Dragons or snakes?

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"So, when exactly are you getting married?" barked Aunty Li, who, like my other relatives, is a fervent believer of the *dating-marriage-children* order of life. This question has plagued me at every recent family gathering, much to the horror of my Swiss partner, who has fortunately now grown accustomed to the cultural differences between East and West.

Aunty Li has always been pertinacious in her interrogations, but her persistence strangely waned during the festivities for the Lunar New Year on February 10, 2024. "Why hasn't she posed her usual question?" I wondered as we watched firecrackers scatter across the streets of my predominantly ethnic Chinese hometown in Malaysia. Perhaps she had simply grown tired of nagging, or had finally accepted that the younger generation need not be rushed into marriage. Miracles do happen, after all.

As the bang of the last firecracker shattered my confusion, the true reason for Aunty Li's silence finally dawned on me. It was 2024, and we were ushering in the Year of the Dragon.

Chinese astrology assigns each lunar year to one of 12 zodiac animals, which follow one another in a set order: rat, ox, tiger, rabbit, dragon, snake, horse, sheep, monkey, rooster, dog, and pig. Those born in the Year of the Rooster, like myself, are destined to be hard-working and dependable, of course, exactly like myself.

The rooster, however, is no match for the dragon—a mythical creature from heaven that symbolizes auspiciousness, power and greatness. China's feudal emperors have long proclaimed themselves sons of the dragon, and the creature has permeated nearly every facet of Chinese culture.

It is widely accepted among my peers that a dragon year is ideal for tying the knot—something about having a majestic married life infused with a potent dose of prosperity. I attended six Chinese weddings in 2024, six more than in 2023.

Way more auspicious than a dragon wedding, however, is having a dragon baby. Everyone wants dragon offspring, or at least hopes their child will become a dragon—there is even a Mandarin saying for this: 望子成龙(wàng zǐ chéng lóng).

A recent study examined the effect of dragon year superstition on birth timing and found that roughly 6.7% of births in Shenzhen were shifted from the week before the dragon year to the week after it began.

It would be futile to nag her nephew this year. Aunty Li can only succumb to the realisation that her repeated efforts over the last years have been fruitless. She is no statistician, but even she knew it was far too late for me to organise a dragon wedding or a dragon baby. Whether you're from the East or West, everyone knows that a modern wedding takes over a year to plan, a baby at least nine months.

Another explanation for Aunty Li's change of heart may lie in the strict order of the zodiac animals. The snake follows the dragon. A snake year is much less auspicious; they come with wit and divination but are also cursed with unpopular traits like malevolence, cattiness and mystery.

A snake wedding could very well be on the agenda if I were to propose soon. Or worse still, I could land her with both a snake baby *and* a snake wedding, God forbid in that order. The risk of this may be too much for her heart. Better to be silent.

All of this could be brushed off as superstitious nonsense by the wider population. But my aunt is just one of many Chinese relatives exerting their share of peer pressure on the fertile population. How strong of an influence do these aunties have?

When investigating whether traditional superstitions still play a role in childbearing, one must account for a crucial trend. Like much of the world, many East Asian countries have seen a dramatic fall in total fertility rates across the last decades (Figure 1), because of the increased cost of child-rearing and shifts in priorities as mortality rates become lower and birth control more accessible.

Singapore saw its fertility rate reach a historic low of 0.97 in 2023, less than half the replacement fertility of 2.1 – the level of fertility, at which the size of the native Singaporean population would remain unchanged.

Thanks to this trend, noisy aunties aren't the only ones voicing their opinions. In his annual Lunar New Year message for 2024, Singapore's then Prime Minister, Lee Hsien Loong—a dragon baby himself, whose given name even includes the character for dragon (龙; lóng)—encouraged Singaporeans to "add a little dragon", i.e., be good citizens and get the deed done. An ageing population will undermine economic growth, and government officials are getting worried.

A simple time series model allowing for both Chinese superstition and the declining trend is

$$R_t = f_t + \beta_{\text{dragon}} \mathbb{1}_{\{t \text{ is a dragon year}\}} + \beta_{\text{snake}} \mathbb{1}_{\{t \text{ is a snake year}\}},$$

where R_t is the total fertility rate in year t, f_t is a smooth function of the year which models the trend and other inter-year differences, $\mathbb{1}$ is equal to 1

Fertility rate: children per woman

The fertility rate, expressed as the number of children per woman, is based on age-specific fertility rates in one particular year.

