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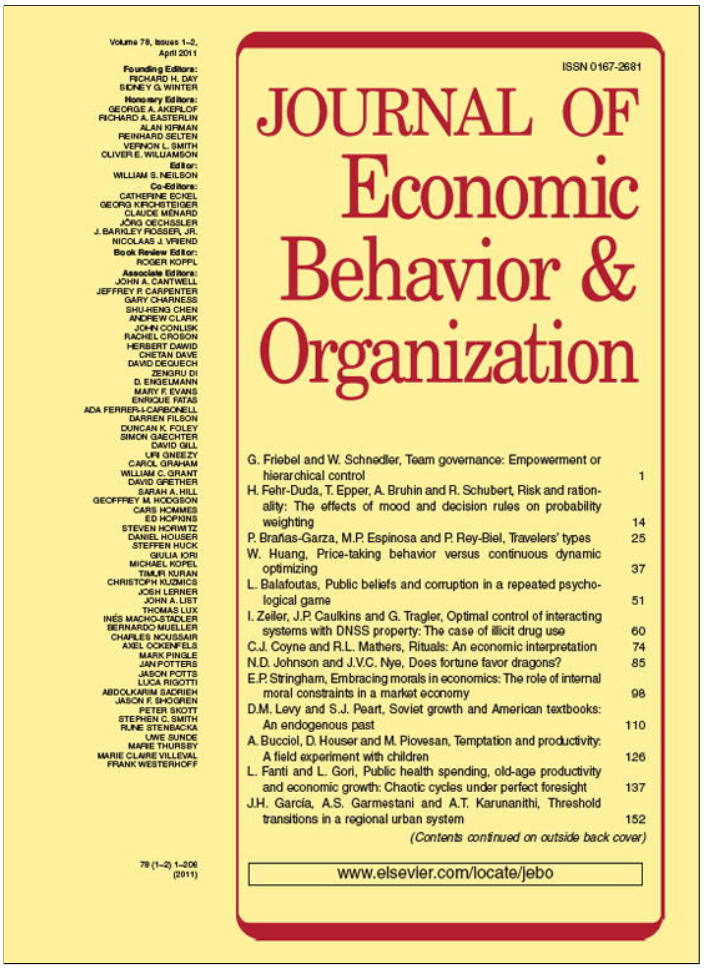

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# Does fortune favor dragons?

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ABSTRACT

Why do seemingly irrational superstitions persist? We analyze the widely held belief among Asians that children born in the Year of the dragon are superior. We use pooled cross section data from the U.S. Current Population Survey to show that Asian immigrants to the United States born in the 1976 year of the dragon are more educated than comparable immigrants from non-dragon years. In contrast, no such educational effect is noticeable for dragon-year children in the general U.S. population. We also provide evidence that Asian mothers of dragon year babies are more educated, richer, and slightly older than Asian mothers of non-dragon year children. This suggests that belief in the greater superiority of dragon-year children is self-fulfilling since the demographic characteristics associated with parents who are more willing and able to adjust their birthing strategies to have dragon children are also correlated with greater investment in their human capital.

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Why do seemingly irrational superstitious beliefs form and persist? To what extent do strong cultural beliefs translate into observable behavior? And how do superstitions about luck and success translate into performance in foreign environments that do not share these beliefs?

Many East Asians, especially ethnic Chinese, have long believed that children born in the Year of the dragon (which comes once every 12 years in the eastern lunar calendar) were especially fortunate, are likely to do well in school, and generally have a better life. Despite this belief, there was no noticeable increase in birth rates among Asian populations in most dragon years before 1976. However demographers began to notice a sizeable boost in births among nations with large ethnic Chinese populations, such as Taiwan, Hong Kong, and Singapore (though not in mainland China) beginning in 1976 and again in 1988 (e.g. Goodkind, 1991). Taiwan showed the most marked effects with an increase in births of 15.5% in 1976 compared to the previous year. This also coincided with a period of rising prosperity, lower average birth rates, and improved access to family planning, suggesting that the capacity to indulge these beliefs has become stronger with modernization.

The demographic spike in 1976 was sufficiently large that governments decided to issue warnings in 1987 against having babies in dragon years because of the problems they caused for the educational system, particularly with respect to finding teachers and classroom space. Editorials were issued that claimed no special luck or intelligence for dragon babies and a government program in Taiwan was designed to alert parents to the special problems faced by children born in an unusually large cohort (Goodkind, 1991, p. 677 cites multiple newspaper accounts of this). Nonetheless, in 1988 there was

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a pronounced fertility jump in Taiwan and Hong Kong and much larger increases among ethnic Chinese living in Singapore and Peninsular Malaysia. Given the costs associated with child planning (Cigno and Ermisch, 1989), why did these people make the counterproductive and seemingly irrational decision to adjust their birthing strategies to have children in a dragon year? Furthermore, if these beliefs are irrational, why do they persist?

There is ample evidence that Asian families adjust their fertility in response to the Chinese Zodiac.[1] Despite these established fertility trends, however, there is less work on the outcomes of children born in fortuitous or non-fortuitous years. Akabayashi (2006) finds that Japanese women born in the unfortuitous 1966 Fire Horse year had more difficulty finding a spouse. Do and Phung (2009) find that Vietnamese children born in fortuitous months have more schooling relative to their siblings. Similar to what we will conclude about Asians living in the United States, they interpret this as evidence for the "wantedness" of a child leading to better outcomes. Wong and Yung (2005) use 1991 and 1996 Hong Kong Census data to ask whether or not children born in the year of the dragon earn higher incomes and find that they do not.

A potentially serious obstacle to identifying the effect of being born in a fortuitous dragon year on outcome is the possibility that "dragon" and "non-dragon" cohorts differ in ways that are difficult to observe or measure. We hope to minimize this bias by comparing Asian immigrants, who believe in the dragon superstition, to non-Asian immigrants who do not in a differences-in-differences framework. To the extent that unobservable factors (such as the business cycle) affect the educational outcomes of Asian and non-Asian immigrants alike, our framework will provide unbiased estimates of the effect of being born in a dragon year on Asians.

Our first main finding is that Asians who decide to alter their child birth timing to coincide with dragon years may simply be responding to evidence that individuals born in dragon years *are* more fortuitous than those born in non-dragon years. We support this claim using pooled cross section data on the educational outcomes of Asian immigrants living in the United States drawn from the 2000, 2002, 2004, 2006, and 2008 Current Population Surveys of the U.S. Census. By using pooled cross section data, we are able to break the perfect collinearity between year of birth and age, and therefore arrive at unbiased estimates of the effect of year of birth on outcome. We begin by comparing the educational attainment of Asian-Americans to non-Asian Americans born in dragon and non-dragon years. We find that Asian-Americans born in dragon years have about a third of a year more education, on average, than non-dragon year Asians. When we narrow our control group to just immigrants, the size of the dragon year effect on Asians increases to half a year of education.

