The Importance of Being Wanted*

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Abstract

We identify birth wantedness as a source of better child outcomes. In Vietnam, the year of birth is widely believed to determine success. As a result, cohorts born in auspicious years are 12 percent larger. Comparing siblings with one another, those of auspicious cohorts are found to have 2 extra months of schooling. The Vietnamese horoscope being gender-specific, this difference will be shown to be driven by birth planning; children born in auspicious years are more likely to have been planned, thus benefitting from a more favorable growth environment.

Keywords: birth planning, child wantedness, schooling, horoscope, superstition.

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1 Introduction

What are the sources of child health and schooling outcome heterogeneity? Becker and Tomes (1976) provided theoretical insights into the family determinants of child development. At the same time, the related empirical literature has put a large emphasis on gender bias, birth order and birth spacing.[1] In all of this work, fertility was viewed as essentially a deterministic process. We instead highlight that parents may have to cope with an unexpected pregnancy, the implications of which we investigate in this paper.[2] While Goldin and Katz (2002) documented the effect of the introduction of the birth control pill on career and marriage outcomes of American women, little, however, is known about the importance of birth planning for child welfare. These issues are relevant for researchers and policy makers alike who wish to understand and address the factors affecting child development.

Vietnam, the country of interest in this study, offers a peculiar cultural setting that will allow us to address this question. Specifically, there is a commonly shared belief that an individual's year of birth is a determinant of ability, success, and character. Accordingly, we find a sharp fertility response, whereby years that are considered auspicious have significantly larger cohorts. Furthermore, when comparing siblings with one another, those born in auspicious years are found to have more years of schooling. Exploiting the fact that the Vietnamese horoscope differs between boys and girls, we show that the observed schooling differences are due not to the horoscope being accurate or self-fulfilling, but rather to birth planning; children born in auspicious years are more likely to have been planned by their parents, thus benefitting from a more favorable growth environment.

[1]See also Behrman et al. (1982), Sheshinski and Weiss (1982), and Rosenzweig and Wolpin (1988) for theoretical discussions on the intra-household allocation of resources. The empirical literature on sex preference includes among others Rosenzweig and Schultz (1982), Behrman et al. (1986), Thomas (1994), Rose (2000), and Duflo (2003); Behrman and Taubman (1986), Hauser and Sewell (1985) and Black et al. (2005) looked at birth order effects; Rosenzweig (1986) and Conde-Aguelo et al. (2006) are among studies that investigated the impact of birth spacing on child outcomes.

[2]Rosenzweig and Wolpin (1980) used the exogenous fertility shock provided by multiple births to identify the interaction between the quantity and quality of children.

We believe our findings to be a significant contribution to the literature on child wantedness for at least three reasons.[3] First, most attempts to address the importance of being wanted have relied on self-reported assessments of wantedness, although these self-reports are likely to be biased.[4] Rosenzweig and Wolpin (1993) and Bachrach and Newcomer (1999) discussed the methodological shortcomings of using self-reported measures of child wantedness. Our strategy instead relies on the property that the horoscope of a child carries information about whether or not she was planned by her parents. Second, identification of child wantedness has generally been obtained out of comparison *between* rather than *within* families. This methodology is, however, subject to a composition bias; if some unobserved parental characteristics drive both the likelihood of an unexpected pregnancy and the child's growth environment, then such latent heterogeneity confounds the effect of child wantedness. Therefore, reduced-form estimates of the impact of fertility planning policies obtained from e.g. Donohue and Levitt (2001) or Pop-Eleches (2006) should not be interpreted as evidence of child wantedness without making strong identification assumptions on the nature of cohort composition.[5] Our use of family fixed-effect estimations largely alleviates this problem since parental ability to both control fertility and provide child care is being factored out when comparing siblings with one another.[6] Finally, the literature on child wantedness has often concluded that an unexpected pregnancy could lead to worse child outcomes because parents care inherently less about children who were not desired, whereas the potential income effect associated with an unplanned birth has largely been discarded. Our findings suggest that such omission is not necessarily warranted, and this has implications for the

[3] see Gipson et al. (2008) for a review of the literature

[4] One exception is Joyce and Grossman (1990), who instead predict wantedness based on observables in a two-step Heckman selection model.

[5] For example, Gruber et al. (1999) find that poorer households are more likely to be affected by changes in abortion regulation. Explicitly controlling for observed confounders still leaves unaddressed the problem of residual latent heterogeneity such as parental valuation of time (see e.g. Cawley and Liu, 2007).

[6] Chalasani et al. (2007) also adopt a fixed-effect specification to compare siblings with varying degrees of wantedness. However, wantedness is measured based on self-reported assessments, and the authors do not control for birth order in their specifications.

interpretation of these earlier results and the formulation of policy prescriptions. To remind ourselves of this identification problem, we henceforth refer to birth *plannedness* rather than birth *wantedness*.

We therefore believe our paper sheds new light on some of the mechanisms that could also be factors underlying the documented impact of abortion regulation on socioeconomic outcomes such as schooling and crime.[7]

To conduct our empirical investigation, we use the Vietnam 1999 population census to compare birth cohort sizes across years. Years that are believed to bring good luck to either boys or girls have birth cohorts that are on average 12 percent larger. There is furthermore no evidence that sex ratios and astrology are correlated, which invalidates hypotheses of sex-selective abortion or gender-biased infant mortality rates being driven by the horoscope. We use data on education from the population census and on health from the 2001 Vietnam National Health Survey, and we find that children of auspicious cohorts have higher levels of education measured by the number of years spent in school. There is, on the other hand, no evidence of any difference in long-term health (measured by height-to-age). Comparing children across families is subject to a composition bias similar to the one mentioned above, whereby parents more able to time fertility according to the horoscope might have unobservable traits that also affect the quality of child rearing. Family fixed-

[7] Our paper is also related to the literature on the complementarities between parental investments and children's endowments (see e.g. Rosenzweig and Wolpin, 1988). We do not find evidence that parents invest either more or less in their child's human capital depending on whether or not she is perceived to be more able. Admittedly, the interpretation of our results is subject to the caveat that the child's horoscope is only one aspect of her perceived ability. It is nevertheless important enough to trigger a 12 percent fertility response. Our paper also deals with issues of religion and beliefs in a way similar to Goodkind (1991, 1996) and Lee and Paik (2006), who document how the horoscope can influence birth timing among Chinese and Korean families respectively. The former finds evidence of a "dragon-year baby boom" among the Chinese populations of South-East Asia, while the latter shows that Korean families avoid the inauspicious year of the horse to have children. Akabayashi (2006) looks at the consequences of the baby bust in Japan associated with the year of the Fire Horse (1966) on the marriage market. Similarly, Vere (2008) exploits superstitious beliefs in Hong Kong to look at the impact of fertility on female labor participation.

effect estimations still indicate that a child born in an auspicious year for either boys or girls will attend school an extra 2 months compared to his or her *sibling* born in a year auspicious for neither boys nor girls. In addition, cohort-size spillover effects, through which larger cohorts exert a positive influence on individual human development, are ruled out since no association between cohort sizes and educational outcomes is detected. We are then left with two potential mechanisms to explain our results. On the one hand, the *child endowment channel* postulates that children born in auspicious years are either effectively or believed to be more able. They might then feel more confident and their parents might dedicate more resources to their education. On the other hand, the *birth plannedness channel* argues that children born in auspicious years are more likely to have been planned by their parents, thus benefiting from more favorable conditions for human development.

To disentangle these two channels, we rely on a second feature of Vietnamese astrology; the horoscope is different for boys and girls so that there are years that are auspicious for boys exclusively (i.e. inauspicious for girls), and vice and versa. Given that gender is not known at the time of the fertility decision, we can test whether differences in outcomes are driven by ex-ante planning (the birth plannedness channel) or ex-post horoscope (the child endowment channel).[8] To illustrate the intuition, let's consider the following Vietnamese three-child family. Bao and Giang are twins; Bao is a boy, while Giang is a girl. They are born in a year that is auspicious for boys exclusively, i.e. bad omen for girls. Bao and Giang have a sister, Nga, who is born in a year that is auspicious for neither boys nor girls. According to the horoscope, Bao is a *lucky* child, while his two sisters are both *unlucky*. By comparing the three siblings, we can assess the empirical relevance of child endowment versus birth plannedness in determining child outcomes. If child endowment is the driving force underlying sibling differences, we should observe better outcomes for *lucky* Bao compared to his *unlucky* twin sister Giang, but not find any difference between the two *unlucky* sisters Giang and Nga. On the other hand, if birth plannedness is the key determinant of sibling

[8] This approach is reminiscent of Rose (2000) who also considers "gender shocks", which occur at birth once the gender of the newborn is known to the parents to look at gender inequality within the household.

heterogeneity, we would not expect any difference between the two twins, while Giang should exhibit better human development outcomes than her sister Nga because she is more likely to have been planned by her parents who targeted an auspicious year for either boys or girls to give birth to her and her twin brother. Our empirical strategy does precisely that. We first look at children born in years auspicious for either boys or girls, and find no evidence of better outcomes for the child for whom gender and horoscope match (we actually find the opposite). We then restrict our sample to *unlucky* children: boys born in years auspicious for girls exclusively, girls born in years auspicious for boys exclusively and children born in years auspicious for neither. *Unlucky* children born in years auspicious for the other sex are still found to have better outcomes than equally *unlucky* children born in years auspicious for neither. Birth plannedness is therefore believed to be the main mechanism underlying the observed heterogeneity between children born in years of varying auspiciousness.

