and economic factors could not explain our empirical findings as above.

Establishing and operating a business online requires less investment in contrast to offline (Wang et al. 2013). This leads to many casual entrepreneurs, characterized by having little time or monetary investments in operating their stores. As a robustness check, we limit our analyses to sellers who complete a minimum number of transactions and redo all of the analyses in earlier sections. Particularly, we require a seller to complete at least one transaction and the sample size for sellers who had completed one or more transactions shrinks to 8.19 million sellers (in contrast to 9 million sellers originally). Despite this change, we get significant coefficients for RAE after Law86 (refer to Table V).

[TABLE V ABOUT HERE]

By the time of data collection, a significant portion of the sellers had exited the market. To examine whether attrition leads to different results, we conduct another robustness check by limiting sellers to those who are still in the market as of the date of data collection and recalculate the dependent variable. Table VI shows that two major results remain unchanged as compared to the baseline. The coefficients for RAE are insignificant during the CR but are salient both before and after the CR. Thus, despite the fact that the new results are subject to attrition effects, RAE is still salient, thus providing strong supports to our baseline results using all samples.

[TABLE VI ABOUT HERE]

### V.B. Estimates for the Ethnic Majority and Minority Sub-samples

China has a tradition of treating ethnic minorities differently, as embodied by decrees in the Compulsory Education Law. According to Law 86, it is legal for parents in the minority nationality areas to send their children to primary schools when they are as old as 7, while for other areas, the age is 6. In addition, Law 86 encourages but does not mandate compulsory enforcement of the school entry COD (Law 1999). It is important to point out that such enforcement flexibility was never clarified in any formal law decree before 1986 (Postiglione 1999). This, in effects, weakens the control of law enforcement on school entry COD, rather than strengthening it. For this reason, we expect RAE to be relatively weak or even insignificant after the law in minority nationality areas, while the key findings for other age cohorts should remain largely unchanged.

Table VII presents the OLS results for minority nationality samples.[xvii] What is most striking in this table is the insignificant RAE after Law 86. As noted, this is in keeping with the lax enforcement of the school entry COD during this period.

[TABLE VII ABOUT HERE]

Table VIII presents the findings in regard to Han majority provinces. As expected, the empirical results are similar to those in the baseline analyses after Law 86. In particular, the coefficient of RAE is significant both before CR and after Law86. It becomes insignificant during CR.

[TABLE VIII ABOUT HERE]

According to Law86, children in ethnic minority provinces could delay school entry until age 7, and we thus wonder whether the analysis results are sensitive to this law decree. Therefore, we replicate the analysis in Tables VII and VIII but define school entry age as 7. The findings are largely unchanged. For succinctness, this set of findings is not included.

### V.C. Estimates for the Interaction Effects between RAE and Gender in Major Cities

The past literature suggested that the RAE is stronger for boys than for girls (McEwan and Shapiro 2008), probably because boys usually experience intellectual and psychological development at a later age than girls do. It follows that there is an interaction effect of RAE and gender, provided that the enforcement of school entry policy is stringent enough across the country. However, this assumption might not hold all the time. Taking geographical region as an example, it is more likely for the boys to delay school entry in rural areas of China where the policy implementation is relatively flexible (Chen 2015, Tsui and Rich 2002). Consequently, this makes it difficult to identify the interaction effect of RAE and gender.

To circumvent the issue, one strategy is leveraging the more fine grained information on buyers' and sellers' locations of registration in the data, in particular the prefecture-level cities. There are overall 365 prefecture-level cities in China, which vary significantly with the level of economic development and administrative capacity. For major cities such as municipality cities (Beijing and Shanghai as examples) and provincial capitals, we expect that the enforcement of the policy is stringent. For under-developed prefecture-level cities, we expect that the enforcement of the policy is flexible. However, there are many other cities that lie in-between the two extremes. For the purpose of this study, we primarily rely on two standards in categorizing cites. First, the list of top tier cities taking into account such factors as size of population, GDP, education system is utilized as the candidate set (Ma 2010). Second, this set is cross-validated by the ratio of households registered in urban areas (as compared to rural areas) according to statistical yearbooks (Sheng 2010). In particular, only fourth tier cities or above are included in the analyses. As a result, 161 prefecture-level cities (which represents 47% of the cities) were identified as the major cities for data analysis. The results are reported in Table IX.

The findings concerning the main effects of RAE are largely unchanged in the full sample and sub-sample for different time periods. Interestingly, the interaction effects of RAE and gender are positive and significant in each analysis (at $p<0.01$ level or above), thus providing strong support for our conjecture. Males suffer more from the RAE than girls in terms of ratio of online entrepreneurs. We further narrowed the analysis to 75 third tier cities or above and the results are similar. This set of results are available upon requests. Overall, it seems that RAE differs for males and females, especially in major cities where the enforcement of the education policy is more rigorous.

[TABLE IX ABOUT HERE]

## V.C. MULTIPLE HYPOTHESES TESTING

In case there are multiple treatments of interest and it is desired to determine which treatments have an effect, the probability of a false rejection may be much higher than desired. This is generally known as Multiple Hypothesis Testing (MHT) problem in the literature (List, Shaikh and Xu 2016, Romano and Wolf 2005). In this paper, we aim at identifying the existence of RAE in four historical periods when the school COD policy was enforced or removed. It is possible for some of the RAE coefficients to be significant simply due to MHT, leading to false rejection of the null hypotheses. To understand why this may happen, we consider testing $N$ null hypotheses simultaneously and suppose that all null hypotheses are true and that the p-values are independent and uniformly distributed. If we were to test each null hypothesis in the usual way at traditional significance level ($\alpha = 0.05$), then the probability of at least one false rejection equals to $1-(1-0.05)^N$, which approaches rapidly to one as $N$ increases. For instance, it equals to 0.185 when $N = 4$, equals to 0.401 when $N = 10$ and to 0.994 when $N = 100$ (Romano and Wolf 2007).

One measure by which we account for MHT is the familywise error rate (FWER), defined as the probability of rejecting at least one of the true null hypotheses. A multiple testing method is said to control the FWER at level $\alpha$ if $FWER < \alpha$ for any underlying probability mechanism of the parameter to be tested (Romano and Wolf 2005).

Many methods have been proposed to control the FWER (see (Romano and Wolf 2007) for a comprehensive review). The Bonferroni method is the most conservative one that falls into the category of single step method. In single-step methods, individual test statistics are compared to their critical values simultaneously, and after this comparison, the procedure stops. As an example, one could consider the Bonferroni method with $N$ hypotheses and $p_i$ is an individual p-value for hypothesis $H_i$. There is a common critical value $\alpha/N$ and $H_i$ is rejected if and only if $p_i < \alpha/N$.