One unfortunate consequence of using the pooled cross section data is that sample sizes are not large enough to focus on specific sub-groups of the Asian population which have been identified by demographers and sociologists as particularly susceptible to the dragon year superstition. Therefore, as a robustness check, we also use cross-sectional data from the 1% Public Use Microdata Sample of the 2000 U.S. Census to investigate the effect of the dragon year specifically on bachelors degree attainment in the Taiwanese U.S. immigrant sub-population. Using this larger data set we find that a Taiwanese-American born in the 1976 dragon year is about 6% more likely to hold a bachelors degree than a non-Taiwanese Asian-American also born in 1976.

Our second main finding is that Asian-American dragons experience good fortune because they have good parents. Using data on fertility from the 1998, 2000, 2002, 2004, 2006, and 2008 Current Population Surveys, we show that Asian mothers of children born in the 1988 or 2000 dragon years are more educated, richer, and older, than non-Asian mothers of dragon year babies. These differences are especially strong for mothers with only one child. We infer from this that the positive educational and economic outcomes associated with being a dragon child are due to the disproportionate self-selection of parents who are more likely to invest in their children into the dragon birth year cohort. Thus, the dragon year superstition is an example of a self-sustaining cultural institution. Those Parents more able to adjust their birthing strategies to have a dragon child also have characteristics correlated with greater investment in children. When these greater investments result in disproportionate success for dragon cohorts, this visible evidence of "fortune; reinforces the desire of parents to have a dragon child. While we do not claim that the positive feedback from dragon child outcomes to future parents is *sufficient* to generate the belief in the dragon birth year tradition, we do argue that positive feedback is, at the very least, *necessary* in order for the superstitious belief to persist. In the conclusion we contrast our story that irrational beliefs are reinforced because of positive feedback due to selection bias with other explanations of superstitious belief which rely on negative feedback being too weak to alter behavior.

## 1. Background on Chinese zodiac and the dragon year fertility spike

In the Chinese zodiac, the dragon appears once every 12 years. It is the only mythical creature in the zodiac and is a symbol of good fortune, power, and wealth. Individuals from "Confucian" cultures (e.g. Chinese, Vietnamese, Korean, and Japanese) spread throughout countries in Asia believe that this year is an auspicious time for business, marriage, and birth. In particular, children born in dragon years are thought to be luckier, brighter, stronger, and more likely to flourish than those born in any other year (cf. Goodkind, 1991; Vere, 2008).

[1] For evidence from Taiwan, Hong Kong, Malaysia, Singapore, Thailand see Goodkind (1991). For Japan see Aso (1978) and Kurosu (1992); For South Korea Park and Cho (1995).

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There is no evidence of a pronounced preference for births in dragon years before 1976 and, even after 1976, there is no evidence for a dragon year fertility spike in the People's Republic of China.[2] Scholars speculate that it is only with the rise of contraceptive availability that the birth year preference could manifest itself (Goodkind, 1991, p. 664). An alternative explanation would be a story based on Becker and Lewis (1973) in which children are inferior goods, but child quality is a normal good. Then, as incomes rose in eastern cultures, having a dragon child would be a relatively low cost means of increasing "quality".

For whatever reason, birth rates spiked in 1976 and 1988 in Taiwan, Hong Kong, Singapore, and among ethnic Chinese populations in Malaysia and other parts of Asia. It is especially interesting that this effect became prominent as general fertility rates fell and incomes rose. Of all the countries, Taiwan experienced the effect most pointedly with a 15.5% birth rate rise in 1976 and a 7.6 rise in 1988 when compared to the previous years (and in decades when the overall fertility trend was downward).[3] Taiwan was the only country in the group that was virtually completely composed of ethnic Chinese who were unconstrained by government policy regarding fertility.[4] In contrast there is no evidence that Asian populations which do not use the lunar calendar/Chinese zodiac such as India had any dragon birth year preferences in 1976 or 1988 (Goodkind, 1991).

The sudden spike in births in 1976 caused a great deal of concern for the Ministry of Education in Taiwan which had great difficulty accommodating the large cohort. As a result the state-owned news media in Taiwan engaged in a campaign to actively discourage excess births starting in 1987, stressing the difficulties the children caused both for the state and for the children themselves, who suffer from greater competition for places in school and university. Although the campaign may have had some effect, enough people maintained their strong preferences that Taiwanese birth rates were still up in 1988 relative to the previous year. Thus, despite claims by the government that dragon year babies were likely to be handicapped by cohort size, enough parents believed in the benefits of dragon year birth the population bulge still emerged, with even larger spikes among the Chinese populations of Singapore and Malaysia (25.9 and 24% respectively). Indeed, the year 2000 saw another birth spike in these countries roughly comparable to 1988 (Moi, 2001). But did fortune favor the dragons?

## 2. Data and identification strategy

Our goal is to measure the causal effect of being born in a dragon year on life outcomes. We choose to look at the outcomes of Asian immigrants living in the United States.[5] There are three reasons for this choice: first, we want to minimize potential crowding effects that may occur in a country like Taiwan where, for example, in the 1976 dragon year there were significantly more dragons born. Consistent with the advice being given by the Taiwanese government in the months leading up to 1976, this may have been enough to reduce school performance through its effect on class sizes or crowd the labor markets after graduation.[6] In the United States there are unlikely to be any crowding effects since the majority of the population does not believe in the dragon year superstition.

The second reason we use data on Asian immigrants to the United States is because this provides us with a ready-made identification strategy. We use the subset of Asian immigrants who are most likely to believe in the dragon superstition as our treatment group, non-Asians as our control group, and interpret individuals who are born in the 1976 dragon year as being treated. We then adopt a differences-in-differences regression strategy to identify the causal effect of being born in a dragon year on the relative educational outcomes of Asians relative to non-Asians.

Lastly, there is evidence that superstitions surrounding birth year and fortune are retained by Asian immigrants after they immigrate to the United States. For example, Goodkind and Goyette (1997) use to data from the 1990 Census to show that individuals with Asian ancestry were about 12% more likely to have a child in 1988 relative to the surrounding two years. This effect increased in strength if the individual was not born in Mainland China and if they did not speak English fluently. Furthermore, consistent with what we will argue below, they find that the fertility of Asians in 1988 increased with education of the mother. While not directly relevant to the dragon year superstitution, Kaku and Matsumoto (1975) find evidence that people of Japanese ancestry living in Hawaii and California similarly adjusted their fertility during the negative 1966 year of the Fire Horse.

[2] The lack of a dragon year fertility spike in Mainland China is often attributed to the draconian fertility policies that were implemented beginning in 1962 as a response by the government to the high mortility experienced during the Great Leap Forward (which was interpreted as a Malthusian check). This state implemented birth control policy was continued with the One and Two Child policies. Arthur Wolf (1986, p. 105) argues that, after 1970, Mainland China experienced, "... the most dramatic decline in fertility ever experienced by a human population during a period of relative peace and prosperity."

[3] The comparable numbers for the ethnic Chinese population in Singapore and for Hong Kong were respectively an increase of 8.3% and a decrease of 2.1% in 1976 and an increase of 25.9% and 5.8% in 1988 (Goodkind, 1991, p. 667). Sun et al. (1978) also find significant increases in births in 1976 in Taiwan, even after controlling for changes to the population age structure.