Our World in Data

World
Vietnam
Asia (UN)
Malaysia
China
Singapore
Taiwan
Hong Kong

Data source: UN, World Population Prospects (2024)

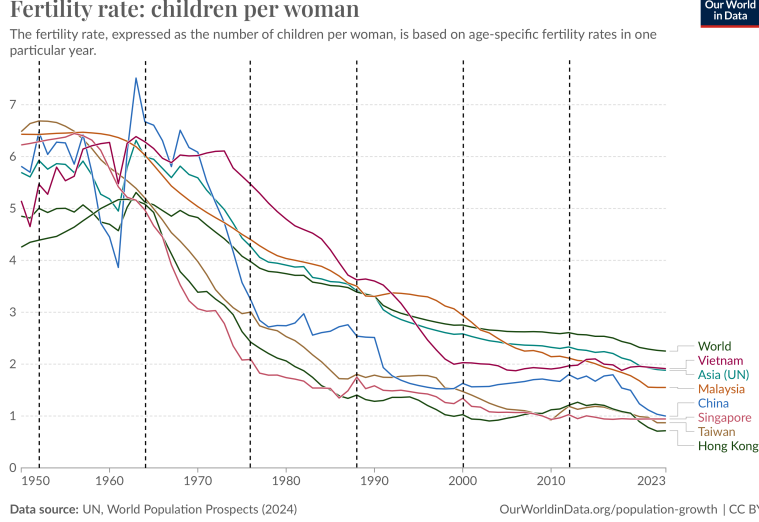OurWorldinData.org/population-growth | CC BY

Figure 1: Annual total fertility rate by country (indicated by the different colours). The dashed lines indicate the Years of the Dragon.

if the subscript holds and 0 otherwise, and β_{dragon} and β_{snake} are the dragon and snake year effects, whose magnitudes and signs indicate the strengths and directions of their effects. All things equal and if β_{dragon} is positive, its magnitude determines the increase in fertility rate in a dragon year compared to other years. Code to fit the model in the Bayesian framework is given in `github.com/kohrrelation/dragon`.

Table 1 shows estimated superstition effects for six countries. Due to limited access to contraception before 1970, we only considered data after 1970. Singapore and China both have a large majority of ethnic Chinese in their populations ($> 70\%$), Malaysia has a moderate share ($< 30\%$), while the U.K., Kenya and Mexico have a tiny share ($< 1\%$[1]).

The dragon effect is strongly positive in Singapore, with a posterior mean of 0.17, a substantial estimated effect on the fertility rate. The same cannot be said for countries with a smaller Chinese population. Though Malaysia has a large minority of ethnic Chinese like myself, it also has a larger non-Chinese population who subscribe less to Chinese astrology.

Perhaps surprising is the result for China, with a low posterior mean of 0.01 and high uncertainty. An explanation could lie in the one-child policy enforced in China between 1979 and 2015, which restricted many families to having only one child to curb population growth. This effectively killed any chance for non-first-time parents to plan a dragon baby. As for first-time parents, a dragon year comes once every 12 years, so only having one shot and timing it right

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[1] We here only considered Chinese and not ethnic Chinese

	β_{dragon}	β_{snake}
Singapore	**0.17** (0.11, 0.23)	-0.02 (-0.08, 0.04)
China	0.01 (-0.09, 0.11)	-0.04 (-0.14, 0.06)
Malaysia	0.02 (-0.01, 0.04)	-0.01 (-0.04, 0.01)
U.K.	0.00 (-0.02, 0.02)	-0.02 (-0.05, 0.00)
Kenya	0.00 (-0.01 , 0.02)	0.00 (-0.01, 0.02)
Mexico	-0.01 (-0.03, 0.00)	-0.01 (-0.02, 0.00)

Table 1: Posterior means and 95% credible intervals (in brackets) for the dragon and snake effects (children/woman), by country for 1970–2023. Bolded figures represent estimates whose 95% credible intervals do not cover zero. Data source: UN, World Population Prospects (2024).

may be too inconvenient. The same model fitted to Hong Kong, a region not subject to this policy, gave posterior mean (95% credible interval) estimates of 0.05 (0.01,0.08) children/woman.

