DRAGON BABIES*

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ABSTRACT

Using multiple sources of individual-level administrative data from the multicultural city-state of Singapore, we study the life outcomes of large birth cohorts created by the Chinese superstitious practice of zodiac birth timing, where parents prefer to give birth in the year of the Dragon. This practice is followed exclusively by the Chinese majority—between 1960 and 2007 the average number of births jumps by 9.3% in Dragon years among the Chinese majority, with no similar patterns detected among non-Chinese minorities. Chinese Dragon babies earn significantly lower income than other Chinese cohorts after entering the labor market (by 6.0%), relative to the income difference between Dragons and non-Dragons within the non-Chinese subpopulation. The adverse labor market outcome is unlikely to be the result of self-selection; rather it reflects the aggregate resource implications of substantially larger cohort sizes. We find a significant negative income effect for the non-Chinese born in Dragon years as well as other birth cohorts who happen to enter college (and labor market) at the same time as Chinese Dragons. The negative income effect partly arises from the rather inelastic labor demand. Despite the government's efforts to increase public educational resources, Dragon babies have lower admission chances to local national universities, suggesting limited capacity of such measures to accommodate the surge in demand for resources associated with larger birth cohorts. Finally, we also find evidence that the superstition-induced birth timing implicates consumption and saving choices.

Keywords: Superstition, Cohort Size, Cohort Effect, Fertility, Education, Income, Consumption, Consumer Behavior, Household Finance

JEL Classification Codes: J21, J13

I. Introduction

Social or cultural environment plays an important role in shaping individual belief and decision-making, which in turn influence aggregate outcomes (e.g., Malmendier and Nagel, 2011, 2016). Superstition is one such prominent example of cultural practice; people appear to believe in the existence of forces not explained by scientific knowledge of the universe. Examples of wide-held superstitious beliefs include luck and prophecy, which are prevalent across different cultures and societies. However, the extent and scope of the effect of superstition remains an open question. If people follow a common superstitious practice, does such herding behavior generate distortion in resource allocation? If so, how does it affect economic outcomes, and how widespread and persistent is such an impact? From a policy perspective, can public policy measures effectively counteract the aggregate implications of superstition?

In this article, we use a unique setting to demonstrate the far-reaching impact of superstition on life outcomes. We explore the consequences of the Chinese superstitious practice of zodiac birth timing in the multi-racial city state of Singapore. Chinese zodiacs follow a twelve-year cycle, and among the twelve animal signs in the Chinese zodiac, the Dragon carries an overwhelmingly positive image. Consequently, Chinese parents prefer to give birth in the year of the Dragon with the belief that children born under this sign are noble, long-lived and bound for success. We show that this cultural preference leads to sharp discontinuities in birth cohort size every twelve years. These unusually large birth cohort sizes in turn carry significant resource implications, leading to a substantial impact on a variety of economic outcomes later in life for the *exposed* population, which includes people who do not practice the Dragon superstition.

Despite the intuitive appeal of the cohort size channel, estimating effects associated with (large) cohort size is empirically challenging. While a substantial literature has attempted to estimate the effects of birth cohort size on wages and employment, the existing analysis typically studies the entire population in a single birth cohort (e.g., baby boomers in the U.S. and Europe). As a result, researchers face various identification challenges such as confounding age and time effects, omitted variable bias, and issues of reverse causality. The limitations in the data and research design methods also restrict the ability to tease out the underlying economic mechanisms.

Singapore provides an ideal research setting due to its multi-racial composition with a Chinese majority (74% of population) and large Malay and Indian minorities (22% of population). Our identification strategy rests on the assumption that zodiac birth timing, where parents aim to give birth in the year of the Dragon, is practiced exclusively by the Chinese in Singapore, allowing other racial groups to provide viable counterfactuals. The data analysis supports this assumption, with no evidence that parents from other races seek to either target or avoid the year. We use a difference-in-differences model that effectively controls for age and time confounding factors, sharpening our research design. Because of the twelve-year cycle in Dragon birth cohorts, this

setting also allows us to observe multiple "treated" cohorts during our sample period, providing another source of identification.

We use five separate sources of novel administrative data in this paper. The five datasets are as follows: (i) monthly birth data from January 1960 to December 2007 for each of the four official race categories (Chinese, Malay, Indian and Other), which are published by Singapore Statistics, (ii) data on (verified) customer monthly income, employment status, savings and transactional card activity collected by a leading bank in Singapore between April 2010 and March 2012, (iii) annual individual-level university admissions data for the two main local universities, the National University of Singapore and Nanyang Technological University, between 1981 and 2015, (iv) data obtained from the Supreme Court of Singapore on all personal bankruptcies cases between 1980 and 2012, and (v) administrative property transactions data obtained from local proprietary sources. Through the first dataset, we observe the fertility trends over time (for Chinese and non-Chinese). More importantly, by exploiting the other data sources, we have accurate information at the individual level on income, employment status, educational attainment, pre-tertiary educational success, outcome of the university applications, as well as consumption behavior and other life outcomes.

We first document a significant spike in the number of Chinese births by 9.3% in the year of the Dragon, with no significant patterns detected among non-Chinese minorities. These unusual circumstances at birth produce statistically and economically significant effects on subsequent labor market outcomes. Relative to the income difference between Dragons and non-Dragons among the non-Chinese population, Chinese Dragon babies earn incomes which are 6.0% lower than Chinese non-Dragons after they enter the labor market (the effect is statistically significant at 1%). The employment status, on the other hand, does not exhibit a significant effect. The effects are largely due to a disproportionately high proportion of low-income earners, rather than a lower proportion of high-income earners

Moreover, we find similar labor market impacts on groups who do not practice the Dragon superstition but nonetheless are exposed to the increased cohort size. First, we find a significant negative income effect for the non-Chinese subpopulation born in Dragon years, even though the aggregate birth statistics reveal no birth timing behavior by this subpopulation. Second, we exploit variation caused by the exogenous national service mandate, which strictly requires all Singaporean males to perform two and a half years of national service, commonly between the ages of 19 and 22. Hence, even though Singaporean men and women born in the same year share similar early life environments, men enter university and the labor market with women who are two years younger. We show that women born in the year of the Horse, who are two years younger than Dragon men, *also* have significantly lower earnings despite having similar levels of educational success as other cohorts, whereas there are no effects for their male counterparts (who do not enter university and labor market with the Dragon cohort). These results show that the

Dragon superstition's impact spills over to a much broader population. The significant spillover effects also strongly support the cohort size channel. These groups do not practice the Dragon superstition, so the negative labor market outcomes cannot reconcile with alternative interpretations based on negative selection or differential parental treatment in response to the stereotypes.

In addition, we find evidence that Dragon babies among Malaysian Chinese residing in Singapore do not earn lower wages. Malaysia is also a multiracial country that shares a great deal of cultural similarity with Singapore, suggesting a similar selection mechanism underlying the birth timing behavior. On the other hand, Malaysia has a much lower proportion of Chinese in the population, so that any cohort size effects due to zodiac birth timing are likely to be weaker. Thus, these results further demonstrate that the selection channel is unlikely to explain our main findings that Chinese Dragons earn lower income.

To investigate the underlying economic mechanisms, we exploit the pairing of Dragon men with Horse women and the (partially) segmented labor market for different races in Singapore, likely due to employers' demand for distinct language skills. We find that non-Chinese Horse women, who enter university together with Chinese Dragon men but compete in differentiated segments of the labor market, do not earn different incomes compared to non-Chinese born in other years. This suggests that one of the channels for the cohort size effect on income is inelastic (or imperfectly elastic) labor demand in the presence of increased labor supply. Consistent with this explanation, we show that Chinese Dragon babies are less likely to be employed in higher-paid formal professional occupations, and more likely to be in lower-paid self-employment work instead.

We also consider the possibility that Dragon babies accumulate lower levels of human capital prior to entering the labor market, potentially due to resource constraints. Consistent with this view, we find that Chinese Dragon babies are 2.3% less likely to be admitted to the two major local universities. More strikingly, the effects on admission chances are larger for admission to the least competitive college majors (in terms of average admission score), suggesting that the cohort size effects disproportionately affect marginal students. To understand the lower admission chances for the Chinese Dragons, first we find no changes in the applicant pool composition for the Dragon birth cohorts – the number of applicants as a fraction of their birth cohort size is similar between Dragons and non-Dragons for the Chinese and non-Chinese subpopulation. Consistent with the lower human capital view, Chinese Dragons score abnormally lower in the standardized college entrance exams compared to Chinese born in other years. We find larger effects for marginal students, consistent with our finding that the negative income effect for the Dragon birth cohorts is due to a disproportionately high proportion of low-income earners, and is also more prominent among those *without* a college degree.

Additional evidence suggests that the Singaporean government anticipated and consciously attempted to accommodate the large Dragon cohorts through the public educational system. Thus, the Dragon cohorts have poorer educational achievement and less developed skills *despite* the policymaker's measures to hire more primary and secondary school teachers and increase (public) university's admission for the Dragon cohorts. Possible reasons for the lower academic achievements include limited educational resources in the private educational market (e.g., tutoring, also known as shadow education) and (in)experience of public school teachers employed in response to the larger Dragon birth cohorts.

Interestingly, we also document that Chinese dragons have comparatively high levels of spending for their income levels. They exhibit a greater tendency to engage in status-seeking reflected in their consumption behavior, consistent with literature on the effects of cohort size on conspicuous consumption. Finally, we conduct a series of additional analyses to study the robustness of our main results.

The findings in the paper contribute to the large literature on the implications of non-standard beliefs and decision-rules. We relate to the studies on group decisions or herd behavior (Avery and Zemsky 1998; Banerjee 1992; Scharfstein and Stein 1990), as well as a separate, rising field of research showing that individuals' economic decisions and outcomes are heavily influenced by the environment or personal experience. For example, Malmendier and Nagel (2011, 2016) show that early personal experiences continue to affect individuals' financial beliefs and behavior later in life, with implications for investment risk taking as well as borrowing or lending behavior. While much of the research has focused on applications to financial markets, the ramifications to societies can be even more widespread and important. We document that the collective practice in superstitious birth timing leads to larger birth cohort sizes, which shape earlier life environment and experiences through the cohort size channel. Such environment and experiences have a long-lasting and economically significant impact on the economic well-being of a significant portion of the population, including those who do *not* practice this superstition.[2]

Our paper also contributes to the literature that aims to identify the cohort size effects. A substantial literature has attempted to estimate the effects of birth cohort size on wages and employment (Berger 1985; Bloom, Freeman and Korenman 1988; Korenman and Neumark 2000; Smith and Welch 1981; Welch 1979), as well as on psychological and social behaviour (e.g., Ahlburg and Schapiro 1984; Easterlin 1961; O'Brien 1989; Savolainen 2000). A daunting challenge in cohort effect studies is to differentiate from age effects, as well as the influence from a plethora of

[2] Some existing studies examine selection into the practice of zodiac superstition as well as differential parental treatment in terms of resource allocation (Do and Phung 2010; Johnson and Nye 2011). Our paper studies an essentially different question by focusing on superstition's resource allocation implications, induced by the large cohort size, and the associated aggregate impact. In addition, the above studies provide evidence of positive selection and parental reinforcement of positive zodiac stereotypes, which lend support to our arguments that the negative income effects are due to spikes in cohort size.

concurrent macroeconomic and sociological changes. In addition, birth cohort size is potentially endogenous to the relative income of preceding generations (Easterlin 1961), resulting in the possibility of reverse causality bias.

We provide strong and robust evidence of a significant negative effect of birth cohort size on income, through the channels of lower acquired skills in the pre-college years and inelastic labor demand in response to increased labor supply. Moreover, the negative life outcomes pertain *despite* the government's pro-active measures to adjust public educational resources, suggesting limited capacity of such efforts to offset the negative consequences of larger birth cohorts (caused by superstitious birth timing). These new insights are informative for cohort size effects in general and not necessarily restricted to the particular source of larger birth cohorts documented in this setting.

The structure of the rest of the paper is as follows. Section II provides a historical overview of zodiac birth timing in Singapore and other Confucian-influenced societies, including the People's Republic of China, Japan, South Korea and Malaysia. It also discusses relevant background information on Singapore's demographic, educational and civil institutions. Section III presents the data sources, summary statistics, and our empirical methodology. Section IV shows the main results of a negative income effect associated with Dragon babies and provide various tests to distinguish the cohort size effect from the selection effect. Section V investigates the potential economic channels to explain the cohort size effect. Section VI presents robustness tests and looks at the consumption behavior of Dragon babies. Section VI summarizes and concludes. A glossary of key variables is provided in Appendix A1.

II. Background

II.A Zodiac birth timing in East and Southeast Asia

The superstitious view that an individual's personality, abilities and luck depend to some extent on the positioning of the constellations and astrological phenomena at the time of birth is fairly commonplace in multiple cultures around the world. In the U.S. and European countries, astrological readings and predictions are primarily based on the Greek zodiac, which has twelve signs based approximately on month of birth. The Chinese zodiac (*sheng xiao*) also has twelve signs, but signs are based on year rather than month of birth.