[4] The population of Taiwan is composed of approximately 98% of Hoklo, Hakka, and Mainland Chinese (post 1945) populations which all arrived from the Mainland at some point and 2% aboriginal population.

[5] In order to better isolate the Dragon birth year effect, we have chosen to look at a subsample of Asian immigrants that exclude several of the largest immigrant groups with no observed home country dragon effect, in particular, India, Pakistan, Burma, the Philippines, and mainland China. Hence, the term Asian in our samples excludes Asian-Americans from these countries. We exclude immigrants from Mainland China because of the effects of official fertility policies imposed by the state. This is examined in more detail in Section 5 below.

[6] For evidence that smaller class sizes can lead to better educational outcomes, see Angrist and Lavy (1999); For evidence that larger birth cohorts experience decreases in wages, see Berger (1985).

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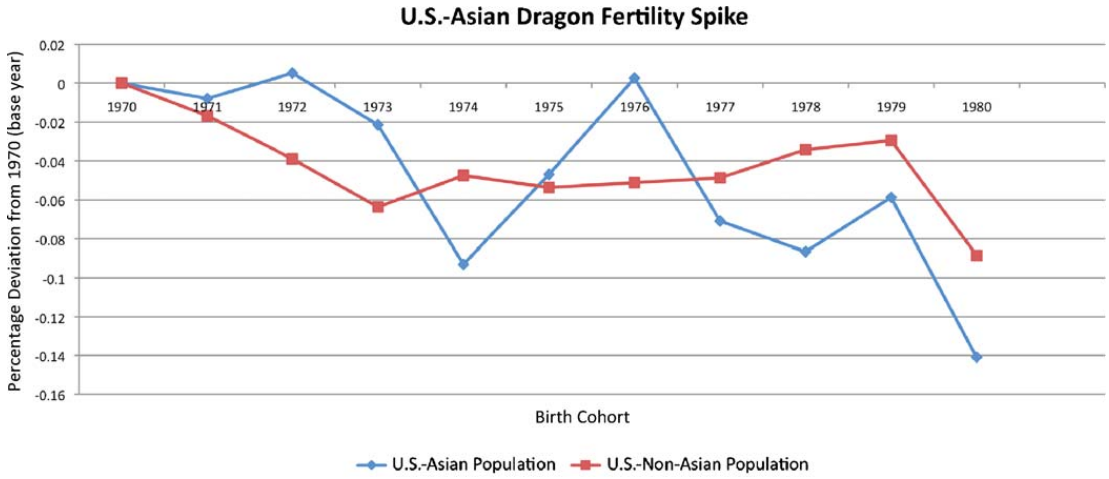


**Fig. 1.** U.S. vs. Asian dragon fertility spike.

In Fig. 1 we confirm the findings of these authors using our own data drawn from the 2000, 2002, 2004, 2006, and 2008 Current Population Surveys. The figure plots the yearly percentage deviation of birth cohort size from the base year of 1970 for Asians and non-Asians living in the United States. There is a noticeable spike in births during the 1976 dragon year of about 5% relative to the previous year. By contrast, there is no spike whatsoever in the non-Asian population. This is strong evidence that Asian families living in the United States also attempt to time births in conjunction with the Zodiac. The question is, are these Asian dragon children any different from other cohorts?

The fact that the dragon year effect did not start showing up in fertility data in Taiwan, Singapore, and Malaysia until 1976, combined with our use of the Current Population Survey data, place restrictions on the outcome variables we can use to answer this query. We use CPS data from 2000 to 2008 and, thus, have dragons in our sample that range in age from 23 to 31 (depending on when they fill out the survey relative to their birth year). Given the fact that a 1976 dragon would be only 23 when answering the questions for the November 2000 CPS (in 1999), it is unlikely that, say, divorce rates or health outcomes, would be an informative measure of the well being of dragons. For this reason, we ultimately chose to focus on educational attainment, since most individuals are typically finished with school by their early twenties.

In addition to the outcome data constructed from the November Current Population Survey, we construct two additional data sets. The second data set contains variables on the educational outcomes of Asian dragons and non-dragons pulled from the Public Use Microdata 1% Sample of the 2000 Decennial Census. The 2000 Census contains a sufficient number of observations that we can check the robustness of our main results from the pooled cross section data using a more well defined sample (Taiwanese Immigrants compared to Non-Taiwanese Asian Immigrants) and a more precise measure of educational attainment (Bachelors degree attainment). This comes at the cost of having much younger 1976 dragons in the sample (they are all either 22 or 23 at the time of the survey (in 1999) which introduces potential bias into our coefficient estimates. Nonetheless, the results from the 2000 Census broadly support the results we find using the smaller sample provided by the CPS. We call the cross sectional Census data set the "2000 Census Data".

The third data set contains pooled cross sectional data pulled from the 1998, 2000, 2002, 2004, 2006, and 2008 June Supplements to the Current Population Survey of the U.S. Census. The June supplements contain questions concerning fertility along with the usual demographic information of respondents. We can, thus, use these surveys to describe the family backgrounds of the dragon children we discuss using the 2000 Census Data.[7] We call this data set the "Mothers Data".

Our main results are based on the pooled cross section data on outcomes which we use to estimate differences-in-differences regressions for two different treatment and control groups. First, we define our treatment group as those who report their ethnicity as "Asian" minus individuals who report their country of origin as India, Pakistan, Burma, the Philippines, or Mainland China.[8] We compare these individuals to a control group composed of "Non-Asians", defined as those who do not self identify as having an Asian background. In our second set of regressions, we restrict our samples to just immigrants to the United States. Thus, the treatment group becomes those immigrants who self-identify as Asians and our control group becomes non-Asian immigrants. Using these methods, we find that Asian dragons have significantly more education than non-Asian dragons.

We explain this result using the "Mothers Data" from which we construct a base data set by restricting the observations to women who have had at least one child since 1985 (there are hardly any observations for women giving birth before 1985). As with the Census Data, we construct treatment and control groups. The treatment group consists of "Asian" mothers, where Asian is defined as those self-identifying with the Asian race, minus those who identify with the Mainland Chinese or

[7] More precisely, we discuss outcomes of 1976 dragon children using the 2000 Census Data, however, because of lack of observations, we can only describe the family backgrounds of 1988 and 2000 dragon children using the Mothers Data.

[8] We provide detailed definitions of all the variables in Appendix A.