Multiple news outlets reported in 2024 that dragon years are associated with baby booms in China, but our analysis shows that this is unclear in the broader scheme of the last five decades. At the time of writing, the total fertility rate for 2024 is not yet available. Only time will tell if China has experienced a dragon baby boom, with 2024 the first dragon year since the end of the one-child policy.

The snake effect on fertility is negligible in all countries, though they are almost all negative. Perhaps my aunt discouraging me from having a snake baby is an outlier after all.

Can we dissect the dragon effect further? We have so far compared countries, but there could be country-specific drivers for the dragon effect that transcend superstition.

One could argue that Lee Hsien Loong's comments were more about civic duty than astrology. In contrast, Xi Jinping, China's premier, is less explicit about fertility in his Lunar New Year addresses. A country-specific analysis could help determine whether the dragon year effect stems more from superstition than from differences between countries, such as the varying effectiveness of fertility-friendly marketing from leadership during dragon years.

Furthermore, my initial hypotheses were based on Aunty Li, an ethnic Chinese in Malaysia, so we should fit the model to more local data. Singapore has an ethnic Chinese population that shares a striking resemblance to those in Malaysia (we were the same country until 1965), so the extrapolation that there are many other similar aunties in Singapore seems reasonable.

Singapore also offers a unique demographic to dissect our analysis further. It has three main ethnicities: the Chinese majority (75–77%), the Malays (15–17%) and the Indians (7–9%). There are cultural differences between them, but they are all Singaporeans.

Lee Hsien Loong's encouragements were directed at all Singaporeans, not just the ethnic Chinese. For the non-Chinese population, did his comments fall on deaf ears? The data suggest so.
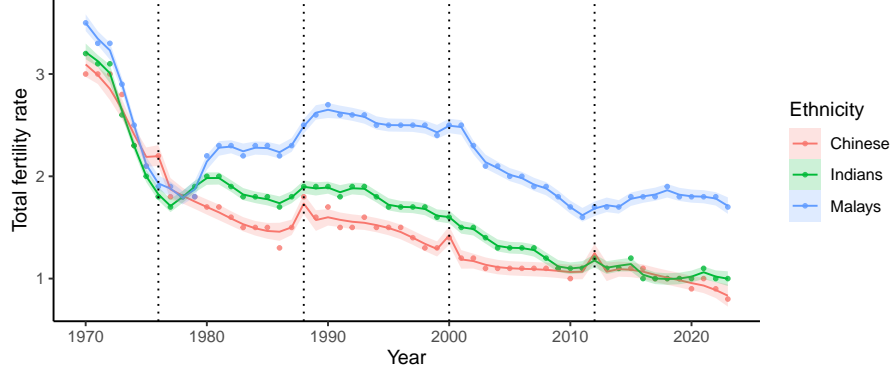
Figure 2: Points showing annual total fertility rate for Singapore, by ethnicity (colours). The solid lines show the posterior mean estimates for our model for each year, along with the pointwise 95% credible intervals indicated by the shaded regions. The dashed lines indicate the Years of the Dragon. Data source: Department of Statistics (2024), Singapore.

	β_{dragon}	β_{snake}
Chinese	**0.18** (0.09, 0.26)	-0.02 (-0.10, 0.06)
Malays	0.07 (-0.01 , 0.15)	**0.09** (0.01,0.17)
Indians	0.03 (-0.04, 0.10)	-0.03 (-0.10, 0.04)

Table 2: Same as Table 1, but for Singapore and by ethnicity. Data source: Department of Statistics (2024), Singapore.

Figure 2 shows the fertility rate over the years for Singapore, grouped by ethnicity. The Chinese consistently raise their total fertility rate during dragon years, while the Indians and Malays respond less. Table 2 suggests that the dragon effect is high for the Chinese, but less so for the Malays and Indians. This suggests that ethnic-specific superstition could be the major driver for baby booms during dragon years in Singapore.

Curiously, the results suggest a slightly positive snake effect for Malays. There is an ongoing debate about whether a dragon baby is *actually* good for the baby. Superstitions aside, larger dragon cohorts face weaker educational and economic prospects due to increased competition, as shown in a recent study. Maybe the Malays have caught wind of this. Without the added superstitious benefit, there might be an incentive to delay birth by a year to avoid the crowded dragon one.

Take this with a pinch of salt. The estimated effect size is small and there are surely other confounders, so one should not overinterpret these findings just yet. Further investigation is warranted.