Among the twelve animal signs in the Chinese zodiac, the Dragon commands a special allure as the only mythical creature. Unlike the Western notion of the Dragon, which is typically associated with the serpent from the Garden of Eden and portrayed as man-eating and destructive, the Chinese conception is overwhelmingly positive and associated with benevolence, intelligence might and potency (Goodkind 1991). Traditionally, the Dragon is used as a symbol for the Chinese emperor

(usually depicted in imperial yellow, the color of royalty), while ordinary Chinese may sometimes refer to themselves as "descendants of the Dragon". Accordingly, children born under this sign are believed to be blessed with good fortune, longevity and nobility, and the men, in particular, are seen as bound for great things. Such belief is popular in many countries in East and Southeast Asia that are influenced by the Chinese culture, including Hong Kong, Malaysia, the Philippines, Singapore, Taiwan and Thailand.

Ironically, in the recent decades, zodiac birth timing kept rising among Chinese populations across East and Southeast Asia but not in mainland China itself, due to state-led condemnation of traditional superstitious beliefs during the 1966-1976 Cultural Revolution (Goodkind 1991). With the opening up of China, there is some indication that zodiac birth timing is beginning to catch on among younger cohorts, especially in higher income areas (Nye and Xue 2014).[3] Among the Japanese and South Koreans, who follow very similar zodiacs, birth timing mainly takes the form of avoiding the year of the Horse for having daughters. However, there is no marked preference or aversion towards children born in the year of the Dragon. Hence, the Dragon seems to be a uniquely Chinese obsession.

There is widespread public fascination with the Chinese practice. The romantic notion of the mythical Dragon, which is strongly bound up with the portrayal of a rising China, and the stereotype of the anxious East Asian parent combine to generate considerable attention from both Eastern and Western media in the year of the Dragon. In Singapore, the setting of our study, there are numerous newspaper accounts with constant bombardment of positive signals and reminders of the upcoming Dragon year through the media and commercial billboards in the preceding months from November to January (e.g., BBC 2012).

II.C Background on Singapore

Singapore is a multi-racial island nation with a land area of 719 square kilometres, which is approximately the same size as New York City. As of 2015, it has a population size of 5.54 million, of which 3.90 million are citizens or permanent residents. The bulk of the population comprises of three main ethnic groups: 74.3% Chinese, 13.3% Malay and 9.1% Indian (Ministry of Health 2016). While the government provides public fair employment practice guidelines, historically there were no legal penalties against employers who expressed race- or language-based preferences in hiring. Currently, it is still not unusual to see job advertisements citing racial or language needs or preferences (see Appendix IA.1 in the Online Appendix).

[3] One implication of the absence of zodiac birth timing in China prior to 2000 is that the negative income effects experienced by Singaporean Chinese Dragons during our sample period cannot be due to increased rates of migration from the mainland.

The education system in Singapore consists of two years of kindergarten at ages 5-6, six years of primary school at ages 7-12 and four years of secondary school at ages 13-16. Under the Bilingual Policy, while English is used as the primary medium of instruction, the school curriculum also includes mother tongue classes (Standard Mandarin, Malay or Tamil) in order to preserve the identities and values of the three main ethnic groups. By far the three most common routes to post-secondary education are: a) two-year junior college programs, considered the elite track for university aspirants, b) three-year polytechnic courses, which award diplomas, and c) Institute of Technical Education (ITEs), which award vocational certificates. Of the 56,808 Singaporean students enrolled in the final year of secondary school in 2013, 15,337 (27.00%), 25,777 (45.38%) and 14,641 (25.77%) enrolled in a junior college, polytechnic and ITE respectively in 2014 (Ministry of Education 2015). Junior college students take the A-level international examinations administered by Cambridge University, which publish the examination results in April of the following year.

Historically, the two main local universities in Singapore are the National University of Singapore (NUS) and Nanyang Technological University (NTU), which were established at around the same time (1980 and 1981 respectively). NUS has a slightly larger student body, with 28,311 undergraduates and 9,996 graduate students in 2015-2016, compared to 24,300 and 8,866 at NTU. (A third local university, Singapore Management University, was established only in 2000, with a much smaller student body of 7,791 undergraduate students and 1,489 graduate students in 2015-2016.[4]) Applicants apply for admission to specific departments within the universities, and the minimum scores for each department are usually announced prior to application deadlines.

There is a strict mandate that all Singaporean males must perform two and a half years of national service, commonly between the ages of 19 and 22. As a result, although most men apply for university in the same year as female members of their birth cohort, they are usually two years older than the women when they enter university and their first job.

Singapore has undergone drastic demographic change in the past five decades since independence. Immediately after independence in 1965, the government established a Family Planning and Population Board Act to reduce the national fertility rate. As baby boom cohorts reached childbearing ages in the early 1970s, the birth rate spiked, leading to re-doubled efforts to control population growth. By the mid-1970s, the fertility rate had fallen from above four in 1965 to below replacement levels. Currently, with high levels of urbanization, economic development and education, the fertility rate in Singapore is far below replacement rate.

III. Data and Descriptive Statistics

[4] Statistics are taken from official university websites, at http://www.nus.edu.sg/registrar/statistics.html, http://www.ntu.edu.sg/AboutNTU/CorporateInfo/FactsFigures/Pages/FactsandFigures.aspx and https://www.smu.edu.sg/about/university-information/student-statistics/student-statistics respectively.

III.A Data

We use five sources of administrative data.

Birth data: We use monthly birth data from Singapore Statistics for four Chinese zodiac cycles (48 years) between Jan 1960 and December 2007, for four races (Chinese, Malay, Indian and Other) and two sexes. We exclude birth data from the current incomplete zodiac cycle to obtain a balanced dataset.[5] The sample size is 4,608.

Most of the results are presented following the western or Julian calendar, which is used by Singaporean educational institutions, since the school entry cutoff birthdate is January 1. We also compare our main results following the lunar calendar beginning in February and ending in January of the following year, as the New Year's Day usually falls between late January and mid-February.

Bank data: We use administrative data of consumer financial transactions as well as socioeconomic and demographic information from a leading bank in Singapore collected between April 2010 and March 2012.

The bank data contain a random, representative sample of all customers. From the entire sample of over 180,000 individuals, we focus on Singaporean citizens aged 20-52 born between 1960 and 1990 (N=104,080), where 1960 is the first year for which we have birth data and 1990 is the last birth cohort for ages 20 and above. Individual monthly income and employment status information are provided and verified by the bank, so these labor market outcomes are measured with high accuracy.[6] We compute the natural logarithm of the average monthly income reported over the sample period of April 2010 to March 2012, winsorized for the top and bottom 1% to remove outliers and adjusted to January 2014 Singapore dollars. In the analysis, we also explicitly address the concern that banks may not have the most updated income and employment information.

We measure individuals' consumption behavior using credit and debit card transactions. We first require that the customer maintains her accounts with the bank for at least three months and that her accounts have never been inactive, transferred or closed. For each individual in the sample, we compute the total monthly spending amount by summing up her credit card and debit card spending

[5] The aggregate birth data may be publicly accessed at http://www.tablebuilder.singstat.gov.sg/publicfacing/mainMenu.action. In addition, our birth timing results are robust to inclusion of more recent years of data after 2007.

[6] In Singapore, all personal information submitted to banks is by request accompanied by copies of identification cards/passports and proof of income (e.g., employer paystubs or tax returns).

in each month.[7] Following the categorization proposed by Charles, Hurst, and Roussanov (2009) and Heffetz (2011), we define conspicuous consumption as expenditures on apparel (including accessories such as watches and jewellery), personal services (such as beauty salons, entertainment, electronics, and dining), and vehicles (excluding maintenance). We compute average monthly spending reported between April 2010 and March 2012, winsorized for the top and bottom 1% to remove outliers and adjusted to January 2014 Singapore dollars. To control for the confounding effect of income, we scale the spending measures by the individual's monthly income.

University admissions data: We use micro-level university admissions data for the two main local universities, National University of Singapore (NUS) and Nanyang Technological University (NTU), between 1981 and 2015. Before 2000, these are effectively the only universities, which enrol over 98% of all university students in the country. Even though more universities were introduced gradually since 2000, over 85% of all undergraduate and graduate students in Singapore are registered with NUS and NTU as of 2016. Between 1989 and 2003, NUS and NTU conducted joint admissions; in all other years, the dataset contains applications to NUS only.[8] Our sample consists of 466,235 Singaporean applicants born between 1960 and 1996.

We consider applicant scores and admission outcomes. Applicant scores are computed by the university admissions offices based on classified metrics, and are not generally comparable across different years or academic tracks. Hence, we measure applicant scores in terms of standard deviations within the same cohort year and academic track (85.44% of applicants apply from junior college programs while 14.56% apply with a polytechnic diploma). Applicants apply for admission to specific university departments, where the minimum admission criteria for each department are usually announced prior to application deadlines.

We examine two admission outcomes: whether the applicant was admitted, and the department that the applicant was admitted to, if any. We assign departments to one of three categories based on mean departmental scores of admitted Singaporean students: the top third, middle third and bottom third, which account for 32.84%, 30.55% and 36.61% of admitted students respectively.

Bankruptcy data: We use the universe of personal bankruptcy data for 998,368 Singaporeans born between 1960 and 1980, based on case records by the Supreme Court of Singapore between 1980 and 2012. For this dataset, we do not include younger Singaporeans born in 1981-1990, as

[7] Like the U.S., debit and credit cards are important mediums of disposable consumption in Singapore, with the spending accounting for approximately 30 percent of aggregate personal consumption in the country (Agarwal and Qian 2014). The remaining 70 percent of consumption occurs through checks, direct transfers, and cash. Consumers with recurring payments including mortgage, rent, and auto loans payments typically use instruments such as checks and direct deposit. Therefore, the credit and debit card spending is able to capture a representative and accurate measure of individual (discretionary) consumption at high frequency.

[8] Our results are qualitatively similar whether we include or exclude years during which joint admissions were conducted, although the effects are slightly smaller with lower levels of statistical significance when the years are excluded, possibly due to lack of power.

relatively few individuals accumulate enough debt to appear in a bankruptcy court case prior to their early 30s.

Property data: We use administrative property transactions data for 1,381,550 Singaporeans born between 1960 and 1990. We consider private condominium residence, an important status symbol in Singapore. Singapore's home ownership rate of more than 90% is one of the highest in the world. As of 2012, 81.55% of the total housing stock, estimated at 1.152 million units, is made up of public housing built and sold by the government. Non-landed private housing, which includes condominiums and apartments, is the largest segment of the private housing market constituting 12.14% of the total private housing stocks.

In addition, we use transactional prices from private residential housing transactional caveats from January 1995 to December 2012 to estimate the value of private residential property holdings of 65,716 Singaporeans born between 1960 and 1989, adjusted to January 2014 Singapore dollars.

III.B Descriptive Statistics

The summary statistics in Table 1 show that even though the Chinese make up almost three-quarters of the population in Singapore, the number of Chinese annual births is only around twice that of the non-Chinese (around 32,000 compared to around 14,000), pointing to their lower fertility rates. On average, the number of annual births rises by around 4,000 or 12.07% in Dragon years relative to other years for the Chinese, while the corresponding figures are around 450 or 3.28% for the non-Chinese.

On average, Chinese individuals tend to have higher monthly incomes than their non-Chinese counterparts (around S$5,500 compared to around S$4,000), with similar levels of unemployment (around 5.5%). Both Chinese and non-Chinese individuals born in the year of the Dragon have significantly lower average monthly incomes–in fact, the raw differences are even larger for the non-Chinese (around S$400 compared to around $150), suggesting significant spillover effects on other races.

Consistent with the income pattern, Chinese individuals are more likely to gain admission to one of the two local national universities (around 60% compared to slightly over 40%), with higher levels of representation in the top two thirds of university departments. The admission outcomes correspond to their higher applicant scores. Again, both Chinese and non-Chinese individuals born in the year of the Dragon have poorer pre-tertiary performance and admission chances, with effects generally larger for the Chinese themselves (a decline in probability of admission by around 5 percentage points compared to around 2.5 percentage points).

III.C Empirical Specification

We begin by estimating the effects of Chinese zodiac birth timing beliefs on birth cohort size. The beliefs favor Dragon years, especially for sons, whereas there are no such views in the Malay and Indian cultures. This institutional setting allows us to use a difference-in-differences model for distinguishing birth timing effects from time trends, by allowing us to control for race, month and year fixed effects.

$$B_{j,t} = \beta_0 + \beta_1 * Dragon_t + \beta_2 * ChineseDragon_{j,t} + X_{j,t} + \theta_j + \varepsilon_i, \quad (1)$$

where $B_{j,t}$ is the dependent variable representing the log of number of births born in a given month-year t to race j. $Dragon_t$ is a dichotomous variable for whether the month-year t is in a Dragon year. $ChineseDragon_{j,t}$ is a dichotomous variable for whether the race j is Chinese and the month-year t is in a Dragon year. Hence, β_2 is a difference-in-differences estimator for the percentage change in number of Chinese births born in the year of the Dragon. $X_{j,t}$ denotes a vector of controls for race, gender, year of birth and month of birth fixed effects, and θ_j captures race-specific quadratic trends in the number of births.