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**Table 1**
Means of education by ethnicity and birth year.

| Panel A: Asians vs. Non-Asians | Asian | Non-Asian | Difference |
|---|---|---|---|
| Dragon year | 14.807 | 13.307 | 1.500 |
| | (0.170) | (0.039) | (0.174) |
| Non-dragon year | 14.578 | 13.392 | 1.186 |
| | (0.067) | (0.013) | (0.064) |
| Difference | 0.229 | −0.085 | 0.314 |
| | (0.183) | (0.041) | (0.186) |

**Table 2**
Summary statistics for Asian and non-Asian comparison groups, 1970–1980.

| | Non-Asians (control group) | | | Asians (treatment group) | | |
|---|---|---|---|---|---|---|
| Variable | Obs. | Mean | Std. dev. | Obs. | Mean | Std. dev. |
| Education | 71,162 | 13.384 | 2.814 | 2635 | 14.602 | 2.826 |
| Sex | 71,162 | 0.506 | 0.500 | 2635 | 0.518 | 0.500 |
| Age | 71,162 | 29.668 | 3.809 | 2635 | 29.630 | 3.745 |
| Income | 71,162 | 14842.870 | 37605.510 | 2635 | 16064.250 | 43124.050 |
| Dragon | 71,162 | 0.093 | 0.291 | 2635 | 0.107 | 0.309 |

Sample weights from CPS used to calculate statistics.

the Indian subcontinent. The control group is all other mothers. In one set of regressions we restrict the sample to mothers of only children. In the other set, we include women who have had one or more children. The reasoning behind doing this is to investigate whether or not families choosing to have only one child try to "maximize" the fortune of that child by giving birth in a dragon year. The sample size of Asian mothers is not large enough to restrict our specifications to just immigrants. Our results from the Mothers data suggest that Asian women who have dragon babies (in 1988 or 2000) are more educated, richer, and slightly older than Asian women having babies in non-dragon years.

The basic idea behind our identification strategy is illustrated in Table 1. The table reports the simple means (with standard errors reported in parentheses) of educational attainment for Asians and non-Asians in both dragon and non-dragon years. The key insight is that in non-dragon years Asians have about a years more education than non-Asians. Asians born in the 1976 dragon year, however, have an additional 0.31 years of education than the average non-Asian also born in a dragon year. By taking the difference in these differences, we control for any unobserved factors affecting these averages which are common to both Asians and non-Asians. Thus, 0.31 years of education can be interpreted as the *causal* effect of being born in a dragon year on educational attainment of Asians, under the assumption that in the absence of the dragon superstition the change in educational attainment for Asians and non-Asians would have been similar. Our simple estimate of 0.31 years of education is borderline significant, but not necessarily economically important. Thus, it is important to generalize this differences-in-differences approach to a regression framework in which we can better control for other observable covariates of educational outcome.

## 3. The dragon superstition is true

The simple means and differences presented in Section 2 are suggestive. In this section, we integrate our identification strategy into a more general regression framework. This allows us to control for observables such as gender, income, state fixed effects, age fixed effects, and year of birth effects. We begin by running the following regression using the CPS Outcome data.

$$education_i = \beta_0 + \beta_1 Asian_i + \beta_2 dragon_i + \beta_3 dragon_i \times Asian_i + \phi + \alpha + X'B + \varepsilon_i \quad (1)$$

where $education_i$ is the educational attainment of person $i$. *Asian* is a dummy variable equal to one if individual $i$ is Asian, *dragon* is a dummy variable equal to one if the subject is born in a dragon year, $\alpha$ is a vector of state fixed effects, $\varphi$ is a vector of birth year fixed effects, and $X$ is a vector of control variables. The variable of interest is $\beta_3$ which captures the difference in the differences between the educational outcomes of Asians and non-Asians across the 1976 dragon year (Tables 2 and 3).[9]

Columns (1), (2), and (3) of Table 4 report the results of our regressions using Asians as the treatment group and non-Asians as the control group. The coefficient on the interaction between being born during the 1976 dragon year and being Asian is consistently estimated to be around 0.35. In specification (3) where we control for state, age, and year of birth fixed effects in addition to income and gender we find that Asians born in 1976 have on average 0.34 years more education (Table 5).

[9] Note that we write down a separate term for the estimate on the dragon cohort even though this is redundant since the vector of cohort dummies, $\phi$, already specifies that variable. In the actual regression, only one cohort dummy for the dragon birth year is included in the specification.

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**Table 3**
Summary statistics for immigrant Asian and non-Asian comparison groups, 1970–1980.

| | Immigrant non-Asians (control group) | | | Immigrant Asians (treatment group) | | |
|---|---|---|---|---|---|---|
| Variable | Obs. | Mean | Std. Dev. | Obs. | Mean | Std. Dev. |
| Education | 10,755 | 11.838 | 4.144 | 1692 | 14.382 | 2.971 |
| Sex | 10,755 | 0.475 | 0.500 | 1692 | 0.536 | 0.499 |
| Income | 10,755 | 14605.400 | 35452.300 | 1692 | 14055.490 | 38364.920 |
| Age | 10,755 | 30.158 | 3.762 | 1692 | 29.969 | 3.667 |
| Dragon | 10,755 | 0.093 | 0.290 | 1692 | 0.099 | 0.299 |

Sample weights from CPS used to calculate statistics.

**Table 4**
Are dragons more educated?.

| | Asians vs. non-Asians | | | Asian immigrants vs. non-Asian immigrants | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Dragon | −0.213*** | 0.015 | −0.771*** | −0.095 | 0.247 | −0.952*** |
| | (0.052) | (0.069) | (0.165) | (0.182) | (0.184) | (0.333) |
| Asian | 1.269*** | 1.278*** | 1.244*** | 2.483*** | 2.523*** | 2.421*** |
| | (0.120) | (0.119) | (0.122) | (0.192) | (0.190) | (0.200) |
| Asian × dragon | 0.347** | 0.353** | 0.339** | 0.540*** | 0.602*** | 0.606*** |
| | (0.150) | (0.144) | (0.138) | (0.215) | (0.212) | (0.203) |
| State fixed effects | × | × | × | × | × | × |
| Age fixed effects | | × | × | | × | × |
| Birth year fixed effects | × | × | × | × | × | × |
| Sex | | | × | | | × |
| Income | | | × | | | × |
| Observations | 73,797 | 73,797 | 73,797 | 12,447 | 12,447 | 12,447 |
| *R*-squared | 0.027 | 0.031 | 0.064 | 0.092 | 0.097 | 0.138 |

Standard errors reported in parentheses. Standard errors clustered on state × year. Observations weighted using sampling weights. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Data are drawn from the 2000, 2002, 2004, 2006, and 2008 November current population surveys.

In specifications (4), (5), and (6) we restrict our attention to just immigrants in an attempt to make the treatment and control groups more comparable. When we do this, the estimated difference between educational attainment for Asian immigrant dragons and immigrant non-dragons increases to between 0.54 and 0.60 years. We interpret this as significant support for the increased "fortune" of dragon year children.

We also ran a version of the specification described by Eq. (1) in which we included a vector of interactions between *Asian* and *all* of the birth years. We then did an *F*-test of the null hypothesis that the coefficients on the interaction terms for all years other than 1976 were equal to 0. This test fails to reject the null at the 0.25 confidence level, thereby supporting the notion that only the 1976 dragon year has an effect on Asian educational outcomes.