How about marriage? The crude marriage rate is typically calculated as the number of marriages in a given year divided by the average size of the population
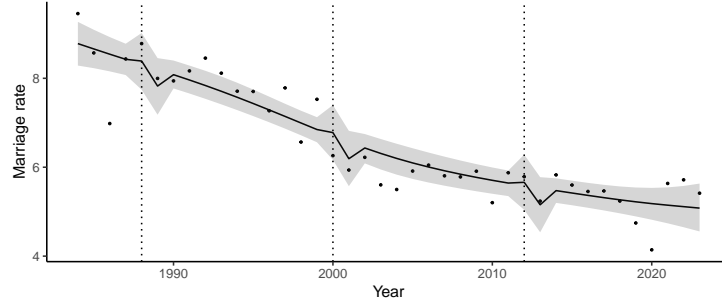
Figure 3: Points showing observed crude wedding rate over the years for the ethnic Chinese in Singapore. The solid lines show the posterior mean estimates of our model for each year, along with the pointwise 95% credible intervals indicated by the shaded regions. The dashed lines indicate the Years of the Dragon. Data source: Department of Statistics (2024), Singapore.

in that year, expressed as the number of marriages per thousand inhabitants. This rate is trickier to calculate by ethnicity, as marriages can involve different ethnicities. Aunty Li is keen to remind me that my wedding would be "odd", meaning it would be categorized as an "Inter-Ethnic" marriage in Singapore's government records, rather than a "Chinese" one, which is reserved for marriages between two ethnic Chinese.

Still, we could define the Chinese crude marriage rate as the number of "Chinese" marriages divided by the ethnic Chinese population. Though this would miss inter-ethnic marriages[2], modelling this rate could still provide information on the dragon effect on marriages involving ethnic Chinese. Figure 3 hints that this effect is less conclusive. There is considerable yearly variation, and the dragon year of 2000 was particularly bad for Chinese marriages. The same model fitted to this marriage rate gave an estimated dragon effect of 0.08 (-0.54, 0.69). A dip seems to always occur in a snake year, suggesting there could be some hesitation to marry in these years, though the available time series is too short here to conclude much; the estimate of the snake effect is -0.37 (-0.99, 0.24).

The data suggests that Chinese superstitions do play a role. This can be quite substantial for the total fertility rate, especially among the ethnic Chinese population in Singapore. The situation is less clear for marriages. A handful of my Chinese peers getting married in 2024 could just be a lucky coincidence, and I'm well aware that entering my thirties is a major confounder.

A healthy dose of superstition, mixed with the Aunty Lis of our world, might just be the solution to our ageing population. As the festivities dwindled and the streets calmed, I was happy to tell Aunty Li that I had actually already been planning my wedding. Her reaction was one of ecstasy, especially after receiving my "save the date". No points for guessing which year was on it.

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[2]Also same-sex ones, among others.

References

Agarwal, S., W. Qian, T. F. Sing, and P. L. Tan (2021). Fortunes of dragons: Cohort size effects on life outcomes. *Population Studies 75*(2), 191–207.

Huang, C., S. Zhang, Q. Zhao, and Y. Lin (2021). Dragon year superstition, birth timing, and neonatal health outcomes. *China Economic Review 66*, 101594.

Boxes to explain terms

[Chinese Astrology] The Chinese zodiac is a 12-year cycle based on the Chinese lunar calendar, with each year represented by one of 12 animals believed to embody particular personality traits. A different animal takes over each Chinese New Year, which typically falls between January 21 and February 20 on the Gregorian calendar. Still widely referenced today, the zodiac has origins that blend history and mythology, with its use traced as far back as the Han dynasty (206 BCE–220 CE). A well-known legend tells of a race between animals, organised by the Jade Emperor—a deity in Chinese mythology—to determine their order in the cycle. Each animal's place corresponds to its finishing position in the race. The author first encountered this story in primary school and was quietly relieved not to have been born in the Year of the Pig, who came in last after stopping to eat and nap along the way.

[Total fertility rate] The age-specific fertility rate (ASFR) for an age group is the total number of live births divided by the total number of woman in that age group, espressed as the number of children per 1000 women. The total fertility rate is the average number of children born to a woman during her reproductive years, assuming she were subject throughout to the prevailing ASFRs in a population. Specifically, the total fertility rate is the sum of ASFRs by five-yearly age groups from 15–49, i.e., 15–19, 20–24, ..., 45–49, multiplied by five and divded by 1000, to give units of children/woman.