Finally, we find that the effect of the horoscope on child outcome is stronger among groups such as ethnic minorities that are less likely both to believe in the Vietnamese horoscope and put an emphasis on child quality, but more likely to face financial constraints. Such results suggest that the inability to smooth an income shock associated with an unexpected pregnancy plays a role in explaining sibling outcome heterogeneity.

The paper is organized as follows: section 2 sketches the cultural framework underlying astrology and superstition in Vietnam. In section 3, we lay out a simple model of parental fertility choice and resource allocation to guide our discussion, and after a description of the data in section 4, we present and discuss our results in section 5. Section 6 concludes.

2 A Short Overview of Vietnamese Astrology

In this section, we briefly describe the basis of Vietnamese astrology. To the connoisseur, this overview will surely look over-simplified. At the root of Vietnamese superstition is the Chinese “Y King” (4000 years B.C.) whereby the Universe found its origin from a unique entity and from such entity, emerged two states, Yin and Yang. Yang is as positive, masculine, left, high and tough as Yin is negative, feminine, right, low and soft. Around 200 years B.C., during the Han dynasty, a school of thought built a theory according to which the tension between Yin and Yang was related to the five elements: Metal, Wood, Water, Fire and Earth. During the Tsong dynasty (10th century A.D.), Chen Ruan made this theory into the "Fengshui", which, among other things, predicted the destiny of an individual based on her date of birth. A year is actually viewed as the association between a terrestrial appellation (Zhi) and one of the five elements. There are 12 terrestrial appellations also known as zodiac animals (Rat, Ox, Tiger,...), and five elements so that the Chinese and Vietnamese calendars are characterized by 60-year cycles.

The horoscope is then determined depending on the compatibility between the gender of the newborn, and the attributes of the year of birth. For example, a year characterized by Yin (Ox, Rabbit, Snake, Goat, Rooster, and Pig) is on average more compatible with girls than with boys, while the reverse holds for Yang years (Rat, Tiger, Dragon, Horse, Monkey, and Dog). On top of that, there are compatibilities based on the elements. Table A1 in the appendix displays the horoscope for the entire 60-year cycle. To read this table, let's consider the top-left corner, "Metal-Rat" (Canh Ty in Vietnamese), which corresponds to 1960 (modulo 60). That year is an inauspicious year for boys and neutral for girls. A one-year increment would then consist of moving one cell (modulo 12) to the right, and alternating between staying in the same row and moving one row down (modulo 10): 1961 would then be the year of "Metal-Ox", while 1962 is the year of the "Water-Tiger", and so on. Table 1 displays the horoscope for the time period we are interested in.

3 Superstition, birth planning, and human development

We build from a now standard Becker (1960) and Becker and Lewis (1973) model of household production. Parents live for three periods $t = 0, 1$, and 2. In each of the two periods $t = 1, 2$, they receive an endowment $W_t \in \{W_L, W_H\}$ with $W_L < W_H$. To capture the idea that parents make financial planning and fertility decisions simultaneously, we suppose that in $t = 0$, parents make an irreversible income timing decision: they decide whether they receive W_L in the first period and W_H in the second, or the opposite. Once income timing is decided, there is neither saving nor borrowing.

Preferences and household production. In each period $t = 1, 2$, parents make fertility decisions $(P_t)_{t=1,2}$. $P_t = 1$ indicates that parents plan to have a child, and $P_t = 0$ otherwise. Actual fertility follows the process:

$$\begin{cases} \Pr(I_t = 1 | P_t = 1) = 1 \\ \Pr(I_t = 1 | P_t = 0) = 1 - \theta \end{cases} \tag{1}$$

where the dummy variable $I_t = 1$ if and only if a child is born in period t. The parameter θ captures the ability to control fertility. θ is household-specific and time-invariant, i.i.d across households with mean $\bar{\theta}$ and cumulative distribution function $F(.)$. (1) means that a child is born whenever planned, while an unplanned pregnancy occurs with probability $1 - \theta$. In each of these two periods $t \in \{1, 2\}$, the endowment W_t is split between a consumption good C_t and a child rearing good Z_t. One can also think of C_t and Z_t as time spent on domestic tasks and child rearing, respectively. If they don't have a child, parents' instantaneous utility is simply $U_t = \bar{U}$, for some $\bar{U} > 0$; otherwise it takes a Cobb-Douglas form:

$$U_t(Z_t, C_t) = (Y_t^{\pi_t})^{\alpha} (C_t)^{1-\alpha}, \tag{2}$$

where Y_t is the child's human development outcome and $\pi_t \in \{\pi_L, \pi_H\}$ is a taste parameter: higher values of π_t indicate that parents care more for a child born in period t. To capture the issue of child wantedness at the heart of our paper, we assume that $\pi_t = \pi_H$ if and only if $P_t = 1$: parents care more for a child born when planned. We account for heterogeneity of outcomes across families and across siblings within a family by assuming the production of human capital Y_t to be log-separable:

$$Y_t = H(\theta) \Phi(N_t) R(Z_t, \gamma_t), \tag{3}$$

where θ, the same parameter as in (1), measures the household's ability to produce human capital (H is increasing); N_t is the child's birth cohort size and $\Phi(.)$ captures cohort size spillover that a priori can be either positive (Φ increasing) or negative (Φ decreasing); Z_t is the amount of education good consumed by the household, and $\gamma_t \in \{\gamma_L, \gamma_H\}$ with $\gamma_L < \gamma_H$ is the endowment of the child.

Parental investments and human development outcomes. In years where a child is born ($I_t = 1$), the first-order condition governing parental choices Z_t^* takes the form

$$\frac{\alpha}{1-\alpha}\Lambda_t = \frac{Z_t^*}{W_t - Z_t^*}$$

where $\Lambda_t = \pi_t \frac{Z_t^*}{R_t} R_Z$ is (the inverse of) the relative price of investments in human capital. The second-order condition, $R_{ZZ} \leq \frac{1-\alpha+\alpha\pi_t}{1-\alpha}\frac{R_Z^2}{R}$, is assumed to always hold. For further discussions, we consider the following supermodularity condition:

$$\frac{R_Z R_\gamma}{R} - R_{Z\gamma} \leq 0, \tag{4}$$

which formalizes the property that education and child's endowment are "sufficiently" complement. Under standard regularity assumptions, the implicit function theorem implies that there exists a differentiable function $\xi(W_t, \gamma_t, \pi_t)$ such that in equilibrium,

$$Z_t^* = \xi(W_t, \gamma_t, \pi_t), \tag{5}$$

and $\xi(.)$ is increasing in W_t and π_t, and increases in γ_t if and only if (4) holds. Investments in child rearing increase if parents have a relatively higher preference for their child, have higher income, or the net private returns to child rearing are larger. Plugging (5) into (3) and taking logs yields

$$y_t = \rho\left[\xi(W_t, \gamma_t, \pi_t), \gamma_t\right] + \eta(\theta) + \phi(N_t) \tag{6}$$

where $y \equiv \ln Y$, $\rho \equiv \ln R$, $\eta \equiv \ln H$, and $\phi \equiv \ln \Phi$.

Horoscope and birth cohort comparisons. Without loss of generality, we assume that $t = 1$ is an auspicious year, while $t = 2$ is inauspicious. A fraction β of parents are superstitious and therefore believe that $(\gamma_1, \gamma_2) = (\gamma_H, \gamma_L)$. The remaining $(1-\beta)$

believe that child endowment is not correlated with the horoscope. Thus, in this economy, a fraction $\frac{1+\beta}{2}$ of parents choose to have a child in $t=1$, while $\frac{1-\beta}{2}$ of them choose $t=0$ instead.[9] Parents will furthermore decide to allocate resources to periods of fertility, i.e. $W_t = P_t W_H + (1-P_t) W_L$.[10] Cohort differences in outcomes $\Delta^{OLS} E(y) \equiv E(y_1) - E(y_2)$ therefore equals

$$\begin{aligned} \Delta^{OLS} E(y) &= \frac{\beta\left(1-\bar{\theta}\right)}{\left(1-\bar{\theta}\frac{1+\beta}{2}\right)\left(1-\bar{\theta}\frac{1-\beta}{2}\right)}\left[\Delta\rho + \int \eta(\theta)\frac{\theta-\bar{\theta}}{1-\bar{\theta}}dF(\theta)\right] \\ &\quad + \left[\phi\left(1-\bar{\theta}\frac{1-\beta}{2}\right) - \phi\left(1-\bar{\theta}\frac{1+\beta}{2}\right)\right] \end{aligned}$$

where $\Delta\rho \equiv \rho\left[\xi\left(W_H, \gamma_H, \pi_H\right)\right] - \rho\left[\xi\left(W_L, \gamma_L, \pi_L\right)\right]$.[11]

$\Delta^{OLS} E(y)$ aggregates three effects:

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[9] The corresponding parameter restriction is $\bar{U} < \tilde{U}(W, \gamma_H, \pi_L)$, where $\tilde{U}$ is the parental indirect utility when investments are determined by (5). To rule out the case where parents wish to have a child in both periods, we further assume $\tilde{U}(W, \gamma_L, \pi_H) < \bar{U}$.