The crucial identifying assumption for our empirical approach is that the trends in educational attainment are similar across treatment and control groups. Fig. 2a and b suggest that this assumption is valid for both the Asian and non-Asian groups as well as the comparisons we make between immigrant Asians and non-Asians. Both figures show the average educational attainment for Asians and non-Asians by year of birth after partialling out the effects of age, gender, and income. Individuals born in 1976 are dragons. There is a noticeable spike in educational attainment for Asians born in 1976 in both figures. We interpret these figures as supportive of our key identifying assumption of similar trends in educational attainment for Asians and non-Asians. It appears that our dragon-year treatment is actually affecting those from Asian cultural backgrounds, but not the general population.

The results using the CPS Outcome data are encouraging. However, our sample size is relatively small. The number of Asian dragons using the non-immigrant sample is 277. For the Immigrants sample there are only 166 Asian dragons. These small numbers force us to define the treatment and control samples more broadly than we would like. For example, it would be more appropriate to compare Taiwanese immigrants to other Asian immigrants (including

**Table 5**
Summary statistics for Taiwanese and non-Taiwanese Asian comparison groups, 1974–1979.

| | Non-Taiwanese Asians (control group) | | | Taiwanese (treatment group) | | |
|---|---|---|---|---|---|---|
| Variable | Obs. | Mean | Std. Dev. | Obs. | Mean | Std. Dev. |
| Bachelors | 9106 | 0.239 | 0.427 | 868 | 0.372 | 0.484 |
| Log Income | 6861 | 9.385 | 1.165 | 566 | 9.199 | 1.609 |
| Sex | 9106 | 0.485 | 0.500 | 868 | 0.481 | 0.500 |
| Age | 9106 | 23.657 | 1.703 | 868 | 23.403 | 1.657 |
| Dragon | 9106 | 0.332 | 0.471 | 868 | 0.368 | 0.483 |

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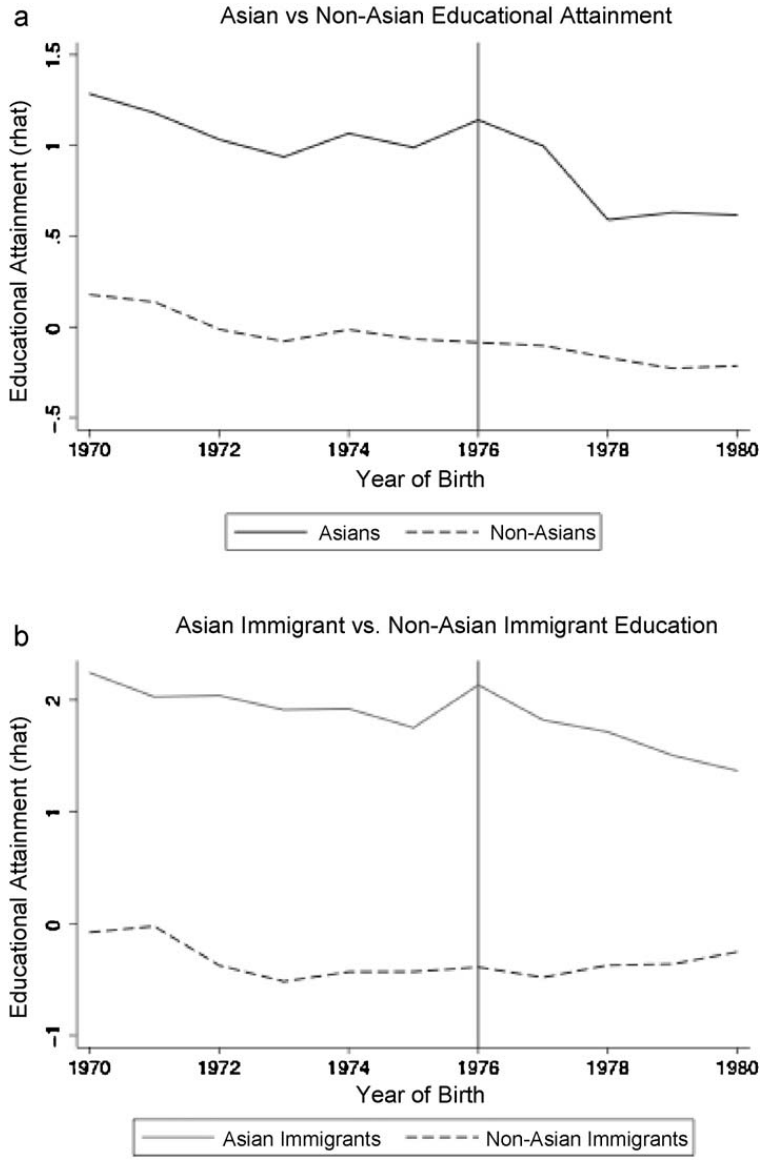


**Fig. 2.** (a) Asian vs. non-Asian educational attainment. (b) Asian immigrant vs. non-Asian immigrant education.

those from India, Mainland China, and the Philippines). In what follows below, we do precisely this using 2000 Census data.

We constructed the 2000 Census sample on outcomes using just the data from California since this is where most Asian immigrants live. We restricted the data to just immigrants who identify themselves as Asians and then we separated from this group those immigrants who report Taiwan as their country of origin. This leaves us with about 868 Taiwanese in the treatment group and 9106 non-Taiwanese Asians in the control group. About 318 of the Taiwanese are "treated" in the sense of having been born in a dragon year.[10] Since the average dragon in the 2000 Census data would be only 22 or 23 when answering the census question about education, we restrict our attention to college degree attainment. We exclude those with greater educational attainment than a bachelors from the sample (i.e. those with Masters degrees and Ph.D.'s are excluded from the sample). We do this so as to minimize potential bias that may arise from the fact that educational attainment increases with age. This could potentially lead to us to finding a positive dragon effect where none exists.

We estimate the following specification using the 2000 Census data,

$$bachelors_i = \beta_0 + \beta_1 Taiwan_{ic} + \beta_2 dragon_i + \beta_3 dragon_i \times Taiwan_i + \phi + X'B + \varepsilon_i \quad (2)$$

where *bachelors* is a dummy variable equal to one if individual *i* reports completing their college degree. *Taiwan* is a dummy if they immigrated from Taiwan, and *X* is a vector of controls including gender and income.

[10] However, given the constraints imposed by the way the Census reports age, we construct the *dragon* variable such that approximately 50% of the observations will actually not be dragons. This leaves us with a "treated" sample of about 159. See Appendix for more on how the variables were constructed.

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**Table 6**
Are dragons more educated? Evidence from the 2000 Census.

| | Taiwanese vs. Non-Taiwanese Asians | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Dragon | −0.033*** | 0.033*** | −0.004*** |
| | (0.012) | (0.012) | (0.013) |
| Taiwan | 0.120*** | 0.118*** | 0.115*** |
| | (0.022) | (0.022) | (0.023) |
| Taiwan × dragon | 0.061* | 0.064* | 0.073** |
| | (0.035) | (0.035) | (0.036) |
| Birth year fixed effects | × | × | × |
| Sex | | × | × |
| Income | | | × |
| Observations | 9974 | 9974 | 7427 |
| Pseudo *R*-squared | 0.081 | 0.085 | 0.107 |

Robust standard errors reported in parentheses. Observations weighted using sampling weights. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Data are drawn from the 2000 Decennial Census 5% PUMS data set for the state of California. Coefficients are marginal effects.