To examine the effects of being born in a Dragon year on life outcomes, we use individual-level data and a difference-in-difference model which fully controls for cohort fixed effects:

$$L_i = \beta_0 + \beta_1 * Dragon_i + \beta_2 * ChineseDragon_i + X_i + \theta_i + \varepsilon_i, \quad (2)$$

where $ChineseDragon_i$ is a binary variable equal to one if the individual is Chinese and born in a Dragon year. X_i denotes a vector of controls for race, gender, year of birth and month of birth fixed effects, and θ_i captures race-specific quadratic age trends in the case of labor market outcomes and consumption behavior, race-specific quadratic time trends in the case of university admissions, and race-specific year of birth trends in the case of bankruptcy and property ownership outcomes.[9] All errors (in the individual-level regressions) are clustered by the residential location, measured using postal code.[10] While the difference-in-difference specification fully controls for time trends, the estimates are lower bounds due to potential spillover effects on non-Chinese races.

[9] We control for time trends for university admissions since most Singaporeans apply for university admissions within a narrow range of ages (19 to 21). We also control for year of birth trends for bankruptcy and property ownership outcomes to allow for multiple bankruptcies and property holdings.

[10] Ideally, we would like to cluster the standard errors at the shock level, i.e., by the zodiac sign. Unfortunately, this specification generates too few clusters (N=12) to provide unbiased estimation of standard errors (Bertrand, Duflo, and Mullainathan 2004; Cameron and Miller 2015). Instead, we resort to clusters that capture characteristics that are crucial drivers of our dependent variables. To the extent that residential location (postal code) provides a fine measure of individuals' socioeconomic and demographic characteristics, clustering at the postal code level allows the error structure of key dependent variables to be correlated among individuals with similar socioeconomic or cultural background, which are important factors for explaining variation in life outcome variables such as labor income.

To check for spillover effects on other races, we conduct the analysis for the Chinese and non-Chinese separately using the following model:

$$L_i = \beta_0 + \beta_1 * Dragon_i + X_i + \theta_i + \varepsilon_i, \quad (3)$$

where L_i is the dependent variable representing labor market outcomes. $Dragon_i$ is a binary variable equal to one if the individual was born in a Dragon year. X_i denotes a vector of controls for gender, and month of birth fixed effects, and θ_i captures quadratic age trends. All errors are clustered by postal code.

IV. Main Results

IV.A Zodiac Birth Timing in Singapore

Table 2 shows the results of the difference-in-differences model, which suggests that the number of monthly births spikes by 9.3% in Dragon years.[11] This effect is both statistically significant and economically large. Figure 1 shows that zodiac birth timing is a uniquely Chinese phenomenon, with no similar trends among the non-Chinese. In addition, Figure 2 shows that, within the Chinese population, the birth spike is unique to the year of the Dragon. Similarly, in the regression result (Table 2, column 1), the insignificant coefficient of the Dragon dummy variable suggests that there is no significant change in the number of births among the non-Chinese in Dragon years.

IV.B Labor Market Consequences for Chinese Dragon Babies

Table 3 suggests that being born in the year of the Dragon has highly significant consequences for labor income when these individuals enter the labor market. Specifically, relative to the difference in income between Chinese and non-Chinese in other years, Chinese born in Dragon years make 6.0% lower incomes. The effect is statistically significant at the 1% level. Due to space constraints, we do not elaborate on the year of birth fixed effects and quadratic age effects in the table but illustrate them in Figure IA.1 of the Online Appendix. We also study the distribution of the income differences. Panel A of Figure 3 shows that the effects are largely due to a disproportionately high proportion of low-income earners, rather than a lower proportion of high-income earners. Given our estimate of a 9.3% surge in Chinese birth numbers in Dragon years, the evidence suggests that the elasticity of income with respect to cohort size is fairly large, on the order of -0.65.

It is worth noting that our measure of income is obtained from the bank's data during the period of 2010-2012. If income information is infrequently updated in the bank's system, then our

[11] The estimated coefficient for log of number of births in column 3 of Table 2 is 0.089, which is equivalent to a percentage decline of 9.3 percent (= exp(0.089) – 1). All subsequent percentage effect interpretations for log dependent variables follow the same formula.

observed income level may be correlated with the time of account opening. This may lead to biased estimates, especially if Chinese Dragons, in particular, opened their bank accounts at an earlier age (when they earn lower income). To study this possibility, we generate a variable for age at account opening, and find that Chinese Dragons on average open their bank accounts at age 21.4, which is very similar to 21.5 for Chinese non-Dragons. We also performed a difference-in-differences analysis, controlling for race and gender fixed effects, birth year and month fixed effects while clustering standard errors by postal code. We find no difference in the age at account opening between Chinese Dragons and Chinese non-Dragons, relative to the same difference for the non-Chinese (the diff-in-diff estimate coefficient is -0.06 with a *p*-value equal to 0.515).

We find less evidence for probability of employment. Bloom, Freeman and Korenman (1988) find that larger cohort sizes led to stable wages but higher youth unemployment in a number of European economies and Japan, whereas they reduced wages but did not substantially increase unemployment in the U.S. Our results for Singapore are more similar to those for those for the U.S., where cohort size effects reduced youth wages while the impact on unemployment rates was mitigated, while in a number of other industrialized economies, youth wages were stable but unemployment rose (Bloom, Freeman and Korenman 1988). Our results likely reflect Singapore's lower levels of labor regulation, since cohort size effects tend to be larger in less flexible markets with fewer employment protection rights for older workers (Brunello 2010; Korenman and Neumark 2000).

IV.C Labor Market Consequences for non-Chinese Dragon Babies

One alternative interpretation of the negative effects on income is selection effects, where families from lower socioeconomic backgrounds and poorer financial management skills are more likely to practice zodiac birth timing, rather than increased competition from larger cohort sizes. In addition, parents may engage in compensatory behavior for non-Dragon children, out of the belief that Dragon children are naturally better endowed. On the other hand, there is also evidence consistent with a positive selection mechanism since parents with more education or resources practice birth timing (and invest more in children's human capital). Consequently, the selection effect remains conceptually ambiguous. Empirically, existing evidence from the demography and sociological literature find the selection effect to be either weak or positive (Goodkind 1995; Do and Phung 2010; Johnson and Nye 2011).

Despite the uncertain predictions of the selection effect associated with birth timing practice, we use several identification strategies to distinguish cohort size effects from selection effects. We first study the labor market performance for the non-Chinese born in the Dragon years. This subpopulation (and their parents) is not influenced by the superstition that is specific to the Chinese culture. Indeed, results in Figure 1 and Table 2 confirm that there is no increase in the number of births during Dragon years for the non-Chinese population in Singapore.

If the negative effect on income documented above arises from difference in the composition of family backgrounds or other socioeconomic characteristics for Chinese Dragons relative to Chinese born in other years, all else being equal, we expect to see no difference in income for non-Chinese Dragons relative to non-Chinese born in other years. On the other hand, if the bigger birth cohort bears resource implications for either educational or labor market, one would expect the associated constraints to spill over to non-Chinese born in Dragon years as well.

In Panel A of Table 4, we compare average incomes between those born in Dragon years and non-Dragon years within the non-Chinese subpopulation. After controlling for gender fixed effects, month of birth fixed effects, as well as quadratic age trends, non-Chinese Dragon birth cohorts earn incomes that are 3.8% lower than non-Chinese non-Dragon birth cohorts. The effect is statistically significant at the 5% level. Once again, the effects are largely due to a disproportionately high proportion of low-income earners (Figure 3, Panel B). Similarly, we do not find a significant difference in the unemployment status between the two groups. Overall, the evidence provides support to the latter hypothesis that traces the negative income for Dragon babies from the implications of a larger birth cohort.

Compared with the income effect for the Chinese Dragons (both in Panel A and Panel B), the effects on other races are noticeably weaker. One possible reading of these results is that half of the decline in income among the Chinese is due to negative selection, since the non-Chinese are exposed only to cohort size effects. This interpretation is only valid if we assume perfect substitutability of labor across races. As discussed above (and to be shown later), this condition is unlikely to hold in Singapore where races tend to have different language skills and thus face different levels of demand from the labor market (see Appendix IA.1 in the Online Appendix).

IV.D Labor Market Consequences of Another Spillover Group

Next, we study the cohort size effect by exploiting a unique institutional feature to identify another group subject to the spillover effects of a large birth cohort. Specifically, we make use of the strict mandate that all Singaporean males must perform two and a half years of National Service, commonly between the ages of 19 and 22, so that men are usually two years older than female members of their birth cohort when they enter university and their first job. Hence, even though Dragon men and women share similar early life environments, men exogenously enter university and labor market in a different year from their female counterparts. Specifically, Dragon men enter university and labor market with women who are two years younger and were born in the year of the Horse.[12]

[12] By the same logic, Dragon women enter the labor market with men born two years before (in the year of the Tiger). However, Tiger years witness smaller birth cohorts potentially as a result of Tiger being an undesirable zodiac according to the Chinese superstition. This introduces confounding factors which makes interpretation more difficult. Thus we will focus on the subgroup of Horse birth cohorts in this analysis.

In the presence of cohort size effects, we hypothesize that women born in Horse years, likely also earn lower wages as they enter university and the labor market with Dragon men. On the other hand, men from the Horse birth cohorts should not be affected. By contrast, the selection argument predicts no income effect for the Horse birth cohorts, since the Horse year is not regarded as an especially auspicious year to give birth in Singapore, as Figure 2 shows.

We compare average incomes between Chinese Horse women and other Chinese. Results in Panel B of Table 4 support the cohort size effect hypothesis. Chinese Horse women earn lower monthly income by 3.1% than the Chinese born in non-Horse years, and the effect is statistically significant at the 1% level. Notably Horse men do not suffer from lower incomes than Chinese born in non-Horse years (the combined effect is -0.032+0.052 = 0.02 which is statistically insignificant), which again suggests that there is no fertility selection in Horse years. In fact, Horse men's average monthly income is higher than that of Horse women by 5.3% (statistically significant at 1%).

Out of curiosity, we briefly investigate whether the lower incomes of Horse women are due to marital pairing with lower income Dragon males. We find that single Horse women also experience significantly lower income than other cohorts, inconsistent with the marital pairing hypothesis (Table IA.1 in the Online Appendix). Overall, these results suggest that Chinese Horse women are adversely affected by the bigger birth cohorts in Dragon years.

IV.E Evidence from Malaysian Chinese Dragons

The above analyses, using distinct groups of the population indirectly exposed to the Dragon superstition, provide strong evidence supporting the cohort effect interpretation. Non-Chinese Dragons as well as Chinese women born two years later (i.e., in the Horse years) do not have abnormally high birth cohorts, but they go to school and enter the labor market at the same time as the large cohort of Chinese Dragons. As a result, the findings of lower incomes for these individuals suggest that the cohort effect plays a major role in explaining the Dragon income effect.

To further alleviate the (negative) selection concern, we use Malaysian Chinese as a counterfactual group. The identification lies in the cultural affinity in the two neighboring countries, which nevertheless have a large difference in the proportion of Chinese residents. In Malaysia, Chinese are the minority group, accounting for 23% of the total population (while the majority group Malay makes up close to 52% of the population). Like Singapore, Chinese populations in Malaysia practice zodiac birth timing, whereas there is little evidence of lunar birth timing among the other races (Goodkind 1995). Compared to Singapore, Chinese racial identity and cultural influences may be even stronger in Malaysia, due to the ongoing state-sponsored discriminatory educational, taxation and labor market laws against the relatively wealthy Chinese minority. Therefore, the

zodiac birth timing among Malaysian Chinese is unlikely to create a sizable increase in birth cohort sizes given their minority status.

We draw from the same bank's data to identify Malaysians who reside in Singapore and perform the same comparison of the income difference between Malaysian Chinese Dragons and Chinese non-Dragons, relative to the difference between Malaysian non-Chinese Dragons vs. non-Chinese non-Dragons. We note that this is a selected sample—we only capture Malaysians who have migrated to or currently reside in Singapore. The identifying assumption rests on comparability of the determinants of location choice between Dragon birth cohorts and non-Dragon birth cohorts among the Malaysian Chinese, relative to that among the Malaysian non-Chinese.[13]

Our evidence suggests that Chinese Dragons have, if anything, higher income than other Chinese Malaysians, relative to the difference between Malaysian non-Chinese Dragons and other non-Chinese Malaysians, although the difference is not statistically significant (Table 5). Given the cultural similarities between Singaporean and Malaysian Chinese, this finding again supports our previous cohort effect evidence.

V. Economic Channels

V.A Inelastic Labor Demand

In the previous analysis in Panel B of Table 4, we find that 1) Chinese Horse women perform worse in their labor market outcomes compared with other Chinese born in non-Horse years; and 2) no such effect is observed among Chinese Horse men. This not only provides strong evidence in support of the cohort size effect by identifying its impact on another spillover group, but importantly the results also shed light on the potential economic channel. Since Chinese Horse women share resources and interact with Chinese Dragon men only in university and when they first enter the labor market, it suggests two potential channels: cohort size affects quality of university education, or it increases job market competition when labor demand is inelastic.[14]

We study non-Chinese women born in Horse years to differentiate the university education quality hypothesis from the labor market inelasticity hypothesis. Since Chinese and non-Chinese face differentiated labor markets due to their distinct (language) skills (see Appendix IA.1 in the Online Appendix), the labor market channel implies that the increase in the college class size for the Horse birth cohorts will primarily affect Chinese Horse women. On the other hand, both Chinese and non-Chinese Horse women enjoy similar levels of access to university education. If the quality of

[13] To check that there is no selection effect for migration into Singapore, we note that in our bank dataset, the ratio of Dragons is 10.56% among the Malaysian Chinese and 10.81% among the Malaysian non-Chinese. Hence, we do not find that the selection effect is differentially stronger for Chinese Dragons.