Single-step methods can be improved in terms of power via stepwise methods, which can nevertheless control for the error rate as well. Stepdown methods start with a single-step method but then continue by possibly rejecting further hypotheses in subsequent steps. This is achieved by decreasing the critical values for the remaining hypotheses depending on the hypotheses already rejected in previous steps. As soon as no further hypotheses are rejected anymore, the procedure stops. Holm method (Holm 1979) is the most well-known step-down method and a simplified version can be formulated as follows.

**Holm Algorithm** (Step-down method for control of the FWER)

1. Relabel the $N$ null hypotheses in ascending order of the p-values: hypothesis $H_1$ corresponds to the smallest p-value $p_1$ and hypothesis $H_N$ to the largest p-value $p_N$.

2. For $j = 1,2,\dots,N$, if $p_j < \alpha/(N-j+1)$, then: (1) reject the null hypothesis $H_j$, (2) let $j = j+1$, and continue; Otherwise, accept $H_j$ and all subsequent hypotheses and stop.

To exclude the possibility that our findings concerning RAE is driven by MHT, we relabeled the level of significance for the coefficients of RAE for all the regression results by applying the Holm Algorithm (see Table X). As is evident in column 2 through column 5, the conclusions concerning RAE remain valid after taking into account of MHT[xviii]. In particular, the RAE is significant before CR in all analysis results (column 2); RAE is insignificant for all analysis results during CR (column 3); RAE is significant again after CR but before Law86 (column 4); RAE is also significant after Law86 (column 5) except for the analysis results for the minority nationality regions (in Table VII), which is consistent to our theoretical prediction. Thus, MHT is unlikely to be a major issue in our empirical results.

[TABLE X ABOUT HERE]

## VI. Discussion and Conclusion

The findings of this study should be interpreted with the following caveats. First, our data come from the largest developing country—China. One advantage of big data is that contributions of minor factors that drive the results are likely to be evened out. Whether the findings are generalizable to other countries with different cultural and economic conditions, however, is still an open question, and warranting more research. Second, our study examined only online entrepreneurship. Whether the findings are generalizable to offline entrepreneurship or other forms of entrepreneurial behaviors also warrants further research.

Despite these limitations, our search calls into question the school systems in the majority of the countries worldwide that are characterized by a single COD of entrance. The literature has shown large and significant advantages in academic achievement for pupils who are more mature than their classmates (Angrist and Krueger 1991, Bedard and Dhuey 2006, Datar 2006, Jacob and Lefgren 2004, Plug 2001). Prior works, however, are split in terms of the endurance of this RAE into adulthood. While one body of literature supports the view that the effect will propagate into career development (Angrist and Krueger 1991, Bedard and Dhuey 2006, Deaner, Lowen and Cobley 2013, Du, Gao and Levi 2012, Kuhn and Weinberger 2005, Plug 2001), another body holds that the effect will diminish (Black, Devereux and Salvanes 2011, Dobkin and Ferreira 2010, Fredriksson and Ockert 2014, Fredriksson and Ockert 2005, Hauck and Finch 1993, Hurwitz, Smith and Howell 2015, Nam 2014). To the best of our knowledge, the literature falls short of presenting evidence for the persistence of RAE after one enters the job market.

By exploiting a unique dataset that contains information about 9 million online entrepreneurs in China, this study finds a causal relationship between birth month and the likelihood of becoming an online entrepreneur as a result of COD. Overall, people born in September are 5.4% more likely to become entrepreneurs compared to those born in August of the same school year, ceteris paribus.

Further, we show evidence that the findings are unlikely to be driven by seasonal effects. During the CR, RAE vanished but is salient both before and after the CR. After the enforcement of the Compulsory Education Law, RAE came back and became more salient. Because the seasons are unaffected by human intervention in the education system, we conclude that our findings are driven primarily by the dynamics of education policy; i.e., what we identified is an RAE rather than a birth-month effect. Finally, the enforcement of the Compulsory Education Law in terms of COD of school entry in ethnic minority regions of China is flexible: Children are eligible to enter into primary school after passing age 6; alternatively, they can delay school entry for one year. Correspondingly, people from those areas are less likely to be subjected to RAE. Our data support this conjecture and lend more credibility to the persistence of RAE into adulthood.

The literature on RAE also is split on the benefits and costs of early school entry. Some empirical results support early entry. For example, Nam (2014) indicates that, for the oldest children in a cohort, educational achievement decreases as their age increases. In contrast, other studies support the idea of late entry. For example, Bedard and Dhuey (2012) found that backing up the COD by one month increases average hourly earnings. McEwan and Shapiro (2008) show that a one-year delay decreases the probability of repeating first grade and increases fourth and eighth grade test scores, with larger effects for boys. Muhlenweg et al. (2012) find more favorable outcomes for higher age at school entry in regard to several temperamental dimensions; such children are more persistent, less often hyperactive, and more adaptable to change. Ponzo and Scoppa (2014) find that younger children score substantially lower than do older peers in the fourth, eighth and tenth grades.

Indeed, more empirical findings are inconclusive. For example, Elder and Lubotsky (2009) find that having older classmates boosts a child's test scores but increases the probability of grade repetition and diagnoses of learning disabilities. Black et al. (2011) find that starting older leads to lower earnings but that boys who start older are less likely to have poor mental health. Suziedelyte and Zhu (2015) find

that an early school start generally improves children's cognitive skills but negatively affects their non-cognitive skills.

The results reported in this paper add to the literature through the consideration of a new dimension: entrepreneurship. Some may think that a single schooling COD is a necessary and beneficial educational component. We found that RAE, which was believed to exist only in the early educational stages, could propagate into later stages of life and affect important career decisions, such as establishing an online business. We also found that RAE is not significant in areas where the enforcement of the school starting date is flexible. Therefore, an alternative policy that aims at ameliorating RAE might endow parents with more rights in deciding when their children are ready to enter school. For example, if children can enter school one year earlier or one year later than scheduled, this would largely cancel out RAE.

Because the relative maturity of children in early childhood is confounded with factors such as gender and race, adopting a flexible school entry date could effectively promote educational fairness. In current educational systems, parents who are aware of the negative effects of relative age react by keeping their children out of school so that they enter school a year later or through grade retention. Such practices could be viewed as passive and post hoc interventions applicable to a small student population. Our research supports a more formal rule as an integral part of the education system. It is worth noting that this recommended system is different from existing systems that are widely adopted in places such as England and the United States, where students are separated into ability-specific curriculum groups (Bedard and Dhuey 2006). Rather than splitting students into groups according to their observed ability (which is confounded with maturity and, thus, subject to measurement errors), it is advisable to give parents more flexibility in deciding when their children are prepared to enter school.