We estimate three specifications based on Eq. (2) using a probit model. We report the marginal effects from these regressions in Table 6. As expected, the sign on the differences-in-differences estimator is positive in all three specifications. In specification (1), where we do not control for sex or income, the coefficient of interest implies that Taiwanese born in the year of the dragon are about 6% more likely to hold a bachelors degree than Taiwanese born in a non-dragon year. The coefficient is significant at the 10% level. When we control for sex and income in specification (3) the coefficient increases to 0.07 and becomes significant at the 5% level.

Taken as a whole, there is significant support for the idea that Asian dragons are luckier than non-dragons. In the next section we offer a possible explanation for why this is the case.

## 4. The dragon superstition is self-fulfilling

One possible explanation for the dragon effect identified in Section 3 is that parents of dragons are different than parents of non-dragons. As with our investigations into the outcomes of dragon children, the chief difficulty in identifying these differences (if they exist) stems from potential bias introduced by unobserved variables that are correlated with a mother giving birth in a dragon year. As in the analysis above, we attempt to control for such biases by defining Asian mothers as our treatment group and non-Asian mothers as our control group. We look at the differences in education, income, and age of women who give birth in these two groups during non-dragon years and compare these numbers to the comparable differences of women who give birth during dragon years. Thus, we are interpreting Asian women who give birth during a dragon year as being treated.

Unfortunately, we do not have sufficient data to look at the characteristics of women who gave birth in the 1976 dragon year. However, so long as we assume that the process that gives rise to the dragon effect is self-reinforcing (as we will argue below) conclusions based on the characteristics of parents of later birth cohorts should also hold for earlier cohorts.

Table 7 provides summary statistics for the mothers in the two data sets we use in our differences-in-differences regressions. We will first look at mothers of only children. Then we will broaden our data set to include mothers of one child or more. There are 14,344 women in our only child data. Of these, 397 women are classified as Asians. The data span births between 1985 and 2008, so there are two dragon years included in this data: 1988 and 2000. There are 34 women of only children who report being Asian and having their child in either 1988 or 2000. If we expand the data set to include mothers of all children, then we start with 48,253 women of which 1304 are Asians. 116 of these Asian women also report having their most recent child (relative to the census they participated in) in a dragon year.

We estimate a group of specifications based on,

$$characteristic_i = \beta_0 + \beta_1 Asian_i + \beta_2 dragon_i + \beta_3 dragon_i \times Asian_i + \phi + \alpha + X'B + \varepsilon_i \quad (3)$$

**Table 7**
Summary statistics for mothers of only children and all mothers, 1985–2006.

| | Mothers of Only Children | | | Mothers of One Child Or More | | |
|---|---|---|---|---|---|---|
| Variable | Obs | Mean | Std. Dev. | Obs | Mean | Std. Dev. |
| Income | 14,344 | 2.271 | .0505 | 48,253 | 2.289 | 0.506 |
| Education | 14,344 | 40.106 | 2.462 | 48,253 | 39.908 | 2.598 |
| Age at birth (months) | 14,344 | 303.779 | 68.862 | 48,253 | 332.167 | 66.529 |
| Asian | 14,344 | 0.0277 | 0.164 | 48,253 | 0.027 | 0.162 |
| Dragon | 14,344 | 0.095 | 0.293 | 48,253 | 0.093 | 0.290 |
| Asian × dragon | 14,344 | 0.002 | 0.049 | 48,253 | 0.002 | 0.049 |

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**Table 8**
Are mothers of dragon babies different?

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Mothers of only children | | | Mothers of one child or more | | |
| Dependent Variable | LogIncome | Education | Age at Birth | LogIncome | Education | Age at Birth |
| Asian | 0.089*** | 0.636*** | 18.275*** | 0.077*** | 0.720*** | 12.661*** |
| | (0.029) | (0.243) | (4.284) | (0.019) | (0.238) | (1.905) |
| Dragon (only children) | 0.009 | 0.069 | 21.947*** | | | |
| | (0.039) | (0.140) | (4.981) | | | |
| Asian × Dragon (only children) | 0.087* | 1.245*** | 31.211** | | | |
| | (0.051) | (0.388) | (12.434) | | | |
| Dragon (1 or more children) | | | | 0.031* | 0.284*** | 28.403*** |
| | | | | (0.016) | (0.099) | (2.778) |
| Asian × dragon (1 or more children) | | | | 0.015 | 0.218 | 17.478*** |
| | | | | (0.047) | (0.404) | (4.613) |
| State fixed effects | × | × | × | × | × | × |
| Year of birth fixed effects | × | × | × | × | × | × |
| Observations | 14,344 | 14,344 | 14,344 | 48,253 | 48,253 | 48,253 |
| *R*-squared | 0.031 | 0.021 | 0.032 | 0.027 | 0.026 | 0.034 |

Standard errors clustered on state. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Data are drawn from the June CPS for 1998, 2000, 2002, 2004, 2006, and 2008.

where $characteristic_i$ represents either the family income, education, or age at the time of giving birth for mother $i$. As with our other specifications, $Asian_i$ is a dummy that is equal to 1 if the individual is part of the treatment group and zero otherwise. $Dragon_i$ is a dummy equal to 1 if the mother in question gave birth in either of the 1988 or 2000 dragon years. The coefficient of interest is $\beta_3$ on the interaction between *Asian* and *dragon*. This is the difference-in-difference effect. We also include a vector of state fixed effects and year of birth fixed effects. [11]

Table 8 reports the results of estimating Eq. (3) using income, education, and age at birth as the dependent variables on both the Only Children and More Than One Child samples. The results for mothers of only children are in columns (1), (2), and (3). According to results in specification (1), mothers of only dragon children are about 0.087 log points richer than mothers of non-dragon children. This represents an increase in family income of about 1.7 standard deviations above the mean income. The results in specification (2) imply that Asian mothers of dragon children have about 1.3 years more education than non-Asian mothers of dragon children. Finally, specification (3) implies that Asian mothers of dragon children are about two and a half years older, on average, than mothers of non-dragon children. If we look at the comparable results using the sample consisting of mothers of one child or more, these findings are supported by the signs of the coefficients for income and education, though these are not significant at traditional levels. The coefficient on age is positive and significant.

Overall, the general picture that emerges from Table 7 is that dragon children have different kinds of parents compared to non-dragon children. In particular, their parents tend to be older, richer and, more educated. This leads us to the conclusion that the dragon effect identified in Section 3 may be self-reinforcing in the sense that those parents who most able to adjust their family planning strategies to have dragon children happen to have characteristics that are correlated with investing more in the success of their children. When these greater investments pay off in terms of higher education and incomes of the dragon children, their success lends support to the dragon superstition, leading another cohort of parents to adjust their child fertility timing to have dragon children.