[14] We confirm that the Horse cohorts do not have different pre-university educational outcomes compared to other birth cohorts, for both genders (see Table IA.2 in the Online Appendix).

university education deteriorates with a larger cohort size, we should expect to observe worse labor market outcomes for non-Chinese Horse women as well.

In Table 6, we compare the difference in labor market outcomes between non-Chinese Horse women and other non-Chinese. Non-Chinese Horse women earn no less income compared to either non-Chinese who were not born in Horse years or non-Chinese Horse men. Similarly as before, among the non-Chinese, Horse men do not earn less than those not born in Horse years. Taken together, the findings are consistent with the labor market competition interpretation: a larger college class intensifies competition when graduates enter the job market, and labor demand is unable to (fully) adjust resulting in lower wages.

We present an additional piece of evidence that supports the labor market inelasticity hypothesis. If demand for labor is less responsive to changes in cohort size of new labor entrants, we would expect that individuals born to larger cohorts would be less likely to be employed in the formal sector and more likely to be engaged in self-employment or other income generating activities. Table 7 shows that Chinese Dragons are indeed 3.4% less likely to enter professional occupations and 1.0% more likely to be self-employed, relative to other Chinese. The effects are statistically significant at the 10% level. Since professional occupations tend to be higher paying than self-employment work throughout the distribution (see Figure 4), competition for scarce formal work is likely to be an important mechanism behind the lower incomes of Chinese Dragons.

V.B Educational Outcome

Next, we study whether educational experiences also contribute to the cohort size effect. Does the larger birth cohort size of the Chinese Dragons hurt their prospect of receiving university education? Table 1 shows that both Chinese and non-Chinese Dragons have lower probability of admission to local universities compared to non-Chinese Dragons and non-Chinese non-Dragons, with larger effects on the Chinese themselves. Consistent with Table 1, Table 8 shows significant difference-in-differences impacts on admission for Chinese Dragons. More strikingly, the effects on admission chances are larger for admission to the bottom tier, suggesting that cohort size affects marginal students more. This is also consistent with the previous finding in Figure 3 that the negative income effect for the Dragon birth cohorts is more pronounced for the lower end of the income distribution.

To interpret the lower admission chances for the Chinese Dragons, we first compute the number of university applicants in each year divided by the size of their birth cohort and compare the average applicant ratios between Dragon and non-Dragon years. For both Chinese and non-Chinese, there are slight increases of 0.005 and 0.004 respectively in the proportion of university applicants for the Dragon birth cohorts, but these increases are statistically insignificant and

economically negligible. More importantly, the difference in differences of the applicant ratios is economically and statistically indistinguishable from zero.

Next we study the university application test outcomes of Chinese Dragons. Most of the applicants took the Cambridge International "A" levels Examination, which are administered externally and unlikely to be affected by cohort size changes in Singapore. Applicant scores are computed by the university admissions offices based on classified metrics, and are not generally comparable across different years or academic tracks. Hence, we measure applicant scores in terms of standard deviations within the same cohort year and academic track. The diff-in-diff coefficient estimate in the last column of Table 8 thus captures Chinese Dragons' lower applicant score by 0.06 of a standard deviation than the same birth cohort non-Chinese, relative to the score difference between Chinese and their same cohort non-Chinese counterparts in other years. The effect is statistically significant at the 1% level. The effects are larger for marginal applicants, who are more likely to apply to departments with the lowest third of cutoff requirements. The results are consistent with Figure 3, which show that income differences are largely due to a disproportionately high proportion of low-income earners.

We also compare the income differences between Dragons and non-Dragons among the subpopulation without a college degree. Table 9 shows that the effects appear to be larger for Dragon babies without a college degree. For both Chinese and non-Chinese, the income differences between Dragons and non-Dragons are very pronounced within the subpopulation *without* a college degree – the coefficients are -6.8% and -5.5% respectively and statistically significant at the 5% level. By contrast, the income difference is much weaker for college graduates. Formal F-tests show that, within the college graduate subpopulation, Chinese Dragons earn 4.0% less than Chinese non-Dragons (statistically significant at the 5% level), while non-Chinese Dragons earn 2.8% less (statistically insignificant). This, together with evidence on their lower university application test scores, provides support to the hypothesis of lower human capital accumulated in the earlier years of life for the Dragon birth cohorts.

One possibility is a decrease in lower quality of pre-tertiary education due to larger cohort sizes. Examining aggregate annual administrative data for Singapore from 1985 to 2015, we find little evidence that Dragon cohorts were disadvantaged by higher student-teacher ratios in primary or secondary schools (Table IA.3 in the Online Appendix). This is consistent with anecdotal observations that the educational system anticipates and prepares for the fluctuations in cohort sizes, including opening nine new primary schools in preparation for the 1988 Dragon year cohort. Hence, the problem may not be as much a lack of educational facilities, but may stem from greater competition for shadow education, ubiquitous in Singapore, and (in)experience of teachers employed in response to the larger Dragon birth cohorts.

Similarly, the national universities appear to adjust the number of available places in response to the larger Chinese Dragon cohorts. On average, universities admit 7.2% more Chinese Dragon applicants than Chinese non-Dragon applicants, compared with an average of 10.7% increase in birth cohort size for Chinese during Dragon years. In addition, we find that the lower admission probability is insignificant once applicant scores are controlled for (Table IA.4 in the Online Appendix). Collectively, the findings suggest that the lower admission percentages among Chinese Dragons are due to their lower human capital despite universities' response (through increasing the enrollment size).

V.C Differential Effects among Dragon Cohorts

The impact of a larger birth cohort on labor market outcomes, either through the channel of inelastic demand or through lower pre-college ability, plausibly dissipates over time as one acquires more experience or on-the-job training. We test this hypothesis next. First, Panel A of Table 10 shows the magnitude of the Dragon effect on birth cohort sizes since 1960. We find strong evidence that all three Dragon cohorts since 1976 were larger than normal, with an economically large increase in cohort size in 1976 (around 30%, statistically significant at the 1% level), a significant spike in cohort size in 1988 (around 20% increase, also statistically significant at the 1% level) and a slightly smaller spike in 2000 (around 15% increase, statistically significant at the 5% level).

In Panel B of Table 10, results show that the negative effects on wages are large (-15.6%) and statistically significant for the 1988 Dragon cohort, the youngest cohort for whom data on labor outcomes are available, but not for the other Dragon cohorts.[15] The results are consistent with the interpretation of a decline in cohort size effects with age (Bloom, Freeman and Korenman 1988; Korenman and Neumann 2000; Wright 1991). Lower starting wages reduces the opportunity costs of investing in human capital, increasing future earnings, gradual movement of labor to less youth-intensive industries, and increased substitutability for experienced workers once they have gained experience (Smith and Welch 1981).

VI. Robustness and Extension

VI.A Robustness Tests

VI.A1 Lunar Calendar Year

There is some evidence that zodiac birth timing follows the lunar rather than the Julian calendar, where parents avoid giving birth in the last month of the lunar Rabbit year (the first month of the

[15] We are unable to estimate the labor market outcomes for the Dragons born in 2000 or 2012, as they have not entered the labor market during our sample period.

Julian Dragon year) and have more babies in the last month of the lunar Dragon year (the first month of the Julian Snake year) (Table IA.5 in the Online Appendix). When we repeat our analyses using the lunar calendar, our results are qualitatively and quantitatively similar, with a 10.2% jump in monthly births, 5.6% decline in average incomes and 2.2 percentage points decline in probability in admission to a local national university (Tables IA.6-7 in the Online Appendix). The smaller Dragon effects on income and academic success makes intuitive sense, given that the Singaporean educational system follows the Julian calendar.

VI.A2 Restricting the Sample to Surrounding Cohorts

The difference-in-differences research design allows us to fully control for year fixed effects in addition to race-specific quadratic trends. To further assuage concerns that our results are driven by other potential time trends such as business cycles, we repeat our analysis with the sample restricted to birth cohorts born within three years of the Dragon cohorts, i.e. Singaporeans born in 1973-1979 and 1985-1991. When we use this restricted sample, we continue to find a 5.7% decline in average incomes in Dragon years, significant at the 5% level (Table IA.8 in the Online Appendix), similar to when we include the full sample (-6.0%).

VI.A3 Differential Effects by Gender

Due to concurrent trends in birth cohort size and female labor participation in the U.S. and European countries, there are relatively few papers which estimate the effects of cohort sizes on women's labor outcomes (Brunello 2010; Wright 1991). An exception is Korenman and Neumark (2000), who find that the effects are generally larger and more significant for women and argue that women may be more vulnerable to cohort size effects (Korenman and Neumann 2000). Moreover, as cohort size increases, the ratio of younger women to older men increases, reducing the chances of Dragon women to find a high quality marriage match. This may increase the female labor supply, leading to stronger negative labor market outcomes. In the case of Singapore, we find that the Dragon effect on cohort size on labor market outcomes are similar for males and females (Table IA.9 in the Online Appendix).

VI.A4 The Case of Tiger Women

At the opposite spectrum from Dragons, Tiger babies are less desired among Singaporean Chinese, as the women are thought to be "fearsome", unsuitable for marriage or even for attending others' weddings, as they may "eat up the good luck at weddings if invited" (Goodkind 1991). We do find evidence consistent with the birth timing argument: there are 7.8% fewer Chinese born in the Tiger years relative to non-Chinese during our sample period (Table IA.10 in the Online Appendix). One interesting question lies in the labor market outcomes of these smaller cohorts (born in the Tiger years).

In contrast to the strongly significant results for Dragons, we find that Chinese Tiger women do not have significantly higher income than other Chinese cohorts.[16] (Table IA.10 shows that they earn 2.1% higher incomes than Chinese Tiger men, who enter university and labor markets with Dragon women, although again this difference is statistically insignificant.) To understand this result, we notice that the Tiger effect began fairly recently in 1986, which restricts the power of the income tests (i.e., we only have one Tiger cohort in the income analysis since the later Tigers born in 1998 have not entered the labor market in our sample period). Alternatively, the impact of cohort size effects on income may be asymmetric. As in Dragon years, educational resources have been adjusted in response to the smaller cohort so that we do not observe a smaller student-teacher ratio. In addition, employers are potentially less willing to increase wages with a temporary decline in cohort size than workers are to accept lower wages when a discontinuous jump in number of job seekers. Given the limited power in our data, we leave this interesting question for future research.

VI.B Additional Outcomes: Credit Access, Bankruptcy, Property Ownership and Consumption

Table 11 shows that Chinese Dragons have lower credit limit compared to other cohorts, likely due to lower income levels. The effect is economically significant at 8.4%, suggesting that they have substantially weaker access to credit. Moreover, we find that Chinese Dragons born between 1960 and 1980 are 0.3% more likely to be involved in a bankruptcy court case, relative to a base probability of bankruptcy of 2.8%, although the effect is not statistically significant. Hence, even though cohort size effects on wages appear to decline with age, the initial wage disadvantages may still have consequences for individuals' long-term financial stability and solvency.

Perhaps unsurprisingly, we find that Chinese Dragons spend a higher fraction (and thus save a lower fraction) of their incomes, particularly on non-conspicuous items including necessities such as groceries and utilities. What *is* striking is that despite their lower levels of income, they *also* spend a significantly higher proportion of their income on conspicuous items such as apparel, watches and jewellery, personal services including entertainment and beauty salons, and vehicles. In addition, Chinese Dragons also do not appear to spend less on residential property and are actually more likely to reside in a private condominium, an important status symbol in Singapore, compared to other Chinese cohorts.

Why do Chinese Dragons spend more than other Chinese on conspicuous consumption, given their lower incomes and credit limits? Consumption, and conspicuous consumption in particular, is a form of social status signalling, giving rise to the Veblen effect where demand curve for a product is upward rather than downward sloping (Bagwell and Bernheim 1996; Corneo and Jeanne 1997;

[16] Results on the labor income as well as education-related variables for the Tiger years are unreported but they are available upon request.

Ireland 1994). In a conformist society, when the number of consumers increases, concave preferences on ranks lead to larger marginal utility gains with a unit change in rank at lower ranks than at higher ranks. In other words, "it is the desire to avoid social ostracism, rather than the search for prestige, which may lead to an upward-sloping demand curve" (Corneo and Jeanne 1997). Hence, the larger cohort size of Dragons may make it especially costly to avoid status signalling behavior.

In that aspect, the superstition-induced zodiac birth timing also implicates consumption and saving choices and self-image. The effects on conspicuous goods for signalling purposes, in turn, may have important implications for economic efficiency since status seeking is a zero-sum game (Corneo and Jeanne 1997; Ireland 1994).

VII. Discussion and Conclusion

We explore the consequences of the Chinese superstitious practice of zodiac birth timing in the multi-racial city state of Singapore, where parents prefer to give birth in the year of the Dragon with the belief that children born under this sign are noble, long-lived and bound for success. This practice is followed exclusively by the Chinese majority, allowing us to distinguish cohort size effects from time trends. On average, the number of births jumps by 9.3% in Dragon years among the Chinese majority, with no similar patterns detected among non-Chinese minorities.