While our research yield robust and novel results, it is worth mentioning that due to lack of exact dates of birth for most entrepreneurs in our sample, we could not leverage the exact dates as McCrary and Royer (2011) in identifying the effect of female education on fertility and infant. Grouping of

subjects according to common treatment periods has been used in the natural experiment literature for program evaluations (Qian 2007). Future research could aim at gathering finer information of birth dates. We hope this study serves as a stepping stone for future research on this important topic.

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**Table I**

SAMPLE STATISTICS

| Variable | Sellers | Buyers |
|---|---|---|
| Sample | 9.0 millions | 8.0 millions |
| Mean Age | 29.3 | 30.0 |
| Female | 47.5% | 44.4% |
| Top Five Provinces | Guangdong | Guangdong |
| | Zhejiang | Zhejiang |
| | Jiangsu | Jiangsu |
| | Shanghai | Shanghai |
| | Shandong | Beijing |
| Bottom Five Provinces | Gansu | Gansu |
| | Hainan | Hainan |
| | Ningxia | Ningxia |
| | Qinghai | Qinghai |
| | Tibet | Tibet |

**TABLE II**

BASELINE REGRESSION RESULTS

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | All (1947-1995) | Pre-CR (1947-1959) | CR (1960-1970) | Post-CR (1971-1979) | Law 86 (1980-1995) |
| Age | -0.0025*** | -0.0243*** | 0.0180*** | 0.0128*** | -0.0701*** |
| | (0.0004) | (0.0020) | (0.0019) | (0.0030) | (0.0015) |
| Female | 0.1946*** | 0.2547*** | 0.2929*** | 0.1247*** | 0.1011*** |
| | (0.0061) | (0.0147) | (0.0102) | (0.0050) | (0.0036) |
| Q2 | 0.0088 | 0.0239 | 0.0128 | -0.0113 | 0.0149** |
| | (0.0097) | (0.0228) | (0.0160) | (0.0081) | (0.0053) |
| Q3 | 0.0260** | 0.0564** | 0.0182 | 0.0227*** | 0.0204*** |
| | (0.0089) | (0.0204) | (0.0153) | (0.0068) | (0.0050) |
| Q4 | 0.0167 | 0.0357 | 0.0057 | 0.0071 | 0.0104 |
| | (0.0089) | (0.0212) | (0.0149) | (0.0066) | (0.0054) |
| T | 0.0068*** | 0.0284*** | 0.0260*** | 0.0026 | 0.0124*** |
| | (0.0008) | (0.0015) | (0.0024) | (0.0031) | (0.0008) |
| RAE | -0.0049*** | -0.0098*** | 0.0006 | -0.0027*** | -0.0029*** |
| | (0.0011) | (0.0025) | (0.0020) | (0.0008) | (0.0007) |
| P | Yes | Yes | Yes | Yes | Yes |
| Adj $R^2$ | 0.40 | 0.63 | 0.64 | 0.74 | 0.69 |
| *F* | 642.31 | 297.60 | 602.00 | 1,070.34 | 1,004.91 |
| *N* | 35,916 | 9,210 | 8,157 | 6,653 | 11,896 |

Notes: Dependent Variable = ln (#seller/#buyer * 100 + 1). Heteroskedastic-consistent standard errors are in brackets. September is the baseline month of comparison. All models include controls for gender, age, time elapsed since the foundation of online stores (T), and province fixed-effect (P). All models include the intercept term. *p < .05, **p < .01, ***p < .001

**TABLE III**

REGRESSION RESULTS BASED ON A LONG PERIOD OF CULTURAL REVOLUTION

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | All (1947-1995) | Pre-CR (1947-1959) | Long CR (1960-1971) | Post-CR (1972-1979) | Law86 (1980-1995) |
| Age | -0.0025*** | -0.0243*** | 0.0222*** | 0.0110*** | -0.0701*** |
| | (0.0004) | (0.0020) | (0.0015) | (0.0032) | (0.0015) |
| Female | 0.1946*** | 0.2547*** | 0.2923*** | 0.1130*** | 0.1011*** |
| | (0.0061) | (0.0147) | (0.0096) | (0.0051) | (0.0036) |
| Q2 | 0.0088 | 0.0239 | 0.0126 | -0.0136 | 0.0149** |
| | (0.0097) | (0.0228) | (0.0150) | (0.0084) | (0.0053) |
| Q3 | 0.0260** | 0.0564** | 0.0172 | 0.0239*** | 0.0204*** |
| | (0.0089) | (0.0204) | (0.0144) | (0.0067) | (0.0050) |
| Q4 | 0.0167 | 0.0357 | 0.0071 | 0.0047 | 0.0104 |
| | (0.0089) | (0.0212) | (0.0140) | (0.0066) | (0.0054) |
| T | 0.0068*** | 0.0284*** | 0.0251*** | 0.0031 | 0.0124*** |
| | (0.0008) | (0.0015) | (0.0024) | (0.0033) | (0.0008) |
| RAE | -0.0049*** | -0.0098*** | 0.0004 | -0.0027** | -0.0029*** |
| | (0.0011) | (0.0025) | (0.0019) | (0.0008) | (0.0007) |
| P | Yes | Yes | Yes | Yes | Yes |
| Adj $R^2$ | 0.40 | 0.63 | 0.64 | 0.75 | 0.69 |
| *F* | 642.31 | 297.60 | 662.74 | 1,011.81 | 1,004.91 |
| *N* | 35,916 | 9,210 | 8,894 | 5,916 | 11,896 |

Notes: Dependent Variable = ln (#seller/#buyer * 100 + 1). Heteroskedastic-consistent standard errors are in brackets. September is the baseline month of comparison. All models include controls for gender, age, time elapsed since the foundation of online stores (T), and province fixed-effect (P). All models include the intercept term. *p < .05, **p < .01, ***p < .001