[10] In this model, the only reason why parents may wish to have lower income in periods of fertility is when the risk of an unexpected pregnancy is sufficiently high *and* wealth and ability and preference parameters are sufficiently substitute. To see this, we note that the income timing decision is driven by the difference $\left[\tilde{U}(W_H, \gamma_H, \pi_H) + (1-\theta)\tilde{U}(W_L, \gamma_L, \pi_L)\right] - \left[\tilde{U}(W_L, \gamma_H, \pi_H) + (1-\theta)\tilde{U}(W_H, \gamma_L, \pi_L)\right]$. As $\tilde{U}$ is increasing, there exists a threshold $\hat{\theta} < 1$ such that the difference is positive for all $\theta \geq \hat{\theta}$: if the risk of an unexpected pregnancy is low enough, then parents allocate high income in periods of fertility. If supermodularity condition (4) holds and health outcomes are normalized in such a way that $H(\theta)\Phi(N) R[\xi(W, \gamma, \pi), \gamma] \geq 1$, such threshold $\hat{\theta}$ can be as low as $\hat{\theta} = 0$: parents such that $\theta = 0$, have a child born in both periods, and the optimal allocation of resources will depend on the complementarity between W, γ and π. Supermodularity is a sufficient condition for parents to be willing to match high income with high levels of γ and π.

[11] For each θ, defining $\rho_k \equiv \rho[\xi(W_k, \gamma_k, \pi_k)]$ for $k \in \{L, H\}$, average human development outcome is: $E(y_1|\theta) = \frac{1+\beta}{2-\theta(1-\beta)}\rho_H + \frac{(1-\beta)(1-\theta)}{2-\theta(1-\beta)}\rho_L + \eta(\theta) + \phi\left(1-\bar{\theta}\frac{1-\beta}{2}\right)$ and $E(y_2|\theta) = \frac{1-\beta}{2-\theta(1+\beta)}\rho_H + \frac{(1+\beta)(1-\theta)}{2-\theta(1+\beta)}\rho_L + \eta(\theta) + \phi\left(1-\bar{\theta}\frac{1+\beta}{2}\right)$. Given fertility process (1), we integrate over θ : $E(y_1) = \frac{1+\beta}{2-\bar{\theta}(1-\beta)}\left[\rho_H + \int \eta(\theta) dF(\theta)\right] + \frac{(1-\beta)(1-\bar{\theta})}{2-\bar{\theta}(1-\beta)}\left[\rho_L + \int \eta(\theta)\frac{1-\theta}{1-\bar{\theta}}dF(\theta)\right] + \phi\left(1-\bar{\theta}\frac{1-\beta}{2}\right)$ and $E(y_2) = \frac{1-\beta}{2-\bar{\theta}(1+\beta)}\left[\rho_H + \int \eta(\theta) dF(\theta)\right] + \frac{(1+\beta)(1-\bar{\theta})}{2-\bar{\theta}(1+\beta)}\left[\rho_L + \int \eta(\theta)\frac{1-\theta}{1-\bar{\theta}}dF(\theta)\right] + \phi\left(1-\bar{\theta}\frac{1+\beta}{2}\right)$. The expression for $\Delta^{OLS} E(y)$ follows immediately.

(i) Sibling heterogeneity, $\Delta\rho$, that can be formally decomposed into:

$$\Delta\rho \cong \underbrace{\rho_Z \cdot \left(\xi_\pi \ \Delta\pi + \xi_W \ \Delta W\right)}_{birth\ plannedness} + \underbrace{\left(\rho_Z \cdot \xi_\gamma + \rho_\gamma\right) \ \Delta\gamma}_{child\ endowment}. \tag{7}$$

where $\Delta\pi = \pi_H - \pi_L$, $\Delta W = W_H - W_L$, and $\Delta\gamma = \gamma_H - \gamma_L$. The difference in outcomes between siblings is driven by two main factors:

- *Birth plannedness:* parents might have an intrinsic preference for children who have been planned, leading to better treatment hence better outcomes. Alternatively, an unexpected birth might be associated with an income shock that in turn affects future human development. For example, Angrist and Evans (1999) document the effect of an unplanned pregnancy on mothers' schooling; Goldin and Katz (2002) study the effect of access to birth control technologies on the career and marriage outcomes of American women.

- *Child endowment:* children born in auspicious years might be truly more gifted, or are believed to be so, thus benefiting from better (resp. worse) treatment from their entourage in a world where higher (resp. lower) endowment decreases (resp. increases) the relative price of investments in human capital. Note that for this effect to hold, parental beliefs about their child's endowment is sufficient: conditional on perceived endowment, true endowment does not matter for parental investments.

(ii) Cohort-composition, $\int \eta(\theta) \frac{\theta - \bar{\theta}}{1-\bar{\theta}} dF(\theta)$, whereby the unobserved ability to control fertility can also drive children's outcomes. This effect has for example been documented by Gruber et al. (1999) who found that poorer mothers were more likely to be affected by an abortion ban.

(iii) Cohort-size effects, $\left[\phi\left(1 - \bar{\theta}\frac{1-\beta}{2}\right) - \phi\left(1 - \bar{\theta}\frac{1+\beta}{2}\right)\right]$, which are either positive (peer effects, increasing returns) or negative (congestion, crowding out of common resources). Behrman and Birdsall (1988) find positive spillover among Brazilian male cohorts, arguing that larger cohorts increase the demand for skilled labor and thus the returns to schooling. On the other hand, Acemoglu, Autor and Lyle (2004) show that increased female labor supply after World War II had the effect of depressing female wages.

The expression for $\Delta^{OLS}E(y)$ also applies for the analysis of fertility planning policies and their impact on child human development outcomes. The empirical specification used in most contexts is the following difference-in-differences framework: $y_{ijkt} = \alpha_0 + \alpha_1 G_{kt} + \alpha_2 f(X_{ijkt}) + \nu_t + \eta_k + \varepsilon_{ijkt}$, where y_{ijkt} is the outcome of child j born to household i in region k in year t. G_{kt} is a measure of family planning in region k in year t, while X_{ijkt} is a vector of characteristics that include child attributes (gender, age...), household-level time-invariant characteristics (parental education and age,...), and region-level time-varying information.[12] As suggested above, under the proposed econometric specification, $\hat{\alpha}_1$ is a reduced-form estimate of the three forces at play described above. Little more can be said without making strong assumptions on the ability of observable variables $(X_{ijkt}, \nu_t, \eta_k)$ to account for cohort composition.

The context of our paper is different and offers a lot of time variation in the horoscope: it is as if family planning policies were changing every year, becoming more liberal in auspicious years, while more restrictive otherwise. Thus every household is subject to high frequency changes in fertility incentives. This allows the use of household fixed-effects that control for both observable and unobservable time-invariant factors that drive the cohort-composition effect discussed so far. This pins down to comparing siblings within families that have children born in years with varying horoscope. The average difference in outcomes $\Delta^{FE} E(y) = E(\Delta y | \gamma_1 = \gamma_H) - E(\Delta y | \gamma_1 = \gamma_L)$ then comes down to

$$\Delta^{FE} E(y) = \beta \Delta \rho + \phi \left(1 - \bar{\theta} \frac{1-\beta}{2}\right) - \phi \left(1 - \bar{\theta} \frac{1+\beta}{2}\right).$$

Our proposed specification to estimate $\Delta^{FE} E(y)$ is thus

$$y_{ijkt} = \alpha_0 + \alpha_1 G_t + \alpha_2 f(X_{ijkt}) + g(t) + \eta_j + \varepsilon_{ijkt}, \tag{8}$$

where G_t now captures the horoscope in year t. The unobserved and time-invariant household

[12] For example, in assessing the impact of family size restrictions such as the One-Child policy in China (see Qian, 2008), G_{kt} would instead capture the coerciveness of the regulatory regime in region k and year t. Similarly, a minor modification of our modeling assumptions would allow us to address the impact of abortion regulation on outcomes (assuming for example that $\Pr_{kt}(child|\text{planned}) = 1$, and $\Pr_{kt}(child|\text{unplanned}) = (1-\theta)(1-G_{kt})$, where $G_{kt} \in \{0,1\}$ indicates the abortion regulatory regime: $G_{kt} = 1$ if and only if abortion is legal in region k in year t).

variables that could be a threat to the identification of α_1 are now captured by fixed-effects η_j. On the other hand, because the horoscope is not region specific, the use of time fixed-effects is not feasible. Identification of $\Delta^{FE}E(y)$ is therefore subject to the additional assumption that the time trend $g(t)$ is correctly specified. Our empirical investigation will estimate $\Delta^{FE}E(y)$ and focus on disentangling that difference further.