## 5. Discussion

Under the assumption that individuals are rational Bayesian updaters, it is difficult to explain the existence of superstitions. One possibility is to examine the class of beliefs which concern supernatural causes of observable phenomenon. For example, various creation myths, or, a belief that weather is ruled by a greater being fall into this category. In these cases, the superstitious belief is insulated from falsification due to the unobservability of the cause itself. A detailed explanation of this type is provided by Fudenberg and Levine (2006) who argue that, "... a mechanism that uses superstitions two or more steps off the equilibrium path... is more likely to persist" (p. 630). As an example, they cite the persistence of Hammurabi's Code, whose Second Law dictates that if a man has an accusation brought against him, he should be thrown in the river. If he sinks, he is guilty, if he floats, he is innocent and the accuser is put to death. In equilibrium, this mechanism was not used much, thus, there was very little feedback which could be used to update beliefs concerning its validity (contrast this superstitious belief with an easily verifiable alternative, such as "lighting will strike down the guilty"). In a similar vein, Suen (2004) argues that "biased belief" can persist for a long (though finite) period if information is costly to gather.

Our analysis of the dragon year superstition suggests an alternative interpretation for the persistence of superstitious belief – or as in this case, increasing the behavioral salience of the belief. In particular, superstitions which, to paraphrase

[11] As with Eq. (1), we do not write down the dragon cohort as a separate coefficient in (3) since doing so would be redundant. It is already included in the vector of birth cohorts $\phi$.

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Fudenberg and Levine, utilize mechanisms that are "on the equilibrium path." The outcomes of dragon children (including the types of families in which they are raised) are observable. Therefore, one cannot easily explain the persistence of the belief in the fortune of dragons as being due to slow Bayesian updating. Rather, our results suggest the possibility that the dragon superstition is an example of a "self-fulfilling prophecy" as described by Merton (1948). According to Merton, the self-fulfilling prophecy is, ". . . in the beginning, a *false* definition of the situation evoking a new behavior which makes the originally false conception come *true*" (p. 695). The "new behavior" by which the false belief is made true, in our case, stems from the differential selection of parents into dragon birth cohorts with attributes that are positively correlated with investment in their children.

A prerequisite for our explanation of the dragon superstition is that acting on the belief is costly, but not too costly. If the costs are too high, then nobody will select into the dragon cohort. For example, there is no evidence that the Chinese ever acted on a belief that giving birth to a child in a dragon year is fortuitous. According to our selection hypothesis, this fact is readily explained by the two-child policy that was in place in 1976 (and which was eventually replaced by a one-child policy in 1979). Under these policies the role of the state in determining birth timing was significant and potential parents were likely to discount all factors other than the permission of the state to have a child in a given year in their decision. More generally, the changing cost of family planning suggests an explanation for why the dragon birth year superstition is not observed before 1976 (Sun et al., 1978).

Goodkind (1991) argues persuasively that, while the superstitious belief in the association between good fortune and the dragon has been around for millennia, the belief that having a child in the dragon year will give them good fortune is relatively recent. As he explains, "The Chinese calendar was not constructed over 2000 years ago in order to help people select among animal years for births. In fact, Chinese astrology holds that the day and hour of birth, which cannot be timed nine months before, are far more important in determining the fate of a newborn child" (p. 665). As such, the dragon birth year superstition is properly understood as a relatively recent creation emerging out of a separate, more ancient, set of beliefs. Our selection story is wholly consistent with this hypothesis. As Becker and Lewis (1973) observed long ago, the shadow price of associated with a higher quality child is inversely related to the number of children one has. Combined with Becker's (1981) observation that, as the opportunity cost of parents' time increases, they wish to reduce the number of children they have, this means rising incomes are associated with a desire for fewer and higher quality children.[12] As birth control (through both selective abortion and the pill) became more widely available during the sixties, parents experienced a decrease in the cost of adjusting their birth timing. As these costs decreased, on the margin, those with larger choice sets (the richer and more educated) were also more likely to adjust their birth timing. As other individuals observed the relatively good fortune of dragon children (by noticing the relative wealth of their parents, or, later, their actual outcomes in school, etc) the belief in the superstition was reinforced.

Of course it is possible that the dragon birth year superstition is not stable in the long run and will eventually fade as the cost of giving birth in dragon years decreases, or, the positive feedback grows large enough that larger proportions of the population choose to select in, thus "lowering" the perceived quality of dragons. This is wholly consistent with the history of any number of "inefficient" beliefs that people hold. For example, fads in music, literature, and art are amenable to an explanation based on selection. If collecting *avant garde* art is sufficiently expensive, then mainly the rich will choose to collect that art. This will automatically create an association between the *avant garde* and material success that will feed into the perpetuation of the fad. Eventually, as the supply of this type of art increases and the access to the fad becomes more widespread, its popularity will fade.

Perhaps more importantly, this reasoning can also explain the persistence of economically important institutions that may be inefficient as well. For example, expensive early childhood education. If only the rich (who also tend to be more educated) send their children to a particular school, then it may *appear* as if the school itself is responsible for the relative success of its students, when in fact, it is the relatively high "quality" of the parents who choose to enroll their children which is the causal factor.

Whether or not the dragon birth year superstition persists is an open question. As new census data becomes available over the next few years, we will be able to test this proposition. Regardless of whether we are at the front or tail end of the dragon birth year tradition, the phenomenon itself and the lessons we can draw about belief and behavior will continue to be relevant for the social sciences.

## Appendix A. Variable descriptions

We use three data sets. The first contains data on the educational outcomes and demographic characteristics of Asians and non-Asians pulled from the November 2000, 2002, 2004, and 2006 Current Population Surveys. We call this data set the "CPS Outcome Data". The second contains data on the educational and economic outcomes of Taiwanese and non-Taiwanese Asian immigrants to the United States. We call this data set the "2000 Census Data". The third data set contains variables pulled from the June Current Population Surveys of the U.S. Census which describe the demographic and fertility characteristics of mothers of dragon children. We call this data set the "Mothers Data". From the "Mothers Data" we construct two subsets of the data. One for mothers of single children only, the other for mothers of one child or greater. Below we describe only the

[12] This is a well developed idea. See Caldwell (1982), Hirschman (1994) and Thornton and Lin (1994).

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variables created for mothers of single children. The variables for mothers of one child or more were generated in exactly the same manner, with the obvious exception that we removed the restriction on the number of children a woman had to have to be included in the sample.

### A.1. Variables from the "CPS Outcome data"

*Asian*: Dummy variable equal to one for the population that reports their race as "Asian" minus those who identify with mainland Chinese, the Indian subcontinent, Pakistan, or the Phillippine Isalnds. Asian is defined in the Census as a person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam. It includes "Asian Indian," "Chinese," "Filipino," "Korean," "Japanese," "Vietnamese," and "Other Asian." Asian Indian. This category includes people who indicated their race as "Asian Indian" or identified themselves as Bengalese, Bharat, Dravidian, East Indian, or Goanese.