**TABLE IV**

REGRESSION RESULTS BASED ON A SCHOOL ENTRY AGE OF 7

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | All (1947-1995) | Pre-CR (1947-1959) | CR (1960-1970) | Post-CR (1971-1979) | Law86 (1980-1995) |
| Age | -0.0025*** | -0.0249*** | 0.0144*** | 0.0215*** | -0.0598*** |
| | (0.0004) | (0.0023) | (0.0020) | (0.0031) | (0.0013) |
| Female | 0.1946*** | 0.2597*** | 0.2878*** | 0.1461*** | 0.0987*** |
| | (0.0061) | (0.0156) | (0.0105) | (0.0058) | (0.0035) |
| Q2 | 0.0088 | 0.0233 | 0.0124 | -0.0125 | 0.0138** |
| | (0.0097) | (0.0242) | (0.0165) | (0.0086) | (0.0052) |
| Q3 | 0.0260** | 0.0541* | 0.0256 | 0.0173* | 0.0177*** |
| | (0.0089) | (0.0214) | (0.0157) | (0.0081) | (0.0049) |
| Q4 | 0.0167 | 0.0426 | 0.0040 | -0.0001 | 0.0067 |
| | (0.0089) | (0.0224) | (0.0157) | (0.0073) | (0.0052) |
| T | 0.0068*** | 0.0281*** | 0.0265*** | 0.0058 | 0.0084*** |
| | (0.0008) | (0.0016) | (0.0023) | (0.0033) | (0.0007) |
| RAE | -0.0049*** | -0.0097*** | -0.0001 | -0.0025* | -0.0028*** |
| | (0.0011) | (0.0026) | (0.0021) | (0.0011) | (0.0007) |
| P | Yes | Yes | Yes | Yes | Yes |
| Adj $R^2$ | 0.40 | 0.63 | 0.64 | 0.73 | 0.71 |
| *F* | 642.31 | 269.04 | 576.95 | 1,051.04 | 1,029.13 |
| *N* | 35,916 | 8,478 | 8,145 | 6,655 | 12,638 |

Notes: Dependent Variable = ln (#seller/#buyer * 100 + 1). Heteroskedastic-consistent standard errors are in brackets. September is the baseline month of comparison. All models include controls for gender, age, time elapsed since the foundation of online stores (T), and province fixed-effect (P). All models include the intercept term. *p < .05, **p < .01, ***p < .001

**TABLE V**

REGRESSION RESULTS FOR SELLERS COMPLETING AT LEAST ONE TRANSACTION

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | All (1947-1995) | Pre-CR (1947-1959) | CR (1960-1970) | Post-CR (1971-1979) | Law86 (1980-1995) |
| Age | 0.0043*** | -0.0158*** | 0.0362*** | 0.0137*** | -0.0694*** |
| | (0.0003) | (0.0020) | (0.0018) | (0.0028) | (0.0024) |
| Female | 0.2298*** | 0.2747*** | 0.3732*** | 0.1521*** | 0.1275*** |
| | (0.0064) | (0.0149) | (0.0112) | (0.0067) | (0.0047) |
| Q2 | 0.0026 | 0.0054 | -0.0009 | -0.0055 | 0.0103 |
| | (0.0101) | (0.0232) | (0.0174) | (0.0111) | (0.0068) |
| Q3 | 0.0202* | 0.0443* | 0.0151 | 0.0316*** | 0.0093 |
| | (0.0093) | (0.0209) | (0.0163) | (0.0094) | (0.0067) |
| Q4 | 0.0143 | 0.0460* | -0.0088 | 0.0161 | 0.0011 |
| | (0.0094) | (0.0218) | (0.0164) | (0.0088) | (0.0072) |
| T | 0.0142*** | 0.0344*** | 0.0257*** | 0.0122*** | 0.0220*** |
| | (0.0006) | (0.0012) | (0.0016) | (0.0022) | (0.0011) |
| RAE | -0.0045*** | -0.0077** | 0.0010 | -0.0025* | -0.0027** |
| | (0.0012) | (0.0026) | (0.0022) | (0.0011) | (0.0010) |
| P | Yes | Yes | Yes | Yes | Yes |
| Adj $R^2$ | 0.49 | 0.68 | 0.69 | 0.71 | 0.58 |
| *F* | 816.04 | 379.95 | 738.04 | 916.05 | 767.54 |
| *N* | 35,916 | 9,210 | 8,157 | 6,653 | 11,896 |

Notes: Dependent Variable = ln (#seller/#buyer * 100 + 1). Heteroskedastic-consistent standard errors are in brackets. September is the baseline month of comparison. All models include controls for gender, age, time elapsed since the foundation of online stores (T), and province fixed-effect (P). All models include the intercept term. *p < .05, **p < .01, ***p < .001

**TABLE VI**

REGRESSION RESULTS FOR SURVIVED SELLERS ONLY

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | All (1947-1995) | Pre-CR (1947-1959) | CR (1960-1970) | Post-CR (1971-1979) | Law86 (1980-1995) |
| Age | -0.0030*** | -0.0302*** | 0.0208*** | 0.0308*** | -0.0429*** |
| | (0.0003) | (0.0024) | (0.0020) | (0.0022) | (0.0019) |
| Female | 0.2344*** | 0.2380*** | 0.3239*** | 0.1473*** | 0.2228*** |
| | (0.0072) | (0.0174) | (0.0125) | (0.0087) | (0.0039) |
| Q2 | 0.0034 | -0.0137 | -0.0100 | -0.0039 | 0.0134* |
| | (0.0113) | (0.0273) | (0.0195) | (0.0131) | (0.0058) |
| Q3 | 0.0473*** | 0.0872*** | 0.0216 | 0.0393** | 0.0085 |
| | (0.0104) | (0.0248) | (0.0179) | (0.0120) | (0.0057) |
| Q4 | 0.0409*** | 0.1019*** | -0.0226 | 0.0157 | 0.0041 |
| | (0.0105) | (0.0255) | (0.0180) | (0.0114) | (0.0058) |
| T | 0.0120*** | 0.0298*** | 0.0283*** | 0.0164*** | -0.0097*** |
| | (0.0006) | (0.0012) | (0.0015) | (0.0019) | (0.0011) |
| RAE | -0.0062*** | -0.0082** | -0.0013 | -0.0040** | -0.0032*** |
| | (0.0013) | (0.0032) | (0.0024) | (0.0014) | (0.0008) |
| P | Yes | Yes | Yes | Yes | Yes |
| Adj $R^2$ | 0.45 | 0.63 | 0.67 | 0.68 | 0.80 |
| *F* | 787.43 | 478.73 | 689.24 | 951.17 | 2,159.21 |
| *N* | 35,916 | 9,210 | 8,157 | 6,653 | 11,896 |

Notes: Dependent Variable = ln (#seller/#buyer * 100 + 1). Heteroskedastic-consistent standard errors are in brackets. September is the baseline month of comparison. All models include controls for gender, age, time elapsed since the foundation of online stores (T), and province fixed-effect (P). All models include the intercept term. *p < .05, **p < .01, ***p < .001