4 Data

The main source of data is a 33 percent random subsample of the Vietnam 1999 Population Census, henceforth census. We use the census to construct cohort sizes. Due to the mismatch between lunar and solar calendars, years of birth have been re-computed so that say 1986 henceforth corresponds to the year of the Tiger (from February 9th, 1986 to January 29th, 1987). The year of birth of a child born in January 1986 will hence be coded 1985. We will focus solely on individuals born in and after 1977, as the country was still at war until April 1975, and we expect birth rates in 1976 to be driven by the return to peace rather than superstitious considerations. Moreover, birth timing is believed to be a fairly recent phenomenon when concerns for child quality started becoming more prevalent. Goodkind (1991), while looking at whether fertility decisions during the auspicious year of the Dragon, concludes "that the Dragon Year was not a salient factor in Chinese fertility-timing decisions until 1976" (p. 666). We will also ignore observations corresponding to children born during the census year, as the timing of the survey would mechanically imply smaller observed cohorts in these years. We thus restrict our sample to birth cohorts spanning from 1977 to 1998.

To measure educational outcomes, we extract from the census the number of years of schooling the child completed at the time of the interview. Health outcomes on the other hand are obtained from the 2000-2001 Vietnam National Health Survey, henceforth VNHS. The survey was undertaken by the Ministry of Health and the General Statistics Office and interviewed a representative sample of the population consisting of 36 000 households.

The 1999 Population Census was used as sampling frame for VNHS. Information collected includes anthropometric measures. Height is the adopted measure of long-term health. We take data on individual height to compute height-for-age z-scores using the UK reference growth charts. The computation follows Cole (1990). The measures hence obtained are arguably comparable across gender and age groups; even though the reference group consists of British individuals, they apply to other countries as well (see Wagstaff et al., 2003 for an application to Vietnam).

Table 2 presents summary statistics of the variables used for the present analysis. An interesting fact to note is that, while the fraction of auspicious years for either boys or girls is 63.6 percent, 69.0 percent of children in the census are born in these auspicious years. This difference is a first indication of fertility decisions being influenced by the horoscope. The following section addresses this question formally.

5 Empirical Results

5.1 Astrology and birth timing

We first look at the extent to which fertility timing decisions are correlated with the Vietnamese horoscope by estimating the following equation:

$$\ln N_t = a_0 + a_1 t + a_2 t^2 + cG_t + e_t, \tag{9}$$

in which N_t is the national-level aggregate number of children born in year t, G_t is the dummy variable that is equal to 1 if year t is an auspicious year according to Vietnamese astrology, and 0 otherwise.

As discussed in section 2, males are "Yang" and females are "Yin", so that horoscopes for boys and girls are likely to be different. We will thus adopt several specifications for variable G_t : (i) whether year t brings luck to boys, (ii) girls, (iii) both, or (iv) either. The results of the estimation of (9) are shown in Table 3, panel A. The first column shows significantly larger cohort sizes in years that are auspicious for either boys or girls. The difference is estimated to 11.7 percent, which is similar to earlier estimates from Goodkind (1996) who finds a 12 to 22 percent increase in fertility during the years of the Dragon (1976, 1988) among Chinese households in Singapore. Columns 2 and 3 suggest that this effect is not driven by the horoscope of a specific gender. It seems that parents seek years that are auspicious for either of the two genders rather than just for boys or just for girls. Furthermore, this phenomenon appears to hold in rural areas (column 5), among Christian and Muslim populations (column 6), and ethnic groups other than the Kinh and Chinese (column 7), although the coefficient in this case is smaller and marginally statistically significant. We also tested for first and second order serial correlation, and could not reject the null hypothesis of neither first nor second-order serial correlation of the error terms. We next investigate whether cohorts of boys and girls behave differently, as we might expect sex-selective abortion or gender-biased infant mortality rates. No evidence of such phenomenon is detected as documented in Table 3, panel B. Boys and girls cohorts respond similarly to the horoscope with no noticeable difference.

Graphically, the effect of astrology is illustrated in Figure 1. The horizontal axis represents time. The smooth line predicts birth rates at the national level (predicted value of the regression of the logarithm of cohort size on a quadratic time trend), while the connected line shows actual country-level cohort sizes. We first notice a sharp fertility transition since the end of the 1980s, coinciding with the beginning of the "Doi Moi", or transition towards a market economy. The results found above indicate that most auspicious years (for boys, for girls, or both) are above the predicted line. Although Vietnamese, Chinese and Korean horoscope are similar, we can see graphically that Vietnamese data exhibit neither a "dragon-year baby boom" in 1988, nor a "horse-year baby bust" in 1978 or 1990 contrary to the findings of Goodkind (1996) and Lee and Paik (2006) respectively. One reason for this, is that according to Vietnamese astrology, the year of the dragon is not systematically an auspicious year and neither is the year of the horse always bad omen as shown in Table 1. Nevertheless, some zodiac animals (Zhi) such as the Snake are never good omen, while others, e.g. the Goat or the Pig, are never bad omen. We might then expect large fertility responses during these years. Appendix Table A2 does not show any evidence of a Goat-year or Pig-year "baby boom" (column 1) but some indication of a Snake-year "baby bust" (column 2).[13]

5.2 Reduced-form results

We now test the hypotheses discussed in the previous section. We estimate the following equation:

$$y_{ijt} = a_0 + a_1 t + a_2 t^2 + cG_t + X_{ijt} b + e_{ijt}, \tag{10}$$

in which y_{ijt} is the outcome of interest (education and health) for child i born in year t into family j, and X_{ijt} includes individual, household and commune-level controls. In all subsequent specifications, G_t is a dummy variable which is equal to 1 if child $i's$ year of birth t is auspicious for either boys or girls, and 0 otherwise. Standard errors are clustered at the year-of-birth level.

Table 4 shows the result from the estimation of (10). Column 1 shows that a child born in an auspicious year is likely to stay 0.3 more years in school. No comparable effect is detected when looking at long-term health, measured by height-to-age (column 4). We include household, parental and commune-level controls in the estimation of (10). The results in columns 2 and 5 show smaller coefficients, yet qualitatively similar to the estimates provided in the regressions without controls. Although parents' socioeconomic background

[13] Appendix Table A2 also looks at alternative specifications for G_t, given that years can be auspicious, inauspicious but also "neutral" (see Table 1). In particular, column 3 suggests that parents do not necessarily try to avoid years that are bad omen for either boys or girls. Yet, as shown in columns 4 and 5, cohorts in inauspicious years for boys are significantly smaller. However, there are only three such years in our sample, and these years also overlap with our original variable. Column 6 presents the results of the estimation of (9) after dropping years that are inauspicious for boys, and the results suggest that our earlier results are not so much driven by parents avoiding inauspicious years, but rather by parents aiming at auspicious years. Finally, column 7 restricts the sample to children for whom we have data on education, i.e. children above the age of 5 at the time of the census: results are stronger than with the entire sample.

might affect child's educational outcome, controlling for observable characteristics does not affect dramatically the observed positive correlation between astrology and schooling. As emphasized in the theoretical section, $\hat{c}^{OLS}$ is an estimate of $\Delta^{OLS}E(y)$, the combined effects of sibling heterogeneity, cohort composition and cohort size spillovers.

To account for cohort composition, we estimate $\Delta^{FE}E(y)$ by estimating a parametric version of (8):

$$y_{ijt} = a_0 + a_1 t + a_2 t^2 + cG_t + X_{ijt}b + \eta_j + u_{ijt} \tag{11}$$

Education policies and infrastructure being largely determined at the provincial level, we cluster standard errors at the province level in education regressions, and at the commune-level for health regressions.[14] The results are presented in columns 3 and 6, and are consistent with the ones presented previously. While no significant difference in height is detected, children born in auspicious years report higher levels of schooling than their *siblings* born in non-auspicious years (column 3). Thus, we draw the conclusion that the observed difference in schooling is not entirely driven by a selection bias, whereby parents better able to time fertility in tune with the horoscope are also better able to invest in their children's human capital. Given that the cohort-composition effect has been dealt with, we are then left with fewer alternative mechanisms to which we now turn.

5.3 What are the mechanisms at work?

First, *the cohort-size channel* assumes that the horoscope affects education through increased birth cohort sizes. In our context, this would mean that larger cohorts generate positive spillovers. Second, the *child endowment* channel, through which children born in auspicious years are intrinsically more gifted or beliefs that they are so induce better treatment, assuming resources and endowment are complements. Finally, the *birth plannedness* channel: in an auspicious year, children are more likely to have been planned, so that financial or affective conditions for their future growth are likely to be more favorable.