Exploiting multiple sources of high-quality individual level datasets, we find large negative effects for life outcomes for the exposed population, including groups who do not practice the superstition. Chinese Dragon babies earn significantly lower income than other Chinese cohorts after entering the labor market (by 6.0%), relative to the income difference between Dragons and non-Dragons within the non-Chinese subpopulation. Moreover, the birth cohort size effect extends beyond the subpopulation that practices Dragon year birth timing; the non-superstitious groups who share the same resources and compete in the same labor market with the Chinese Dragon babies also suffer from significantly lower incomes. Apart from labor demand being inelastic, the negative income effect associated with the Dragon birth cohorts is also attributable to lower human capital accumulated in the early years of their lives (despite the adjustment in public educational resources to accommodate the larger birth cohorts). The Dragon birth cohorts have lower university applicant scores, admission chances, and the lower income effect is more prominent for those *without* college degrees.

Findings in this paper bear direct policy implications for Singapore and other Chinese (-influenced) cultures (e.g., People's Republic of China and other parts of East Asia). While birth timing is a household-specific choice, we show that the collective decision to time childbearing in one specific year due to superstitious beliefs can give rise to long-lasting negative outcomes for a significant portion of the population. While the public educational system actively attempts to offset the

effects of zodiac birth timing, it has limited capacity to accommodate the surge in demand for resources. Our findings suggest that one way to ameliorate the negative impacts is to adjust school entry laws to reduce the overlap between school (and hence university and labor market entry) cohorts and zodiac cycles. The results also shed light on cohort size effects in general, and are not necessarily restricted to the specific source of the larger birth cohort documented in this setting.

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Appendix A1: Variable Definitions

A.1 Main independent variables. ***Dragon*** is a dichotomous variable for whether the individual was born in the year of the Dragon, i.e. in 1964, 1972, 1988, and 2000. For regression models which control for year fixed effects, the coefficient includes the year fixed effect for one of the Dragon years due to perfect multicollinearity.

Chinese Dragon is a dichotomous variable for whether the individual is Chinese and born in the year of the Dragon.

A.2 Fertility outcomes. ***Births*** is the number of monthly births by gender and race (Chinese, Malay, Indian and Other) between January 1960 and December 2007.

A.3 Labor market outcomes. ***Monthly income*** is the average of individual monthly incomes reported between April 2010 and March 2012 among Singaporeans born in 1960-1990, adjusted to January 2014 Singapore dollars, with the top 1% and bottom 1% of Singaporean and Malaysian monthly incomes winsorized.

Ever unemployed is a dichotomous variable for whether an individual has ever reported their employment status as "housewife" or "non-worker". The variable is coded as missing for individuals who are currently students, national servicemen or retired.

Professional is a dichotomous variable for whether an individual has ever reported their occupation as "professional". The variable is coded as missing for individuals who are currently students, national servicemen or retired.

Self-employed is a dichotomous variable for whether an individual has ever reported their occupation as "self-employed". The variable is coded as missing for individuals who are currently students, national servicemen or retired.

A.4 Educational outcomes. ***Applicant scores*** are measured using the applicant's Z-score within the same application year and academic track reported between 1980 and 2015 among Singaporeans born in 1960-1990. The raw scores are computed by the university admissions offices based on classified metrics, and are not generally comparable across different years or academic tracks. We consider applicants from two major academic tracks: junior college and polytechnic, which accounts for 85.44% and 14.56% of applicants respectively.

Admitted is a dichotomous indicator for whether the individual was admitted to either of the two main local universities, National University of Singapore and Nanyang Technological University.

Admitted to top third is a dichotomous indicator for whether the individual was admitted to a department where the mean departmental applicant score is more than 0.7 of a standard deviation above the average applicant score among Singaporeans and Malaysians.

Admitted to middle third is a dichotomous indicator for whether the individual was admitted to a department where the mean departmental applicant score is between 0.3 and 0.7 of a standard deviation above the average applicant score among Singaporeans and Malaysians.

Admitted to bottom third is a dichotomous indicator for whether the individual was admitted to a department where the mean departmental applicant score is less than 0.3 of a standard deviation above the average applicant score among Singaporeans and Malaysians.

A.5 Credit access and consumption outcomes. ***Credit limit*** is the average of total credit limits across all credit cards reported between April 2010 and March 2012 among Singaporeans born in 1960-1990, adjusted to January 2014 Singapore dollars, with the top 1% and bottom 1% of values winsorized.

Ratio of consumption to income is the average monthly spending as measured by credit and debit card transactions reported between April 2010 and March 2012, adjusted to January 2014 Singapore dollars. We winsorize the spending amount at the top and bottom 1% level and report it as a fraction of monthly income.

Ratio of conspicuous consumption to income is the average monthly conspicuous spending as measured by credit and debit card transactions reported between April 2010 and March 2012, adjusted to January 2014 Singapore dollars. Following the categorization proposed by Charles, Hurst, and Roussanov (2009) and Heffetz (2011), we define conspicuous consumption as expenditures on apparel (including accessories such as watches and jewellery), personal services (such as beauty salons, entertainment, electronics, and dining) and vehicles (excluding maintenance). We winsorize the spending amount at the top and bottom 1% level and report it as a fraction of monthly income.

Ratio of other consumption to income is the average monthly non-conspicuous spending as measured by credit and debit card transactions reported between April 2010 and March 2012, adjusted to January 2014 Singapore dollars. Following the categorization proposed by Charles, Hurst, and Roussanov (2009) and Heffetz (2011), non-conspicuous spending is all other expenditures other than expenditures on apparel, personal services and vehicles, which include groceries, utilities and travel. We winsorize the spending amount at the top and bottom 1% level and report it as a fraction of monthly income.

A.6 Bankruptcy outcomes. ***Bankruptcy*** is a dichotomous variable for whether an individual has ever been involved in a bankruptcy case in court, based on 1980-2012 records by the Supreme Court of Singapore among Singaporeans born in 1960-1980.

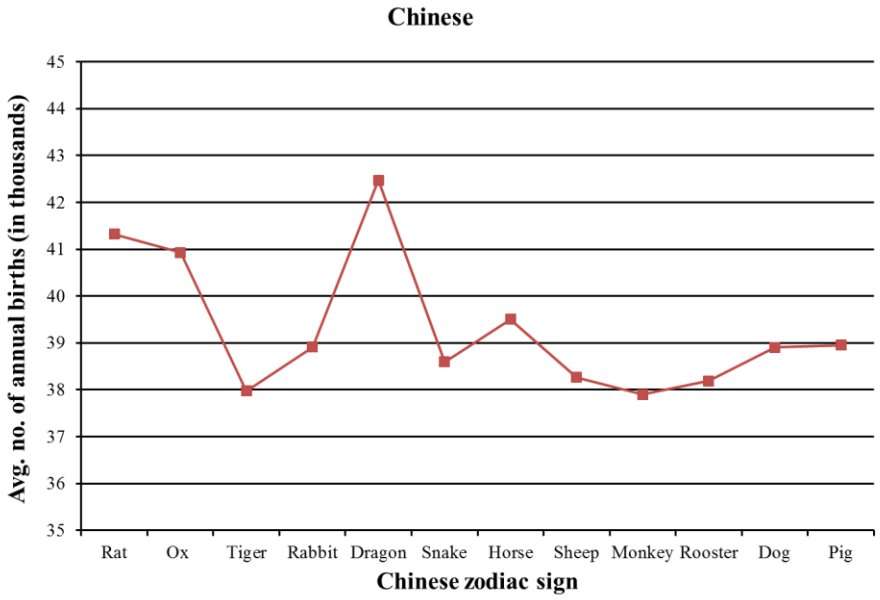
A.7 Property ownership outcomes. ***Condo residence*** is a dichotomous variable for whether an individual is listed as living in a private condominium among Singaporeans born in 1960-1990.

Private property holdings is the total value of an individual's private residential property holdings. We estimate the values of residential properties using transactional prices from private residential housing transactional caveats from January 1995 to December 2012, adjusted to January 2014 Singapore dollars, with the top 1% and bottom 1% of values winsorized.

Figure 1: Average Number of Annual Births by Zodiac Sign, Controlling for Linear Time Trends, 1960-2007

This figure shows the average number of annual births by zodiac sign, controlling for linear time trends. Panels A and B show the results for Chinese and non-Chinese separately, using equal vertical scales. Birth data are obtained from Singapore Statistics.

Panel A



Panel B

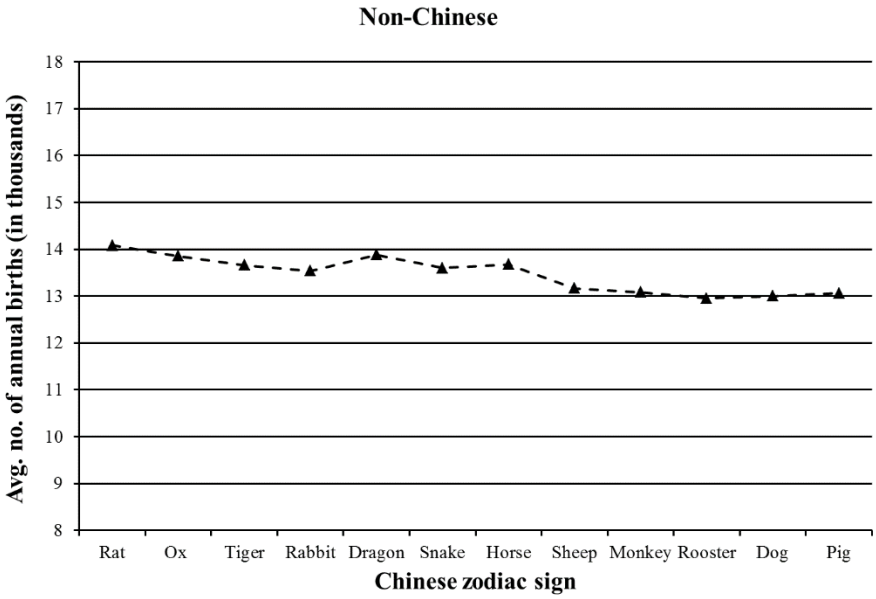


Figure 2. Difference-in-Differences Effects, Controlling for Race, Year and Month Fixed Effects and Race-Specific Quadratic Time Trends, 1960-2007

This figure shows the difference-in-difference estimates (as well as the 95% confidence intervals) on the number of annual births by zodiac sign, controlling for gender and race fixed effects, year and month of birth fixed effects, and race-specific quadratic time trends. Birth data are obtained from Singapore Statistics.

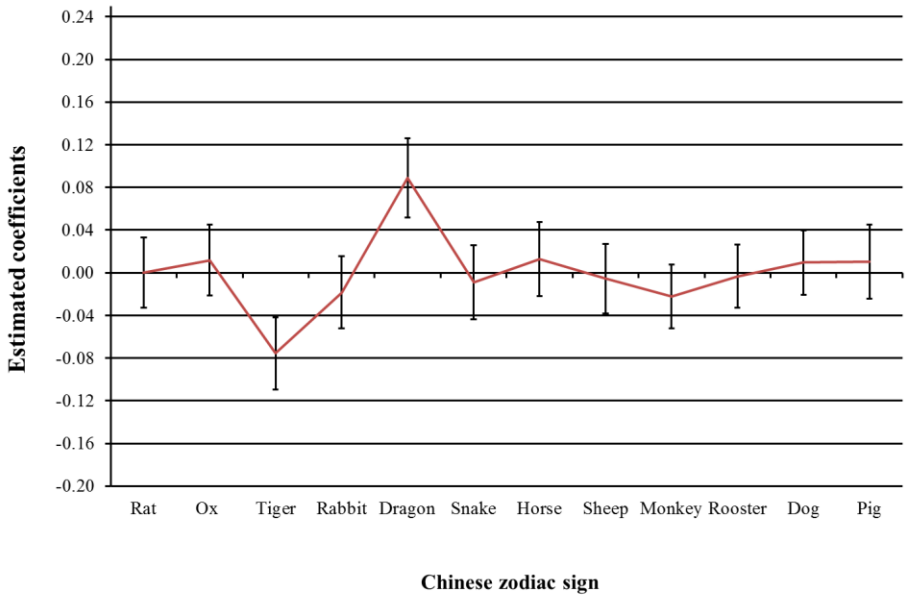
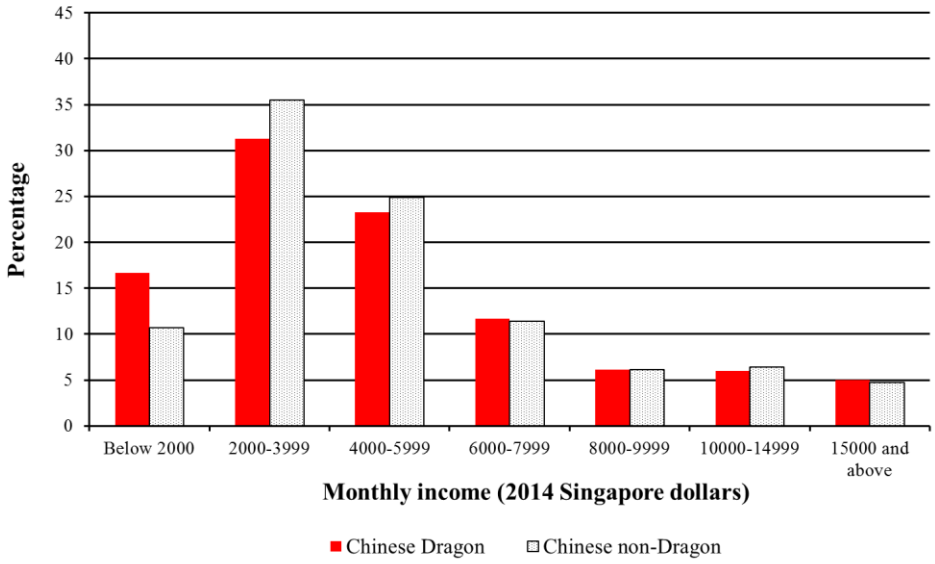


Figure 3: Income Distribution among Singaporeans Born in the Year of the Dragon, by Race

This figure shows the distribution of monthly income among Singaporeans born in the year of the Dragon, compared to Singaporeans born in other years. All values are winsorized for the top and bottom 1% to remove outliers and adjusted to January 2014 Singapore dollars. Please refer to Appendix A1 for a detailed explanation of the income measure.