**TABLE VII**

REGRESSION RESULTS FOR AGE COHORTS BORN IN HAN MINORITY PROVINCES (AUTONOMOUS REGIONS) ONLY

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | All (1947-1995) | Pre-CR (1947-1959) | CR (1960-1970) | Post-CR (1971-1979) | Law86 (1980-1995) |
| Age | -0.0294*** | -0.0696*** | -0.0097 | 0.0030 | -0.0792*** |
| | (0.0010) | (0.0081) | (0.0073) | (0.0057) | (0.0050) |
| Female | 0.1940*** | 0.3460*** | 0.2770*** | 0.0699** | 0.0551*** |
| | (0.0224) | (0.0598) | (0.0442) | (0.0229) | (0.0121) |
| Q2 | 0.0293 | 0.1320 | 0.0043 | -0.0354 | 0.0069 |
| | (0.0345) | (0.0901) | (0.0701) | (0.0398) | (0.0187) |
| Q3 | 0.0494 | 0.0594 | 0.0386 | 0.0532 | 0.0306 |
| | (0.0323) | (0.0819) | (0.0672) | (0.0332) | (0.0172) |
| Q4 | 0.0435 | 0.0647 | 0.0383 | 0.0571 | 0.0131 |
| | (0.0336) | (0.0895) | (0.0680) | (0.0312) | (0.0178) |
| T | 0.0358*** | 0.0453*** | 0.0384*** | 0.0126* | 0.0193*** |
| | (0.0015) | (0.0026) | (0.0036) | (0.0051) | (0.0028) |
| RAE | -0.0092* | -0.0272** | 0.0025 | -0.0087* | -0.0014 |
| | (0.0042) | (0.0105) | (0.0085) | (0.0038) | (0.0023) |
| P | Yes | Yes | Yes | Yes | Yes |
| Adj $R^2$ | 0.47 | 0.64 | 0.51 | 0.40 | 0.44 |
| *F* | 197.73 | 216.68 | 70.23 | 120.00 | 187.65 |
| *N* | 5,678 | 1,413 | 1,298 | 1,055 | 1,912 |

Notes: Dependent Variable = ln (#seller/#buyer * 100 + 1). Heteroskedastic-consistent standard errors are in brackets. September is the baseline month of comparison. All models include controls for gender, age, time elapsed since the foundation of online stores (T), and province fixed-effect (P). All models include the intercept term. *p < .05, **p < .01, ***p < .001

**TABLE VIII**

REGRESSION RESULTS FOR HAN MAJORITY PROVINCES ONLY

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | All (1947-1995) | Pre-CR (1947-1959) | CR (1960-1970) | Post-CR (1971-1979) | Law86 (1980-1995) |
| Age | 0.0047*** | -0.0130*** | 0.0251*** | 0.0035* | -0.0680*** |
| | (0.0004) | (0.0020) | (0.0018) | (0.0015) | (0.0013) |
| Female | 0.1933*** | 0.2515*** | 0.2817*** | 0.1215*** | 0.1103*** |
| | (0.0051) | (0.0130) | (0.0085) | (0.0035) | (0.0035) |
| Q2 | 0.0049 | 0.0072 | 0.0094 | -0.0051 | 0.0163** |
| | (0.0084) | (0.0207) | (0.0130) | (0.0053) | (0.0051) |
| Q3 | 0.0182* | 0.0518** | 0.0081 | 0.0158*** | 0.0182*** |
| | (0.0075) | (0.0177) | (0.0123) | (0.0048) | (0.0050) |
| Q4 | 0.0131 | 0.0379* | -0.0039 | 0.0033 | 0.0097 |
| | (0.0073) | (0.0175) | (0.0120) | (0.0048) | (0.0054) |
| T | -0.0075*** | 0.0158*** | 0.0117*** | -0.0102*** | 0.0110*** |
| | (0.0009) | (0.0019) | (0.0034) | (0.0014) | (0.0007) |
| RAE | -0.0038*** | -0.0066** | 0.0009 | -0.0013* | -0.0031*** |
| | (0.0009) | (0.0021) | (0.0017) | (0.0006) | (0.0007) |
| P | Yes | Yes | Yes | Yes | Yes |
| Adj $R^2$ | 0.41 | 0.55 | 0.65 | 0.86 | 0.72 |
| *F* | 889.84 | 317.60 | 788.59 | 1,381.38 | 1,052.48 |
| *N* | 30,238 | 7,797 | 6,859 | 5,598 | 9,984 |

Notes: Dependent Variable = ln (#seller/#buyer * 100 + 1). Heteroskedastic-consistent standard errors are in brackets. September is the baseline month of comparison. All models include controls for gender, age, time elapsed since the foundation of online stores (T), and province fixed-effect (P). All models include the intercept term. *p < .05, **p < .01, ***p < .001

**TABLE IX**

REGRESSION RESULTS FOR INTERACTION EFFECTS BETWEEN RAE AND GENDER IN MAJOR CITIES

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | All (1947-1995) | Pre-CR (1947-1959) | CR (1960-1970) | Post-CR (1971-1979) | Law86 (1980-1995) |
| Age | -0.0150*** | -0.0936*** | -0.0022 | 0.0094*** | -0.0486*** |
| | (0.0002) | (0.0019) | (0.0015) | (0.0008) | (0.0008) |
| Female | 0.2243*** | 0.1247*** | 0.3192*** | 0.1322*** | 0.1108*** |
| | (0.0081) | (0.0246) | (0.0149) | (0.0060) | (0.0051) |
| Q2 | -0.0101 | -0.0484* | -0.0151 | -0.0111* | 0.0088** |
| | (0.0063) | (0.0206) | (0.0130) | (0.0055) | (0.0033) |
| Q3 | 0.0233*** | 0.0711*** | -0.0008 | 0.0144** | 0.0076* |
| | (0.0060) | (0.0193) | (0.0124) | (0.0050) | (0.0032) |
| Q4 | -0.0801*** | -0.1396*** | 0.0255* | -0.0295*** | -0.1859*** |
| | (0.0067) | (0.0203) | (0.0121) | (0.0051) | (0.0046) |
| T | 0.0243*** | 0.0425*** | 0.0225*** | -0.0027*** | 0.0087*** |
| | (0.0003) | (0.0005) | (0.0008) | (0.0006) | (0.0004) |
| RAE | -0.0042*** | -0.0120*** | -0.0023 | -0.0025** | -0.0048*** |
| | (0.0010) | (0.0032) | (0.0021) | (0.0008) | (0.0005) |
| RAE*Female | 0.0031* | 0.0125** | 0.0066** | 0.0039*** | 0.0041*** |
| | (0.0012) | (0.0038) | (0.0024) | (0.0010) | (0.0007) |
| City | Yes | Yes | Yes | Yes | Yes |
| Adj $R^2$ | 0.29 | 0.50 | 0.32 | 0.48 | 0.50 |
| $F$ | 240.65 | 148.52 | 146.54 | 318.82 | 393.87 |
| $N$ | 161,956 | 34,429 | 40,640 | 33,839 | 53,048 |