[14] The commune is the smallest administrative unit in Vietnam. The country consists of 10 090 communes grouped into 589 districts that form 58 provinces as of 1999.

5.3.1 Cohort size

We first attempt to rule out cohort-size effects and test the hypothesis $H_0 : \phi'(.) = 0$. Controlling for cohort size in equation (11) does not allow identification of c as larger cohorts are also better-off cohorts. We nevertheless add measures of cohort size in equation (11), with the expectation that the estimate of c is going to be biased downward. In Table 5, column 1 reproduces the result of Table 4 column 3 for comparison. Columns 2-4 control for commune, district and province-level cohort sizes respectively. While the "auspicious-year" coefficient effectively drops, it remains positive and statistically significant. An alternative approach is to instead estimate the following equation:

$$y_{ijkt} = a_0 + dN_{kt} + X_{ijkt}b + \eta_j + \nu_t + u_{ijt}$$

where y_{ijkt} is educational outcomes for child i born to household j in region k and year t. Family and year-of-birth fixed effects are controlled for and d therefore captures the extent of cohort size spillover. Results are presented in Table 5, columns 5-7: cohort sizes at the commune, district or province-level do not show any statistically significant association with educational outcomes. We therefore cannot reject that there are no cohort size spillovers i.e. that $\phi'(.) = 0$. We consequently rule out the possibility that our results are driven by the positive effect of larger birth cohorts characterizing auspicious years.

5.3.2 Explaining sibling heterogeneity: child endowment or birth plannedness?

Cohort composition being controlled for and cohort size spillovers being ruled out, sibling heterogeneity is hereafter the reduced-form effect of child endowment and birth plannedness. We can rewrite $\Delta^{FE}E(y)$ as follows:

$$\text{(12)} \qquad \Delta^{FE}E(y) = \beta\Delta\rho \cong \beta\left\{\underbrace{\left[\rho_Z\cdot(\xi_\pi\ \Delta\pi + \xi_W\ \Delta W)\right]}_{birth\ plannedness} + \underbrace{\left[\left(\rho_Z\cdot\xi_\gamma + \rho_\gamma\right)\ \Delta\gamma\right]}_{child\ endowment}\right\}.$$

The child endowment effect, $\left[\left(\rho_Z\cdot\xi_\gamma + \rho_\gamma\right)\ \Delta\gamma\right]$, is driven by two dimensions of child endowment: *true* and *perceived* endowment. The child's true endowment has a direct effect on his or her subsequent human development, while his/her perceived endowment (whether it reflects the truth or not) affects the relative price of education, that in turn determines parental investments and eventually child outcomes. Assuming that being born in an auspicious year does not determine true but only perceived endowment, we will be able to assess the extent to which differences across siblings are driven by initial differences in perceived endowment that are then exacerbated by parents' allocation of resources across children. The child endowment effect is therefore reduced to $\left[\left(\rho_Z \cdot \xi_\gamma\right)\ \Delta\gamma\right]$ and, given that ρ_Z and $\Delta\gamma$ are positive, validating the (perceived) child endowment channel is equivalent to rejecting $H_0 : \xi_\gamma \leq 0$.

The alternative effect, $[\rho_Z \cdot (\xi_\pi\ \Delta\pi + \xi_W\ \Delta W)]$, has to do with birth plannedness: child outcomes are driven by parental socioeconomic conditions at the time of birth ($\rho_Z \cdot \xi_W > 0$) and also by their intrinsic preference for the newborn, irrespective of his or her gender, birth order or other attributes ($\rho_Z \cdot \xi_\pi > 0$). Untimely pregnancies can lead to worse human development outcomes if these are associated with an adverse income shock ($\Delta W < 0$), or by parental "aversion" vis-à-vis a child born unplanned ($\Delta\pi < 0$). A test of the birth plannedness channel thus pins down to a test of hypothesis $H_0 : \Delta W \leq 0$ and $\Delta\pi \leq 0$.

In order to implement these tests, we observe that the gender of the future child is not known when the fertility decision is made, and that auspicious years for boys usually differ from auspicious years for girls. We can then see whether ex-ante planning or ex-post horoscope matter for subsequent human development outcomes. If child endowment is the driving force behind our results, then a boy must be born in an auspicious year for boys, and a girl must be born in an auspicious year for girls in order to be privileged. On the other hand, in the birth plannedness scenario, irrespective of gender, being born in an auspicious year for either boys or girls is the only thing that matters. We construct the dummy variable *born-lucky* defined by $g_{ijt} = 1$ if and only if child i born to family j in year t is a boy and t is an auspicious year for boys, or i is a girl and t is an auspicious year for girls. We then estimate equation (11) with both variables G_t and g_{ijt} on the right-hand side. Results are presented in Table 6, columns 1 and 2. The results suggest that most difference in education are driven by fertility planning rather than the self-fulfilling horoscope. Admittedly the two variables G_t and g_{ijt} are highly correlated with a correlation coefficient of 0.75, making a definitive interpretation of the results difficult.

To address this issue further, we restrict the sample to birth cohorts born in auspicious years for either boys or girls. We compare children for whom horoscope and gender match ($g_{ijt} = 1$: boys born in years auspicious for boys and girls born in years auspicious for girls) with children for whom they don't ($g_{ijt} = 0$: boys born in years auspicious for girls only and girls born in years auspicious for boys only). By construction, the sample of children considered in this analysis is characterized by $\Delta W = \Delta\pi = 0$, so that in regression

$$E\left(y_{ijt}|G_t = 1\right) = a_0 + a_1 t + a_2 t^2 + c g_{ijt} + X_{ijt} b + \eta_j + E\left(e_{ijt}|G_t = 1\right),$$

$\hat{c} = \beta E\left[\widehat{\left(\rho_Z \cdot \xi_\gamma\right)}\ \Delta\gamma\right]$. Table 6, columns 3 and 4 show the results of the estimation, and if anything, among birth cohorts born in auspicious years, being *lucky* is negatively correlated with schooling outcomes. However, given the gender-biased nature of the horoscope (there are twice as many years auspicious for boys than years auspicious for girls), the negative coefficient also reflects the fact that overall, boys have fewer years of schooling than girls born in the same year (cf. table 4). We nevertheless leave open the possibility that the negative coefficient reflects parental compensation for *unlucky* children who were otherwise planned.

An alternative approach consists of restricting our sample to a subset of children for whom $\Delta\gamma = 0$. We therefore focus on children such that $g_{ijt} = 0$: these are boys born in a year auspicious for girls only (hence not auspicious for boys), girls born in a year auspicious for boys only (hence not auspicious for girls), and children born in a year auspicious for neither boys, nor girls. If, for this subset, we run the following regression:

$$E\left(y_{ijt}|g_{ijt} = 0\right) = a_0 + a_1 t + a_2 t^2 + c G_t + X_{ijt} b + \eta_j + E\left(e_{ijt}|g_{ijt} = 0\right),$$

then $\hat{c} = \beta E\left[\rho_Z \cdot \left(\xi_\pi\ \widehat{\Delta\pi} + \xi_W\ \Delta W\right)\right]$. Rejecting $H_0 : c \leq 0$, is evidence that $\Delta W > 0$ or $\Delta\pi > 0$. Column 5 in table 6 shows that among *unlucky* children, those who were born in a year auspicious for either boys or girls are doing better than otherwise; even though the horoscope is not favorable to these children, being the fruit of fertility planning translates into better schooling outcomes.

The results presented here suggest that the intra-household allocation of resources does not depend on parental perceived endowment of the child as we could not reject the null that $\xi_\gamma \leq 0$. Thus, differences in outcomes between siblings is not driven as much by a relative price effect of education as it is by birth plannedness, which is either an income effect ($\Delta W > 0$) or an intrinsic difference in taste for children ($\Delta\pi > 0$) who were planned versus their siblings who were not.

5.3.3 More on birth plannedness

Given that birth planning seems to be central in explaining differences in outcomes between siblings, we come back to the question of child wantedness. As we mentioned in the introduction, we did not refer to child wantedness throughout the paper because we believed that the literature on child wantedness had largely been assuming away the income effect that accompanies an unplanned pregnancy ($\Delta W > 0$), and reduced its interpretation to a preference argument: unwanted children are worse-off because parents intrinsically value them relatively less than their "wanted" siblings ($\Delta\pi > 0$). Our results so far do not allow us to disentangle these two alternative explanations of birth plannedness. We have so far isolated the path linking the horoscope to schooling outcomes:

$$\Delta^{FE}E(y) \cong \beta \left[\rho_Z \cdot \left(\underbrace{\xi_\pi \, \Delta\pi}_{taste\ shock} + \underbrace{\xi_W \, \Delta W}_{income\ shock} \right)\right]$$

Looking at the heterogeneity of the effect of the horoscope on educational attainment might allow us to push the analysis further. Differences in the effect of the horoscope across groups are driven by:

(i) Prevalence of superstitious beliefs: If members of a group are not superstitious, then comparing cohorts with differing horoscope is irrelevant, while widespread superstition translates into large sibling heterogeneity as $\frac{\partial}{\partial\beta}\Delta^{FE}E(y) \geq 0$.