Panel A



Panel B

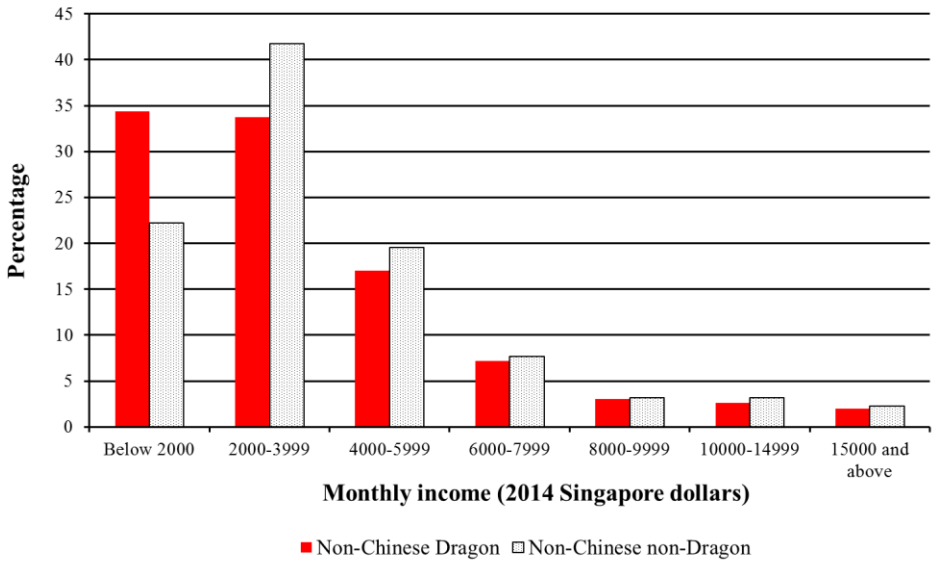


Figure 4: Income Distribution among Singaporeans by Occupation

This figure shows the distribution of monthly income among Singaporeans by occupation. All values are winsorized for the top and bottom 1% to remove outliers and adjusted to January 2014 Singapore dollars. Please refer to Appendix A1 for a detailed explanation of the income measure.

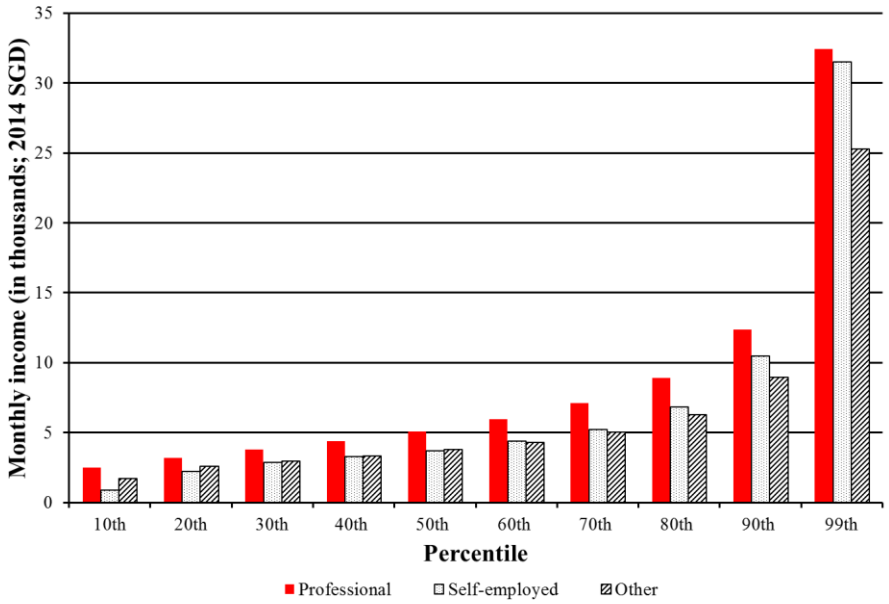


Table 1: Summary Statistics

This table reports the summary statistics of Chinese and non-Chinese Singaporeans, by whether they are born in the year of the Dragon. Panel A displays differences in annual number of births and birth rates between 1960 and 2007. Birth rates are computed using mid-year population estimates from Singapore Statistics. Panel B displays differences in average labor market outcomes. Panel C displays differences in average educational outcomes. Applicant raw scores are computed by the university admissions offices based on classified metrics, with an approximate range of -100 to 100, and are generally not comparable across different years of admission or academic tracks. Please refer to Appendix A for the definition of all other variables. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Chinese			*Non-Chinese*		
	Dragon	Non-Dragon	Diff. in means	Dragon	Non-Dragon	Diff. in means
Panel A: Births						
Annual births	36,193	32,294	3,899	14,045	13,598	446
Birth rate (births per 1,000 pop.)	19.97	17.67	2.30	25.51	24.10	1.41
# of year obs.	4	44		4	44	
Panel B: Labor market outcomes						
Monthly income	5,440	5,594	-154***	3,727	4,146	-420***
Ever unemployed (%)	5.56	5.43	0.13	6.12	5.08	1.04
N	8,415	81,920		1,368	12,377	
Panel C: Educational outcomes						
Admitted (%)	57.62	62.63	-5.02***	40.70	43.14	-2.44***
Admitted to top third (%)	20.43	21.00	-0.57***	9.35	9.83	-0.48
Admitted to middle third (%)	18.09	19.14	-1.05***	12.61	12.73	-0.12
Admitted to bottom third (%)	19.10	22.49	-3.39***	18.74	20.58	-1.84***
Applicant raw scores	63.53	64.16	-0.64***	57.41	58.40	-0.99***
N	38,692	376,184		4,408	46,951	

Table 2: Percentage Increase in Births in Dragon Years

This table reports the difference-in-differences percentage change in number of monthly births in the year of the Dragon for the Chinese born between 1960 and 2007, compared to other races. The dependent variable in all columns is the natural logarithm of monthly births by race and gender. Please refer to Appendix A for the definition of all other variables. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

	(1)	(2)	(3)	(4)
	Ln(monthly births)			
Chinese Dragon	0.120***	0.120***	0.089***	0.089***
	(0.026)	(0.025)	(0.023)	(0.019)
Dragon	-0.001		0.017	
	(0.020)		(0.018)	
Constant	4.218***	4.330***	1,753***	0.912
	(0.013)	(0.038)	(128.441)	(1.120)
Gender fixed effects	Y	Y	Y	Y
Race fixed effects	Y	Y	Y	Y
Year and month of birth fixed effects	N	Y	N	Y
Quadratic year trends	N	N	Y	Y
Chinese*Quadratic year trends	N	N	Y	Y
Observations	4,608	4,608	4,608	4,608
R-squared	0.940	0.957	0.953	0.966

Table 3: Labor Market Outcomes for Singaporeans Born in the Year of the Dragon

This table reports the effects on labor market outcomes for Singaporeans born in the year of the Dragon, using the difference-in-difference specification. The dependent variable in column 1 is the natural logarithm of monthly income in January 2014 Singapore dollars. The dependent variable in column 2 is a dichotomous indicator for whether the individual has ever been unemployed. Please refer to Appendix A for the definition of unemployed and all other variables. Standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

	(1) Ln(monthly income)	(2) Ever unemployed
Chinese Dragon	-0.062*** (0.021)	-0.000 (0.008)
Race and gender fixed effects	Y	Y
Year and month of birth fixed effects	Y	Y
Quadratic age trends	Y	Y
Chinese*Quadratic age trends	Y	Y
Observations	104,080	94,737
R-squared	0.220	0.016

Table 4: Externality in Labor Market Outcomes

This table reports the effects on labor market outcomes for two spillover groups. Panel A shows the income comparison of Dragons vs. non-Dragons among the non-Chinese. Panel B shows the income comparison for Chinese born two years after the Dragon babies (i.e., in Horse years). The dependent variable in column 1 is the natural logarithm of monthly income in January 2014 Singapore dollars. The dependent variable in column 2 is a dichotomous indicator for whether the individual has ever been unemployed. Please refer to Appendix A for the definition of unemployed and all other variables. Standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

Panel A:Non-Chinese born in Dragon years		
	(1)	(2)
	Ln(monthly income)	Ever unemployed
Dragon	-0.039**	0.009
	(0.019)	(0.007)
Gender fixed effects	Y	Y
Month of birth fixed effects	Y	Y
Quadratic age trends	Y	Y
Observations	13,745	12,401
R-squared	0.325	0.025
Panel B: Chinese born in Horse years		
	Ln(monthly income)	Ever unemployed
Horse	-0.032***	0.006
	(0.011)	(0.005)
Horse*Male	0.052***	-0.009
	(0.018)	(0.006)
Gender fixed effects	Y	Y
Month of birth fixed effects	Y	Y
Quadratic age trends	Y	Y
Observations	90,335	82,336
R-squared	0.175	0.013

Table 5: Labor Market Outcomes for Malaysians Born in the Year of the Dragon

This table reports the results on labor market outcomes for Malaysians born in the year of the Dragon, using the difference-in-difference specification. The dependent variable in column 1 is the natural logarithm of monthly income in January 2014 Singapore dollars. The dependent variable in column 2 is a dichotomous indicator for whether the individual has ever been unemployed. Please refer to Appendix A for the definition of unemployed and all other variables. Standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

	(1) Ln(monthly income)	(2) Ever unemployed
Chinese Dragon	0.081 (0.078)	-0.013 (0.017)
Race and gender fixed effects	Y	Y
Year and month of birth fixed effects	Y	Y
Quadratic age trends	Y	Y
Chinese*Quadratic age trends	Y	Y
Observations	13,150	12,633
R-squared	0.190	0.012

Table 6: Non-Chinese Born in the Year of the Horse

This table reports the effects on labor market outcomes for non-Chinese who are born two years after the Dragon years (i.e., in the year of the Horse). The dependent variable in column 1 is the natural logarithm of monthly income in January 2014 Singapore dollars. The dependent variable in column 2 is a dichotomous indicator for whether the individual has ever been unemployed. Please refer to Appendix A for the definition of unemployed and all other variables. Standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

	Ln(monthly income)	Ever unemployed
	(1)	(2)
Horse	0.003	-0.017
	(0.032)	(0.014)
Horse*Male	0.034	0.008
	(0.045)	(0.015)
Gender fixed effects	Y	Y
Month of birth fixed effects	Y	Y
Quadratic age trends	Y	Y
Observations	13,745	12,401
R-squared	0.325	0.025

Table 7: Occupational Outcomes for Singaporeans Born in the Year of the Dragon

This table reports the effects on occupation for Singaporeans born in the year of the Dragon, using the difference-in-difference specification. The dependent variables in columns 1-3 are dichotomous indicators for whether the individual has ever been employed as a professional, ever been self-employed and other. Please refer to Appendix A1 for the definition of professional and all other variables. Standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

	(1) Professional	(2) Self-employed	(3) Others
Chinese Dragon	-0.034** (0.016)	0.010* (0.005)	0.025 (0.016)
Race and gender fixed effects	Y	Y	Y
Year and month of birth fixed effects	Y	Y	Y
Quadratic age trends	Y	Y	Y
Chinese*Quadratic age trends	Y	Y	Y
Observations	94,737	94,737	94,737
R-squared	0.026	0.013	0.030

Table 8: Educational Outcomes for Singaporeans Born in the Year of the Dragon

This table reports the effects on educational outcomes for Singaporeans born in the year of the Dragon, using the difference-in-difference specification. The dependent variable in column 1 is a dichotomous indicator for admission to either of the two main local universities. The dependent variable in columns 2-4 is a dichotomous indicator for admission to the top, middle and bottom third of departments respectively. The dependent variable in column 5 is applicant score, measured using the applicant's Z-score within the same application year and academic track. In all specifications, we control for academic track and the 1989-2003 university joint admission exercise. Please refer to Appendix A for the definition of all variables. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