Notes: Dependent Variable = ln (#seller/#buyer * 100 + 1). Heteroskedastic-consistent standard errors are in brackets. September is the baseline month of comparison. All models include controls for gender, age, time elapsed since the foundation of online stores (T), and prefecture-level city fixed-effect (City). All models include the intercept term. *p < .05, **p < .01, ***p < .001

**TABLE X**

SUMMARY OF REGRESSION RESULTS ON RAE AFTER ACCOUNTING FOR MULTIPLE HYPOTHESES TESTING

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | All | Pre-CR | CR | Post-CR | Law86 |
| Table II[&] | -0.0049*** | -0.0098[2,*] | 0.0006[4,ns] | -0.0027[3,*] | -0.0029[1,*] |
| | (0.0011) | (0.0025) | (0.0020) | (0.0008) | (0.0007) |
| Table III | -0.0049*** | -0.0098[2,*] | 0.0004[4,ns] | -0.0027[3,*] | -0.0029[1,*] |
| | (0.0011) | (0.0025) | (0.0019) | (0.0008) | (0.0007) |
| Table IV | -0.0049*** | -0.0097[2,*] | -0.0001[4,ns] | -0.0025[3,*] | -0.0028[1,*] |
| | (0.0011) | (0.0026) | (0.0021) | (0.0011) | (0.0007) |
| Table V | -0.0045*** | -0.0077[1,*] | 0.0010[4,ns] | -0.0025[3,*] | -0.0027[2,*] |
| | (0.0012) | (0.0026) | (0.0022) | (0.0011) | (0.0010) |
| Table VI | -0.0062*** | -0.0082[3,*] | -0.0013[4,ns] | -0.0040[2,*] | -0.0032[1,*] |
| | (0.0013) | (0.0032) | (0.0024) | (0.0014) | (0.0008) |
| Table VII | -0.0092* | -0.0272[1,*] | 0.0025[4,ns] | -0.0087[2,*] | -0.0014[3,ns] |
| | (0.0042) | (0.0105) | (0.0085) | (0.0038) | (0.0023) |
| Table VIII | -0.0038*** | -0.0066[2,*] | 0.0009[4,ns] | -0.0013[3,*] | -0.0031[1,*] |
| | (0.0009) | (0.0021) | (0.0017) | (0.0006) | (0.0007) |
| Table IX | -0.0042*** | -0.0120[2,*] | -0.0023[4,ns] | -0.0025[3,*] | -0.0048[1,*] |
| (RAE) | (0.0010) | (0.0032) | (0.0021) | (0.0008) | (0.0005) |
| Table IX | 0.0031* | 0.0125[3,*] | 0.0066[4,*] | 0.0039[2,*] | 0.0041[1,*] |
| (RAE*Female) | (0.0012) | (0.0038) | (0.0024) | (0.0010) | (0.0007) |

Notes. [ns] Not Significant, *p < .05, **p < .01, ***p < .001; the numbers appeared in the superscripts indicate the order of statistical tests in Holm algorithm. [&]The Tables (II, III, IV, and so on) are corresponding to the tables in the paper.