*Sex:* Dummy equal to 1 for female and 0 for male.

*Education*: The CPS reports educational attainment categories rather than the number of years of education they have completed. We measure years of education by assigning the years to education categories as follows: Less than first grade = 0, first, second, third, or fourth grade = 2.5, fifth or sixth grade = 5.5, seventh or eighth grade = 7.5, ninth grade = 9, tenth grade = 10, eleventh grade or twelth grade with no diploma = 11, high school graduate, diploma or equivalent (GED) = 12, some college but no degree = 13, associate degree, occupational/vocational, or, associate degree, academic program = 14, bachelor's degree = 16, master's degree or professional school degree = 18, doctorate = 20. This is similar to measures of years of schooling used in other studies of assimilation; see, for example, Schoeni (1998).

*Dragon*: The CPS asks for the individual's age in November of the survey year. The Chinese Lunar calendar if offset from the Western calendar by about a month depending on the year. Also there is likely error in reporting given the fact that Asians brought up within a Chinese influenced culture (for example in Taiwan) consider themselves "1" when they come out of the womb. Thus, if we used the February CPS we would likely miss many dragon Asians who mis-report their ages by one year. Thus, we choose to use a CPS from earlier in order to minimize this potential source of error. We assume for the 2000 CPS that dragons are those who report an age of 24, for the 2002 CPS we use age 26, for 2004 we use 28, and for 2006 we use 30.

*Income:* The CPS reports family income categories rather than family income. We measure nominal family income by assigning dollar amounts to categories for the 2004 and 2006 CPS as follows: less than $5000 = $2500, $5000 to $7499 = $6250, $7500 to $9999 = $8750, $10,000 to $12,499 = $11,250, $12,500 to $14,999 = $13,750, $15,000 to $19,999 = $17,500, $20,000 to $24,000 = $22,500, $25,000 to $29,999 = $27,500, $30,000 to $34,999 = $32,500, $35,000 to $39,999 = $37,500, $40,000 to $49,999 = $45,000, $50,000 to $59,999 = $55,000, $60,000 to $74,999 = $67,500, $75,000 to $99,999 = $87,500, $100,000 to $149,999 = $125,000, $150,000 or more = $225,000. For the 1996, 1998, 2000, and 2002 CPS, we assign the same amounts to the same categories. The only difference is that for these years, the last three categories are combined into a single category "$75,000 or more," to which we assign $112,500. We assign income to the open-ended categories by multiplying the lower bound of the category by 1.5; see Borjas (1995).

### A.2. Variables from the 2000 Census Data

*Taiwanese*: Dummy variable equal to one for individuals reporting their place of birth as Taiwan.

*Asian*: Dummy variable equal to one for the population that reported their race as "Asian" on the 2000 Census Long-Form questionnaire. The 2000 Census defines "Asian" as a person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam. It includes "Asian Indian," "Chinese," "Filipino," "Korean," "Japanese," "Vietnamese," and "Other Asian." Asian Indian. This category includes people who indicated their race as "Asian Indian" or identified themselves as Bengalese, Bharat, Dravidian, East Indian, or Goanese.

*Dragon*: A dummy variable equal to one if the individual reports his or her age as 23 or 24 on the 2000 Census. Since the 2000 Census asks people in 1999 what their age will be in April 2000, we choose to use both 23 and 24 year olds in order to ensure that we capture 100% of the dragons. The cost is that, assuming dragons are born uniformally in every month of the year, only 50% of the treated group will actually be dragons. We consider this an acceptable trade-off given the large sample sizes available when using the Decennial Census (as opposed to with the CPS outcome sample in which we lose some dragons at the cost of likely capturing more dragons relative to non-dragons).

*Bachelors*: Dummy variable equal to one for those reporting their highest educational attainment as "completed bachelors degree" or greater. Equal to zero otherwise.

*Personal Income*: Continuous variable defined as the sum of the eight types of income reported in the census accruing to the individual subject (as opposed to his or her household). The eight types of income are: Wage or salary income, Self-employment income, Interest, dividends, or net rental income, Social security income, Supplemental Security Income (SSI), Public assistance income, Retirement income, All other income. For detailed definitions of each of these sources see the 2000 Public Use Microdata Technical Documentation from the U.S. Census, page 318.

*Sex*: Dummy equal to 0 for female and 1 for male.

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*Citizen*: Dummy variable equal to one if subject born in the United States. Equal to zero if either not a citizen, or, a citizen by naturalization. Excludes population reported as residing in Puerto Rico or a U.S. island (e.g. Guam). Also excludes individuals born to American parents abroad.

### *A.3. Variables from the mothers data*

*Income*: Discrete variable describing household income. Includes money from jobs, net income from business, farm or rent, pensions, dividends, interest, social security payments, and any other money income received by family members who are 15 years of age or older. Valid entries are:

| | |
|---|---|
| 1 | Less than $5,000 |
| 2 | 5000 to 7499 |
| 3 | 7500 to 9999 |
| 4 | 10,000 to 12,499 |
| 5 | 12,500 to 14,999 |
| 6 | 15,000 to 19,999 |
| 7 | 20,000 to 24,999 |
| 8 | 25,000 to 29,999 |
| 9 | 30,000 to 34,999 |
| 10 | 35,000 to 39,999 |
| 11 | 40,000 to 49,999 |
| 12 | 50,000 to 59,999 |
| 13 | 60,000 to 74,999 |
| 14 | 75,000 or more |

*Education*: Highest level of school completed or degree received. Valid entries are:

| | |
|---|---|
| 31 | Less than 1st grade |
| 32 | 1st, 2nd, 3rd or 4th grade |
| 33 | 5th or 6th grade |
| 34 | 7th or 8th grade |
| 35 | 9th grade |
| 36 | 10th grade |
| 37 | 11th grade |
| 38 | 12th grade no diploma |
| 39 | High school grad-diploma or equiv (GED) |
| 40 | Some college but no degree |
| 41 | Associate degreeoccupational/vocational |
| 42 | Associate degree-academic program |
| 43 | Bachelor's degree (ex: BA, AB, BS) |
| 44 | Master's degree (EX: MA, MS, MEng, MEd, MSW) |
| 45 | Professional school deg (EX: MD, DDS, DVM) |
| 46 | Doctorate degree (EX: PhD, EdD) |

*Age at Birth*: Age of mother in months when she gave birth to her most recent child.

*Asian*: Dummy variable equal to one for the population that reports their race as "Asian" minus those who identify with mainland Chinese, the Indian subcontinent, or the Phillippine Islands. Asian is defined as a person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam. It includes "Asian Indian," "Chinese," "Filipino," "Korean," "Japanese," "Vietnamese," and "Other Asian." Asian Indian. This category includes people who indicated their race as "Asian Indian" or identified themselves as Bengalese, Bharat, Dravidian, East Indian, or Goanese.

*Dragon*: Any women who identified herself as having her latest child in either of the 1988 or 2000 dragon years.

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