(ii) Credit constraints: in our model, we assumed that parents do not have access to credit

markets to optimally allocate income across periods. To somehow relax this assumption, we assume that heterogeneity in credit market access can be captured by heterogeneity across groups in the magnitude of ΔW. With perfect credit markets, $\Delta W = 0$. If an unplanned pregnancy is associated with a larger income shock, then one might expect larger sibling differences when access to credit is more difficult as $\frac{\partial}{\partial \Delta W} \Delta^{FE} E(y) \geq 0$.
(iii) Family endowments: another source of heterogeneity works through differences in family endowments. Parents can differ by how they value or perceive the average "quality" of their offspring, and by their average income level. In the model, the determinants of sib heterogeneity are the differences in resources between planned and unplanned children (namely ΔW, $\Delta\pi$, and $\Delta\gamma$), while difference-in-differences also depend on family endowments, i.e. $\frac{1}{2}(W_L + W_H)$, $\frac{1}{2}(\pi_L + \pi_H)$, and $\frac{1}{2}(\gamma_L + \gamma_H)$. Thus, whether the birth plannedness effect is stronger among larger, wealthier and more educated families living in urban areas is ambiguous. We effectively expect this subset of families to put a higher emphasis on the quality versus quantity of children, be wealthier and face a smaller price of education. While more average schooling is unambiguously expected for children of these families, the relative magnitude of sibling heterogeneity is uncertain and is ultimately an empirical question.

We estimate (10) with family fixed-effects and interaction terms. Table 7 displays the regression results. Birth plannedness seems to affect boys more than girls. Moreover, the results indicate that birth plannedness matters less for first-born children, as we expect the first child in the family to be expected eventually (column 1). Columns 2 to 7 document how household characteristics affect the relationship between astrology and schooling. Columns 2 to 4 document a larger effect of birth plannedness in smaller families (column 2), in families with more educated parents holding more assets (column 3), or in urban families (column 4). As these families are expected to be less rather than more credit constrained, the positive coefficient suggests that either superstition is more prevalent among this subgroup, or differences in family endowments yield wider sibling heterogeneity. Column 5 indicates a larger effect of the horoscope on educational outcomes among ethnic minorities (non-Kinh and non-Hoa): while ethnic minorities are less likely to adhere to Vietnamese astrology (as suggested in the fertility response regressions, Table 3, panel A), previous evidence suggests that differences in family endowments would have yielded an opposite result: the negative interaction term is then suggestive evidence that more restricted access to credit markets however makes it more difficult to cope with an unplanned pregnancy.

6 Conclusion

Superstition in Vietnam seems pervasive. Years that might bring luck to girls or boys have birth cohorts 12 percent larger on average over the period 1977-1998. We find that overall, being born in these years does not have an effect on health but increases years of schooling by 2 months or 0.06 standard deviations. Our findings suggest that birth planning plays an important role in explaining the observed differences: children that have been planned are born in economic and emotional environments that are more conducive to human development. We find suggestive evidence that financial conditions at the time of birth matter. One question yet remains: what explains the persistence of superstition? If the persistence of superstitious beliefs is driven by observational data, why don't parents factor out the effects described in the paper and update their beliefs accordingly? This remains a puzzle to us.

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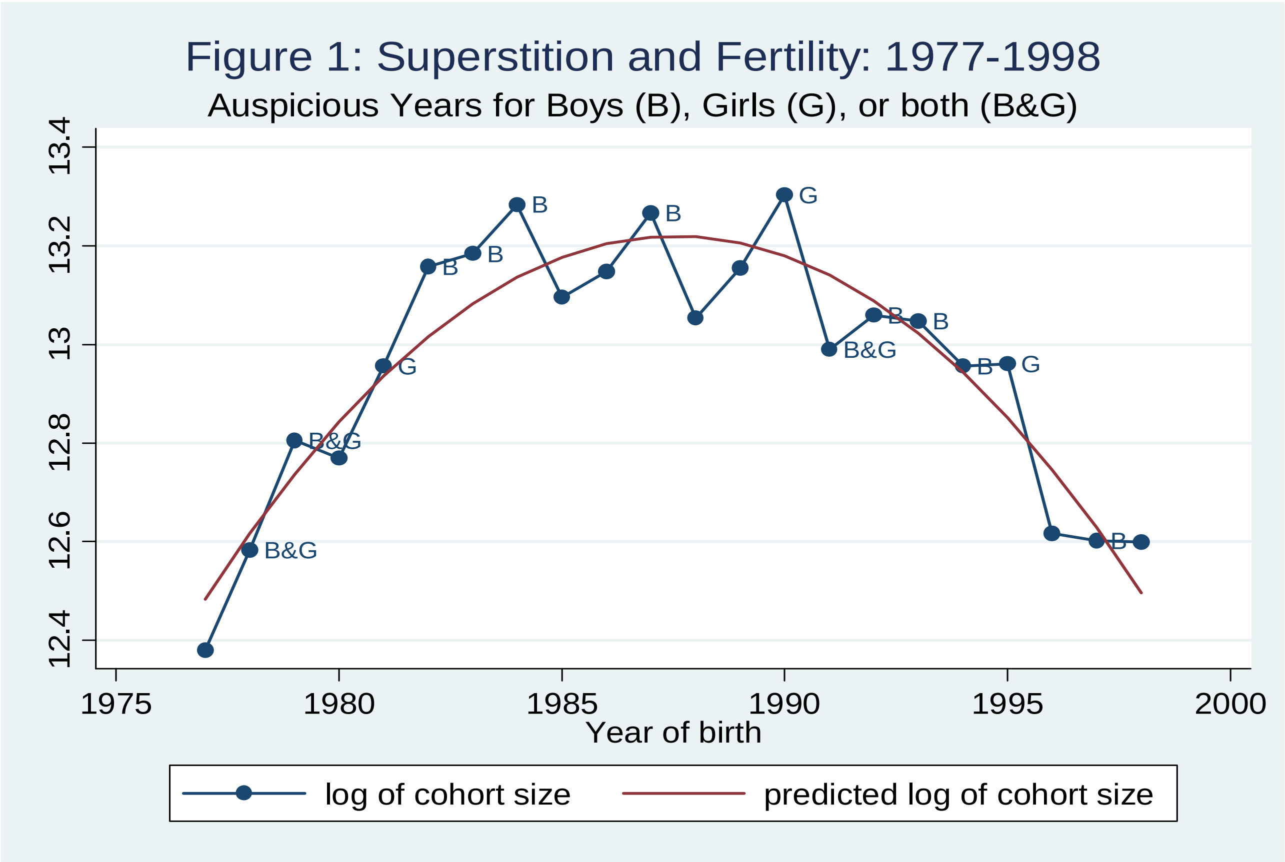
Figure 1: Superstition and Fertility: 1977-1998



Data source: 1999 Population Census.

Table 1: Vietnamese horoscope 1977-1998

Birth year	Name of year*	Boy	Girl
1977	Dinh Ty (Fire Snake)	Neutral	Bad omen
1978	Mau Ngo (Earth Horse)	Good omen	Good omen
1979	Ky Mui (Earth Goat)	Good omen	Good omen
1980	Canh Than (Metal Monkey)	Bad omen	Bad omen
1981	Tan Dau (Metal Rooster)	Neutral	Good omen
1982	Nham Tuat (Water Dog)	Good omen	Bad omen
1983	Quy Hoi (Water Pig)	Good omen	Neutral
1984	Giap Ty (Wood Rat)	Good omen	Bad omen
1985	At Suu (Wood Ox)	Bad omen	Bad omen
1986	Binh Dan (Fire Tiger)	Neutral	Bad omen
1987	Dinh Mao (Fire Rabbit)	Good omen	Bad omen
1988	Mau Thin (Earth Dragon)	Neutral	Neutral
1989	Ky Ty (Earth Snake)	Bad omen	Neutral
1990	Canh Ngo (Metal Horse)	Neutral	Good omen
1991	Tan Mui (Metal Goat)	Good omen	Good omen
1992	Nham Than (Water Monkey)	Good omen	Bad omen
1993	Quy Dau (Water Rooster)	Good omen	Bad omen
1994	Giap Tuat (Wood Dog)	Good omen	Neutral
1995	At Hoi (Wood Pig)	Neutral	Good omen
1996	Binh Ty (Fire Rat)	Neutral	Neutral
1997	Dinh Suu (Fire Ox)	Good omen	Bad omen
1998	Mau Dan (Earth Tiger)	Neutral	Bad omen