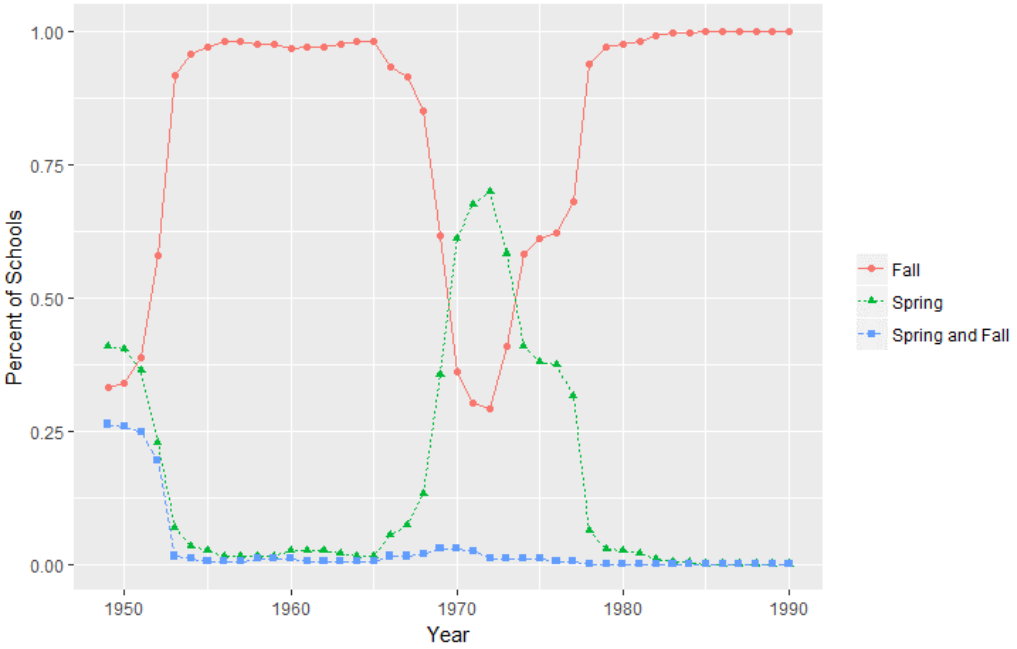


**FIGURE I**

Statistics on the School Entry Seasons in China

Note. N = 206

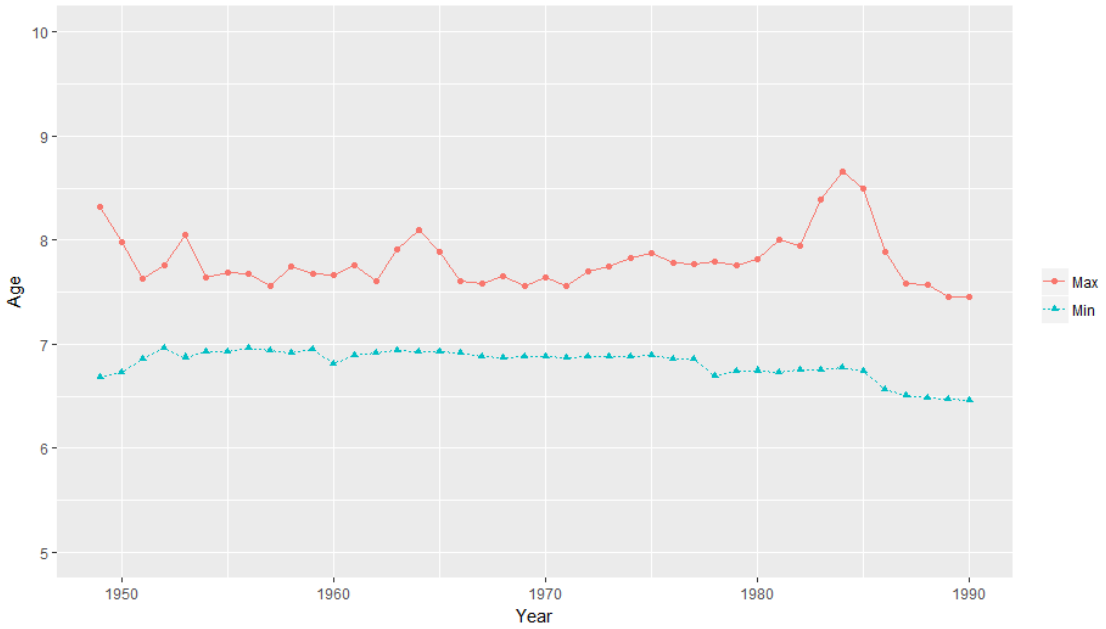


**FIGURE II**

The Minimal and Maximal Ages of Primary School Entry in China

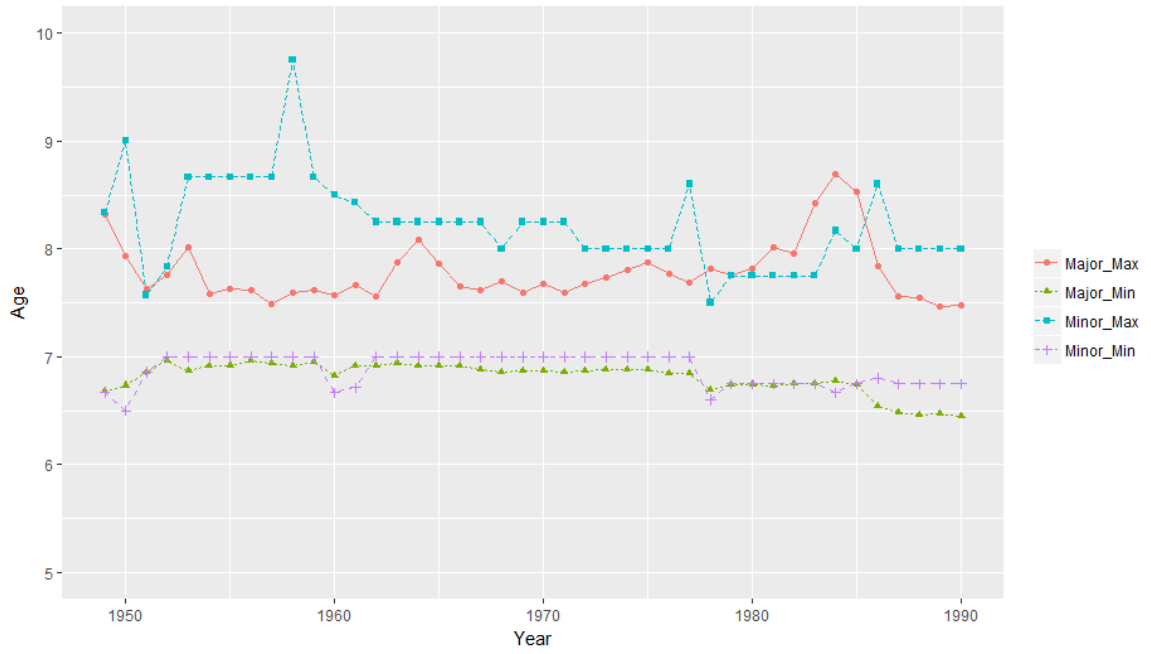


**FIGURE III**

Statistics on Age of Students Who Enter Primary Schools for Han Majority Regions and Han Minority Regions in China

Notes. N = 247 and 16 for Han majority counties and Han minority counties, respectively.

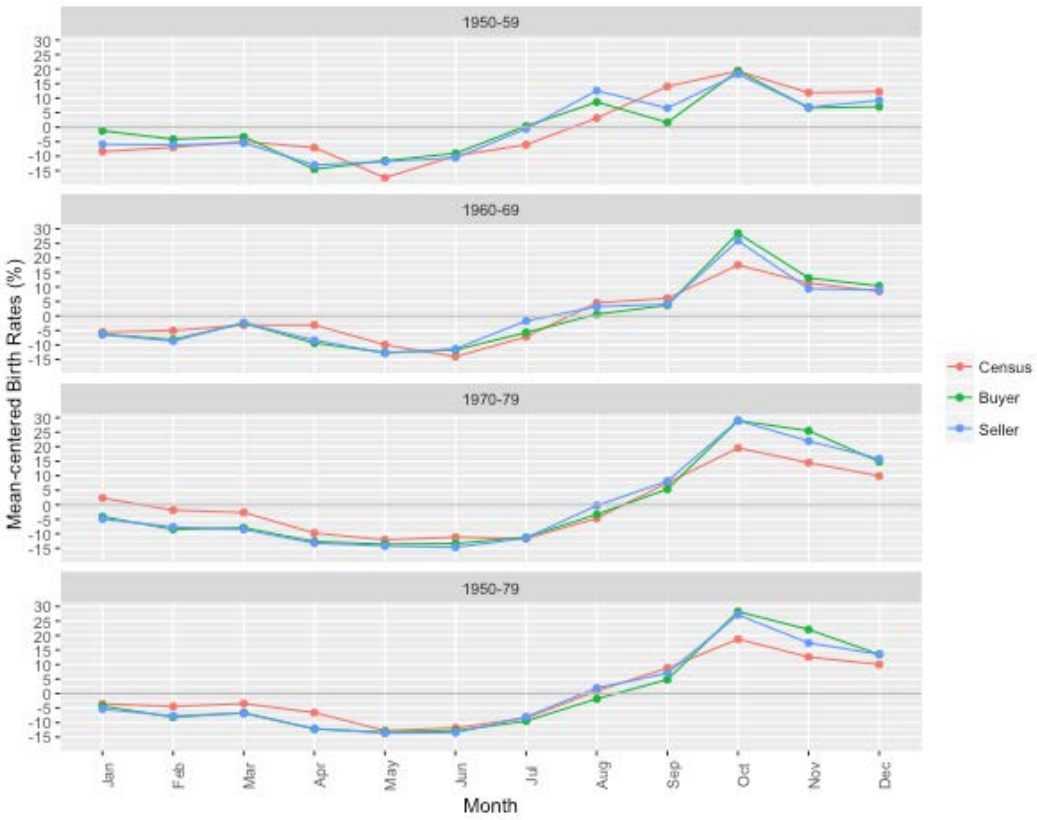


**FIGURE IV**

The Mean-Centered Birth Rates per Month

Notes. The top panel shows birth rates for people born between 1950 and 1959. The second panel shows birth rates for people born between 1960 and 1969. The third panel shows birth rates for people born between 1970 and 1979. The bottom panel shows birth rates for all people born between 1950 and 1979. The statistics are organized by three groups: people born in the whole society (1998 census data), Taobao buyers, and Taobao sellers.