	(1) Admitted	(2) Admitted to top third	(3) Admitted to middle third	(4) Admitted to bottom third	(5) Applicant score
Chinese Dragon	-0.023***	0.001	-0.008	-0.017***	-0.055***
	(0.008)	(0.006)	(0.008)	(0.006)	(0.019)
Race and gender fixed effects	Y	Y	Y	Y	Y
Year and month of birth fixed effects	Y	Y	Y	Y	Y
Quadratic admission year trends	Y	Y	Y	Y	Y
Chinese*Quadratic admission year trends	Y	Y	Y	Y	Y
Observations	466,235	466,235	466,235	466,235	466,235
R-squared	0.201	0.052	0.036	0.050	0.111

Table 9: Labor Market Outcomes by Educational Outcome

This table reports the effects on labor market outcomes for each cohort by college education. Panel A shows the results for Chinese Singaporeans only, and Panel B shows the results for non-Chinese Singaporeans only. The dependent variable in column 1 is the natural logarithm of monthly income in January 2014 Singapore dollars. The dependent variable in column 2 is a dichotomous indicator for whether the individual has ever been unemployed. Please refer to Appendix A for the definition of unemployed and all other variables. Standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

Panel A: Chinese		
	(1)	(2)
	Ln(monthly income)	Ever unemployed
Dragon	-0.070***	0.005
	(0.016)	(0.006)
Dragon*College	0.029	-0.011
	(0.023)	(0.008)
Gender and college fixed effects	Y	Y
Month of birth fixed effects	Y	Y
Quadratic age trends	Y	Y
Observations	48,981	44,267
R-squared	0.217	0.010
Panel B: Non-Chinese		
	Ln(monthly income)	Ever unemployed
Dragon	-0.057**	0.002
	(0.028)	(0.011)
Dragon*College	0.029	0.037*
	(0.052)	(0.022)
Gender and college fixed effects	Y	Y
Month of birth fixed effects	Y	Y
Quadratic age trends	Y	Y
Observations	7,180	6,560
R-squared	0.298	0.017

Table 10: Percentage Changes in Births and Labor Market Outcomes by Cohort

This table reports the effects on cohort size and labor market outcomes for each cohort born in the year of the Dragon. Panel A shows the difference-in-differences percentage change in number of monthly births in the year of the Dragon for the Chinese, compared to other races. Panel B shows the difference-in-difference results for labor market outcomes. The dependent variable in column 1 is the natural logarithm of monthly income in January 2014 Singapore dollars. The dependent variable in column 2 is a dichotomous indicator for whether the individual has ever been unemployed. Please refer to Appendix A for the definition of unemployed and all other variables. For Panel B, standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

Panel A: Percentage change in births

	(1) Ln(monthly births)
Chinese Dragon	-0.059 (0.052)
Chinese Dragon*1976 year	0.278*** (0.055)
Chinese Dragon*1988 year	0.171*** (0.059)
Chinese Dragon*2000 year	0.144** (0.060)
Race and gender fixed effects	Y
Dragon, year and month of birth fixed effects	Y
Quadratic year trends	Y
Chinese*Quadratic year trends	Y
Observations	4,608
R-squared	0.966

Panel B: Difference-in-differences in labor market outcomes

	(1) Ln(monthly income)	(2) Ever unemployed
Chinese Dragon	-0.012 (0.035)	-0.001 (0.009)
Chinese Dragon*1976 year	-0.013 (0.050)	-0.010 (0.015)
Chinese Dragon*1988 year	-0.170*** (0.054)	0.032 (0.029)
Race and gender fixed effects	Y	Y
Dragon, year and month of birth fixed effects	Y	Y
Quadratic age trends	Y	Y
Chinese*Quadratic age trends	Y	Y
Observations	104,080	94,737
R-squared	0.220	0.016

Table 11: Consumption and Other Outcomes for Singaporeans Born in Dragon Years

This table reports the effects on consumption and other outcomes for Singaporeans born in the year of the Dragon, using the difference-in-difference specification. Panel A shows the results for credit access, bankruptcy, private property holdings and probability of condo residence. The dependent variable in column 1 is the natural logarithm of average credit limit across all credit cards in January 2014 Singapore dollars. The dependent variable in column 2 is the probability of ever being involved in a bankruptcy case in court, coded as a dichotomous indicator multiplied by 100%. The dependent variable in columns 3 and 4 are the natural logarithm of total value of an individual's private residential property holdings in January 2014 Singapore dollars, and the probability of living in a private condominium, coded as a dichotomous indicator multiplied by 100%, respectively. Panel B shows the results for consumption. The dependent variable in column 1 is the ratio of average monthly spending to monthly income, while the dependent variables in column 2-3 are the ratios of average conspicuous and non-conspicuous consumption respectively to monthly income. Please refer to Appendix A1 for the definition of credit limit and all other variables. For all results except for probability of condo residence, standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

Panel A: Credit access, bankruptcy, property ownership and condo residence

	(1)	(2)	(3)	(4)
	Ln(credit limit)	Probability of bankruptcy (%)	Ln(private property holdings)	Probability of condo residence (%)
Chinese Dragon	-0.088***	0.214	0.028	0.453**
	(0.025)	(0.154)	(0.031)	(0.181)
Race and gender fixed effects	Y	Y	Y	Y
Year and month of birth fixed effects	Y	Y	Y	Y
Quadratic age trends	Y	N	N	N
Chinese*Quadratic age trends	Y	N	N	N
Quadratic year of birth trends	N	Y	Y	Y
Chinese*Quadratic year of birth trends	N	Y	Y	Y
Observations	95,903	998,368	65,716	1,381,550
R-squared	0.309	0.011	0.012	0.018

Panel B: Consumption behavior

	(1)	(2)	(3)
	Ratio of consumption to income	Ratio of conspicuous consumption to income	Ratio of other consumption to income
Chinese Dragon	0.058***	0.017*	0.041***
	(0.020)	(0.010)	(0.012)
Race and gender fixed effects	Y	Y	Y
Year and month of birth fixed effects	Y	Y	Y
Quadratic age trends	Y	Y	Y
Chinese*Quadratic age trends	Y	Y	Y
Quadratic age trends	Y	Y	Y
Observations	104,075	104,076	104,022
R-squared	0.026	0.025	0.021

Online Appendix

(Not Intended for Publication)

Appendix IA.1: Singaporean Job Advertisements for Language Speakers

Prior to 2013, the Singaporean government provided public fair employment practices guidelines but did not impose legal penalties on employers who practised racial discrimination in hiring. In 2013, the Ministry of Manpower required companies found to have posted discriminatory job advertisements to put online public apologies for 30 days, and barred them from hiring foreign workers for six months at the end of the 30 days (Ministry of Manpower 2017, http://www.mom.gov.sg/newsroom/press-releases/2013/mom-takes-action-against-15-more-companies-for-discriminatory-job-advertisements). Under the Tripartite Alliance for Fair Employment Practices (TAFEP) guidelines, employers should not cite racial preferences but may specify proficiency in a particular language as a relevant qualification if a job-related reason is provided (TAFEP 2014, https://www.tafep.sg/sites/default/files/Publications%20-%20Tripartite%20Guidelines%20on%20Fair%20Employment%20Practices%20%28English%29%20as%20of%20March%202014_1.pdf).

Below, we provide five examples of job advertisements requiring specific language skills, showing potential racial segmentation of the labor market. All examples are taken from two local job search sites, https://www.indeed.com.sg and http://www.stjobs.sg, and were posted within 30 days of 1 March 2017.

Example 1

Membership Officer
[redacted]
Handle membership-related matters e.g. queries, processing of membership applications and refunds
- Collate reports and involvement in other administrative duties
- Provide administrative support for [redacted] activities and events for members
- Sourcing of new merchant and club tie-ups
- Assist in the execution of membership recruitment programs

Job Requirements:
- Candidate must possess at least a diploma/ advanced graduate diploma/ post graduate /Bachelor's Degree/professional degree/marketing/business/
- mass communications or equivalent
- Bilingual in English and Chinese (to liaise with Chinese speaking associates)
- Customer-service oriented and enjoys meeting people
- Independent, self-motivated, with a desire to learn
- Applicants must be willing to work in [redacted]
- Entry level applicants are welcomed
- Singaporeans are encouraged to apply

Example 2

Account Executive
[redacted] Pte Ltd - Singapore
Job Description:
- Perform day to day accounting functions and full set of account.
- Assist in claims and finance related matters.
- Monitor and record payment response.
- Handle invoice, purchase order, delivery order.
- Provide business operational support and general office administrative assistance.
- Able to undertake any other tasks given by Director and Supervisor

Requirements: Job Requirments:
- Diploma in Accounting/LCCI/ACCA or equivalent
- 2 years relevant working experience
- Positive working attitude and keen to learn
- Ability to multi-task and work independently
- Proficient in MS Office, MYOB preferred
- Bilingual English and Mandarin (able to liaise with Chinese speaking clients)
- Working Location: [redacted]

Example 3

Assistant Director, [redacted]
QUALIFICATIONS

- Post-graduate degree with at least 8 years' of relevant work experience, preferably including professional experience in higher education, preferably [redacted]
- Results-oriented and bottom-line driven
- Able to set and meet enrolment targets
- Excellent communication (written & spoken) and interpersonal skills, with the ability to speak to large crowds
- Proficient in the Chinese language, both written and spoken so as to liaise with Chinese-speaking coutnerparties
- Ability to build relationships and interact well with faculty, staff, students, alumni, corporate sponsors, and parents
- Able to both work independently and as a team player
- Strong planning and organisational skills
- Able to analyze data, quantify results and manage budget/P&L
- Able to travel
- Experience in managing educational programmes with partners from China is an advantage

Example 4

TEACHER/ PRINCIPAL
[redacted] **KINDERGARTEN**
Kindergarten needs
Qualified TEACHER/ PRINCIPAL
* DECCE-T/ L/ CECCE
* 5-day week.
* Singaporean only
* Liaise with Malay speaking students
Call: [redacted]

Example 5

Litigation Secretary
[redacted] - [redacted] Singapore
Junior Litigation & Litigation Secretary (2 positions available)
Responsibilities:

- Provides secretarial and administrative support to our lawyers
- Handle full range of litigation/court matters including E-filing of court documents via E-litigation
- Any ad-hoc duties assigned

Requirements:

- Good command of the English, Tamil and/or Mandarin Language (Spoken & Written) as need to liaise with Tamil & Mandarin speaking clients
- Quick and accurate typing speed
- Proficient in Microsoft Word

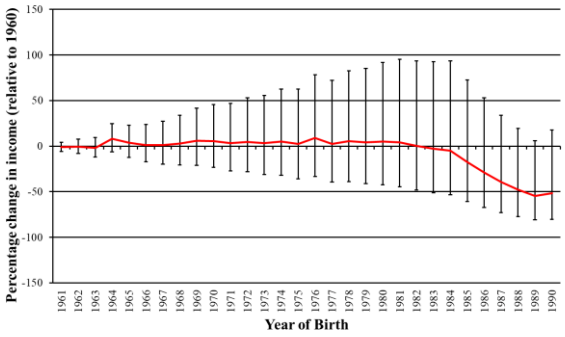
Interested candidates are invited to apply online stating your current and expected salary and date of availability to us.
We regret that only shortlisted candidates will be notified.
Thank you for your application.
Required languages:

- English
- Mandarin

Figure IA.1 Year of Birth and Age Effects

This figure shows year of birth and age effects on income (as well as the 95% confidence intervals), as estimated in Table 3, controlling for race, gender, month of birth and Chinese Dragon fixed effects. Panel A presents year of birth fixed effects in terms of percentage differences relative to individuals born in 1960. Panel B presents the marginal effect of quadratic age terms on income for Chinese and non-Chinese Singaporeans respectively (income scaled to be 100 for non-Chinese at age 20). The other co-variates are evaluated at the sample mean. All values are winsorized for the top and bottom 1% to remove outliers and adjusted to January 2014 Singapore dollars. Please refer to Appendix A1 for a detailed explanation of the income measure.