* Name of year is given in Vietnamese
Data source: see Table A1

Table 2: Summary statistics

	N.	mean	std dev.	min	max
Cross sectional data 1977-1998 (1999 Population Census)					
Individual-level characteristics					
Number of years of schooling	7,026,416	5.472	3.072	0	14
Gender (1:boy,0:girl)	9,261,468	0.519	0.500	0	1
Year of birth	9,261,468	1,987.121	5.453	1,977	1,997
Birth order	9,261,468	2.239	1.316	1	15
Year of birth is auspicious for either boys or girls (1:yes,0:no)	9,261,468	0.690	0.463	0	1
Year of birth is auspicious for boys (1:yes,0:no)	9,261,468	0.533	0.499	0	1
Year of birth is auspicious for girls (1:yes,0:no)	9,261,468	0.274	0.446	0	1
Year of birth is auspicious for both boys and girls (1:yes,0:no)	9,261,468	0.118	0.323	0	1
Household-level characteristics					
Number of siblings	3,863,389	2.671	1.385	1	15
Age of mother in 1999	3,784,783	38.057	9.794	15	77
Mother's number of years of schooling	3,392,138	7.110	3.020	0	14
Age of father in 1999	3,436,940	40.410	10.487	16	96
Father's number of years of schooling	3,147,216	7.606	2.982	0	14
Ethnicity (1:Kinh or Chinese, 0:others)	3,863,389	0.872	0.334	0	1
Religion (1: Christian or Muslim;0:others)	3,863,389	0.092	0.289	0	1
Household lives in urban area (1:yes,0:no)	3,863,389	0.216	0.411	0	1
House is permanent or semi-permanent (1:yes,0:no)	3,860,048	0.614	0.487	0	1
House area (sq m)	3,845,053	268.598	402.913	1	999
Household has running or rain water (1:yes,0:no)	3,861,060	0.761	0.426	0	1
Household has electricity (1:yes,0:no)	3,859,989	0.214	0.410	0	1
Household has flush toilet (1:yes,0:no)	3,858,770	0.152	0.359	0	1
Household has a TV (1:yes,0:no)	3,856,586	0.552	0.497	0	1
Household has a radio (1:yes,0:no)	3,859,059	0.456	0.498	0	1

Table 2 (cont'ed): Summary statistics

	N.	mean	std dev.	min	max
Time series data 1977-1998 (1999 Population Census)					
Cohort size (all individuals)	22	435,461	105,406	238,105	599,368
Cohort size (boys)	22	225,731	51,111	141,846	307,552
Cohort size (girls)	22	209,730	54,683	96,259	291,816
Cohort size (urban areas)	22	79,495	18,036	45,624	111,448
Cohort size (rural areas)	22	355,966	89,464	180,234	500,213
Year of birth is auspicious for either boys or girls (1:yes,0:no)	22	0.636	0.492	0	1
Year of birth is auspicious for boys (1:yes,0:no)	22	0.500	0.512	0	1
Year of birth is auspicious for girls (1:yes,0:no)	22	0.273	0.456	0	1
Year of birth is auspicious for both boys and girls (1:yes,0:no)	22	0.136	0.351	0	1
Cross sectional data 1977-2000 (2000-2001 Vietnam National Health Survey)					
Individual-level characteristics					
Height (cm)	58,883	136.161	23.461	60.0	186.6
Height to age (z-score)	55,246	-1.710	1.057	-8.613	7.383
Gender (1:boy,0:girl)	61,586	0.531	0.499	0	1
Year of birth	61,586	1,988.720	5.785	1,977	2,000
Birth order	61,586	2.046	1.173	1	11
Year of birth is auspicious for either boys or girls (1:yes,0:no)	61,586	0.630	0.483	0	1
Year of birth is auspicious for boys (1:yes,0:no)	61,586	0.491	0.500	0	1
Year of birth is auspicious for girls (1:yes,0:no)	61,586	0.241	0.428	0	1
Year of birth is auspicious for both boys and girls (1:yes,0:no)	61,586	0.102	0.303	0	1
Household-level characteristics					
Number of siblings	26,549	2.443	1.222	1	11
Age of mother in 1997-1998	26,134	40.356	9.624	18	84
Mother's number of years of schooling	24,220	7.040	3.937	0	15
Age of father in 1997-1998	23,636	42.542	10.045	18	86
Father's number of years of schooling	22,719	7.813	3.788	0	15
Household lives in urban area (1:yes,0:no)	26,549	0.219	0.414	0	1
Ethnicity (1:Kinh or Chinese, 0:others)	26,549	0.773		0	1
Religion (1: Christian or Muslim;0:others)	26,549	0.197	0.398	0	1
Per capita expenditures ('000 VND)	26,507	3,811	4,358	199	389,507

Notes: statistical weights applied to observations from VNHS

Table 3, panel A: Fertility response to the Vietnamese horoscope (1977-1998)

	Dependent variable logarithm of birth cohort size						
	All				**rural area**	**Christian or Muslim**	**non-Kinh and non-Chinese**
Independent variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Year is auspicious for either boys or girls (1:yes,0:no)	0.111***				0.105***	0.087***	0.075*
	(0.035)				(0.038)	(0.032)	(0.042)
Year is auspicious for boys (1:yes,0:no)		0.056					
		(0.042)					
Year is auspicious for girls (1:yes,0:no)			0.033				
			(0.055)				
Year is auspicious for both boys and girls (1:yes,0:no)				-0.051			
				(0.069)			
Year	25.746***	26.164***	26.511***	25.948***	27.046***	19.819***	26.476***
	(2.324)	(2.408)	(2.506)	(2.707)	(2.517)	(2.175)	(2.737)
Year squared	-0.006***	-0.007***	-0.007***	-0.007***	-0.007***	-0.005***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Durbin Watson test of first-order serial correlation	1.863	2.125	1.956	2.082	1.871	2.053	2.157
Durbin test of second-order serial correlation (chi squared)	0.594	1.207	0.588	2.132	0.723	1.650	3.922
Durbin test of second-order serial correlation (P-value)	0.743	0.547	0.745	0.344	0.697	0.438	0.141
Number of observations	22	22	22	22	22	22	22
Adjusted R-squared	0.891	0.855	0.845	0.846	0.889	0.842	0.909

Note: Robust standard errors in parentheses. The symbols *, **, and *** indicate that the coefficient is statistically significant at the 10, 5, and 1 percent level respectively. Constant not reported.

Table 3, panel B: Gender-specific fertility response to the Vietnamese horoscope (1977-1998)

	Dependent variable: logarithm of birth cohort size							
	Boys	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**
Independent variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Year is auspicious for either boys or girls (1:yes,0:no)	0.107***	0.117***						
	(0.033)	(0.042)						
Year is auspicious for boys (1:yes,0:no)			0.055	0.057				
			(0.039)	(0.047)				
Year is auspicious for girls (1:yes,0:no)					0.034	0.033		
					(0.053)	(0.062)		
Year is auspicious for both boys and girls (1:yes,0:no)							-0.040	-0.061
							(0.060)	(0.086)
Year	23.355***	28.641***	23.752***	29.086***	24.106***	29.438***	23.615***	28.800***
	(2.048)	(2.855)	(2.105)	(2.980)	(2.146)	(3.159)	(2.242)	(3.495)
Year squared	-0.006***	-0.007***	-0.006***	-0.007***	-0.006***	-0.007***	-0.006***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Test of difference in slopes boys/girls	-0.010		-0.002		0.002		0.020	
	(0.023)		(0.021)		(0.028)		(0.039)	
Number of observations	22	22	22	22	22	22	22	22
Adjusted R-squared	0.889	0.882	0.850	0.849	0.839	0.841	0.837	0.843

Note: Robust standard errors in parentheses. The symbols *, **, and *** indicate that the coefficient is statistically significant at the 10, 5, and 1 percent level respectively. Constant not reported. The test is constructed by regressing the logarithm of the sex ratio on the same set of independent variables and by taking the coefficient on the auspicious year dummy variable

Table 4: Astrology and human development outcomes

Independent variables	Dependent variables: Education (years) (1)	(2)	(3)	Height to age (z-score) (4)	(5)	(6)
Year of birth is auspicious (1:yes,0:no)	0.291**	0.242**	0.206***	-0.004	-0.017	0.009
	(0.130)	(0.115)	(0.018)	(0.039)	(0.041)	(0.014)
Gender (1:boy,0:girl)	-0.119***	-0.067***	-0.008	-0.075***	-0.052**	-0.050***
	(0.016)	(0.020)	(0.028)	(0.024)	(0.024)	(0.014)
Mother's age (years)		0.006***			-0.001	
		(0.001)			(0.002)	
Mother's education (years)		0.086***			0.029***	
		(0.017)			(0.006)	
Father's age (years)		0.007***			0.011***	
		(0.002)			(0.002)	
Father's education (years)		0.112***			-0.013*	
		(0.020)			(0.007)	
Ethnicity (1:Kinh, Chinese, 0:others)		0.323***			0.044**	
		(0.065)			(0.019)	
Religion (1:Christian or Muslims;0:others)		-0.112***			-0.019	
		(0.039)			(0.021)	
Household socio-economic status	no	yes	no	no	yes	no
Family size dummies	yes	yes	no	yes	yes	no
Family fixed-effects	no	no	yes	no	no	yes
Cluster	year of birth	year of birth	province	year of birth	year of birth	commune
Number of observations	7,026,416	5,461,074	7,026,416	55,246	43,795	55,246
Adjusted R2	0.596	0.701	0.782	0.051	0.120	0.712