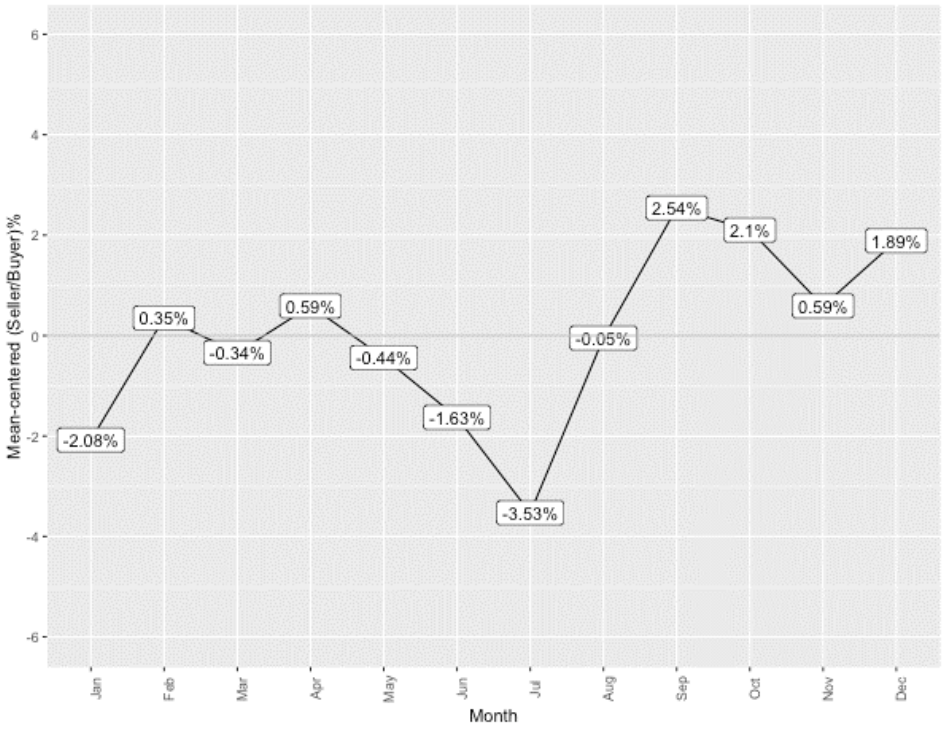


**FIGURE V**

The Mean-Centered Ratio of Sellers to Buyers on Taobao

[i]GMV (Gross Merchandise Volume) refers to the value of confirmed orders of products and services on Taobao, regardless of whether the buyer and seller settle the transaction. GMV is the metric commonly used to reflect the gross sales for e-commerce companies. The numbers come from Alibaba Group's Annual Report for the fiscal year ending March 31, 2016, which were downloaded from http://www.alibabagroup.com/en/ir/pdf/agm160524_ar.pdf. The USD 294.4 billion is calculated based on the Taobao GMV of RMB 1,877 billion and an exchange of 6.38 RMB to USD 1.

[ii]http://www.alexa.com/siteinfo/taobao.com

[iii]Using a small sample ($N$ = 375), Du et al. (2012) found that the proportion of CEOs born in different months in the Fortune 500 companies differ and favor those born early in the corresponding academic years.

[iv]Significant differences in achievement test scores were found for students in Grades 4 and 8 in various OECD countries (Bedard and Dhuey 2006). In terms of attending universities, evidence of RAE was found in the United States and Canada only.

[v]The 6-3-3-4/5 structure refers to six years of elementary school, three years of lower secondary school (corresponding to U.S. junior high school), three years of upper secondary school (corresponding to U.S. senior high school), and four or five years of university education.

[vi]Hainan province was a part of Guangdong province before 1988. Thus, we do not have any records on the school season for Hainan province.

[vii]A large majority of the spring COD was March 1. Similarly, the fall COD was set for September 1.

[viii]There are no records for Hainan province because it had been a part of Guangdong province before 1988.

[ix]Enacted on May 31, 1984.

[x] Simple random sampling procedure was applied. Each seller is attached to a randomly generated serial number and 8 million sellers were randomly drawn from the seller population (each with equal probability, without replacement). The 9 million buyers were drawn in a similar manner.

[xi] The data are obtained pursuant to the company's standard data usage agreement to support academic research. These confidential data have been deposited with Taobao, and can be requested in accordance with Taobao's data sharing protocol. More information about Alibaba Research Institute is available from http://www.aliresearch.com/. We are happy to release our statistical code used to generate the analysis results so that others who are able to obtain the data can replicate our analyses.

[xii] We would be happy to share these non-proprietary databases, including the Chinese census data, the archive data concerning school entry dates in China, and the city-level macro-economic variables.

[xiii] We obtain similar results using a surviving sample.

[xiv]Alternatively, RAE could be quantified by 11 dummies that correspond to each birth month except September (which is the baseline month). In this model specification, a negative and significant coefficient estimate for a month dummy variable would indicate the salience of RAE. We replicate the analyses using this model specification and obtain very similar findings to those reported in this section.

[xv]The coefficient estimate of 0.49% will translate into a 5.4% disadvantage for the youngest cohort, which is 11 months younger than the oldest cohort within the same school age group.

[xvi]North China includes 16 provinces (Heilongjiang, Jilin, Liaoning, Neimenggu, Beijing, Tianjin, Hebei, Henan, Shandong, Xinjiang, Tibet, Gansu, Qinghai, Ningxia, Shaanxi, and Shanxi) and is defined by the line formed by the Huai River and Qinling Mountain range, the former of which follows the January zero degree average temperature line (Celsius). Urban Provinces refer to the 13 provinces with a higher ratio of residents who work in cities (larger than median) based on data from the 2010 statistical yearbook for a regional economy (Beijing, Tianjin, Neimenggu, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong, Hainan, and Xinjiang). High Education provinces include those 13 provinces with a higher ratio of students per 100,000 inhabitants (above the median), based on the data in the statistical yearbook for regional economy (Beijing, Tianjin, Shanxi, Neiminggu, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Hubei, Hunan, Guangdong, and Sihaanxi).

[xvii]China has five province-level autonomous regions, which include Xinjiang, Neimenggu, Ningxia, Tibet, and Guangxi.

[xviii] Analysis results in column 1 of Table X are free from MHT issue, because all data samples are utilized in the analyses.