Panel A: Year of birth fixed effects



Panel B: Chinese and Non-Chinese quadratic age effects

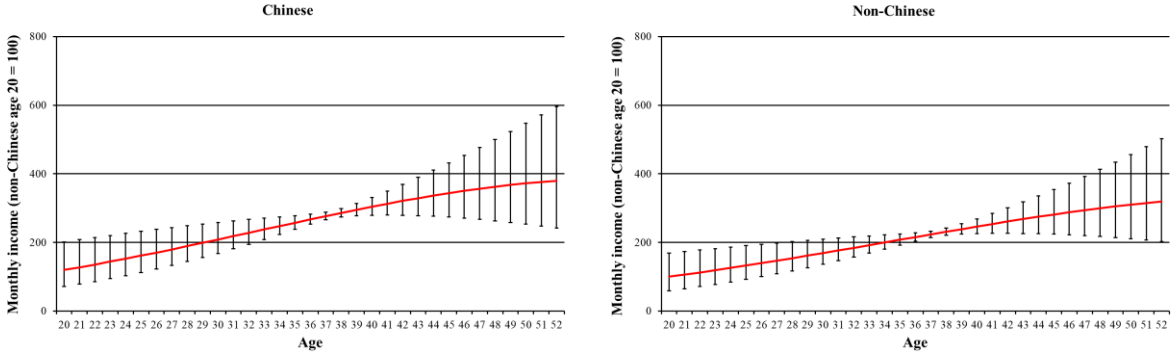


Table IA.1: Labor Market Outcomes for Chinese Born in the Year of the Horse, by Marital Status

This table reports the difference-in-differences results for labor market outcomes for Chinese Singaporeans born in the year of the Horse by marital status, using the difference-in-difference specification. Panel A shows the results for ever-married Singaporeans, and Panel B shows the results for never-married Singaporeans. The dependent variable in column 1 is the natural logarithm of monthly income in January 2014 Singapore dollars. The dependent variable in column 2 is a dichotomous indicator for whether the individual has ever been unemployed. Please refer to Appendix A for the definition of unemployed and all other variables. Standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

Panel A: Ever-married Singaporeans		
	(1)	(2)
	Ln(monthly income)	Ever unemployed
Chinese Horse	-0.031	0.014
	(0.037)	(0.012)
Chinese Horse*Male	0.018	-0.002
	(0.028)	(0.009)
Race and gender fixed effects	Y	Y
Horse, year and month of birth fixed effects	Y	Y
Quadratic age trends	Y	Y
Chinese*Quadratic age trends	Y	Y
Observations	42,900	42,524
R-squared	0.084	0.040
Panel B: Never-married Singaporeans		
	(1)	(2)
	Ln(monthly income)	Ever unemployed
Chinese Horse	-0.136**	0.013
	(0.054)	(0.016)
Chinese Horse*Male	0.080**	-0.010
	(0.033)	(0.010)
Race and gender fixed effects	Y	Y
Horse, year and month of birth fixed effects	Y	Y
Quadratic age trends	Y	Y
Chinese*Quadratic age trends	Y	Y
Observations	33,214	30,226
R-squared	0.268	0.014

Table IA.2: Educational Outcomes for Singaporeans Born in the Year of the Horse

This table reports the effects on educational outcomes for Singaporean men and women born in the year of the Horse, using the difference-in-differences specification. The dependent variable in column 1 is a dichotomous indicator for admission to either of the two main local universities. The dependent variable in column 2 is applicant score, measured using the applicant's Z-score within the same application year and academic track. In all specifications, we control for academic track and the 1989-2003 university joint admission exercise. Please refer to Appendix A for the definition of all variables. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

	(1) Admitted	(2) Applicant score
Chinese Horse	-0.000	-0.001
	(0.008)	(0.021)
Chinese Horse*Male	-0.015	-0.026
	(0.010)	(0.016)
Race and gender fixed effects	Y	Y
Year and month of birth fixed effects	Y	Y
Quadratic admission year trends	Y	Y
Chinese*Quadratic admission year trends	Y	Y
Observations	466,235	466,235
R-squared	0.201	0.111

Table IA.3: Number of Teachers and Student-Teacher Ratio by Cohort Zodiac Sign

This table reports effects on educational resources for Singaporeans. Panel A displays average number of teachers and student-teacher ratios in primary and secondary school during years attended by Singaporeans born in the year of the Dragon and by Singaporeans born in other cohorts. Panel B reports regression results, controlling for quadratic year trends. All figures are based on aggregate annual administrative data for Singapore from 1985 to 2007. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

Panel A: Average no. of teachers and student-teacher ratio

	(1)	(2)	(3)	(4)
	Primary school		*Secondary school*	
	Average no. of teachers	Student-teacher ratio	Average no. of teachers	Student-teacher ratio
Dragon	10,827	25.66	9,030	20.09
Non-Dragon	11,193	24.72	8,733	20.68
N	23	23	23	23

Panel B: Regression results, controlling for quadratic year trends

	(1)	(2)	(3)	(4)
	Primary school		*Secondary school*	
	Ln(Average no. of teachers)	Student-teacher ratio	Ln(Average no. of teachers)	Student-teacher ratio
Dragon	0.002	0.637	0.021	-0.480*
	(0.013)	(0.375)	(0.020)	(0.252)
Quadratic year trends	Y	Y	Y	Y
Observations	23	23	23	23
R-squared	0.886	0.827	0.919	0.799

Table IA.4: Educational Outcomes, Controlling for Applicant Scores

This table reports the effects on educational outcomes for Singaporeans born in the Dragon years using the difference-in-difference specification, after controlling for applicant scores. Applicant scores are measured as Z-scores within the same application year and academic track. The dependent variable in column 1 is a dichotomous indicator for admission to either of the two main local universities. The dependent variable in columns 2-4 is a dichotomous indicator for admission to the top, middle and bottom third of departments respectively. In all specifications, we control for academic track and the 1989-2003 university joint admission exercise. Please refer to Appendix A for the definition of all variables. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

	(1) Admitted	(2) Admitted to top third	(3) Admitted to middle third	(4) Admitted to bottom third
Chinese Dragon	-0.006	0.012**	-0.004	-0.015**
	(0.007)	(0.005)	(0.008)	(0.006)
Race and gender fixed effects	Y	Y	Y	Y
Year and month of birth fixed effects	Y	Y	Y	Y
Quadratic admission year trends	Y	Y	Y	Y
Chinese*Quadratic admission year trends	Y	Y	Y	Y
Observations	466,235	466,235	466,235	466,235
R-squared	0.558	0.272	0.073	0.056

Table IA.5: Discontinuities in Monthly Births around the Year of the Dragon

This table reports the difference-in-differences percentage change in number of monthly births surrounding the beginning and end of the year of the Dragon for the Chinese, compared to other races. The dependent variable in all columns is the natural logarithm of monthly births. Please refer to Appendix A for the definition of all other variables. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

	(1) Ln(monthly births)
Chinese Dragon	0.098*** (0.019)
Chinese Dragon calendar year * January (last month of lunar Rabbit year)	-0.106*** (0.038)
Chinese Dragon calendar year * February (first month of lunar Dragon year)	-0.008 (0.033)
Chinese Snake	-0.011 (0.018)
Chinese Snake calendar year * January (last month of lunar Dragon year)	0.090*** (0.027)
Chinese Snake calendar year * February (first month of lunar Snake year)	0.031 (0.028)
Race and gender fixed effects	Y
Dragon, Snake, year and month of birth fixed effects	Y
Quadratic year trends	Y
Chinese*Quadratic year trends	Y
Observations	4,608
R-squared	0.966

Table IA.6: Percentage Increase in Births in Dragon Years Based on Lunar Calendar

This table reports the difference-in-differences percentage change in number of monthly births in the year of the Dragon for the Chinese born between 1960 and 2007, compared to other races, based on the lunar calendar rather than the Julian calendar. The dependent variable in all columns is the natural logarithm of monthly births. Please refer to Appendix A for the definition of all other variables. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

	(1)	(2)	(3)	(4)
	Ln(monthly births)			
Chinese Dragon	0.127***	0.127***	0.097***	0.097***
	(0.025)	(0.025)	(0.023)	(0.018)
Dragon	-0.003		0.015	
	(0.020)		(0.018)	
Constant	4.218***	4.251***	1,752***	1.315
	(0.013)	(0.134)	(128.360)	(2.845)
Gender fixed effects	Y	Y	Y	Y
Race fixed effects	Y	Y	Y	Y
Year and month of birth fixed effects	N	Y	N	Y
Quadratic year trends	N	N	Y	Y
Chinese*Quadratic year trends	N	N	Y	Y
Observations	4,608	4,608	4,608	4,608
R-squared	0.940	0.957	0.953	0.966

Table IA.7: Labor Market and Educational Outcomes Based on Lunar Calendar

This table reports the difference-in-differences effects on labor market and educational outcomes for Singaporeans born in the year of the Dragon, based on the lunar calendar rather than the Julian calendar. Panel A shows the effects on labor market outcomes. The dependent variable in column 1 is the natural logarithm of monthly income in January 2014 Singapore dollars. The dependent variable in column 2 is a dichotomous indicator for whether the individual has ever been unemployed. Panel B shows the effects on educational outcomes. The dependent variable in column 1 is a dichotomous indicator for admission to either of the two main local universities. The dependent variable in columns 2-4 is a dichotomous indicator for admission to the top, middle and bottom third of departments respectively. The dependent variable in column 5 is applicant score, measured using the applicant's Z-score within the same application year and academic track. For Panel B, in all specifications, we control for academic track and the 1989-2003 university joint admission exercise. Please refer to Appendix A for the definition of all variables. For Panel A, standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

Panel A: Labor market outcomes	(1) Ln(monthly income)	(2) Ever unemployed
Chinese Dragon	-0.058*** (0.021)	0.002 (0.008)
Race and gender fixed effects	Y	Y
Year and month of birth fixed effects	Y	Y
Quadratic admission year trends	Y	Y
Chinese*Quadratic admission year trends	Y	Y
Observations	103,846	94,516
R-squared	0.219	0.016

Panel B: Educational outcomes	(1) Admitted	(2) Admitted to top third	(3) Admitted to middle third	(4) Admitted to bottom third	(5) Applicant score
Chinese Dragon	-0.022*** (0.008)	0.003 (0.006)	-0.011 (0.008)	-0.014** (0.006)	-0.051*** (0.018)
Race and gender fixed effects	Y	Y	Y	Y	Y
Year and month of birth fixed effects	Y	Y	Y	Y	Y
Quadratic admission year trends	Y	Y	Y	Y	Y
Chinese*Quadratic admission year trends	Y	Y	Y	Y	Y
Observations	466,235	466,235	466,235	466,235	466,235
R-squared	0.201	0.051	0.036	0.050	0.111

Table IA.8: Labor Market Outcomes for Singaporeans Born in the Year of the Dragon When the Sample is Restricted to Surrounding Cohorts

This table reports the difference-in-differences results on labor market outcomes for Singaporeans born in the year of the Dragon when the sample is restricted to birth cohorts born within three years of the year, i.e. Singaporeans born in 1973-1979 and 1985-1991 only. The dependent variable in column 1 is the natural logarithm of monthly income in January 2014 Singapore dollars. The dependent variable in column 2 is a dichotomous indicator for whether the individual has ever been unemployed. Please refer to Appendix A1 for the definition of unemployed and all other variables. Standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

	(1) Ln(monthly income)	(2) Ever unemployed
Chinese Dragon	-0.059**	-0.003
	(0.028)	(0.012)
Race and gender fixed effects	Y	Y
Year and month of birth fixed effects	Y	Y
Quadratic age trends	Y	Y
Chinese*Quadratic age trends	Y	Y
Observations	38,425	33,486
R-squared	0.301	0.011

Table IA.9: Percentage Changes in Births and Labor Market Outcomes by Gender

This table reports the effects on cohort size and labor market outcomes for men and women born in the year of the Dragon. Panel A shows the difference-in-differences percentage change in number of monthly births in the year of the Dragon for the Chinese, compared to other races. Panel B shows the difference-in-difference results for labor market outcomes. The dependent variable in column 1 is the natural logarithm of monthly income in January 2014 Singapore dollars. The dependent variable in column 2 is a dichotomous indicator for whether the individual has ever been unemployed. Please refer to Appendix A for the definition of unemployed and all other variables. For Panel B, standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

Panel A: Percentage change in births

	(1) Ln(monthly births)
Chinese Dragon	0.085*** (0.022)
Chinese Dragon*Male	0.008 (0.022)
Race and gender fixed effects	Y
Dragon, year and month of birth fixed effects	Y
Quadratic year trends	Y
Chinese*Quadratic year trends	Y
Observations	4,608
R-squared	0.966

Panel B: Difference-in-differences in labor market outcomes

	(1) Ln(monthly income)	(2) Ever unemployed
Chinese Dragon	-0.058*** (0.022)	-0.001 (0.009)
Chinese Dragon*Male	-0.007 (0.017)	0.002 (0.006)
Race and gender fixed effects	Y	Y
Dragon, year and month of birth fixed effects	Y	Y
Quadratic age trends	Y	Y
Chinese*Quadratic age trends	Y	Y
Observations	104,080	94,737
R-squared	0.220	0.016

Table IA.10: Percentage Changes in Births and Labor Market Outcomes for Singaporeans Born in the Year of the Tiger

This table reports the effects on cohort size and labor market outcomes for Singaporeans born in the year of the Tiger. Panel A shows the difference-in-differences percentage change in number of monthly births in the year of the Tiger for the Chinese, compared to other races. Panel B shows the difference-in-difference results for labor market outcomes. The dependent variable in column 1 is the natural logarithm of monthly income in January 2014 Singapore dollars. The dependent variable in column 2 is a dichotomous indicator for whether the individual has ever been unemployed. Please refer to Appendix A1 for the definition of unemployed and all other variables. For Panel B, standard errors are clustered by postal code. ***, **, and * correspond to statistical significance at 1%, 5% and 10% level respectively.

Panel A: Percentage change in births

	(1) Ln(monthly births)
Chinese Tiger	-0.081*** (0.021)
Chinese Tiger*Male	0.011 (0.022)
Race and gender fixed effects	Y
Tiger, year and month of birth fixed effects	Y
Quadratic year trends	Y
Chinese*Quadratic year trends	Y
Observations	4,608
R-squared	0.965

Panel B: Difference-in-differences in labor market outcomes

	(2) Ln(monthly income)	(3) Ever unemployed
Chinese Tiger	0.019 (0.023)	-0.002 (0.009)
Chinese Tiger*Male	-0.021 (0.018)	-0.004 (0.006)
Race and gender fixed effects	Y	Y
Tiger, year and month fixed effects	Y	Y
Quadratic age trends	Y	Y
Chinese*Quadratic age trends	Y	Y
Observations	104,080	94,737
R-squared	0.220	0.016