Note: Standard errors in parentheses, clustered at the year-of-birth level (columns 1-2, 4-5), the province level (column 3) or the commune level (column 6). The symbols *, **, and *** indicate that the coefficient is statistically significant at the 10, 5, and 1 percent level respectively. All regressions include a constant, a quadratic time trend, a set of month of birth and birth order dummies. Socio-economic status is captured by assets (Census, columns 1-3) and per capita expenditure (Survey, columns 4-6)

Table 5: Cohort-size effects

Independent variables	Dependent variable: Education (years)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Year of birth is auspicious (1:yes,0:no)	0.206***	0.176***	0.173***	0.215***			
	(0.018)	(0.019)	(0.037)	(0.051)			
Logarithm of commune-level birth cohort size		0.200			0.183		
		(0.131)			(0.138)		
Logarithm of district-level birth cohort size			0.216			0.178	
			(0.281)			(0.320)	
Logarithm of province-level birth cohort size				-0.057			-0.176
				(0.367)			(0.468)
Year of birth fixed-effects	no	no	no	no	yes	yes	yes
Number of observations	7,026,416	7,026,416	7,026,416	7,026,416	7,259,248	7,259,248	7,259,248
Adjusted R-squared	0.782	0.782	0.782	0.782	0.785	0.785	0.785

Note: Standard errors in parentheses, clustered at the province level. The symbols *, **, and *** indicate that the coefficient is statistically significant at the 10, 5, and 1 percent level respectively. All regressions include a constant, a quadratic time trend, family fixed-effects, a gender dummy, and a set of month of birth and birth order dummy variables.

Table 6: Child endowment versus birth plannedness

	Dependent variable: Education (years)				
	Full sample		**Auspicious year cohorts**		**"Unlucky" child**
Independent variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Child is born lucky (1:yes;0:no)	0.043***	-0.149***	-0.211***	-0.408***	
	(0.009)	(0.006)	(0.014)	(0.029)	
Interaction Gender * Child is born lucky				0.434***	
				(0.045)	
Year of birth is auspicious (1:yes,0:no)		0.292***			0.230***
		(0.020)			(0.022)
Gender (1:boy;0:girl)	-0.020	0.030	-0.086**	-0.166***	-0.103***
	(0.029)	(0.029)	(0.041)	(0.029)	(0.024)
Family fixed-effects	yes	yes	yes	yes	yes
Cluster	province	province	province	province	province
Number of observations	7,026,417	7,026,416	4,582,366	4,582,366	4,221,978
Adjusted R2	0.780	0.782	0.793	0.793	0.771

Note: Robust standard errors in parentheses, clustered at the province-level. The symbols *, **, and *** indicate that the coefficient is statistically significant at the 10, 5, and 1 percent, respectively. Regressions include a constant, a quadratic time trend, a set of birth order dummies, and month of birth dummies. Columns 3 and 4 restrict to years that are auspicious for neither boys nor girls. Column 5 restricts to boys born in years not auspicious for boys and girls born in years not auspicious for girls.

Table 7: Heterogeneity in response to the horoscope

	Dependent variable: Education (years)					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Main effect						
Year of birth is auspicious for either boys or girls (1:yes;0:no)	0.122***	0.314***	-0.073*	-0.118**	0.341***	-0.039
	(0.022)	(0.025)	(0.038)	(0.051)	(0.055)	(0.073)
Interaction of auspicious year dummy variable with:						
Gender (1:boy,0:girl)	0.062***	0.049***	0.058***	0.058***	0.048***	0.058***
	(0.012)	(0.011)	(0.012)	(0.012)	(0.011)	(0.012)
Birth order	0.022***	0.078***	0.088***	0.088***	0.079***	0.088***
	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Number of siblings		-0.082***	-0.064***	-0.064***	-0.083***	-0.063***
		(0.007)	(0.006)	(-0.092)	(0.008)	(0.007)
Mother's education (years of schooling)			0.019***	0.019***		0.018***
			(0.003)	(0.003)		(0.003)
Father's education (years of schooling)			0.023***	0.023***		0.023***
			(0.002)	(0.002)		(0.002)
Household lives in permanent or semi-permanent home (1:yes;0:no)			0.047***	0.045***		0.053***
			(0.016)	(0.016)		(0.015)
Household has flush toilet (1:yes;0:no)			0.041**	0.056***		0.060***
			(0.019)	(0.016)		(0.017)
Household lives in an urban area (1:yes;0:no)				0.031***		0.030**
				(0.012)		(0.012)
Ethnicity (1:Kinh or Chinese;0:other)					-0.072**	-0.113***
					(0.029)	(0.025)
Religion (1:Christian or Muslim;0:other)					0.043	0.027
					(0.048)	(0.033)
Number of observations	7,026,416	7,026,416	5,482,348	5,482,348	7,026,416	5,482,348
Adjusted R2	0.782	0.782	0.785	0.785	0.782	0.785

Note: Robust standard errors in parentheses clustered at the province level. The symbols *, **, and *** indicate that the coefficient is statistically significant at the 10, 5, and 1 percent level respectively. All regressions include a constant, a quadratic time trend, a set of birth order dummies, month of birth dummies, and family fixed-effects. Coefficients of interactions with some asset variables not presented when there is no statistical significance to report.

Appendix Table A1: the Vietnamese horoscope cycle

		Rat	Ox	Tiger	Rabbit	Dragon	Snake	Horse	Goat	Monkey	Rooster	Dog	Pig
Metal	Boy	Bad	Neutral	Neutral	Good	Neutral	Bad	Neutral	Good	Bad	Neutral	Neutral	Good
	Girl	Neutral	Neutral	Bad	Neutral	Bad	Neutral	Good	Good	Bad	Good	Neutral	Good
Water	Boy	Neutral	Neutral	Good	Neutral	Good	Neutral	Good	Good	Good	Good	Good	Good
	Girl	Bad	Bad	Bad	Bad	Neutral	Bad	Bad	Good	Bad	Bad	Bad	Good
Wood	Boy	Good	Bad	Good	Bad	Good	Neutral	Good	Good	Neutral	Bad	Good	Neutral
	Girl	Bad	Bad	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Bad	Neutral	Neutral	Good
Fire	Boy	Neutral	Good	Neutral	Good	Neutral	Neutral	Neutral	Good	Bad	Good	Neutral	Good
	Girl	Neutral	Bad	Bad	Bad	Bad	Bad	Good	Good	Bad	Bad	Bad	Neutral
Earth	Boy	Neutral	Bad	Neutral	Neutral	Neutral	Bad	Good	Good	Bad	Bad	Bad	Good
	Girl	Good	Neutral	Bad	Good	Neutral	Neutral	Good	Good	Bad	Neutral	Good	Good

Data Source: *Lich Van Nien* (Nha Xuat Ban Dan Toc Publishing house, 1999)

Appendix Table A2: Fertility response to the horoscope

	Dependent variable logarithm of birth cohort size						
	All					80-85-89 excluded	1977-1994
Independent variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Year of the Goat or Year of the Pig (1:yes,0:no)	0.039						
	(0.064)						
Year of the Snake (1:yes,0:no)		-0.091**					
		(0.038)					
Year is inauspicious for either boys or girls (1:yes,0:no)			-0.020				
			(0.044)				
Year is inauspicious for boys (1:yes,0:no)				-0.086**			
				(0.034)			
Year is inauspicious for boys and girls (1:yes;0:no)					-0.092***		
					(0.031)		
Year is auspicious for either boys or girls (1:yes,0:no)						0.114**	0.148***
						(0.045)	(0.029)
Year	26.336***	25.927***	26.251***	27.010***	26.566***	25.561***	31.143***
	(2.460)	(2.240)	(2.430)	(2.694)	(2.596)	(2.568)	(1.984)
Year squared	-0.007***	-0.007***	-0.007***	-0.007***	-0.007***	-0.006***	-0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Number of observations	22	22	22	22	22	19	18
Adjusted R-squared	0.845	0.853	0.843	0.856	0.853	0.881	0.917

Note: Robust standard errors in parentheses. The symbols *, **, and *** indicate that the coefficient is statistically significant at the 10, 5, and 1 percent level respectively. Constant not reported. Column (6) excludes years that are inauspicious for boys. Columns (7) restricts to years relevant for children at school age.